ACCOUNTING FOR MANAGERS



Lumen Learning

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Book: Accounting for Managers (Lumen)

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TABLE OF CONTENTS

Licensing

16.2: Course Contents at a Glance

About This Book

Assignments

Learning Outcomes

1: Whole Numbers, Fractions, Decimals, Percents and Problem Solving

- 1.1: Introduction to Decimal Calculations
- 1.2: Place Value in Decimals
- 1.3: Adding and Subtracting Decimals
- 1.4: Multiplying and Dividing Decimals
- 1.5: Convert Between Decimals and Fractions
- 1.6: Introduction to Percent Calculations
- 1.7: Solving Problems Using Ratios
- 1.8: Writing Fractions and Decimals as Percents
- 1.9: Solving Problems Using Percents
- 1.10: Percent Increase and Decrease
- 1.11: Why It Matters- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
- 1.12: Putting It Together- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
- 1.13: Assignment- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
- 1.14: Introduction to Whole Number Calculations
- 1.15: Place Value in Whole Numbers
- 1.16: Rounding Whole Numbers
- 1.17: Adding, Subtracting, Multiplying, and Dividing Whole Numbers
- 1.18: Introduction to Fraction Calculations
- 1.19: Convert Between Types of Fractions
- 1.20: Adding and Subtracting Fractions
- 1.21: Multiplying and Dividing Fractions

2: Calculations and Solving Equations

- 2.1: Mark-Up Problems
- 2.2: Discount Problems
- 2.3: Simple and Compound Interest
- 2.4: Solving Formulas for a Specific Variable
- 2.5: Introduction to Reading and Using Graphs
- 2.6: Graphing Points on a Coordinate Plane
- 2.7: Identifying Trends of a Graph
- 2.8: Rate of Change
- 2.9: Analyzing Graphical Data
- 2.10: Putting It Together- Calculations and Solving Equations
- 2.11: Why It Matters- Calculations and Solving Equations
- 2.12: Assignment- Calculations and Solving Equations

- 2.13: Introduction to Solving Equations
- 2.14: Variables
- 2.15: Solving Single-Step Equations
- 2.16: Solving Multi-Step Equations
- 2.17: Introduction to Translating Word Problems into Equations
- 2.18: Translating Words Into Algebra
- 2.19: Algebraic Problem Solving Strategies
- 2.20: Introduction to Solving Complex Equations

3: Accounting Theory

- 3.1: The Annual Report
- 3.2: Introduction to Accounting Principles
- 3.3: The Accounting Entity
- 3.4: Basic Accounting Principles
- 3.5: Accrual Basis Accounting
- 3.6: Putting It Together- Accounting Theory
- 3.7: Assignment- Accounting Theory
- 3.8: Why It Matters- Accounting Theory
- 3.9: Introduction to Accounting
- 3.10: Roles of Accounting in Business
- 3.11: Financial Accounting Standards
- 3.12: Ethics and Accounting
- 3.13: Introduction to Users of Accounting
- 3.14: Users of Accounting Information
- 3.15: Organizational Structure
- 3.16: Forms of Doing Business

4: Financial Statements of Business Organizations

- 4.1: Bookkeeping Terms and Phrases
- 4.2: Bookkeeping Journal Entries
- 4.3: Relationships Between Financial Statements
- 4.4: Key Information in Financial Statements
- 4.5: Introduction to Analyzing Data from Financial Statements
- 4.6: Reporting Inventories
- 4.7: Reporting Current Assets
- 4.8: Reporting Noncurrent Assets
- 4.9: Reporting Stockholder Equity
- 4.10: Reporting Unearned Revenue
- 4.11: Why It Matters- Financial Statements of Business Organizations
- 4.12: Reporting Expenses
- 4.13: Introduction to Other Financial Components
- 4.14: Core Financial Ratios
- 4.15: Calculating Return on Investment
- 4.16: Calculating Return on Equity
- 4.17: Other Key Ratios
- 4.18: Calculating Profitability Ratios
- 4.19: Limitations of Financial Statements
- 4.20: Putting It Together- Financial Statements of Business Organizations
- 4.21: Assignment- Financial Statements of Business Organizations

- 4.22: Introduction to Financial Statements
- 4.23: Transactions
- 4.24: Accounting Equation
- 4.25: Account Categories
- 4.26: Double Entry Bookkeeping System
- 4.27: Structures of Key Financial Statements
- 4.28: Introduction to the Bookkeeping Process
- 4.29: Expanded Accounting Equation

5: Managerial Accounting in Business

- 5.1: Influence on Accounting Decisions
- 5.2: Putting It Together- Managerial Accounting in Business
- 5.3: Assignment- Managerial Accounting in Business
- 5.4: Why It Matters- Managerial Accounting in Business
- 5.5: Introduction to Financial and Managerial Accounting
- 5.6: Differentiating Between Financial and Managerial Accounting
- 5.7: Managerial Accounting
- 5.8: Relationship Between Financial and Managerial Accounting
- 5.9: Introduction to Managerial Accounting Perspectives
- 5.10: Accounting Decision Makers
- 5.11: Strategy Development
- 5.12: Risk Management Planning

6: Cost Behavior Patterns

- 6.1: High-Low Method
- 6.2: Least Squares Regression Method
- 6.3: Putting It Together- Cost Behavior Patterns
- 6.4: Assignment- Cost Behavior Patterns
- 6.5: Why It Matters- Cost Behavior Patterns
- 6.6: Introduction to Costs
- 6.7: Product vs. Period Costs
- 6.8: Manufacturing Costs
- 6.9: Fixed vs. Variable Costs
- 6.10: Relevant Range
- 6.11: Introduction to Mixed Cost Analysis
- 6.12: Mixed Costs
- 6.13: Independent vs. Dependent Variable

7: Costing Methods

- 7.1: Introduction to Process Costing
- 7.2: Job Order Costing vs Process Costing
- 7.3: Flow of Costs (Process Costing)
- 7.4: Equivalent Unit Calculations
- 7.5: Cost Reconciliation
- 7.6: Direct and Step-Down Methods
- 7.7: Introduction to Cost Accounting Methods
- 7.8: Activity-Based Costing
- 7.9: Traditional Costing vs. ABC

- 7.10: Putting It Together- Costing Methods
- 7.11: Why It Matters- Costing Methods
- 7.12: Assignment- Costing Methods
- 7.13: Introduction to Cost Management
- 7.14: Value Chain
- 7.15: Direct and Indirect Costs
- 7.16: Introduction to Job Order Costing
- 7.17: Job Order Costing
- 7.18: Calculating Costs
- 7.19: Flow of Costs (Job Order Costing)
- 7.20: Recording Job Order Costs

8: Cost Volume Profit Analysis

- 8.1: Statement of Variable Costs and Sales Volume
- 8.2: Statement of Fixed Cost, Selling Price, and Sales Volume
- 8.3: Statement of Variable Cost, Fixed Cost, and Sales Volume
- 8.4: Introduction to Break-Even Point Analysis
- 8.5: Break-Even Point
- 8.6: Methods to Determine the Break-Even Point
- 8.7: Target Profit Analysis
- 8.8: Margin of Safety
- 8.9: The Break-Even Point and the Sales Mix
- 8.10: Introduction to Cost-Volume-Profit and Cost Structures
- 8.11: Why It Matters- Cost Volume Profit Analysis
- 8.12: Cost Structures
- 8.13: Operating Leverage
- 8.14: Putting It Together- Cost Volume Profit Analysis
- 8.15: Assignment- Cost Volume Profit Analysis
- 8.16: Introduction to Cost-Volume-Profit Elements
- 8.17: Cost-Volume-Profit Analysis
- 8.18: Contribution Margin Model
- 8.19: Net Operating Income
- 8.20: Contribution Margin Ratio
- 8.21: Introduction to the Application of Cost-Volume-Profit Concepts
- 8.22: Cost-Volume-Profit Analysis and Decision Making
- 8.23: Statement of Fixed Cost and Sales Volume

9: Operating Budgets

- 9.1: Production Budget
- 9.2: Direct Materials Budget
- 9.3: Direct Labor Budget
- 9.4: Manufacturing Overhead Budget
- 9.5: Ending Inventory Budget
- 9.6: Selling and Administrative Budget
- 9.7: Cash Budget
- 9.8: Budgeted Income
- 9.9: Budgeted Balance Sheet
- 9.10: Introduction to Flexible Budgeting
- 9.11: Why It Matters- Operating Budgets

- 9.12: Shortcomings of Static Budgets
- 9.13: Flexible Budget Report
- 9.14: Flexible Budget Reports and Multiple Cost Drivers
- 9.15: Putting It Together- Operating Budgets
- 9.16: Assignment- Operating Budgets
- 9.17: Introduction to the Master Budget
- 9.18: Budgeting and Business
- 9.19: Responsibility Accounting
- 9.20: Alternative Budget Periods
- 9.21: Self-Imposed Budgeting
- 9.22: Introduction to Preparing a Master Budget
- 9.23: Sales Forecast and the Master Budget
- 9.24: Components of the Master Budget

10: Cost Variance Analysis

- 10.1: Reducing Material Variances
- 10.2: Introduction to Labor Variances
- 10.3: Expected Labor Rate
- 10.4: Labor Rate Variance
- 10.5: Reducing Labor Variances
- 10.6: Introduction to Variable Manufacturing Overhead Variances
- 10.7: Variable Manufacturing Rate Variances
- 10.8: Variable Manufacturing Overhead Rate Variances
- 10.9: Reducing Variable Manufacturing Overhead
- 10.10: Putting It Together- Cost Variance Analysis
- 10.11: Why It Matters- Cost Variance Analysis
- 10.12: Assignment- Cost Variance Analysis
- 10.13: Introduction to Variance Basics
- 10.14: Steps of Cost Variance Analysis
- 10.15: Favorable versus Unfavorable Variances
- 10.16: Significant Variance
- 10.17: Introduction to Material Variances
- 10.18: Material Cost Variance
- 10.19: Price Variance
- 10.20: Quantity Variance

11: Relevant Revenues and Costs

- 11.1: Make or Buy Decisions
- 11.2: Special Order Decisions
- 11.3: Introduction to Constrained Resources
- 11.4: Constrained Resource
- 11.5: Putting It Together- Relevant Revenues and Costs
- 11.6: Assignment- Relevant Revenues and Costs
- 11.7: Why It Matters- Relevant Revenues and Costs
- 11.8: Introduction to Cost Types
- 11.9: Differential Cost
- 11.10: Avoidable Costs
- 11.11: Sunk Costs
- 11.12: Opportunity Costs

- 11.13: Analyzing Costs
- 11.14: Introduction to Relevant Costs
- 11.15: Add or Drop Decisions

12: Managerial Decisions

- 12.1: Special Order Decisions
- 12.2: Cost-Plus or Target Costing Decisions
- 12.3: Putting It Together- Managerial Decisions
- 12.4: Assignment- Managerial Decisions
- 12.5: Why It Matters- Managerial Decisions
- 12.6: Introduction to Managerial Decision-Making
- 12.7: Differential Analysis
- 12.8: Qualitative Factors
- 12.9: Introduction to the Role of Data in Business
- 12.10: Customer Elimination Decisions
- 12.11: Add or Drop Decisions
- 12.12: Make or Buy Decisions
- 12.13: Sell or Process Further Decisions

13: Statement of Cash Flows

- 13.1: Introduction to Preparing a Statement of Cash Flow
- 13.2: Net and Gross Cash Flows
- 13.3: Preparing a Statement of Cash Flow
- 13.4: Cash Flow Analysis
- 13.5: Putting It Together- Statement of Cash Flows
- 13.6: Assignment- Statement of Cash Flows
- 13.7: Why It Matters- Statement of Cash Flows
- 13.8: Introduction to Key Concepts in Cash Flows
- 13.9: Non-Cash Activities
- 13.10: Operating Activities
- 13.11: Investing Activities
- 13.12: Financing Activities
- 13.13: Introduction to Direct Method versus Indirect Method
- 13.14: The Indirect Method
- 13.15: The Direct Method

14: Performance Evaluation in Organizations

- 14.1: For-Profit Organizations
- 14.2: Non-Profit Organizations
- 14.3: Putting It Together- Performance Evaluation in Organizations
- 14.4: Assignment- Performance Evaluation in Organizations
- 14.5: Why It Matters- Performance Evaluation in Organizations
- 14.6: Introduction to Non-Financial Performance Measures
- 14.7: Balanced Scorecard
- 14.8: Performance Reports
- 14.9: Introduction to Financial Performance Measures
- 14.10: Trend Analysis of Financial Statements
- 14.11: Common-Size Analysis of Financial Statements

- 14.12: Ratio Analysis of Financial Information
- 14.13: Introduction to Evaluating an Organization

15: Capital Budgeting Decisions

- 15.1: Simple Rate of Return
- 15.2: Introduction to Risk and Capital Budgeting
- 15.3: Risk and Return
- 15.4: Introduction to Finalizing Capital Budgeting Decisions
- 15.5: Analyzing a Project
- 15.6: Postaudit
- 15.7: Putting It Together- Capital Budgeting Decisions
- 15.8: Assignment- Capital Budgeting Decisions
- 15.9: Why It Matters- Capital Budgeting Decisions
- 15.10: Introduction to Capital Budgeting
- 15.11: Steps of Capital Budgeting
- 15.12: When to Make Capital Budgeting Decisions
- 15.13: Time Value of Money
- 15.14: Introduction to Budget Methods for Making Decisions
- 15.15: The Payback Method
- 15.16: Internal Rate of Return
- 15.17: Net Present Value

Index

Glossary

Glossary

Detailed Licensing

Licensing

*A detailed breakdown of this resource's licensing can be found in **Back Matter/Detailed Licensing**.*

16.2: Course Contents at a Glance

The following list shows a summary of the topics covered in this course. To see all of the course pages, visit the Table of Contents.

Module 1: Whole Numbers, Fractions, Decimals, Percents and Problem Solving

- Whole Number Calculations
- Fraction Calculations
- Decimal Calculations
- Percent Calculations

Module 2: Calculations and Solving Equations

- Solving Equations
- Translating Word Problems into Equations
- Solving Complex Equations
- Reading and Using Graphs

Module 3: Accounting Theory

- Accounting
- Users of Accounting
- Accounting Principles

Module 4: Financial Statements of Business Organizations

- Financial Statements
- Bookkeeping Process
- Analyzing Data from Financial Statement
- Other Financial Components

Module 5: Managerial Accounting in Business

- Financial and Managerial Accounting
- Managerial Accounting Perspectives

Module 6: Cost Behavior Patterns

- Costs
- Mixed Cost Analysis

Module 7: Costing Methods

- Cost Management
- Job Order Costing
- Process Costing
- Cost Accounting Methods

Module 8: Cost Volume Profit Analysis

- Cost-Volume-Profit Elements
- Application of Cost-Volume-Profit Concepts
- Break-Even Point Analysis
- Cost-Volume-Profit and Cost Structures

Module 9: Operating Budgets

- Master Budget
- Preparing a Master Budget
- Flexible Budgeting

Module 10: Cost Variance Analysis

- Variance Basics
- Material Variances
- Labor Variances
- Variable Manufacturing Overhead Variances

Module 11: Relevant Revenues and Costs

- Cost Types
- Relevant Costs
- Constrained Resources

Module 12: Managerial Decisions

- Managerial Decision-Making
- Role of Data in Business

Module 13: Statement of Cash Flows

- Key Concepts in Cash Flows
- Direct Method versus Indirect Method
- Preparing a Statement of Cash Flow

Module 14: Performance Evaluation in Organizations

- Non-financial Performance Measures
- Financial Performance Measures
- Evaluating an Organization

Module 15: Capital Budgeting Decisions

- Capital Budgeting
- Budget Methods for Making Decisions
- Risk and Capital Budgeting
- Finalizing Capital Budgeting Decisions

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About This Book

In Accounting for Managers, students learn the basic accounting principles needed to effectively make business decisions as a manager. The course begins with a review of basic math and accounting principles, ensuring students are prepared for the material that follows. Students will learn how to make financial decisions, including decisions around budgeting, financial statements, and cost and profit analysis.

Contributors

This course was developed by the Lumen Learning team with contributions from

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Assignments

The assignments for Accounting for Managers help students practice analyzing and making decisions based on accounting data and business scenarios. You can view them below or throughout the course.

Assignments and Alignment

Assignment	Module
Assignment: Whole Numbers, Fractions, Decimals, Percents, and Problem Solving	Module 1: Whole Numbers, Fractions, Decimals, Percents and Problem Solving
Assignment: Calculations and Solving Equations	Module 2: Calculations and Solving Equations
Assignment: Accounting Theory	Module 3: Accounting Theory
Assignment: Financial Statements of Business Organizations	Module 4: Financial Statements of Business Organizations
Assignment: Managerial Accounting in Business	Module 5: Managerial Accounting in Business
Assignment: Cost Behavior Patterns	Module 6: Cost Behavior Patterns
Assignment: Costing Methods	Module 7: Costing Methods
Assignment: Cost Volume Profit Analysis	Module 8: Cost Volume Profit Analysis
Assignment: Operating Budgets	Module 9: Operating Budgets
Assignment: Cost Variance Analysis	Module 10: Cost Variance Analysis
Assignment: Relevant Revenues and Costs	Module 11: Relevant Revenues and Costs
Assignment: Managerial Decisions	Module 12: Managerial Decisions
Assignment: Statement of Cash Flows	Module 13: Statement of Cash Flows
Assignment: Performance Evaluation in Organizations	Module 14: Performance Evaluation in Organizations
Assignment: Capital Budgeting Decisions	Module 15: Capital Budgeting Decisions

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Learning Outcomes

The content, assignments, and assessments for Accounting for Managers are aligned to the following learning outcomes. A full list of course learning outcomes can be viewed here: Accounting For Managers

Module 1: Manipulate numerical expressions involving fractions, decimals, and percents

Make calculations with whole numbers of varying magnitude

- Make calculations with whole numbers of varying magnitude
- Round whole numbers to a determined place value
- Use addition, substraction, multiplication, and division when evaluation whole number expressions

Make calculations with proper fractions, improper fractions, and mixed numbers

- Identify different types of fractions and convert between them
- Use addition and subtraction when evaluating with fractions
- Use multiplication and division when evaluating expressions with fractions

Make calculations with decimals of varying magnitude

- Use place value to define all digits of a decimal number
- Use addition and subtraction when evaluating expressions with decimals
- Use multiplication and division when evaluating expressions with decimals
- Convert decimals to fractions and fractions to decimals

Make calculations using percents or finding percents

- Use ratios to solve simple word problems
- Use percent to represent a given fraction or decimal
- Evaluate expressions and word problems involving percents
- Solve problems involving percent increase and decrease

Module 2: Apply math skills to solve problems with a variable of unknown value

Solve single and multi-step equations for a given variable

- Define and identify variables
- Use the addition, subtraction, multiplication, and division properties to solve single-step equations
- Solving multi-step equations with variables on both sides

Write and solve equations from word problems

- Translating simple word phases into math notation
- Use a problem solving strategy to set up and solve word problems

Solve equations for word problems that contain fractions, decimals, and percents

- Use mathematical questions to solve mark-up problems
- Use mathematical questions to solve discount problems
- Calculate simple and compound interest
- Solve any given formula for a specific variable

Use tables and graphs to visually represent numerical data

- Graph points on a coordinate plane
- Recognize the trend of a graph
- Calculate the rate of change using data points and graphical presentation
- Compare and contrast graphical data to decipher information and make decisions

Module 3: Identify the Major Principles of Accounting

Describe the place of finance and accounting within a business

- Discuss the roles of finance and accounting in a business
- Summarize the background and sources of financial accounting standards
- Demonstrate how ethics applies to the field of accounting

Discuss the financial consequences of various organizational structures

- Outline the variety of accounting roles internal and external to a business
- Differentiate between functional and divisional organization
- Describe the legal implications of a business' organization on its accounting
- Summarize the information provided in a corporation's annual report

Explore the fundamentals of accounting

- Define the accounting entity and discuss the going concern concept
- Identify the major underlying accounting principles of consistency, full disclosure, materiality, verifiability and conservatism
- Explain the accounting concept

Module 4: Describe the different types of business organizations and the financial statements they rely on

Examine the elements of common financial statements

- Define transactions
- Solving the accounting equation
- Identify general categories of accounts
- Describe the double entry bookkeeping system
- Explain how key financial statements are structured

Discuss the bookkeeping process and the overall effects of transactions

- Illustrate the expanded accounting equation
- Define common bookkeeping terms and phrases
- Construct bookkeeping journal entries based on given parameters
- Analyze the relationships between key financial statements
- Identify important information found on key financial statements

Analyze data from financial statements

- Describe how inventories are reported on balance sheets and income statements
- Demonstrate how current assets are reported on the balance sheet
- Show how noncurent assets are reported on the balance sheet
- Describe the presentation of stockholder's equity on the balance sheet and statement of owners' equity
- Discuss how expenses are reported on the income statement
- Explain how expenses are reported on the income statement

Explore how other financial components are accounted for and presented

- Compute core financial ratios that communicate essential information
- Calculate return on investment
- Calculating return on equity
- Analyze other key ratios to interpret financial statement data
- Discuss the limitations of financial statements

Module 5: Define managerial accounting, its key elements, and its role in a business

Describe the difference between financial and managerial accounting

- Compare and contrast financial and managerial accounting
- Explain the key components of managerial accounting
- Analyze the relationship between financial and managerial accounting and how they are compartmentalized within modern businesses

Examine the various managerial accounting perspectives throughout an organization

- Identify the roles/people in a business who take on managerial accounting decisions
- Explain how accounting affects strategy development
- Explain how accounting is tied to risk management planning
- Explain how accounting decisions are influenced by both employee and leadership beliefs and needs

Module 6: Predict fixed, mixed, and variable cost behaviors

Classify costs to better understand the business expenses

- Differentiate between product costs and period costs
- Classify a variety of manufacturing costs
- Define and give examples of fixed and variable costs
- Describe the relevant range and its use in managerial accouning

Summarize the key elements of mixed cost analysis

- Define and outline examples of mixed costs in retail and manufacturing businesses
- Define dependent variable and independent variable
- Analyze mixed costs using the high-low method
- Use the least-squares regression method to create a regression line on a graph of cost data

Module 7: Compare and contrast job costing, process costing, activity costing for tracking business costs

Discuss the importance of cost management

- Describe the relationship between cost management and managerial accounting relating to the value chain
- Differentiate between direct and indirect costs

Examine the job order cost accounting system

- Describe a situation in which job order costing is used
- Calculate an overhead rate, manufacturing overhead, and unit costs
- Explain the flow of costs in a job order costing system
- Prepare a sample journal entry that records job order costs

Examine the process cost accounting system

- Compare and contrast job order and process costing
- Explain the flow of costs in a process costing system
- Calculate equivalent units of production and costs per equivalent unit using the weighted average and FIFO method
- Prepare sample cost reconciliation journals for both the weighted average and FIFO methods
- Discuss how to allocate service costs as operations costs using the direct and step-down methods

Examine the benefits and limitations of both cost accounting methods

- Describe situations in which activity-based absorption costing is used
- Illustrate the difference between tradition costing and activity-based absorption costing

Module 8: Use cost-volume-profit relationships to predict the effects of possible changes to those varriables

Describe the key elements of cost-volume-profit analysis

- List the factors associated with cost-volume-profit analysis
- Outline the contribution margin model
- Calculate net operating income using the profit equation
- Compute the contribution margin ratio

Illustrate the application of cost-volume-profit concepts

- Explain why changes to key cost-volume-profit factors can significantly affect planning and decision making
- Prepare a statement that shows a charge in fixed cost and sales volume
- Prepare a statement that shows a charge in variable costs and sales volume
- Prepare a statement that shows a change in fixed cost, selling price and sales volume
- Prepare a statement that shows change in variable cost, fixed cost and sales volume

Examine various methods of break-even analysis

- Define the break-even point
- Determine the break-even point using the equation method, the formula method, and in dollar sales and sales units
- Define target profit analysis and use it to make sales volume calculations
- Compute margin of safety
- Analyze the break-even point data for a company that wants to adjust its sales mix

Identify cost-volume-profit considerations for choosing a cost structure

- Compare and contrast sample cost structures for company strengths and weakness
- Describe operating leverage and use it to evaluate sample cost structures

Module 9: Interpret all aspects of an operating budget

Discuss the purpose of an master budget

- Describe the advantages of budgeting to a business
- Define responsibility accounting
- Differentiate between alternative budget periods
- Identify the benefits of self-imposed and participatory budgeting

Illustrate the use of accounting data in a prepared master budget

- Summarize the impact of the sales forecast on the master budget
- Outline the sequence of components of the master budget
- Create a production budget
- Create a direct materials budget
- Create a direct labor budget
- Create a manufacturing overhead budget
- Create an ending inventory budget
- Create a selling and administrative budget
- Create a cash budget
- Create a budgeted income statement
- Create a budgeted balance sheet

Outline the effects of flexible budgeting on budgetary control

- Describe the shortcomings of a statistic budget
- Create a flexible budget report that shows sales, activity, labor, or cost variances
- Create a flexible budget report that shows multiple cost drivers

Module 10: Identify problems using cost variance analysis

Discuss the basic principles of cost variance analysis

- Identify the four steps of simple cost variance analysis
- Differentiate between favorable and unfavorable variances
- Determine if a variance is significant

Discuss different types of material variances

- Analyze the variance between expected material cost and actual material costs
- Analyze the variance between standard unit price and actual price of materials purchased
- Analyze the variance between expected amount of materials purchased and the actual amount of materials purchased
- Discuss strategies to limit and reduce material variances

Discuss different types of labor variances

- Estimate expected labor costs
- Analyze the variance between expected labor cost and actual labor costs
- Discuss strategies to limit and reduce labor variances

Discuss the variable manufacturing overhead variances

- Analyze the variance between expected variable manufacturing overhead cost and actual variable manufacturing overly costs
- Analyze the variance between expected variable manufacturing overhead efficiency and actual variable manufacturing overhead efficiency
- Discuss strategies to limit and reduce variable manufacturing overhead variances

Module 11: Determine relevant revenues and costs for both short and long-term decision making

Explore cost types that affect decision making

- Define differential cost
- Describe avoidable costs
- Recognize sunk costs
- Identify opportunity costs
- Summarize the concept of different costs analyzed for different purposes

Recognize relevant costs for common business decisions

- Identify the data needed to support an add or drop decision
- Identify the data needed to support a make or buy decision
- Identify the data needed to support a special order decision

Determine the profitability of making changes to a constrained resource

- Described a constrained resource in retail business

Module 12: Present a variety of managerial decisions based on differential analysis

Discuss the process of managerial decision-making and the factors involved

- Explain the process of differential analysis
- Analyze qualitative factors that can also affect managerial decisions

Analyze data to create reports and make business decisions

- Create a report outlining the data to support a customer elimination decision
- Create a report outlining the data to support an add or drop decision
- Create a report outlining the data to support a make or buy decision
- Create a report outlining the data to support a sell or process further decision
- Create a report outlining the data to support a special order decision

- Create a report outlining the data to support a cost-plus pricing or target costing decision

Module 13: Analyze a statement of cash flows

Discuss key financial principles needed to produce and analyze a statement of cashflows

- Explain the nature of non-cash activities
- Identify cash flows that result from operating activities
- Identify cash flows that result from investing activites
- Identify cash flows that result from financing activities

Distinguish between the Direct and Indirect methods of preparing a statement of cash flow

- Calculate cash flows from operating activities by the indirect method
- Calculate cash flows from operating activities by the direct method

Prepare a statement of cash flow and describe how it can be used to evaluate a business

- Differentiate between net and gross cash flows
- Prepare a statement of cash flow using that indirect method
- Describe how cash flow factors can be used to improve or evaluate a business

Module 14: Describe the financial and non-financial data that managers use to measure performance

Identify common non-financial measures of performance and discuss their impact on an organization

- Discuss non-financial components of the balanced scorecard
- Describe what a performance report is

Analyze an organization's financial performance

- Perform a trend analysis on a financial statement
- Perform a common-size analysis on a financial statement
- Perform a ratio analysis on a financial statement

Evaluate an organization's performance using financial and non-financial data

- Evaluate a for-profit organization's performance using financial and non-financial data
- Evaluate a non-profit organization's performance using financial and non-financial data

Module 15: Explain how capital budgeting is used in decision making

Discuss capital budgeting

- Discuss the steps in the capital budgeting process
- Identify situations that require capital budgeting decision making
- Discuss the time value of money

Differentiate between the different capital budget methods

- Describe the pay-back method
- Describe the internal rate of return method
- Describe the net present value method
- Describe the simple rate of return method

Describe different ways to identify and measure potential risk of investments

- Evaluate a party's risk aversion when proposing investment opportunities

Discuss different influences on making capital budgeting decisions

- Analyze a possible replacement projects to determine if it should be implemented
- Conduct a postaudit on an example case to determine if the expected results were achieved

CHAPTER OVERVIEW

1: Whole Numbers, Fractions, Decimals, Percents and Problem Solving

1.1: Introduction to Decimal Calculations
1.2: Place Value in Decimals
1.3: Adding and Subtracting Decimals
1.4: Multiplying and Dividing Decimals
1.5: Convert Between Decimals and Fractions
1.6: Introduction to Percent Calculations
1.7: Solving Problems Using Ratios
1.8: Writing Fractions and Decimals as Percents
1.9: Solving Problems Using Percents
1.10: Percent Increase and Decrease
1.11: Why It Matters- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
1.12: Putting It Together- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
1.13: Assignment- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving
1.14: Introduction to Whole Number Calculations
1.15: Place Value in Whole Numbers
1.16: Rounding Whole Numbers
1.17: Adding, Subtracting, Multiplying, and Dividing Whole Numbers
1.18: Introduction to Fraction Calculations
1.19: Convert Between Types of Fractions
1.20: Adding and Subtracting Fractions
1.21: Multiplying and Dividing Fractions

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1.1: Introduction to Decimal Calculations



In 1784, Thomas Jefferson proposed a decimal currency system for the United States based on the Spanish dollar, with coins for 10 dollars, 1 dollar, 1⁄10 dollar, and 1⁄100 dollar. One argument he advanced in favor of this system was that the 1⁄100-dollar coin would be similar in value to existing copper coins. The initial currency of the United States was minted in 1792 with the dollar being equal to 100 cents. Working with decimals is essential when calculating or analyzing most currency data, whether it be from historical or modern times!

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1.2: Place Value in Decimals

Learning Objectives

- Use place value to define all digits of a decimal number

You probably already know quite a bit about decimals based on your experience with money. Suppose you buy a sandwich and a bottle of water for lunch. If the sandwich costs $\$3.45$, the bottle of water costs $\$1.25$, and the total sales tax is $\$0.33$, what is the total cost of your lunch?

$3.45	Sandwich
$1.25	Water
+ $0.33	Tax
$5.03	Total

The total is $\$5.03$. Suppose you pay with a $\$5$ bill and 3 pennies. Should you wait for change? No, $\$5$ and 3 pennies is the same as $\$5.03$.

Because $100 \text{ pennies} = \$1$, each penny is worth $\frac{1}{100}$ of a dollar. We write the value of one penny as $\$0.01$, since $0.01 = \frac{1}{100}$.

Writing a number with a decimal is known as decimal notation. It is a way of showing parts of a whole when the whole is a power of ten. In other words, decimals are another way of writing fractions whose denominators are powers of ten. Just as the counting numbers are based on powers of ten, decimals are based on powers of ten. The table below shows the counting numbers.

Counting number	Name
1	One
$10 = 10$	Ten
$10 \cdot 10 = 100$	One hundred
$10 \cdot 10 \cdot 10 = 1000$	One thousand
$10 \cdot 10 \cdot 10 \cdot 10 = 10,000$	Ten thousand

How are decimals related to fractions? The table below shows the relation.

Decimal	Fraction	Name
0.1	$\frac{1}{10}$	One tenth
0.01	$\frac{1}{100}$	One hundredth
0.001	$\frac{1}{1,000}$	One thousandth
0.0001	$\frac{1}{10,000}$	One ten-thousandth

When we name a whole number, the name corresponds to the place value based on the powers of ten. Likewise, the names of the decimal places correspond to their fraction values. Notice how the place value names in the first table relate to the names of the fractions from the second table.

This chart illustrates place values to the left and right of the decimal point.

Place Value											
Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones		Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths
						.					

Notice two important facts shown in the tables.

- The “th” at the end of the name means the number is a fraction. “One thousand” is a number larger than one, but “one thousandth” is a number smaller than one.
- The tenths place is the first place to the right of the decimal, but the tens place is two places to the left of the decimal.

Remember that $\$5.03$ lunch? We read $\$5.03$ as *five dollars and three cents*. Naming decimals (those that don’t represent money) is done in a similar way. We read the number 5.03 as *five and three hundredths*. Which makes sense, since each hundredth of a dollar is a cent.

We sometimes need to translate a number written in decimal notation into words. As shown in the image below, we write the amount on a check in both words and numbers. The bank looks at the check to make sure the decimal number and the written number match — this helps prevent errors.



Let’s try naming a decimal, such as 15.68.	
We start by naming the number to the left of the decimal.	fifteen_____
We use the word “and” to indicate the decimal point.	fifteen and_____
Then we name the number to the right of the decimal point as if it were a whole number.	fifteen and sixty-eight_____
Last, name the decimal place of the last digit.	fifteen and sixty-eight hundredths

The number 15.68 is read *fifteen and sixty-eight hundredths*.

Name a decimal number

- Name the number to the left of the decimal point.
- Write “and” for the decimal point.
- Name the “number” part to the right of the decimal point as if it were a whole number.
- Name the decimal place of the last digit.

Exercises

Name each decimal:

1. 4.3

2. 2.45

3. 0.009

4. -15.571

Solution

1.	
4.3	
Name the number to the left of the decimal point.	four_____
Write “and” for the decimal point.	four and_____
Name the number to the right of the decimal point as if it were a whole number.	four and three_____
Name the decimal place of the last digit.	four and three tenths

2.	
2.45	
Name the number to the left of the decimal point.	two_____
Write “and” for the decimal point.	two and_____
Name the number to the right of the decimal point as if it were a whole number.	two and forty-five_____
Name the decimal place of the last digit.	two and forty-five hundredths

3.	
0.009	
Name the number to the left of the decimal point.	Zero is the number to the left of the decimal; it is not included in the name.
Name the number to the right of the decimal point as if it were a whole number.	nine_____
Name the decimal place of the last digit.	nine thousandths

4.	
-15.571	
Name the number to the left of the decimal point.	negative fifteen
Write “and” for the decimal point.	negative fifteen and_____
Name the number to the right of the decimal point as if it were a whole number.	negative fifteen and five hundred seventy-one_____
Name the decimal place of the last digit.	negative fifteen and five hundred seventy-one thousandths

TRY It

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[ohm_question]146225[/ohm_question]

[ohm_question]146568[/ohm_question]

[ohm_question]146569[/ohm_question]

Now we will translate the name of a decimal number into decimal notation. We will reverse the procedure we just used.

Write a decimal number from its name.

1. Look for the word “and”—it locates the decimal point.
2. Mark the number of decimal places needed to the right of the decimal point by noting the place value indicated by the last word.
   - Place a decimal point under the word “and.” Translate the words before “and” into the whole number and place it to the left of the decimal point.
   - If there is no “and,” write a “0” with a decimal point to its right.
3. Translate the words after “and” into the number to the right of the decimal point. Write the number in the spaces—putting the final digit in the last place.
4. Fill in zeros for place holders as needed.

example

1. Write the number six and seventeen hundredths:

six and seventeen hundredths	
The word *and* tells us to place a decimal point.	___.___
The word before *and* is the whole number; write it to the left of the decimal point.	6._____
The decimal part is seventeen hundredths. Mark two places to the right of the decimal point for hundredths.	6._ _
Write the numerals for seventeen in the places marked.	6.17

2. Write fourteen and thirty-seven hundredths as a decimal.
[reveal-answer q=”796510″]Show Answer[/reveal-answer]
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Solution

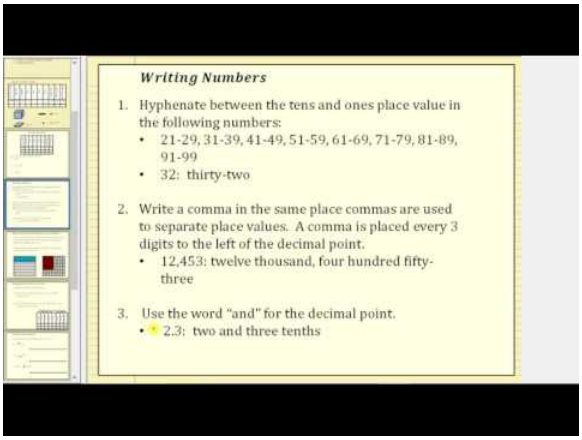
fourteen and thirty-seven hundredths	
Place a decimal point under the word ‘and’.	_____. _____
Translate the words before ‘and’ into the whole number and place it to the left of the decimal point.	14. _____
Mark two places to the right of the decimal point for “hundredths”.	14.__ __
Translate the words after “and” and write the number to the right of the decimal point.	14.37
Fourteen and thirty-seven hundredths is written 14.37.	

[/hidden-answer]

try it

[ohm_question]146570[/ohm_question]

In the following video we show more examples of how to write the name of a decimal using a place value chart.



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The second bullet in Step 1 is needed for decimals that have no whole number part, like 'nine thousandths'. We recognize them by the words that indicate the place value after the decimal – such as 'tenths' or 'hundredths.' Since there is no whole number, there is no 'and.' We start by placing a zero to the left of the decimal and continue by filling in the numbers to the right, as we did above.

example

Write twenty-four thousandths as a decimal.
[reveal-answer q="425300"]Show Answer[/reveal-answer]
[hidden-answer a="425300"]

Solution

twenty-four thousandths	
Look for the word "and".	There is no "and" so start with 0 0.
To the right of the decimal point, put three decimal places for thousandths.	0. _ _ _ tenths hundredths thousandths
Write the number 24 with the 4 in the thousandths place.	0. _ 2 4 tenths hundredths thousandths
Put zeros as placeholders in the remaining decimal places.	0.024
So, twenty-four thousandths is written 0.024	

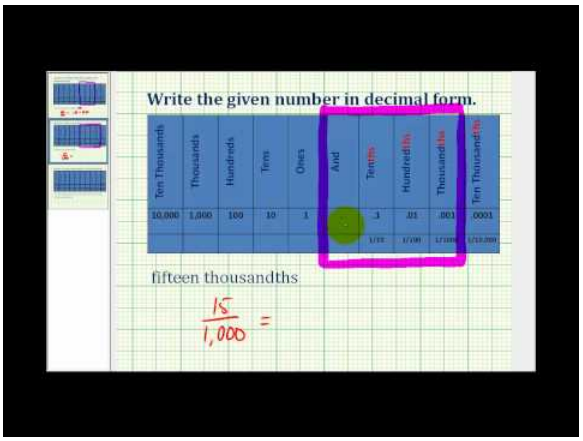
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try it

[ohm_question]146571[/ohm_question]

[ohm_question]146572[/ohm_question]

In the next video we will show more examples of how to write a decimal given its name in words.



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1.3: Adding and Subtracting Decimals

Learning Objectives

- Use addition and subtraction when evaluating expressions with decimals

Understanding how to work with decimals when making calculations involving money is very important in business. We know that $1 is the same as $1.00. But the way we write $1, or $1.00, depends on the context. In the same way, integers can be written as decimals with as many zeros as needed to the right of the decimal.

$$5 = 5.0 \qquad -2 = -2.0$$
$$5 = 5.00 \qquad -2 = -2.00$$
$$5 = 5.000 \qquad -2 = -2.000$$

and so on ...

So when making calculations with money, you may have to fill in zeros as place holders to correctly align the values.

Let's say you stopped by Bouchon Bakery for breakfast this morning: the orange juice was three and a half dollars, the coffee was $1.85, and the scone was $4. All three items first need to be represented in dollars in cents so we can correctly add the numbers.

$3.50 juice
$1.85 coffee
+ $4.00 scone
$9.35 total

We lined up the dollars under the dollars and the cents under the cents, with the decimal points lined up between them. Then we just added each column, as if we were adding whole numbers. By lining up decimals this way, we can add or subtract the corresponding place values just as we did with whole numbers.

Add or subtract decimals

1. Write the numbers vertically so the decimal points line up.
2. Use zeros as place holders, as needed.
3. Add or subtract the numbers as if they were whole numbers. Then place the decimal in the answer under the decimal points in the given numbers.

We'll practice adding decimals in the example below. Remember — just like with whole number addition — you might have to "carry" a ten to the next place value as you add each column.

example

Add: $3.7 + 12.4$

Solution

	$3.7 + 12.4$
Write the numbers vertically so the decimal points line up.	'_' allowed only in math mode
Place holders are not needed since both numbers have the same number of decimal places.	
Add the numbers as if they were whole numbers. Then place the decimal in the answer under the decimal points in the given numbers.	'_' allowed only in math mode

try it

[ohm_question]146586[/ohm_question]

[ohm_question]146587[/ohm_question]

example

Add: $23.5 + 41.38$
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[hidden-answer a="920268"]

Solution

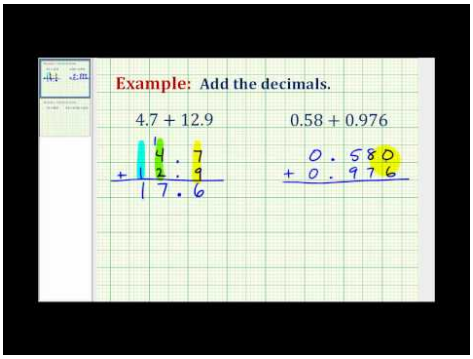
	$23.5 + 41.38$
Write the numbers vertically so the decimal points line up.	$\begin{array}{r} 23.5 \\ +\ 41.38 \\ \hline \end{array}$
Place 0 as a place holder after the 5 in 23.5, so that both numbers have two decimal places.	$\begin{array}{r} 23.50 \\ +\ 41.38 \\ \hline \end{array}$
Add the numbers as if they were whole numbers. Then place the decimal in the answer under the decimal points in the given numbers.	$\begin{array}{r} 23.50 \\ +\ 41.38 \\ \hline 64.88 \end{array}$

[/hidden-answer]

try it

[ohm_question]146588[/ohm_question]

In the following video we show another example of how to add decimals.



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Subtracting decimals follows the same process as adding decimals. Remember — just like with whole number subtraction — you may have to "borrow" ten from the next place value as you subtract each column.

example

How much change would you get if you handed the cashier a $\$20$ bill for a $\$14.65$ purchase? We will show the steps to calculate this in the next example.

Subtract: $20 - 14.65$
[reveal-answer q="678104"]Show Answer[/reveal-answer]
[hidden-answer a="678104"]

Solution

	$20 - 14.65$
Write the numbers vertically so the decimal points line up. Remember 20 is a whole number, so place the decimal point after the 0.	$\begin{array}{r} 20. \\ -\ 14.65 \\ \hline \end{array}$
Place two zeros after the decimal point in 20, as place holders so that both numbers have two decimal places.	$\begin{array}{r} 20.00 \\ -\ 14.65 \\ \hline \end{array}$
Subtract the numbers as if they were whole numbers. Then place the decimal in the answer under the decimal points in the given numbers.	$\begin{array}{r} {}^{1}\not{2}{}^{9}\not{0}{}^{9}\not{0}{}^{10}\not{0} \\ -\ 14.65 \\ \hline 5.35 \end{array}$

[/hidden-answer]

try it

[ohm_question]146590[/ohm_question]

example

Subtract: $2.51 - 7.4$
[reveal-answer q="743542"]Show Answer[/reveal-answer]
[hidden-answer a="743542"]

Solution
If we subtract 7.4 from 2.51, the answer will be negative since $7.4 > 2.51$. To subtract easily, we can subtract 2.51 from 7.4. Then we will place the negative sign in the result.

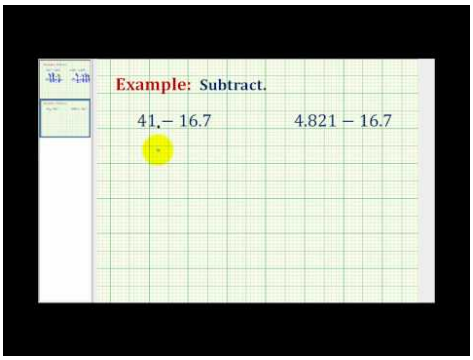
	$2.51 - 7.4$
Write the numbers vertically so the decimal points line up.	$\begin{array}{r} 7.4 \\ -\ 2.51 \\ \hline \end{array}$
Place zero after the 4 in 7.4 as a place holder, so that both numbers have two decimal places.	$\begin{array}{r} 7.40 \\ -\ 2.51 \\ \hline \end{array}$
Subtract and place the decimal in the answer.	$\begin{array}{r} 7.40 \\ -\ 2.51 \\ \hline 4.89 \end{array}$
Remember that we are really subtracting $2.51 - 7.4$ so the answer is negative	$2.51 - 7.4 = -4.89$

[/hidden-answer]

try it

[ohm_question]146591[/ohm_question]

This video shows another example of how to subtract one decimal from another.



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1.4: Multiplying and Dividing Decimals

Learning Objectives

- Use multiplication and division when evaluating expressions with decimals

Multiplying and dividing decimals can become complex, but we're going to start with some basic multiplication by ten to warm-up.

Multiply by Powers of 10

In many fields, especially in the sciences, it is common to multiply decimals by powers of 10. Let's see what happens when we multiply 1.9436 by some powers of 10.

1.9436(10)

$$\begin{array}{r} 1.9436 \\ \times \quad 10 \\ \hline 19.4360 \end{array}$$

1.9436(100)

$$\begin{array}{r} 1.9436 \\ \times \quad 100 \\ \hline 194.3600 \end{array}$$

1.9436(1000)

$$\begin{array}{r} 1.9436 \\ \times \quad 1000 \\ \hline 1943.6000 \end{array}$$

Look at the results without the final zeros. Do you notice a pattern?

$$\begin{aligned} 1.9436\,(10) &= 19.436 \\ 1.9436\,(100) &= 194.36 \\ 1.9436\,(1000) &= 1943.6 \end{aligned}$$

The number of places that the decimal point moved is the same as the number of zeros in the power of ten. The table below summarizes the results.

Multiply by	Number of zeros	Number of places decimal point moves
10	1	1 place to the right
100	2	2 places to the right
$1,000$	3	3 places to the right
$10,000$	4	4 places to the right

We can use this pattern as a shortcut to multiply by powers of ten instead of multiplying using the vertical format. We can count the zeros in the power of 10 and then move the decimal point that same of places to the right.

So, for example, to multiply 45.86 by 100, move the decimal point 2 places to the right.

$45.86 \times 100 = 4586.$

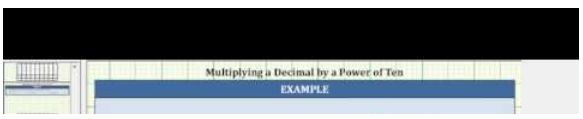
Sometimes when we need to move the decimal point, there are not enough decimal places. In that case, we use zeros as placeholders. For example, let's multiply 2.4 by 100. We need to move the decimal point 2 places to the right. Since there is only one digit to the right of the decimal point, we must write a 0 in the hundredths place.

$2.4 \times 100 = 240.$

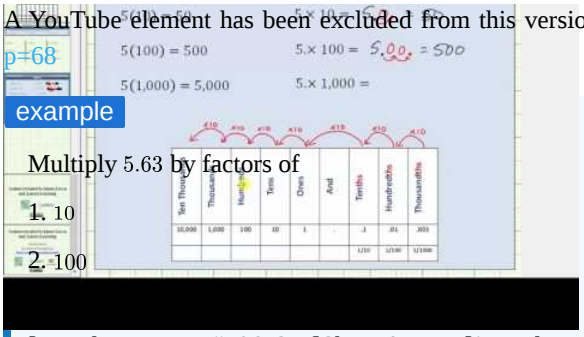
Multiply a decimal by a power of 10

1. Move the decimal point to the right the same number of places as the number of zeros in the power of 10.
2. Write zeros at the end of the number as placeholders if needed.

In the following video we show more examples of how to multiply a decimal by 10, 100, and 1000.



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example

Multiply 5.63 by factors of

1. 10
2. 100

[reveal-answer q="296737"]Show Answer[/reveal-answer]
[hidden-answer a="296737"]

Solution
By looking at the number of zeros in the multiple of ten, we see the number of places we need to move the decimal to the right.

1.	
$56.3\,(10)$	
There is 1 zero in 10, so move the decimal point 1 place to the right.	5.63
56.3	

2.	
$5.63\,(100)$	
There are 2 zeros in 100, so move the decimal point 2 places to the right.	5.63
563	

3.	
$5.63\,(1000)$	
There are 3 zeros in 1000, so move the decimal point 3 places to the right.	5.63
A zero must be added at the end.	$5,630$

[/hidden-answer]

TRY IT

[ohm_question]146599[/ohm_question]

Multiplying Decimals

Multiplying decimals is very much like multiplying whole numbers—we just have to determine where to place the decimal point. The procedure for multiplying decimals will make sense if we first review multiplying fractions.

Do you remember how to multiply fractions? To multiply fractions, you multiply the numerators and then multiply the denominators.

So let's see what we would get as the product of decimals by converting them to fractions first. We will do two examples side-by-side below. Look for a pattern.

	A	B
	$(0.3)\,(0.7)$	$(0.2)\,(0.46)$
Convert to fractions.	$\left(\frac{3}{10}\right)\left(\frac{7}{10}\right)$	$\left(\frac{2}{10}\right)\left(\frac{46}{100}\right)$
Multiply.	$\frac{21}{100}$	$\frac{92}{1000}$
Convert back to decimals.	0.21	0.092

There is a pattern that we can use. In A, we multiplied two numbers that each had one decimal place, and the product had two decimal places. In B, we multiplied a number with one decimal place by a number with two decimal places, and the product had three decimal places.

How many decimal places would you expect for the product of $(0.01)\,(0.004)$? If you said "five", you recognized the pattern. When we multiply two numbers with decimals, we count all the decimal places in the factors—in this case two plus three—to get the number of decimal places in the product—in this case five.

$$\underset{\text{2 places}}{(0.01)}\ \underset{\text{3 places}}{(0.004)}\ = \underset{\text{5 places}}{0.00004}$$

$$\left(\frac{1}{100}\right)\left(\frac{4}{1000}\right) = \frac{4}{100{,}000}$$

Once we know how to determine the number of digits after the decimal point, we can multiply decimal numbers without converting them to fractions first. The number of decimal places in the product is the sum of the number of decimal places in the factors. The rules for multiplying positive and negative numbers apply to decimals too.

Multiply decimal numbers

1. Determine the sign of the product.
2. Write the numbers in vertical format, lining up the numbers on the right.
3. Multiply the numbers as if they were whole numbers, temporarily ignoring the decimal points.
4. Place the decimal point. The number of decimal places in the product is the sum of the number of decimal places in the factors. If needed, use zeros as placeholders.
5. Write the product with the appropriate sign.

example

Multiply: $(3.9)\,(4.075)$

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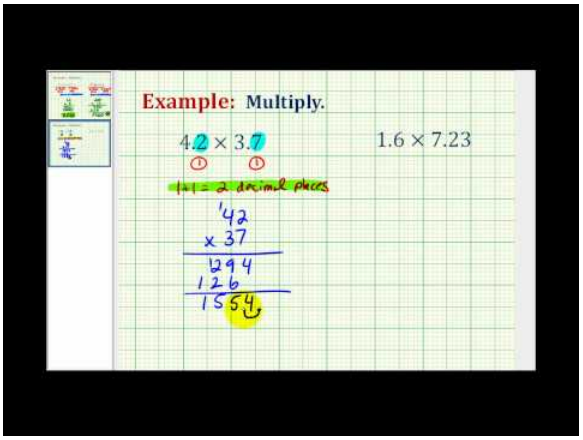
Solution

$(3.9)\,(4.075)$	
Determine the sign of the product. The signs are the same.	The product will be positive.
Write the numbers in vertical format, lining up the numbers on the right.	$\begin{array}{r} 4.075 \\ \times\ 3.9 \\ \hline \end{array}$
Multiply the numbers as if they were whole numbers, temporarily ignoring the decimal points.	$\begin{array}{r} 4.075 \\ \times\ 3.9 \\ \hline 36675 \\ 12225 \\ \hline 158925 \end{array}$
Place the decimal point. Add the number of decimal places in the factors $(1+3)$. Place the decimal point 4 places from the right.	$\begin{array}{r} 4.075 \quad 3 \text{ places} \\ \times\ 3.9 \quad 1 \text{ place} \\ \hline 36675 \\ 12225 \\ \hline 158925 \quad 4 \text{ places} \end{array}$
The product is positive.	$(3.9)\,(4.075) = 15.8925$

try it

[ohm_question]146596[/ohm_question]

In the following video we show another example of how to multiply two decimals.



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Dividing Decimals

Just as with multiplication, division of decimals is very much like dividing whole numbers — we have to figure out where the decimal point must be placed.

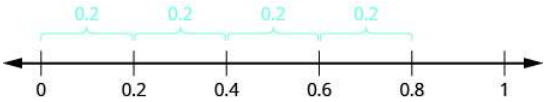
To understand decimal division, let's consider the multiplication problem

$$(0.2)\,(4) = 0.8$$

Remember, a multiplication problem can be rephrased as a division problem. So we can write

$$0.8 \div 4 = 0.2$$

We can think of this as "If we divide 8 tenths into four groups, how many are in each group?" The number line below shows that there are four groups of two-tenths in eight-tenths. So $0.8 \div 4 = 0.2$.



Using long division notation, we would write

$$4\overline{)0.8}\quad 0.2$$

Notice that the decimal point in the quotient is directly above the decimal point in the dividend.

To divide a decimal by a whole number, we place the decimal point in the quotient above the decimal point in the dividend and then divide as usual. Sometimes we need to use extra zeros at the end of the dividend to keep dividing until there is no remainder.

Divide a decimal by a whole number

1. Write as long division, placing the decimal point in the quotient above the decimal point in the dividend.
2. Divide as usual.

example

Divide: $0.12 \div 3$

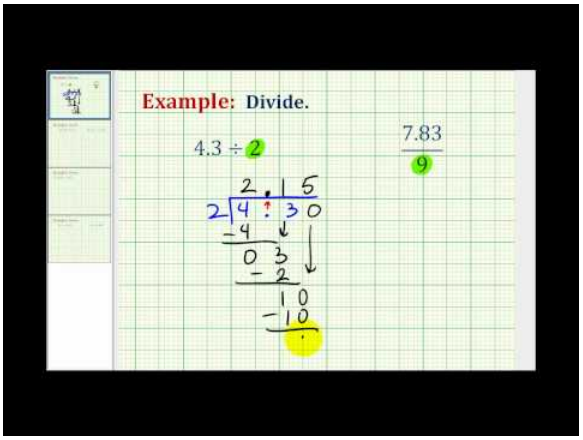
Solution

	$0.12 \div 3$
Write as long division, placing the decimal point in the quotient above the decimal point in the dividend.	$3\overline{)0.12}$
Divide as usual. Since 3 does not go into 0 or 1 we use zeros as placeholders.	$3\overline{)0.12}\quad 0.04$ 12 0
	$0.12 \div 3 = 0.04$

try it

[ohm_question]146600[/ohm_question]

Watch the following video to see another example of how to divide a decimal by a whole number.



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Most commonly, this calculation will be done with money while shopping. Prices of products tend to be presented as a combination of dollars and cents (i.e. $\$5.75$, 2.99, or $\$25.60$). You can then divide by the number of items or the number of units to determine the cost per item or unit.

example

Suppose a case of 24 water bottles cost $\$3.99$. To find the price per water bottle, we would divide $\$3.99$ by 24, and round the answer to the nearest cent (hundredth).

Divide: $\$3.99 \div 24$
[reveal-answer q="929706"]Show Answer[/reveal-answer]
[hidden-answer a="929706"]

Solution

	$\$3.99 \div 24$
Place the decimal point in the quotient above the decimal point in the dividend.	$24\overline{)3.99}$
Divide as usual. When do we stop? Since this division involves money, we round it to the nearest cent (hundredth). To do this, we must carry the division to the thousandths place.	$\begin{array}{r} 0.166 \\ 24\overline{)3.990} \\ \underline{24} \\ 159 \\ \underline{144} \\ 150 \\ \underline{144} \\ 6 \end{array}$
Round to the nearest cent.	$\$0.166 \approx \$0.17$
	$\$3.99 \div 24 \approx \$0.17$

This means the price per bottle is 17 cents.

[/hidden-answer]

try it

[ohm_question]145993[/ohm_question]

[ohm_question]156951[/ohm_question]

Next, we will divide a whole number by a decimal.

example

Divide: $4 \div 0.05$
[reveal-answer q="616625"]Show Answer[/reveal-answer]
[hidden-answer a="616625"]

Solution

	$4 \div 0.05$
The signs are the same.	The quotient is positive.
Make the divisor a whole number by 'moving' the decimal point all the way to the right. Move the decimal point in the dividend the same number of places, adding zeros as needed.	$0.05\overline{)4.00}$
Divide. Place the decimal point in the quotient above the decimal point in the dividend.	$\begin{array}{r} 80. \\ 5\overline{)400.} \\ 40 \\ \hline 00 \\ 00 \end{array}$
Write the quotient with the appropriate sign.	$4 \div 0.05 = 80$

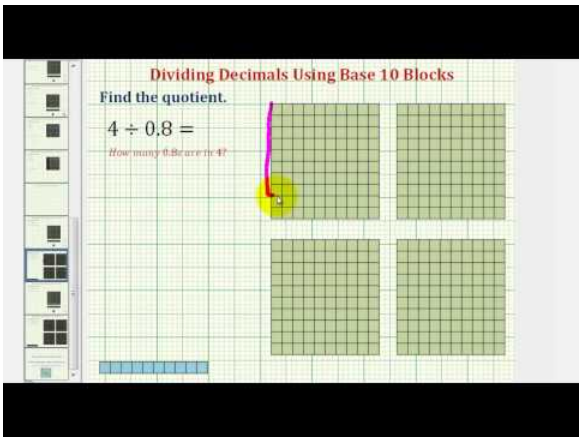
We can relate this example to money. How many nickels are there in four dollars? Because $4 \div 0.05 = 80$, there are 80 nickels in $\$4$.

[/hidden-answer]

try it

[ohm_question]146607[/ohm_question]

The following example shows how to divide a whole number by a decimal using base ten blocks.



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1.5: Convert Between Decimals and Fractions

Learning OUTCOME

- Convert decimals to fractions and fractions to decimals

We often need to rewrite decimals as fractions or mixed numbers. Let's go back to that lunch order to see how we can convert decimal numbers to fractions. We know that $\$5.03$ means 5 dollars and 3 cents. Since there are 100 cents in one dollar, 3 cents means $\frac{3}{100}$ of a dollar, so $0.03 = \frac{3}{100}$.

We convert decimals to fractions by identifying the place value of the farthest right digit. In the decimal 0.03, the 3 is in the hundredths place, so 100 is the denominator of the fraction equivalent to 0.03.

$$0.03 = \frac{3}{100}$$

For our $\$5.03$ lunch, we can write the decimal 5.03 as a mixed number.

$$5.03 = 5\frac{3}{100}$$

Notice that when the number to the left of the decimal is zero, we get a proper fraction. When the number to the left of the decimal is not zero, we get a mixed number.

Convert a decimal to a fraction or mixed number

1. Look at the number to the left of the decimal.
   - If it is zero, the decimal converts to a proper fraction.
   - If it is not zero, the decimal converts to a mixed number.
     - Write the whole number.
2. Determine the place value of the final digit.
3. Write the fraction.
   - numerator—the 'numbers' to the right of the decimal point
   - denominator—the place value corresponding to the final digit
4. Simplify the fraction, if possible.

example

Write each of the following decimal numbers as a fraction or a mixed number:

1. 4.09
2. 3.7
3. -0.286

Solution:

1.	
4.09	
There is a 4 to the left of the decimal point. Write "4" as the whole number part of the mixed number.	$4\frac{\square}{\square}$
Determine the place value of the final digit.	4. 0 9 tenths hundredths
Write the fraction. Write 9 in the numerator as it is the number to the right of the decimal point.	$4\frac{9}{\square}$
Write 100 in the denominator as the place value of the final digit, 9, is hundredth.	$4\frac{9}{100}$
The fraction is in simplest form.	So, $4.09 = 4\frac{9}{100}$

Did you notice that the number of zeros in the denominator is the same as the number of decimal places?

2.	
3.7	
There is a 3 to the left of the decimal point. Write "3" as the whole number part of the mixed number.	$3\frac{\square}{\square}$
Determine the place value of the final digit.	3. 7 tenths
Write the fraction. Write 7 in the numerator as it is the number to the right of the decimal point.	$3\frac{7}{\square}$
Write 10 in the denominator as the place value of the final digit, 7, is tenths.	$3\frac{7}{10}$
The fraction is in simplest form.	So, $3.7 = 3\frac{7}{10}$

3.	
-0.286	
There is a 0 to the left of the decimal point. Write a negative sign before the fraction.	$-\frac{\square}{\square}$
Determine the place value of the final digit and write it in the denominator.	−0. 2 8 6 tenths hundredths thousandths
Write the fraction. Write 286 in the numerator as it is the number to the right of the decimal point. Write $1,000$ in the denominator as the place value of the final digit, 6, is thousandths.	$-\frac{286}{1000}$
We remove a common factor of 2 to simplify the fraction.	$-\frac{143}{500}$

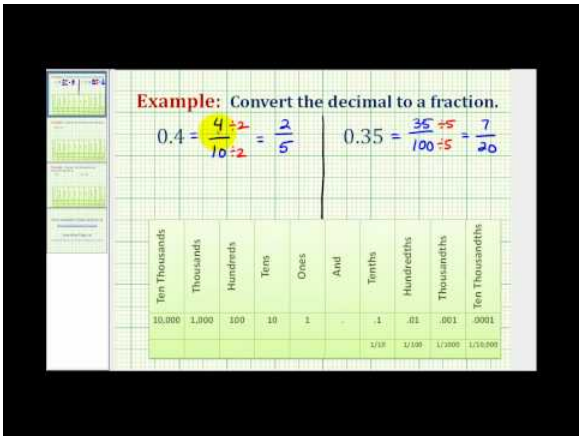
try it

[ohm_question]146573[/ohm_question]

[ohm_question]146574[/ohm_question]

[ohm_question]146575[/ohm_question]

In the next video example, we who how to convert a decimal into a fraction.



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Now we will do the reverse—convert fractions to decimals. Remember that the fraction bar indicates division. So $\frac{4}{5}$ can be written $4 \div 5$ or $5\overline{)4}$. This means that we can convert a fraction to a decimal by treating it as a division problem.

Convert a Fraction to a Decimal

To convert a fraction to a decimal, divide the numerator of the fraction by the denominator of the fraction.

The next decimal shows how to dived a numerator by a denominator using long division, but you can always use a calculator if it's allowed in your class.

example

Write the fraction $\frac{3}{4}$ as a decimal.

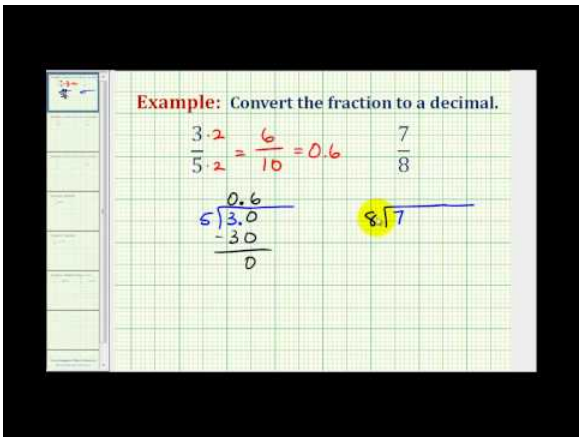
Solution

A fraction bar means division, so we can write the fraction $\frac{3}{4}$ using division.	$4\overline{)3}$
Divide.	$\begin{array}{r} 0.75 \\ 4\overline{)3.00} \\ \underline{28} \\ 20 \\ \underline{20} \\ 0 \end{array}$
	So the fraction $\frac{3}{4}$ is equal to 0.75

try it

[ohm_question]146253[/ohm_question]

The following video contains an example of how to write a fraction as a decimal.



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example

Write the fraction $-\frac{7}{2}$ as a decimal.
[reveal-answer q="746734"]Show Answer[/reveal-answer]
[hidden-answer a="746734"]

Solution

The value of this fraction is negative. After dividing, the value of the decimal will be negative. We do the division ignoring the sign, and then write the negative sign in the answer.	$-\frac{7}{2}$
Divide 7 by 2	$\begin{array}{r} 3.5 \\ 2\overline{)7.0} \\ \underline{6} \\ 10 \\ \underline{10} \\ 0 \end{array}$
So,	$-\frac{7}{2} = -3.5.$

[/hidden-answer]

try it

[ohm_question]146257[/ohm_question]

It is useful to convert between fractions and decimals when we need to add or subtract numbers in different forms. To add a fraction and a decimal, for example, we would need to either convert the fraction to a decimal or the decimal to a fraction.

example

Simplify: $\frac{7}{8} + 6.4$
[reveal-answer q="422720"]Show Answer[/reveal-answer]
[hidden-answer a="422720"]

Solution

		$\frac{7}{8}+6.4$
Change $\frac{7}{8}$ to a decimal.	$\begin{array}{r} 0.875 \\ 8\overline{)7.000} \\ \underline{64} \\ 60 \\ \underline{56} \\ 40 \\ \underline{40} \\ 0 \end{array}$	$0.875+6.4$
Add.		7.275

[/hidden-answer]

try it

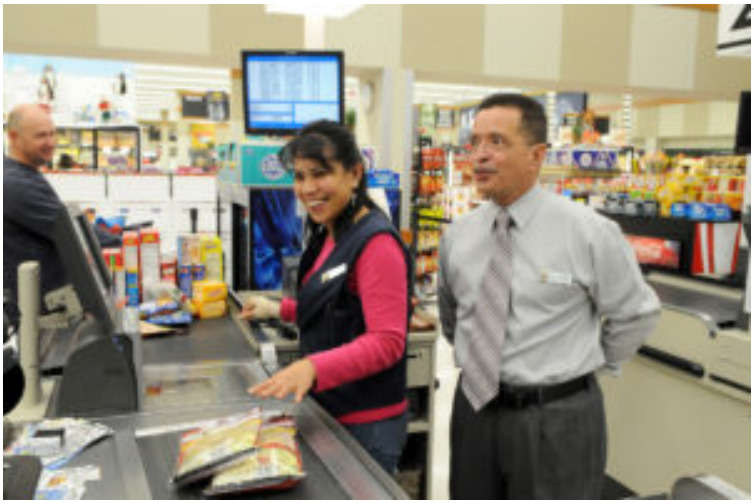
[ohm_question]146261[/ohm_question]

[ohm_question]146263[/ohm_question]

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1.6: Introduction to Percent Calculations



As a retail manager, you often create reports based on data collected by the information systems in place at your store. Sometimes those numbers need to be presented as percents to give you the most valuable information from which to base your decisions. Year over year sales growth, customer conversion rate, and gross profit margin are just a few examples of percent metrics that you will need to analyze your store performance.

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1.7: Solving Problems Using Ratios

Learning Outcome

- Use ratios to solve simple word problems

When you apply for a mortgage, the loan officer will compare your total debt to your total income to decide if you qualify for the loan. This comparison is called the debt-to-income ratio. The ratio must fall below a certain threshold for a lender to agree to loan you money. You can improve your debt to income ratio either by increasing your income, decreasing your debt, or both.

Ratios

A ratio compares two numbers or two quantities and indicates their proportion to one another.

The ratio of a to b is written a to b, $\frac{a}{b}$, or a :b

In this section, we will use the various notations interchangeably (i.e. $\frac{5}{7}$ is the same as $5:7$, is the same as 5 to 7). When a ratio is written in fraction form, the fraction should be simplified. If it is an improper fraction, we do not change it to a mixed number. Because a ratio compares two quantities, we would leave a ratio as $\frac{4}{1}$ or $4:1$ instead of simplifying it to 4 so that we can see the two parts of the ratio.

example

Write each ratio as a fraction:

1. 15 to 27
2. 45 to 18

Solution

1.	
	15 to 27
Write as a fraction with the first number in the numerator and the second in the denominator.	$\frac{15}{27}$
Simplify the fraction.	$\frac{5}{9}$

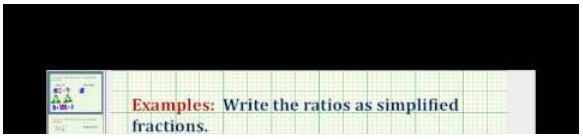
2.	
	45 to 18
Write as a fraction with the first number in the numerator and the second in the denominator.	$\frac{45}{18}$
Simplify.	$\frac{5}{2}$

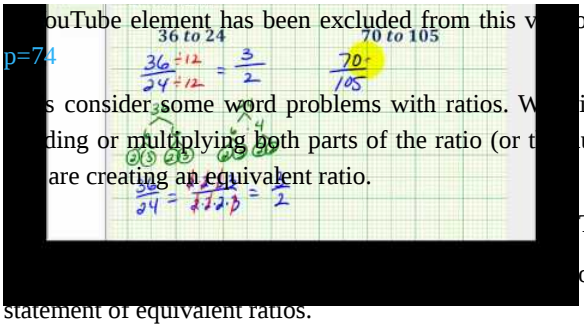
Notice we leave the second ratio as an improper fraction.

try it

[ohm_question]146453[/ohm_question]

In the following video you will see more examples of how to express a ratio as a fraction.





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s consider some word problems with ratios. W ill need to remember how to create equivalent ratios. As long as you are ding or multiplying both parts of the ratio (or t umerator and denominator, if you are using a faction representation), then are creating an equivalent ratio.

Take the ratio $10 : 4$

ommon factor is 2, so let's divide both values by 2. The result is a true statement of equivalent ratios.

$10 : 4$ equals $5 : 2$

or

$\frac{10}{4} = \frac{5}{2}$

Let's create another equivalent ratio by making it larger. Let's multiply both values by 3. The result is a true statement of equivalent ratios.

$10 : 4$ equals $30 : 12$

or

$\frac{10}{4} = \frac{30}{12}$

EXample

If Maria buys one dress for every three pairs of pants, and last year she bought nine pairs of pants, how many dresses did she buy last year?

Solution:

We will set up two equivalent ratio sentences like this:

_____ dress : _____ pants (Maria's purchase ratio)

_____ dress : _____ pants (last year's actual purchases)

Then we will fill them out with the values we know:

__1__ dress : __3__ pants

__?__ dress : __9__ pants

To make an equivalent ratio and to get from 3 pants to 9 pants, we know that we must have multiplied the initial value by 3. Let's do the same to the dresses to complete the equivalent ratio.

$$3 \cdot 1 = 3$$

Therefore, if Maria bought nine pairs of pants last year, based on her purchase ratio, she also bought three dresses.

Try It

The ratio of Sophomores to Seniors at Mauve Hills High School is seven to ten. If there are 154 Sophomores enrolled this year, how many Seniors are there?

[reveal-answer q="368717"]Show Answer[/reveal-answer]
[hidden-answer a="368717"]

__7__ Sophomores : __10__ Seniors

__154__ Sophomores : __?__ Seniors

We know that to make equivalent fractions, the 7 must have been multiplied by something. So let's divide 154 by 7 to find out what that multiplier was.

$$154 \div 7 = 22$$

Let's take that multiplier of 22 and multiply it by the 10 Seniors in the original ratio to create an equivalent ratio.

$$10 \cdot 22 = 220$$

There are 220 Seniors at Mauve Hills High School.

[/hidden-answer]

The next examples go one step further and take a little more thought as to what value you are looking for and what to do with it after you calculate it.

EXAMPLE

The Pet Adoption Center in San Antonio houses a ratio of 4 cats to 7 dogs. If the shelter can house 49 dogs, how many total animals can they keep at the shelter?

[reveal-answer q="587115"]Show Answer[/reveal-answer]
[hidden-answer a="587115"]

First, we need to figure out how many cats are at the shelter.

$$\frac{4}{7} = \frac{?}{49}$$
$$\frac{4}{7} \cdot \frac{7}{7} = \frac{28}{49}$$

There are 28 cats at the shelter. So in total there are $28 + 49 = 77$ animals housed at the Pet Adoption Center in San Antonio.

[/hidden-answer]

TRY IT

[ohm_question]156943[/ohm_question]

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1.8: Writing Fractions and Decimals as Percents

Learning Outcome

- Use percent to represent a given fraction or decimal

How many cents are in one dollar? There are 100 cents in a dollar. How many years are in a century? There are 100 years in a century. Does this give you a clue about what the word "percent" means? It is really two words, "per cent," and means per one hundred. A percent is a ratio whose denominator is 100. We use the percent symbol, $\%$, to show percent.

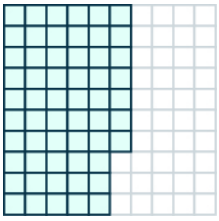
Percent

A percent is a ratio whose denominator is 100.

For example $46\% = \frac{46}{100}$

According to data from the American Association of Community Colleges (2015), about 57 of community college students are female. This means 57 out of every 100 community college students are female, as the image below shows. Out of the 100 squares on the grid, 57 are shaded, which we write as the ratio $\frac{57}{100}$.

Among every 100 community college students, 57 are female.



Similarly, 25 means a ratio of $\frac{25}{100}$, 3 means a ratio of $\frac{3}{100}$ and 100 means a ratio of $\frac{100}{100}$. In words, "one hundred percent" means the total 100 is $\frac{100}{100}$, and since $\frac{100}{100} = 1$, we see that 100 means 1 whole.

To convert a decimal to a percent, remember that percent means per hundred. If we change the decimal to a fraction whose denominator is 100, it is easy to change that fraction to a percent.

Convert a decimal to a percent

1. Write the decimal as a fraction.
2. If the denominator of the fraction is not 100, rewrite it as an equivalent fraction with denominator 100.
3. Write this ratio as a percent.

example

Convert each decimal to a percent:

1. 0.05

2. 0.83

Solution

1.	
	0.05
Write as a fraction. Five hundredths – the denominator is 100.	$\frac{5}{100}$
Write this ratio as a percent.	5%

2.	
	0.83
Write as a fraction. Eighty-three hundredths – the denominator is 100.	$\frac{83}{100}$
Write this ratio as a percent.	83%

try it

[ohm_question]146666[/ohm_question]

Let's look at a few more examples of converting decimals to percents, but these aren't as straight forward!

example

Convert each decimal to a percent:
1. 0.2

2. 1.05

2. 0.075

[reveal-answer q="740440"]Show Answer[/reveal-answer]
[hidden-answer a="740440"]

Solution

1.	
	0.2
Write as a fraction. The denominator is 10.	$\frac{2}{10}$
Multiply the numerator and denominator by 10, so that the denominator is 100.	$\frac{20}{100}$
Write this ratio as a percent.	20%

Notice that you could also have written 0.2 as 0.20 and gotten to $\frac{20}{100}$ without doing any calculations.

2.	
	0.05
Write as a fraction.	$1\frac{5}{100}$
Write as an improper fraction. The denominator is 100.	$\frac{105}{100}$
Write this ratio as a percent.	105%

Notice that since $1.05 > 1$, the result is more than 100%.

3.	
	0.075
Write as a fraction. The denominator is $1,000$.	$\frac{75}{1,000}$
Divide the numerator and denominator by 10, so that the denominator is 100.	$\frac{7.5}{100}$
Write this ratio as a percent.	7.5%

Notice that any decimal that has value beyond the hundredths place will have a decimal answer when converted to a percent.

[/hidden-answer]

try it

[ohm_question]146667[/ohm_question]

[ohm_question]156959[/ohm_question]

[ohm_question]156964[/ohm_question]

Let's summarize some of the results from the previous examples in the table below so we can look for a pattern.

Decimal	Percent
0.05	5
0.83	83
0.2	20
1.05	105
0.075	7.5

Do you see the pattern? To convert a decimal to a percent, we move the decimal point two places to the right and then add the percent sign.

The next table uses the decimal numbers in the table above and shows visually to convert them to percents by moving the decimal point two places to the right and then writing the $\%$ sign.

Percent	Decimal
006.%	0.06
078.%	0.78
135.%	1.35
012.5%	0.125

In an earlier lesson, we learned how to convert fractions to decimals. Now we also know how to change decimals to percents. So to convert a fraction to a percent, we first change it to a decimal and then convert that decimal to a percent.

Convert a fraction to a percent

1. If possible, convert the fraction to a denominator of 100.
2. If not, convert the fraction to a decimal by dividing.
3. Convert the decimal to a percent.

example

Convert each fraction or mixed number to a percent:

1. $\frac{3}{4}$
2. $\frac{11}{8}$
3. $2\frac{1}{5}$

[reveal-answer q="32099"]Show Answer[/reveal-answer]
[hidden-answer a="32099"]

Solution
To convert a fraction to a decimal, divide the numerator by the denominator.

1.	$\frac{3}{4}$
Change to a decimal.	0.75
Write as a percent by moving the decimal two places.	75%

2.	$\frac{11}{8}$
Change to a decimal.	1.375
Write as a percent by moving the decimal two places.	137.5%

3.	$2\frac{1}{5}$
Write as an improper fraction.	$\frac{11}{5}$
Change to a decimal.	2.2 2.20
Write as a percent.	220%

Notice that we sometimes need to add zeros at the end of the number when moving the decimal two places to the right.

[/hidden-answer]

Sometimes when changing a fraction to a decimal, the division continues for many decimal places and we will need to round off the quotient. Typically, you will round before converting to a percent unless instructed otherwise. The number of decimal places we round to will depend on the situation. If the decimal calculation involves money, we round it to the hundredths place. For most other cases, we will round the number to the nearest thousandth, so the percent will be rounded to the nearest tenth.

try it

[ohm_question]146669[/ohm_question]

[ohm_question]146670[/ohm_question]

[ohm_question]146671[/ohm_question]

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1.9: Solving Problems Using Percents

Learning Outcome

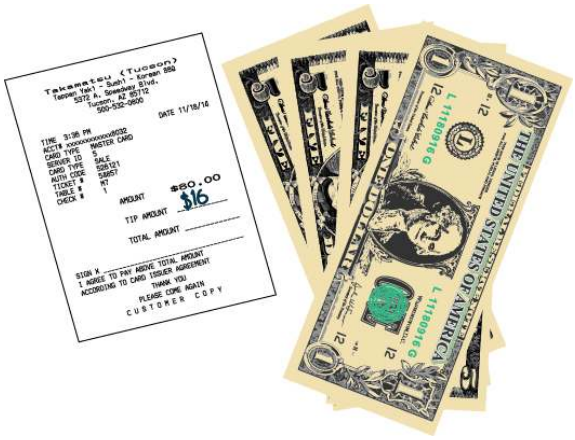
- Evaluate expressions and word problems involving percents

In this section we will solve percent questions by identifying the parts of the problem. We'll look at a common application of percent—tips to a server at a restaurant—to see how to set up a basic percent application.

When Aolani and her friends ate dinner at a restaurant, the bill came to $\$80$. They wanted to leave a 20% tip. What amount would the tip be?

To solve this, we want to find what *amount* is 20% of $\$80$. The $\$80$ is called the *base*. The *percent* is the given 20%. The amount of the tip would be $0.20(80)$, or $\$16$ — see the image below. To find the amount of the tip, we multiplied the percent by the base.

A 20% tip for an $\$80$ restaurant bill comes out to $\$16$.



Pieces of a Percent Problem

Percent problems involve three quantities: the ***base*** amount (the whole), the ***percent***, and the ***amount*** (a part of the whole or partial amount).

The amount is a percent of the base.

Let's look at another example:

Jeff has a Guitar Strings coupon for 15% off any purchase of $\$100$ or more. He wants to buy a used guitar that has a price tag of $\$220$ on it. Jeff wonders how much money the coupon will take off the original $\$220$ price. Problems involving percents will have some combination of these three quantities to work with: the *percent*, the *amount*, and the *base*. The percent has the percent symbol (%) or the word percent. In the problem above, 15% is the percent off the purchase price. The base is the whole amount or original amount. In the problem above, the "whole" price of the guitar is $\$220$, which is the base. The amount is the unknown and what we will need to calculate.

There are thee cases: a missing amount, a missing percent or a missing base. Let's take a look at each possibility.

Solving for the Amount

When solving for the amount in a percent problem, you will multiply the percent (as a decimal or fraction) by the base. Typically we choose the decimal value for percent.

$$\text{percent} \cdot \text{base} = \text{amount}$$

Example

Find 50% of 20

Solution:

First identify each piece of the problem:

percent: 50% or $.5$

base: 20

amount: unknown

Now plug them into your equation $\text{percent} \cdot \text{base} = \text{amount}$

$$.5 \cdot 20 = ?$$

$$.5 \cdot 20 = 10$$

Therefore, 10 is the amount or part that is 50% of 20.

Example

What is 25% of 80?

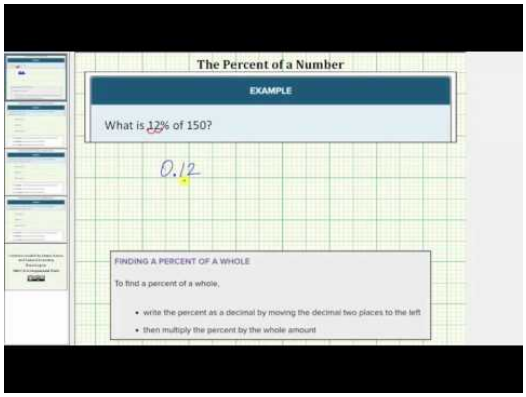
[reveal-answer q="813233"]Show Answer[/reveal-answer]
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The base is 80 and the percent is 25%, so amount $= 80(0.25) = 20$

[/hidden-answer]

Try It

[ohm_question]80094[/ohm_question]



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Solving for the Percent

When solving for the percent in a percent problem, you will divide the amount by the base. The equation above is rearranged and the percent will come back as a decimal of fraction you can report in the form asked of you.

$$\frac{\text{amount}}{\text{base}} = \text{percent}$$

Example

What percent of 320 is 80?

Solution:

First identify each piece of the problem:

percent: unknown

base: 320

amount: 80

Now plug the values into your equation $\frac{\text{amount}}{\text{base}} = \text{percent}$

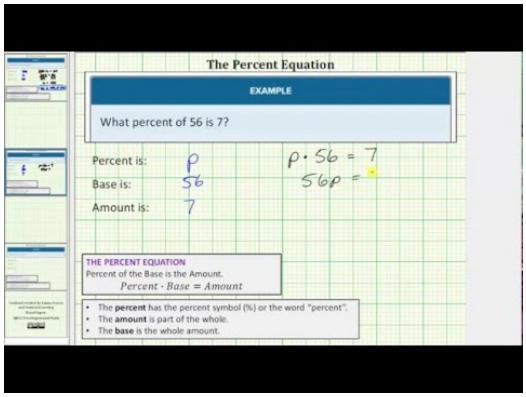
$$\frac{80}{320} = ?$$

$$\frac{80}{320} = .25$$

Therefore, 80 is 25% of 320.

TRY IT

[ohm_question]80097[/ohm_question]



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Solving for the Base

When solving for the base in a percent problem, you will divide the amount by the percent (as a decimal or fraction). The equation above is rearranged and you will find the base after plugging in the values.

$$\frac{\text{amount}}{\text{percent}} = \text{base}$$

EXample

60 is 40% of what number?

Solution:

First identify each piece of the problem:

percent: 40% or $.4$

base: unknown

amount: 60

Now plug the values into your equation $\frac{\text{amount}}{\text{percent}} = \text{base}$

$$(60) \div (.4) = ?$$

$$(60) \div (.4) = 150$$

Therefore, 60 is 40% of 150.

Example

An article says that 15% of a non-profit's donations, about $\$30,000$ a year, comes from individual donors. What is the total amount of donations the non-profit receives?

[reveal-answer q="731314"]Show Answer[/reveal-answer]
[hidden-answer a="731314"]

The percent is 15%, and $\$30,000$ is the amount (or part of the whole). We are looking for the base.

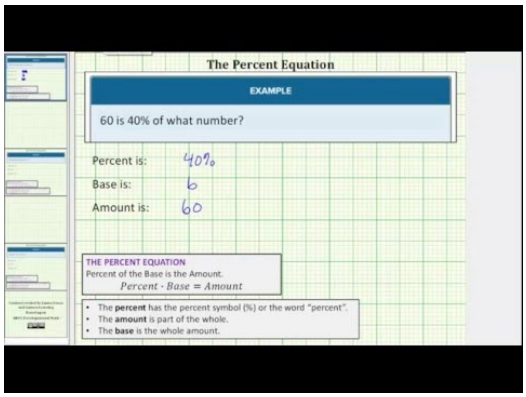
base = $30000 \div (.15) = \$200000$

The non-profit receives $\$200000$ a year in donations

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TRY IT

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Here are a few more percent problems for you to try.

try it

[ohm_question]146672[/ohm_question]

try it

[ohm_question]146692[/ohm_question]

try it

[ohm_question]146693[/ohm_question]

Many applications of percent occur in our daily lives, such as tips, sales tax, discount, and interest. To solve these applications we'll translate to a basic percent equation, just like those we solved in the previous examples in this section. Once you translate the sentence into a percent equation, you know how to solve it.

example

Dezohn and his girlfriend enjoyed a dinner at a restaurant, and the bill was $\$68.50$. They want to leave an 18 tip. If the tip will be 18 of the total bill, how much should the tip be?

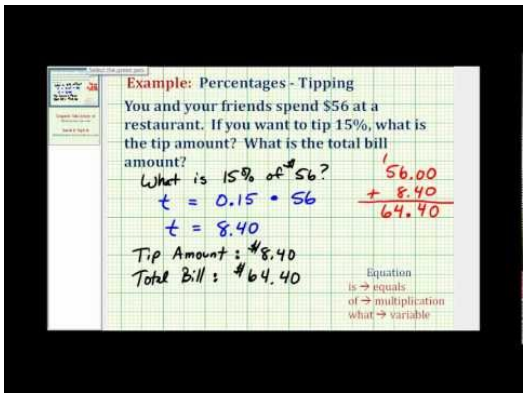
Solution

What are you asked to find?	the amount of the tip
What formula/equation should you use?	$\text{percent} \cdot \text{base} = \text{amount}$
Substitute in the correct values.	$(.18) \cdot 68.50$
Solve.	$(.18) \cdot 68.50 = 12.33$
Write a complete sentence that answers the question.	The couple should leave a tip of $\$12.33$.

try it

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In the next video we show another example of finding how much tip to give based on percent.



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example

The label on Masao's breakfast cereal said that one serving of cereal provides 85 milligrams (mg) of potassium, which is 2 of the recommended daily amount. What is the total recommended daily amount of potassium?

Nutrition Facts

Serving Size: 1 cup (47g)
Servings Per Container: About 7

Amount Per Serving	Cereal	With Milk
Calories	180	230
Calories from Fat	10	20
	% Daily Value*	
Total Fat 1g	**2%**	**2%**
Saturated Fat 0g	**0%**	**0%**
Trans Fat 0g		
Polyunsaturated Fat 0.5g		
Monounsaturated Fat 0.5g		
Cholesterol 0mg	**0%**	**0%**
Sodium 190mg	**8%**	**11%**
Potassium 85mg	**2%**	**8%**
Total Carbohydrate 40g	**13%**	**15%**
Dietary Fiber 1g	**4%**	**4%**
Sugars 8g		
Protein 3g		

[reveal-answer q="744443"]Show Answer[/reveal-answer]
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Solution

What are you asked to find?	the total daily amount of potassium recommended (whole)
What formula/equation should you use?	$\frac{\text{amount}}{\text{percent}} = \text{base}$
Substitute in the correct values.	$\frac{85}{.02}$
Solve.	$\frac{85}{.02} = 4250$
Write a complete sentence that answers the question.	The amount of potassium that is recommended is $4,250$ mg.

[/hidden-answer]

try it

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[ohm_question]146702[/ohm_question]

try it

[ohm_question]146703[/ohm_question]

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1.10: Percent Increase and Decrease

Learning Outcome

- Solve problems involving percent increase and decrease

People in the media often talk about how much an amount has increased or decreased over a certain period of time — referring to politics, economics, demographics, etc. These statistical increases or decreases are usually expressed as a percent. In business, data is also often presented as percent change — analyzing profits, website traffic, customer satisfaction scores, etc.

Percent change refers to either percent increase or percent decrease depending on how the number has gained or lost value or magnitude.

Percent Increase

To find the percent increase, first we find the amount of increase, which is the difference between the new amount and the original amount. Then we find what percent the amount of increase is of the original amount.

Find Percent Increase

Step 1. Find the amount of increase.

- *increase = new amount − original amount*

Step 2. Find the percent increase as a percent of the original amount.

example

In 2011, the California governor proposed raising community college fees from $26 per unit to $36 per unit. Find the percent increase. (Round to the nearest tenth of a percent.)

Solution

What are you asked to find?	the percent increase
Choose a variable to represent it.	Let $p =$ percent.
Find the amount of increase.	$\underbrace{36}_{\text{new amount}} - \underbrace{26}_{\text{original amount}} = \underbrace{10}_{\text{increase}}$
Find the percent increase.	The increase is what percent of the original amount?
Translate to an equation.	$\underbrace{10}_{10} \underbrace{\text{is}}_{=} \underbrace{\text{what percent}}_{p} \underbrace{\text{of}}_{\cdot} \underbrace{26?}_{26}$
Divide both sides by 26.	$\frac{10}{26} = \frac{26p}{26}$
Round to the nearest thousandth.	$0.384 = p$
Convert to percent form.	$38.4 = p$
Write a complete sentence.	The new fees represent a 38.4 increase over the old fees.

try it

[ohm_question]146704[/ohm_question]

[ohm_question]146705[/ohm_question]

Percent Decrease

Finding the percent decrease is very similar to finding the percent increase, but now the amount of decrease is the difference between the original amount and the final amount. Then we find what percent the amount of decrease is of the original amount.

Find percent decrease

Step 1. Find the amount of decrease.

- *decrease = original amount − new amount*

Step 2. Find the percent decrease as a percent of the original amount.

example

The average price of a gallon of gas in one city in June 2014 was $3.71. The average price in that city in July was $3.64. Find the percent decrease.
[reveal-answer q="516647"]Show Answer[/reveal-answer]
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Solution

What are you asked to find?	the percent decrease
Choose a variable to represent it.	Let $p =$ percent.
Find the amount of decrease.	$\underbrace{3.71}_{\text{original amount}} - \underbrace{3.64}_{\text{new amount}} = \underbrace{0.07}_{\text{increase}}$
Find the percent of decrease.	The decrease is what percent of the original amount?
Translate to an equation.	$\underbrace{0.07}_{0.07} \underbrace{\text{is}}_{=} \underbrace{\text{what percent}}_{p} \underbrace{\text{of}}_{\cdot} \underbrace{3.71}_{3.71}$
Divide both sides by 3.71.	$\frac{0.07}{3.71} = \frac{3.71p}{3.71}$
Round to the nearest thousandth.	$0.019 = p$
Convert to percent form.	$1.9 = p$
Write a complete sentence.	The price of gas decreased 1.9.

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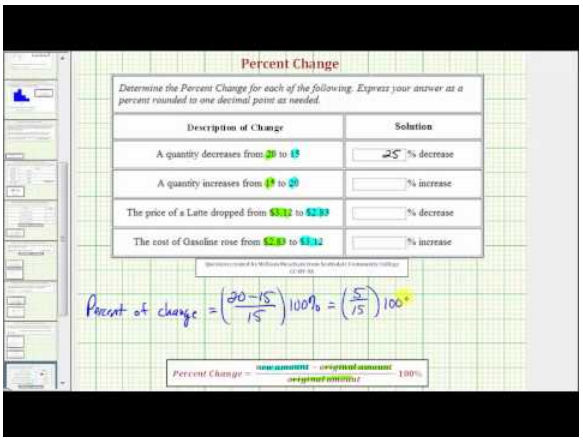
try it

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Percent Change

In the following video we show more examples of how to find percent increase and decrease.



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1.11: Why It Matters- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving

Why learn essential math principles?

Mathematics is often referred to solely as a subject of study in school—while in reality, you use math all the time to make daily calculations and decisions. There are times when you need to work with numbers in a variety of ways to determine how you want to proceed with a purchase or a project.



Your friend Samuel is graduating next week and you want to throw him a party to celebrate. He'll be moving away next month to start a management internship with a national retailer. Everyone is proud of him and you know dozens of people who will want to wish him farewell and good luck. It looks like an evening event will work for most people, and your favorite party theme is a dessert bar: cupcakes, fizzy drinks, ice cream sundaes, and cookies.

At the grocery store you see two different brands of cake mix to make the cupcakes: Sweet Sprinkles and Chocolover. They are both on sale for different prices. Sweet Sprinkles cake mix boxes are 2 for $\$5.50$, or 1 for $\$3.75$. Chocolover cake mix boxes are 3 for $\$6.99$, or 1 for $\$2.55$.

First, you'll want to figure out the most economical way to purchase the boxes of cake mix to have enough for everyone. Then, once you're home, you'll have to triple your frosting recipe to make enough for the party — and there are fraction amounts ($\frac{3}{4}$ cup) in the original recipe! You also know you'll need to estimate the number of drinks that will be consumed, which will likely involve rounding. Some of Samuel's other friends offered to chip in to pay for all the party supplies, so you'll need to calculate how to split the cost evenly between the group.

This party is turning out to involve **a lot** of math! Let's review some core math concepts, so that we can better work with complex accounting equations in later modules.

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1.12: Putting It Together- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving

Let's revisit the math you'll need to make decisions for Samuel's graduation party.

You determine that you will need five boxes of cupcake mix to make enough for the crowd. Sweet Sprinkles cake mix boxes are 2 for $\$5.50$, or 1 for $\$3.75$. Chocolover cake mix boxes are 3 for $\$6.99$, or 1 for $\$2.55$. What is the most economical way to purchase what you need?



All Sweet Sprinkles: $(2 \cdot 5.50) + 3.75 = \$14.75$

All Chocolover: $(2 \cdot 2.55) + 6.99 = \$12.09$

Combination of brands: $5.50 + 6.99 = \$12.49$

You will need to triple your frosting recipe, which calls for 3/4 cup of cream cheese, 1/3 tsp of vanilla, and 2.5 cups of powdered sugar. How much of each ingredient will you need?

Cream cheese: $3 \cdot (\frac{3}{4}) = (\frac{3}{1})(\frac{3}{4}) = \frac{9}{4}$ or $2\frac{1}{4}$ cups

Vanilla: $3 \cdot (\frac{1}{3}) = (\frac{3}{1})(\frac{1}{3}) = \frac{3}{3}$ or 1 teaspoon

Powdered sugar: $2.5 = \frac{5}{2}$; $3 \cdot (\frac{5}{2}) = (\frac{3}{1})(\frac{5}{2}) = \frac{15}{2}$ or $7\frac{1}{2}$ cups

You have invited 96 people to the party and guess that only about 76% will be able to show up. First, figure out how many people you think will attend the party (round to the ones place — whole person). According to what you've read online, people consume about 5 drinks per person at a party. If drinks come in 12-packs, how many packs will you need to buy to cover the estimated drink needs?

Attendees: $96 \cdot (.76) = 72.96$ rounded to 73 whole people

Drinks needed: $73 \cdot 5 = 365$ drinks

12-packs to buy: $365/12 \approx 30.41667$ rounded up to 31 packs to cover the estimated drink needs

You have six friends who are willing to split the cost of food, drinks, and decorations as long as you cover the dishes and utensils. The total cost for everything was $\$480.39$ and the plates, napkins, spoons, etc. added up to $\$125.61$. How much will each of the friends need to pay you for their share?

Cost of food, drinks, decorations: $\$480.39 - \$125.61 = \$354.78$

Split cost: $\$354.78/6 = \$59.13$

As you can see, the math we reviewed in the module is extremely useful in a making calculations and decisions for a scenario like a big graduation party!

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1.13: Assignment- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving

Read the scenarios below and thoroughly complete the tasks posed in each one.

1. Pick a city in the US that you would like to travel to. Pretend you have a $950 budget to travel to this city for a four night vacation. Do some research and write up a basic budget of how you plan to spend that money — include travel to and from the city, accommodations, food, activities, and any other expenses.
2. Choose a publicly traded company that interests you and find the price of its stock on your last birthday and yesterday. Calculate the difference in its stock value between yesterday and your last birthday. Calculate how much you would have made or lost if you had purchased 1000 shares of that stock on your last birthday and sold it yesterday. Show all your calculations in your response.

This assignment is also available for download as a Word Document.

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1.14: Introduction to Whole Number Calculations



If it has been a while since you've studied math, it can be helpful to review fundamental topics. The most basic numbers used in math are those we use to count objects: $1, 2, 3, 4, 5, ...$ and so on. These are called the counting numbers, or natural numbers.

Whole numbers are all non-negative numbers that have no fractional or decimal part: $0, 1, 2, 3, 4, 5, 6, ...$ and so on. Working with whole numbers lays the foundation for working with all other types of numbers. Using mathematical rules to manipulate whole numbers allows us to better analyze more complex numbers and data collected from the world around us.

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1.15: Place Value in Whole Numbers

Learning Objectives

- Use place value to define all digits of a whole number

Our number system is called a place value system because the value of a digit depends on its position, or place, in a number. The number 537 has a different value than the number 735. Even though they use the same digits, their value is different because of the different placement of the 3 and the 7 and the 5.

Money gives us a familiar model of place value. Suppose a wallet contains three $100 bills, seven $10 bills, and four $1 bills. The amounts are summarized in the image below. How much money is in the wallet?

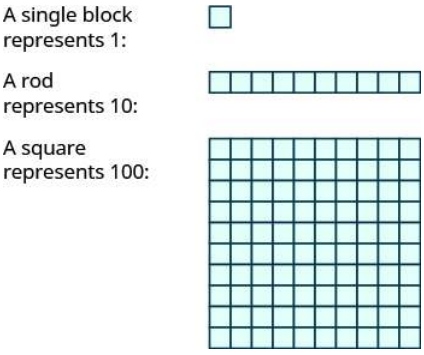


Three $100 bills	Seven $10 bills	Four $1 bills
$3 \times \$100$	$7 \times \$10$	$4 \times \$1$
$300	$70	$4

Find the total value of each kind of bill, and then add to find the total. The wallet contains $374.



Base-10 blocks provide another way to model place value, as shown in the image below. The blocks can be used to represent hundreds, tens, and ones. Notice that the tens rod is made up of 10 ones, and the hundreds square is made of 10 tens, or 100 ones.



The image below shows the number 138 modeled with base-10 blocks.

We use place value notation to show the value of the number 138.

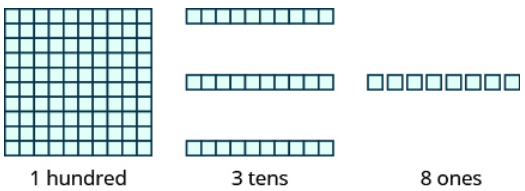
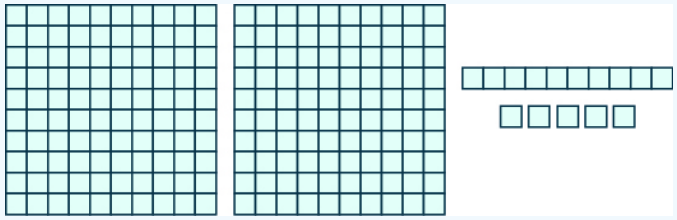


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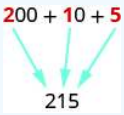
Digit	Place value	Number	Value	Total value
1	hundreds	1	100	100
3	tens	3	10	30
8	ones	8	1	+ 8
				Sum =138

example

Use place value notation to find the value of the number modeled by the base-10 blocks shown.



[reveal-answer q="664749"]Show Answer[/reveal-answer]
[hidden-answer a="664749"]
There are 2 hundreds squares, which is 200.
There is 1 tens rod, which is 10.
There are 5 ones blocks, which is 5.

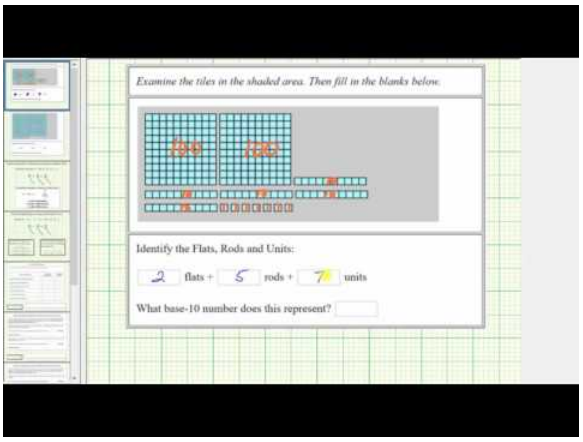


Digit	Place value	Number	Value	Total value
2	hundreds	2	100	200
1	tens	1	10	10
5	ones	5	1	+ 5
				215

The base-10 blocks model the number 215.
[/hidden-answer]

Try it

[ohm_question hide_question_numbers=1]143031[/ohm_question]



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By looking at money and base-10 blocks, we saw that each place in a number has a different value. A place value chart is a useful way to summarize this information. The place values are separated into groups of three, called periods. The periods are *ones*, *thousands*, *millions*, *billions*, *trillions*, and so on. In a written number, commas separate the periods.

Just as with the base-10 blocks, where the value of the tens rod is ten times the value of the ones block and the value of the hundreds square is ten times the tens rod, the value of each place in the place-value chart is ten times the value of the place to the right of it.

The chart below shows how the number $5,278,194$ is written in a place value chart.

Place Value													
Trillions			Billions			Millions			Thousands			Ones	
Hundred trillions	Ten trillions	Trillions	Hundred billions	Ten billions	Billions	Hundred millions	Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
								5	2	7	8	1	9	4

- The digit 5 is in the millions place. Its value is $5,000,000$.
- The digit 2 is in the hundred thousands place. Its value is $200,000$.
- The digit 7 is in the ten thousands place. Its value is $70,000$.
- The digit 8 is in the thousands place. Its value is $8,000$.
- The digit 1 is in the hundreds place. Its value is 100.
- The digit 9 is in the tens place. Its value is 90.
- The digit 4 is in the ones place. Its value is 4.

example

In the number $63,407,218$; find the place value of each of the following digits:

1. 7
2. 0
3. 1
4. 6
5. 3

[reveal-answer q="17862"]Show Answer[/reveal-answer]
[hidden-answer a="17862"]

Write the number in a place value chart, starting at the right.

Trillions			Billions			Millions			Thousands			Ones		
Hundred trillions	Ten trillions	Trillions	Hundred billions	Ten billions	Billions	Hundred millions	Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
							6	3	4	0	7	2	1	8

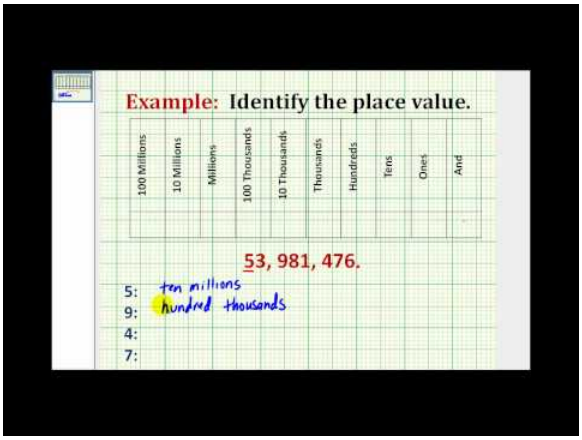
- The 7 is in the thousands place.
- The 0 is in the ten thousands place.
- The 1 is in the tens place.
- The 6 is in the ten millions place.
- The 3 is in the millions place.

[/hidden-answer]

try it

[ohm_question hide_question_numbers=1]130[/ohm_question]

The video below shows more examples of how to determine the place value of a digit in a number.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=48

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1.16: Rounding Whole Numbers

Learning Objectives

- Round whole numbers to a determined place value



Best Buy Storefront

The electronics retailer, Best Buy, had $1,026$ brick and mortar stores open in October of 2016. Depending on how this information will be used, it might be enough to say that the company has approximately one thousand stores. The word *approximately*means that one thousand is not the exact count, but is close to the exact value.

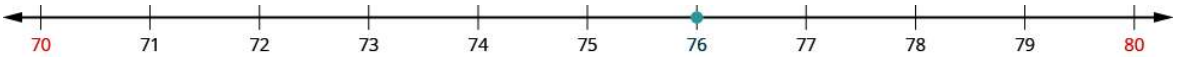
In 2017, the social network app, Facebook, reported its annual revenue as 40.7 billion US dollars. This could mean they actually brought in $\$40,742,985,316$ or $\$40,654,872,131$. Sometimes the detail is needed, but sometimes just an approximate value is good enough. The real estate app, Zillow, recorded a profit of 1.07 billion US dollars; this is an approximate value. If you want to compare Facebook's 2017 revenue with Zillow's 2017 revenue, the precise dollars or even millions of dollars are unnecessary.

The process of approximating a number is called **rounding**. Numbers are rounded to a specific place value depending on how much accuracy is needed. Identifying the number of stores owned by Best Buy as approximately 1 thousand means we rounded to the thousands place. Reporting the annual revenue of Facebook as 40.7 billion US dollars means we rounded to the hundred millions place. Often the place value to which we round depends on how we will need to use the number.

Using a number line can help us visualize and understand the rounding process. Look at the number line below.

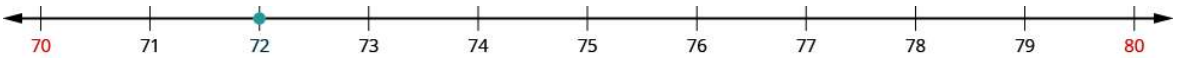
Suppose we want to round the number 76 to the nearest ten. Is 76 closer to 70 (7 tens) or 80 (8 tens) on the number line?

We can see that 76 is closer to 80 than to 70. So 76 rounded to the nearest ten is 80.



Now consider the number 72. Find 72 on the number line.

We can see that 72 is closer to 70, so 72 rounded to the nearest ten is 70.



How do we round 75 to the nearest ten?

Find 75 on the number line.

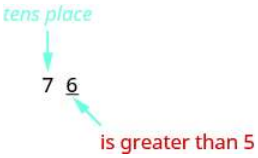
The number 75 is exactly midway between 70 and 80.



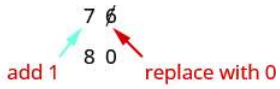
So that everyone rounds the same way in cases like this, mathematicians have agreed to round up to the higher number. So, 75 rounded to the nearest ten is 80.

Now that we have looked at this process on the number line, we can introduce a more general procedure. To round a number to a specific place, look at the number to the right of that place. If the number is less than 5, round down. If it is greater than or equal to 5, round up.

So, for example, to round 76 to the nearest ten, we look at the digit in the ones place.

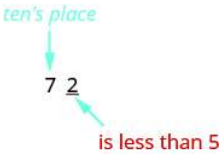


The digit in the ones place is a 6. Because 6 is greater than or equal to 5, we increase the digit in the tens place by one. So the 7 in the tens place becomes an 8. Now, replace any digits to the right of the 8 with zeros. So, 76 rounds to 80.

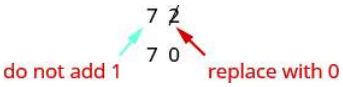


76 rounded to the nearest ten is 80.

Let's look again at rounding 72 to the nearest 10. Again, we look to the ones place.



The digit in the ones place is 2. Because 2 is less than 5, we keep the digit in the tens place the same and replace the digits to the right of it with zero. So 72 rounded to the nearest ten is 70.



Round a whole number to a specific place value

1. Locate the given place value. All digits to the left of that place value do not change.
2. Underline the digit to the right of the given place value.
3. Determine if this digit is greater than or equal to 5.
   - Yes—add 1 to the digit in the given place value.
   - No—do not change the digit in the given place value.
4. Replace all digits to the right of the given place value with zeros.

example

Round 843 to the nearest ten.

Solution

Locate the tens place.	tens place 843
Underline the digit to the right of the tens place.	843
Since 3 is less than 5, do not change the digit in the tens place.	843
Replace all digits to the right of the tens place with zeros.	840
Rounding 843 to the nearest ten gives 840.	

try it

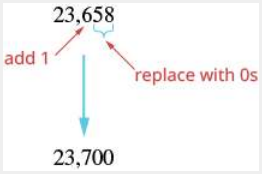
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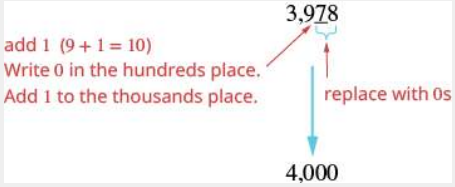
Example

Round each number to the nearest hundred:

1. $23,658$
2. $3,978$

[reveal-answer q="210558"]Show Answer[/reveal-answer]
[hidden-answer a="210558"]

1.	
Locate the hundreds place.	
The digit of the right of the hundreds place is 5. Underline the digit to the right of the hundreds place.	23,658
Since 5 is greater than or equal to 5, round up by adding 1 to the digit in the hundreds place. Then replace all digits to the right of the hundreds place with zeros.	 So 23,658 rounded to the nearest hundred is 23,700.

2.	
Locate the hundreds place.	
Underline the digit to the right of the hundreds place.	3,978
The digit to the right of the hundreds place is 7. Since 7 is greater than or equal to 5, round up by added 1 to the 9. Then place all digits to the right of the hundreds place with zeros.	 So 3,978 rounded to the nearest hundred is 4,000.

[/hidden-answer]

try it

[ohm_question hide_question_numbers=1]147152[/ohm_question]

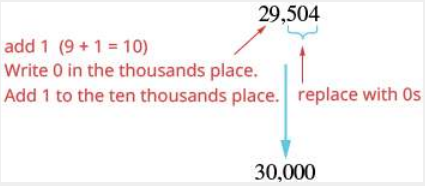
example

Round each number to the nearest thousand:

1. $147,032$
2. $29,504$

[reveal-answer q="935310"]Show Answer[/reveal-answer]
[hidden-answer a="935310"]

1.	
Locate the thousands place. Underline the digit to the right of the thousands place.	
The digit to the right of the thousands place is 0. Since 0 is less than 5, we do not change the digit in the thousands place.	147,032
We then replace all digits to the right of the thousands pace with zeros.	147,000 So 147,032 rounded to the nearest thousand is 147,000.

2.	
Locate the thousands place.	
Underline the digit to the right of the thousands place.	29,504
The digit to the right of the thousands place is 5. Since 5 is greater than or equal to 5, round up by adding 1 to the 9. Then replace all digits to the right of the thousands place with zeros.	 So 29,504 rounded to the nearest thousand is 30,000.

Notice that in part 2, when we add 1 thousand to the 9 thousands, the total is 10 thousands. We regroup this as 1 ten thousand and 0 thousands. We add the 1 ten thousand to the 3 ten thousands and put a 0 in the thousands place.
[/hidden-answer]

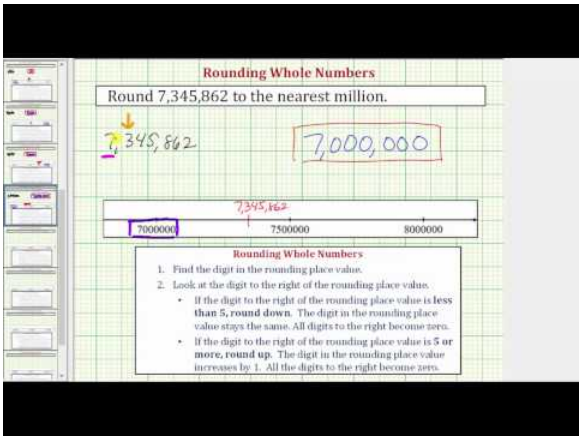
try it

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TRY IT

[ohm_question hide_question_numbers=1]143030[/ohm_question]

Watch the video below for more examples of how to round whole numbers to a given place value.



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1.17: Adding, Subtracting, Multiplying, and Dividing Whole Numbers

Learning Objectives

- Use addition, subtraction, multiplication, and division when evaluating whole number expressions

Working with whole numbers and performing basic calculations is the backbone of all math. We're going to assume you remember how to do single digit addition, subtraction, multiplication, and division. You will often have a calculator on hand to do these calculations, but a quick refresher will help you better understand how to work with numbers so that complex equations are less daunting.

Addition

example

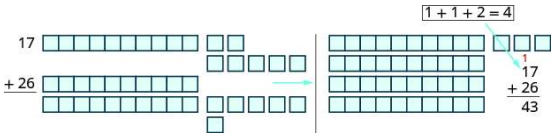
Add: $28 + 61$

Solution
To add numbers with more than one digit, it is often easier to write the numbers vertically in columns.

Write the numbers so the ones and tens digits line up vertically.	'_' allowed only in math mode
Then add the digits in each place value. Add the ones: $8 + 1 = 9$ Add the tens: $2 + 6 = 8$	'_' allowed only in math mode

In the previous example, the sum of the ones and the sum of the tens were both less than 10. But what happens if the sum is 10 or more? Let's use our base-10 model to find out.

The graphic below shows the addition of 17 and 26 again.



When we add the ones, $7 + 6$, we get 13 ones. Because we have more than 10 ones, we can exchange 10 of the ones for 1 ten. Now we have 4 tens and 3 ones. Without using the model, we show this as a small red 1 above the digits in the tens place.

When the sum in a place value column is greater than 9, we carry over to the next column to the left. Carrying is the same as regrouping by exchanging. For example, 10 ones for 1 ten or 10 tens for 1 hundred.

Add whole numbers

1. Write the numbers so each place value lines up vertically.
2. Add the digits in each place value. Work from right to left starting with the ones place. If a sum in a place value is more than 9, carry to the next place value.
3. Continue adding each place value from right to left, adding each place value and carrying if needed.

example

Add: $43 + 69$
[reveal-answer q="61333"]Show Answer[/reveal-answer]
[hidden-answer a="61333"]

Solution

Write the numbers so the digits line up vertically.	'_' allowed only in math mode
Add the digits in each place. Add the ones: $3 + 9 = 12$	
Write the 2 in the ones place in the sum. Add the 1 ten to the tens place.	'_' allowed only in math mode
Now add the tens: $1 + 4 + 6 = 11$ Write the 11 in the sum.	'_' allowed only in math mode

[/hidden-answer]

try it

[ohm_question]147154[/ohm_question]

try it

[ohm_question]147156[/ohm_question]

When the addends have different numbers of digits, be careful to line up the corresponding place values starting with the ones and moving toward the left.

example

Add: $1,683 + 479$.
[reveal-answer q="603010"]Show Answer[/reveal-answer]
[hidden-answer a="603010"]

Solution

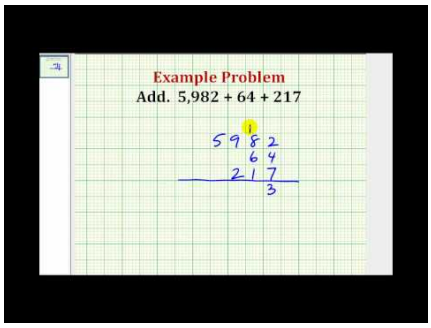
Write the numbers so the digits line up vertically.	'_' allowed only in math mode
Add the digits in each place value.	
Add the ones: $3 + 9 = 12$. Write the 2 in the ones place of the sum and carry the 1 ten to the tens place.	'_' allowed only in math mode
Add the tens: $1 + 7 + 8 = 16$ Write the 6 in the tens place and carry the 1 hundred to the hundreds place.	'_' allowed only in math mode
Add the hundreds: $1 + 6 + 4 = 11$ Write the 1 in the hundreds place and carry the 1 thousand to the thousands place.	'_' allowed only in math mode
Add the thousands $1 + 1 = 2$. Write the 2 in the thousands place of the sum.	'_' allowed only in math mode

[/hidden-answer]

try it

[ohm_question]156996[/ohm_question]

Watch the video below for another example of how to add three whole numbers by lining up place values.



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Subtraction

Addition and subtraction are inverse operations. Addition undoes subtraction, and subtraction undoes addition.
We know $7 - 3 = 4$ because $4 + 3 = 7$. Knowing all the addition number facts will help with subtraction. Then we can check subtraction by adding. In the examples above, our subtractions can be checked by addition.

$7 - 3 = 4$	because	$4 + 3 = 7$
$13 - 8 = 5$	because	$5 + 8 = 13$
$43 - 26 = 17$	because	$17 + 26 = 43$

To subtract numbers with more than one digit, it is usually easier to write the numbers vertically in columns just as we did for addition. Align the digits by place value, and then subtract each column starting with the ones and then working to the left.

Exercise

Subtract and then check by adding: $89 - 61$.
[reveal-answer q="656368"]Show Answer[/reveal-answer]
[hidden-answer a="656368"]

Solution

Write the numbers so the ones and tens digits line up vertically.	'_' allowed only in math mode
Subtract the digits in each place value. Subtract the ones: $9 - 1 = 8$ Subtract the tens: $8 - 6 = 2$	'_' allowed only in math mode
Check using addition. '_' allowed only in math mode	

Our answer is correct.

[/hidden-answer]

TRY IT

A link to an interactive elements can be found at the bottom of this page.

Subtract whole numbers

1. Write the numbers so each place value lines up vertically.
2. Subtract the digits in each place value. Work from right to left starting with the ones place. If the digit on top is less than the digit below, borrow as needed.
3. Continue subtracting each place value from right to left, borrowing if needed.
4. Check by adding.

excercise

Subtract: $43 - 26$.

[reveal-answer q="491725"]Show Answer[/reveal-answer]

[hidden-answer a="491725"]

Solution

Write the numbers so each place value lines up vertically.	$\begin{array}{r} 43 \\ -\,26 \\ \hline \end{array}$
Subtract the ones. We cannot subtract 6 from 3, so we borrow 1 ten. This makes 3 tens and 13 ones. We write these numbers above each place and cross out the original digits.	$\begin{array}{r} {\scriptstyle 3\ 13} \\ \not{4}\not{3} \\ -\,26 \\ \hline \end{array}$
Now we can subtract the ones. $13 - 6 = 7$. We write the 7 in the ones place in the difference.	$\begin{array}{r} {\scriptstyle 3\ 13} \\ \not{4}\not{3} \\ -\,26 \\ \hline 7 \end{array}$
Now we subtract the tens. $3 - 2 = 1$. We write the 1 in the tens place in the difference.	$\begin{array}{r} {\scriptstyle 3\ 13} \\ \not{4}\not{3} \\ -\,26 \\ \hline 17 \end{array}$
Check by adding. $\begin{array}{r} 17 \\ +26 \\ \hline 43 \checkmark \end{array}$ Our answer is correct.	

[/hidden-answer]

In the example above, if we model subtracting 26 from 43, we would exchange 1 ten for 10 ones. When we do this without models, we say we borrow 1 from the tens place and add 10 to the ones place.

try it

A link to an interactive elements can be found at the bottom of this page.

Exercise

Subtract and then check by adding: $207 - 64$.

[reveal-answer q="125839"]Show Answer[/reveal-answer]

[hidden-answer a="125839"]

Solution

Write the numbers so each place value lines up vertically.	$\begin{array}{r} 207 \\ -\ 64 \\ \hline \end{array}$
Subtract the ones. $7-4=3$. Write the 3 in the ones place in the difference. Write the 3 in the ones place in the difference.	$\begin{array}{r} 207 \\ -\ 64 \\ \hline 3 \end{array}$
Subtract the tens. We cannot subtract 6 from 0 so we borrow 1 hundred and add 10 tens to the 0 tens we had. This makes a total of 10 tens. We write 10 above the tens place and cross out the 0. Then we cross out the 2 in the hundreds place and write 1 above it.	$\begin{array}{r} {\scriptstyle 1\ 10} \\ 2\not{0}7 \\ -\ 64 \\ \hline 3 \end{array}$
Now we subtract the tens. $10-6=4$. We write the 4 in the tens place in the difference.	$\begin{array}{r} {\scriptstyle 1\ 10} \\ 2\not{0}7 \\ -\ 64 \\ \hline 43 \end{array}$
Finally, subtract the hundreds. There is no digit in the hundreds place in the bottom number so we can imagine a 0 in that place. Since $1-0=1$, we write 1 in the hundreds place in the difference.	$\begin{array}{r} {\scriptstyle 1\ 10} \\ 2\not{0}7 \\ -\ 64 \\ \hline 143 \end{array}$
Check by adding. $\begin{array}{r} {\scriptstyle 1} \\ 143 \\ +\ 64 \\ \hline 207\checkmark \end{array}$ Our answer is correct.	

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

Exercise

Subtract and then check by adding: $2,162-479$.
[reveal-answer q="61197"]Show Answer[/reveal-answer]
[hidden-answer a="61197"]

Solution

Write the numbers so each place values line up vertically.	$\begin{array}{r} 2,162 \\ -\ 479 \\ \hline \end{array}$
Subtract the ones. Since we cannot subtract 9 from 2, borrow 1 ten and add 10 ones to the 2 ones to make 12 ones. Write 5 above the tens place and cross out the 6. Write 12 above the ones place and cross out the 2.	$\begin{array}{r} \overset{}{2,1}\overset{5}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline \end{array}$
Now we can subtract the ones.	$12-9=3$
Write 3 in the ones place in the difference.	$\begin{array}{r} \overset{}{2,1}\overset{5}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 3 \end{array}$
Subtract the tens. Since we cannot subtract 7 from 5, borrow 1 hundred and add 10 tens to the 5 tens to make 15 tens. Write 0 above the hundreds place and cross out the 1. Write 15 above the tens place.	$\begin{array}{r} \overset{}{2,}\overset{0}{\cancel{1}}\overset{15}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 3 \end{array}$
Now we can subtract the tens.	$15-7=8$
Write 8 in the tens place in the difference.	$\begin{array}{r} \overset{}{2,}\overset{0}{\cancel{1}}\overset{15}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 83 \end{array}$
Now we can subtract the hundreds.	$\begin{array}{r} \overset{10}{\cancel{2}},\overset{1}{\cancel{1}}\overset{15}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 83 \end{array}$
Write 6 in the hundreds place in the difference.	$\begin{array}{r} \overset{1}{\cancel{2}},\overset{10}{\cancel{1}}\overset{15}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 683 \end{array}$
Subtract the thousands. There is no digit in the thousands place of the bottom number, so we imagine a 0. $1-0=1$. Write 1 in the thousands place of the difference.	$\begin{array}{r} \overset{1}{\cancel{2}},\overset{10}{\cancel{1}}\overset{15}{\cancel{6}}\overset{12}{\cancel{2}} \\ -\ 479 \\ \hline 1,683 \end{array}$
Check by adding. '_' allowed only in math mode	

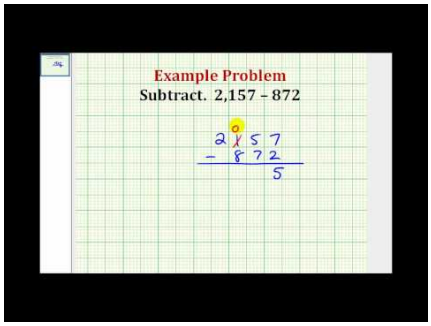
Our answer is correct.

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

Watch the video below to see another example of subtracting whole numbers by lining up place values.



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Multiplication

In order to multiply without using models, you need to know all the one digit multiplication facts. Make sure you know them fluently before proceeding in this section. The table below shows the multiplication facts.

Each box shows the product of the number down the left column and the number across the top row. If you are unsure about a product, model it. It is important that you memorize any number facts you do not already know so you will be ready to multiply larger numbers.

×	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

We know that changing the order of addition does not change the sum. We saw that $8 + 9 = 17$ is the same as $9 + 8 = 17$.

Is this also true for multiplication? Let's look at a few pairs of factors.

$$4 \cdot 7 = 28 \quad 7 \cdot 4 = 28$$
$$9 \cdot 7 = 63 \quad 7 \cdot 9 = 63$$
$$8 \cdot 9 = 72 \quad 9 \cdot 8 = 72$$

When the order of the factors is reversed, the product does not change. This is called the Commutative Property of Multiplication.

Commutative Property of Multiplication

Changing the order of the factors does not change their product.

$$a \cdot b = b \cdot a$$

example

Multiply:

$8 \cdot 7$
$7 \cdot 8$

[reveal-answer q="468629"]Show Answer[/reveal-answer]
[hidden-answer a="468629"]

Solution:

1.	$8 \cdot 7$
Multiply.	56
2.	$7 \cdot 8$
Multiply.	56

Changing the order of the factors does not change the product.

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

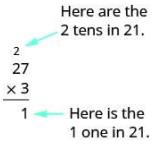
To multiply numbers with more than one digit, it is usually easier to write the numbers vertically in columns just as we did for addition and subtraction.

'_' allowed only in math mode

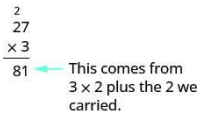
We start by multiplying 3 by 7.

$$3 \times 7 = 21$$

We write the 1 in the ones place of the product. We carry the 2 tens by writing 2 above the tens place.



Then we multiply the 3 by the 2, and add the 2 above the tens place to the product. So $3 \times 2 = 6$, and $6 + 2 = 8$. Write the 8 in the tens place of the product.



The product is 81.

When we multiply two numbers with a different number of digits, it's usually easier to write the smaller number on the bottom. You could write it the other way, too, but this way is easier to work with.

example

Multiply: $15 \cdot 4$

[reveal-answer q="942773"]Show Answer[/reveal-answer]
[hidden-answer a="942773"]

Solution

Write the numbers so the digits 5 and 4 line up vertically.	'_' allowed only in math mode
Multiply 4 by the digit in the ones place of 15. $4 \cdot 5 = 20$.	
Write 0 in the ones place of the product and carry the 2 tens.	'_' allowed only in math mode
Multiply 4 by the digit in the tens place of 15. $4 \cdot 1 = 4$. Add the 2 tens we carried. $4 + 2 = 6$.	
Write the 6 in the tens place of the product.	'_' allowed only in math mode

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

example

Multiply: $286 \cdot 5$

[reveal-answer q="849168"]Show Answer[/reveal-answer]
[hidden-answer a="849168"]

Solution

Write the numbers so the digits 5 and 6 line up vertically.	'_' allowed only in math mode
Multiply 5 by the digit in the ones place of 286. $5 \cdot 6 = 30$	
Write the 0 in the ones place of the product and carry the 3 to the tens place.Multiply 5 by the digit in the tens place of 286. $5 \cdot 8 = 40$	'_' allowed only in math mode
Add the 3 tens we carried to get $40 + 3 = 43$. Write the 3 in the tens place of the product and carry the 4 to the hundreds place.	'_' allowed only in math mode
Multiply 5 by the digit in the hundreds place of 286. $5 \cdot 2 = 10$. Add the 4 hundreds we carried to get $10 + 4 = 14$. Write the 4 in the hundreds place of the product and the 1 to the thousands place.	'_' allowed only in math mode

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

When we multiply by a number with two or more digits, we multiply by each of the digits separately, working from right to left. Each separate product of the digits is called a partial product. When we write partial products, we must make sure to line up the place values.

Multiplication of whole numbers

1. Write the numbers so each place value lines up vertically.
2. Multiply the digits in each place value.
   - Work from right to left, starting with the ones place in the bottom number.

- Multiply the bottom number by the ones digit in the top number, then by the tens digit, and so on.
- If a product in a place value is more than 9, carry to the next place value.
- Write the partial products, lining up the digits in the place values with the numbers above.

- Repeat for the tens place in the bottom number, the hundreds place, and so on.
- Insert a zero as a placeholder with each additional partial product.

3. Add the partial products.

example

Multiply: $62 \cdot (87)$

[reveal-answer q="698602"]Show Answer[/reveal-answer]
[hidden-answer a="698602"]

Solution

Write the numbers so each place lines up vertically.	$\begin{array}{r} 62 \\ \times\ 87 \\ \hline \end{array}$
Start by multiplying 7 by 62. Multiply 7 by the digit in the ones place of 62. $7 \cdot 2 = 14$. Write the 4 in the ones place of the product and carry the 1 to the tens place.	$\begin{array}{r} {\scriptstyle 1} \\ 62 \\ \times\ 87 \\ \hline 4 \end{array}$
Multiply 7 by the digit in the tens place of 62. $7 \cdot 6 = 42$. Add the 1 ten we carried. $42 + 1 = 43$latex]. Write the 3 in the tens place of the product and the 4 in the hundreds place.	$\begin{array}{r} {\scriptstyle 1} \\ 62 \\ \times\ 87 \\ \hline 434 \end{array}$
The first partial product is 434.	
Now, write a 0 under the 4 in the ones place of the next partial product as a placeholder since we now multiply the digit in the tens place of 87 by 62. Multiply 8 by the digit in the ones place of 62 $8 \cdot 2 = 16$. Write the 6 in the next place of the product, which is the tens place. Carry the 1 to the tens place.	$\begin{array}{r} {\scriptstyle 1} \\ 62 \\ \times\ 87 \\ \hline 434 \\ 60 \end{array}$
Multiply 8 by 6, the digit in the tens place of 62, then add the 1 ten we carried to get 49. Write the 9 in the hundreds place of the product and the 4 in the thousands place.	$\begin{array}{r} {\scriptstyle 1} \\ 62 \\ \times\ 87 \\ \hline 434 \\ 4960 \end{array}$
The second partial product is 4960. Add the partial products.	$\begin{array}{r} {\scriptstyle 1} \\ 62 \\ \times\ 87 \\ \hline 434 \\ 4960 \\ \hline 5394 \end{array}$

The product is $5,394$.

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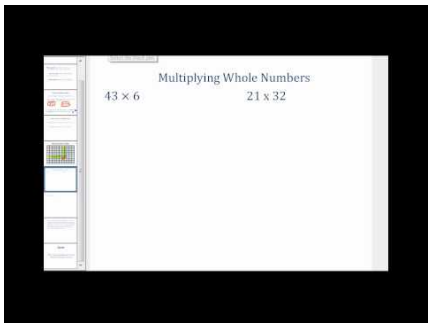
try it

A link to an interactive elements can be found at the bottom of this page.

When there are three or more factors, we multiply the first two and then multiply their product by the next factor. For example:

to multiply	$8 \cdot 3 \cdot 2$
first multiply $8 \cdot 3$	$24 \cdot 2$
then multiply $24 \cdot 2$	48

In the video below, we summarize the concepts presented on this page including the multiplication property of zero, the identity property of multiplication, and the commutative property of multiplication.m



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Division

We said that addition and subtraction are inverse operations because one undoes the other. Similarly, division is the inverse operation of multiplication. We know $12 \div 4 = 3$ because $3 \cdot 4 = 12$. Knowing all the multiplication number facts is very important when doing division.

We check our answer to division by multiplying the quotient by the divisor to determine if it equals the dividend. We know $24 \div 8 = 3$ is correct because $3 \cdot 8 = 24$.

example

Divide. Then check by multiplying.

1. $42 \div 6$
2. $\frac{72}{9}$
3. $7\overline{)63}$

Solution:

1.	
	$42 \div 6$
Divide 42 by 6.	7
Check by multiplying. $7 \cdot 6$	
42 ✓	

2.	
	$\frac{72}{9}$
Divide 72 by 9.	8
Check by multiplying. $8 \cdot 9$	
72 ✓	

3.	
	$7\overline{)63}$
Divide 63 by 7.	9
Check by multiplying. $9 \cdot 7$	
63 ✓	

try it

[ohm_question]144463[/ohm_question]

What is the quotient when you divide a number by itself?

$$\frac{15}{15} = 1 \text{ because } 1 \cdot 15 = 15$$

Dividing any number $(\text{except } 0)$ by itself produces a quotient of 1. Also, any number divided by 1 produces a quotient of the number. These two ideas are stated in the Division Properties of One.

Division Properties of One

Any number (except 0) divided by itself is one.	$a \div a = 1$
Any number divided by one is the same number.	$a \div 1 = a$

example

Divide. Then check by multiplying:

1. $11 \div 11$
2. $\frac{19}{1}$

[reveal-answer q="519474"]Show Answer[/reveal-answer]
[hidden-answer a="519474"]

Solution:

1.	
	$11 \div 11$
A number divided by itself is 1.	1
Check by multiplying. $1 \cdot 11$	
11 ✓	

2.	
	$\frac{19}{1}$
A number divided by 1 equals itself.	19
Check by multiplying. $19 \cdot 1$	
19 ✓	

[/hidden-answer]

try it

[ohm_question]144635[/ohm_question]

Suppose we have $\$0$, and want to divide it among 3 people. How much would each person get? Each person would get $\$0$. Zero divided by any number is 0.

Now suppose that we want to divide $\$10$ by 0. That means we would want to find a number that we multiply by 0 to get 10. This cannot happen because 0 times any number is 0. Division by zero is said to be *undefined*.

These two ideas make up the Division Properties of Zero.

Division Properties of Zero

Zero divided by any number is 0.	$0 \div a = 0$
Dividing a number by zero is undefined.	$a \div 0$ undefined

Another way to explain why division by zero is undefined is to remember that division is really repeated subtraction. How many times can we take away 0 from 10? Because subtracting 0 will never change the total, we will never get an answer. So we cannot divide a number by 0.

example

Divide. Check by multiplying:

1. $0 \div 3$
2. $\frac{10}{0}$

[reveal-answer q="208505"]Show Answer[/reveal-answer]
[hidden-answer a="208505"]

Solution

1.	
	$0 \div 3$
Zero divided by any number is zero.	0
Check by multiplying. $0 \cdot 3$	
0 ✓	

2.	
	$10/0$
Division by zero is undefined.	undefined

[/hidden-answer]

try it

[ohm_question]144478[/ohm_question]

When the divisor or the dividend has more than one digit, it is usually easier to use the $4\overline{)12}$ notation. This process is called long division. Let's work through the process by dividing 78 by 3.

Divide the first digit of the dividend, 7, by the divisor, 3.	
The divisor 3 can go into 7 two times since $2 \times 3 = 6$. Write the 2 above the 7 in the quotient.	$3\overline{)78}$ with 2 above the 7
Multiply the 2 in the quotient by 2 and write the product, 6, under the 7.	$3\overline{)78}$ with 2 above the 7 and 6 under the 7
Subtract that product from the first digit in the dividend. Subtract $7 - 6$. Write the difference, 1, under the first digit in the dividend.	$3\overline{)78}$ with 2 above the 7, 6 under the 7, and 1 under the 6
Bring down the next digit of the dividend. Bring down the 8.	$3\overline{)78}$ with 2 above the 7, 6 under the 7, and 18 under the 6
Divide 18 by the divisor, 3. The divisor 3 goes into 18 six times.	$3\overline{)78}$ with 26 above the 78, 6 under the 7, and 18 under the 6
Write 6 in the quotient above the 8.	
Multiply the 6 in the quotient by the divisor and write the product, 18, under the dividend. Subtract 18 from 18.	$3\overline{)78}$ with 26 above the 78, 6 under the 7, 18 under the 6, and 18 under the 18

We would repeat the process until there are no more digits in the dividend to bring down. In this problem, there are no more digits to bring down, so the division is finished.

$$\text{So } 78 \div 3 = 26.$$

Check by multiplying the quotient times the divisor to get the dividend. Multiply 26×3 to make sure that product equals the dividend, 78.

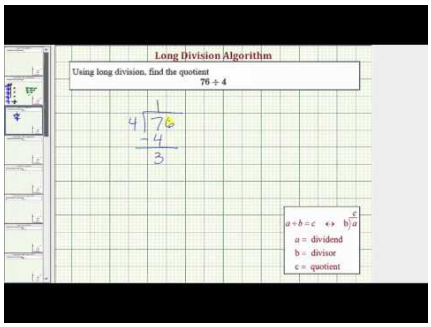
'_' allowed only in math mode

It does, so our answer is correct. ✓

Division of whole numbers

1. Divide the first digit of the dividend by the divisor.If the divisor is larger than the first digit of the dividend, divide the first two digits of the dividend by the divisor, and so on.
2. Write the quotient above the dividend.
3. Multiply the quotient by the divisor and write the product under the dividend.
4. Subtract that product from the dividend.
5. Bring down the next digit of the dividend.
6. Repeat from Step 1 until there are no more digits in the dividend to bring down.
7. Check by multiplying the quotient times the divisor.

In the video below we show another example of using long division.



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example

Divide $2,596 \div 4$. Check by multiplying:
[reveal-answer q="252445"]Show Answer[/reveal-answer]
[hidden-answer a="252445"]

Solution

Let's rewrite the problem to set it up for long division.	$4\overline{)2596}$
Divide the first digit of the dividend, 2, by the divisor, 4.	$4\overline{)2596}$
Since 4 does not go into 2, we use the first two digits of the dividend and divide 25 by 4. The divisor 4 goes into 25 six times.	
We write the 6 in the quotient above the 5.	$\begin{array}{r}6\\4\overline{)2596}\end{array}$
Multiply the 6in the quotient by the divisor 4 and write the product, 24, under the first two digits in the dividend.	$\begin{array}{r}6\\4\overline{)2596}\\24\end{array}$
Subtract that product from the first two digits in the dividend. Subtract $25-24$. Write the difference, 1, under the second digit in the dividend.	$\begin{array}{r}6\\4\overline{)2596}\\24\\\hline1\end{array}$
Now bring down the 9 and repeat these steps. There are 4 fours in 19. Write the 4 over the 9. Multiply the 4 by 4 and subtract this product from 19.	$\begin{array}{r}64\\4\overline{)2596}\\24\\\hline19\\16\\\hline3\end{array}$
Bring down the 6 and repeat these steps. There are 9 fours in 36. Write the 9 over the 6. Multiply the 9 by 4 and subtract this product from 36.	$\begin{array}{r}649\\4\overline{)2596}\\24\\\hline19\\16\\\hline36\\36\\\hline0\end{array}$
So $2,596\div4=649$.	
Check by multiplying. $\begin{array}{r}{}^{1}{}^{3}649\\\times\quad4\\\hline2{,}596\end{array}$ ✓	

It equals the dividend, so our answer is correct.

[/hidden-answer]

try it

[ohm_question]144636[/ohm_question]

example

Divide $4,506\div6$. Check by multiplying:
[reveal-answer q="474096"]Show Answer[/reveal-answer]
[hidden-answer a="474096"]

Solution

Let's rewrite the problem to set it up for long division.	$6\overline{)4506}$
First we try to divide 6 into 4.	$6\overline{)4506}$
Since that won't work, we try 6 into 45. There are 7 sixes in 45. We write the 7 over the 5.	$\begin{array}{r} 7 \\ 6\overline{)4506} \end{array}$
Multiply the 7 by 6 and subtract this product from 45.	$\begin{array}{r} 7 \\ 6\overline{)4506} \\ \underline{42} \\ 3 \end{array}$
Now bring down the 0 and repeat these steps. There are 5 sixes in 30. Write the 5 over the 0. Multiply the 5 by 6 and subtract this product from 30.	$\begin{array}{r} 75 \\ 6\overline{)4506} \\ \underline{42} \\ 30 \\ \underline{30} \\ 0 \end{array}$
Now bring down the 6 and repeat these steps. There is 1 six in 6. Write the 1 over the 6. Multiply 1 by 6 and subtract this product from 6	$\begin{array}{r} 751 \\ 6\overline{)4506} \\ \underline{42} \\ 30 \\ \underline{30} \\ 06 \\ \underline{6} \\ 0 \end{array}$
Check by multiplying. $\begin{array}{r} {\scriptstyle 3}\,751 \\ \times \quad 6 \\ \hline 4{,}506 \checkmark \end{array}$	

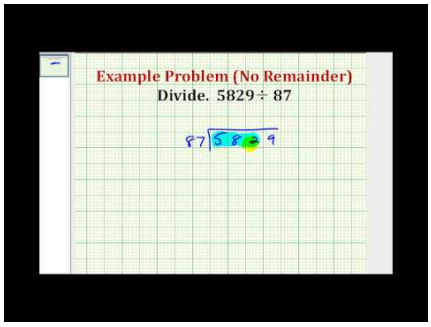
It equals the dividend, so our answer is correct.

[/hidden-answer]

try it

[ohm_question]144640[/ohm_question]

Watch this video for another example of how to use long division to divide a four digit whole number by a two digit whole number.

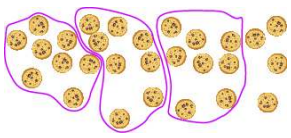


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So far all the division problems have worked out evenly. For example, if we had 24 cookies and wanted to make bags of 8 cookies, we would have 3 bags. But what if there were 28 cookies and we wanted to make bags of 8? Start with the 28 cookies.



Try to put the cookies in groups of eight.



There are 3 groups of eight cookies, and 4 cookies left over. We call the 4 cookies that are left over the remainder and show it by writing R4 next to the 3. (The R stands for remainder.)

To check this division we multiply 3 times 8 to get 24, and then add the remainder of 4.

'_' allowed only in math mode

example

Divide $1,439 \div 4$. Check by multiplying.
[reveal-answer q="498101"]Show Answer[/reveal-answer]
[hidden-answer a="498101"]

Solution

Let's rewrite the problem to set it up for long division.	$4\overline{)1439}$
First we try to divide 4 into 1. Since that won't work, we try 4 into 14. There are 3 fours in 14. We write the 3 over the 4.	$\begin{array}{r} 3 \\ 4\overline{)1439} \end{array}$
Multiply the 3 by 4 and subtract this product from 14.	$\begin{array}{r} 3 \\ 4\overline{)1439} \\ \underline{12} \\ 2 \end{array}$
Now bring down the 3 and repeat these steps. There are 5 fours in 23. Write the 5 over the 3. Multiply the 5 by 4 and subtract this product from 23.	$\begin{array}{r} 35 \\ 4\overline{)1439} \\ \underline{12\downarrow} \\ 23 \\ \underline{20} \\ 3 \end{array}$
Now bring down the 9 and repeat these steps. There are 9 fours in 39. Write the 9 over the 9. Multiply the 9 by 4 and subtract this product from 39. There are no more numbers to bring down, so we are done. The remainder is 3.	$\begin{array}{r} 359\text{R}3 \\ 4\overline{)1439} \\ \underline{12} \\ 23 \\ \underline{20\downarrow} \\ 39 \\ \underline{36} \\ 3 \end{array}$
Check by multiplying. $\begin{array}{rl} {\scriptstyle 2\,3} & \\ 359 & \text{quotient} \\ \times\quad 4 & \text{divisor} \\ \hline 1,436 & \\ +\quad 3 & \text{remainder} \\ \hline 1,439\checkmark & \end{array}$	

So $1,439 \div 4$ is 359 with a remainder of 3. Our answer is correct.

[/hidden-answer]

try it

[ohm_question]144643[/ohm_question]

example

Divide and then check by multiplying: $1,461 \div 13$.
[reveal-answer q="174689"]Show Answer[/reveal-answer]
[hidden-answer a="174689"]

Solution

Let's rewrite the problem to set it up for long division.	$13\overline{)1,461}$
First we try to divide 13 into 1. Since that won't work, we try 13 into 14. There is 1 thirteen in 14. We write the 1 over the 4.	$\begin{array}{r} 1 \\ 13\overline{)1461} \end{array}$
Multiply the 1 by 13 and subtract this product from 14.	$\begin{array}{r} 1 \\ 13\overline{)1461} \\ \underline{13} \\ 1 \end{array}$
Now bring down the 6 and repeat these steps. There is 1 thirteen in 16. Write the 1 over the 6. Multiply the 1 by 13 and subtract this product from 16.	$\begin{array}{r} 11 \\ 13\overline{)1461} \\ \underline{13\downarrow} \\ 16 \\ \underline{13} \\ 3 \end{array}$
Now bring down the 1 and repeat these steps. There are 2 thirteens in 31. Write the 2 over the 1. Multiply the 2 by 13 and subtract this product from 31. There are no more numbers to bring down, so we are done. The remainder is 5. $1,462 \div 13$ is 112 with a remainder of 5.	$\begin{array}{r} 112\text{R}5 \\ 13\overline{)1461} \\ \underline{13\downarrow} \\ 16 \\ \underline{13\downarrow} \\ 31 \\ \underline{26} \\ 5 \end{array}$
Check by multiplying. 112 quotient × 13 divisor 336 1,120 + 5 remainder 1,461 ✓	

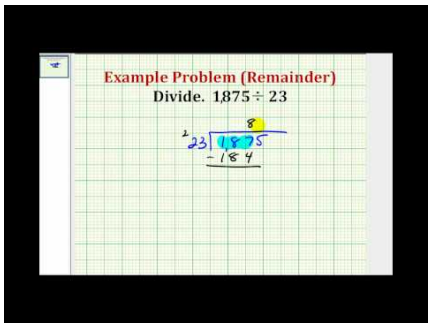
Our answer is correct.

[/hidden-answer]

try it

[ohm_question]144644[/ohm_question]

Watch the video below for another example of how to use long division to divide whole numbers when there is a remainder.



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1.18: Introduction to Fraction Calculations



Often we want to express a relationship between two numbers that measure different things. For example, you may want to track the number of customers who pass through your store each day. Or maybe you want to narrow that number down to customers per hour to determine the busiest time of day, so you can staff the store appropriately. These rates can all be expressed as fractions, or one measurement over another: $\frac{2253 \text{ customers}}{2 \text{ days}}$, or comparing $\frac{88 \text{ customers}}{1 \text{ hour}}$ at 11am to $\frac{356 \text{ customers}}{1 \text{ hour}}$ at 3pm on Fridays. We can then use these numerical fractions to make further calculations or decisions.

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1.19: Convert Between Types of Fractions

Learning Outcomes

- Identify different types of fractions and convert between them

Andy and Bobby love pizza. On Tuesday night, Andy and Bobby share a pizza with their parents, Fred and Christy, with each person getting an equal amount of the whole pizza. How much of the pizza does each person get? There is one whole pizza, divided evenly into four equal parts. Each person has one of the four equal parts, so each has $\frac{1}{4}$ of the pizza.



On Wednesday, the family invites some friends over for a pizza dinner. There are a total of 12 people. If they share the pizza equally, each person would get $\frac{1}{12}$ of the pizza.

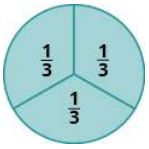


Fractions

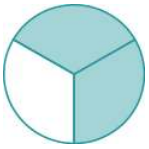
A fraction is written $\frac{a}{b}$, where a and b are integers and $b \neq 0$. In a fraction, a is called the numerator and b is called the denominator.

A fraction is a way to represent parts of a whole. The denominator b represents the number of equal parts the whole has been divided into, and the numerator a represents how many parts are included. The denominator, b, cannot equal zero because division by zero is undefined.

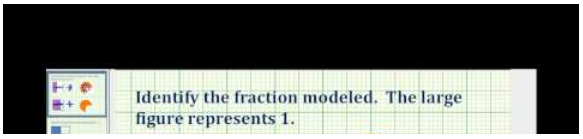
In the image below, the circle has been divided into three parts of equal size. Each part represents $\frac{1}{3}$ of the circle. This type of model is called a fraction circle. Other shapes, such as rectangles, can also be used to model fractions.

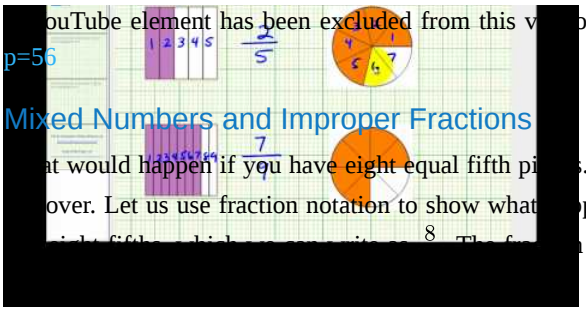


What does the fraction $\frac{2}{3}$ represent? The fraction $\frac{2}{3}$ means two of three equal parts.



Watch the following video to see more examples of how to write fractions given a model.





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t would happen if you have eight equal fifth pi s. You can use five of them to make one whole, but you'll have three fifths over. Let us use fraction notation to show what pened. You had eight pieces, each of them one fifth, $\frac{1}{5}$, so altogether you ight fifths, which we can write as $\frac{8}{5}$. The fra $\frac{8}{5}$ is one whole, 1, plus three fifths, $\frac{3}{5}$, or $1\frac{3}{5}$, which is read as *one and*

The number $1\frac{3}{5}$ is called a mixed number.

Mixed Numbers

A mixed number consists of a whole number a and a fraction $\frac{b}{c}$ where $c \neq 0$. It is written as follows.

$$a\frac{b}{c},\ c \neq 0$$

The number $\frac{8}{5}$ is called an improper fraction.

Proper and Improper Fractions

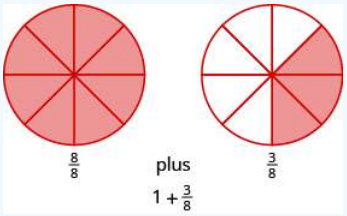
The fraction $\frac{a}{b}$ is a proper fraction if $a < b$ and an improper fraction if $a \geq b$.

Fractions such as $\frac{5}{4}, \frac{3}{2}, \frac{5}{5}$, and $\frac{7}{3}$ are called improper fractions. In an improper fraction, the numerator is greater than or equal to the denominator, so its value is greater than or equal to one. When a fraction has a numerator that is smaller than the denominator, it is called a proper fraction, and its value is less than one. Fractions such as $\frac{1}{2}, \frac{3}{7}$, and $\frac{11}{18}$ are proper fractions.

Example

Draw a figure to model $\frac{11}{8}$.
[reveal-answer q="992194"]Show Answer[/reveal-answer]
[hidden-answer a="992194"]

Solution:
The denominator of the improper fraction is 8. Draw a circle divided into eight pieces and shade all of them. This takes care of eight eighths, but we have 11 eighths. We must shade three of the eight parts of another circle.

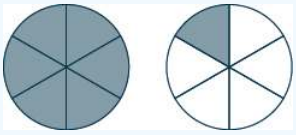


So, $\frac{11}{8} = 1\frac{3}{8}$.

[/hidden-answer]

Try it

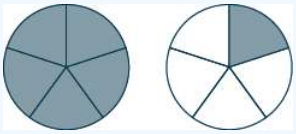
Draw a figure to model $\frac{7}{6}$
[reveal-answer q="924546"]Show Answer[/reveal-answer]
[hidden-answer a="924546"]



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[/hidden-answer]

Draw a figure to model $\frac{6}{5}$
[reveal-answer q="203648"]Show Answer[/reveal-answer]
[hidden-answer a="203648"]



[/hidden-answer]

Example

Name the improper fraction modeled. Then write the improper fraction as a mixed number.

[reveal-answer q="670905"]Show Answer[/reveal-answer]
[hidden-answer a="670905"]

Solution:
Each circle is divided into three pieces, so each piece is $\frac{1}{3}$ of the circle. There are four pieces shaded, so there are four thirds or $\frac{4}{3}$. The figure shows that we also have one whole circle and one third, which is $1\frac{1}{3}$. So, $\frac{4}{3} = 1\frac{1}{3}$.[/hidden-answer]

try it

[ohm_question]145976[/ohm_question]

[ohm_question]145977[/ohm_question]

Example

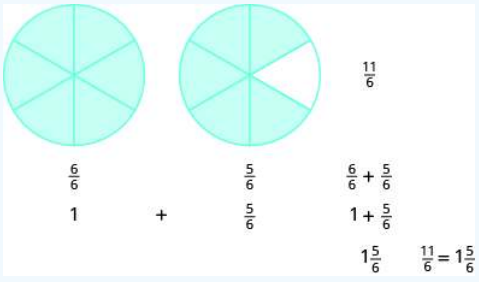
Use a model to rewrite the improper fraction $\frac{11}{6}$ as a mixed number.
[reveal-answer q="121702"]Show Answer[/reveal-answer]
[hidden-answer a="121702"]

Solution:
We start with 11 sixths $\left(\frac{11}{6}\right)$. We know that six sixths makes one whole.

$$\frac{6}{6} = 1$$

That leaves us with five more sixths, which is $\frac{5}{6}$ (11 sixths minus 6 sixths is 5 sixths).

So, $\frac{11}{6} = 1\frac{5}{6}$

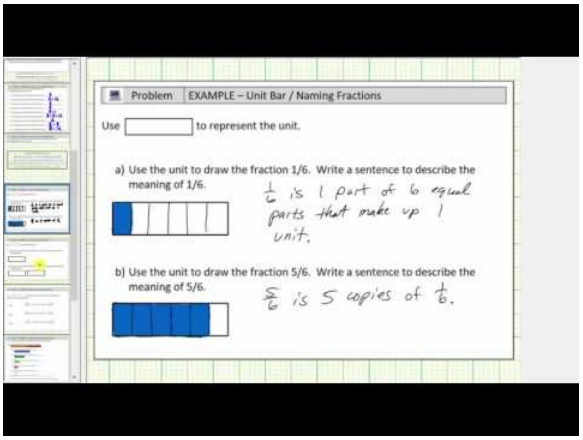


[/hidden-answer]

Try it

[ohm_question]145982[/ohm_question]

In the next video we show another way to draw a model that represents a fraction. You will see example of both proper and improper fractions shown.



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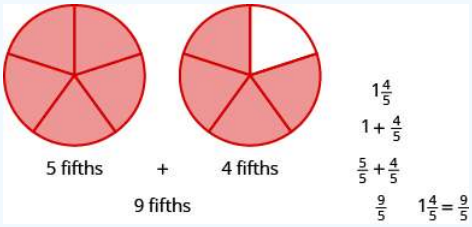
Example

Use a model to rewrite the mixed number $1\frac{4}{5}$ as an improper fraction.
[reveal-answer q="852331"]Show Answer[/reveal-answer]
[hidden-answer a="852331"]

Solution:

The mixed number $1\frac{4}{5}$ means one whole plus four fifths. The denominator is 5, so the whole is $\frac{5}{5}$. Together five fifths and four fifths equals nine fifths.

So, $1\frac{4}{5} = \frac{9}{5}$



[/hidden-answer]

Try it

[ohm_question]145981[/ohm_question]

There is another method to turning a mixed number into an improper fraction — it's just a shortcut to what you've been practicing above.

Mixed Numbers to Improper Fractions

1. Multiply the whole number by the denominator
2. Add that value to the numerator (this becomes the numerator of the improper fraction)
3. Place the denominator of the mixed number in the denominator of the improper fraction

EXAMPLE

Convert $5\frac{2}{3}$ into an improper fraction using the shortcut

1. Multiply the whole number by the denomimator	$5 \cdot 3 = 15$
2. Add that value to the numerator	$15 + 2 = 17$
new numerator for improper fraction	$\frac{17}{?}$
3. Place the denominator of the mixed number in the denominator of the improper fraction	$\frac{17}{3}$

TRY IT

[ohm_question]156957[/ohm_question]

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1.20: Adding and Subtracting Fractions

Learning OUTCOMES

- Use addition and subtraction when evaluating expressions with fractions

Addition and Subtraction of Fractions with Common Denominators

How many quarters are pictured below?



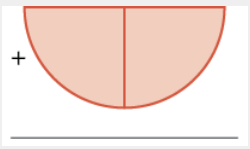
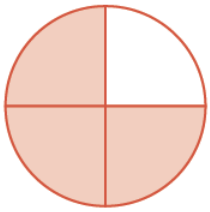
You can quickly count three, but if you look carefully the image represents 1 quarter plus 2 quarters equals 3 quarters.

Remember, quarters are really fractions of a dollar. Quarters are another way to say fourths. So the picture of the coins shows that

$$\frac{1}{4} + \frac{2}{4} = \frac{3}{4}$$

$$\text{one quarter} \ + \ \text{two quarters} \ = \ \text{three quarters}$$

Let's use fraction circles to model the same example, $\frac{1}{4} + \frac{2}{4}$.

Start with one $\frac{1}{4}$ piece.		$\frac{1}{4}$
Add two more $\frac{1}{4}$ pieces.		$+\frac{2}{4}$
The result is $\frac{3}{4}$.		$\frac{3}{4}$

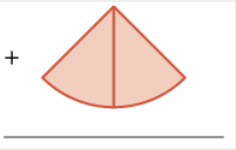
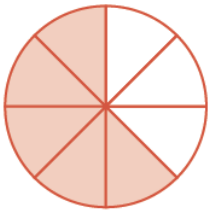
So again, we see that

$$\frac{1}{4} + \frac{2}{4} \ = \frac{3}{4}$$

example

Use a model to find the sum $\frac{3}{8} + \frac{2}{8}$.

Solution:

Start with three $\frac{1}{8}$ pieces.		$\frac{3}{8}$
Add two $\frac{1}{8}$ pieces.		$+\frac{2}{8}$
How many $\frac{1}{8}$ pieces are there?		$\frac{5}{8}$

There are five $\frac{1}{8}$ pieces, or five-eighths. The model shows that $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$.

try it

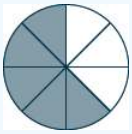
Use a model to find each sum. Show a diagram to illustrate your model.

$\frac{1}{8}+\frac{4}{8}$

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$\frac{5}{8}$



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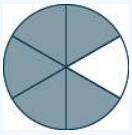
Use a model to find each sum. Show a diagram to illustrate your model.

$\frac{1}{6}+\frac{4}{6}$

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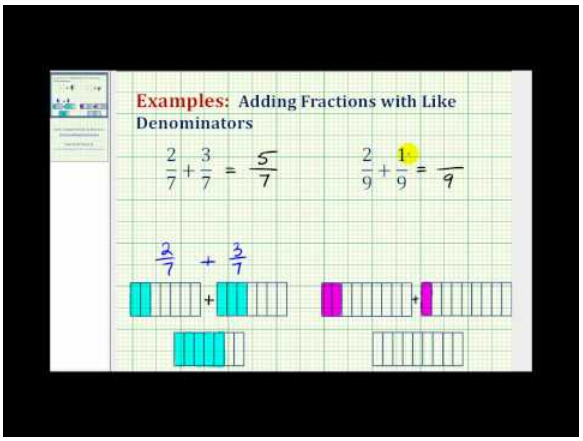
$\frac{5}{6}$



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The following video shows more examples of how to use models to add fractions with like denominators (the value in the lower part of a fraction that represents how many equal parts a whole has been divided into).



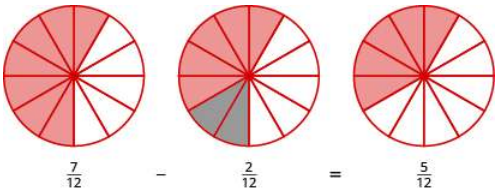
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Subtracting two fractions with common denominators follows the same process as adding fractions with common denominators. Think of a pizza that was cut into 12 slices. Suppose five pieces are eaten for dinner. This means that, after dinner, there are seven pieces (or $\frac{7}{12}$ of the pizza) left in the box. If Leonardo eats 2 of these remaining pieces (or $\frac{2}{12}$ of the pizza), how much is left? There would be 5 pieces left (or $\frac{5}{12}$ of the pizza).

$$\frac{7}{12} - \frac{2}{12} = \frac{5}{12}$$

Let's use fraction circles to model the same example, $\frac{7}{12} - \frac{2}{12}$.

Start with seven $\frac{1}{12}$ pieces. Take away two $\frac{1}{12}$ pieces. How many twelfths are left?



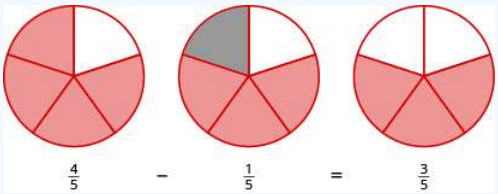
Again, we have five twelfths, $\frac{5}{12}$.

Example

Use fraction circles to find the difference: $\frac{4}{5} - \frac{1}{5}$

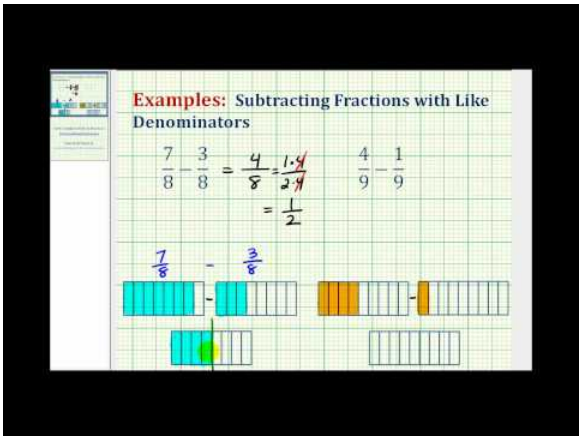
Solution:

Start with four $\frac{1}{5}$ pieces. Take away one $\frac{1}{5}$ piece. Count how many fifths are left. There are three $\frac{1}{5}$ pieces left, or $\frac{3}{5}$ of the circle left.



Try It

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The examples above show that to add or subtract the same-size pieces—meaning that the fractions have the same denominator—we just add or subtract the number of pieces.

Fraction Addition

If $a, b,$ and c are numbers where $c \neq 0$, then

$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

To add fractions with a common denominators, add the numerators and place the sum over the common denominator.

Fraction Subtraction

If $a, b,$ and c are numbers where $c \neq 0$, then

$$\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}$$

To subtract fractions with a common denominators, subtract the numerators and place the difference over the common denominator.

Example

Find the difference: $\frac{23}{24} - \frac{14}{24}$
[reveal-answer q="842015"]Show Answer[/reveal-answer]
[hidden-answer a="842015"]

Solution:

$\frac{23}{24} - \frac{14}{24}$	
Subtract the numerators and place the difference over the common denominator.	$\frac{23-14}{24}$
Simplify the numerator.	$\frac{9}{24}$
Simplify the fraction by removing common factors.	$\frac{3}{8}$

[/hidden-answer]

Try It

[ohm_question height="270"]146191[/ohm_question]

Now lets do an example that involves both addition and subtraction.

Example

Simplify: $\frac{3}{8}+\left(\frac{7}{8}\right)-\frac{2}{8}$

[reveal-answer q="637721"]Show Answer[/reveal-answer]

[hidden-answer a="637721"]

Solution:

	$\frac{3}{8}+\left(\frac{7}{8}\right)-\frac{5}{8}$
Combine the numerators over the common denominator.	$\frac{3+(7)-5}{8}$
Simplify the numerator, working left to right.	$\frac{10-5}{8}$
Subtract the terms in the numerator.	$\frac{5}{8}$

[/hidden-answer]

Try It

[ohm_question height="270"]146250[/ohm_question]

Addition and Subtraction of Fractions with Different Denominators

We just reviewed how to add and subtract fractions with common denominators. But how can we add and subtract fractions with unlike denominators?

Let's think about coins again. Can you add one quarter and one dime? You could say there are two coins, but that's not very useful. To find the total value of one quarter plus one dime, you change them to the same kind of unit—cents. One quarter equals 25 cents and one dime equals 10 cents, so the sum is 35 cents. See the image below.

Together, a quarter and a dime are worth 35 cents, or $\frac{35}{100}$ of a dollar.

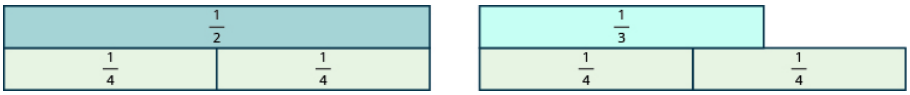


Similarly, when we add fractions with different denominators we have to convert them to equivalent fractions with a common denominator. With the coins, when we convert to cents, the denominator is 100. Since there are 100 cents in one dollar, 25 cents is $\frac{25}{100}$ and 10 cents is $\frac{10}{100}$. So we add $\frac{25}{100}+\frac{10}{100}$ to get $\frac{35}{100}$, which is 35 cents.

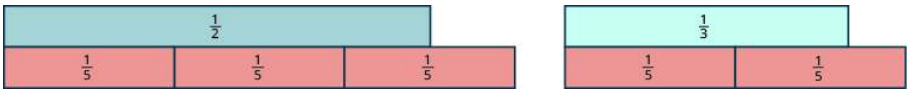
You have practiced adding and subtracting fractions with common denominators. Now let's see what you need to do with fractions that have different denominators.

First, we will use fraction tiles to model finding the common denominator of $\frac{1}{2}$ and $\frac{1}{3}$.

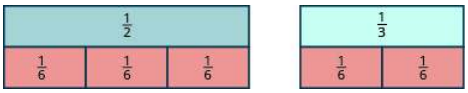
We'll start with one $\frac{1}{2}$ tile and $\frac{1}{3}$ tile. We want to find a common fraction tile that we can use to match *both* $\frac{1}{2}$ and $\frac{1}{3}$ exactly. If we try the $\frac{1}{4}$ pieces, 2 of them exactly match the $\frac{1}{2}$ piece, but they do not exactly match the $\frac{1}{3}$ piece.



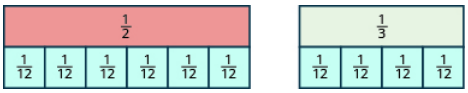
If we try the $\frac{1}{5}$ pieces, they do not exactly cover the $\frac{1}{2}$ piece or the $\frac{1}{3}$ piece.



If we try the $\frac{1}{6}$ pieces, we see that exactly 3 of them cover the $\frac{1}{2}$ piece, and exactly 2 of them cover the $\frac{1}{3}$ piece.



If we were to try the $\frac{1}{12}$ pieces, they would also work.



Even smaller tiles, such as $\frac{1}{24}$ and $\frac{1}{48}$, would also exactly cover the $\frac{1}{2}$ piece and the $\frac{1}{3}$ piece.

The denominator of the largest piece that covers both fractions is the least common denominator (LCD) of the two fractions. So, the least common denominator of $\frac{1}{2}$ and $\frac{1}{3}$ is 6.

Notice that all of the tiles that cover $\frac{1}{2}$ and $\frac{1}{3}$ have something in common: Their denominators are common multiples of 2 and 3, the denominators of $\frac{1}{2}$ and $\frac{1}{3}$. The least common multiple (LCM) of the denominators is 6, and so we say that 6 is the least common denominator (LCD) of the fractions $\frac{1}{2}$ and $\frac{1}{3}$.

Least Common Denominator

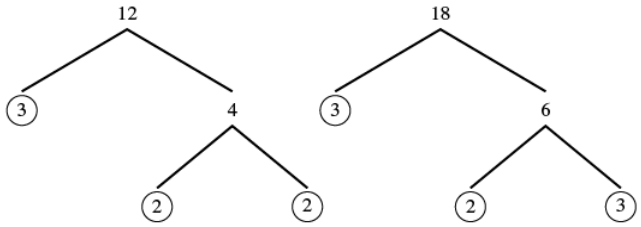
The least common denominator (LCD) of two fractions is the least common multiple (LCM) of their denominators.

To find the LCD of two fractions, we will find the LCM of their denominators. We follow the procedure we used earlier to find the LCM of two numbers. We only use the denominators of the fractions, not the numerators, when finding the LCD.

Example

Find the LCD for the fractions: $\frac{7}{12}$ and $\frac{5}{18}$

Solution:

Factor each denominator into its primes.	
List the primes of 12 and the primes of 18 lining them up in columns when possible.	$12 = 2 \cdot 2 \cdot 3$ $18 = 2 \cdot \quad 3 \cdot 3$
Bring down the columns.	$12 = 2 \cdot 2 \cdot 3$ $18 = 2 \cdot \quad 3 \cdot 3$ $\text{LCM} = 2 \cdot 2 \cdot 3 \cdot 3$
Multiply the factors. The product is the LCM.	$\text{LCM} = 36$

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The LCM of 12 and 18 is 36, so the LCD of $\frac{7}{12}$ and $\frac{5}{18}$ is 36.	LCD of $\frac{7}{12}$ and $\frac{5}{18}$ is 36.

Try it

[ohm_question height="270"]146252[/ohm_question]

To find the LCD of two fractions, find the LCM of their denominators. Notice how the steps shown below are similar to the steps we took to find the LCM.

Find the least common denominator (LCD) of two fractions

1. Factor each denominator into its primes.
2. List the primes, matching primes in columns when possible.
3. Bring down the columns.
4. Multiply the factors. The product is the LCM of the denominators.
5. The LCM of the denominators is the LCD of the fractions.

Example

Find the least common denominator for the fractions: $\frac{8}{15}$ and $\frac{11}{24}$
[reveal-answer q="954069"]Show Answer[/reveal-answer]
[hidden-answer a="954069"]

Solution:
To find the LCD, we find the LCM of the denominators.
Find the LCM of 15 and 24.

$$\begin{aligned} 15 &= 3 \cdot 5 \\ 24 &= 2 \cdot 2 \cdot 2 \cdot 3 \\ \hline \text{LCD} &= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 \\ \text{LCD} &= 120 \end{aligned}$$

The LCM of 15 and 24 is 120. So, the LCD of $\frac{8}{15}$ and $\frac{11}{24}$ is 120.

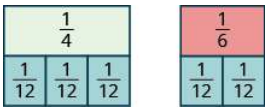
[/hidden-answer]

Try It

[ohm_question height="270"]146251[/ohm_question]

Earlier, we used fraction tiles to see that the LCD of $\frac{1}{4}$ and $\frac{1}{6}$ is 12. We saw that three $\frac{1}{12}$ pieces exactly covered $\frac{1}{4}$ and two $\frac{1}{12}$ pieces exactly covered $\frac{1}{6}$, so

$$\frac{1}{4} = \frac{3}{12} \text{ and } \frac{1}{6} = \frac{2}{12}.$$



We say that $\frac{1}{4}$ and $\frac{3}{12}$ are equivalent fractions and also that $\frac{1}{6}$ and $\frac{2}{12}$ are equivalent fractions.

We can use the Equivalent Fractions Property to algebraically change a fraction to an equivalent one. Remember, two fractions are equivalent if they have the same value. The Equivalent Fractions Property is repeated below for reference.

Equivalent Fractions Property

If a, b, c are whole numbers where $b \neq 0, c \neq 0$, then

$$\frac{a}{b} = \frac{a \cdot c}{b \cdot c} \text{ and } \frac{a \cdot c}{b \cdot c} = \frac{a}{b}$$

To add or subtract fractions with different denominators, we will first have to convert each fraction to an equivalent fraction with the LCD. Let's see how to change $\frac{1}{4}$ and $\frac{1}{6}$ to equivalent fractions with denominator 12 without using models.

Example

Convert $\frac{1}{4}$ and $\frac{1}{6}$ to equivalent fractions with denominator 12, their LCD.

Solution:

Find the LCD.	The LCD of $\frac{1}{4}$ and $\frac{1}{6}$ is 12.
Find the number to multiply 4 to get 12.	$4 \cdot 3 = 12$
Find the number to multiply 6 to get 12.	$6 \cdot 2 = 12$
Use the Equivalent Fractions Property to convert each fraction to an equivalent fraction with the LCD, multiplying both the numerator and denominator of each fraction by the same number.	$\frac{1}{4}\ \frac{1}{6}$ $\frac{1 \cdot 3}{4 \cdot 3}\ \frac{1 \cdot 2}{6 \cdot 2}$
Simplify the numerators and denominators.	$\frac{3}{12}\ \frac{2}{12}$

We do not reduce the resulting fractions. If we did, we would get back to our original fractions and lose the common denominator.

Try it

[ohm_question height="270"]146254[/ohm_question]

Convert two fractions to equivalent fractions with their LCD as the common denominator

1. Find the LCD.
2. For each fraction, determine the number needed to multiply the denominator to get the LCD.
3. Use the Equivalent Fractions Property to multiply both the numerator and denominator by the number you found in Step 2.
4. Simplify the numerator and denominator.

Example

Convert $\frac{8}{15}$ and $\frac{11}{24}$ to equivalent fractions with denominator 120, their LCD.
[reveal-answer q="831064"]Show Answer[/reveal-answer]
[hidden-answer a="831064"]

Solution:

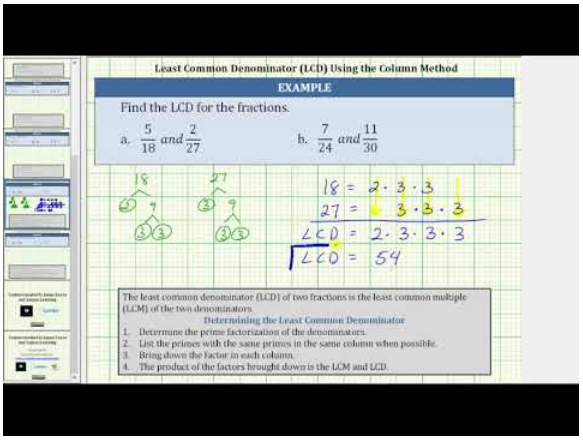
The LCD is 120. We will start at Step 2.	
Find the number that must multiply 15 to get 120.	$15 \cdot 8 = 120$
Find the number that must multiply 24 to get 120.	$24 \cdot 5 = 120$
Use the Equivalent Fractions Property.	$\frac{8 \cdot 8}{15 \cdot 8}\ \frac{11 \cdot 5}{24 \cdot 5}$
Simplify the numerators and denominators.	$\frac{64}{120}\ \frac{55}{120}$

[/hidden-answer]

Try it

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In our next video we show two more examples of how to use the column method to find the least common denominator of two fractions.



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Once we have converted two fractions to equivalent forms with common denominators, we can add or subtract them by adding or subtracting the numerators.

Add or subtract fractions with different denominators

1. Find the LCD.
2. Convert each fraction to an equivalent form with the LCD as the denominator.
3. Add or subtract the fractions.
4. Write the result in simplified form.

Example

Add: $\frac{1}{2}+\frac{1}{3}$

Solution:

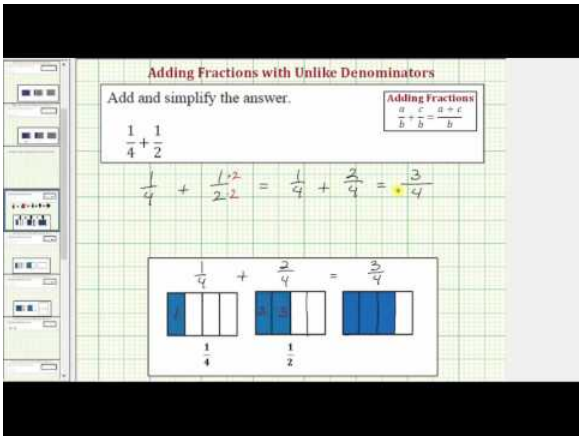
	$\frac{1}{2}+\frac{1}{3}$
Find the LCD of $2, 3$.	$\begin{array}{r} 2=2 \\ 3=\quad 3 \\ \hline \text{LCD}=2\cdot 3 \\ \text{LCD}=6 \end{array}$
Change into equivalent fractions with the LCD 6.	$\frac{1\cdot 3}{2\cdot 3}+\frac{1\cdot 2}{3\cdot 2}$
Simplify the numerators and denominators.	$\frac{3}{6}+\frac{2}{6}$
Add.	$\frac{5}{6}$

Remember, always check to see if the answer can be simplified. Since 5 and 6 have no common factors, the fraction $\frac{5}{6}$ cannot be reduced.

Try It

[ohm_question height="230"]146262[/ohm_question]

Watch the following video to see more examples and explanation about how to add two fractions with unlike denominators.



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Example

Add: $\frac{7}{12}+\frac{5}{18}$

[reveal-answer q="826911"]Show Answer[/reveal-answer]

[hidden-answer a="826911"]

Solution:

	$\frac{7}{12}+\frac{5}{18}$
Find the LCD of 12 and 18.	$12=2\cdot 2\cdot 3$ $18=2\cdot \quad 3\cdot 3$ $\text{LCD}=2\cdot 2\cdot 3\cdot 3$ $\text{LCD}=36$
Rewrite as equivalent fractions with the LCD.	$\frac{7\cdot 3}{12\cdot 3}+\frac{5\cdot 2}{18\cdot 2}$
Simplify the numerators and denominators.	$\frac{21}{36}+\frac{10}{36}$
Add.	$\frac{31}{36}$

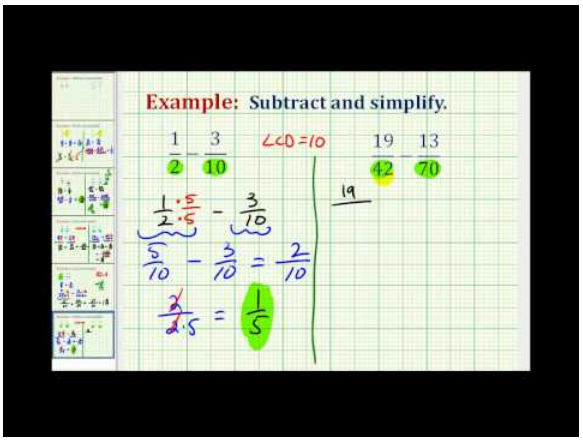
Because 31 is a prime number, it has no factors in common with 36. The answer is simplified.

[/hidden-answer]

Try It

[ohm_question height="230"]146264[/ohm_question]

The following video provides two more examples of how to subtract two fractions with unlike denominators.



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Try It

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Try It

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1.21: Multiplying and Dividing Fractions

Learning Objectives

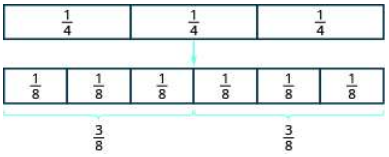
- Use multiplication and division when evaluating expressions with fractions

Fraction Multiplication

A model may help you understand multiplication of fractions. We will use fraction tiles to model $\frac{1}{2} \cdot \frac{3}{4}$.

To multiply $\frac{1}{2}$ and $\frac{3}{4}$, think "I need to find $\frac{1}{2}$ of $\frac{3}{4}$."

Start with fraction tiles for three-fourths. To find one-half of three-fourths, we need to divide them into two equal groups. Since we cannot divide the three $\frac{1}{4}$ tiles evenly into two parts, we exchange them for smaller tiles.



We see $\frac{6}{8}$ is equivalent to $\frac{3}{4}$. Taking half of the six $\frac{1}{8}$ tiles gives us three $\frac{1}{8}$ tiles, which is $\frac{3}{8}$.

Therefore, $\frac{1}{2} \cdot \frac{3}{4} = \frac{3}{8}$

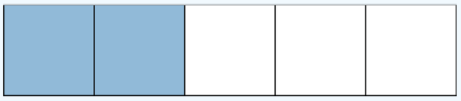
Example

Use a diagram to model $\frac{1}{3} \cdot \frac{2}{5}$

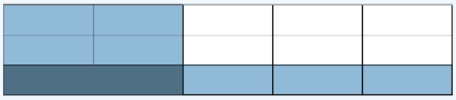
Solution:

You want to find one-third of two-fifths.

First shade in $\frac{2}{5}$ of the rectangle.



We will take $\frac{1}{3}$ of this $\frac{2}{5}$, so we heavily shade $\frac{1}{3}$ of the shaded region.



Notice that 2 out of the 15 pieces are heavily shaded. This means that $\frac{2}{15}$ of the rectangle is heavily shaded.
Therefore, $\frac{1}{3}$ of $\frac{2}{15}$ is $\frac{2}{15}$, or $\frac{1}{3} \cdot \frac{2}{5} = \frac{2}{15}$

Try it

[ohm_question height="270"]146020[/ohm_question]

Look at the result we got from the examples above. We found that $\frac{1}{2} \cdot \frac{3}{4} = \frac{3}{8}$ and $\frac{1}{3} \cdot \frac{2}{5} = \frac{2}{15}$. Do you notice that we could have gotten the same answers by multiplying the numerators and multiplying the denominators?

	$\frac{1}{2} \cdot \frac{3}{4}$	$\frac{1}{3} \cdot \frac{2}{5}$
Multiply the numerators, and multiply the denominators.	$\frac{1}{2} \cdot \frac{3}{4} = \frac{1 \cdot 3}{2 \cdot 4}$	$\frac{1}{3} \cdot \frac{2}{5} = \frac{1 \cdot 2}{3 \cdot 5}$
Simplify.	$\frac{3}{8}$	$\frac{2}{15}$

This leads to the definition of fraction multiplication. To multiply fractions, we multiply the numerators and multiply the denominators. Then we write the fraction in simplified form.

Fraction Multiplication

If $a, b, c,$ and d are numbers where $b \neq 0$ and $d \neq 0$, then $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$

Example

Multiply, and write the answer in simplified form: $\frac{3}{4} \cdot \frac{1}{5}$
[reveal-answer q="56385"]Show Answer[/reveal-answer]
[hidden-answer a="56385"]

Solution:

$\frac{3}{4} \cdot \frac{1}{5}$	
Multiply the numerators; multiply the denominators.	$\frac{3 \cdot 1}{4 \cdot 5}$
Simplify.	$\frac{3}{20}$

There are no common factors, so the fraction is simplified.

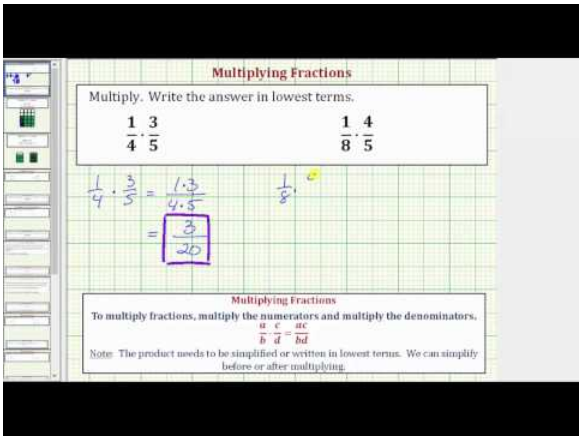
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Try It

[ohm_question]146021[/ohm_question]

Note that when multiplying fractions, the properties of positive and negative numbers still apply. It is a good idea to determine the sign of the product as the first step.

The following video provides more examples of how to multiply fractions, and simplify the result.



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When multiplying a fraction by an integer, it may be helpful to write the integer as a fraction. Any integer, a, can be written as $\frac{a}{1}$. So, $3 = \frac{3}{1}$, for example.

example

Multiply, and write the answer in simplified form:

1. $\frac{1}{7} \cdot 56$
2. $(-20)(\frac{12}{5})$

[reveal-answer q="597781"]Show Answer[/reveal-answer]
[hidden-answer a="597781"]

Solution:

1.	
	$\frac{1}{7} \cdot 56$
Write 56 as a fraction.	$\frac{1}{7} \cdot \frac{56}{1}$
Determine the sign of the product; multiply.	$\frac{56}{7}$
Simplify.	8

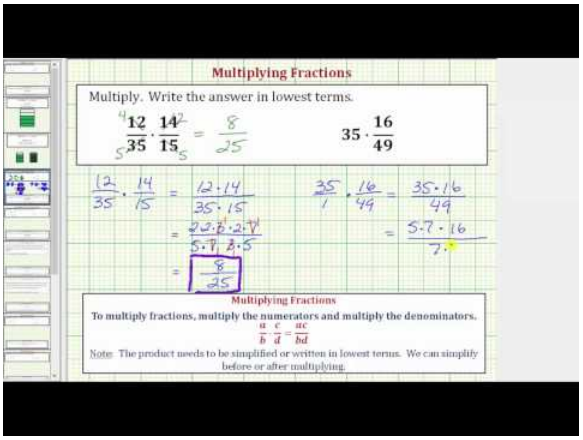
2.	
	$(-20)(\frac{12}{5})$
Write -20 as a fraction.	$\frac{-20}{1}(\frac{12}{5})$
Determine the sign of the product; multiply.	$-\frac{20 \cdot 12 \cdot}{1 \cdot 5}$
Multiply and simplify.	$-\frac{240}{5} = -\frac{2 \cdot 5 \cdot 24}{5}$
	-48

[/hidden-answer]

Try it

[ohm_question]156968[/ohm_question]

Watch the following video to see more examples of how to multiply a fraction and a whole number,



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Reciprocals

The fractions $\frac{2}{3}$ and $\frac{3}{2}$ are related to each other in a special way. So are $-\frac{10}{7}$ and $-\frac{7}{10}$. Do you see how? Besides looking like upside-down versions of one another, if we were to multiply these pairs of fractions, the product would be 1.

$$\frac{2}{3} \cdot \frac{3}{2} = 1 \text{ and } -\frac{10}{7}\left(-\frac{7}{10}\right) = 1$$

Such pairs of numbers are called reciprocals.

Reciprocal

The reciprocal of the fraction $\frac{a}{b}$ is $\frac{b}{a}$, where $a \neq 0$ and $b \neq 0$. A number and its reciprocal have a product of 1.

$\frac{a}{b} \cdot \frac{b}{a} = 1$

To find the reciprocal of a fraction, we invert the fraction. This means that we place the numerator in the denominator and the denominator in the numerator. To get a positive result when multiplying two numbers, the numbers must have the same sign. So reciprocals must have the same sign.

$\frac{a}{b} \cdot \frac{b}{a} = 1$ positive

$3 \cdot \frac{1}{3} = 1$ and $-3 \cdot \left(-\frac{1}{3}\right) = 1$

both positive both negative

To find the reciprocal, keep the same sign and invert the fraction. The number zero does not have a reciprocal. Why? A number and its reciprocal multiply to 1. Is there any number r so that $0 \cdot r = 1$? No. So, the number 0 does not have a reciprocal.

Example

Find the reciprocal of each number. Then check that the product of each number and its reciprocal is 1.

1. $\frac{4}{9}$
2. $-\frac{1}{6}$
3. $-\frac{14}{5}$
4. 7

Solution:
To find the reciprocals, we keep the sign and invert the fractions.

1.	
Find the reciprocal of $\frac{4}{9}$.	The reciprocal of $\frac{4}{9}$ is $\frac{9}{4}$.
Check:	
Multiply the number and its reciprocal.	$\frac{4}{9} \cdot \frac{9}{4}$
Multiply numerators and denominators.	$\frac{36}{36}$
Simplify.	1 ✓

2.	
Find the reciprocal of $-\frac{1}{6}$.	$-\frac{6}{1}$
Simplify.	-6
Check:	$-\frac{1}{6} \cdot (-6)$
	1 ✓

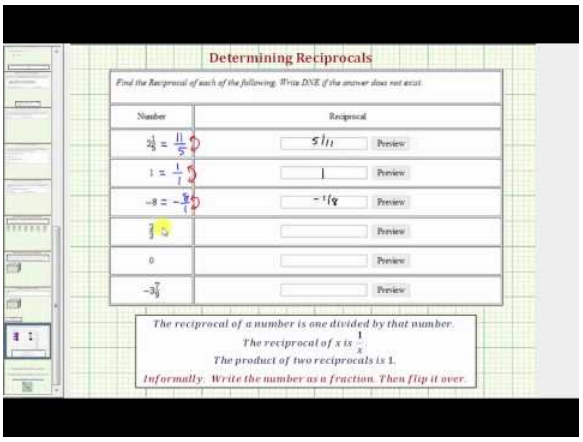
3.	
Find the reciprocal of $-\frac{14}{5}$.	$-\frac{5}{14}$
Check:	$-\frac{14}{5} \cdot \left(-\frac{5}{14}\right)$
	$\frac{70}{70}$
	1 ✓

4.	
Find the reciprocal of 7.	
Write 7 as a fraction.	$\frac{7}{1}$
Write the reciprocal of $\frac{7}{1}$.	$\frac{1}{7}$
Check:	$7 \cdot \left(\frac{1}{7}\right)$
	1 ✓

Try It

[ohm_question]141842[/ohm_question]

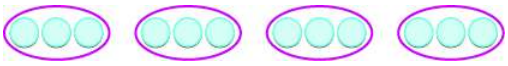
In the following video we will show more examples of how to find the reciprocal of integers, fractions and mixed numbers.



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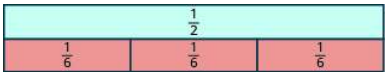
Dividing Fractions

Why is $12 \div 3 = 4$? We previously modeled this with counters. How many groups of 3 counters can be made from a group of 12 counters?



There are 4 groups of 3 counters. In other words, there are four 3s in 12. So, $12 \div 3 = 4$.

What about dividing fractions? Suppose we want to find the quotient: $\frac{1}{2} \div \frac{1}{6}$. We need to figure out how many $\frac{1}{6}$s there are in $\frac{1}{2}$. We can use fraction tiles to model this division. We start by lining up the half and sixth fraction tiles as shown below. Notice, there are three $\frac{1}{6}$ tiles in $\frac{1}{2}$, so $\frac{1}{2} \div \frac{1}{6} = 3$.

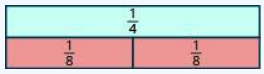


Example

Model: $\frac{1}{4} \div \frac{1}{8}$

Solution:

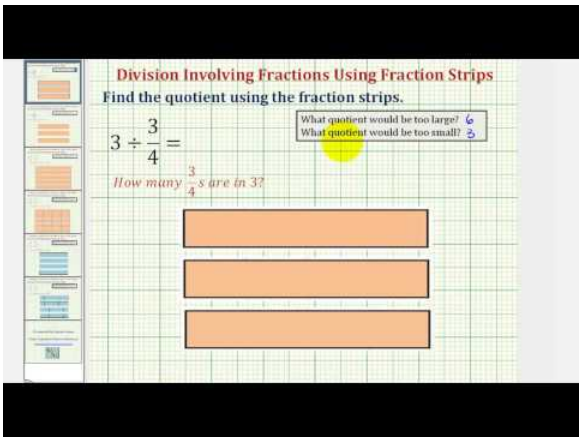
We want to determine how many $\frac{1}{8}$s are in $\frac{1}{4}$. Start with one $\frac{1}{4}$ tile. Line up $\frac{1}{8}$ tiles underneath the $\frac{1}{4}$ tile.



There are two $\frac{1}{8}$s in $\frac{1}{4}$.

So, $\frac{1}{4} \div \frac{1}{8} = 2$.

The following video shows a whole number being divided by a fraction using a slightly different method.



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Example

Model: $2 \div \frac{1}{4}$
[reveal-answer q="391699"]Show Answer[/reveal-answer]
[hidden-answer a="391699"]

Solution:
We are trying to determine how many $\frac{1}{4}$s there are in 2. We can model this as shown.

1				1			
$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

Because there are eight $\frac{1}{4}$s in $2, 2 \div \frac{1}{4} = 8$.

[/hidden-answer]

Try It

Model: $2 \div \frac{1}{3}$
[reveal-answer q="73567"]Show Answer[/reveal-answer]
[hidden-answer a="73567"]

1			1		
$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$

[/hidden-answer]

Model: $3 \div \frac{1}{2}$
[reveal-answer q="354856"]Show Answer[/reveal-answer]
[hidden-answer a="354856"]

1		1		1	
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$

[/hidden-answer]

[ohm_question height="270"]117216[/ohm_question]

Let's use money to model $2 \div \frac{1}{4}$ in another way. We often read $\frac{1}{4}$ as a 'quarter', and we know that a quarter is one-fourth of a dollar as shown in the image below. So we can think of $2 \div \frac{1}{4}$ as, "How many quarters are there in two dollars?" One dollar is 4 quarters, so 2 dollars would be 8 quarters. So again, $2 \div \frac{1}{4} = 8$.

Using fraction tiles, we showed that $\frac{1}{2} \div \frac{1}{6} = 3$. Notice that $\frac{1}{2} \cdot \frac{6}{1} = 3$ also. How are $\frac{1}{6}$ and $\frac{6}{1}$ related? They are reciprocals. This leads us to the procedure for fraction division.

Fraction Division

If $a, b, c,$ and d are numbers where $b \neq 0, c \neq 0,$ and $d \neq 0$, then $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c}$

To divide fractions, multiply the first fraction by the reciprocal of the second.

We need to say $b \neq 0, c \neq 0$ and $d \neq 0$ to be sure we don't divide by zero.

Example

Divide, and write the answer in simplified form: $\frac{2}{5} \div \left(-\frac{3}{7}\right)$
[reveal-answer q="261121"]Show Answer[/reveal-answer]
[hidden-answer a="261121"]

Solution:

$\frac{2}{5} \div \left(-\frac{3}{7}\right)$	
Multiply the first fraction by the reciprocal of the second.	$\frac{2}{5}\left(-\frac{7}{3}\right)$
Multiply. The product is negative.	$-\frac{14}{15}$

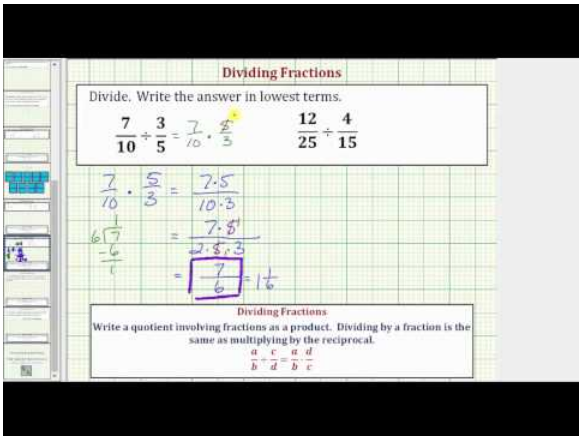
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Try It

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[ohm_question height="270"]146067[/ohm_question]

Watch this video for more examples of dividing fractions using a reciprocal.



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Example

Divide, and write the answer in simplified form: $\frac{7}{18} \div \frac{14}{27}$
[reveal-answer q="987562"]Show Answer[/reveal-answer]
[hidden-answer a="987562"]

Solution:

	$\frac{7}{18} \div \frac{14}{27}$
Multiply the first fraction by the reciprocal of the second.	$\frac{7}{18} \cdot \frac{27}{14}$
Multiply.	$\frac{7 \cdot 27}{18 \cdot 14}$
Rewrite showing common factors.	$\frac{7 \cdot 9 \cdot 3}{9 \cdot 2 \cdot 7 \cdot 2}$
Remove common factors.	$\frac{3}{2 \cdot 2}$
Simplify.	$\frac{3}{4}$

[/hidden-answer]

Try It

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CHAPTER OVERVIEW

2: Calculations and Solving Equations

2.1: Mark-Up Problems
2.2: Discount Problems
2.3: Simple and Compound Interest
2.4: Solving Formulas for a Specific Variable
2.5: Introduction to Reading and Using Graphs
2.6: Graphing Points on a Coordinate Plane
2.7: Identifying Trends of a Graph
2.8: Rate of Change
2.9: Analyzing Graphical Data
2.10: Putting It Together- Calculations and Solving Equations
2.11: Why It Matters- Calculations and Solving Equations
2.12: Assignment- Calculations and Solving Equations
2.13: Introduction to Solving Equations
2.14: Variables
2.15: Solving Single-Step Equations
2.16: Solving Multi-Step Equations
2.17: Introduction to Translating Word Problems into Equations
2.18: Translating Words Into Algebra
2.19: Algebraic Problem Solving Strategies
2.20: Introduction to Solving Complex Equations

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2.1: Mark-Up Problems

Learning OUTCOME

- Use mathematical notation to solve markup problems



Blue Boat Design Earrings

Ana runs Blue Boat Designs, where she makes colorful beaded earrings. She sells her earrings to boutiques around Los Angeles for $\$18$. A shop called Treasure Hunt purchases Ana's earrings for $\$18$, marks them up 50% and then sells them to shop customers for $\$27$.

Applications of mark-up are very common in retail settings. The price a retailer pays for an item is called the **wholesale price**. The retailer then adds a **mark-up** to the wholesale price to get the **list price**, the price he sells the item for. The mark-up is usually calculated as a percent of the wholesale price. The percent is called the **mark-up rate**. To determine the amount of mark-up, multiply the mark-up rate by the wholesale price. We summarize the mark-up model in the box below.

Mark-up

The mark-up is the amount added to the wholesale price.

amount of mark-up = mark-up rate · wholesale price

list price = wholesale price + mark up

The list price should always be more than the wholesale price, or it would be a mark-down, not a mark-up.

The mark-up rate can be less than, equal to, or greater than 100%.

example

Adam's art gallery bought a photograph at the wholesale price of $\$250$. Adam marked the price up 40. Find the amount of mark-up and the list price of the photograph.
[reveal-answer q="661316"]Show Answer[/reveal-answer]
[hidden-answer a="661316"]

Solution

ⓐ	
Identify what you are asked to find.	What is the amount of mark-up?
Choose a variable to represent it.	Let $m =$ the amount of each mark-up.
Write a sentence that gives the information to find it.	The mark-up is 40 of the wholesale price.
Translate into an equation.	$\underbrace{\text{The mark-up}}_{m} \ \underbrace{\text{is}}_{=} \ \underbrace{40\%}_{0.40} \ \underbrace{\text{of}}_{\cdot} \ \underbrace{\text{the \$250 wholesale price.}}_{250}$
Simplify.	$m = 100$
Check if this answer is reasonable.	
Yes. The markup rate is less than 50 and $\$100$ is less than half of $\$250$.	
Write a complete sentence that answers the question.	The mark-up on the photograph was $\$100$.

ⓑ	
Identify what you are asked to find.	What is the list price?
Choose a variable to represent it.	Let $p =$ the list price.
Write a sentence that gives the information to find it.	The list price is the wholesale price plus the mark-up.
Translate into an equation.	$\underbrace{\text{The list price}}_{p} \ \underbrace{\text{is}}_{=} \ \underbrace{\text{the \$250 wholesale price}}_{250} \ \underbrace{\text{plus}}_{+} \ \underbrace{\text{the \$100 mark-up.}}_{100}$
Simplify.	$p = 350$
Check if this answer is reasonable.	
Yes. The list price, $\$350$, is more than the wholesale price, $\$250$.	
Write a complete sentence that answers the question.	The list price of the photograph was $\$350$.

[/hidden-answer]

try it

[ohm_question hide_question_numbers=1]146778[/ohm_question]

TRY IT

[ohm_question hide_question_numbers=1]978[/ohm_question]

EXAMPLE

A very common mark-up strategy in retail stores is to simply double the price they paid for the item. Let's walk through how you would calculate the mark-up rate for this situation.

Braided Salon purchases natural hair dyes for $\$38$ from a beauty supply wholesaler. If the owner plans to double the price before selling it to customers, what is the mark-up rate?

[reveal-answer q="664216"]Show Answer[/reveal-answer]
[hidden-answer a="664216"]

Solution

If Braided Salon purchases the hair dye for $\$38$, they will charge customers $\$56 (2 \cdot \$38 = \$56)$. The mark-up in this case is the difference between the final price tag and the wholesale cost: $\$56 - \$38 = \$38$.

amount of mark-up = mark-up rate $\cdot$ wholesale price

$\$38 = x \cdot \$38$

$x = 1$

$1 = 100$

The mark-up rate is 100 when doubling the wholesale cost.

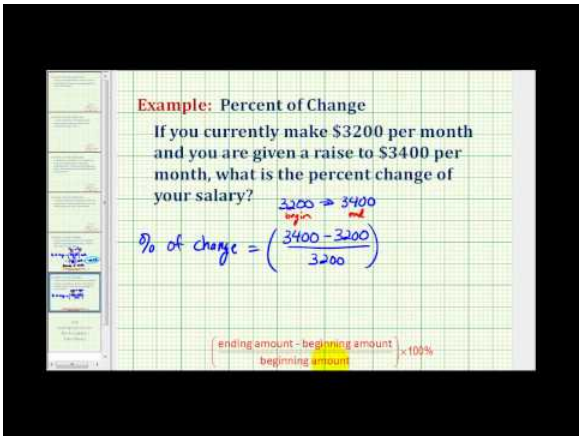
[/hidden-answer]

The next question refers to profit, which, in this case, is the same as mark-up amount.

TRY IT

[ohm_question hide_question_numbers=1]154749[/ohm_question]

Mark-up is one type of **percent of change** problem. In the next video we show an example of how to calculate the percent increase of a salary, which is similar to the process of marking-up the price of an item.



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2.2: Discount Problems

Learning outcome

- Use mathematical notation to solve discount problems



Feminine Furnishings Bedding Sale

A store called Feminine Furnishings is having a sale on bedding. Their queen sheet sets have a list price of $126. During the first two weeks of February, the store has a—Snuggle Up In Love Sale— where customers save 14% on any white, pink, or red bedding set. Carly selects a bedding set with pink stripes and pays $108.36.

Applications of discount are very common in retail settings. When you buy an item on sale, the **original** or **list price** of the item has been reduced by some dollar amount. The **discount rate**, usually given as a percent, is used to determine the amount of the discount. To determine the **amount of discount**, we multiply the discount rate by the original price. We summarize the discount model in the box below.

Discount

An amount of discount is subtracted from the original price.

amount of discount = discount rate · original price

sale price = original price − discount

The sale price should always be less than the original price.

In some cases, the amount of discount is a fixed dollar amount. Then we just find the sale price by subtracting the amount of discount from the original price. For example, as you walk into a store you may see a sign that says “Spend $100 or more, and receive a $20 discount!”

example

Jason bought a pair of sunglasses from a rack that was labeled $10 off all Retrop brand glasses. The original price of the sunglasses was $39. What was the sale price of the sunglasses?

[reveal-answer q=”967734″]Show Answer[/reveal-answer]
[hidden-answer a=”967734″]

Solution

Identify what you are asked to find.	What is the sale price?
Choose a variable to represent it.	Let $s =$ the sale price.
Write a sentence that gives the information to find it.	The sale price is the original price minus the discount.
Translate into an equation.	$\underbrace{\text{The sale price}}_{s} \; \underbrace{\text{is}}_{=} \; \underbrace{\text{the original \$39 price}}_{39} \; \underbrace{\text{minus}}_{-} \; \underbrace{\text{the \$10 discount.}}_{10}$
Simplify.	$s = 29$
Check if this answer is reasonable.	
Yes. The sale price, $\$29$, is less than the original price, $\$39$.	
Write a complete sentence that answers the question.	The sale price of the sunglasses was $\$29$.

[/hidden-answer]

try it

[ohm_question]146772[/ohm_question]

In the first example, the amount of discount was a set or static amount. In the next example, the discount is given as a percent of the original price.

Example

Elise bought a dress that was discounted 35 off of the original price of $\$140$. What was the amount of discount and the sale price of the dress?
[reveal-answer q="967374"]Show Answer[/reveal-answer]
[hidden-answer a="967374"]

Solution
ⓐ Before beginning, you may find it helpful to organize the information in a list.

Original price = $\$140$

Discount rate = 35

Amount of discount = ?

Identify what you are asked to find.	What is the amount of discount?
Choose a variable to represent it.	Let $d =$ the amount of discount.
Write a sentence that gives the information to find it.	The discount is 35 of the original price.
Translate into an equation.	$\underbrace{\text{The discount}}_{s} \; \underbrace{\text{is}}_{=} \; \underbrace{\text{35\%}}_{0.35} \; \underbrace{\text{of}}_{\cdot} \; \underbrace{\text{the \$140 original price.}}_{140}$
Simplify.	$d = 49$
Check if this answer is reasonable.	
Yes. A $\$49$ discount is reasonable for a $\$140$ dress.	
Write a complete sentence that answers the question.	The amount of discount was $\$49$.

ⓑ

Original price = $140

Amount of discount = $49

Sale price = ?

Identify what you are asked to find.	What is the sale price of the dress?
Choose a variable to represent it.	Let $s =$ the sale price.
Write a sentence that gives the information to find it.	The sale price is the original price minus the discount.
Translate into an equation.	$\underbrace{\text{The sale price}}_{s}\ \underbrace{\text{is}}_{=}\ \underbrace{\text{the \$140}}_{140}\ \underbrace{\text{minus}}_{-}\ \underbrace{\text{the \$49 discount.}}_{49}$
Simplify.	$s = 91$
Check if this answer is reasonable.	
Yes. The sale price, $91, is less than the original price, $140.	
Write a complete sentence that answers the question.	The sale price of the dress was $91.

[/hidden-answer]

try it

[ohm_question]146775[/ohm_question]

There may be times when you buy something on sale and want to know the discount rate. The next example will show this case.

example

Jeannette bought a swimsuit at a sale price of $13.95. The original price of the swimsuit was $31. Find the ⓐ amount of discount and ⓑ discount rate.
[reveal-answer q="123339"]Show Answer[/reveal-answer]
[hidden-answer a="123339"]

Solution
ⓐ Before beginning, you may find it helpful to organize the information in a list.

Original price = $31

Amount of discount = ?

Sale price = $13.95

Identify what you are asked to find.	What is the amount of discount?
Choose a variable to represent it.	Let $d =$ the amount of discount.
Write a sentence that gives the information to find it.	The discount is the original price minus the sale price.
Translate into an equation.	$\underbrace{\text{The discount}}_{s}\ \underbrace{\text{is}}_{=}\ \underbrace{\text{the \$31 original price}}_{31}\ \underbrace{\text{minus}}_{-}\ \underbrace{\text{the \$13.95 sale price.}}_{13.95}$
Simplify.	$d = 17.05$
Check if this answer is reasonable.	
Yes. The $17.05 discount is less than the original price.	
Write a complete sentence that answers the question.	The amount of discount was $17.05.

ⓑ Before beginning, you may find it helpful to organize the information in a list.

Original price = $31

Amount of discount = $17.05

Discount rate = ?

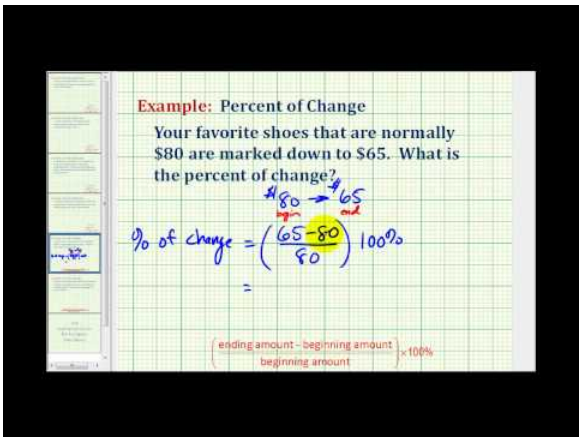
Identify what you are asked to find.	What is the discount rate?
Choose a variable to represent it.	Let $r =$ the discount rate.
Write a sentence that gives the information to find it.	The discount is what percent of the original price?
Translate into an equation.	$\underbrace{\text{The discount of \$17.05}}_{s}\ \underbrace{\text{is}}_{=}\ \underbrace{\text{what percent}}_{r}\ \underbrace{\text{of}}_{.}\ \underbrace{\text{the \$31 original price.}}_{31}$
Divide.	$\frac{17.05}{31} = \frac{r(31)}{31}$
Simplify.	$0.55 = r$
Check if this answer is reasonable.	
The rate of discount was a little more than 50 and the amount of discount is a little more than half of $31.	
Write a complete sentence that answers the question.	The rate of discount was 55.

[/hidden-answer]

try it

[ohm_question]156971[/ohm_question]

In the following video we show another example of how to find the discount rate (also called the percent of change) given the original price and the marked-down price.



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2.3: Simple and Compound Interest

Learning outcome

- Calculate simple and compound interest

When a person takes out a loan, most lenders charge interest on the loan. **Interest** is a fee or change for borrowing money, typically a percent rate charged per year. We can compute simple interest by finding the interest rate percentage of the amount borrowed, then multiply by the number of years interest is earned. Another type of interest calculates interest on both the money initially deposited as well as the interest money earned, and is called compound interest. We'll start with simple interest.

Simple Interest Equation

$I = p \cdot r \cdot t$

Where:

I is the **interest** paid

p is the **principal**—the original amount of money borrowed

r is the **interest rate**, a per-year rate, written as a decimal

t is the **time** of the loan, expressed in years or portions of a year

Example

Treasury Notes (T-notes) are bonds issued by the federal government to cover its expenses. Suppose you obtain a $\$1,000$ T-note with a 4% annual rate, with a maturity in 2 years. How much interest will you earn?

[reveal-answer q="694437"]Show Solution[/reveal-answer]
[hidden-answer a="694437"]

Identify the information given in the problem.

Interest (I): unknown

Principal (p): $\$1000$

Rate (r): $4\% = 0.04$

Time (t): 2 years

Put the information in the simple interest equation.

$$I = 1000 \cdot 0.04 \cdot 2$$

Multiply.

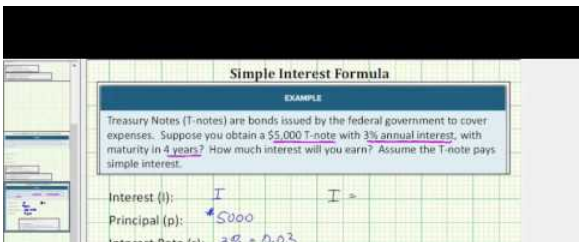
$$I = 80$$

Answer

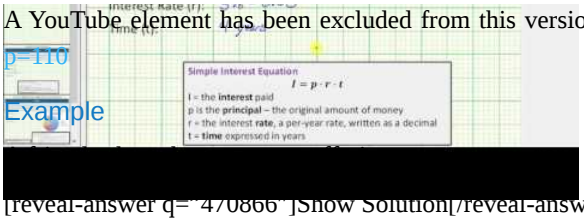
You would earn $\$80$ in interest.

[/hidden-answer]

In the following video, you are shown how to find how much interest is earned on a specified investment amount.



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Example

[redacted] in 1 month. What annual interest rate is this equivalent to?

[reveal-answer q="470866"]Show Solution[/reveal-answer]
[hidden-answer a="470866"]

Identify the information given in the problem. Here your friend is paying back $10 more than he borrowed, so that is the interest paid.

Interest (I): $\$10$

Principal (p): $\$240$

Rate (r): unknown

Time (t): 1 month

Convert the time to years.

$$1 \text{ month} = \frac{1}{12} \text{ year}$$

Put the information in the simple interest equation.

$$10 = 240 \cdot r \cdot \frac{1}{12}$$

Regroup and simplify.

$$10 = r \cdot 240 \cdot \frac{1}{12}$$

$$10 = r \cdot \frac{240}{12}$$

$$10 = r \cdot 20$$

Divide to undo the multiplication.

$$r = 10 \div 20 = 0.50$$

Rewrite as a percent.

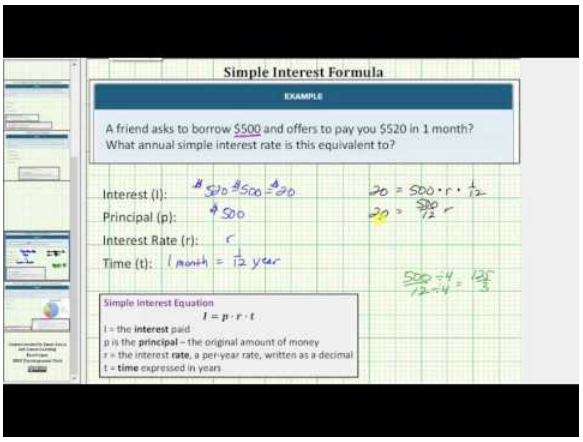
$$0.50 = 50\%$$

Answer

This is equivalent to a 50% annual interest rate.

[/hidden-answer]

The example video that follows shows how to determine the annual simple interest rate.



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Applications with simple interest usually involve either investing money or borrowing money. To solve these applications, we continue to use the same strategy for applications that we have used earlier in this chapter. The only difference is that in place of translating to get an equation, we can use the simple interest formula. We will provide examples of how to find interest earned, calculate the rate of interest, and how to find the principal given a rate and the interest earned.

We will start by solving a simple interest application to find the interest.

example

Nathaly deposited $\$12{,}500$ in her bank account where it will earn 4 interest. How much interest will Nathaly earn in 5 years?

Solution

We are asked to find the interest, I.

Organize the given information in a list.

$I = ?$

$p = \$12,500$

$r = 4\%$

$t = 5$ years

Write the formula.	$I = Prt$
Substitute the given information.	$I = (12,500)\,(0.04)\,(5)$
Simplify.	$I = 2,500$
Check your answer. Is $\$2{,}500$ a reasonable interest on $\$12{,}500$ over 5 years?	
At 4 interest per year, in 5 years the interest would be 20 of the principal. Is 20 of $\$12{,}500$ equal to $\$2{,}500$? Yes.	
Write a complete sentence that answers the question.	The interest is $\$2{,}500$.

try it

[ohm_question]146792[/ohm_question]

There may be times when you know the amount of interest earned on a given principal over a certain length of time, but you don't know the rate. For instance, this might happen when family members lend or borrow money among themselves instead of dealing with a bank. In the next example, we'll show how to solve for the rate.

example

Loren lent his brother $\$3,000$ to help him buy a car. In 4 years his brother paid him back the $\$3,000$ plus $\$660$ in interest. What was the rate of interest?
[reveal-answer q="361018"]Show Answer[/reveal-answer]
[hidden-answer a="361018"]

Solution
We are asked to find the rate of interest, r.
Organize the given information.

$I = 660$

$P = \$3,000$

$r = ?$

$t = 4$ years

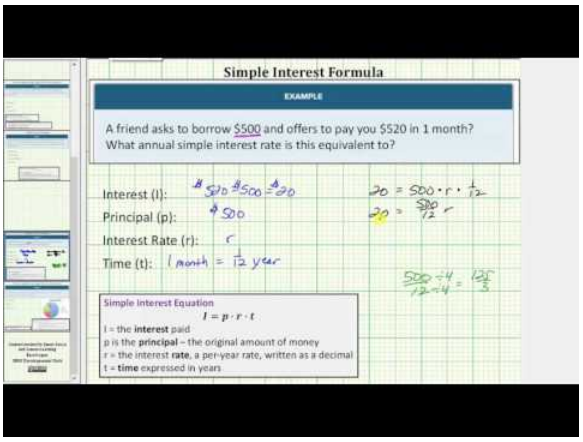
Write the formula.	$I = Prt$
Substitute the given information.	$660 = (3,000)\, r\, (4)$
Multiply.	$660 = (12,000)\, r$
Divide.	$\frac{660}{12,000} = \frac{(12,000)r}{12,000}$
Simplify.	$0.055 = r$
Change to percent form.	$5.5\% = r$
Check your answer. Is 5.5% a reasonable interest rate to pay your brother?	
$I = Prt$	
$660 \stackrel{?}{=} (3,000)\,(0.055)\,(4)$	
$660 = 660$ ✓	
Write a complete sentence that answers the question.	The rate of interest was 5.5%.

[/hidden-answer]

try it

[ohm_question]146793[/ohm_question]

In the next video we use the simple interest formula to find the rate of interest given an amount of money borrowed and the amount if interest paid.



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There may be times when you take a loan for a large purchase and the amount of the principal is not clear. This might happen, for instance, in making a car purchase when the dealer adds the cost of a warranty to the price of the car. In the next example, we will solve a simple interest application for the principal.

example

Eduardo noticed that his new car loan papers stated that with an interest rate of 7.5, he would pay $\$6{,}596.25$ in interest over 5 years. How much did he borrow to pay for his car?
[reveal-answer q="754756"]Show Answer[/reveal-answer]
[hidden-answer a="754756"]

Solution
We are asked to find the principal, P.
Organize the given information.

$$\begin{aligned} I &= 6,596.25 \\ P &= ? \\ r &= 7.5 \\ t &= 5 \text{ years} \end{aligned}$$

Write the formula.	$I = Prt$
Substitute the given information.	$6,596.25 = P\,(0.075)\,(5)$
Multiply.	$6,596.25 = 0.375P$
Divide.	$\frac{6,596.25}{0.375} = \frac{0.375P}{0.375}$
Simplify.	$17,590 = P$
Check your answer. Is $\$17{,}590$ a reasonable amount to borrow to buy a car?	
$I = Prt$	
$6,596.25 \stackrel{?}{=} (17,590)\,(0.075)\,(5)$	
$6,596.25 = 6,596.25$ ✓	
Write a complete sentence that answers the question.	The amount borrowed was $\$17,590$.

[/hidden-answer]

TRY IT

[ohm_question]146794[/ohm_question]

In the simple interest formula, the rate of interest is given as an annual rate, the rate for one year. So the units of time must be in years. If the time is given in months, we convert it to years.

example

Caroline got $\$900$ as graduation gifts and invested it in a 10-month certificate of deposit that earned 2.1% interest. How much interest did this investment earn?
[reveal-answer q="799758"]Show Answer[/reveal-answer]
[hidden-answer a="799758"]

Solution
We are asked to find the interest, I.
Organize the given information.

$$\begin{aligned} I &= ? \\ P &= \$900 \\ r &= 2.1 \\ t &= 10 \text{ months} \end{aligned}$$

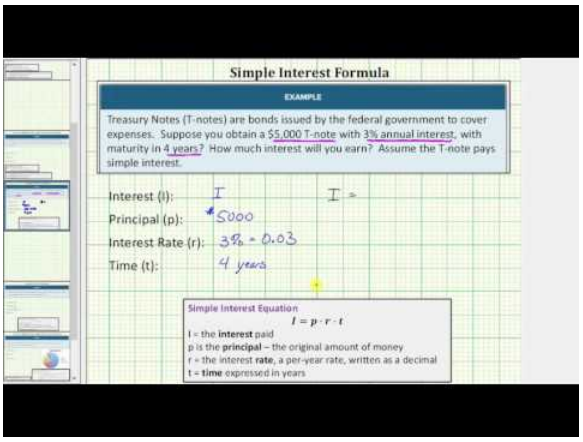
Write the formula.	$I = Prt$
Substitute the given information, converting 10 months to $\frac{10}{12}$ of a year.	$I = \$900\,(0.021)\left(\frac{10}{12}\right)$
Multiply.	$I = 15.75$
Check your answer. Is $\$15.75$ a reasonable amount of interest?	
If Caroline had invested the $\$900$ for a full year at 2 interest, the amount of interest would have been $\$18$. Yes, $\$15.75$ is reasonable.	
Write a complete sentence that answers the question.	The interest earned was $\$15.75$.

[/hidden-answer]

try it

[ohm_question]146796[/ohm_question]

In the following video we show an example of how to calculate the amount of interest earned on a treasury note.



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THE COMPOUND INTEREST FORMULA

Compound interest can be calculated using the formula

$A(t) = P(1 + r)^t$

where

- $A(t)$ is the account value,
- t is measured in years,
- P is the starting amount of the account, often called the principal, or more generally present value,
- r is the annual percentage rate (APR) expressed as a decimal, and assuming the interest is only compounded once a year

In our next example we will calculate the value of an account after ten years of interest compounded annually.

Example

If we invest $\$3,000$ in an investment account paying 3% interest compounded annually, how much will the account be worth in 10 years?
[reveal-answer q="689928"]Show Answer[/reveal-answer]
[hidden-answer a="689928"]

Because we are starting with $\$3,000$, $P = 3000$. Our interest rate is 3%, so $r = 0.03$. We want to know the value of the account in 10 years, so we are looking for $A(10)$, the value when $t = 10$.

$$\begin{aligned} A(t) &= P(1+r)^t && \text{Use the compound interest formula.} \\ A(10) &= 3000(1+0.03)^{10} && \text{Substitute using given values.} \\ &\approx 4031.75 && \text{Round to two decimal places.} \end{aligned}$$

The account will be worth about $\$4,031.75$ in 10 years.

[/hidden-answer]

Sometimes you will be asked for the final total amount in an account after interest is added. Make sure that after you solve for interest earned, you add it back onto the principal to get the total amount.

TRY IT

[ohm_question]2556[/ohm_question]

Now we will look at an example that uses the compound interest formula to solve for the principal.

Example

A 529 Plan is a college-savings plan that allows relatives to invest money to pay for a child's future college tuition; the account grows tax-free. Lily wants to set up a 529 account for her new granddaughter and wants the account to grow to $\$40,000$ over 18 years. She believes the account will earn 6% compounded annually. To the nearest dollar, how much will Lily need to invest in the account now?
[reveal-answer q="254680"]Show Answer[/reveal-answer]
[hidden-answer a="254680"]

The nominal interest rate is 6%, so $r = 0.06$

We want to find the initial investment, P, needed so that the value of the account will be worth $\$40,000$ in 18 years. Substitute the given values into the compound interest formula, and solve for P.

\(\begin{array}{c}A\left(t\right)\hfill & =P{\left(1+r\right)}^{t}\hfill & \text{Use the compound interest formula}.\hfill \ 40,000\hfill & =P{\left(1+0.06\right)}^{18}\hfill & \text{Substitute using given values }A\text{, }r, n\text{, and }t.\hfill \ 40,000\hfill & =P{\left(1.06\right)}^{18}\hfill & \text{Simplify}.\hfill \ \frac{40,000}

\hfill & =P\hfill & \text{Isolate }P.\hfill \ P\hfill & \approx 14,013.75\hfill & \text{Divide and round to the nearest dollar}.\hfill \end{array}\)

Lily will need to invest $\$14,013.75$ to have $\$40,000$ in 18 years.

[/hidden-answer]

TRY IT

[ohm_question]157038[/ohm_question]

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2.4: Solving Formulas for a Specific Variable

Learning outcome

- Solve any given formula for a specific variable

Though mathematical, formulas are the backbone of understanding content form many areas of study. They are useful in the sciences and social sciences—fields such as chemistry, physics, biology, psychology, sociology, and criminal justice. Healthcare workers use formulas, too, even for something as routine as dispensing medicine. The widely used spreadsheet program Microsoft Excel™ relies on formulas to do its calculations. Many teachers use spreadsheets to apply formulas to compute student grades. It is important to be familiar with formulas and be able to manipulate them easily.

A common formula is $d = rt$ for calculating distance based on rate and time. This formula gives the value of d when you substitute in the values of r and t. But what if you have to find the value of t. We would need to substitute in values of d and r and then use algebra to solve for t. If you had to do this often, you might wonder why there isn't a formula that gives the value of t when you substitute in the values of d and r. We can get a formula like this by solving the formula $d = rt$ for t.

To solve a formula for a specific variable means to get that variable by itself with a coefficient of 1 on one side of the equation and all the other variables and constants on the other side. We will call this solving an equation for a specific variable *in general*. This process is also called *solving a literal equation*. The result is another formula, made up only of variables. The formula contains letters, or *literals*.

Let's try a few examples, starting with the distance, rate, and time formula we used above.

example

Solve the formula $d = rt$ for t:

1. When $d = 520$ and $r = 65$
2. Algebraically

Solution:
We'll write the solutions side-by-side so you can see that solving a formula in general uses the same steps as when we have numbers to substitute.

	1. When $d = 520$ and $r = 65$	2. Algebraically
Write the formula.	$d = rt$	$d = rt$
Substitute any given values.	$520 = 65t$	
Divide to isolate *t*.	$\frac{520}{65} = \frac{65t}{65}$	$\frac{d}{r} = \frac{rt}{r}$
Simplify.	$8 = t$ $t = 8$	$\frac{d}{r} = t$ $t = \frac{d}{r}$

We say the formula $t = \frac{d}{r}$ is solved for t. We can use this version of the formula any time we are given the distance and rate and need to find the time.

Try it

A link to an interactive elements can be found at the bottom of this page.

We can use the formula $A = \frac{1}{2}bh$ to find the area of a triangle when we are given the base and height. In the next example, we will solve this formula for the height.

example

The formula for area of a triangle is $A = \frac{1}{2}bh$. Solve this formula for h:

1. When $A = 90$ and $b = 15$
2. Algebraically

[reveal-answer q="190834"]Show Answer[/reveal-answer]

[hidden-answer a="190834"]

Solution:

	1. When A = 90 and b = 15	2. Algebraically
Write the forumla.	$A = \frac{1}{2}bh$	$A = \frac{1}{2}bh$
Substitute any given values.	$90 = \frac{1}{2} \cdot 15\,h$	
Clear the fractions.	$2 \cdot 90 = 2 \cdot \frac{1}{2} \cdot 15\,h$	$2 \cdot A = 2 \cdot \frac{1}{2} \cdot b\,h$
Simplify.	$180 = 15h$	$2A = bh$
Solve for h.	$12 = h$	$\frac{2A}{b} = h$

We can now find the height of a triangle, if we know the area and the base, by using the formula

$h = \frac{2A}{b}$

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

Previously, we used the formula $I = Prt$ to calculate simple interest, where I is interest, P is principal, r is rate as a decimal, and t is time in years.

example

Solve the formula $I = Prt$ to find the principal, P:

1. When $I = \$5{,}600, r = 4, t = 7\text{years}$
2. Algebraically

[reveal-answer q="542986"]Show Answer[/reveal-answer]

[hidden-answer a="542986"]

Solution:

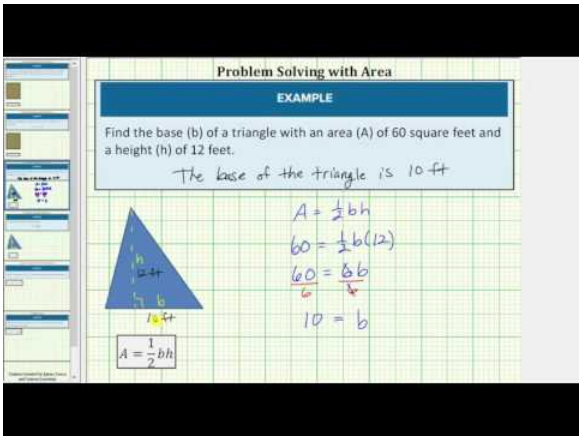
	1. I = \$5600, r = 4%, t = 7 years	2. Algebraically
Write the forumla.	$I = Prt$	$I = Prt$
Substitute any given values.	$5600 = P(0.04)(7)$	$I = Prt$
Multiply $r \cdot t$.	$5600 = P(0.28)$	$I = P(rt)$
Divide to isolate P.	$\frac{5600}{0.28} = \frac{P(0.28)}{0.28}$	$\frac{I}{rt} = \frac{P(rt)}{rt}$
Simplify.	$20{,}000 = P$	$\frac{I}{rt} = P$
State the answer.	The principal is \$20,000.	$P = \frac{I}{rt}$

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

Watch the following video to see another example of how to solve an equation for a specific variable.



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Later in this class, and in future algebra classes, you'll encounter equations that relate two variables, usually x and y. You might be given an equation that is solved for y and you need to solve it for x, or vice versa. In the following example, we're given an equation with both x and y on the same side and we'll solve it for y. To do this, we will follow the same steps that we used to solve a formula for a specific variable.

example

Solve the formula $3x + 2y = 18$ for y:

1. When $x = 4$
2. Algebraically

[reveal-answer q="908211"]Show Answer[/reveal-answer]

[hidden-answer a="908211"]

Solution:

	1. When $x = 4$	2. Algebraically
Write the equation.	$3x + 2y = 18$	$3x + 2y = 18$
Substitute any given values.	$3(4) + 2y = 18$	$3x + 2y = 18$
Simplify if possible.	$12 + 2y = 18$	$3x + 2y = 18$
Subtract to isolate the y-term.	$12-12 + 2y = 18-12$	$3x-3x + 2y = 18-3x$
Simplify.	$2y = 6$	$2y = 18 - 3x$
Divide.	$\frac{2y}{2} = \frac{6}{2}$	$\frac{2y}{2} = \frac{18-3x}{2}$
Simplify.	$y = 3$	$y = \frac{18-3x}{2}$

[/hidden-answer]

In the previous examples, we used the numbers in part (a) as a guide to solving algebraically in part (b). Do you think you're ready to solve a formula in general without using numbers as a guide?

example

Solve the formula $P = a + b + c$ for a.

[reveal-answer q="872233"]Show Answer[/reveal-answer]

[hidden-answer a="872233"]

Solution:
We will isolate a on one side of the equation.

We will isolate *a* on one side of the equation.		
Write the equation.		$P = a + b + c$
Subtract *b* and *c* from both sides to isolate *a*.		$P - b - c = a + b + c - b - c$
Simplify.		$P - b - c = a$

So, $a = P - b - c$

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

example

Solve the equation $3x + y = 10$ for y.

[reveal-answer q="923766"]Show Answer[/reveal-answer]

[hidden-answer a="923766"]

Solution
We will isolate y on one side of the equation.

We will isolate *y* on one side of the equation.		
Write the equation.		$3x + y = 10$
Subtract 3*x* from both sides to isolate *y*.		$3x - 3x + y = 10 - 3x$
Simplify.		$y = 10 - 3x$

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

example

Solve the equation $6x + 5y = 13$ for y.

[reveal-answer q="259834"]Show Answer[/reveal-answer]

[hidden-answer a="259834"]

Solution:
We will isolate y on one side of the equation.

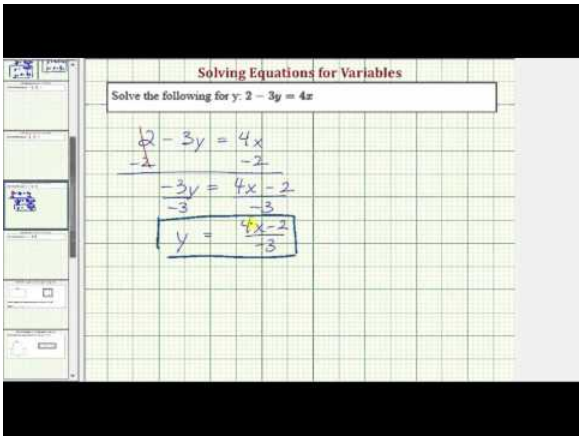
We will isolate y on one side of the equation.	
Write the equation.	$6x + 5y = 13$
Subtract to isolate the term with y.	$6x + 5y - 6x = 13 - 6x$
Simplify.	$5y = 13 - 6x$
Divide by 5 to make the coefficient 1.	$\frac{5y}{5} = \frac{13-6x}{5}$
Simplify.	$y = \frac{13-6x}{5}$

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

In the following video we show another example of how to solve an equation for a specific variable.

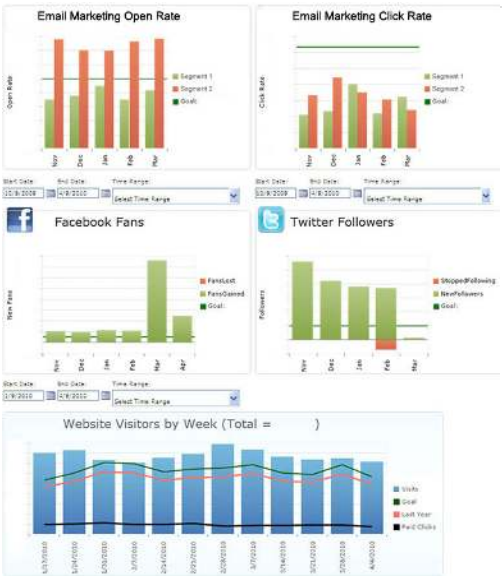


A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=112

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2.5: Introduction to Reading and Using Graphs



When presenting numerical data or information, it's often best to present those numbers visually for your audience. Visual depictions of data are much easier for the viewer to understand—creating a graph from your data is the simplest way to achieve that goal. There are many kinds of graphs depending on the numbers and what you are trying to communicate about them: bar graph, line graph, pie chart, scatterplots, histograms, etc. A graph lets your audience interpret the numerical information more effectively because the data is presented in an organized fashion that provides a basic framework for understanding.

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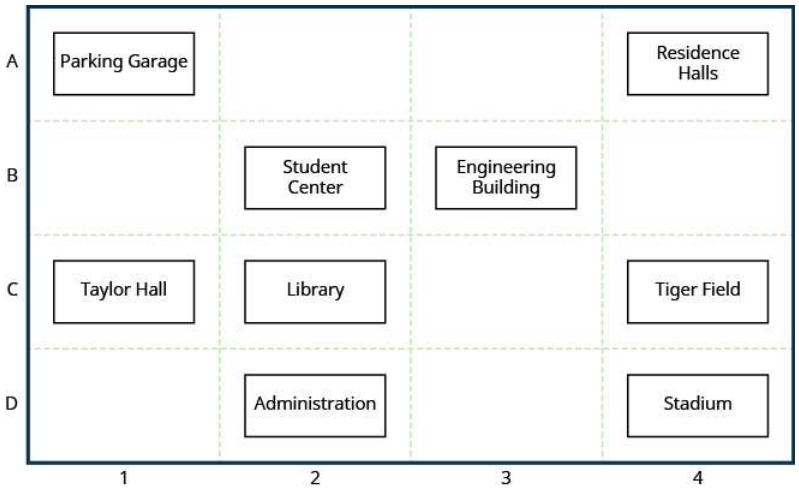
2.6: Graphing Points on a Coordinate Plane

Learning outcome

- Graph points (ordered pairs) on a coordinate plane

Many maps, such as the Campus Map shown below, use a grid system to identify locations. Do you see the numbers $1, 2, 3$, and 4 across the top and bottom of the map and the letters A, B, C, and D along the sides? Every location on the map can be identified by a number and a letter.

For example, the Student Center is in section 2B. It is located in the grid section above the number 2 and next to the letter B. In which grid section is the Stadium? The Stadium is in section 4D.



example

Use the map above.

1. Find the grid section of the Residence Halls.
2. What is located in grid section 4C?

Solution

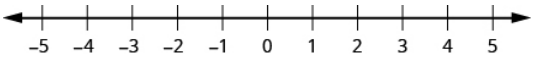
1. Read the number below the Residence Halls, 4, and the letter to the side, A. So the Residence Halls are in grid section 4A.
2. Find 4 across the bottom of the map and C along the side. Look below the 4 and next to the C. Tiger Field is in grid section 4C.

try it

[ohm_question]146887[/ohm_question]

[ohm_question]146888[/ohm_question]

Just as maps use a grid system to identify locations, a grid system is used in algebra to show a relationship between two variables in a rectangular coordinate system. To create a rectangular coordinate system, start with a horizontal number line. Show both positive and negative numbers as you did before, using a convenient scale unit. This horizontal number line is called the x-axis.

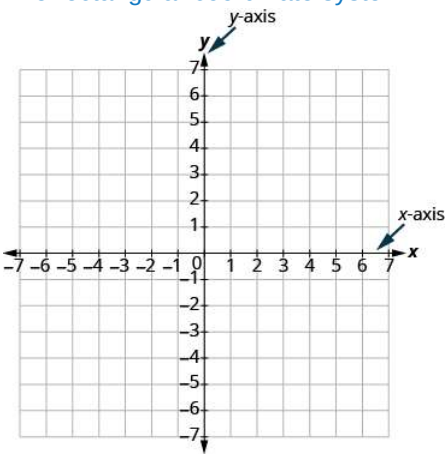


Now, make a vertical number line passing through the x-axis at 0. Put the positive numbers above 0 and the negative numbers below 0. See the image below. This vertical line is called the$y$-axis.

Vertical grid lines pass through the integers marked on the x-axis. Horizontal grid lines pass through the integers marked on the y-axis]. The resulting grid is the rectangular coordinate system.

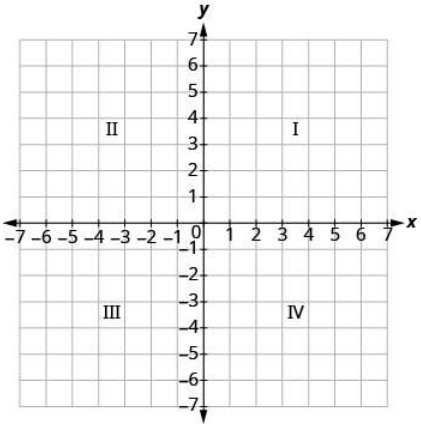
The rectangular coordinate system is also called the x-y plane, the coordinate plane, or the Cartesian coordinate system (since it was developed by a mathematician named René Descartes.)

The rectangular coordinate system



The x-axis] and the y-axis form the rectangular coordinate system. These axes divide a plane into four areas, called quadrants. The quadrants are identified by Roman numerals, beginning on the upper right and proceeding counterclockwise. See the image below.

The four quadrants of the rectangular coordinate system

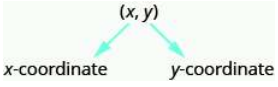


In the rectangular coordinate system, every point is represented by an ordered pair. The first number in the ordered pair is the *x*-coordinate of the point, and the second number is the *y*-coordinate of the point.

Ordered Pair

An ordered pair, (x, y) gives the coordinates of a point in a rectangular coordinate system.

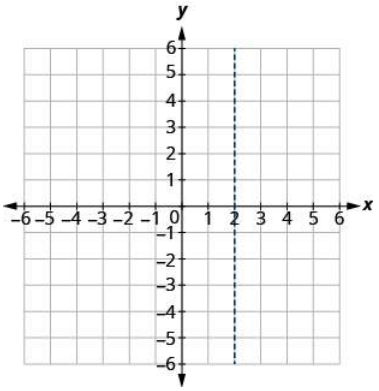
The first number is the x-coordinate.
The second number is the y-coordinate.



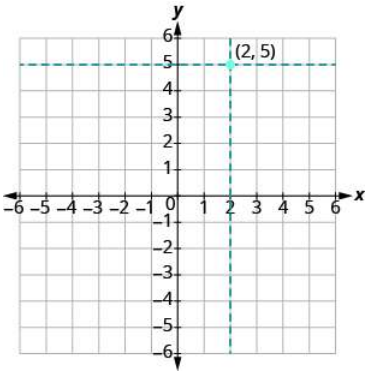
So how do the coordinates of a point help you locate a point on the x-y plane?

Let's try locating the point $(2, 5)$. In this ordered pair, the x -coordinate is 2 and the y -coordinate is 5.

We start by locating the x value, 2, on the x-axis. Then we lightly sketch a vertical line through $x = 2$, as shown in the image below.



Now we locate the y value, 5, on the y -axis and sketch a horizontal line through $y = 5$. The point where these two lines meet is the point with coordinates $(2, 5)$. We plot the point there, as shown in the image below.

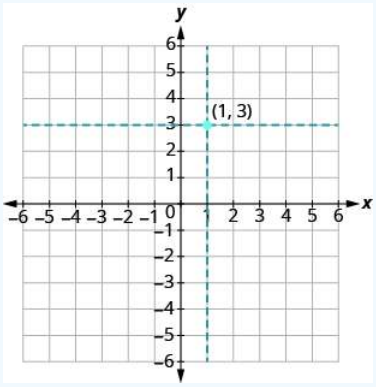


example

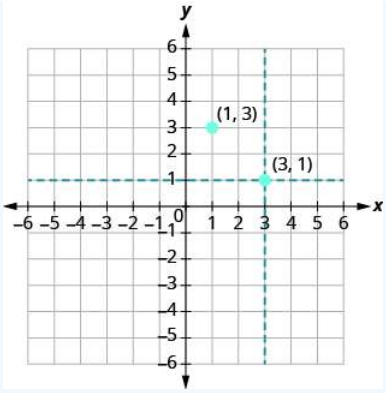
Plot $(1, 3)$ and $(3, 1)$ in the same rectangular coordinate system.
[reveal-answer q="501893"]Show Answer[/reveal-answer]
[hidden-answer a="501893"]

Solution

The coordinate values are the same for both points, but the x and y values are reversed. Let's begin with point $(1, 3)$. The x-coordinate is 1 so find 1 on the x-axis and sketch a vertical line through $x = 1$. The y-coordinate is 3 so we find 3 on the y-axis and sketch a horizontal line through $y = 3$. Where the two lines meet, we plot the point $(1, 3)$.



To plot the point $(3, 1)$, we start by locating 3 on the x-axis and sketch a vertical line through $x = 3$. Then we find 1 on the y-axis and sketch a horizontal line through $y = 1$. Where the two lines meet, we plot the point $(3, 1)$.



Notice that the order of the coordinates does matter, so, $(1,3)$ is not the same point as $(3,1)$.

[/hidden-answer]

try it

[ohm_question]146882[/ohm_question]

Exercises

Plot each point in the rectangular coordinate system and identify the quadrant in which the point is located:

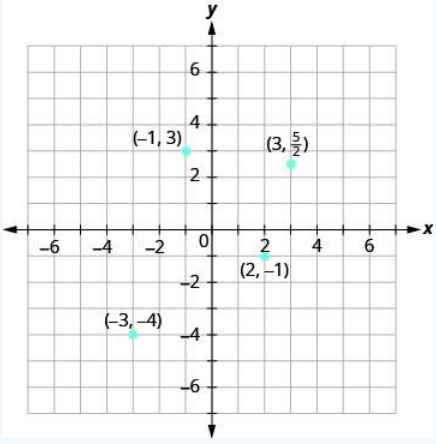
1. $(-1,3)$
2. $(-3,-4)$
3. $(2,-3)$
4. $\left(3,\frac{5}{2}\right)$

[reveal-answer q="933080"]Show Answer[/reveal-answer]
[hidden-answer a="933080"]

Solution

The first number of the coordinate pair is the x-coordinate, and the second number is the y-coordinate.

1. Since $x=-1, y=3$, the point $(-1,3)$ is in Quadrant II.
2. Since $x=-3, y=-4$, the point $(-3,-4)$ is in Quadrant III.
3. Since $x=2, y=-1$, the point $(2,-1)$ is in Quadrant lV.
4. Since $x=3, y=\frac{5}{2}$, the point $\left(3,\frac{5}{2}\right)$ is in Quadrant I. It may be helpful to write $\frac{5}{2}$ as the mixed number, $2\frac{1}{2}$, or decimal, 2.5. Then we know that the point is halfway between 2 and 3 on the y-axis.



[/hidden-answer]

try it

[ohm_question]146883[/ohm_question]

example

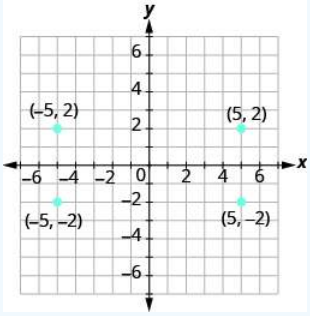
How do the signs affect the location of the points?

Plot each point:

1. $(-5, 2)$
2. $(-5, -2)$
3. $(5, 2)$
4. $(5, -2)$

[reveal-answer q="83169"]Show Answer[/reveal-answer]
[hidden-answer a="83169"]

Solution
As we locate the x-coordinate and the y-coordinate, we must be careful with the signs.



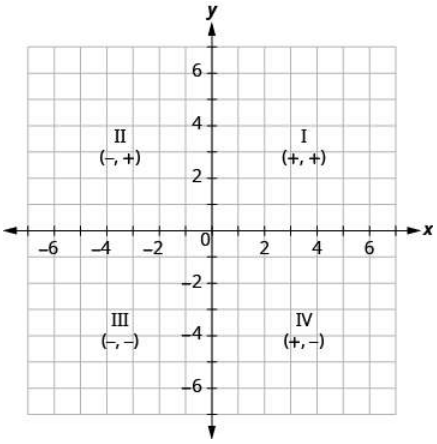
[/hidden-answer]

try it

[ohm_question]146885[/ohm_question]

You may have noticed some patterns as you graphed the points in the two previous examples. We can summarize sign patterns of the quadrants as follows. Also see the graph below.

Quadrant I	Quadrant II	Quadrant III	Quadrant IV
(*x*,*y*)	(*x*,*y*)	(*x*,*y*)	(*x*,*y*)
(+,+)	(−,+)	(−,−)	(+,−)



What if one coordinate is zero? Where is the point $(0, 4)$ located? Where is the point $(-2, 0)$ located? The point $(0, 4)$ is on the y-axis and the point $(-2, 0)$ is on the x-axis.

Points on the Axes

Points with a y-coordinate equal to 0 are on the x-axis, and have coordinates $(a, 0)$.

Points with an x-coordinate equal to 0 are on the y-axis, and have coordinates $(0, b)$.

What is the ordered pair of the point where the axes cross? At that point both coordinates are zero, so its ordered pair is $(0, 0)$. The point has a special name. It is called the *origin*.

The Origin

The point $(0, 0)$ is called the **origin**. It is the point where the x-axis and y-axis intersect.

ExAMPLE

Plot each point on a coordinate grid:

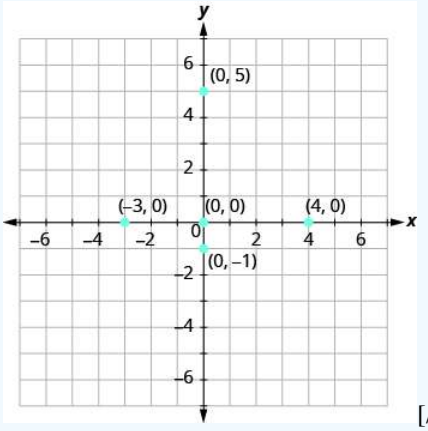
1. $(0, 5)$
2. $(4, 0)$
3. $(-3, 0)$
4. $(0, 0)$
5. $(0, -1)$

[reveal-answer q="803167"]Show Answer[/reveal-answer]
[hidden-answer a="803167"]

Solution

1. Since $x = 0$, the point whose coordinates are $(0, 5)$ is on the y-axis.
2. Since $y = 0$, the point whose coordinates are $(4, 0)$ is on the x-axis.
3. Since $y = 0$, the point whose coordinates are $(-3, 0)$ is on the x-axis.
4. Since $x = 0$ and $y = 0$, the point whose coordinates are $(0, 0)$ is the origin.

5. Since $x = 0$, the point whose coordinates are $(0, -1)$ is on the y-axis.

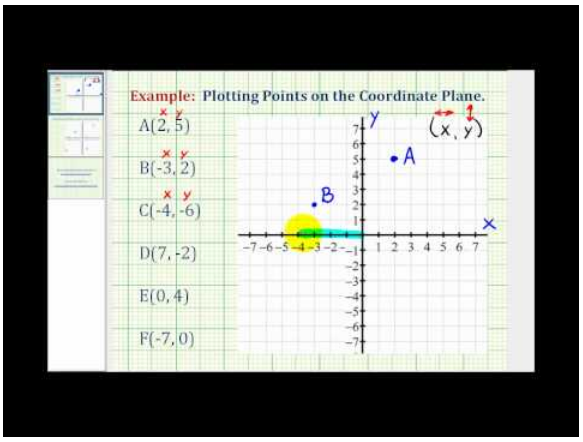


[/hidden-answer]

TRY IT

[ohm_question]146886[/ohm_question]

In the following video, we show another example of how to plot several different points on the coordinate plane.

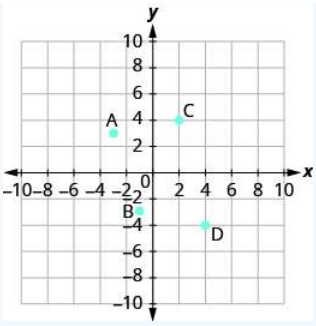


A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=116

In data and graph analysis, being able to identify the coordinates of a point shown on a graph is just as important as being able to plot points. To identify the x-coordinate of a point on a graph, read the number on the x-axis directly above or below the point. To identify the y-coordinate of a point, read the number on the y-axis directly to the left or right of the point. Remember, to write the ordered pair using the correct order (x, y).

example

Name the ordered pair of each point shown:



Solution

Point A is above -3 on the x-axis, so the x-coordinate of the point is -3. The point is to the left of 3 on the y-axis, so the y-coordinate of the point is 3. The coordinates of the point are $(-3, 3)$.

Point B is below -1 on the x-axis, so the x-coordinate of the point is -1. The point is to the left of -3 on the y-axis, so the y-coordinate of the point is -3. The coordinates of the point are $(-1, -3)$.

Point C is above 2 on the x-axis, so the x-coordinate of the point is 2. The point is to the right of 4 on the y-axis, so the y-coordinate of the point is 4. The coordinates of the point are $(2, 4)$.

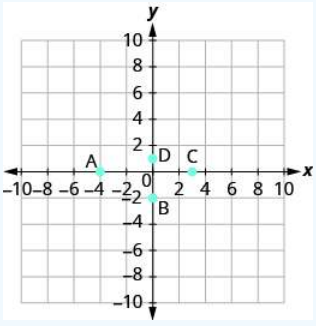
Point D is below 4 on the $x-$axis, so the x-coordinate of the point is 4. The point is to the right of -4 on the y-axis, so the y-coordinate of the point is -4. The coordinates of the point are $(4, -4)$.

try it

[ohm_question]146915[/ohm_question]

example

Name the ordered pair of each point shown:



[reveal-answer q="228616"]Show Answer[/reveal-answer]
[hidden-answer a="228616"]

Solution

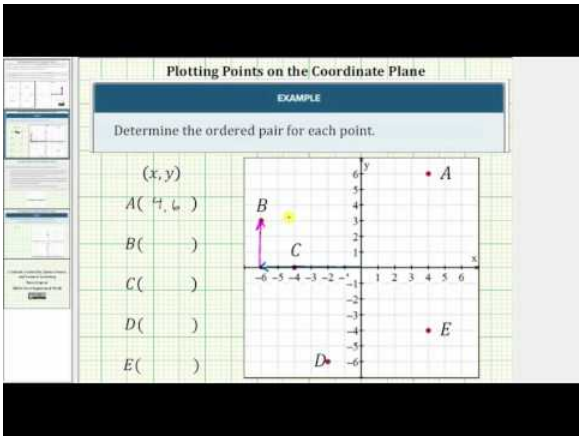
Point A is on the *x*-axis at $x = -4$	The coordinates of point A are $(-4, 0)$
Point B is on the *y*-axis at $y = -2$	The coordinates of point B are $(0, -2)$
Point C is on the *x*-axis at $x = 3$	The coordinates of point C are $(3, 0)$
Point D is on the *y*-axis at $y = 1$	The coordinates of point D are $(0, 1)$

[/hidden-answer]

try it

[ohm_question]146919[/ohm_question]

Watch the following video for another example of how to determine the ordered pair for points on the coordinate plane.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=116

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2.7: Identifying Trends of a Graph

Learning outcome

- Recognize the trend of a graph

Data from the real world typically does not follow a perfect line or precise pattern. However, depending on the data, it does often follow a trend. Trends can be observed overall or for a specific segment of the graph. When looking a graph to determine its trend, there are usually four options to describe what you are seeing.

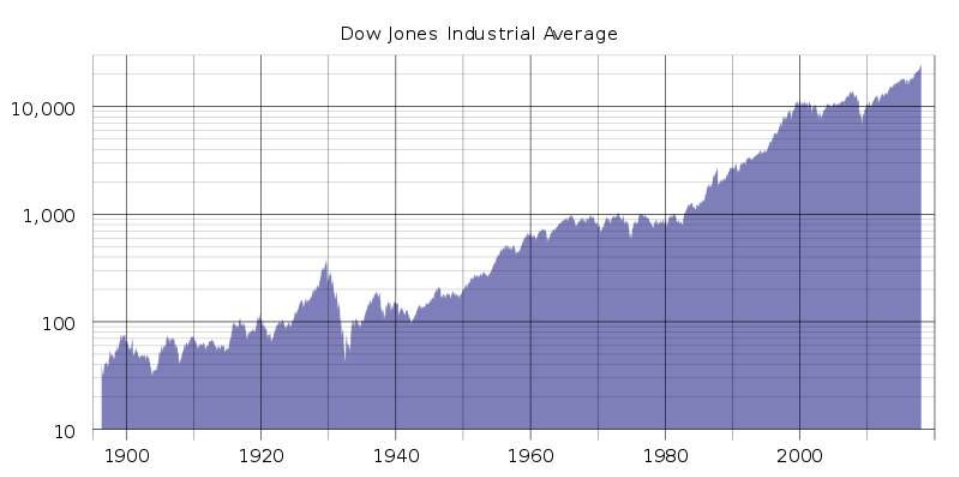
Graph Trends

- One variable increases as the other increases
- One variable decreases as the other increases
- There is no change in one variable as the other increases or decreases
- The data is so scattered and random that no trend can be determined from the graph

Let's take a look at some graph depicting real data and see what we can determine about their trends.

Example

The graph below shows the closing value in ($) of the Dow Jones index in relation to the year. What is the overal trend of this data?



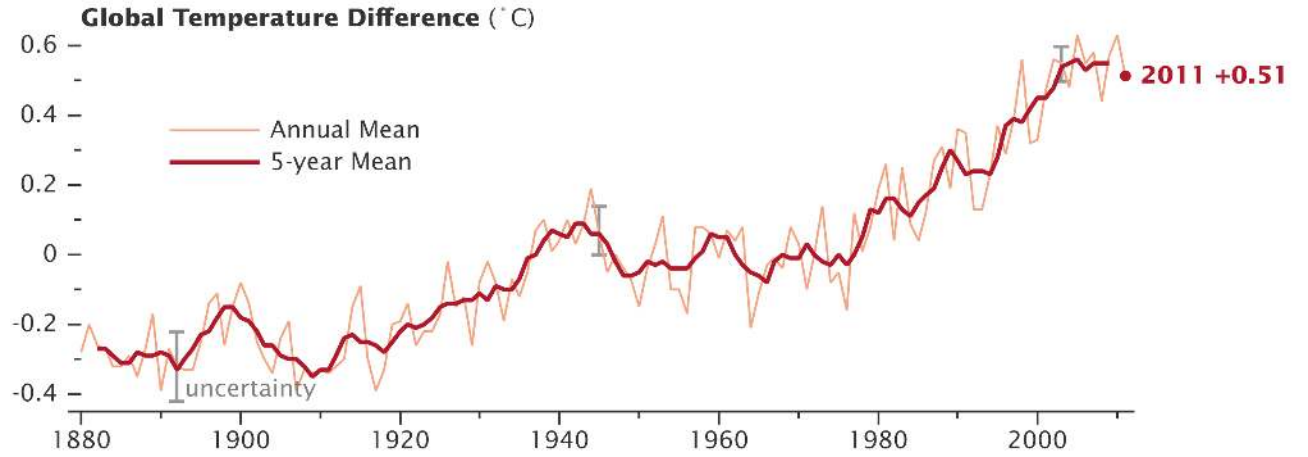
Though the points don't create a perfect line, if you hold your pencil over the data points, you can see that a diagonal line going up to the right is formed. If we pick pick a point from each end we can analyze the values. In 1920 the Dow Jones was at about $\$100$. In 2000 the Dow Jones was at about $\$10,000$. So as the years increased by 80, the value of the index increased by $\$9,900$.

We can say that the data on this graph fits the trend — "one variable increases as the other increases".

As time passes, or the years increase, the value of the Dow Jones also increases.

TrY IT

Now let's look at a graph that show the global temperature differences collected over the 100+ years. How would you describe the trend of this graph?



[reveal-answer q="785039"]Show Answer[/reveal-answer]
[hidden-answer a="785039"]

Holding a straight edge over the data points gives us an approximate line that rises up to the right.

Taking some endpoints allows us to collect more evidence for our answer:

In 1910 the temperature difference was at about $-0.3^{\circ}C$.

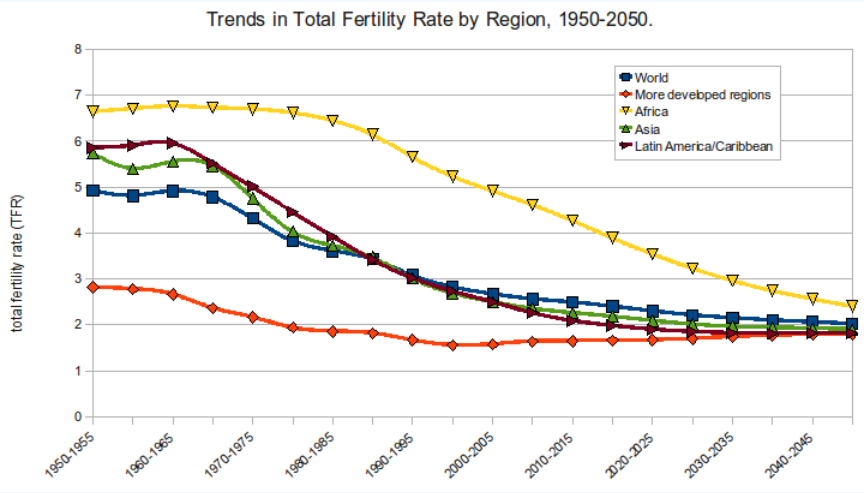
In 2000 the temperature difference was at about $0.4^{\circ}C$.

The global temperature difference increases as time passes, or as the years increase.

[/hidden-answer]

ExAMPLE

The following graph shows the fertility rate in various regions in a hundred year range.



Looking at this graph we can observe overall trends, individual regions, or segments of time.

1. What would you say is the overall trend of this data (Worldwide)?
2. What is the trend in more developed regions (red line w/ diamond points)?

[reveal-answer q="50301"]Show Answer[/reveal-answer]
[hidden-answer a="50301"]

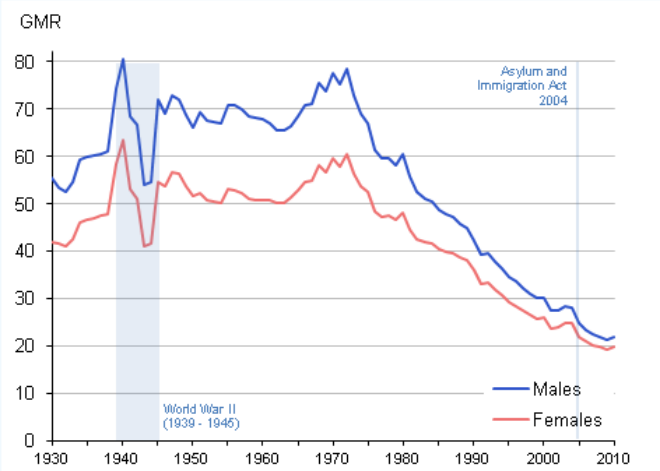
1. The worldwide data is depicted on the blue line with square points. Holding a straight edge gives us a shallow line that goes down to the right. This implies that the trend is the fertility rate decrease over time, or as the years increase.

2. The developed regions line starts with a slight decrease over time and then a very slight increase after the lowest point. The change is not enough to infer a consistent pattern, so the trend is that the fertility rate is static or unchanging over time, or as the years increase.

[/hidden-answer]

TRY IT

The graph below show the marriage rates in Great Britain over the past 80 years.



Looking at this graph answer the following questions.

1. What is the trend of this data for males between 1940 and 1975?
2. What is the trend of this data for females between 1980 and 2010?

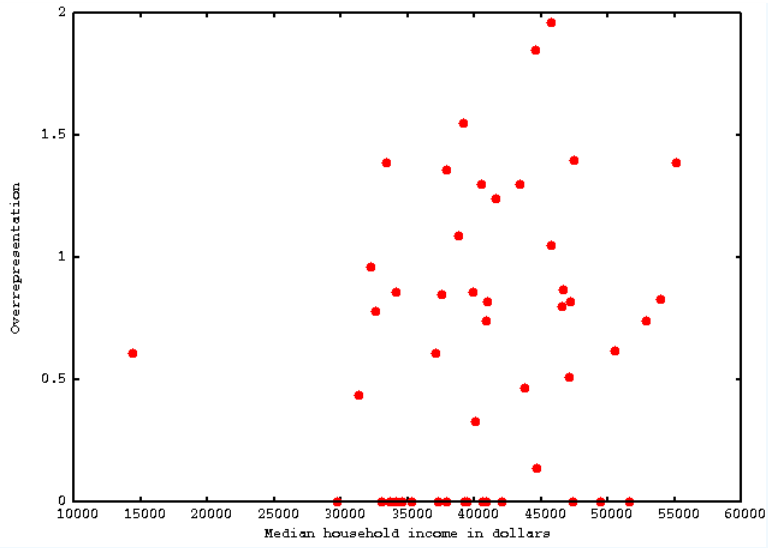
[reveal-answer q="447895"]Show Answer[/reveal-answer]
[hidden-answer a="447895"]

1. For males (the blue line), the data for 1940 and 1975 looks to be the same, 70. So even though there are lots and up and downs between, there is no consistent increase or decrease. The trend for males during this time period is that the marriage rate was unchanging as the years increased.
2. For females (the red line), the marriage rate in 1980 was about 45, and in 2010 it was about 20. There were slight blips of increases in that time frame, but the trend during that time period shows that the marriage rate for females decreased as time passed, or years increased.

[/hidden-answer]

Example

Look at the data points scattered all over the graph below. It's possible that if a statistician analyzed the numbers, there is a slight trend. However, based on our knowledge and the data provided, we cannot tell how median household income is related to overrepresentation.



We would say that we cannot determine the trend of this data based on the graph.

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2.8: Rate of Change

Learning outcome

- Calculate the rate of change using data points and graphical representations

Frequently we want to compare two different types of measurements, such as miles to gallons. To make this comparison, we use a rate. Examples of rates are 120 miles in 2 hours, 160 words in 4 minutes, and $\$5$ dollars per 64 ounces.

Rate

A rate compares two quantities of different units. A rate is usually written as a fraction.

When writing a fraction as a rate, we put the first given amount with its units in the numerator and the second amount with its units in the denominator. When rates are simplified, the units remain in the numerator and denominator.

example

Bob drove his car 525 miles in 9 hours. Write this rate as a fraction.

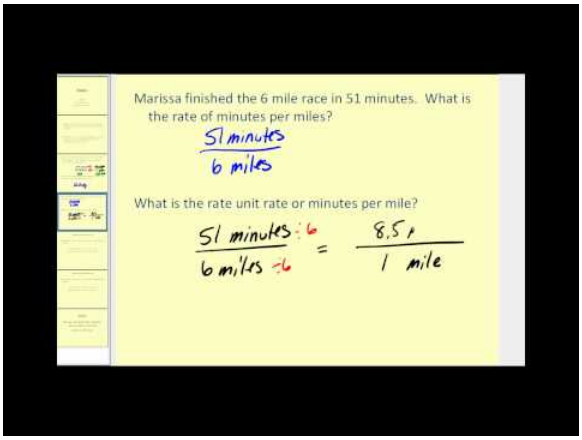
Solution

	525 miles in 9 hours
Write as a fraction, with 525 miles in the numerator and 9 hours in the denominator.	$\frac{525 \text{ miles}}{9 \text{ hours}}$
	$\frac{175 \text{ miles}}{3 \text{ hours}}$

So 525 miles in 9 hours is equivalent to $\frac{175 \text{ miles}}{3 \text{ hours}}$

try it

[ohm_question]146615[/ohm_question]

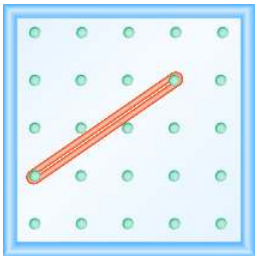


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Let's examine how a rate is represented on a graph and determine how to identify it.

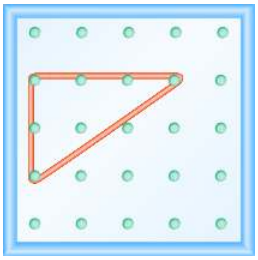
Using rubber bands on a geoboard gives a concrete way to model lines on a coordinate grid. By stretching a rubber band between two pegs on a geoboard, we can discover how to find the slope of a line. And when you ride a bicycle, you feel the slope as you pump uphill or coast downhill.

We'll start by stretching a rubber band between two pegs to make a line as shown in the image below.

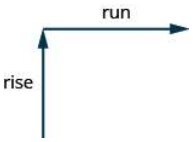


Does it look like a line?

Now we stretch one part of the rubber band straight up from the left peg and around a third peg to make the sides of a right triangle as shown in the image below. We carefully make a 90° angle around the third peg, so that one side is vertical and the other is horizontal.



To find the slope of the line, we measure the distance along the vertical and horizontal legs of the triangle. The vertical distance is called the *rise* and the horizontal distance is called the *run*, as shown below.



To help remember the terms, it may help to think of the images shown below.



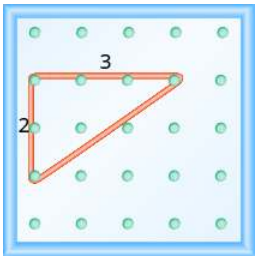
It goes straight up, as if along the *y*-axis.
RISE ↕



A jogger runs straight across, as if along the *x*-axis.
RUN ↔

On our geoboard, the rise is 2 units because the rubber band goes up 2 spaces on the vertical leg. See the image below.

What is the run? Be sure to count the spaces between the pegs rather than the pegs themselves! The rubber band goes across 3 spaces on the horizontal leg, so the run is 3 units.



The slope of a line is the ratio of the rise to the run. So the slope of our line is $\frac{2}{3}$. In mathematics, the slope is always represented by the letter m.

Slope of a line or rate of change

The slope of a line is $m = \frac{\text{rise}}{\text{run}}$.

The rise measures the vertical change and the run measures the horizontal change.

What is the slope of the line on the geoboard in the image above?

$$m = \frac{\text{rise}}{\text{run}}$$

$$m = \frac{2}{3}$$

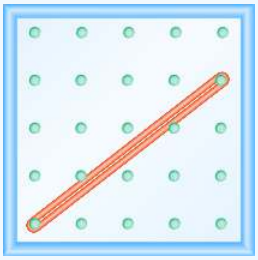
The line has slope $\frac{2}{3}$

If we start by going up the rise is positive, and if we stretch it down the rise is negative. We will count the run from left to right, just like you read this paragraph, so the run will be positive.

Since the slope formula has rise over run, it may be easier to always count out the rise first and then the run.

example

What is the slope of the line on the geoboard shown?



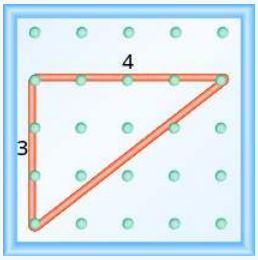
Solution

Use the definition of slope.

$m = \frac{\text{rise}}{\text{run}}$

Start at the left peg and make a right triangle by stretching the rubber band up and to the right to reach the second peg.

Count the rise and the run as shown.



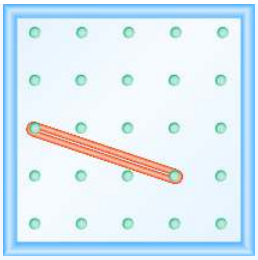
The rise is 3 units. $m = \frac{3}{\text{run}}$

The run is4 units. $m = \frac{3}{4}$

The slope is $\frac{3}{4}$

example

What is the slope of the line on the geoboard shown?

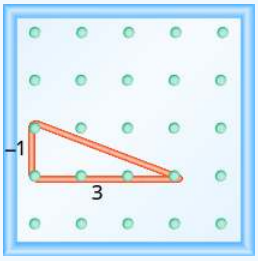


[reveal-answer q="698295"]Show Answer[/reveal-answer]
[hidden-answer a="698295"]

Solution
Use the definition of slope.

$m = \frac{\text{rise}}{\text{run}}$

Start at the left peg and make a right triangle by stretching the rubber band to the peg on the right. This time we need to stretch the rubber band down to make the vertical leg, so the rise is negative.



The rise is -1.	$m = \frac{-1}{\text{run}}$
The run is3.	$m = \frac{-1}{3}$
	$m = -\frac{1}{3}$
	The slope is $-\frac{1}{3}$

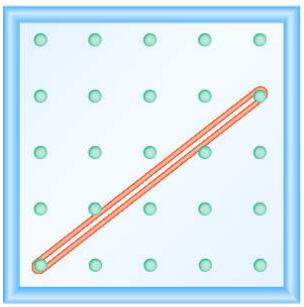
[/hidden-answer]

try it

[ohm_question]147013[/ohm_question]

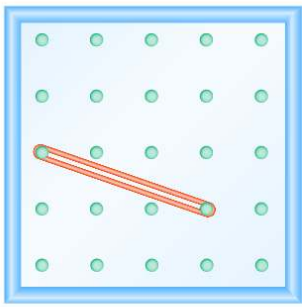
Notice that in the first example, the slope is positive and in the second example the slope is negative. Do you notice any difference in the two lines shown in the images below.

A



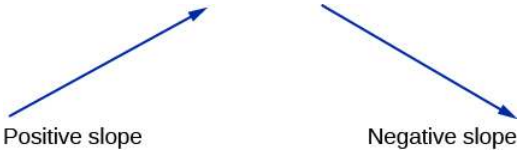
$m = \frac{3}{4}$

B



$m = -\frac{1}{3}$

As you read from left to right, the line in Figure A, is going up; it has positive slope. The line Figure B is going down; it has negative slope.



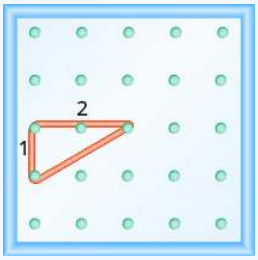
example

Use a geoboard to model a line with slope $\frac{1}{2}$.
[reveal-answer q="225850"]Show Answer[/reveal-answer]
[hidden-answer a="225850"]

Solution
To model a line with a specific slope on a geoboard, we need to know the rise and the run.

Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Replace m with $\frac{1}{2}$.	$\frac{1}{2} = \frac{\text{rise}}{\text{run}}$

So, the rise is 1 unit and the run is 2 units.
Start at a peg in the lower left of the geoboard. Stretch the rubber band up 1 unit, and then right 2 units.

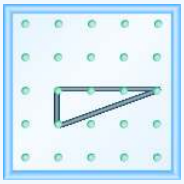


The hypotenuse of the right triangle formed by the rubber band represents a line with a slope of $\frac{1}{2}$.

[/hidden-answer]

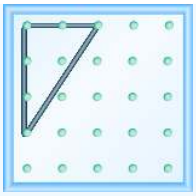
try it

Use a geoboard to model a line with the given slope: $m = \frac{1}{3}$.
[reveal-answer q="152695"]Show Answer[/reveal-answer]
[hidden-answer a="152695"]



[/hidden-answer]

Use a geoboard to model a line with the given slope: $m = \frac{3}{2}$.
[reveal-answer q="64394"]Show Answer[/reveal-answer]
[hidden-answer a="64394"]



[/hidden-answer]

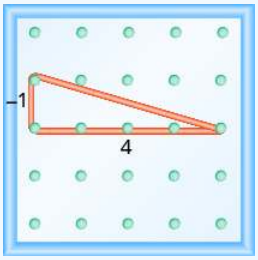
example

Use a geoboard to model a line with slope $\frac{-1}{4}$
[reveal-answer q="953715"]Show Answer[/reveal-answer]
[hidden-answer a="953715"]

Solution

Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Replace m with $-\frac{1}{4}$.	$-\frac{1}{4} = \frac{\text{rise}}{\text{run}}$

So, the rise is -1 and the run is 4.
Since the rise is negative, we choose a starting peg on the upper left that will give us room to count down. We stretch the rubber band down 1 unit, then to the right 4 units.

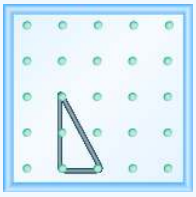


The hypotenuse of the right triangle formed by the rubber band represents a line whose slope is $-\frac{1}{4}$.

[/hidden-answer]

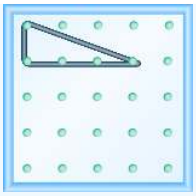
try it

Use a geoboard to model a line with the given slope: $m = \frac{-3}{2}$.
[reveal-answer q="99402"]Show Answer[/reveal-answer]
[hidden-answer a="99402"]



[/hidden-answer]

Use a geoboard to model a line with the given slope: $m = \frac{-1}{3}$.
[reveal-answer q="714001"]Show Answer[/reveal-answer]
[hidden-answer a="714001"]



[/hidden-answer]

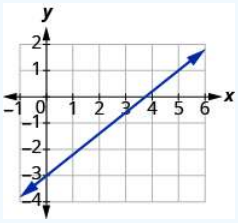
Now we'll look at some graphs on a coordinate grid to find their slopes. The method will be very similar to what we just modeled on our geoboards.

To find the slope, we must count out the rise and the run. But where do we start?

We locate any two points on the line. We try to choose points with coordinates that are integers to make our calculations easier. We then start with the point on the left and sketch a right triangle, so we can count the rise and run.

example

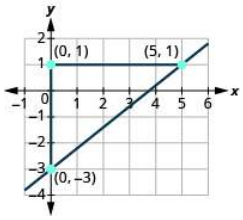
Find the slope of the line shown:



Solution

Locate two points on the graph, choosing points whose coordinates are integers. We will use $(0, -3)$ and $(5, 1)$.

Starting with the point on the left, $(0, -3)$, sketch a right triangle, going from the first point to the second point, $(5, 1)$.



Count the rise on the vertical leg of the triangle.	The rise is 4 units.
Count the run on the horizontal leg.	The run is 5 units.
Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Substitute the values of the rise and run.	$m = \frac{4}{5}$
The slope of the line is $\frac{4}{5}$.	

Notice that the slope is positive since the line slants upward from left to right.

try it

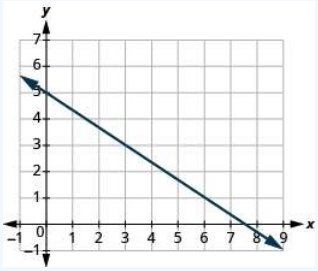
[ohm_question]147014[/ohm_question]

Find the slope from a graph

1. Locate two points on the line whose coordinates are integers.
2. Starting with the point on the left, sketch a right triangle, going from the first point to the second point.
3. Count the rise and the run on the legs of the triangle.
4. Take the ratio of rise to run to find the slope. $m = \frac{\text{rise}}{\text{run}}$

example

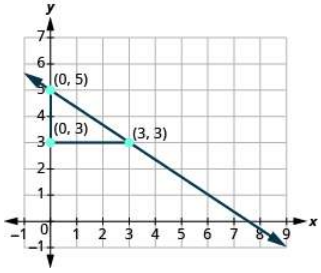
Find the slope of the line shown:



[reveal-answer q="966343"]Show Answer[/reveal-answer]
[hidden-answer a="966343"]

Solution

Locate two points on the graph. Look for points with coordinates that are integers. We can choose any points, but we will use $(0, 5)$ and $(3, 3)$. Starting with the point on the left, sketch a right triangle, going from the first point to the second point.

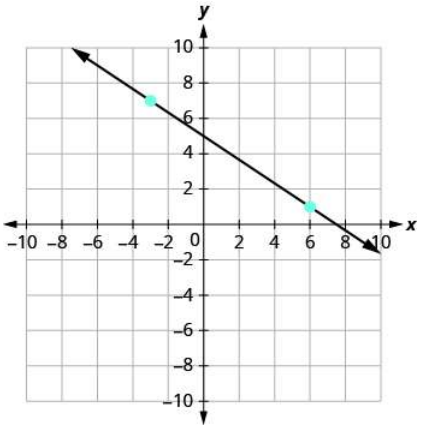


Count the rise – it is negative.	The rise is -2.
Count the run.	The run is 3.
Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Substitute the values of the rise and run.	$m = \frac{-2}{3}$
Simplify.	$m = -\frac{2}{3}$
The slope of the line is $-\frac{2}{3}$.	

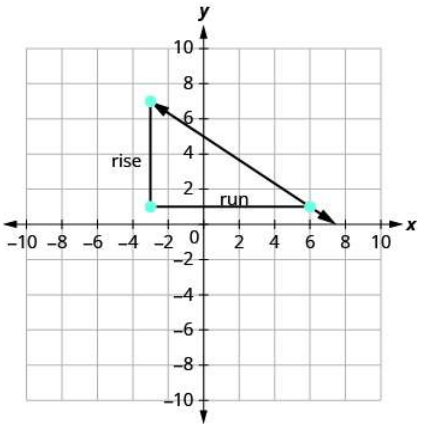
[/hidden-answer]

Notice that the slope is negative since the line slants downward from left to right.

What if we had chosen different points? Let's find the slope of the line again, this time using different points. We will use the points $(-3, 7)$ and $(6, 1)$.



Starting at $(-3, 7)$, sketch a right triangle to $(6, 1)$.



Count the rise.	The rise is -6.
Count the run.	The run is 9.
Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Substitute the values of the rise and run.	$m = \frac{-6}{9}$
Simplify the fraction.	$m = -\frac{2}{3}$
The slope of the line is $-\frac{2}{3}$.	

It does not matter which points you use—the slope of the line is always the same. The slope of a line is constant!

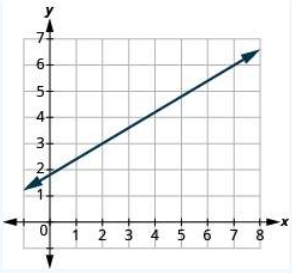
try it

[ohm_question]147015[/ohm_question]

The lines in the previous examples had y -intercepts with integer values, so it was convenient to use the *y*-intercept as one of the points we used to find the slope. In the next example, the y -intercept is a fraction. The calculations are easier if we use two points with integer coordinates.

example

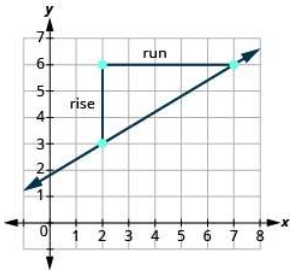
Find the slope of the line shown:



[reveal-answer q="439279"]Show Answer[/reveal-answer]
[hidden-answer a="439279"]

Solution

Locate two points on the graph whose coordinates are integers.	$(2,3)$ and $(7,6)$
Which point is on the left?	$(2,3)$
Starting at $(2,3)$, sketch a right angle to $(7,6)$ as shown below.	



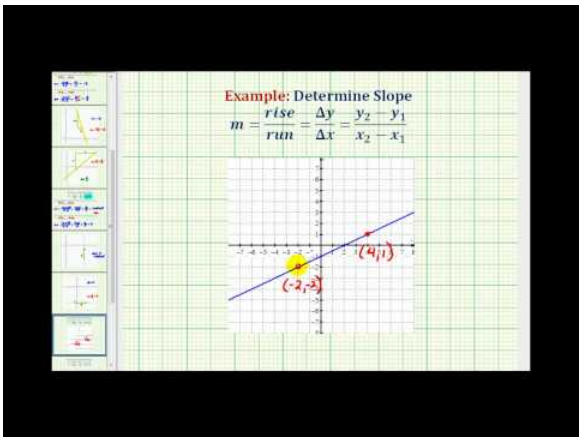
Count the rise.	The rise is 3.
Count the run.	The run is 5.
Use the slope formula.	$m = \frac{\text{rise}}{\text{run}}$
Substitute the values of the rise and run.	$m = \frac{3}{5}$
The slope of the line is $\frac{3}{5}$.	

[/hidden-answer]

try it

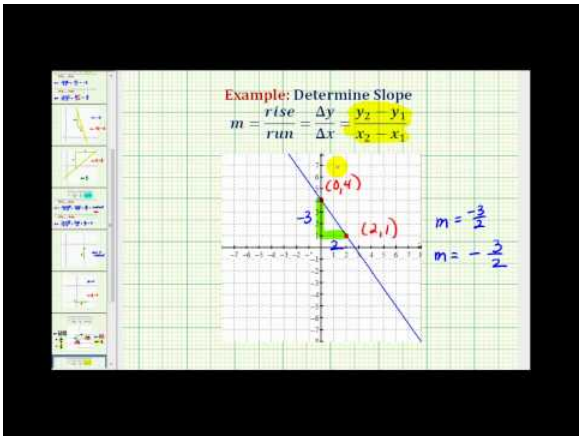
[ohm_question]147016[/ohm_question]

In the following video we show another example of how to find the slope of a line given a graph. This graph has a positive slope.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=120

In the following video we show another example of how to find the slope of a line given a graph. This graph has a negative slope.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=120

Sometimes we need to find the slope of a line between two points and we might not have a graph to count out the rise and the run. We could plot the points on grid paper, then count out the rise and the run, but there is a way to find the slope without graphing.

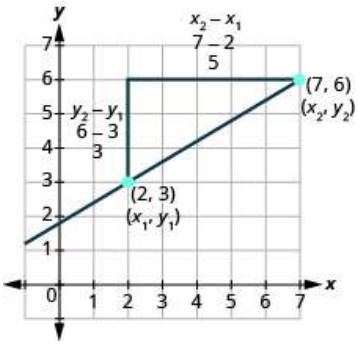
Before we get to it, we need to introduce some new algebraic notation. We have seen that an ordered pair (x, y) gives the coordinates of a point. But when we work with slopes, we use two points. How can the same symbol (x, y) be used to represent two different points?

Mathematicians use subscripts to distinguish between the points. A subscript is a small number written to the right of, and a little lower than, a variable.

- (x_1, y_1) read x sub $1, y$ sub 1
- (x_2, y_2) read x sub $2, y$ sub 2

We will use (x_1, y_1) to identify the first point and (x_2, y_2) to identify the second point. If we had more than two points, we could use (x_3, y_3), (x_4, y_4), and so on.

To see how the rise and run relate to the coordinates of the two points, let's take another look at the slope of the line between the points $(2, 3)$ and $(7, 6)$ below.



Since we have two points, we will use subscript notation.

\(\stackrel

{\left(2,3\right)}\stackrel{\left(7,6\right)}\)

On the graph, we counted the rise of 3. The rise can also be found by subtracting the y-coordinates of the points.

$$y_2 - y_1$$
$$6 - 3$$
$$3$$

We counted a run of 5. The run can also be found by subtracting the x-coordinates.

$$x_2 - x_1$$
$$7 - 2$$
$$5$$

We know	$m = \frac{\text{rise}}{\text{run}}$
So	$m = \frac{3}{5}$
We rewrite the rise and run by putting in the coordinates.	$m = \frac{6-3}{7-2}$
But 6 is the y -coordinate of the second point, y_2 and 3 is the y -coordinate of the first point y_1. So we can rewrite the rise using subscript notation.	\(m={\Large\frac{7 - 2}}\)
Also 7 is the x -coordinate of the second point, x_2 and 2 is the x -coordinate of the first point x_2. So we rewrite the run using subscript notation.	\(m={\Large\frac}\)

We've shown that \(m={\Large\frac

}\) is really another version of $m = \frac{\text{rise}}{\text{run}}$. We can use this formula to find the slope of a line when we have two points on the line.

Slope Formula or rate of Change formula

The slope of the line between two points (x_1, y_1) and (x_2, y_2) is

\(m={\Large\frac

}\)

Say the formula to yourself to help you remember it:

$$\text{Slope is } y \text{ of the second point minus } y \text{ of the first point}$$
$$\text{over}$$
$$x \text{ of the second point minus } x \text{ of the first point.}$$

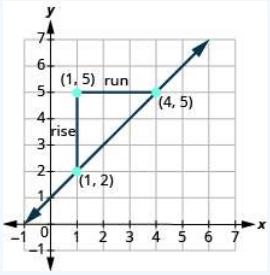
example

Find the slope of the line between the points $(1, 2)$ and $(4, 5)$.

Solution

We'll call $(1, 2)$ point #1 and $(4, 5)$ point #2.	\(\stackrel{\left(1,2\right)}\text{and}\stackrel{\left(4,5\right)}\)
Use the slope formula.	\(m={\Large\frac}\)
Substitute the values in the slope formula:	
y of the second point minus y of the first point	\(m={\Large\frac{5 - 2}}\)
x of the second point minus x of the first point	$m = \frac{5-2}{4-1}$
Simplify the numerator and the denominator.	$m = \frac{3}{3}$
	$m = 1$

Let's confirm this by counting out the slope on the graph.



The rise is 3 and the run is 3, so

$m = \frac{\text{rise}}{\text{run}}$
$m = \frac{3}{3}$
$m = 1$

try it

[ohm_question]147021[/ohm_question]

How do we know which point to call #1 and which to call #2? Let's find the slope again, this time switching the names of the points to see what happens. Since we will now be counting the run from right to left, it will be negative.

We'll call $(4, 5)$ point #1 and $(1, 2)$ point #2.	\(\stackrel{\left(4,5\right)}\text{and}\stackrel{\left(1,2\right)}\)
Use the slope formula.	\(m={\Large\frac}\)
Substitute the values in the slope formula:	
y of the second point minus y of the first point	\(m={\Large\frac{2 - 5}}\)
x of the second point minus x of the first point	$m = \frac{2-5}{1-4}$
Simplify the numerator and the denominator.	$m = \frac{-3}{-3}$
	$m = 1$

The slope is the same no matter which order we use the points.

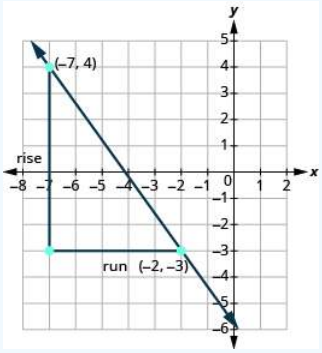
example

Find the slope of the line through the points $(-2,-3)$ and $(-7,4)$.
[reveal-answer q="265532"]Show Answer[/reveal-answer]
[hidden-answer a="265532"]

Solution

We'll call $(-2,-3)$ point #1 and $(-7,4)$ point #2.	\(\stackrel{\left(-2,-3\right)}\text{and}\stackrel{\left(-7,4\right)}\)
Use the slope formula.	\(m={\Large\frac}\)
Substitute the values	
y of the second point minus y of the first point	\(m={\Large\frac{4-\left(-3\right)}}\)
x of the second point minus x of the first point	$m=\frac{4-(-3)}{-7-(-2)}$
Simplify.	$m=\frac{7}{-5}$
	$m=-\frac{7}{5}$

Let's confirm this on the graph shown.



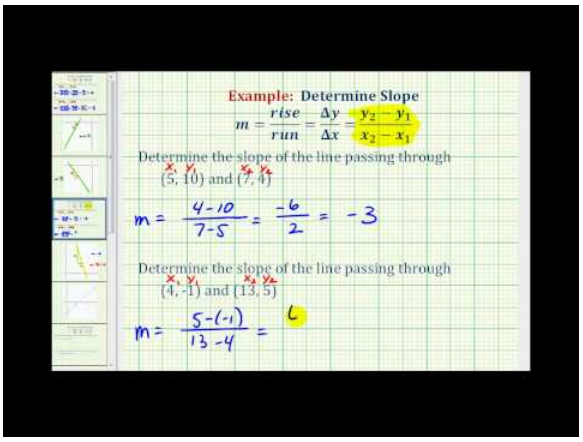
$m=\frac{\text{rise}}{\text{run}}$
$m=\frac{-7}{5}$
$m=-\frac{7}{5}$

[/hidden-answer]

try it

[ohm_question]147022[/ohm_question]

Watch this video to see more examples of how to determine slope given two points on a line.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=120

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2.9: Analyzing Graphical Data

Learning outcome

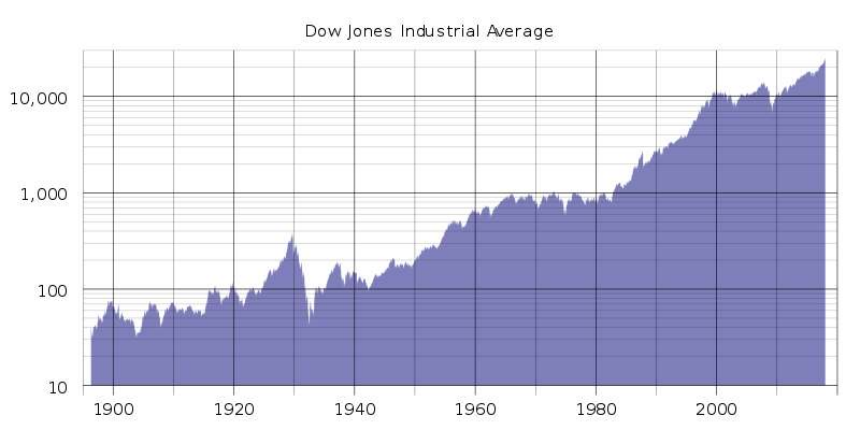
- Compare and contrast graphical data to decipher information and make decisions

We looked at graph trends earlier to determine if there was a general statement that could be made about the data presented. But if you are a retail professional and are given accounting information or other data on a graph, you'll also need to be able to make decisions based on what you can observe and infer.

Let's take a look at a familiar graph of the Dow Jones Industrial Average.

Example

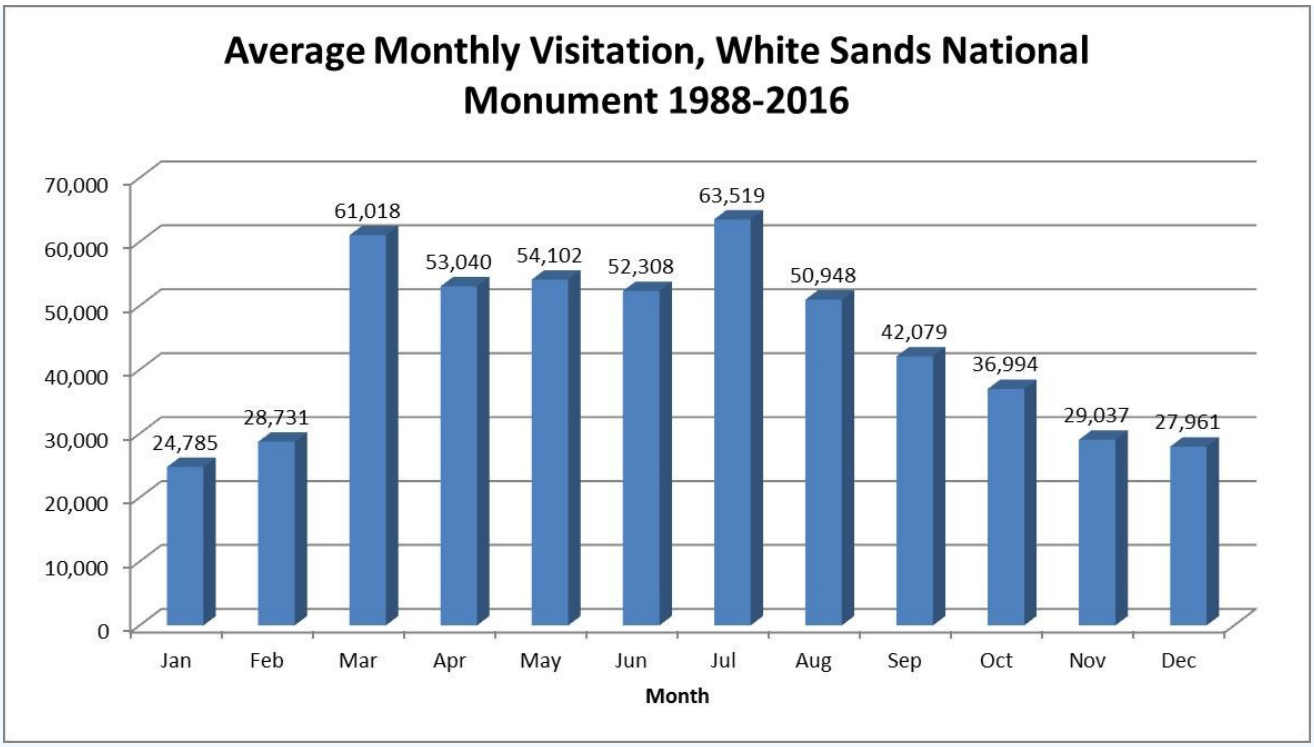
What can we infer from this graph?



We already determined that the trend was an increase in value over time. We can also say that even after a sharp decrease, the value has risen back to the highest prior point within 25 years. If you were asked the question, "Should I trust that the Dow Jones will continue to increase over time?", your reply should be, "Based on historical data, the Dow Jones will continue to increase indefinitely." There's nothing on this graph that should lead us to believe otherwise.

TRY IT

The graph below shows the average monthly visitor count at White Sands National Monument sorted by month of the year. Next year, you plan to set up a roadside stand nearby to sell carved wooden souvenirs that you make in your garage. To make a decent profit, you need to dedicate half the year to making the wooden carvings and half the year to selling them. Based on the data below, which half of the year should you set up your roadside stand nearby to the park?



[reveal-answer q="307205"]Show Answer[/reveal-answer]
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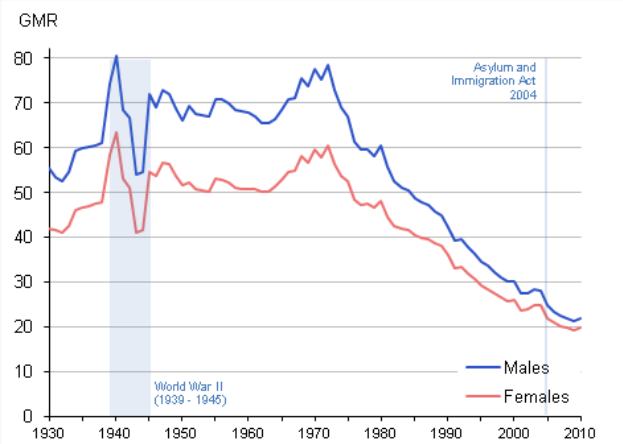
Finding the top six months for average visitor count is going to be your best bet for when you'll have the most potential customers. March, April, May, June, July, and August all average over $50,000$ visitors at White Sands, while the other months all average below $50,000$ visitors. From this graph you should schedule yourself to sell your wooden souvenirs from March to August and then work on making more during the months of September to February.

[/hidden-answer]

Now let's take a look again at the graph of the marriage rates in Great Britain.

Example

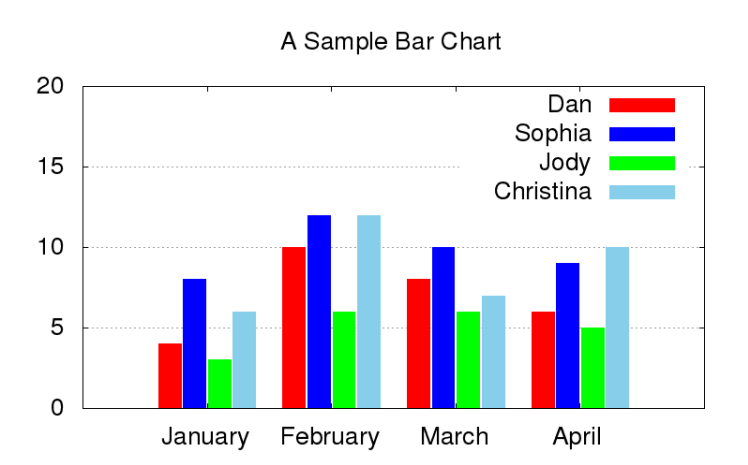
Let's first examine the time frame 1930 to 1975. During that time, the data on this graph is all over the place, but there is a slight trend of an increase in marriage rates. However, in the middle of this trend, there is a very sharp incline and then a very sharp decline. Why do you think this is?



On this graph they have highlighted the 1930 to 1945 time period as World War II. Often historical data is indicative of economic and political events. The strong peak at the start of this time period is evidence that prior to young men heading off to war, they were quickly marrying before deployment. The sharp valley indicates that a huge number of men were overseas and marriage was not a top priority as citizens were focused on supporting the military and struggling economy.

Try It

The following bar graph shows the number of customers helped per hour by each of the employees at Sofa Central, a furniture store downtown. Lara, the store manager, is trying to decide who she should promote to floor lead to help mentor the other employees on good sales and service practices. Who should Lara promote?



[reveal-answer q="270373"]Show Answer[/reveal-answer]
[hidden-answer a="270373"]

During two of the months (half the documented time), Sophia helped the most customers. Then in one other month she and Christina helped the same number of customers. In the final month, Sophia came in second, just behind Christina. Based on this analysis, it looks like Sophia is most consistently on top when it comes to the number of customers helped.

Another way to look at this data would be to compare the actual values:

Sophia: $8, 12, 10, 9$, which is a total of 39 customers helped in a four month period

Christina: $6, 12, 7, 10$, which is a total of 35 customers helped in a four month period

Dan: $4, 10, 8, 6$, which is a total of 28 customers helped in a four month period

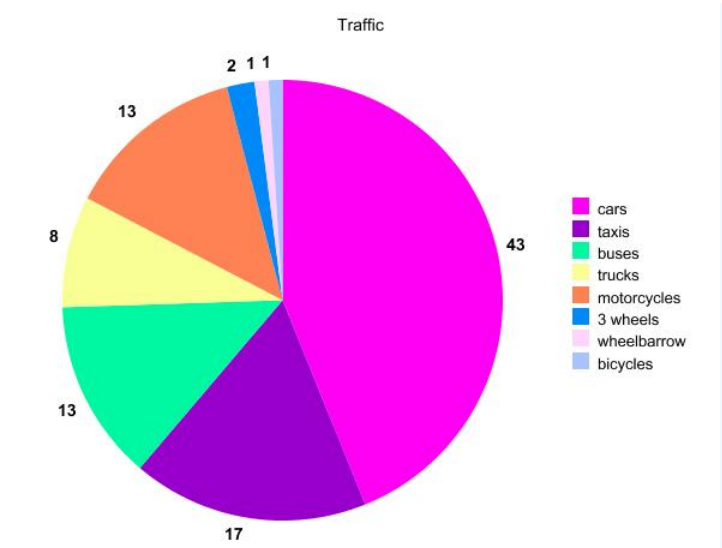
Jody: $3, 6, 6, 5$, which is a total of 20 customers helped in a four month period

Sophia should be promoted to floor lead!

[/hidden-answer]

TRY IT

Kelsey would like to provide a raffle prize that appeals the most people based on their main transportation choice. The pie chart below shows the poll results from the employee newsletter where people were asked how they most commonly get to work. Should the raffle prize be the best parking spot in the lot for a month, a new bike lock and free tune-up at the bicycle shop, a gift card for the local taxi company, a month-long public transit pass, or a new motorcycle helmet?



[reveal-answer q="280987"]Show Answer[/reveal-answer]
[hidden-answer a="280987"]

Anyone who drives a car or truck to work is going to be excited to get a better space in the parking lot. So let's determine what percent of the employees that would be.

$43 + 8 = 51$ employees, and there were a total of 98 employees polled

$\frac{51}{98} \approx (0.52) = 52\%$

Likely, based on the data, only 17 would want a taxi gift card, only 13 would want a motorcycle helmet, only 13 would want a transit pass, and only 1 person would want the bicycle prize.

None of the other transportation categories come close, since more than half the employees would benefit from a nice parking space. So Kelsey should offer the parking space as a raffle prize to sell the most raffle tickets.

[/hidden-answer]

Graphs allow us to visualize data to quickly see trends or odd outliers to better make decisions. Rather than basing decisions off your gut feeling about something, having data to support that decision is key. Data displayed in graphs gives you the chance to "see" where those values are coming from, use your knowledge to explain variations and results, and anticipate where the data is headed.

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2.10: Putting It Together- Calculations and Solving Equations

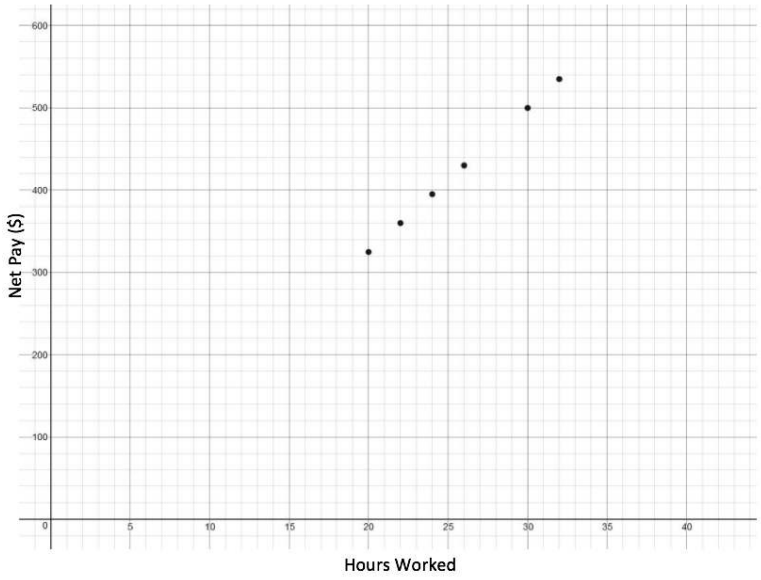
Kareem works as a checkout clerk at Best Food Supermarket and received the following report for his pay over the past couple months:

Employee Name	Kareem Martin	
Employee ID	#32156	
Pay Period Ending	**Hours**	**Net Pay**
Dec 11, 2016	20	$325.00
Dec 4, 2016	26	$430.00
Nov 27, 2016	32	$535.00
Nov 20, 2016	22	$360.00
Nov 13, 2016	24	$395.00
Nov 6, 2016	30	$500.00

He wants to make sure he got paid correctly, so he's going to analyze the information he has been sent. Kareem decides it will be easier if he can visualize the data, so he creates six ordered pairs from the table that he can graph:

$$(20, 325), (26, 430), (32, 535), (22, 360), (24, 395), (30, 500)$$

He then plots those points on a graph:



Kareem can observe a few things from this graph:

1. He can determine a trend in his pay
2. He can calculate the rate of change to find his hourly rate
3. He can analyze the values to see if he's being paid correctly

Let's solve those problems!

1. Using a straight edge he can see that the data rises to the right in what looks to be a perfectly straight line.
2.

We'll call $(20, 325)$ point #1 and $(30, 500)$ point #2.	\(\stackrel{\left(20,325\right)}\text{and}\stackrel{\left(30,500\right)}\)
Use the slope formula to find the rate of change.	\(m={\Large\frac}\)
Substitute the values in the slope formula:	
y of the second point minus y of the first point	\(m={\Large\frac{500 - 325}}\)
x of the second point minus x of the first point	$m = \frac{500-325}{30-20}$
Simplify the numerator and the denominator.	$m = \frac{175}{10}$
	$m = 17.5$

3. If Kareem makes $\$17.5$/hr, then shouldn't he be paid $\$350$ for 20 hours of work? And for 30 hours of work he's paid $\$25$ less than his hourly wage too. I looks like $\$25$ is being taken off each of his paychecks.

Can you determine an equation to represent his pay based on the number of hours he worked?

Kareem is getter paid $\$17.5$/hr, since that is the rate of change between his paychecks of different hour amounts. However each amount in the net pay column is $\$25$ less than the number of hours multiplied by his hourly wage. Kareem then remembers that he has $\$25$ deducted and put into his Health Savings Account each paycheck. So he makes $\$17.5$ per hour worked minus $\$25$. If we translate into an equation, Kareem's pay equals:

$$P = 17.5h - 25$$

How much money would Kareem make if he works 28 hours?

Now that we have an equation to represent Kareem's pay, we can plug in 28 for h

$$P = 17.5h - 25$$

$$P = 17.5(28) - 25$$

$$P = 17.5(28) - 25$$

$$P = \$458$$

We could also have drawn a line through all the points on the graph, found 28 on the x-axis, and and figured out what the y value would be when we hit the line. With these larger numbers that likely wouldn't have been as accurate as using the equation.

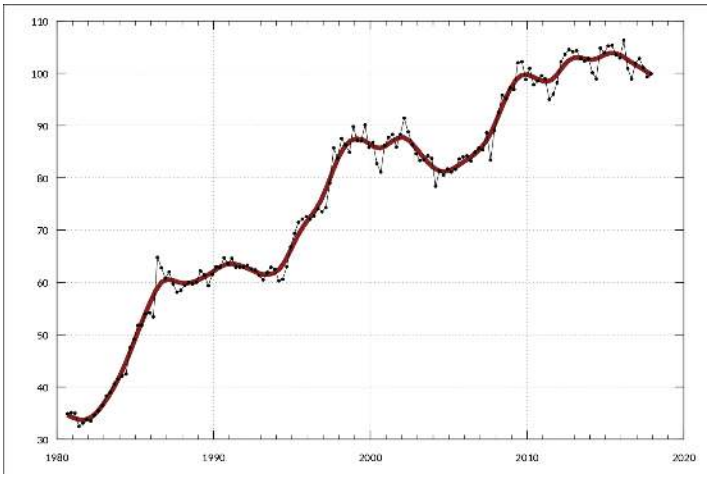
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2.11: Why It Matters- Calculations and Solving Equations

Why learn to complete calculations and solve equations?

Do you pay attention to the cost of a cup of coffee? Most people recognize that when they make coffee at home it's cheaper than buying a cup of coffee that someone else has made. You've probably also noticed that some coffee places are more expensive than others—a cup of coffee at Starbucks usually costs more than one at a gas station, for instance. Regardless of where you decide to buy coffee, the price can change dramatically.

While retailers make decisions about how much they will mark up the coffee drinks they sell, the underlying coffee prices all around the world are driven by supply and demand. Coffee bean prices fluctuate for a variety of reasons and impact the final price you pay at your local coffee shop. The graph below shows the trading price of the coffee commodities index in Australia over the course of 40 years.



Coffee index prices in Austalia

If you own a bakery or another establishment that sells coffee, the data in this graph can be very useful. You can observe an overall historical trend and also relate political and environmental events to changes in that trend. If you need information about a specific year or a range of prices, you should be able to read this graph to gather that information.

As a retail professional, when you receive data specific to your store or product, it's important that you can interpret the numbers so that you can make better decisions. Data will often be presented to you in the form of a graph, which is supposed to help readers visualize the information. Accounting information is initially documented in tables, but the outcomes can be presented in graphs to compare results over a desired time period. Tracking changes in profits, investments, customer spending, etc. is crucial in making decisions that will positively affect your business.

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2.12: Assignment- Calculations and Solving Equations

For this assignment, you will download and complete the following worksheet:

- Assignment: Calculations and Solving Equations (.docx)

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2.13: Introduction to Solving Equations



Carefully placed on top of each other—one by one—the rocks used in this tower are able to avoid toppling from the pull of gravity because they are a balanced mass. Any shift in either direction from wind, erosion, any other force could cause the tower to fall. In this section, we will solve equations by keeping quantities on both sides of an equal sign in perfect balance. We will practice using mathematical rules of equality to unwrap the equation and solve for the unknown quantity.

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2.14: Variables

Learning Objectives

- Define and identify variables

\(Two men dressed similarly, with the same haircut, and both wear round glasses take a selfie with each other." class="wp-image-830 alignright" height="223" width="298" src="/@api/deki/files/24115/32381921555_c399a66856_o-300x225.jpg" />Greg and Alex have the same birthday, but they were born in different years. This year Greg is 20\) years old and Alex is \(23\), so Alex is \(3\) years older than Greg. When Greg was \(12\), Alex was \(15\). When Greg is \(35\), Alex will be \(38\). No matter what Greg's age is, Alex's age will always be \(3\) years more, right?</p

In the language of algebra, we say that Greg's age and Alex's age are variable and the three is a constant. The ages change, or vary, so age is a variable. The 3 years between them always stays the same, so the age difference is the constant.

In mathematics, letters of the alphabet are used to represent variables. Suppose we call Greg's age g. Then we could use $g+3$ to represent Alex's age. See the table below.

Greg's age	Alex's age
12	15
20	23
35	38
g	$g+3$

Letters are used to represent variables. Letters often used for variables are $x, y, a, b,$ and c.

Variables and Constants

A variable is a letter that represents a number or quantity whose value may change (ex. x, y, z, a, t, k etc.).

A constant is a number whose value always stays the same.

EXAMPLE

Identify the variable(s) in each expression or equation

1. $x+2$
2. $5-3y$
3. $7+5b-z=9$

[reveal-answer q="114888"]Show Answer[/reveal-answer]
[hidden-answer a="114888"]

Solution

1. x
2. y
3. b and z

[/hidden-answer]

TRY IT

[ohm_question]156972[/ohm_question]

To write algebraically, we need some symbols as well as numbers and variables. There are several types of symbols we will be using. There are multiple symbols and phrases to represent the four basic arithmetic operations: addition, subtraction,

multiplication, and division. We will summarize them here:

Operation	Notation	Say:	The result is…
Addition	$a+b$	a plus b	the sum of a and b
Subtraction	$a-b$	a minus b	the difference of a and b
Multiplication	$a \cdot b, (a)(b), (a)b, a(b)$	a times b	The product of a and b
Division	$a \div b, a/b, \frac{a}{b}, b\overline{)a}$	a divided by b	The quotient of a and b

In algebra, the cross symbol, $\times$, is not used to show multiplication because that symbol may cause confusion. Does $3xy$ mean $3 \times y$ (three times y) or $3 \cdot x \cdot y$ (three times x times y)? To make it clear, use • or parentheses for multiplication.

Grouping symbols in algebra are much like the commas, colons, and other punctuation marks in written language. They indicate which expressions are to be kept together and separate from other expressions. The table below lists three of the most commonly used grouping symbols in algebra.

Common Grouping Symbols	
parentheses	( )
brackets	[ ]
braces	{ }

Here are some examples of expressions that include grouping symbols.

$$8(14-8)21-3$$
$$[2+4(9-8)]$$
$$24 \div \{13-2[1(6-5)+4]\}$$

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2.15: Solving Single-Step Equations

Learning Outcome

- Use the addition, subtraction, multiplication, and division properties to solve single-step equations

We will begin solving equations below, but first we need to understand what a solution to an equation looks like. The purpose in solving an equation is to find the value or values of the variable that make each side of the equation the same — it is the answer to the puzzle.

Solution of an Equation

A solution of an equation is a value of a variable that makes a true statement when substituted into the equation.

Determine whether a number is a solution to an equation.

1. Substitute the number for the variable in the equation.
2. Simplify the expressions on both sides of the equation.
3. Determine whether the resulting equation is true.
   - If it is true, the number is a solution.
   - If it is not true, the number is not a solution.

In the following example, we will show how to determine whether a number is a solution to an equation that contains addition and subtraction. You can use this idea to check your work later when you are solving equations.

EXAMPLE

Determine whether $y = \frac{3}{4}$ is a solution for $4y + 3 = 8y$.

Solution:

	$4y + 3 = 8y$
Substitute $\frac{3}{4}$ for y	$4(\frac{3}{4}) + 3 \stackrel{?}{=} 8(\frac{3}{4})$
Multiply.	$3 + 3 \stackrel{?}{=} 6$
Add.	$6 = 6$ ✓

Since $y = \frac{3}{4}$ results in a true equation, $\frac{3}{4}$ is a solution to the equation $4y + 3 = 8y$.

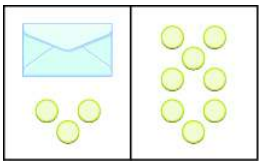
Now it is your turn to determine whether a fraction is the solution to an equation.

TRY IT

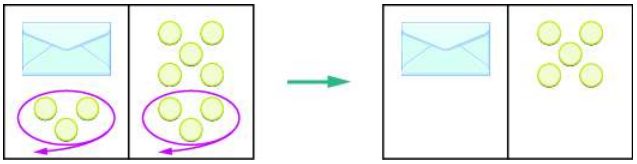
A link to an interactive elements can be found at the bottom of this page.

Let's use a model to help understand how the process of solving an equation is like solving a puzzle. An envelope represents the variable – since its contents are unknown – and each counter represents one.

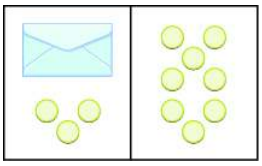
Suppose a desk has an imaginary line dividing it in half. We place three counters and an envelope on the left side of desk, and eight counters on the right side of the desk. Both sides of the desk have the same number of counters, but some counters are hidden in the envelope. Can you tell how many counters are in the envelope?



What steps are you taking in your mind to figure out how many counters are in the envelope? Perhaps you are thinking "I need to remove the 3 counters from the left side to get the envelope by itself. Those 3 counters on the left match with 3 on the right, so I can take them away from both sides. That leaves five counters on the right, so there must be 5 counters in the envelope."



What algebraic equation is modeled by this situation? Each side of the desk represents an expression and the center line takes the place of the equal sign. We will call the contents of the envelope x, so the number of counters on the left side of the desk is $x+3$. On the right side of the desk are 8 counters. We are told that $x+3$ is equal to 8 so our equation is $x+3=8$.



$x+3=8$

Let's write algebraically the steps we took to discover how many counters were in the envelope.

	$x+3=8$
First, we took away three from each side.	$x+3-3=8-3$
Then we were left with five.	$x=5$

Now let's check our solution. We substitute 5 for x in the original equation and see if we get a true statement.

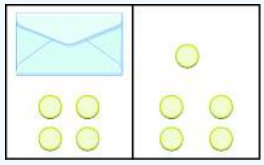
$x+3=8$

$5+3=8$

$8=8$ ✓ Our solution is correct. Five counters in the envelope plus three more equals eight.

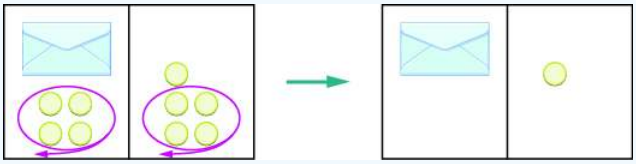
example

Write an equation modeled by the envelopes and counters, and then solve the equation:



Solution

On the left, write x for the contents of the envelope, add the 4 counters, so we have $x+4$.	$x+4$
On the right, there are 5 counters.	5
The two sides are equal.	$x+4=5$
Solve the equation by subtracting 4 counters from each side.	



We can see that there is one counter in the envelope. This can be shown algebraically as:

$$x+4=5$$

$$x+4-\,-4=5-\,-4$$

$$x=1$$

Substitute 1 for x in the equation to check.

$$x+4=5$$

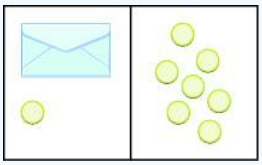
$$1+4=5$$

$$5=5 \quad \checkmark$$

Since $x=1$ makes the statement true, we know that 1 is indeed a solution.

try it

Write the equation modeled by the envelopes and counters, and then solve the equation:



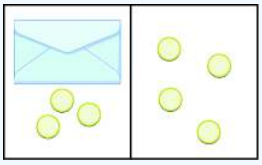
[reveal-answer q="7845"]Show Answer[/reveal-answer]
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$x+1=7$

$x=6$

[/hidden-answer]

Write the equation modeled by the envelopes and counters, and then solve the equation:



[reveal-answer q="9034"]Show Answer[/reveal-answer]
[hidden-answer a="9034"]

$x + 3 = 4$

$x = 1$

[/hidden-answer]

Our puzzle has given us an idea of what we need to do to solve an equation. The goal is to isolate the variable by itself on one side of the equation. In the previous examples, we used the Subtraction Property of Equality, which states that when we subtract the same quantity from both sides of an equation, we still have equality.

Subtraction Property of Equality

For all real numbers a, b, and c, if $a = b$, then $a - c = b - c$.

In all the equations we have solved so far, a number was added to the variable on one side of the equation. We used subtraction to "undo" the addition in order to isolate the variable.

But suppose we have an equation with a number subtracted from the variable, such as $x - 5 = 8$. We want to isolate the variable, so to "undo" the subtraction we will add the number to both sides.

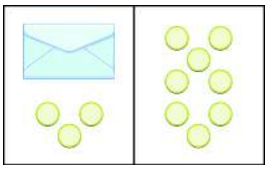
We use the Addition Property of Equality, which says we can add the same number to both sides of the equation without changing the equality. Notice how it mirrors the Subtraction Property of Equality.

Addition Property of Equality

For all real numbers a, b, and c, if $a = b$, then $a + c = b + c$.

When you add or subtract the same quantity from both sides of an equation, you still have equality.

We introduced the Subtraction Property of Equality earlier by modeling equations with envelopes and counters. The image below models the equation $x + 3 = 8$.



The goal is to isolate the variable on one side of the equation. So we "took away" 3 from both sides of the equation and found the solution $x = 5$.

Some people picture a balance scale, as in the image below, when they solve equations.



1 mass on each side = balanced



2 masses on each side = balanced



1 mass on one side and 2 masses on the other = unbalanced

The quantities on both sides of the equal sign in an equation are equal, or balanced. Just as with the balance scale, whatever you do to one side of the equation you must also do to the other to keep it balanced.

In the following examples we review how to use Subtraction and Addition Properties of Equality to solve equations. We need to isolate the variable on one side of the equation. You can check your solutions by substituting the value into the original equation to make sure you have a true statement.

EXAMPLE

Solve: $x+11=-3$
[reveal-answer q="190834"]Show Answer[/reveal-answer]
[hidden-answer a="190834"]

Solution:
To isolate x, we undo the addition of 11 by using the Subtraction Property of Equality.

		$x+11=-3$
Subtract 11 from each side to "undo" the addition.		$x+11-11=-3-11$
Simplify.		$x=-14$
Check:	$x+11=-3$	
Substitute $x=-14$.	$-14+11\stackrel{?}{=}-3$	
	$-3=-3$ ✓	

Since $x=-14$ makes $x+11=-3$ a true statement, we know that it is a solution to the equation.

[/hidden-answer]

Now you can try solving an equation that requires using the addition property.

TRY IT

A link to an interactive elements can be found at the bottom of this page.

In the original equation in the previous example, 11 was added to the x, so we subtracted 11 to "undo" the addition. In the next example, we will need to "undo" subtraction by using the Addition Property of Equality.

EXAMPLE

Solve: $m-4=-5$
[reveal-answer q="604060"]Show Answer[/reveal-answer]
[hidden-answer a="604060"]

Solution:

		$m-4=-5$
Add 4 to each side to "undo" the subtraction.		$m-4+4=-5+4$
Simplify.		$m=-1$
Check:	$m-4=-5$	
Substitute $m=-1$.	$-1+4\stackrel{?}{=}-5$	
	$-5=-5$ ✓	
		The solution to $m-4=-5$ is $m=-1$

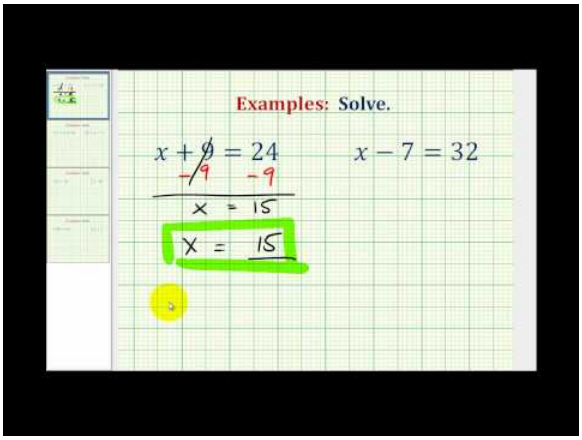
[/hidden-answer]

Now you can try using the addition property to solve an equation.

TRY IT

A link to an interactive elements can be found at the bottom of this page.

In the following video, we present more examples of solving equations using the addition and subtraction properties.



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You may encounter equations that contain fractions or decimals — especially in financial applications — so let's practice solving those in the following problems.

TRY IT

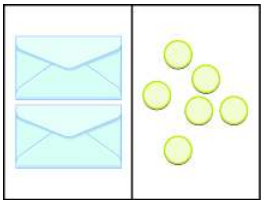
A link to an interactive elements can be found at the bottom of this page.

TRY IT

[ohm_question]156990[/ohm_question]

All of the equations we have solved so far have been of the form $x + a = b$ or $x - a = b$. We were able to isolate the variable by adding or subtracting the constant term. Now we'll see how to solve equations that involve division.

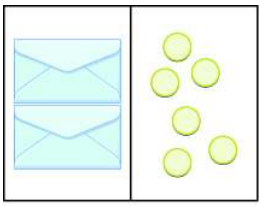
We will model an equation with envelopes and counters.



Here, there are two identical envelopes that contain the same number of counters. Remember, the left side of the workspace must equal the right side, but the counters on the left side are "hidden" in the envelopes. So how many counters are in each envelope?

To determine the number, separate the counters on the right side into 2 groups of the same size. So 6 counters divided into 2 groups means there must be 3 counters in each group (since $6 \div 2 = 3$).

What equation models the situation shown in the figure below? There are two envelopes, and each contains x counters. Together, the two envelopes must contain a total of 6 counters. So the equation that models the situation is $2x = 6$.



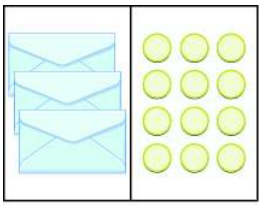
We can divide both sides of the equation by 2 as we did with the envelopes and counters.

$$\frac{2x}{2} = \frac{6}{2}$$

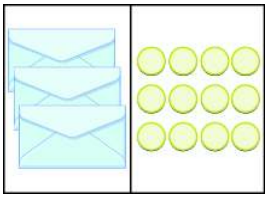
$$x = 3$$

We found that each envelope contains 3 counters. Does this check? We know $2 \cdot 3 = 6$, so it works. Three counters in each of two envelopes does equal six.

Another example is shown below.



Now we have 3 identical envelopes and 12 counters. How many counters are in each envelope? We have to separate the 12 counters into 3 groups. Since $12 \div 3 = 4$, there must be 4 counters in each envelope.



The equation that models the situation is $3x = 12$. We can divide both sides of the equation by 3.

$$\frac{3x}{3} = \frac{12}{3}$$

$$x = 4$$

Does this check? It does because $3 \cdot 4 = 12$.

Division Property of Equality

For all real numbers a, b, c, and $c \neq 0$, if $a = b$, then $\frac{a}{c} = \frac{b}{c}$.

Stated simply, when you divide both sides of an equation by the same quantity, you still have equality.

Remember, the goal is to "undo" the operation on the variable. In the example below the variable is multiplied by 4, so we will divide both sides by 4 to "undo" the multiplication.

example

Solve: $4x = -28$

Solution:

To solve this equation, we use the Division Property of Equality to divide both sides by 4.

$4x = -28$	
Divide both sides by 4 to undo the multiplication.	$\frac{4x}{4} = \frac{-28}{4}$
Simplify.	$x = -7$
Check your answer.	$4x = -28$
Let $x = -7$. Substitute -7 for x.	$4(-7) \stackrel{?}{=} -28$
	$-28 = -28$

Since this is a true statement, $x = -7$ is a solution to $4x = -28$.

Now you can try to solve an equation that requires division and includes negative numbers.

try it

A link to an interactive elements can be found at the bottom of this page.

Now, consider the equation $\frac{x}{4} = 3$. We want to know what number divided by 4 gives 3. So to "undo" the division, we will need to multiply by 4. The *Multiplication Property of Equality* will allow us to do this. This property says that if we start with two equal quantities and multiply both by the same number, the results are equal.

Multiplication Property of Equality

For all real numbers a, b, c, if $a = b$, then $ac = bc$.

Stated simply, when you multiply both sides of an equation by the same quantity, you still have equality.

Previously we learned how to "undo" multiplication by dividing. How do you think we "undo" division?

Next, we will show an example that requires us to use multiplication to undo division.

example

Solve: $\frac{a}{-7} = -42$

[reveal-answer q="399032"]Show Answer[/reveal-answer]
[hidden-answer a="399032"]

Solution:
Here a is divided by -7. We can multiply both sides by -7 to isolate a.

$\frac{a}{-7} = -42$	
Multiply both sides by -7.	$-7(\frac{a}{-7}) = -7(-42)$ $\frac{-7a}{-7} = 294$
Simplify.	$a = 294$
Check your answer.	$\frac{a}{-7} = -42$
Let $a = 294$.	$\frac{294}{-7} \stackrel{?}{=} -42$
	$-42 = -42$ ✓

[/hidden-answer]

Now see if you can solve a problem that requires multiplication to undo division. Recall the rules for multiplying two negative numbers — two negatives give a positive when they are multiplied.

try it

A link to an interactive elements can be found at the bottom of this page.

As you begin to solve equations that require several steps you may find that you end up with an equation that looks like the one in the next example, with a negative variable. As a standard practice, it is good to ensure that variables are positive when you are solving equations. The next example will show you how.

example

Solve: $-r = 2$

[reveal-answer q="388033"]Show Answer[/reveal-answer]
[hidden-answer a="388033"]

Solution:
Remember $-r$ is equivalent to $-1r$.

$-r = 2$	
Rewrite $-r$ as $-1r$.	$-1r = 2$
Divide both sides by -1.	$\frac{-1r}{-1} = \frac{2}{-1}$
Simplify.	$r = -2$
Check.	$-r = 2$
Substitute $r = -2$	$-(-2) \stackrel{?}{=} 2$
Simplify.	$2 = 2$ ✓

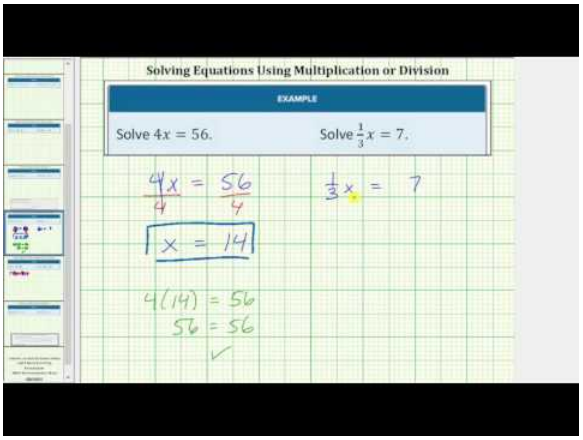
[/hidden-answer]

Now you can try to solve an equation with a negative variable.

try it

A link to an interactive elements can be found at the bottom of this page.

The next video includes examples of using the division and multiplication properties to solve basic equations.



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2.16: Solving Multi-Step Equations

Learning outcome

- Solve multi-step equations with variables on both sides

In the examples up to this point, we have been able to isolate the variable with just one operation. Many of the equations we encounter in real life will take more steps to solve. Often, we will need to simplify one or both sides of an equation before using the Subtraction or Addition Properties of Equality. You should always simplify as much as possible before trying to isolate the variable — this is called combining like-terms.

Example

Solve:

$3x-7-2x-4=1$

Solution:
The left side of the equation has an expression that we should simplify before trying to isolate the variable.

	$3x-7-2x-4=1$
Rearrange the terms, using the Commutative Property of Addition.	$3x-2x-7-4=1$
Combine like terms.	$x-11=1$
Add 11 to both sides to isolate x.	$x-11+11=1+11$
Simplify.	$x=12$
Check. Substitute $x=12$ into the original equation. $3x-7-2x-4=1$ $3(12)-7-2(12)-4=1$ $36-7-24-4=1$ $29-24-4=1$ $5-4=1$ $1=1$ ✓ The solution checks.	

Now you can try solving a couple equations where you should simplify first.

TRY IT

A link to an interactive elements can be found at the bottom of this page.

The goal has been to familiarize you with the many ways to apply the addition, subtraction, multiplication, and division properties that are used to solve equations algebraically. Let's work through an example that will employ all the techniques you've learned.

Example

Solve: $8x+9x-5x=-3+15$

Solution:

First, we need to simplify both sides of the equation as much as possible

Start by combining like terms to simplify each side.

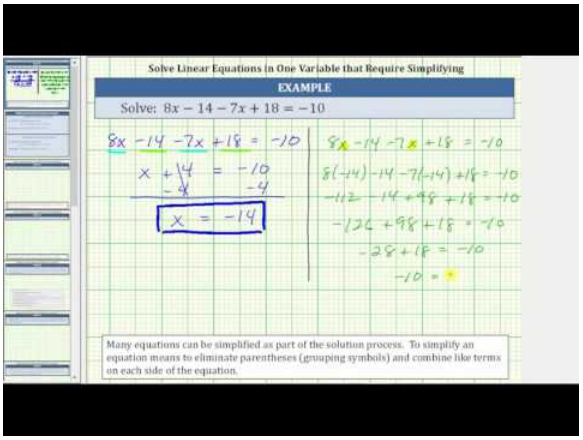
	$8x+9x-5x=-3+15$
Combine like terms.	$12x=12$
Divide both sides by 12 to isolate x.	$\frac{12x}{12}=\frac{12}{12}$
Simplify.	$x=1$
Check your answer. Let $x=1$	
$8x+9x-5x=-3+15$	
$8\cdot 1+9\cdot 1-5\cdot 1\stackrel{?}{=}-3+15$	
$8+9-5\stackrel{?}{=}-3+15$	
$12=12$ ✓	

Here is a similar problem for you to try.

Try it

A link to an interactive elements can be found at the bottom of this page.

In the following video we present another example of how to solve an equation that requires simplifying before using the addition and subtraction properties.



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You may not always have the variables on the left side of the equation, so we will show an example with variables on the right side. You will see that the properties used to solve this equation are exactly the same as the previous example.

example

Solve: $11-20=17y-8y-6y$

[reveal-answer q="399032"]Show Answer[/reveal-answer]
[hidden-answer a="399032"]

Solution:

Simplify each side by combining like terms.

	$11-20=17y-8y-6y$
Simplify each side.	$-9=3y$
Divide both sides by 3 to isolate y.	$\frac{-9}{3}=\frac{3y}{3}$
Simplify.	$-3=y$
Check your answer. Let $y=-3$	
$11-20=17y-8y-6y$	
$11-20\stackrel{?}{=}17(-3)-8(-3)-6(-3)$	
$11-20\stackrel{?}{=}-51+24+18$	
$-9=-9$ ✓	

[/hidden-answer]

Notice that the variable ended up on the right side of the equal sign when we solved the equation. You may prefer to take one more step to write the solution with the variable on the left side of the equal sign.

Now you can try solving a similar problem.

try it

A link to an interactive elements can be found at the bottom of this page.

In our next example, we have an equation that contains a set of parentheses. We will use the distributive property of multiplication over addition first, simplify, then use the division property to finally solve.

Let's review how the Distributive Property works.

Distributive Property

If a, b, c are real numbers, then

$a\,(b+c)=ab+ac$

example

Simplify: $3\,(x+4)$

Solution:

$3\,(x+4)$	
Distribute.	$3\cdot x+3\cdot 4$
Multiply.	$3x+12$

Some students find it helpful to draw in arrows to remind them how to use the Distributive Property. Then the first step in the previous example would look like this:



$$3\cdot x+3\cdot 4$$

Now you give it a try.

try it

[ohm_question]146473[/ohm_question]

Apply your understanding of the Distributive Property to an equation that needs to be solved.

example

Solve: $-3\,(n-2)-6=21$

Remember—always simplify each side first.
[reveal-answer q="789987"]Show Answer[/reveal-answer]
[hidden-answer a="789987"]

Solution:

	$-3(n-2)-6=21$
Distribute.	$-3n+6-6=21$
Simplify.	$-3n=21$
Divide both sides by -3 to isolate n.	$\frac{-3n}{-3}=\frac{21}{-3}$ $n=-7$
Check your answer. Let $n=-7$.	
$-3(n-2)-6=21$	
$-3(-7-2)-6\stackrel{?}{=}21$	
$-3(-9)-6\stackrel{?}{=}21$	
$27-6\stackrel{?}{=}21$	
$21=21$ ✓	

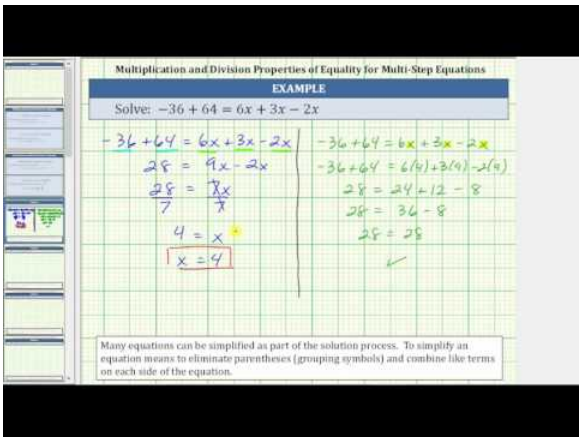
[/hidden-answer]

Now you can try a similar problem.

try it

A link to an interactive elements can be found at the bottom of this page.

In the following video you will see another example of using the division property of equality to solve an equation as well as another example of how to solve a multi-step equation that includes a set of parentheses.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=96

You may have noticed that in all the equations we have solved so far, we had variables on only one side of the equation. This does not happen all the time—so now we'll see how to solve equations where there are variable terms on both sides of the equation. We will start like we did above—choosing a variable side and a constant side, and then use the Subtraction and Addition Properties of Equality to collect all variables on one side and all constants on the other side. Remember, what you do to the left side of the equation, you must do to the right side as well.

In the next example, the variable, x, is on both sides, but the constants appear only on the right side, so we'll make the right side the "constant" side. Then the left side will be the "variable" side.

ExampleS

Solve: $5x = 4x + 7$
[reveal-answer q="235739"]Show Answer[/reveal-answer]
[hidden-answer a="235739"]

Solution:

$5x$ is the side containing only a variable. $4x + 7$ is the side containing a constant.		
We don't want any variables on the right, so subtract the $4x$.		$5x - 4x = 4x - 4x + 7$
Simplify.		$x = 7$
We have all the variables on one side and the constants on the other. We have solved the equation.		
Check:		$5x = 4x + 7$
Substitute 7 for x.		$5(7) \stackrel{?}{=} 4(7) + 7$
		$35 \stackrel{?}{=} 28 + 7$
		$35 = 35$ ✓

[/hidden-answer]

Solve: $7x = -x + 24$.
[reveal-answer q="192799"]Show Answer[/reveal-answer]
[hidden-answer a="192799"]

Solution:
The only constant, 24, is on the right, so let the left side be the variable side.

$7x$ is the side containing only a variable. $-x+24$ is the side containing a constant.	
Remove the $-x$ from the right side by adding x to both sides.	$7x+x=-x+x+24$
Simplify.	$8x=24$
All the variables are on the left and the constants are on the right. Divide both sides by 8.	$\frac{8x}{8}=\frac{24}{8}$
Simplify.	$x=3$
Check:	$7x=-x+24$
Substitute $x=3$.	$7(3)\stackrel{?}{=}-(3)+24$
	$21=21$ ✓

[/hidden-answer]

Now you can try solving an equation with variables on both sides where it is beneficial to move the variable term to the left side.

try it

A link to an interactive elements can be found at the bottom of this page.
A link to an interactive elements can be found at the bottom of this page.

In our last examples, we moved the variable term to the left side of the equation. In the next example, you will see that it is beneficial to move the variable term to the right side of the equation. There is no “correct” side to move the variable term, but the choice can help you avoid working with negative signs.

example

Solve: $5y-8=7y$
[reveal-answer q=”100719″]Show Answer[/reveal-answer]
[hidden-answer a=”100719″]

Solution:
The only constant, -8, is on the left side of the equation, and the variable, y, is on both sides. Let's leave the constant on the left and collect the variables to the right.

$5y-8$ is the side containing a constant. $7y$ is the side containing only a variable.	
Subtract $5y$ from both sides.	$5y-5y-8=7y-5y$
Simplify.	$-8=2y$
We have the variables on the right and the constants on the left. Divide both sides by 2.	$\frac{-8}{2}=\frac{2y}{2}$
Simplify.	$-4=y$
Rewrite with the variable on the left.	$y=-4$
Check:	$5y-8=7y$
Let $y=-4$.	$5(-4)-8\stackrel{?}{=}7(-4)$
	$-20-8\stackrel{?}{=}-28$
	$-28=-28$ ✓

[/hidden-answer]

Now you can try solving an equation where it is beneficial to move the variable term to the right side.

try it

A link to an interactive elements can be found at the bottom of this page.

Solve Equations with Variables and Constants on Both Sides

The next example will be the first to have variables *and* constants on both sides of the equation. As we did before, we'll collect the variable terms to one side and the constants to the other side. You will see that as the number of variable and constant terms increases, so do the number of steps it takes to solve the equation.

Examples

Solve: $7x+5=6x+2$
[reveal-answer q="859740"]Show Answer[/reveal-answer]
[hidden-answer a="859740"]

Solution:
Start by choosing which side will be the variable side and which side will be the constant side. The variable terms are $7x$ and $6x$. Since 7 is greater than 6, make the left side the variable side and so the right side will be the constant side.

	$7x+5=6x+2$
Collect the variable terms to the left side by subtracting $6x$ from both sides.	$7x-6x+5=6x-6x+2$
Simplify.	$x+5=2$
Now, collect the constants to the right side by subtracting 5 from both sides.	$x+5-5=2-5$
Simplify.	$x=-3$
The solution is $x=-3$.	
Check:	$7x+5=6x+2$
Let $x=-3$.	$7(-3)+5\stackrel{?}{=}6(-3)+2$
	$-21+5\stackrel{?}{=}-18+2$
	$16=16$ ✓

[/hidden-answer]

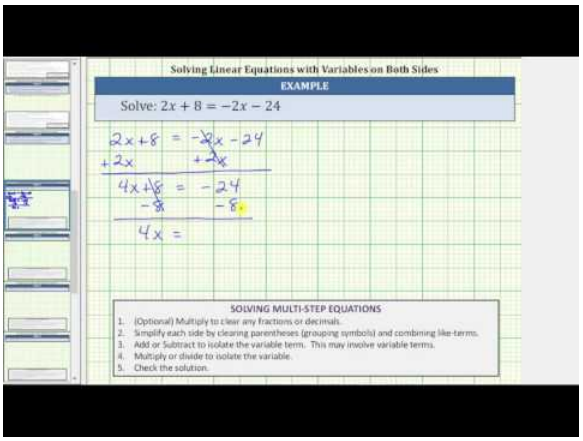
Solve: $6n-2=-3n+7$

[reveal-answer q="399032"]Show Answer[/reveal-answer]
[hidden-answer a="399032"]
We have $6n$ on the left and $-3n$ on the right. Since image-3" title="6>-3" class="latex mathjax">, make the left side the "variable" side.

	$6n-2=-3n+7$
We don't want variables on the right side—add $3n$ to both sides to leave only constants on the right.	$6n+3n-2=-3n+3n+7$
Combine like terms.	$9n-2=7$
We don't want any constants on the left side, so add 2 to both sides.	$9n-2+2=7+2$
Simplify.	$9n=9$
The variable term is on the left and the constant term is on the right. To get the coefficient of n to be one, divide both sides by 9.	$\frac{9n}{9}=\frac{9}{9}$
Simplify.	$n=1$
Check:	$6n-2=-3n+7$
Substitute 1 for n.	$6(1)-2\stackrel{?}{=}-3(1)+7$
	$4=4$ ✓

[/hidden-answer]

In the following video we show an example of how to solve a multi-step equation by moving the variable terms to one side and the constants to the other side. You will see that it doesn't matter which side you choose to be the variable side; you can get the correct answer either way.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=96

In the next example, we move the variable terms to the right side to keep a positive coefficient on the variable.

EXAMPLE

Solve: $2a - 7 = 5a + 8$

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[hidden-answer a="654456"]

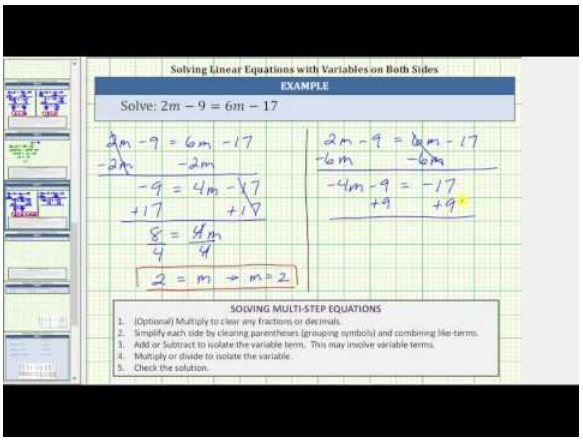
Solution:

This equation has $2a$ on the left and $5a$ on the right. Since  2" title="5>2" class="latex mathjax">, make the right side the variable side and the left side the constant side.

	$2a - 7 = 5a + 8$
Subtract $2a$ from both sides to remove the variable term from the left.	$2a{-}2a - 7 = 5a{-}2a + 8$
Combine like terms.	$-7 = 3a + 8$
Subtract 8 from both sides to remove the constant from the right.	$-7{-}8$ $= 3a$ $+ 8{-}8$
Simplify.	$-15 = 3a$
Divide both sides by 3 to make 1[/latex] the coefficient of a.	$\frac{-15}{3} = \frac{3a}{3}$
Simplify.	$-5 = a$
Check:	$2a - 7 = 5a + 8$
Let $a = -5$	$2(-5) - 7 \stackrel{?}{=} 5(-5) + 8$
	$-10 - 7 \stackrel{?}{=} -25 + 8$
	$-17 = -17$ ✓

[/hidden-answer]

The following video shows another example of solving a multi-step equation by moving the variable terms to one side and the constants to the other side.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=96

Try these problems to see how well you understand how to solve linear equations with variables and constants on both sides of the equal sign.

try it

A link to an interactive elements can be found at the bottom of this page.
A link to an interactive elements can be found at the bottom of this page.

Here is a much more complex multi-step equation.

EXAMPLE

Solve: $\frac{x+22}{3} = 2x + 4$

	$\frac{x+22}{3} = 2x + 4$
Multiply both sides of the equation by 3	$3 \cdot \frac{x+22}{3} = (2x + 4)3$
Eliminate the $\frac{3}{3} = 1$ on the left and Distribute on the right	$x + 22 = 3(2x) + 3(4)$
Multiply	$x + 22 = 6x + 12$
Subtract x from both sides (keeps variable term positive)	$22 = 5x + 12$
Subtract 12 from both sides (isolates the variable term)	$10 = 5x$
Divide both sides by 5 (isolates the variable)	$2 = x$
Rewrite solution with variable on the right	$x = 2$
The solution is $x = 2$	
Check:	$\frac{x+22}{3} = 2x + 4$
Let $x = -11$.	$\frac{2+22}{3} = 2(2) + 4$
	$\frac{24}{3} \stackrel{?}{=} 4 + 4$
	$8 = 8 \quad \checkmark$

We just showed a lot of examples of different kinds of linear equations you may encounter. There are some good habits to develop that will help you solve all kinds of linear equations. We'll summarize the steps we took so you can easily refer to them.

Solve an equation with variables and constants on both sides

1. Choose one side to be the variable side and then the other will be the constant side.
2. Collect the variable terms to the variable side, using the Addition or Subtraction Property of Equality.
3. Collect the constants to the other side, using the Addition or Subtraction Property of Equality.
4. Make the coefficient of the variable 1, using the Multiplication or Division Property of Equality.
5. Check the solution by substituting it into the original equation.

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2.17: Introduction to Translating Word Problems into Equations



Math in everyday life is like a constant string of word problems. How much should I tip the waitress? What time should I leave on my 16 mile bike ride if I want to by to the café at noon? If I only have $550 a year set aside for getting to and from work, should I spend it on driving/parking or public transportation? It's important to learn how to write and solve equations based on the math events that may impact you. Maybe you want to figure out your maximum budget when buying your first home. You can use the current interest rate and your desired monthly mortgage payment to solve for the most money you can offer on the purchase of a house. Equations can also be written to determine whether or not it's more cost efficient to buy a new car or keep repairing your old one. Once you can translate words into algebraic equations, you can solve a variety of tough problems that involve numbers.

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2.18: Translating Words Into Algebra

Learning outcome

- Translate simple word phrases into math notation

We know there are many operation symbols that are used in algebra. Now, we'll translate word phrases into algebraic expressions and equations. The symbols and variables we've talked about will help us do that. They are summarized below.

Operation	Phrase	Expression
Addition	a plus b the sum of a and b a increased by b b more than a the total of a and b b added to a	$a+b$
Subtraction	a minus b the difference of a and b b subtracted from a a decreased by b b less than a	$a-b$
Multiplication	a times b the product of a and b	$a \cdot b$, ab, $a\,(b)$, $(a)\,(b)$
Division	a divided by b the quotient of a and b the ratio of a and b b divided into a	$a \div b$, a/b, $\frac{a}{b}$, $b\overline{)a}$

Look closely at these phrases using the four operations:

- the sum *of* a *and* b
- the difference *of* a *and* b
- the product *of* a *and* b
- the quotient *of* a *and* b

Each phrase tells you to operate on two numbers. Look for the words ***of*** and ***and*** to find the numbers.

example

Translate each word phrase into an algebraic expression:

1. The difference of 20 and 4

2. The quotient of $10x$ and 3

Solution

1. The key word is *difference*, which tells us the operation is subtraction. Look for the words *of* and *and* to find the numbers to subtract.

   The difference of 20 and 4

   20 minus 4

   $20-4$

2. The key word is *quotient*, which tells us the operation is division.

The quotient of $10x$ and 3

divide $10x$ by 3

$10x \div 3$

This can also be written as $(10x)/3$ or $\frac{10x}{3}$

try it

[ohm_question]146541[/ohm_question]

[ohm_question]143240[/ohm_question]

[ohm_question]143207[/ohm_question]

[ohm_question]146542[/ohm_question]

example

Translate each word phrase into an algebraic expression:

1. How old will you be in eight years? Let's say your current age is y.
2. How old were you seven years ago? This is seven years less than your age now. Let's say your current age is $9z$.

[reveal-answer q="879313"]Show Answer[/reveal-answer]
[hidden-answer a="879313"]

Solution:

1. Eight more than y

The key words are *more than*. They tell us the operation is addition. *More than* means "added to".

Eight more than y

Eight added to y

$y + 8$

2. Seven less than $9z$.

The key words are *less than*. They tell us the operation is subtraction. *Less than* means "subtracted from".

Seven less than $9z$

Seven subtracted from $9z$

$9z - 7$

[/hidden-answer]

try it

[ohm_question]144907[/ohm_question]

example

Translate each word phrase into an algebraic expression:

1. Five times the sum of m and n
2. The sum of five times m and n

[reveal-answer q="888823"]Show Answer[/reveal-answer]
[hidden-answer a="888823"]

Solution

1. There are two operation words: *times* tells us to multiply and *sum* tells us to add. Because we are multiplying 5 times the sum, we need parentheses around the sum of m and n.

   five times the sum of m and n

   $5(m+n)$

2. To take a sum, we look for the words *of* and *and* to see what is being added. Here we are taking the sum *of* five times m and n.

   the sum of five times m and n

   $5m+n$

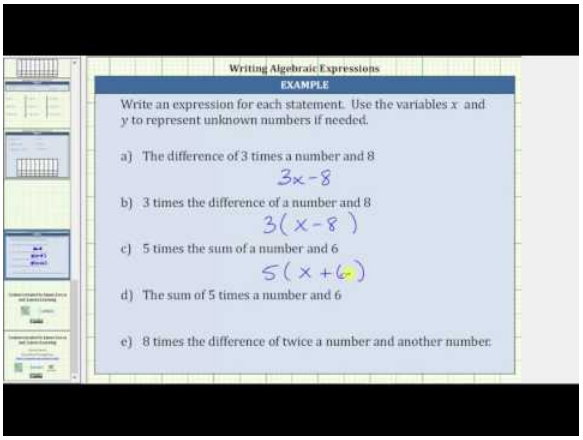
Notice how the use of parentheses changes the result. In part 1, we add first and in part 2, we multiply first.

[/hidden-answer]

try it

[ohm_question]144916[/ohm_question]

Watch the video below to better understand how to write algebraic expressions from statements.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=100

We'll eventually apply our skills in algebra to solving equations in complex word problems. Usually start by translating a word phrase to an algebraic equation. Remember, an equation has an equal sign between two algebraic expressions. So if we have a sentence that tells us that two phrases are equal, we can translate it into an equation. We look for clue words that mean *equals*. Some words that translate to the equal sign are:

- is equal to
- is the same as
- is
- gives
- was
- will be

It may be helpful to put a box around the *equals* word(s) in the sentence to help you focus separately on each phrase. Then translate each phrase into an expression, and write them on each side of the equal sign.

example

Translate the sentence into an algebraic equation: The sum of 6 and 9 is 15.

Solution

The word *is* tells us the equal sign goes between 9 and 15.

Locate the "equals" word(s).	The sum of 6 and 9 is 15.
Write the = sign.	The sum of 6 and 9 = 15.
Translate the words to the left of the *equals* word into an algebraic expression.	6 + 9 = ___
Translate the words to the right of the *equals* word into an algebraic expression.	6 + 9 = 15

try it

[ohm_question]146546[/ohm_question]

example

Translate the sentence into an algebraic equation: Twice the difference of x and 3 gives 18.

[reveal-answer q="79895"]Show Answer[/reveal-answer]

[hidden-answer a="79895"]

Solution

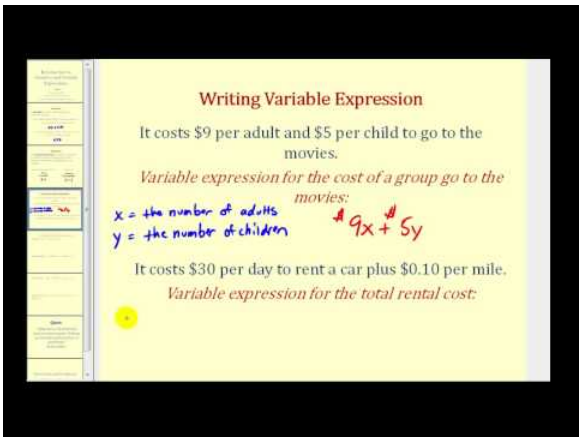
Locate the "equals" word(s).	Twice the difference of x and 3 gives 18.
Recognize the key words: *twice; difference of …. and ….*	*Twice* means two times.
Translate.	Twice the difference of x and 3 gives 18. 2 $(x-3)$ = 18
	$2(x-3)=18$

[/hidden-answer]

try it

[ohm_question]146549[/ohm_question]

[ohm_question]146550[/ohm_question]



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Now let's apply our understanding of translating words to algebra in a real world scenario.

example

The height of a rectangular window is 6 inches less than the width. Let w represent the width of the window. Write an expression for the height of the window.
[reveal-answer q="704093"]Show Answer[/reveal-answer]
[hidden-answer a="704093"]

Solution

Write a phrase about the height.	6 less than the width
Substitute w for the width.	6 less than w
Rewrite 'less than' as 'subtracted from'.	6 subtracted from w
Translate the phrase into algebra.	$w-6$

[/hidden-answer]

try it

[ohm_question]144917[/ohm_question]

example

Blanca has dimes and quarters in her purse. The number of dimes is 2 less than 5 times the number of quarters. Let q represent the number of quarters. Write an expression for the number of dimes.
[reveal-answer q="365611"]Show Answer[/reveal-answer]
[hidden-answer a="365611"]

Solution

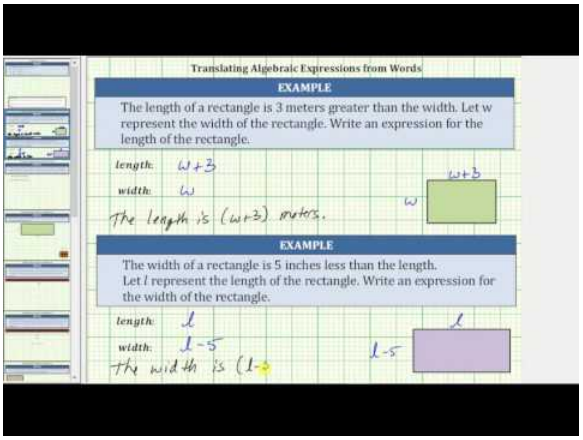
Write a phrase about the number of dimes.	two less than five times the number of quarters
Substitute q for the number of quarters.	2 less than five times q
Translate 5 *times* q.	2 less than $5q$
Translate the phrase into algebra.	$5q-2$

[/hidden-answer]

try it

[ohm_question]144918[/ohm_question]

In the following video we show more examples of how to write basic algebraic expressions from words, and simplify.



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Let’s practice translating sentences into algebraic equations and then solving them.

example

Translate and solve: Three more than x is equal to 47.
[reveal-answer q=”989526″]Show Answer[/reveal-answer]
[hidden-answer a=”989526″]

Solution

		Three more than x is equal to 47.
Translate.		$x+3=47$
Subtract 3 from both sides of the equation.		$x+3-\,-3=47-\,-3$
Simplify.		$x=44$
We can check. Let $x=44$.	$x+3=47$	
	$44+3=47$	
	$47=47$ ✓	

So $x=44$ is the solution.

[/hidden-answer]

try it

[ohm_question]146551[/ohm_question]

example

Translate and solve: The difference of y and 14 is 18.
[reveal-answer q="763260"]Show Answer[/reveal-answer]
[hidden-answer a="763260"]

Solution

		The difference of y and 14 is 18.
Translate.		$y-14=18$
Add 14 to both sides.		$y-14+14=18+14$
Simplify.		$y=32$
We can check. Let $y=32$.	$y--14=18$	
	$32--14=18$	
	$18=18$ ✓	

So $y=32$ is the solution.

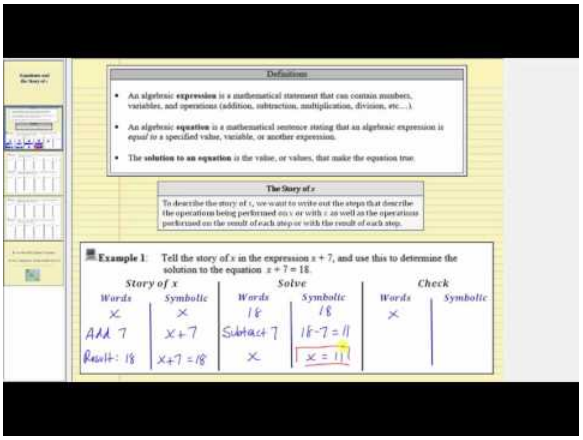
[/hidden-answer]

try it

[ohm_question]146552[/ohm_question]

[ohm_question]146386[/ohm_question]

In the following video we show more examples of how to translate an equation into words and solve. Note that this is different from the written examples on this page because we start with the mathematical equation then translate it into words.



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Exercises

Translate from algebra to words:

1. $12+14$
2. $(30)\,(5)$
3. $64\div 8$
4. $x-y$

Solution:

1.
$12+14$
12 plus 14
the sum of twelve and fourteen

2.
$(30)\,(5)$
30 times 5
the product of thirty and five

3.
$64 \div 8$
64 divided by 8
the quotient of sixty-four and eight

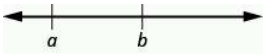
4.
$x-y$
x minus y
the difference of x and y

TRY IT

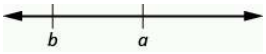
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A link to an interactive elements can be found at the bottom of this page.
A link to an interactive elements can be found at the bottom of this page.

What if we are working with expressions that are not equal? An inequality is used in algebra to compare two quantities that may have different values. The number line can help you understand inequalities. Remember that on the number line the numbers get larger as they go from left to right. So if we know that b is greater than a, it means that b is to the right of a on the number line. We use the symbols $<$ and image}" title="\text{>}" class="latex mathjax"> for inequalities.

$a<b$ is read a is less than b
a is to the left of b on the number line



\(image" src="http://localhost:3000/latex?latex=a%...font=TeX#fixme" />b" title="a>b" class="latex mathjax"> is read
a\) is greater than \(b\)
 a is to the right of b on the number line



The expressions imageb" title="a**b" class="latex mathjax"> can be read from left-to-right or right-to-left, though in English we usually read from left-to-right. In general,**

imagea.\text{ For example, }7<11\text{ is equivalent to }11>7.\hfill \ a>b\text{ is equivalent to }b4\text{ is equivalent to }4<17.\hfill \end{array}" title="

$a < b$ is equivalent to $b > a$. For example, $7 < 11$ is equivalent to $11 > 7$.
$a > b$ is equivalent to $b4$ is equivalent to $4 < 17$. (2.18.1)

" class="latex mathjax">

When we write an inequality symbol with a line under it, such as $a \leq b$, it means $a < b$ or $a = b$. We read this a is less than or equal to b. Also, if we put a slash through an equal sign, $\neq$, it means not equal.

We summarize the symbols of equality and inequality in the table below.

Algebraic Notation	Say
$a = b$	a is equal to b
$a \neq b$	a is not equal to b
$a < b$	a is less than b
imageb" title="a>b" class="latex mathjax">	a is greater than b
$a \leq b$	a is less than or equal to b
$a \geq b$	a is greater than or equal to b

Symbols Misplaced & and Misplaced &

The symbols Misplaced & and Misplaced & each have a smaller side and a larger side.

smaller side Misplaced & larger side

larger side Misplaced & smaller side

The smaller side of the symbol faces the smaller number and the larger faces the larger number.

Exercises

Translate from algebra to words:

1. $20 \leq 35$
2. $11 \neq 15 - 3$
3. image10\div 2" title="9>10\div 2" class="latex mathjax">
4. $x + 2 < 10$

[reveal-answer q="346424"]Show Answer[/reveal-answer]
[hidden-answer a="346424"]

Solution:

1.
$20 \leq 35$
20 is less than or equal to 35

2.
$11 \neq 15-3$
11 is not equal to 15 minus 3

3.
image10\div 2" title="9>10\div 2" class="latex mathjax">
9 is greater than 10 divided by 2

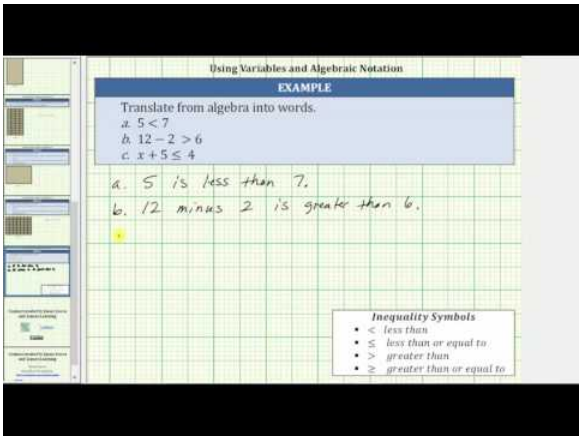
4.
$x+2<10$
x plus 2 is less than 10

[/hidden-answer]

TRY IT

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A link to an interactive elements can be found at the bottom of this page.

In the following video we show more examples of how to write inequalities as words.



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2.19: Algebraic Problem Solving Strategies

Learning outcome

- Use a problem-solving strategy to set up and solve word problems

The world is full of word problems. How much money do I need to fill the car with gas? How much should I tip the server at a restaurant? How many socks should I pack for vacation? How big a turkey do I need to buy for Thanksgiving dinner, and what time do I need to put it in the oven? If my sister and I buy our mother a present, how much will each of us pay?



Now that we can solve equations, we are ready to apply our new skills to word problems.

Previously, you translated word phrases into algebraic equations using some basic mathematical vocabulary and symbols. Since then you've increased your math vocabulary as you learned about more algebraic procedures. You've also solved some word problems applying math to everyday situations. This method works as long as the situation is familiar to you and the math is not too complicated.

Now we'll develop a strategy you can use to solve any word problem. This strategy will help you become successful with word problems. We'll demonstrate the strategy as we solve the following problem.

Example

Pete bought a shirt on sale for $18, which is one-half the original price. What was the original price of the shirt?

Solution:
Step 1. **Read** the problem. Make sure you understand all the words and ideas. You may need to read the problem two or more times. If there are words you don't understand, look them up in a dictionary or on the Internet.

- *In this problem, do you understand what is being discussed? Do you understand every word?*

Step 2. **Identify** what you are looking for. It's hard to find something if you are not sure what it is! Read the problem again and look for words that tell you what you are looking for!

- *In this problem, the words "what was the original price of the shirt" tell you what you are looking for: the original price of the shirt.*

Step 3. **Name** what you are looking for. Choose a variable to represent that quantity. You can use any letter for the variable, but it may help to choose one that helps you remember what it represents.

- *Let $p =$ the original price of the shirt*

Step 4. **Translate** into an equation. It may help to first restate the problem in one sentence, with all the important information. Then translate the sentence into an equation.

18	is	one-half	of	the original price .
18	=	$\frac{1}{2}$	·	p

Step 5. **Solve** the equation using good algebra techniques. Even if you know the answer right away, using algebra will better prepare you to solve problems that do not have obvious answers.

Write the equation.	$18 = \frac{1}{2}p$
Multiply both sides by 2.	$2 \cdot 18 = 2 \cdot \frac{1}{2}p$
Simplify.	$36 = p$

Step 6. **Check** the answer in the problem and make sure it makes sense.

- *We found that $p = 36$, which means the original price was $36. Does $36 make sense in the problem? Yes, because 18 is one-half of 36, and the shirt was on sale at half the original price.*

Step 7. **Answer** the question with a complete sentence.

- *The problem asked "What was the original price of the shirt?" The answer to the question is: "The original price of the shirt was $36."*

If this were a homework exercise, our work might look like this:

Let p = the original price.

18 is one-half the original price.

$$18 = \frac{1}{2}p$$

$$2 \cdot 18 = 2 \cdot \frac{1}{2}p$$

$$36 = p$$

Check:

Is \$36 a reasonable price for a shirt? *Yes*.

Is 18 one-half of 36? *Yes*.

The original price of the shirt was \$36.

Try it

[ohm_question]142694[/ohm_question]

We list the steps we took to solve the previous example.

Problem-Solving Strategy

1. **Read** the word problem. Make sure you understand all the words and ideas. You may need to read the problem two or more times. If there are words you don't understand, look them up in a dictionary or on the internet.
2. **Identify** what you are looking for.
3. **Name** what you are looking for. Choose a variable to represent that quantity.
4. **Translate** into an equation. It may be helpful to first restate the problem in one sentence before translating.
5. **Solve** the equation using good algebra techniques.
6. **Check** the answer in the problem. Make sure it makes sense.
7. **Answer** the question with a complete sentence.

Let's use this approach with another example.

Example

Yash brought apples and bananas to a picnic. The number of apples was three more than twice the number of bananas. Yash brought 11 apples to the picnic. How many bananas did he bring?

[reveal-answer q="15930"]Show Answer[/reveal-answer]

[hidden-answer a="15930"]

Solution:

Step 1. **Read** the problem.	
Step 2. **Identify** what you are looking for.	How many bananas did he bring?
Step 3. **Name** what you are looking for. Choose a variable to represent the number of bananas.	Let b = number of bananas
Step 4. **Translate.** Restate the problem in one sentence with all the important information. Translate into an equation.	11 $\Rightarrow$ The number of apples $=$ $\Rightarrow$ was 3 $\Rightarrow$ three $+$ $\Rightarrow$ more than $2b$ $\Rightarrow$ twice the number of bananas
Step 5. **Solve** the equation.	$11 = 2b + 3$
Subtract 3 from each side.	$11-3 = 2b + 3-3$
Simplify.	$8 = 2b$
Divide each side by 2.	$\frac{8}{2} = \frac{2b}{2}$
Simplify.	$4 = b$
Step 6. **Check:** First, is our answer reasonable? Yes, bringing four bananas to a picnic seems reasonable. The problem says the number of apples was three more than twice the number of bananas. If there are four bananas, does that make eleven apples? Twice 4 bananas is 8. Three more than 8 is 11.	
Step 7. **Answer** the question.	Yash brought 4 bananas to the picnic.

[/hidden-answer]

Try it

A link to an interactive elements can be found at the bottom of this page.

In the next example, we will apply our Problem-Solving Strategy to applications of percent.

example

Nga's car insurance premium increased by $60, which was 8 of the original cost. What was the original cost of the premium?
[reveal-answer q="662772"]Show Answer[/reveal-answer]
[hidden-answer a="662772"]

Solution:

Step 1. **Read** the problem. Remember, if there are words you don't understand, look them up.	
Step 2. **Identify** what you are looking for.	the original cost of the premium
Step 3. **Name.** Choose a variable to represent the original cost of premium.	Let $c =$ the original cost
Step 4. **Translate.** Restate as one sentence. Translate into an equation.	$\underbrace{\$60}_{60}$ $\underbrace{\text{was}}_{=}$ $\underbrace{8\%}_{0.08}$ $\underbrace{\text{of}}_{\cdot}$ $\underbrace{\text{the original cost}}_{c}$.
Step 5. **Solve** the equation.	$60 = 0.08c$
Divide both sides by 0.08.	$\frac{60}{0.08} = \frac{0.08c}{0.08}$
Simplify.	$c = 750$
Step 6. **Check:** Is our answer reasonable? Yes, a $\$750$ premium on auto insurance is reasonable. Now let's check our algebra. Is 8% of 750 equal to 60? $750 = c$ $0.08(750) = 60$ $60 = 60$ ✓	
Step 7. **Answer** the question.	The original cost of Nga's premium was $\$750$.

[/hidden-answer]

Try it

A link to an interactive elements can be found at the bottom of this page.
A link to an interactive elements can be found at the bottom of this page.

Now we will translate and solve number problems. In number problems, you are given some clues about one or more numbers, and you use these clues to build an equation. Number problems don't usually arise on an everyday basis, but they provide a good introduction to practicing the Problem-Solving Strategy. Remember to look for clue words such as *difference*, *of*, and *and*.

Example

The difference of a number and six is 13. Find the number.

Solution:

Step 1. **Read** the problem. Do you understand all the words?	
Step 2. **Identify** what you are looking for.	the number
Step 3. **Name.** Choose a variable to represent the number.	Let $n =$ the number
Step 4. **Translate.** Restate as one sentence. Translate into an equation.	$n - 6$ ⇒ The difference of a number and 6 $=$ ⇒ is 13 ⇒ thirteen $n - 6 = 13$
Step 5. **Solve** the equation. Add 6 to both sides. Simplify.	$n - 6 = 13$ $n - 6 + 6 = 13 + 6$ $n = 19$
Step 6. **Check:** The difference of 19 and 6 is 13. It checks.	
Step 7. **Answer** the question.	The number is 19.

try it

A link to an interactive elements can be found at the bottom of this page.

example

The sum of twice a number and seven is 15. Find the number.

[reveal-answer q="190834"]Show Answer[/reveal-answer]

[hidden-answer a="190834"]

Solution:

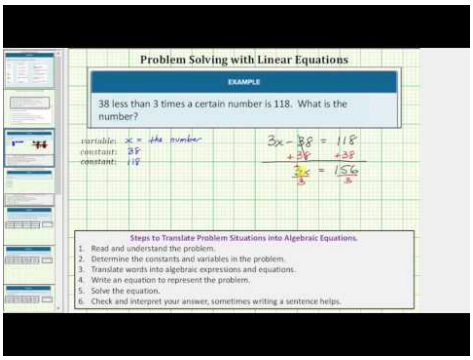
Step 1. **Read** the problem.	
Step 2. **Identify** what you are looking for.	the number
Step 3. **Name.** Choose a variable to represent the number.	Let $n =$ the number
Step 4. **Translate.** Restate the problem as one sentence. Translate into an equation.	$2n$ $\Rightarrow$ The sum of twice a number $+$ $\Rightarrow$ and 7 $\Rightarrow$ seven $=$ $\Rightarrow$ is 15 $\Rightarrow$ fifteen
Step 5. **Solve** the equation.	$2n + 7 = 15$
Subtract 7 from each side and simplify.	$2n = 8$
Divide each side by 2 and simplify.	$n = 4$
Step 6. **Check:** is the sum of twice 4 and 7 equal to 15? $2 \cdot 4 + 7 = 15$ $8 + 7 = 15$ $15 = 15$ ✓	
Step 7. **Answer** the question.	The number is 4.

[/hidden-answer]

try it

A link to an interactive elements can be found at the bottom of this page.

Watch the following video to see another example of how to solve a number problem.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=102

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2.20: Introduction to Solving Complex Equations



When you deposit money into an account at a bank, there is typically an interest rate applied to the amount you maintain in that account. The interest paid to you is a percent of your balance that the bank rewards you for keeping your money with them. The bank can then use that money as loans to other customers and collect interest on those loans. Calculating interest and working with interest equations are a little trickier than the equations we solved in the last section. The ability to manipulate complex equations like the interest formula is an important skill, as you will then be able to solve equations for any unknown.

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CHAPTER OVERVIEW

3: Accounting Theory

3.1: The Annual Report
3.2: Introduction to Accounting Principles
3.3: The Accounting Entity
3.4: Basic Accounting Principles
3.5: Accrual Basis Accounting
3.6: Putting It Together- Accounting Theory
3.7: Assignment- Accounting Theory
3.8: Why It Matters- Accounting Theory
3.9: Introduction to Accounting
3.10: Roles of Accounting in Business
3.11: Financial Accounting Standards
3.12: Ethics and Accounting
3.13: Introduction to Users of Accounting
3.14: Users of Accounting Information
3.15: Organizational Structure
3.16: Forms of Doing Business

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3.1: The Annual Report

Learning Outcomes

- Summarize the information provided in a corporation's annual report

Publicly traded corporations, like FaceBook (NASDAQ:FB), Home Depot (NYSE:HD), and Wells Fargo (NYSE:WFC) are required by the SEC to submit and publish an annual report that describes their operations and financial conditions. Most of the report is management's discussion and analysis (MD&A) chronicling the company's activities over the past year, along with challenges and market risks. The final quarter of the report, more or less, is comprised of the audited financial statements and accompanying notes and disclosures. The whole package usually runs around a hundred pages or so. Just for fun sometime, look up an annual report for a company you think is publicly traded, but be aware that just because a company is monolithic or iconic doesn't mean it's publicly traded. For instance, Fender Musical Instruments, Corp. is world famous for its guitars and is traded on the National Association of Securities Dealers Automated Quotations (NASDAQ) as FNDR, but Gibson Brands, Inc. is privately held, so there is no publicly disclosed information.

For those companies that are publicly traded, the annual report should include the following sections: Management's Discussion and Analysis, and the audited financial statements.

Management Discussion and Analysis (unaudited)

In the Management discussion and analysis (MD&A) section of a company's annual report, management provides an overview of the previous year's operations and how the company performed financially. Management also discusses the upcoming year by outlining future goals and approaches to new projects. The SEC requires an independent CPA firm perform an annual audit of a company's financial statements, and an audit is an opinion as to whether the financials are free of material misstatement. Auditors perform test work to determine if the financial statements are materially correct, but CPAs do not audit the information in the MD&A section.

The Audited Financial Statements

The basic company financial statements included in the annual report are the balance sheet, the income statement, the statement of retained earnings, and the statement of cash flows.

Balance Sheet

Assets are what a company owns. Equity and liabilities show who owns it. Liabilities are debt, and equity is what is left over for the owners if all the assets and liabilities were liquidated at the amounts shown on the balance sheet. You could imagine a simple balance sheet centered around your home or your car. Let's say your car cost you $25,000 and you put $5,000 down and financed the rest. A simple balance sheet would show an asset of $25,000 that was equal to (balanced by) debt of $20,000 and equity of $5,000. A business balance sheet would be more complete—in fact, one of the underlying accounting principles requires companies to show all assets and all liabilities on the balance sheet (the completeness principle.)

Income Statement

Also called the P&L for Profit and Loss, or the Statement of Earnings, the income statement shows increases and decreases in net assets from running the business. Assets are increased by revenues and decreased by expenses. Revenues are the earnings of the business from selling goods or services, and expenses are the costs of doing business—they measure the amount of resources used up producing revenue. In fact, the word "expense" literally means "used up," as in, "I went to the gym and expended all my energy." In this case, expenses are assets, mostly cash, but also equipment and other capital investments, used up in creating new wealth.

Statement of Retained Earnings

The statement of owners' equity, also called the statement of retained earnings, reconciles the net income from the year to the balance sheet statement of equity. In other words, if a company started with $30,000 in equity (last year's ending equity) and made $125,000 in net income, it would then have $155,000 in equity, before any additions or withdrawals. If the owners took out

$90,000 for their own use, equity would then show on the balance sheet as $65,000 ($155,000 less $90,000.) If, in addition, the company sold stock on the open market raising $1,000,000, equity would then be $1,065,000. All of this information and more is available on the statement of retained earnings. There is a companion statement called the statement of comprehensive income that includes such things as unrealized gains and losses on investments; however, that is beyond the scope of this overview.

Statement of Cash Flows

Finally, the audited financial statements include a reconciliation of beginning and ending cash, called the statement of cash flows. Similar to the statement of equity, it shows the transactions that affected cash in three sections: operations, investing, and financing. Investing includes purchasing (and selling) fixed assets. Financing includes both debt and equity sources of capital. Operations is usually represented by a reconciliation of accrual basis net income to cash basis.

Footnotes and Disclosures

In addition to the basic financial statements, companies using GAAP are required to add pages and pages of footnotes and disclosures, covering everything from the basis of accounting and the fiscal year, to how revenues are recognized, to outstanding lawsuits and other contingencies. Some of these footnotes explain the amounts on the face of the financial statements, and some add information not apparent from the financials themselves.

The Auditor’s Reports

The SEC requires an independent CPA firm perform an annual audit of a company’s financial statements, and an audit is an opinion as to whether the financials are free of material misstatement. Auditors perform test work to determine if the financial statements are materially correct. However, CPAs do not audit the information in the MD&A section.

Practice Questions

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3.2: Introduction to Accounting Principles

What you'll learn to do: Explore the fundamentals of accounting



The primary objective of financial accounting reporting is to provide useful, relevant information to lenders and investors. That is why the FASB has constructed the conceptual framework of accounting rules called Generally Accepted Accounting Principles. Underlying the conceptual framework is the notion that in order for the information to be useful, it has to be complete, neutral, and free from material error.

In this section, we'll describe the concept of the economic accounting entity and the importance of the going concern concept; define consistency, full disclosure, materiality, verifiability, and importance of making conservative choices in accounting policies; and explain the accrual basis of accounting and how it is different than the cash basis that you are probably more familiar with.

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3.3: The Accounting Entity

Learning Outcomes

- Define the accounting entity and discuss the going concern concept

What is the Accounting Concept of the Economic Entity?

One of the most basic underlying assumptions of GAAP is that there are boundaries around a business organization that define a single economic reporting entity. This may sound obvious at first, but in today's complex business world, those boundaries aren't always crystal clear. Another one of the fundamental principles of GAAP is that the economic entity, the business, is a going concern. In other words, it's not in the midst of wrapping up its affairs.

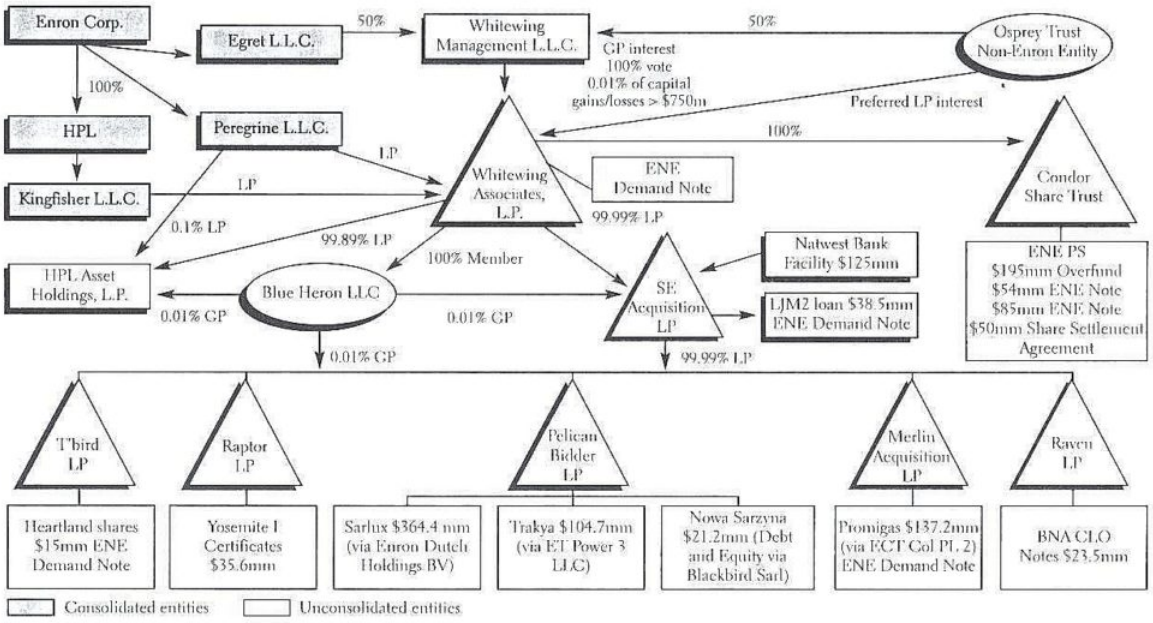
Enron



Let's revisit Enron as an example.

Enron started out as a legitimate business in 1985 when two relatively small pipeline companies, HNG and InterNorth, merged into one.

HNG was formed from the Houston Oil Co. in the 1920s and provided gas to retail customers in Houston. In 1976 it sold its retail gas business in Houston to concentrate on gas exploration and production and other businesses. By 1984 HNG had assets of $3.7 billion, sales of over $2 billion, and profits of $123 million. InterNorth began as Northern Natural Gas Company, organized in Omaha, Nebraska, in 1930. When InterNorth, with one of the nation's premier pipeline networks with revenues of $7.5 billion in 1984, found itself the potential takeover target of corporate raiders, CEO Sam Segnar sought to buy out HNG, and a deal was announced in May 1985 in which InterNorth would acquire HNG for $2.4 billion. The arrangement stipulated that the merged entities would be known as HNG/InterNorth and be headquartered in Omaha with Segnar as chairman and CEO. However by 1986 Segnar had retired, Kenneth Lay was chairman and CEO, and the company was renamed Enron with corporate headquarters in Houston. The new company had the second largest pipeline network in the United States with over 36,000 miles of pipe stretching across the continent and north into Canada.



With a small business, like a sole proprietor, the boundaries of the entity are fairly clear, but as a business grows and acquires new assets and even whole entities, the lines can become blurred. That's why it's important, when looking at financial accounting information, to know exactly the scope of the information; to know which business entities are included and which are not. It's also important to know if the business as reported is a viable entity, and not just something temporary. That's the second underlying assumption of GAAP—that the entity being observed is a going concern.

What is the Going Concern Principle?

The going concern assumption under GAAP presumes that the economic entity will remain in operation for the foreseeable future and has no plans to wrap up operations, because an entity that is going bankrupt or is contemplating ending operations is probably not a good investment.

Enron

In order to hide the reality of the failing commodities trading from investors and creditors, Enron creatively adopted accounting practices from other industries, all GAAP compliant, such as mark-to-market accounting. For the most part, mark-to-market revenue recognition was used by investment firms in order to adjust securities from cost to current market value, but Enron was using the practice to report revenues that hadn't even been earned yet.

For instance, in January 2000 Enron announced its entry into the broadband fiber optic business, citing this move as a natural extension of the company's services. However, the timing was bad. The supply of fiber optic capacity far exceeded demand and prices were actually dropping around the country. In retrospect, analysts estimate that Enron lost over $1 billion in its broadband venture. Even so, Enron accountants managed to record a profit of over $100 million by reporting a deal with Blockbuster that, in reality, never produced a single dollar of revenue.

Even as Enron secretly plunged toward bankruptcy, the stock rose 56 percent in 1999 and another 87 percent in 2000. And where were the outside auditors in all this? Arthur Anderson, the accounting firm hired by Enron to audit the annual financial statements, also held large consulting contracts with the company that impaired its independence and ultimately resulted in a clean audit opinion. In reality, Enron was teetering on the edge of bankruptcy. On December 2, 2001, Enron filed for protection under United States bankruptcy laws, at that time the largest such filing of its kind in United States history. Stock prices that year fell from a high of over $90 per share to nothing.

Practice Questions

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3.4: Basic Accounting Principles

Learning Outcomes

- Identify the major underlying accounting principles of consistency, full disclosure, materiality, verifiability and conservatism

What is the Consistency Principle?

The consistency principle states that, once you adopt an accounting principle or method, continue to follow it consistently in future accounting periods so that the results reported from period to period are comparable. However, companies can change an accounting principle or method if the new version in some way improves the usefulness of the reported financial results. For instance, GAAP allows for several different ways of valuing inventory (goods held for sale in the ordinary course of business.)

During the first nine months of fiscal 2008, Home Depot implemented a new enterprise resource planning ("ERP") system, including a new inventory system, for its retail operations in Canada and changed its method of accounting for inventory for its retail operations in Canada from the lower of cost (first-in, first-out) or market, as determined by the retail inventory method, to the lower of cost or market using a weighted-average cost method. This was disclosed, as required by GAAP, in the footnotes to the audited financial statements.

What is Full Disclosure?

The full disclosure principle states that you should include in an entity's financial statements all information that would affect a reader's understanding of those statements, such as changes in accounting principles applied. The interpretation of this principle is highly judgmental, since the amount of information that can be provided is potentially massive. To reduce the amount of disclosure, it is customary to only disclose information about events that are likely to have a material impact on the entity's financial position or financial results. In fact, the full disclosure concept is not usually followed for internally-generated financial statements, where management may only want to read the "bare bones" financial statements.

What is the Materiality Concept?

The materiality principle states that an accounting standard can be ignored if the net impact of doing so has such a small impact on the financial statements that a reader of the financial statements would not be misled. Under generally accepted accounting principles (GAAP), you do not have to implement the provisions of an accounting standard if an item is immaterial. This definition does not provide definitive guidance in distinguishing material information from immaterial information, so it is necessary to exercise judgment in deciding if a transaction is material.

The Securities and Exchange Commission has suggested for presentation purposes that an item representing at least 5% of total assets should be separately disclosed in the balance sheet. However, much smaller items may be considered material. For example, if a minor item would have changed a net profit to a net loss, that item could be considered material, no matter how small it might be. Similarly, a transaction would be considered material if its inclusion in the financial statements would change a ratio sufficiently to bring an entity out of compliance with its lender covenants.

As an example of a clearly immaterial item, you may have prepaid $100 of rent on a post office box that covers the next six months; under the matching principle, you should charge the rent to expense over six months. However, the amount of the expense is so small that no reader of the financial statements will be misled if you charge the entire $100 to expense in the current period, rather than spreading it over the usage period. In fact, if the financial statements are rounded to the nearest thousand or million dollars, this transaction would not alter the financial statements at all.

The materiality concept varies based on the size of the entity. A massive multi-national company may consider a $1 million transaction to be immaterial in proportion to its total activity, but $1 million could exceed the revenues of a small local firm, and so would be very material for that smaller company.

The materiality principle is especially important when deciding whether a transaction should be recorded as part of the closing process, since eliminating some transactions can significantly reduce the amount of time required to issue financial statements. It is

useful to discuss with the company's auditors what constitutes a material item, so that there will be no issues with these items when the financial statements are audited.

What is the Principle of Verifiability?

A company's accounting results are verifiable when they're reproducible, so that, given the same data and assumptions, an independent accountant would come up with the same result the company did. Verifiably is the cumulative effect of using historical cost, objectivity, and the monetary unit principle.

Cost Principle

Under GAAP in the U.S., assets are recorded and reported on the balance sheet at their original cost. Although some assets may be overstated, and some, like land, may actually be understated in terms of their actual fair market value, the FASB has determined that reporting assets at their historical cost serves the combined principles of consistency (from firm to firm and from year to year), objectivity, and conservatism. Historical cost is objective because an auditor, or anyone for that matter, could observe the receipt for the asset and come up with the same cost, which is, in fact, one of the tests that auditors perform on major assets.

Suppose a firm purchases land for $20,000 and a building for $100,000. The combined asset reported on the balance sheet would be $120,000, and any accountant or accounting firm asked to record or verify this amount would come up with the same number, even if one person thought the land might be worth $60,000 and another hired an appraiser to estimate a fair market value of only $10,000. Outside opinions don't matter in the world of historical cost.

Under International Financial Reporting Standards (IFRS), the company would be allowed to restate and report the land at fair market value, if that could be established with any certainty (usually by comparing the asset to current sales of similar assets.) This is one of the major differences between IFRS and GAAP. The FASB justifies using historical cost under the standard of objectivity.

Objectivity

The objectivity principle is the concept that the financial statements of an organization are based on solid evidence. This is what got Enron into trouble. The CEO and CFO were basing revenues and asset values on opinions and guesses, it turned out. The auditors were not objective in their assessment of the financial statements, presumably because they were under pressure from the consulting side of the business (Arthur Anderson.) The principles at the firm wanted to keep the multi-million dollar contract with Enron, causing them to be less than independent in their audit.

By using an objective viewpoint when constructing financial statements, the result should be financial information that investors can rely upon when evaluating the financial results, cash flows, and financial position of an entity.

The Monetary Unit Principle

The monetary unit principle states that you only record business transactions that can be expressed in terms of a currency and assumes that the value of that currency remains relatively stable over time. When you are reading a U.S. GAAP prepared financial statement, looking at inventory, for instance, you know you are looking at a dollar figure, not a number of physical units.

What is Conservatism?

The conservatism principle says if there is doubt between two alternatives, the accountant should opt for the one that reports a lesser asset amount or a greater liability amount, and a lesser amount of net income. Thus, when given a choice between several outcomes where the probabilities of occurrence are equally likely, you should recognize that transaction resulting in the lower amount of profit, or at least the deferral of a profit. Similarly, if a choice of outcomes with similar probabilities of occurrence will impact the value of an asset, recognize the transaction resulting in a lower recorded asset valuation.

Under the conservatism principle, if there is uncertainty about incurring a loss, you should tend toward recording the loss. Conversely, if there is uncertainty about recording a gain, you should not record the gain.

The conservatism principle is the foundation for the lower of cost or market rule, which states that you should record inventory at the lower of either its acquisition cost or its current market value.

Practice Questions

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3.5: Accrual Basis Accounting

Learning Outcomes

- Explain the accrual accounting concept

What is Accrual Basis Accounting?

Imagine that you start a landscaping business in December. You hire a few employees and decide to operate as a sole proprietor for now. In December, you and your crew mow and edge 20 lawns (assume it's Florida or Arizona.) At each home you leave an invoice for $100 payable within 30 days. On December 31, at a party, an acquaintance asks you about your new business. If you were prone to share such information, you could tell your friend that you made $2,000, even if you hadn't collected any of it yet. This is the gist of the accrual basis of accounting: recognizing revenue as it is earned, as opposed to recognizing it as it is received. If you take the entire month of January off, doing no work, but you get paid by all of your December customers, you then have your $2,000 in cash. However, under the accrual basis of accounting, you already accounted for the revenue in December. You don't count it again in January. Conversely, if you opt to use a cash basis of accounting, you would recognize and report the revenue in January when you receive it, not in December, even though that's when you earned it.

The term "accrual basis" is based on the idea of accruing revenue, which means reporting it when it becomes a legally enforceable claim. To accrue is to come about naturally—it's the effect in cause and effect. You do the work, you have earned the revenue, and GAAP requires a company to report that revenue as it is earned. Your small landscaping business will likely not be subject to GAAP—in fact, the tax law may require you to report revenues and expenses on a cash basis, but, for publicly traded companies, auditors will only certify financial statements if they have been prepared using the accrual basis of accounting.

The critical point in this example is not how much you earned, but rather when you report it. That's why the time period concept in accounting is so important, so let's tackle that next.

What is the Time Period Concept?

Because we cut financial reporting into discrete time periods, usually a year or a quarter, we have to decide when to recognize revenue—in which period. For instance, let's say in the landscaping example above, you hired employees to mow and edge lawns, and you now owe them $500 for services they have rendered (ignore employment taxes for this example.) You'll pay them in January on the tenth for all work done in December, and then again on February 10 for work done in January, and so on. The question then arises: if you recognize the revenue of $2,000 in December, when you run your financial statements for that month, do you include the wages incurred but not yet paid as a cost of doing business that offsets the revenue for that month?

In other words, do you show for December $2,000 in revenue and $500 in expenses for a net income of $1,500, or do you show $2,000 in revenue for December and an expense of $500 in January when you pay the salaries of the workers for December?

The answer that the FASB came up with in creating GAAP was the former: show $2,000 in revenue and $500 in expenses for a net income of $1,500 for the month of December.

This can cause some timing differences between internal (managerial) accounting reports and external (financial) accounting reports. For instance, if you offer a commission to your employees based on cash collected, they wouldn't get commissions on $2,000 in December, even though financial accounting reports would show that as revenue earned. Assuming all the cash is collected in January (and assume no cash collected from any January sales) the internal reports would show $2,000 in revenue while the external would show revenue earned (whatever that might be.)

What is a Fiscal Year?

Many retail stores choose a fiscal year end that is different than the calendar year. One of the most popular fiscal year ends is the 52/53 week fiscal year, that would end on a particular day of a particular month. For instance, Macy's fiscal year ends on the Saturday closest to January 31, so for 2017 it ended on January 28, 2017 but for 2016 it ended on January 30. Many companies adopt a fiscal year that allows them to process transaction, like sales returns, letting the holiday dust settle before trying to manage the timing and recognition of both year end sales and expenses. As a corollary, the cut-off point is not as critical during the rest of

the year, only at the very beginning and the very end, unless the company is producing quarterly reports or wishes to have an accurate reflection of the timing and extent of transactions for monthly (probably internal) analysis.

What is the Difference Between Realizing and Recognizing Revenue?

In accounting, when we say we recognize revenue, we mean that we are recording it in the books on that date. In our landscaping example, we recognize revenue in December, even though we receive it in January. Receiving the income is the point at which we realize it.

Operationally, it works like this:

We record revenue as it is earned (recognize) and we also record a receivable, which is basically and IOU from the customer to us. We show the revenue as income on our income statement then. Later, when the cash is received, we eliminate the receivable, which is an asset to us because we own it and it is worth money, and we show a deposit in our bank account. Basically, the receivable (IOU) turned in to cash. Similarly, revenue is realizable when there is good reason to believe it will be collected, and that is the test for accruing revenue. In other words, in order for revenue to be recognized, it must be realizable—it must be fairly certain that the company will collect it.

Recognized Revenue

Technically speaking, revenue is an increase in assets or decrease in liabilities caused by the provision of services or products to customers. If you think back to the accounting equation, where Assets = Liabilities + equity, either an increase in assets or a decrease in liabilities will result in an increase in equity, meaning that the owners of the business have increased their stake—in essence, revenues are an increase in wealth. The business is like a wealth-generating machine, churning out increases in equity by producing goods or services that sell for more than they cost, hopefully. Net income, as you may recall, is the difference between revenues generate by the company and the expenses. Expenses are the ordinary and necessary costs of doing business, like wages, rent, and communications. Revenues minus (net of) expenses is net income, and a positive net income increases the wealth of the owners. It's that straight-forward.

Realized Revenue

Revenue is realizable when there is every good reason to believe it will be received. For instance, in some sales situations the customer is allowed to use the item for a period of time as a way to decide whether or not to buy. In that case, revenue from the sale may not be realizable. However, if the customer signs a sales agreement and title to the item passes to the buyer, there is a legal obligation for the buyer to pay and the revenue becomes realizable. When the customer pays, the revenue is realized. Recognition of the revenue usually happens when it is realizable, rather than when it is realized (although in a cash sale the two usually happen simultaneously.)

What is the Matching Concept?

There are two kinds of expenses: those directly related to producing income, and those that are period costs. The timing of expenses is determined by the timing of the revenue. The goal is to match expenses against the revenues, either directly or indirectly. This is called the matching principle and it's at the heart of accrual basis accounting.

For instance, in our landscaping example, the wages of our employees are both period costs and direct costs of generative revenue. However, if we received a business phone bill in January for our December marketing efforts, would we post that (recognize it) in December, when it was incurred, or in January, when we received it, or maybe even in February, when we pay it (assuming we pay it in February, of course.)

Accrual basis accounting requires matching expenses to revenues whenever possible. The matching principle requires that revenues and any related expenses be recognized together in the same period. Thus, if there is a cause-and-effect relationship between revenue and the expenses, record them at the same time. If there is no such relationship, then charge the cost to expense at once. This is one of the most essential concepts in accrual basis accounting, since it mandates that the entire effect of a transaction be recorded within the same reporting period.

Therefore, under the cash basis of accounting, we would post the phone bill in February, but under the accrual basis of accounting we would post it in December so that it shows as a cost of generating the $2,000 in December revenue, even though the whole bill

may not be directly related to the revenue, it still belongs in the same period as it was incurred. That's the basic rule: recognize expenses as incurred, matching them to revenue either by period or by direct effort.

Here is one more example of the matching principle:

Under a bonus plan, an employee earns a $10,000 bonus. The bonus is paid in 2018 based on 2017 results of operations as shown on the audited financial statements. Under GAAP, the bonus would be recorded and shown as an expense in 2017, matching it against 2017 sales revenue.

You may hear accountants talk in terms of debits and credits. Debit literally means left, and credit means right. Accountants use a two-column journal to record transactions, so the above bonus would be recorded like this in 2017:

Account	Debit	Credit
Bonus (expense)	5,000	
Accrued Bonus (liability)		5,000

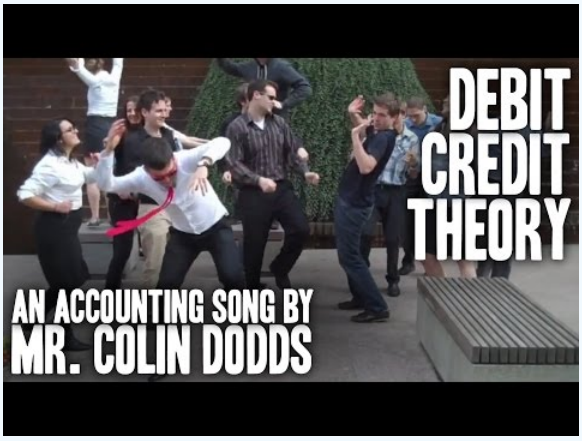
In this entry, the bonus is recognized before the cash payment to the salesperson actually occurs, along with a liability in the same amount. In the following month, when the company pays the bonus, it would record the following entry:

Account	Debit	Credit
Accrued Bonus (liability)	5,000	
Checking Account (asset)		5,000

The cash balance declines as a result of paying the commission, which also eliminates the liability. The reason your debit card is called a debit card is because the bank shows your balance as a liability because they owe your money to you—in essence, they are just holding it for you. A liability usually has a credit balance (balance on the right side of the ledger) and so when you spend money and they pay it out on your account, they debit your account (a debit offsets a credit.)

LEarn More

For more on debits and credits, watch the video below.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=156

Practice Questions

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3.6: Putting It Together- Accounting Theory

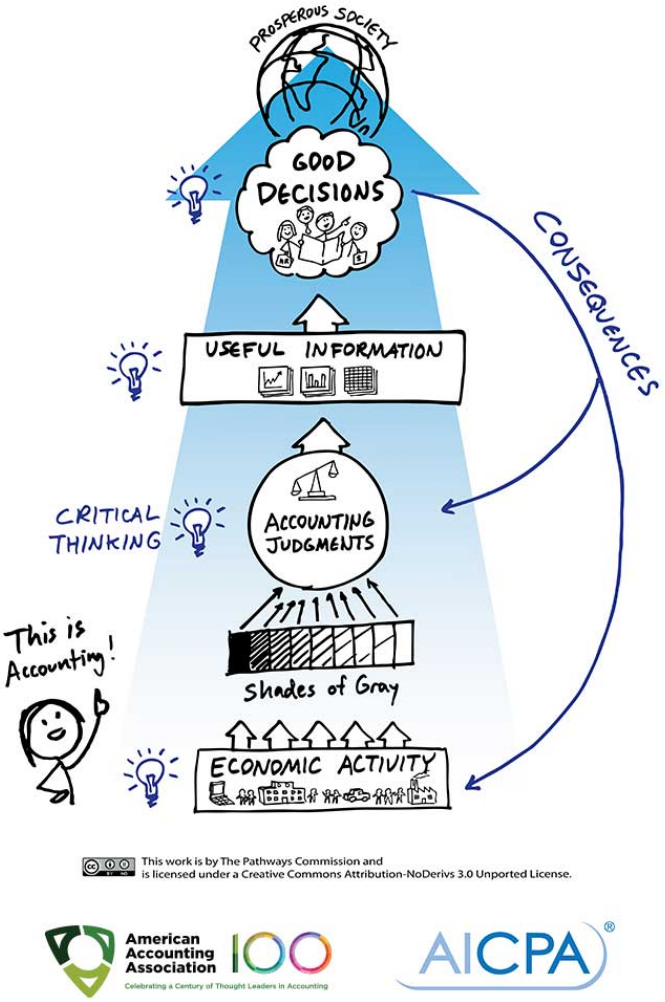
Accountants take massive amounts of data and turn it into useful financial information. It's the accountant's job to communicate that financial information, but it is the user's responsibility to learn the language in order to be able to use the information to make an informed decision, whether it is for long-term investing (as in your retirement plan) or for business planning and operating issues.

Accrual basis accounting may seem complicated. Why bother? Why not keep it simple and just report cash in and cash out? To answer those questions, let's think about the landscaping example from earlier in this chapter, but let's make our business this time a carrier, like FedEx and UPS. Assume your target market is Business to Business (B2B) so you do a lot of work on credit. In a summer month you haul packages and bill $1,000,000 to your customers as realizable revenue, and in November and December that amount is triple the summer average, but since you bill your customers, you collect the cash a month or two later. Accrual basis accounting is an economic measure of the health of your business, so we report $3,000,000 in revenue in November, even though it will be collected in December and January. In addition, under accrual basis accounting, we record the increased expenses, like jet fuel and wages, in the same month they are incurred, even though we are paying our suppliers a month later. Recognizing revenues as earned and expenses as incurred gives us an accurate indication of the amount of wealth we earned in November, without regard to the cash flows (this is why we have a statement of cash flows in addition to an income statement.)

So financial accountants follow the sometimes complex rules of accounting under GAAP in order to give reliable, consistent, and relevant financial information to outside users. In so doing, they use their best judgment about which accounting principles to apply in order to provide the best information in each situation. The same goes for managerial accountants who are providing information to internal users. Even though they don't have to follow GAAP, they are required by the demands of management to provide the same level of useful, timely, and reliable information.

All of this so that you, as a business owner or an investor, can make informed business and investing decisions.

In our society, a robust, well-run business adds to the overall quality of life by creating jobs, products, and opportunities, so it is important that the financial information the company produces is useful, relevant, and timely. And that, in a nutshell, is what accounting is all about.



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3.7: Assignment- Accounting Theory

This assignment is available for download as a Word Document.

Read the following scenario and complete the questions and tasks below.

Marcy recently started her first job after graduating from business school with her accounting degree. She is very excited to be working in her field and although she knows she still has a lot to learn, she already feels like she is getting a good feel for what it takes to be successful. She has been assigned to work under one of the senior accountants, Mrs. Bradlee, and so far, she has been easy to work with and very helpful. For the last several weeks Marcy has spent most of her time entering data into the firm's computer system in preparation for the issuance of their clients' annual reports. On Friday, as she is preparing to leave for the day her supervisor calls her into her office.

"Well, Marcy, still enjoying your work here with us?" Mrs. Bradlee asks.

"Oh, yes ma'am, very much. I know I am still new and have a great deal to learn, but I am very happy with my job," Marcy replies.

"That's good to hear, Marcy. We are all very happy that you are here and I think you will be a valuable asset to the firm. In fact, I have something that I would like for you to do for me. I understand you are available to work over the weekend, is that correct?" Mrs. Bradlee inquired.

"Yes, I am happy to come in over the weekend if you need me to!" Marcy replied.

"Excellent," Mrs. Bradlee said as she pulled a folder from her desk drawer. Handing the folder to Marcy she continued, "we identified some errors in the data that was entered for the Dale account and I would consider it a personal favor if you could get these numbers corrected over the weekend. I have already taken the liberty of alerting building security, so you won't need to worry about getting into the office. I don't expect anyone else to be here, are you okay with being in the office alone?"

Marcy took the folder from Mrs. Bradlee's outstretched hand and opened it to see what she had committed to. There were several pages of entries to be corrected, but Marcy breathed a sigh of relief when she realized that the work was not that different from what she had been doing for the last several weeks.

"Oh, I will be just fine. I should be able to get all of these corrections made in a few hours, ma'am." Marcy said.

"Well, then, that's that," said Mrs. Bradlee, smiling at Marcy.

Taking that as her queue to leave, Marcy gathered up the folder and her belongings and headed towards the door. Just as she got to the door Mrs. Bradlee spoke again.

"Oh, and Marcy, I would appreciate it very much if you didn't discuss this matter with your colleagues. It, ummm, might be an embarrassment to Mark Murphy. He made the original entries and I would hate for him to look bad in front of the other junior partners. You understand, I'm sure." Mrs. Bradlee said.

"Of course, Mrs. Bradlee, I wouldn't want Mr. Murphy to be put in a bad position. He has been very helpful and I really like him." Marcy replied.

"Then it's settled. If you just get these few minor corrections made over the weekend we will be back on track to get the Dale annual report out on time. And please make sure that you put in overtime for your hours. I will sign off on them personally on Monday morning." Mrs. Bradlee said as she turned her attention to the stack of phone messages on her desk.

Marcy thanked Mrs. Bradlee for giving her the opportunity to be of assistance as she walked out of her office, pulling the door closed behind her.

On Saturday morning Marcy got dressed and was seated at her desk at 8am. As she waited for her computer to boot up, she began looking through the documents Mrs. Bradlee had given her the day before. There were several pages of entries that had to be made and it slowly dawned on Marcy that all of the entries had something in common – they either increased revenue or decreased an expense. Several of the entries re-classified long-term debt as capital improvements.

"Well, these entries will totally change the financial position of the company," Marcy said to herself. "How could Mr. Murphy have made this many errors?" she thought. "Something about this isn't right," Marcie thought out loud. Slouching back in her chair she

suddenly found herself liking her job and Mrs. Bradlee less than she did when she had gotten up that morning.

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1. Putting yourself in Marcy's position, what do you do next? Consider the outcome of her various courses of action and the long-term effects of her actions.
2. What are the implications of the work Marcy has been asked to perform? Consider all of the stakeholders of accounting information when responding.
3. Why would someone in Mrs. Bradlee's position ask an employee to perform this kind of task?

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3.8: Why It Matters- Accounting Theory

Why learn about accounting?



Accounting is often called the language of business, and knowing the language is absolutely essential for any business person. You may have already been in a meeting with a customer, or the sales staff, or even the management of your company, where you heard accounting terms like “bottom line” and “gross profit.” In a sense, accounting is more than just a language. It’s also a way to keep score and to measure progress and accomplishment. Even more simply, things like a sales commission are directly based on accounting information.

Accounting terms and concepts pervade business, so learning the language, not just the words but the meanings, is essential for success. In this module you’ll delve into history, ethical dilemmas, and the legal implications of accounting, along with some of the essential nuts and bolts of accounting for business transactions. All this will give you a working knowledge of the venerable and ancient art of accounting—the language and the scorecard of business.

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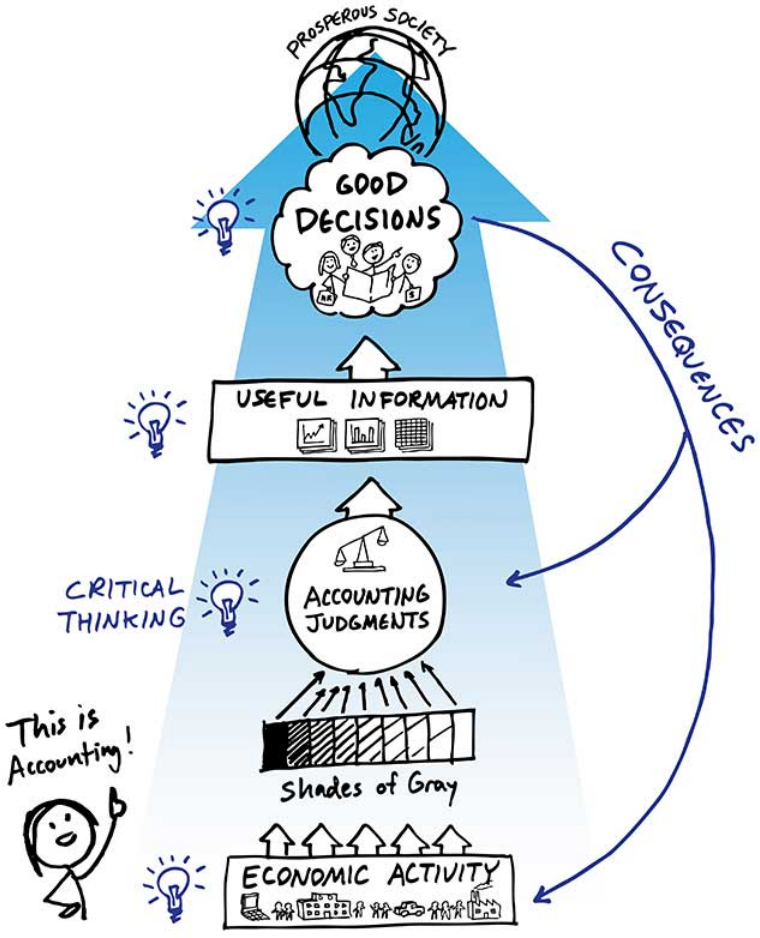
3.9: Introduction to Accounting

What you'll learn to do: define accounting

What we think of as accounting can be divided into two distinct functions: bookkeeping, and accounting. The bookkeeping function, recording transactions, is as old as commerce itself, having arisen as a necessity of recording for taxes, business, and investments. In fact, Luca Pacioli, and Italian mathematician who collaborated with Leonardo da Vinci, mentions double entry booking in his his 1494 "Summa de Arithmetica, Geometria, Proportioni et Proportionalita."

As the world of business grew and expanded, so did the complexity and variety of accounting practices, and so did the opportunity for profits and losses for investors. Today, accounting is the application of theoretical principles to the books and records of the company in order to produce useful information for decision-making, by following, in the U.S., Generally Accepted Accounting Principles (GAAP).

In this section, we'll define accounting, examine the financial standards, and describe the importance of ethics in accounting.



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3.10: Roles of Accounting in Business

Learning Outcomes

- Discuss the roles of financial and managerial accounting in business

What is Accounting?



Accounting is often referred to as the language of business. More formally, it is described as the information system that measures business activities, process the information into reports, and communicates the results to decision makers. You can also think of it as the scorecard of business. Most businesses are formed in order to make a profit, which in essence is an increase in the wealth of the owners, and the way to measure and report that increase in wealth is through accounting.

Balancing your checkbook is an essential accounting function if you want to know exactly how much money you have in the bank, but it's only a small piece of business accounting, because stakeholders such as business owners, investors, bankers, and other users of financial information want to know more. They want to know what the business owns, how much debt it has, how much revenue it generated, how much it cost the company to make that amount of revenue, and how much new wealth was generated. In addition, those stakeholders want to be assured that the financial reports are accurate, and not just made up numbers.

Learn More

To learn more, check out this page that discusses how to balance your checkbook.

The accounting profession in general can be divided into two distinct fields: financial accounting, and managerial accounting. Financial accounting focuses on external users, such as lenders (including vendors that extend credit to the company), regulatory agencies (such as the Internal Revenue Service), and investors. Managerial accounting focuses on internal users, such as production managers, sales managers, and employees. For example, a sales report used to calculate and pay commissions would be an internal, managerial accounting document, while a balance sheet informing shareholders of the assets and liabilities of the company would be an external, financial accounting report.

Financial Accounting

Since financial accounting is geared toward parties outside of the organization, it needs to be useful, understandable, accurate, and accessible. At times in history, certain organizations, like the now iconic Enron, Corp., have been less than faithful in their financial representations to the public, and investors, including individuals, have seen millions of dollars of investment become worthless. This still happens, despite the fact that long before Enron and other financial disasters, the government had stepped in and, with the help of the American Institute of Certified Public Accountants, created an accounting framework, commonly known as Generally Accepted Accounting Principles (GAAP), that provide a set of standard accounting rules for the industry to follow. Publicly traded companies are required to submit their financial statements to an examination by a Certified Public Accountant (CPA) before submitting them to the public with a letter from the CPA firm attesting to the fact that the financial statements are in compliance with GAAP.

Managerial Accounting

Unlike financial accounting, which is governed by a set of published guidelines, managerial accounting is governed by what management needs to know. It needs to be just as accurate and useful, and it arises from the same financial data, but it also includes other sources such as marketing data, volume data, demographic data, production data like turn-around time on a process, time and cost budgets, and cost/benefit analysis on equipment purchases. Some reports are standard, produced every month so that management can stay on top of trends, both good and bad, and some are ad hoc, as needed.

What Do Accountants Do?

Accountants turn data into information. Next time you are at Home Depot or a large department store like Macy's or even ordering on-line through Amazon, try to imagine the sheer volume of financial data that is being generated each day as customers buy products. In addition to recording the sale itself, the store has to buy the product in order to sell it to you, or they have to make it (i.e. McDonalds) and so they incur costs that have to be tracked and reported. They have to pay employees, rent, insurance, utilities, transportation costs, outside consultants like accountants, and an incredible number of other costs of doing business. A common saying in the business world when it comes to costs like that is, "You have to spend money to make money." All of that is data.

Information is the data sorted, compiled, and turned into useful reports, either managerial or financial. That is the job of the accountant. Financial accountants follow GAAP to produce statements that summarize the data into four general categories: the income statement, that tells how much wealth was generated by the company during a certain time period, usually a year; the statement of owners' equity, that tells how much the owners put in to the company and how much they took out; the balance sheet, that shows the company's assets (what it owns) and it's liabilities and equity (who owns it), and the statement of cash flows, that describes in detail the changes in the cash balance from the beginning of the reporting period to the end. We'll take a look at each of these in a later section. These are published in an annual report available to the general public.

One of the drawbacks of financial accounting from a manager's perspective is that the information represents past performance. This is useful in giving out bonuses, and of course in reporting to the public, but proactive internal decisions have to come from the most current data available, and have to be tailored to the decision being considered. That is the purview of the managerial accountant. For instance, if management is considering replacing a machine to improve production, a managerial accountant could produce an ad hoc report comparing the cost of the new machine with lower maintenance costs and higher production yields against keeping the old machine and putting more dollars into maintaining and improving it, and maybe even options to lease a machine or outsource that particular process.

In summary, the difference between financial accounting and managerial accounting can be summed up by examining the users of the information:

Financial Accounting – people and organizations outside the firm	**Managerial Accounting – people within the firm**
Should I extend credit to this business?	How much product should we produce this month?
Is this business profitable? What does it own? How far in debt is it?	How much cash do we need to set aside to pay our debts?
Should I invest in this business?	How do our actual costs compare to our budgeted costs?

What is Finance?

Finance and accounting sometimes get lumped into one category in conversations, but in business there is a difference between the two. If you think of balancing your checkbook as an accounting function, then planning to buy a car, shopping for it, and getting a loan to pay for it would be a finance function. Finance activities in business are more future focused, and, like managerial accounting, the information is only available to inside users such as purchase managers, the controllers, the chief executive officer, and other people in charge of short and long-term financial planning. However, finance managers use both financial accounting and managerial accounting information to help make decisions, just as you would use your own financial information if you were planning to buy a car.

In short, the most distinctive characteristics of financial accounting are its focus on past performance and it's availability to the general public. Both managerial accounting reports and information generated by the finance department are rarely shared outside the organization.

Practice Questions

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3.11: Financial Accounting Standards

Learning Outcomes

- Summarize the background and sources of financial accounting standards

The Importance of Accounting Standards

Dutch tulip bulbs were the Bitcoin of the early seventeenth century. Traders were making unheard of profits buying and selling in the backrooms of taverns and inns. Prices doubled and tripled within months. In 1637 the market collapsed, mostly because even the wealthiest speculators could no longer afford a single bulb. Purchases came to a screeching halt, and so did sales, and the trade business collapsed almost overnight, leaving investors broke.

By the turn of the twentieth century, corporations had become a primary moving force in the American economy, and the general public was investing with reckless abandon in everything from railroads to automobiles to agriculture. The frenzy caused the market to rise to astronomical levels, and it looked at the time as if it would never slow down. It was the age of economic exuberance. A few savvy investors spent the time and energy needed to research each investment, but most investors simply rode the rising tide, buying and selling stock on the New York Stock Exchange, which has started as a small merchant trading club in 1792.

Generally Accepted Accounting Principles

The bubble popped in August of 1929. Stock certificates became worthless as companies went bankrupt and disappeared. In the aftermath, the government moved to rebuild confidence in the financial markets by imposing stricter guidelines for financial reporting. The accounting profession was faced with a choice–self-regulate or accept government regulation. The end result was a little of both. Congress created the Securities and Exchange Commission (SEC) to regulate the financial markets, and the SEC charged the American Institute of Certified Public Accountants (AICPA) with the task of developing financial accounting standards in the private sector. The standards-setting committees of the AICPA struggled with both internal strife and the growing complexity of the task of creating a unified structure, so the association created a separate, independent body in 1971 called the Financial Accounting Standards Board (FASB) that still operates today, discussing, creating, and implementing Generally Accepted Accounting Standards (GAAP). These are the standards that financial accounts and the general public rely upon to ensure that financial statements are universally understandable and usable.

International Financial Reporting Standards

The United States is one of the few countries that follows its own accounting principles. More than 116 other nations have adopted International Financial Reporting Standards (IFRS) that are created by an International Accounting Standards Board (IASB). IFRS are based on broad principles as opposed to the more specific guidance of GAAP. For instance, GAAP requires companies to record and report assets at historical cost. IFRS allows a company to report assets at market value.

The SEC requires publicly traded companies to follow GAAP, and although there have been discussions in the industry about adopting IFRS, currently there is little movement in that direction.

The Internal Revenue Code

In addition to GAAP, companies must comply with an entirely different set of rules to report income to the Internal Revenue Service annually for tax purposes. The original Internal Revenue Code (IRC) of 1939 was a compilation of various tax statutes enacted during the early part of the twentieth century. Since then, the IRC has undergone two major re-codifications, one in 1954 and another in 1986. The 1986 act was extensive enough to warrant re-naming the code as the Internal Revenue Code of 1986.

In addition to Federal income tax, companies are often subject to a variety of state and local taxes, each with slightly different rules and regulations.

Practice Questions

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3.12: Ethics and Accounting

Learning Outcomes

- Demonstrate how ethics applies to the field of accounting

The Role of Ethics in Accounting

Enron was the rising star of the energy sector in publicly traded companies in the late twentieth century. In 2000, it's annual revenue reached $100 billion, and it ranked as the seventh-largest company on the Fortune 500 and the sixth-largest energy company in the world. The company's stock price peaked at $90 that year, but the Cinderella story was about to unravel.

Top executives, often called the "C Suite" because they carry titles like Chief Executive Officer (CEO) and Chief Financial Officer (CFO), had been craftily overstating revenues and assets through the creative application of accounting principles and by using shell companies to raise capital. A simple article in Fortune magazine asked the question: Is Enron overpriced? As investors began to see through the multiple layers of deceptions, the stock price fell, top executives jumped ship, and the SEC launched an investigation. By the end of 2001, Enron was bankrupt and investors had lost billions of dollars. For many employees who had invested their retirement funds completely in company stock, it was their entire life savings.



After the crash of 1929 and the formation of the SEC and the FASB, how does this kind of fraud still happen?

Companies are run by people, and people can succumb to pressure. With 800 million shares of stock outstanding, a downward shift of just $1 per share for Enron would wipe out $800 million of company value. Conversely, when the stock rose in value from $80 to just over $90 per share, investors made millions.

What Is Ethics?

Ethics is the code or moral system that provides criteria for evaluating right and wrong. As Potter Stewart puts it, "Ethics is knowing the difference between what you have a right to do and what is right to do."

As with most professions, accounting's ethical standards are articulated in a published code of ethics. These codes provide guidance, but ethical or unethical behavior remains a personal decision. Accountants, like others operating in the business world, can be faced with ethical dilemmas almost daily, some of which are complex and difficult to resolve. For instance, as with Enron, the capital markets' focus on periodic profits may tempt a company's management to bend or even break accounting rules in order to inflate reported net income and thereby please stakeholders.

The AICPA has its own Code of Professional Conduct that prescribes the ethical conduct members should strive to achieve. Similarly, the Institute of Management Accountants (IMA)—the primary national organization of accountants working in industry

and government—has its own code of ethics, as does the Institute of Internal Auditors—the national organization of accountants providing internal auditing services.

The AICPA issued guidance to help CPAs solve ethical dilemmas not explicitly addressed in the code. Even though this guidance is for CPAs, it makes sense for anyone facing an ethical dilemma:

1. Recognize and consider all relevant facts and circumstances, including applicable rules, laws or regulations,
2. Consider the ethical issues involved,
3. Consider established internal procedures, and then
4. Formulate alternative courses of action.

After weighing the consequences of each course of action, you select the best course of action based on your own judgment.

If, after exhausting all reasonable possibilities, the ethical conflict remains unresolved, the guide suggests that you should consider withdrawing from the situation and perhaps, if the dilemma is serious enough, consider the stronger response of resigning from the client or employment position.

Enron

The spectacular crash of Enron is not an isolated incidence. In late 1999, telecommunications giant WorldCom began showing declining revenues, and a subsequent audit of the 2001 and 2002 financial statements showed that WorldCom had violated GAAP, overstating revenues. WorldCom filed for bankruptcy in July of 2002 and is still today seen as one of the biggest bankruptcies in history.

Ironically, but not coincidentally, both Enron and WorldCom during those years had been audited by Arthur Anderson, one of the largest CPA firms in the world. If the system had been working correctly, auditors at Arthur Anderson would have caught the fraudulent reporting and corrected it before the financial statements were published, but there are tremendous financial pressures at work behind the scenes. In addition to auditing companies, Arthur Anderson had a lucrative consulting business that they did not want to lose. In order to keep their clients happy, Arthur Anderson auditors looked the other way during the financial statement audits. However, unethical behavior caught up the Arthur Anderson. By the end of 2002, the firm, once one of the largest public accounting firms in the world, was effectively out of business.

A significant fallout from the Enron/WorldCom era was passing of more legislation enacting stricter controls and standards in the form of the Sarbanes-Oxley Act (SOX) that created a new oversight committee and enacted stiffer penalties for falsifying financial statements. Even so, ethical violations continue to slip by the watchdogs. Companies like Volkswagen, that used software to cheat emissions controls in order to sell more vehicles, and Wells Fargo, that created millions of false bank accounts in order to boost sales numbers, loom large in the popular press, but there are smaller instances of fraud occurring all the time that don't make the national news. Again, it's not the company that is defrauding the public, it is the people at the helm. At it's root, ethical violations are personal decisions.

Public Accounting firms, like Arthur Anderson, are supposed to catch these frauds and misstatements during the audit process, where accounting staff pour over the books and records, verifying the financial statements and making sure that all debts, assets, and even contingent liabilities such as lawsuits are recorded and reported according to GAAP.

Practice Questions

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3.13: Introduction to Users of Accounting

What you'll learn to do: Discuss the financial consequences of various organizational structures

Accounting information allows individuals to understand the financial health and stability of a business. Companies typically share their accounting information via financial statements, which helps users measure performance and make better financial decisions. Several types of people utilize financial statements, but they generally fall into two major categories: internal users and external users.

In this section, you'll learn to outline the needs and roles of various users, differentiate between the major organizational structures, describe the effects of different forms of doing business, and summarize information in an annual report.

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3.14: Users of Accounting Information

Learning Outcomes

- Outline the variety of accounting roles internal and external to a business

The Focus of Financial Accounting: External Users



The most common external user of financial information is the investor, be it institutional or individual. If you are saving for retirement and your money is invested in mutual funds via a 401(k), you may in fact own a tiny fraction of FaceBook, or Home Depot, or any number of publicly traded companies. Or, you may have your own investment account on the side, picking your own stocks. However, most of the investors in the stock market are retirement funds and mutual funds, and those funds are run by people, like you, who need reliable financial information in order to make an informed decision.

The SEC requires public traded companies to undergo, at their own cost, an annual financial audit by independent Certified Public Accountant. A financial statement audit is the examination of an entity's financial statements and accompanying disclosures. The result of this examination is a report by the auditor, attesting to the fairness of presentation of the financial statements and related disclosures. The audit report is included in the annual filing of form 10-K with the SEC and in the company's annual report that includes the financial statements.

Similarly, lenders typically require financial statements for any entity to which they lend funds. Suppliers may also require financial statements before they will be willing to extend trade credit. For non-publicly traded companies, CPAs will often prepare statements under a standard of review that is less stringent than an audit, but that still gives the external user some level of confidence that the statements are prepared in compliance with GAAP.

External Users (financial accounting)	Internal Users (managerial accounting)
Institutional investors	"C" Suite
Vendors	Budget office
Individual investors	Management
Creditors (lenders)	Finance department

Internal Users of Accounting Information

While external users are waiting for historical data to be presented in the form of financial statements and all the related disclosures, internal users, mainly management of the company, are dipping in to the accounting data in real time. Production managers want to know what the product costs to build right now, and how much and how many to build to meet future demands and sales goals. Sales managers want to know both historical sales by quarter and by region, and what the predicted demand will be. Upper management wants to know profit margins, overhead costs by division and by function, and how the company is progressing against the plan (budget.)

Finally, the budget office often spans the gap between external and internal users by creating prospective financial reports (budget) and comparing those budgeted reports against actual results (the financial statements, audited or unaudited.)

All of these users, internal and external, have something in common: they are decision-makers seeking accurate, reliable, relevant information.

Practice Questions

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3.15: Organizational Structure

Learning Objectives

- Differentiate between functional and divisional organization

What is Organizational Structure?

Organizational structure is the built-in hierarchy that defines roles, responsibility, and supervision. It's the plan that outlines who reports to whom and who is responsible for what, and it falls between two ends of a spectrum:

- A centralized structure that gives most of the authority and decision-making power to the team at the top, or
- A decentralized structure distributes authority and decision-making power at lower levels, which might include departments, groups, or business units.

In addition, structure can be classified as either functional or divisional.

Functional Structure

Most small to medium-sized firms structure themselves around basic business functions such as marketing, operations, and finance and accounting. For instance, a sole proprietor performs all the functions all the time, and even a small partnership of two or three people will end up being functionally organized. But to fully understand the functional form of organization, it helps to look toward the other end of the spectrum, to divisional structure.

Divisional Structure

CalPortland Company (CPC), one of the largest building materials providers on the West Coast, is a privately-held company that employs over 2,000 people, operating 3 cement plants, 10 cement terminals, 76 ready mix plants, 4 asphalt plants and over 2500 ready mix trucks. It has operations in Alaska, Washington, Oregon, California, Nevada and Arizona as well as in British Columbia and Alberta. Rather than a functional structure, that would have one accounting department, one sales department, and one production department for all locations, CalPortland is organized regionally. The greater Seattle and western Washington state forms a division with it's own safety manager, accounting staff, sales staff, and management. British Colombia forms another division, and Oregon another. CPC organized itself geographically, but that's not the only way divisions can form. Other companies may form divisions around product lines, or service types.

Functional Structure, revisited

A centralized accounting function across all the product lines, geographic locations, and other divisional kinds of structures, can take advantage of both economies of scale (to a certain point) and centralization of information without having to pry it from the alternative, many divisional accounting departments with sometimes competing interests. On the other hand, too many transactions processed in one centralized department can bog down the system, making it slower to react, adjust, and even provide information. If you've ever waited six weeks for some simple paper work to be processed, like a loan application or a refund check from the IRS, you're probably dealing with a huge organization that is organized functionally, rather than by divisions.

Culture

Business people often say that culture trumps mission. Culture develops organically over time from the cumulative traits of the people the company hires. It encompasses the everyday social interactions among employees that transcends formal jobs and job interrelationships, effectively altering a company's intended formal structure. Great managers and leaders can cultivate a strong, affirmative organizational culture, but culture can also reinforce office politics that put the interests of individuals ahead of those of the firm and can disseminate distorted or inaccurate information.

Wells Fargo



How does this related to sales management and accounting? Let's examine Wells Fargo's now notorious account proliferation fiasco as an example of how structure can affect management, and as a lesson of culture trumping stated mission, vision, and values.

Although Wells Fargo doesn't have a formal mission statement, it does have Vision and Values statements. Here's the company vision:

Our vision

We want to satisfy our customers' financial needs and help them succeed financially.

This unites us around a simple premise: Customers can be better served when they have a relationship with a trusted provider that knows them well, provides reliable guidance, and can serve their full range of financial needs.

And the five values:

Our values

Five primary values guide every action we take:

What's right for customers. We place customers at the center of everything we do. We want to exceed customer expectations and build relationships that last a lifetime.

People as a competitive advantage. We strive to attract, develop, motivate, and retain the best team members — and collaborate across businesses and functions to serve customers.

Ethics. We're committed to the highest standards of integrity, transparency, and principled performance. We do the right thing, in the right way, and hold ourselves accountable.

Diversity and inclusion. We value and promote diversity and inclusion in all aspects of business and at all levels. Success comes from inviting and incorporating diverse perspectives.

Leadership. We're all called to be leaders. We want everyone to lead themselves, lead the team, and lead the business — in service to customers, communities, team members, and shareholders.

Take special note of the first and the third values, along with the vision – to help customers succeed, to be a trusted provider, to do what is right for customers, and to be committed to the highest ethical standards. And yet, in 2017, news broke that sales staff in the Community Bank division had been opening accounts for more than a half decade without customers' permission. In addition, the firm's consumer operations revealed that the bank had charged as many as 500,000 customers for auto insurance they didn't need. Seventy senior managers and 5,300 employees lost their jobs and the firm was charged a fine of $185 million.

Learn More: Wells Fargo by the numbers.

The sales-driven business model, coupled with the de-centralized divisional organizational structure allowed sales managers to run unfettered by higher management, who maintained a "run it like you own it" deference to the divisional managers. Divisional organizational structure itself isn't inherently bad, and neither is functional organization. Each has to be assessed and used according to its strengths and weaknesses. Understanding those opportunities and challenges is an essential part of the management function.

Functional and divisional organizational structures comprise two ends of a vast spectrum. In between are variations like virtual, international, matrix, learning, and team structures, each with certain strengths and weaknesses. The one thing all these structures

have in common is that they are always subject to the effects of company culture. Remember, culture can trump mission, vision, values, and even formal organizational structures.

Practice Questions

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3.16: Forms of Doing Business

Learning Outcomes

- Describe the legal implications of a business' organization on its accounting

As we discussed in the prior section, most small businesses are organized functionally. As a business grows, it tends to gravitate toward a divisional structure, often landing somewhere between the two. In addition to the formal and informal internal structure, however, there is a legal side to the business organization.

Many small businesses in the United States are classified as sole proprietorships, which, just like it sounds, means that one person is the owner and is responsible for all the debts and is the beneficiary of all the profits. A sole proprietorship can have employees, can secure debt, buy assets, sell goods and services, and do anything that any business does. It can even grow large, with revenues in the hundreds of millions of dollars, but that kind of volume is rare is a sole proprietorship, because it takes more business acumen and attention to grow to that size than a single person, even a talented individual, possesses.

The single biggest drawback to a sole proprietorship is that the legal liability for debts and lawsuits (suppose someone slips and falls in your store) lies with the owner. A sole proprietor is not separate from the business, and so the owner's personal assets are at risk if the business gets into trouble. The proprietor is the business. However, a sole proprietorship is easy to set up, simple to run, and the profits flow through the business to the owner, reported on the proprietor's Federal and state income tax returns as self-employment income, and is then subject to both the employer and employee portion of Federal payroll taxes, in addition to Federal income tax. The tax issue could be a benefit or a burden, depending on the tax rates on the other forms of doing business.

Adding an additional owner, or two, or even more, transforms a sole proprietorship into a partnership. A general partnership looks for tax purposes much like a sole proprietorship, with the added challenge of splitting profits and losses between partners. There's no steadfast legal rule on how that is done—it's up to the partners to figure that out and account for it. There is one additional legal issue worth noting with a general partnership; any general partner may make a business decision (or blunder) that binds all of the general partners. Thus, the idea of the limited partnership was born. Limited partners are sometimes called silent partners, because they invest their money in the business but have no say in how it is run, thus they are sheltered from the general partnership liabilities and decisions. In addition, any time a partner comes on board or leaves, legally the old partnership dissolves and a new one has to be formed, and often a new partner can only be admitted upon approval of the existing partners, making continuity of the partnership sometimes problematic. That's why every partnership should have a written agreement covering a wide variety of terms, such as admitting a new partner, divvying up profits and losses, distribution to the owner, and dissolution.

Most large companies though are incorporated. The word incorporated literally means "embodied." In order to form a corporation, the owners file articles of incorporation with a state government and an artificial person is created. A corporation is a separate legal entity, able to buy and sell property, to be sued and to sue others, and to engage in business and commerce. Because it is a separate legal entity run by a board of directors who then delegate the day to day business to the "C suite" of leadership (CEO, CFO, etc.), owners are protected from debts, illegal acts, lawsuits, and all the myriad challenges that sole proprietors and general partners face in running a business. Corporate owners, called shareholders or stockholders, simply invest money in the business in exchange for a return on that investment. Profits are reported and taxed at the corporate level, If the corporation pays out profits to shareholders, the shareholders report that income as taxable (so it is, in essence, taxed twice). Distributions of profits from a corporation are called dividends.

In addition to these three basic forms of doing business, there are a myriad of alternatives and variations, the most notable of which is the Limited Liability Company (LLC). An LLC is much like a partnership. The partners are usually called members, and the LLC can elect to be taxed as a partnership is, with the profits reported on the partner's individual income tax returns, or as a corporation, where the profits are taxed at the corporate level and distributions to members are dividends that are taxed again at the individual level. Of course, if an LLC or a corporation decides to retain income in the company for operating purposes and future growth and expansion, the double taxation is not an issue. The same holds true for S-Corporations, which are small corporations (100 shareholders or less) that elect to be taxed as a partnership. Other forms of ownership include Professional Service Corporations (PSC), Co-op for farms, factories, and even apartment buildings, and Publicly Traded Partnerships (mostly oil and gas companies.) In addition, some firms, like Kahn Academy, the Red Cross, and many colleges and private school, apply for and are

granted to be exempt from tax. These not-for-profit entities have no shareholders, since they are held in the public trust, and the excess of revenues over expenditures have to stay in the organization to further the exempt purpose, like education, health, and social justice. However, most businesses can be categorized into one of the three main categories: corporation, partnership, and sole proprietorship.

Organization Type	Number of Organizations in U.S.
C-Corporations and S-Corporations	3.9 million
Partnerships	0.7 million
Sole Proprietors	0.9 million

But why would an investor buy shares of stock in a corporation if the business was not paying out earnings in the form dividends? The answer is growth—specifically, growth in the price of the stock on the open market.

FAceBook

Take FaceBook for example. Mark Zuckerberg started FaceBook in his dorm room in 2004 with no real capital and a single, informal partner—his roommate Eduardo Saverin. As the site grew in popularity, Zuckerberg and Saverin formalized their arrangement by registering in Florida as a Limited Liability Company.

As investors came on board, the company incorporated, still keeping it's highly centralized management style and functional organizational structure. The initial public offering of stock (IPO) on May 18, 2012 generated $16 billion, with shares selling at just over $38 each. The proceeds from the IPO went directly into the company coffers to fund future expansion, but subsequent trading of those shares of stock issued are between investors who are banking on FaceBook's continued success (if they are buying) or who are taking their gains and profits (if they are selling). Just under six years later, the stock was trading at a high of over $190 a share. An investor who purchased $10,000 worth of stock during the IPO could have sold that stock in early 2018 for $50,000, making a $40,000 profit for an annualized return on investment of over 32%.

Of course, not every company boasts grand gains. Even the most astute investors lose money on some stocks. That's why the accounting information that these publicly traded companies provide to the marketplace in the form of quarterly and annual reports is so important. Investors, lenders, and vendors extending credit are relying on that information to make informed judgments and rational financial decisions.

Below is a summary of forms of business ownership and organization:

Organization by Type	Sole Proprietorship	General Partnership	Limited Partnership	Limited Liability Company (LLC)	C-Corporation	S-Corporation
Ownership	One person	Two or more	At least one general partner plus or one or more limited partners	One or more members	Virtually unlimited number of shareholders	No more than 100 stock holders
Capital	Generally comes from personal assets of owner	Generally comes from personal assets of owners and ability to borrow	Limited partners generally provide capital	Members provide capital, limited ability to borrow	Capital can be raised by selling shares on the open market, also debt issuance	Members provide capital, limited ability to borrow
Liability	Owner liable for all legal obligations	Partners are jointly and severally liable	General partners are jointly and severally liable but limited partners are not	Members are not liable for LLC legal obligations	Corporation is a separate legal entity. Shareholders are not personally liable for corporate obligations	Corporation is a separate legal entity. Shareholders are not personally liable for corporate obligations
Taxation	Net income taxed at the personal level	Net income taxed at the personal level	Net income taxed at the personal level	Can elect to be taxed as a partnership or a corporation	Net income taxed at the corporate level	Net income taxed at the personal level
Distributions to owners from profits	Not taxed	Not taxed	Not taxed	Depends on tax election	Taxed as dividends	Not taxed
Other	Easy to form and account for, no continuity	Relatively easy to form and account for, some continuity	More difficult to form and account for, some continuity	More difficult to form and account for, some continuity	Most difficult to form and account for, generally continuous	More difficult to form and account for, some continuity

Practice Questions

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CHAPTER OVERVIEW

4: Financial Statements of Business Organizations

4.1: Bookkeeping Terms and Phrases
4.2: Bookkeeping Journal Entries
4.3: Relationships Between Financial Statements
4.4: Key Information in Financial Statements
4.5: Introduction to Analyzing Data from Financial Statements
4.6: Reporting Inventories
4.7: Reporting Current Assets
4.8: Reporting Noncurrent Assets
4.9: Reporting Stockholder Equity
4.10: Reporting Unearned Revenue
4.11: Why It Matters- Financial Statements of Business Organizations
4.12: Reporting Expenses
4.13: Introduction to Other Financial Components
4.14: Core Financial Ratios
4.15: Calculating Return on Investment
4.16: Calculating Return on Equity
4.17: Other Key Ratios
4.18: Calculating Profitability Ratios
4.19: Limitations of Financial Statements
4.20: Putting It Together- Financial Statements of Business Organizations
4.21: Assignment- Financial Statements of Business Organizations
4.22: Introduction to Financial Statements
4.23: Transactions
4.24: Accounting Equation
4.25: Account Categories
4.26: Double Entry Bookkeeping System
4.27: Structures of Key Financial Statements
4.28: Introduction to the Bookkeeping Process
4.29: Expanded Accounting Equation

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4.1: Bookkeeping Terms and Phrases

Learning Outcomes

Define common bookkeeping terms and phrases

In order to learn to speak the language of business (accounting), it is necessary to familiarize yourself with some of the most common terms and phrases used by bookkeepers and accountants.

- **Account**: An account is the physical record of the transactions incurred related to an asset, liability, revenue, expense, etc.
- **Accounting Cycle**: An accounting cycle is the series of steps to be followed while preparing financial statements. The steps in the accounting cycle are budgeting, journal entries, adjusting entries, ledger posting, preparing financial reports, and closing of accounts.
- **Accounts Payable**: Accounts payable are those accounts wherein the business has an obligation to pay for receiving goods or services. They are classified as a liability.
- **Accounts Receivable**: Accounts receivable are those accounts where the business can owe money for providing goods or services. They are assets.
- **Accrual Concept**: Accrual concept is one of the core accounting concepts. Accrual concept states that a economic event should be recorded in the period in which it is incurred rather than when it is paid for or when cash is received in return. This can apply to assets, liabilities, income, expenses, inventory, payroll, taxes, revenue and interest.
- **Asset**: Asset is something that is owned by a business that has commercial value or exchange value.
- **Balance**: Balance is the difference between the credit and the debit sides of an account.
- **Balance Sheet**: A balance sheet is the list of all the assets and liabilities of the business.
- **Cash**: Cash refers to the liquid money available with the business in the form of notes and coins for the purpose of payment.
- **Cost Assignment**: Cost Assignment is the assigning of costs of an account to the various accounts that are responsible for incurring the cost.
- **Credit:** Credit is an arrangement between a buyer and a seller for deferred payment on goods and services. A credit entry is an entry, which eventually will reduce assets or increase liabilities.
- **Debit:** A debit is an entry on the left side of a ledger account, which eventually increases the amount of assets or expenses or decreases the liabilities, revenue, or the net worth.
- **Dividend :** Dividend is a portion of the earnings of the business that is paid to the shareholders of the company.
- **Earned Income:** Earned income is the income earned by selling goods and services.
- **Expenses:** Expenses are daily costs incurred to run and maintain a business.
- **Gross Profit:** Gross profit is the excess of sales over production or sales costs.
- **Inventory:** Inventory is the stock of raw materials, work in progress or finished goods/merchandise available for sale
- **Liability:** Liability is a loan or a debt for the business that needs to be discharged.
- **Net:** Net is the final amount calculated after all the necessary deductions are made to the gross amount.
- **Operating Expenses:** Operating expenses are the general and administrative and selling expenses of the business.
- **Payroll:** Payroll is the list of all the employees in the organization and their salaries.
- **Profit:** Profit is the excess of income over expenses.
- **Revenue:** Revenue is the money that comes in on account of sales of goods or provision of services.

This is far from a comprehensive list of all of the phrases and terminology associated with bookkeeping. For additional terms and their definitions, click on this link: Glossary of Accounting Terms and Definitions.

practice questions

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4.2: Bookkeeping Journal Entries

Learning Outcomes

- Construct bookkeeping journal entries based on given parameters

Entering Transactions in the Journal

The financial statements that are the end product of the accounting cycle are only as good as the journal entries that happen at the beginning of the cycle. In order to better understand how bookkeeping entries are constructed, here is a simplified case study of the accounting process, starting with the daily log of transactions—the journal.

On January 10, you start a gift shop called Holiday Gifts. The first thing you do file for an assumed business name with the state and then, when you get the business name, you go to a local bank and make a $10,000 transfer from your personal checking to a new business checking account. In order to keep track of your financial results, you decided to follow GAAP and best bookkeeping practices, so you buy an accounting journal and make the following entry:

Jan		Debit	Credit
10	Checking account	5,000	
	Capital Contributions		5,000

Note that you have written the debit portion of the entry first, and that you indented the account name for the credit entry, according to common practice. You decide to wait for a few more transactions before posting to the general ledger.

On the 12th, you pay insurance in the amount of $600 and you journalize the transaction as follows:

12	Insurance Expense	600	
	Checking Account		600

On January 15 you paid $1,000 in rent for the next 5 months ($200 per month for January through May).

The journal entry to record both the rent paid in advance and the rent for the current month would be:

15	Prepaid Rent (an asset)	800	
	Rent Expense (for January)	200	
	Checking Account		1,000

On January 16 you bought 10 picnic baskets to resell. The vendor gave you 30 days to pay in full. You paid $60 each for them and you plan to resell them for $100 each.

The journal entry to record the purchase of inventory would be:

16	Merchandise Inventory	600	
	Accounts Payable (a liability)		600

On January 20 you hired a part-time sales person to mind the store so that you could spend time building the customer list. Your sales person is paid twice a month on the 10th and 25th and will start immediately.

No journal entry in needed for this activity since it did not rise to the level of a financial transaction.

On January 21 you borrowed $15,000 from the bank for working capital.

21	Checking Account	15,000	
	Note Payable		15,000

On January 30 you sold 4 picnic baskets to various cash-paying customers.

30	Checking Account	400	
	Merchandise Sales (a revenue account)		400
30	Cost of Goods Sold (an expense)	240	
	Inventory (an asset)		240

Note in the last entry on the 30th we reduced the amount of inventory we are reporting as having on hand (an assets) by the amount of picnic baskets we sold, and matched that as an expense against the sales price. That specific matching concept results in an amount accountants call Gross Profit. Gross profit is the sales price of an item less its cost. In this case, the Gross Profit per item is $40, and the total Gross Profit for January was $160.

On January 30 you paid $2,750 cash for a small travel trailer that will serve as a mobile store. You expect it to last for five years and then you'll sell it for about $750.

20	Furniture and equipment (an asset)	2,750	
	Checking account		2,750

Posting Entries to the Accounts

Once all the transactions for the month are journalized, they are posted to the ledger pages. Each journal entry is transferred line by line to the appropriate account. For instance, the cash ledger would appear like this:

General Ledger				
Checking Account #1101				
Jen	Ref	Debit	Credit	Balance
Opening Balance		0		0
10	GJ1	5,000		5,000
12	GJ1		600	4,400
15	GJ1		1,000	3,400
20	GJ1		2,750	650
21	GJ1	15,000		15,650
30	GJ2	400		16,050

Notice that in the cash account, which is an asset account, a debit (entry to the left side of an account) represents an increase, and a credit (entry to the right side of the account) represents a decrease, and the balance is the combination of the two. This is the exact opposite for accounts on the right side of the accounting equation:

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

In liability and equity accounts that represent increases in those major categories, account balances are increased by a credit and account balances are decreased by a debit. The opposite is true for accounts that decrease those major categories.

In the ledgers, the reference number is to the page in the journal (also called the General Journal) where the entry is found. In the journal, the reference number is the company-assigned account number to which the journal entry is posted. Assume all the following entries have been posted to the appropriate ledger "pages". The highlighted entries are the ones posted to the Cash account ledger. Notice that the ledger provides a running total but the journal does not, since it is chronological by transaction, rather than by account.

General Journal Page 1				
Jan		Ref	Debit	Credit
10	Checking Account	1101	5,000	
	Capital Contributions	3310		5,000
12	Insurance Expense	5520	600	
	Checking Account	1101		600
15	Prepaid Rent	1320	800	
	Rent Expense	5510	200	
	Checking Account	1101		1,000
16	Merchandise Inventory	1210	600	
	Accounts Payable	2101		600
20	Furniture and Equipment	1620	2,750	
	Checking Account	1101		2,750
21	Checking Account	1101	15,000	
	Note Payable	2550		15,000

General Journal Page 2				
Jan		Ref	Debit	Credit
30	Checking Account	1101	400	
	Merchandise Sales	4510		400
30	Cost of Goods Sold	5200	240	
	Merchandise Inventory	1210		240

The Trial Balance

The next step in the accounting cycle is to create a trial balance, to make sure that all the debit entries are balanced out by credit entries. The trial balance is simply a list of all the accounts with the ending balances in the correct column, debit or credit, taken right from the general ledger.

On February 3, you calculate that your employee earned $500 in wages from January 20 through January 31, to be paid on the 10th of February, and you record an Adjusting Journal Entry (AJE) to match January wages earned (incurred) with January revenue.

31	Wage Expense	500	
	Wages Payable (a liability)		500

Note that you are backdating this AJE to the last day of January so that it shows up in the correct month on the financial statements. This is called an accrual. It is written in the journal and posted to the ledger. Page 2 of the journal would now look like this:

General Journal Page 2				
Jan		Ref	Debit	Credit
30	Checking Account	1101	400	
	Merchandise Sales	4510		400
30	Cost of Goods Sold	5200	240	
	Inventory	1210		240
31	Wage Expense	5300	500	
	Wages Payable	2201		500

Wages decrease equity, since they offset revenue. Equity is on the right side of the accounting equation which means that an increase to equity is shown by a credit entry and a decease is shown by a debit entry. Wages always decrease equity, so wage expense, in fact, every expense account, is always debited and always has a debit balance.

The Adjusted Trial Balance

Once all of the adjusting journal entries are posted to the ledgers, the accountant runs one final check of debits and credits, called the adjusted trial balance. In this simplified example, the adjusted trial balance would look like this:

Adjusted Trial Balance as of Jan 31, 20XX			
		Debit	Credit
1101	Checking	16,050	
1210	Merchandise Inventory	360	
1320	Prepaid Rent	800	
1620	Furniture and Equipment	2,750	
2101	Accounts Payable		600
2201	Wages Payable		500
2550	Notes Payable		15,000
3310	Capital Contributions		5,000
4510	Merchandise Sales		400
5200	Cost of Goods Sold	240	
5300	Wage Expense	500	
5510	Rent Expense	200	
5520	Insurance Expense	600	
	Total debits must equal total credits	21,500	21,500

These transactions, including the adjusting entries, give us enough information to create the adjusted trial balance so that we can move on to the next step in the accounting process—creating the financial statements.

practice questions

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4.3: Relationships Between Financial Statements

Learning Outcomes

- Analyze the relationships between key financial statements

Income Statement

The Income Statement is also called the Earning Statement or the Profit and Loss Statement, sometimes shortened to the P&L, but no matter what it is called, net income or loss is always the bottom line. This bottom line flows to the next statement, the Statement of Owners' Equity. That is why it is the first statement to be compiled from the adjusted trial balance.

Statement of Owners' Equity

The Statement of Owners' Equity reconciles beginning capital to ending capital. Remember that the Balance Sheet shows that assets are equal to liabilities plus equity. Ending capital and equity are synonymous, so the bottom line from the Statement of Owners' Equity, ending capital, flows to the next statement—the Balance Sheet.

Balance Sheet

Net income from the Income Statement flows to the Statement of Owners' Equity, and the ending capital balance flows from the Statement of Owners' Equity to the Balance Sheet.

Statement of Cash Flow

Finally, the statement of cash flows reconciles beginning cash and cash equivalents from the balance sheet (ending cash from the prior set of financial statements) to ending cash from the current balance sheet, effectively reconciling accrual basis accounting to cash basis.

Practice questions

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4.4: Key Information in Financial Statements

Learning Outcomes

- Identify important information found on key financial statements

As you have seen, the financial statements summarize a massive amount of raw data, turning it into information that is presented in a specific format.

The Income Statement, Revisited

A multiple-step income statement begins with Net Sales, which is Gross Sales less Returns and Allowances and net of Sales Discounts.

Cost of Goods Sold directly matches the cost of products sold against Net Sales. Often, a company then reports Gross Profit, which is Net Sales less Cost of Goods Sold. For instance, looking at The Home Depot, Inc. annual report (http://www.homedepotar.com/financial-highlights.html) for the fiscal year 2017, Net Sales were $100.9 billion (rounded to the nearest billion) and Cost of Sales (aka Cost of Goods Sold) was $66.5 billion, giving a gross profit of $34.4 billion. That remaining amount of $34.4 billion goes to pay operating expenses, income taxes, and other costs of doing business.

For The Home Depot, Inc., for the 2017 fiscal year, Selling, General, and Administrative expenses totaled $19.7 billion, leaving an operating income of $14.7 billion. Lowe's, Inc. shows an operating income of $6.6 billion.

Typical Statement of Earnings		
(Income Statement)		
Comparison of Home Depot to Lowe's		
For the 2017 fiscal year (all monetary amounts in billions)		
	Home Depot	Lowe's
Net Sales	$100.9	$68.6
Cost of sales	66.51	45.2
Gross profit	34.4	23.4
Selling, general, and admin	19.7	16.8
Operating income	14.7	6.6
Other income and expenses	1.0	1.1
Net income before taxes	13.7	5.5
Provision for income taxes	5.1	2.0
Net income	$8.6	$3.5

Other income and expenses include interest expense and non-operating expenses. By separating out these non-operational amounts, operating income is more comparable across different companies. For instance, if Lowe's borrowed very little money and was mostly funded by owner contributions, and if Home Depot borrowed heavily, operating income would not be affected, even though other income and expenses would be quite different, affecting the bottom line significantly.

The Statement of Owners' Equity, Revisited

As discussed earlier, net income flows from the bottom line of the income statement to the statement of owners' equity. For publicly traded companies like Home Depot and Lowe's, the statement of owners' equity can be called the Statement of Shareholders' Equity or something similar. In any case, it shows changes in owners' equity, as follows:

Typical Statement of Owner's Equity		
Comparison of Home Depot to Lowe's		
For the 2017 fiscal year (all monetary amounts in billions)		
	Home Depot	Lowe's
Beginning equity	$4.3	$6.4
Net income	8.6	3.5
	12.9	9.9
Less: Dividends	4.2	1.3
	8.7	8.6
Repurchase of common stock and other equity transactions	(7.2)	(2.7)
Ending equity	$1.5	$5.9

Publicly traded corporations like Home Depot and Lowe's raise capital by either borrowing or selling stock on the open market. Distributions to owners are called dividends and are declared by the governing board of directors, rather than by individual owners. Note that ending equity for both Lowe's and Home Depot was less than beginning equity, even though both companies showed positive net income. That is because both companies are buying stock on the open market, hoping to reduce the number of shares of stock outstanding. Dividends, stock repurchasing, and net losses reduce equity, while issuing stock and net income increase equity. See http://phx.corporate-ir.net/phoenix....-reportsannual for a copy of Lowe's annual report.

The Balance Sheet, revisited

The balance sheet, also known as the statement of financial position, shows the company's assets, liabilities and owners' equity (net worth). The asset portion of the balance sheet is generally broken into three broad categories: current assets, fixed assets (property, plant and equipment), and other non-current assets.

Although each company is unique, every balance sheet shares one thing in common: total assets are always equal to the total of liabilities and equity. Below is a condensed version of the balance sheet for Home Depot for the fiscal year 2017.

The Statement of Cash Flows, Revisited

The statement of cash flows shows how changes in balance sheet accounts and income affect cash and cash equivalents, and breaks the analysis down to operating, investing and financing activities. Essentially, the cash flow statement is concerned with the flow of cash in and out of the business. The statement captures both the current operating results and the accompanying changes in the balance sheet. As an analytical tool, the statement of cash flows is useful in determining the short-term viability of a company, particularly its ability to pay bills.

The financial statements are augmented by an extensive set of footnotes. The notes typically describe each item on the balance sheet, income statement and cash flow statement in further detail. Notes to financial statements are considered an integral part of the financial statements and are audited along with the financials.

Practice questions

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4.5: Introduction to Analyzing Data from Financial Statements

What you will learn to do: Analyze data from Financial Statements



Measuring a company's financial performance is one of the primary reasons for the creation of financial statements.

The key financial statements of a company provide a snapshot of the financial position of the organization and this is extremely useful to the internal and external stakeholders of the business. However, the real power of financial statements lies in our ability to analyze the information on these financial statements to evaluate the past and present financial position of the company.

Financial statement analysis allows us to determine the health of the business in terms of how well it manages its inventories, expenses, revenues and debt. Analyzing these financial statements also gives us the ability to compare the financial health of the business against other companies in the same industry. In this section you will learn how companies report items such as inventories, assets, stockholder equity, revenues and expenses on their financial statements.

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4.6: Reporting Inventories

Learning Outcomes

- Describe how inventories are reported on balance sheets and income statements

All businesses that sell a product or goods have inventory. Inventory is the raw materials, work-in-progress goods, and the company's finished goods held for sale in the ordinary course of business. Depending on the company, the exact makeup of the inventory account will differ. For example, a manufacturing firm will carry a large amount of raw materials from which they produce their finished goods. For example a furniture manufacturer will have lumber and hardware in inventory awaiting its conversion to tables or desks. On the other hand, a retailer, like Home Depot or Lowe's, will purchase finished goods ready for sale to the consumer and therefore their inventory will be comprised of finished goods—generally referred to as merchandise or merchandise inventory. Regardless of whether the inventory is held by a manufacturer or a re-seller, inventory amounts are reflected on the the Balance Sheet as an asset.

The figure below shows how inventories from a manufacturing firm would be reported on the Balance Sheet:

Manufacturing Company		
Balance Sheet		
Assets		
Current Assets	Debit	Credit
Cash and Cash Equivalents		$35,000
Short-Term Investments		$26,000
Accounts Receivable		$52,000
Inventories:	Debit	Credit
Finished Goods	$25,000	
Work in Process	$42,000	
Raw Materials	$15,000	
Packaging Materials	$11,000	$93,000
Prepaid Expenses		$12,500

However, inventory does not just impact the Balance Sheet. Some costs associated with inventory are recognized as expenses and thus appear on the Income Statement. For a retailer, merchandise inventory includes all of the costs of expenditures necessary, directly or indirectly, to bring an item to the business to be sold to consumers. This means that the cost of an inventory item includes its invoice cost minus any discount for early or cash payment, plus any incidental costs. Incidental costs can include shipping, storage, and insurance. The matching principle states that inventory costs should be recorded as cost of goods sold in the period when inventory is sold. This is illustrated on the excerpt from the Income Statement shown below:

Retail Company			
Income Statement			
Sales Revenue		$100,000	
	Cost of Sales		
	Beginning Inventory	$65,000	
	Purchases	$55,000	
	Ending Inventory	$45,000	$75,000
	Gross Margin		$25,000

Because inventory impacts both the Balance Sheet and Income Statement properly accounting for inventory costs is a critical responsibiity of managers, bookkeepers and accountants.

practice questions

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4.7: Reporting Current Assets

Learning Objectives

- Demonstrate how current assets are reported on the balance sheet

We have already identified assets as a resource with economic value that a company owns or controls with the expectation that it will provide a future benefit. Assets are reported on a company's balance sheet and are bought or created to increase a firm's value or benefit the firm's operations. One of the characteristics of assets is that they can be classified as long-term (held for over one year) or current (held for less than one year).

Current assets include cash and cash equivalents, accounts receivable, and inventory. Cash includes bank account balances, petty cash, and cash equivalents. Cash equivalents are very safe assets that can be readily converted into cash, such as U.S. Treasury Notes and marketable securities such as stocks and bonds. As you learned in the previous section, another major category of current assets is inventory.

Another class of current assets is Accounts Receivable. Companies often sell products or services to customers on credit; these obligations, result in an amount owed to the company or a receivable which are also classified as current assets.

Current assets are the most liquid assets and are listed first on the balance sheet. This is because they will or may turn into cash within a short period of time. For instance, accounts receivable are usually collected within 30 days. In any case, in order for an asset to be classified as current, it must have a life span of less than one year.

It should be noted that not all current assets convert to cash. For instance, prepaid expenses that will expire within the one-year window are listed as current assets. This type of current asset includes things like the annual premium paid for insurance and rent paid in advance. The excerpt from a balance sheet shown below illustrates how current assets are presented:

Company A	
Balance Sheet	
Assets	
Current Assets	
Cash and Cash Equivalents	$65,000
Short Term Investments	$55,000
Accounts Receivable	$45,000
Inventory	$125,000
Prepaid Expenses	$75,000
Other Current Assets	$25,000

Practice questions

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4.8: Reporting Noncurrent Assets

Learning Outcomes

Show how noncurrent assets are reported on the balance sheet

A noncurrent asset is an asset that is not expected to be consumed within one year. Some noncurrent assets, such as land, may theoretically have unlimited useful lives. A noncurrent asset is recorded as an asset when acquired, rather than being charged to expense. In a capital-intensive industry, such as automobile manufacturing, a large part of the assets of the business may be noncurrent assets. On the other hand, a service business like an accounting firm that requires a minimal amount of fixed assets may have few or no noncurrent assets.

A class of noncurrent assets are intangible assets. These are assets that the business holds but do not have tangible form. Intangible assets include goodwill, brand recognition, copyrights, patents, trademarks, trade names, and customer lists. Some businesses further divide intangible assets into two categories: intellectual property and goodwill.

Whether tangible or intangible, all noncurrent assets are presented on the balance sheet, and are listed after all current assets, but before liabilities and equity.

The figure below illustrates how noncurrent assets are presented on a balance sheet.

Company A			
Balance Sheet			
Assets			
	Non- Current Assets		
	Long Term Investments	$ 1,250,000	
	Property, Plant and Equipment	$ 4,589,000	
	Accumulated Depreciation	$ 1,125,000	
	Vehicles	$ 985,000	
	Long-term Notes Receivable	$ 875,245	
	Goodwill	$ 1,100,000	
	Patents	$ 2,895,000	
	Other Long Term Assets	$ 1,478,962	
			$ 14,298,207

practice questions

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4.9: Reporting Stockholder Equity

Learning Outcomes

Describe the presentation of stockholder's equity on the balance sheet and statement of owners' equity

You have learned that the accounting equation is presented as Assets = Liabilities + Equity. Let us take a closer look at the Equity portion of that equation and how it is presented on the Balance Sheet and the Statement of Owners' Equity.

Stockholders' Equity (also known as Shareholders Equity) is an account on a company's balance sheet that consists of capital plus retained earnings. When the business is not a corporation and therefore has no stockholders, the equity account will be reflected as Owners' Equity on the balance sheet.

In short, the Equity portion of the accounting equation is the amount left over after liabilities are deducted from assets and represents the residual value of assets minus liabilities. Owner's or stockholders' equity also reports the amounts invested into the company by the owners plus the cumulative net income of the company that has not been withdrawn or distributed to the owners. When there are shareholders this distribution comes in the form of dividends. Let's look at the expanded accounting equation to clarify what constitutes Owners' or Shareholders' Equity before we examine its presentation on the Balance Sheet and Statement of Owners' Equity.

For a corporation with shareholders the accounting equation is:

$$\text{Assets} = \text{Liabilities} + \text{Paid-in Capital} + \text{Revenues} - \text{Expenses} - \text{Dividends} - \text{Treasury Stock}$$

For a sole proprietorship or a company without shareholders the accounting equation expands to be:

$$\text{Assets} = \text{Liabilities} + \text{Owner's Capital} + \text{Revenues} - \text{Expenses} - \text{Owner's Draws}$$

As you can see, Equity includes several components regardless of the type of business.

The figure below is an example of how Equity is reported on the Balance Sheet of a corporation when stock has been issued.

Company A			
Balance Sheet			
Stockholders' Equity			
	Paid in Capital	$ 2,500,000	
	Preferred Stock	$ 2,500,000	
	Common Stock	$ 4,500,000	
	Paid-in capital I excess of par value – preferred	$ 1,550,000	
	Paid-in capital in excess of par – common stock	$ 2,850,000	
	Paid-in capital from treasury stock	$ 952,000	
	Retained Earnings (Revenues – Expenses)	$ 2,458,000	
	Accumulated other comprehensive income	$ 3,525,000	$ 20,835,000
	Less: Treasury Stock	$ 2,895,000	
	Total stockholder's equity		$ 17,940,000

For a company that has not issued stock and is privately held, the statement of equity on the balance sheet will be presented as follows:

Company A			
Balance Sheet			
	Owner's Equity		
	Beginning owners' equity	$ 245,000	
	+ Owners capital investments	$ 27,000	
	+ Gross Revenue	$ 258,000	
	– Expenses	$ 189,000	
	– Owners' withdrawals	$ 56,000	
	Total Owner's Equity		$ 285,000

What both statements have in common is that they include the net income information from the company's income statement! Remember, equity is simply the difference between the company's assets and the liabilities the company has taken out against those assets.

practice questions

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4.10: Reporting Unearned Revenue

Learning Outcomes

Discuss how unearned revenues are reported on the balance sheet

Unearned revenue is money received by a or company for a service or product that has yet to be fulfilled. Unearned revenue can be thought of as a “prepayment” for goods or services that a person or company is expected to produce for the purchaser at some later date or time. As a result of this prepayment, the seller has a liability equal to the revenue earned until delivery of the good or service.

For example, you pay $1200 for a one-year membership at a local gym on January 1. Your payment of the entire years’ membership creates a liability for the gym until you “use up” some of your pre-paid membership. The transaction would be recorded as an increase to cash (debit) and an increase to unearned revenue (liability). These are both Balance Sheet accounts!

Every month the gym will make an entry to recognize the revenue from your membership. This will be a decrease in unearned revenue (liability) and increase in earned revenue (income). They will continue to recognize the $100 every month until you have “used up” your pre-paid membership.

Why then does your pre-paid membership create a liability for the company? If the gym burned down in May and you could no longer go to the gym, the company would be “liable” to you for the remaining 7 months of membership dues that you paid for but did not get to use. They would have to refund you $700—thus a liability is created.

This recognition of revenues when they are earned is at the heart of accrual accounting and the “matching principle.”

practice questions

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4.11: Why It Matters- Financial Statements of Business Organizations

Why learn to understand financial statements of business organizations?

Understanding the relationship among all of the financial transactions of a business is key to a manager's ability to use financial information as a decision making tool. Like the parts of an automobile engine, individual pieces of accounting information work together to create a picture of a company's financial health. Imagine you are the manager of a small business and need to go to the bank for a business loan. The first thing your banker will ask to see are your financial statements—the report card for your business's financial performance. Understanding the relationship among accounts, transactions and financial statements is one of the critical success factors in either owning or managing any business operation.

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4.12: Reporting Expenses

Learning Outcomes

Explain how expenses are reported on the income statement

The expenses that are deducted from gross income to arrive at net income of the business are reported on the company's income statement. The number of expenses and types of expenses that are reported on the income statement varies widely from business to business. Large corporations such as Ford Motor Company could have pages of expenses on its income statement while a small Mom and Pop retail store may have only a handful. Key to the preparation of an accurate profit and loss statement is the "matching" of expenses to the revenues those expenses helped generate.

The matching principle is one of the basic underlying guidelines in accounting. The matching principle directs a company to report an expense on its income statement in the same period as the related revenues.

The matching principle is associated with the accrual method of accounting and adjusting entries. Without the matching principle, a company might report $10,000 of expenses in January (when it is paid) instead of December (when the expense and the liability are incurred). A retailer's or a manufacturer's cost of goods sold is another example of an expense that is matched with sales through a cause and effect relationship.

Let us examine how this matching principle impacts the Income Statement for a small retail company. The income statement below shows the income and expenses for Mom's Flower Shop without matching revenue to expenses for the month of March, 20XX. The owner paid an entire years insurance premium of $3,650 on March 1 and deducted the entire amount as an expense from her March revenue. This gave her net income of $6,052 for the month as shown below.

Mom’s Flower Shop					
Income Statement, March 20XX					
Sales Revenue					
	Cash Sales				$24,550
	Credit Sales				$850
Cost of Goods Sold					
	Beginning Inventory, 3/1/20XX		$85,250		
	+ Purchases			$2,750	
	Goods Available for Sale		$88,000		
	– Ending Inventory, 3/31/20XX		$75,725		
	Cost of Goods Sold				$12,275
	Gross Profit				$13,125
Operating Expenses					
	Advertising			$565.00	
	Insurance				$3,650.00
	Salaries				$1,300.00
	Website				$165.00
	Repairs & Maintenance		$85.00		
	Travel				$-
	Entertainment			$-	
		Total Operating Expenses		$5,765.00	
General Expenses					
	Utilities				$275.00
	Telephone			$169.00	
	Professional Fees			$200.00	
	Postage				$85.00
	Payroll Taxes			$279.00	
		Total General Expenses		$1,008.00	
Other Expenses					

Mom’s Flower Shop					
Income Statement, March 20XX					
	Bad Check Expense			$25.00	
	Miscellaneous Expense		$275.00		
		Total Other Expenses		$300.00	
		Total Expenses			$7,073.00
		Net Income			$6,052.00

Now, let’s look at the income statement when the owner recognizes just the insurance expense for the month of March, 20XX.

Mom’s Flower Shop					
Income Statement, March 20XX					
Sales Revenue					
	Cash Sales				$24,550
	Credit Sales				$ 850
Cost of Goods Sold					
	Beginning Inventory, 3/1/20XX		$85,250		
	+ Purchases			$2,750	
	Goods Available for Sale		$88,000		
	– Ending Inventory, 3/31/20XX		$75,725		
	Cost of Goods Sold				$12,275
	Gross Profit				$13,125
Operating Expenses					
	Advertising			$565.00	
	Insurance				$304.00
	Salaries				$1,300.00
	Website				$165.00
	Repairs & Maintenance		$85.00		
	Travel				$ –
	Entertainment			$-	
		Total Operating Expenses		$2,419.00	
General Expenses					
	Utilities				$275.00
	Telephone			$169.00	
	Professional Fees			$200.00	
	Postage				$85.00
	Payroll Taxes			$279.00	
		Total General Expenses		$1,008.00	
Other Expenses					

Mom’s Flower Shop					
Income Statement, March 20XX					
	Bad Check Expense			$25.00	
	Miscellaneous Expense		$275.00		
		Total Other Expenses		$300.00	
		Total Expenses			$3,727.00
		Net Income			$9,398.00

As you can see, recognizing just the portion of insurance that was “used” for March, 20XX increases her net income to $9,398.00 and is a much more accurate representation of the financial performance of the business during the month.

Since net income flows to the statement of owners’ equity, it is important that managers understand the importance of this matching principal since both internal and external stakeholders will use the company’s financial statements for decision making purposes.

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4.13: Introduction to Other Financial Components

What you will learn to do: Explore how other financial components are accounted for and presented.



Analyzing financial ratios allows a business to evaluate its overall financial health and identify trends

Financial statements are an essential tool for analyzing the financial position of a business. In addition to reporting items such as assets, equity, revenues and expenses they allow managers to calculate financial ratios that communicate essential information about the financial health of a business. Core financial ratios that measure items such as return on investment and equity are just two of the key financial ratios calculated from information on the financial statements.

Using ratio analysis managers can quickly evaluate how effectively the company is using debt to fund operations, its overall cash position and well as it's ratio of debt to income. By calculating key financial ratios managers are able to make period to period comparisons of the financial position of the company and be alerted to potential problems or opportunities to make the company more efficient and profitable. As a manager, it is essential that an individual understand how the financial ratios are calculated and interpreted.

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4.14: Core Financial Ratios

Learning Outcomes

Understand how core financial ratios communicate essential information

Businesses need a sound system of analyzing their financial information to serve as an early warning of potential financial difficulties. The financial statements will provide them with periodic information on the overall health of the business, but when profits decline or cash is short businesses need a way to hone in on specific areas of the business that are causing these problems. Ratio analysis is the process that business, both large and small use to act as a barometer of the business's health. These ratios often measure the relationship between two or more components of the financial statements. They are used most effectively when results over several periods are compared.Ratio analysis not only allows managers and owners to evaluate their performance period to period, but also compare their results with specific companies in their industry or the industry as a whole.

For ratios to be useful and meaningful, they must be:

- Calculated using reliable, accurate financial information (does your financial information reflect your true cost picture?)
- Calculated consistently from period to period
- Used in comparison to internal benchmarks and goals
- Used in comparison to other companies in your industry
- Viewed both at a single point in time and as an indication of broad trends and issues over time
- Carefully interpreted in the proper context, considering there are many other important factors and indicators involved in assessing performance.

There are 12 key financial ratios that businesses use to assess their performance. These ratios are grouped into four categories, measuring four dimension of a business's financial status: liquidity ratios, leverage ratios, operating ratios and profitability ratios. All of these ratios can be calculated using the company's key financial statements.

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4.15: Calculating Return on Investment

Learning Outcomes

Calculate return on investment

Liquidity ratios measure the financing that is supplied by the owners of the business versus the financing that is provided by creditors such as suppliers and banks. Leverage ratios also are indicators of the financial risk a business is exposed to. Low leverage ratios indicate that a downturn in the economy will have minimal impact on the financial position of a business. For example, if a business is funding its operations primarily through bank loans, a downturn in the economy will decrease revenues, but the business will still be responsible for payments to its creditors and lenders.

1. Current Ratio. The current ratio measures a company's ability to pay its current liabilities from its current assets.

$$\text{Current Ratio} = (\text{Current Assets})/(\text{Current Liabilities})$$

Generally, the higher the current ratio, the stronger the financial position of the business and typically financial analysts consider a current ratio of 2:1 to be ensure that a business has sufficient working capital to fund ongoing operations.

2. Quick Ratio or Return on Investment (ROI). The quick ratio or return on investment (sometimes referred to as the acid test ratio) is more conservative than the current ratio because it does not include inventory in current assets. The quick ratio measures a company's ability to pay its current debts if all revenue ceased.

$$\text{Quick Ratio} = (\text{Current Assets} — \text{Inventory})/(\text{Current Liabilities})$$

A quick ratio of 1:1 is considered satisfactory and a ratio higher than this is an indicator of greater financial security.

practice questions

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4.16: Calculating Return on Equity

Learning Outcomes

Calculate return on equity

Financial leverage refers to the use of debt to acquire additional assets. Although most companies require some type of financing to start, expand or continue their operations, these leverage ratios inform potential creditors of the potential risk associated with extending credit to the business. Business's that carry a heavy debt load run the risk of over-extending themselves to the point that funds are not available for the key functions of the business.

1. Debt Ratio. The debt ratio measures the percentage of the company's total assets that are financed by creditors and lenders as opposed to the owners. The debt ratio is calculated as follows:

Debt Ratio= (Total Debt or Liabilities)/(Total Assets)

Total debt includes all current liabilities and any outstanding long-term debt such as loans, notes or bonds. The total assets include all of the company's current assets, fixed assets and any intangible assets such as goodwill. Business owners prefer a higher debt ratio than lenders because the higher debt ratio reflects that the owner has less invested in the business and consequently has less to lose.

2. Debt-to-Net-Worth Ratio. This ratio also expresses the relationship between the capital contributions of the owners and the capital contributed by lenders. It is fundamentally the ratio of what the business is worth compared to what the business owes.

Debt-to-Net-Worth Ratio= (Total Debt or Liabilities)/(Tangible Net Worth)

In this ratio total debt includes both current and long-term liabilities as was the case with the Debt Ratio. However, in order to calculate the Debt-to-Net-Worth ratio we must derive the tangible net worth of the business. The tangible net worth of the business represents the owner's investment in the business less any intangible assets. We find tangible net worth as follows: Owners Capital + Capital Stock + Earned Surplus + Retained Earnings – Intangible Assets (such as goodwill). A high Debt-to-Net-Worth ratio indicates that the company is highly leveraged and will make it difficult for a business to borrow funds since lenders will consider them "maxed out" when it comes to borrowing.

3. Times-Interest-Earned Ratio. This ratio is the measure of a business's ability to make its interest payments on borrowed capital. In literally tells the business how many times their earnings will cover the interest payments on the loans it is carrying. It is calculated as follows:

Times Interest Earned Ratio= (EBIT (Earnings Before Interest & Taxes))/(Total Interest Expense)

EBIT is the company's profit after deducting all expenses but before deducting interest expense and income tax. A high Times-Interest-Earned Ratio indicates that the company has little trouble making its interest payments and generally lender prefer a ratio of at least 2:1. It is not unusual for lenders to require this ratio to be as high as 6:1 if the business is a start-up or very young.

Return on Equity is the measure of both profit and efficiency. An increase in ROE over time is a good thing for a business. However, some industries tend to ROEs in a specific range so it's important to compare companies from the same industry.

ROE= (Net Income)/(Shareholder's Equity)

practice questions

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4.17: Other Key Ratios

Learning Outcomes

Analyze other key ratios used to interpret financial statement data

Operating Ratios

Operating ratios measure how effectively a company is utilizing its resources. These ratios also help identify areas for improvement in operations that will improve overall financial health. Operating ratios are commonly used when comparing a business to "industry standards" or benchmarks.

1. Average-Inventory-Turnover Ratio. This ratio measures the number of times that a company's inventory turns over or sells out during the accounting period. It is very common for retail businesses to rely heavily on this ratio for obvious reasons – their primary source of revenue is derived from selling inventory. This ratio can also help a business determine if its inventory is obsolete, understocked or overstocked and is calculated as follows:

$$\text{Average Inventory Turnover Ratio} = (\text{Cost of Goods Sold})/(\text{Average Inventory})$$

Average inventory is determined by inventory at the beginning of the accounting period to inventory at the end of the accounting period and dividing by 2. This ratio will vary considerably by business type. For example, an automobile dealership may turn its inventory only twice a year as opposed to a grocery store that may turn its inventory 15 times annually. Because of this disparity it is key to compare a business's inventory turn-over ration to similar businesses or industry standards.

2. Average-Collection-Period Ratio. This ratio is often referred to as days sales outstanding because it tells the business the average number of days that it takes to collect its accounts receivable. In order to calculate this ratio a business must first calculate its receivables turnover ratio as follows:

$$\text{Average Collection Period Ratio} = (\text{Days in the Accounting Period})/(\text{Receivables Turnover Ratio})$$

The higher the receivables turnover ratio, the shorter the time between a credit sale and payment. Once we have this ratio we can then calculate the Average-Collection-Period ratio as follows:

One of the most beneficial uses for this ratio is comparison to industry averages. This ratio, like the Average-Inventory-Turnover Ratio varies among industries. A company can also use this ratio to evaluate its credit terms. A rule of thumb is that the collection period ratio should be no more than one-third greater than its credit terms. For example, if a company extends credit to its customers and gives them 30 days to pay their bill then their average collection ratio should be no more than 40 days ($30 + 30 \times 1/3$).

3. Average-Payable-Period Ratio. This ratio measures the number of days it takes a company to pay its accounts payable. Like the collection period ratio, we must first calculate the Payables Turnover Ratio as follows:

$$\text{Payables Turnover Ratio} = \text{Purchases}/(\text{Accounts Payable})$$

Then we are able to calculate the Average-Payable-Period Ratio as follows:

$$\text{Average Payable Period Ratio} = (\text{Days in Accounting Period})/(\text{Payables Turnover Ratio})$$

One of the most meaningful comparisons for this ratio is to compare the ratio to the terms offered by suppliers and creditors. If the average payable period ratio is higher than the terms offered by creditors, then this may signal that the company needs to improve its accounts payable system. A high average payable period ratio may also be discovered by companies that are short on cash. Allowing this ratio to remain high has the long-term consequences of damaging the company's reputation with suppliers and creditors and may make it very difficult for the company to purchase necessary materials or inventory on credit terms. On the other hand, if the average payable period ratio is very low then the company may not be putting its cash to its best use by paying creditor too fast. Cleary there is a "happy medium" when it comes to managing payables for a business.

4. Net-Sales-to-Total Assets Ratio. This ratio measures a company's ability to generate sales revenue based upon the assets of the business. It is a measure of productivity but is only meaningful when compared to similar businesses or industry benchmarks. The Net-Sales-to-Total Assets Ratio is calculated as follows:

Net Sales to Total Assets= (Net Sales)/(Net Total Assets)

For the purposes of calculating this ratio, total net assets is the sum of everything the business owns (cash, buildings, equipment, land, tools, etc.) less depreciation.

practice questions

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Profitability Ratios

Profitability ratios are a measurement of how efficiently a company is being managed and run. More than any other type of ratio, profitability ratios provide owners and managers with information about a business's ability to use its resources to generate a profit.

1. Net-Profit-on-Sales Ratio. This ratio measures a company's profit per dollar of sales. The ratio is expressed as a percentage and shows the percentage of each dollar remaining after paying expenses. The ratio is calculated as follows:

Net Profit on Sales = Net Profit/Net Sales

For a small, privately owned company this ratio generally ranges from 3 to 7%, but like many of the other ratios we have discussed it varies based on the industry. Retail businesses generally have a net profit on sales ratio between 2 and 4% but other industries such as the healthcare industry have ratios as high as 15%. When businesses see their net profit on sales ratio fall, they often undertake drastic cost-cutting measures. This is not always the best approach as many times cost reduction measures have a negative impact on the overall health and future of the business. Rather, businesses should look at their gross margin in comparison to similar businesses or their industry. If their gross sales are comparable, then it makes sense for the business to investigate what in their operations is driving less revenue to the bottom line (net profit).

2. Net-Profit-to-Assets Ratio. This ratio is also referred to as a return-on-assets ratio because it measures how much profit a company is generating for every dollar it has invested in the assets of the company. This ratio is calculated as follows:

Net Profit to Assets Ratio= (Net Profit)/(Total Assets)

This ratio provides information about how "asset intensive" a business or industry is. Manufacturing companies that require expensive machinery to produce a product will have a much lower net profit to asset ratio than an accounting firm, for instance. Again, this is a comparative ratio. A business will look at the industry average for similar businesses to determine if changes need to be made in how assets are utilized in the course of day-to-day operations.

3. Net-Profit-to-Equity Ratio. This ratio is often referred to as a return on net worth ratio because it measures the owner's return on investment (ROI). It reflects the percentage of the owner's investment in the business that is returned annually via the profit of the business. It is one of the most important ratios when evaluating the company's overall profitability. This ratio is computed as follows:

Net Profit to Equity Ratio= (Net Profit)/(Owners Equity)

One of the most common uses for this ratio is in comparison to a company's cost of capital (interest rate on money borrowed). The business should produce a rate of return (ROI) that exceeds its cost of capital.

In general, ratios are useful in measuring a firm's overall performance and identifying areas where the firm can improve. In addition to being able to calculate these ratios, owners and managers must understand how to interpret them in order to increase efficiency and profitability. Ratio analysis is an ongoing process, comparing the ratios not only to industry benchmarks but also to the company's own ratios from prior periods.

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4.18: Calculating Profitability Ratios

Learning outcome

- Calculate and interpret profitability ratios

Profitability Ratios

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4.19: Limitations of Financial Statements

Learning Outcome

- Discuss the limitations of financial statements

One of the drawbacks of financial accounting from a manager's perspective is that the information represents past performance. This is useful in giving out bonuses, and of course in reporting to the public, but proactive internal decisions have to come from the most current data available, and have to be tailored to the decision being considered. That is the purview of the managerial accountant. For instance, if management is considering replacing a machine to improve production, a managerial accountant could produce an ad hoc report comparing the cost of the new machine with lower maintenance costs and higher production yields against keeping the old machine and putting more dollars into maintaining and improving it, and maybe even options to lease a machine or outsource that particular process. There are other limitations as well.

Historical Cost versus FMV

Following the general concept of verifiability and conservatism, GAAP requires most assets to be recorded at cost. However, there are some provisions within GAAP to revalue assets such as marketable securities, and even inventory, if the market value is less than the original cost. Even so, items like land, that may appreciated in value over time, are stated at the original cost, which may result in understating the actual value of the asset. Inflation can also affect the value of assets and is not taken into account under GAAP. Historical cost is objective and therefore reduces the chance that management is subjectively valuing assets for more than they are worth, as Enron did when it fraudulently led investors to believe the company was worth far more than it actually was.

Using historical cost can also overstate the value of an asset. For instance, in our cab company example from earlier, the cost of the cab may be $60,000 but its actual value may be much less. Under the historical cost principle of GAAP, however, it will still be listed as a $60,000 asset.

Undervalued Assets

Some intangible assets, such as customer lists, are not recorded as assets. Instead, any expenditures made to create an intangible asset are immediately charged to expense. This policy can drastically underestimate the value of a business, especially one that has spent a large amount to build up a brand image or to develop new products. It is a particular problem for startup companies that have created intellectual property, but which have so far generated minimal sales.

Predictive Value

The information in a set of financial statements provides information about either historical results or the financial status of a business as of a specific date. The statements do not necessarily provide any value in predicting what is happening in the present or what will happen in the future. For example, a company may show solid financial results for the fiscal year ended December 31, but be struggling in March when the statements are issued to the general public, as was the case with Harley Davidson, Inc., which issued its financial statements and SEC form 10-K on February 21, 2018 for the fiscal year ended December 31, 2017. Looking at past financials for the venerable motorcycle company doesn't make it obvious that sales were quickly sliding downward as the core demographic for big bikes aged and demand shifted toward smaller, cheaper bikes. By the first quarter of 2018, when the financials were being issued, Harley was already shutting down a plant and cutting jobs, but none of that was apparent from the published income statement or balance sheet, partly due to the historical nature of the statements, and partly due to the fact that the financials are just numbers reflecting past performance.

Comparability

Many investors use financial statements as a way to compare one company against another; however, even companies that are similar, such as Home Depot and Lowe's, may not use the same accounting methods. Depreciation and inventory costing are examples of accounting issues that offer choices and rely upon estimates. Although these issues are detailed in the footnotes and disclosures, it may be difficult, if not impossible, to reconcile the differences between two companies that choose different accounting methodologies.

Fraud

Management may deliberately skew financial information, as did the Enron team when they reported income that had not yet been earned in order to bolster the stock price. Relying on audited financial statements can give you some assurance that the information is correct, but recall that Enron's financial statements had been audited. Fraud like that can arise when there is undue pressure, such as shareholders are demanding and expecting excellent results that will push the stock price higher.

practice questions

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4.20: Putting It Together- Financial Statements of Business Organizations

Accounting is the language of business and in this module, you have seen how accounting information is created and can then be made to “speak” to owners and managers through ratio and financial statement analysis. Regardless of whether you are responsible for making the accounting entries or not—as a manager you will be responsible for the performance of your company, division or department. Being an informed consumer of this accounting information and what you can learn from an analysis of the information may one day be the secret to your success.

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4.21: Assignment- Financial Statements of Business Organizations

For this assignment, you will download and complete the following worksheet:

- Assignment: Financial Statements of Business Organizations (.docx)

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4.22: Introduction to Financial Statements

What you will learn to do: Examine the elements of common financial statements

There are many ways that we can describe a business—by product, by target market or even by geographic location. However, simply describing a business gives us little information about the internal workings of the business and how efficiently it is managing its resources. This internal examination is accomplished by looking at a company's financial statements. These statements are like a company report card. They tell external (and internal) stakeholders how well the company is managing its financial resources. In order to understand this financial report card it is necessary to first have a basic understanding of how companies account for all of the financial transactions of the business using the double entry accounting system.

Once you see how financial transactions effect the various accounts you can move on to reading and understanding the key financial statements of the business. Ultimately these financial statements will be used to create annual financial reports that investors can use to evaluate the overall financial health of the business. As you can imagine, creating these financial statements is an essential part of managing a business.

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4.23: Transactions

Learning Outcomes

- Define transactions

Transactions Defined

A transaction for financial accounting purposes is an economic event that has a monetary impact on the financial statements. Each monetary transaction is recorded in a journal, and the journal entries are then sorted by account and posted to a ledger. The ledger balances are transferred to the financial statements. Recall the monetary unit assumption that states that the amounts on the financial statements are monetary amounts, so in the United States, the amount of the transaction would be in U.S. dollars.

Because transactions are monetary events, they almost always produce some kind of supporting document. For instance, when a company purchases supplies, the supplier issues a receipt. Assume your company pays $2,000 for consulting services. This is an expense to the business and the invoice from the consulting firm is the documentation that supports the expense. Recall that expenses (an accounting transaction) are recognized (recorded) as incurred

Examples of transactions for a small, mom-and-pop grocery store:

- Collect cash from a customer in exchange for a product
- Pay a supplier for produce that will be sold in the store
- Place an advertisement in a weekly newspaper
- Pay employees to work in the store stocking shelves

Pay Cash for Inventory

Inventory is the term for goods held for sale in the ordinary course of business. In the grocery store, eggs are inventory. When the store buys milk from the supplier, the bookkeeper records the purchase of inventory in U.S. dollars and records the payment to the supplier as an expenditure in the check register. The supplier should provide a receipt. (By the way, for the supplier, this is a cash sale to a customer.)

Purchase a Display Case on Account

 When the owner buys an asset, like a display case, the bookkeeper records the acquisition of the asset and a related debt. For a small purchase such as this it would be an Accounts Payable entry (generally 90 days or less). However, If it was a larger purchase, such as a piece of machinery where the seller finances it for a period of time the entry may be to Notes Payable instead of Accounts Payable.

Not every business event rises immediately to the level of an accounting transaction, even though it may fit the definition of a legal transaction.

For instance, assume the owner decides to hire you as a consultant and you both sign an agreement stating that, upon completion of the work, the owner will pay you $1,500. Although there is backup documentation and a dollar amount, there is no completed transaction for the bookkeeper to record, since the economic event occurs upon completion of the contract. In other words, if you don’t do the work, you don’t get paid, so the transaction is recorded when the work is done, even if the cash is paid in advance.

Practice questions

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4.24: Accounting Equation

Learning Outcome

- Solve the accounting equation

The Accounting Equation

Double entry bookkeeping and the reports it produces are based on a single, important concept called the accounting equation. The equation is self-balancing:

$$\text{Assets} = \text{Liabilities} + \text{Equity}.$$

In order to understand its importance, it's best to see it in action in a simple form. Assets are what a company owns. For instance, assume you are starting a cab service. You buy an automobile for $60,000 by putting $10,000 down and financing the rest. Applying the accounting equation to your business, you would have the following:

$$\$60{,}000 = \$50{,}000 + \$10{,}000$$

The cab is your asset, and the liability, which is the claim against it held by the bank, is $50,000, leaving you $10,000 in equity. Liabilities are claims held by non-owners, while equity are claims against the assets held by the owners. In short, assets are what a company owns, and liabilities and equity show who owns it.

Another way to look at the accounting equation is to solve it for equity:

$$\text{Assets} - \text{Liabilities} = \text{Equity}.$$

If you sold your assets for exactly what you paid for them and paid off the debt, equity is what you have left over. Equity then is the owner's claim against the asset(s).

The Expanded Accounting Equation

The basic accounting equation can be expanded to include the four major subaccounts of equity as follows:

$$\text{Equity} = \text{Owner Contributions} - \text{Owner Withdrawals} + \text{Revenues} - \text{Expenses}.$$

This expanded equity portion of the equation allows the user of financial accounting information to see the changes in equity. In it's entirety, the expanded equation looks like this:

$$\text{Assets} = \text{Liabilities} + \text{Owner Contributions} - \text{Owner Withdrawals} + \text{Revenues} - \text{Expenses}.$$

This equation is the basis for the entire set of financial statements. It shows what the company owns (assets), how much debt there is (liabilities) and the components of owners' equity—how much have the owners invested and how much did the company add to the owners' wealth.

The revenue and expense accounts can be further broken down into subaccounts for data collection and informational purposes. For instance, revenue is a broad category under the general heading of equity, but a particular company may want to summarize revenues in even greater detail, using accounts such as Service Revenue, Sales of Merchandise, Interest Income, and other accounts that roll up into the general category of revenue.

In addition, most companies capture expenses at a more detailed level, using accounts such as Rent Expense, Payroll Expense, Insurance Expense, and more.

Practice questions

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4.25: Account Categories

Learning Outcome

- Identify general categories of accounts

Accounts in Accounting

The categories into which transactions are classified are called accounts, and, as you have seen, there are three broad categories: assets, liabilities, and equity. However, recording transactions into broad categories does not provide enough detail for managers to make decisions and actually use accounting information, so they are broken down further into more detailed accounts.

For instance, one of the most common accounts is the company checking account. Transactions such as paying bills decrease this account and making deposits increases the account. Assume an ending balance of $1,000 from last month in your company checking account. When you write a check for rent in the amount of $110, you subtract that from the balance. When you make a cash sale in the amount of $500 and deposit the cash into the bank, you increase the balance in your company records.

- Assets
  - Checking account
    - Beginning balance $1,000
    - Check 101 ($110)
    - Deposit $500
    - Ending balance $1,390

Note that in accounting we usually show negative numbers in parenthesis instead of with a minus sign. The parenthesis are easier to see.

The list of transactions in a particular account is called a ledger. The ledger is chronological and includes the current balance. All of the accounts taken together are called the general ledger. Pre-computer, the general ledger was an actual book with a page (actually, pages) for each account.

Accounting Ledger Sheet number: _____

	Date	Account	Memo	Debit	Credit	Balance
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
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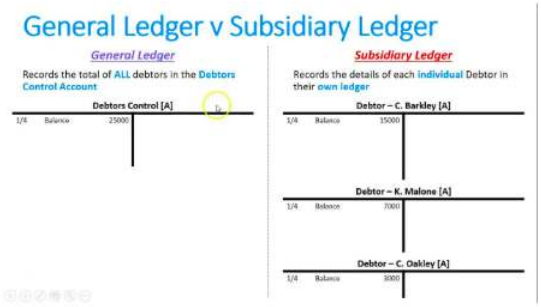
The accounting ledger is a chronological listing of all financial transactions of a business, in date order.

In addition to the checking account, a company will have assets such as accounts receivable (amounts that customers owe the company), prepaid expenses (such as insurance paid in advance), and inventory (good held for sale in the ordinary course of business.) These account belong to a subclass of assets called current assets. Current assets are those assets that will turn into cash within the next twelve months. Long-term assets are those assets that would take longer than 12-months to convert them to cash and usually includes things such as land, equipment, building, furniture and fixtures.

In addition to current assets and long-term assets, the company tracks current and long-term liabilities. Current liabilities include accounts payable (amounts owed to vendors that have granted credit terms) and other payables like income tax, payroll taxes, and sales tax, as well as accruals such as wages payable. These current liabilities are those debts that must be paid within one ear or within the normal operating cycle of the business. On the other hand, long term liabilities include long-term debt and other debts that are due in more than 12 months.

Control Accounts and Subsidiary Ledgers

Assets like accounts receivable and inventory are also called control accounts, since they show a balance, with transactions, that is backed-up by a subsidiary ledger. The account balance in the subsidiary ledger is the same as the account balance in the control account, but the subsidiary ledger is sorted by customer, in the case of accounts receivable, and by item in the case of inventory. For example, assume the accounts receivable general ledger account has a balance of $25,000. The subsidiary ledger would also have a balance of $25,000. The figure below illustrates the difference between a general and subsidiary ledger.



Any transaction posted to the general ledger control account would also be posted to the correct subsidiary ledger account. Thus, the control account and the subsidiary ledger always match. Because the general ledger account is a chronological listing of every transaction, it would be very difficult to find how much a particular customer owes at any given moment. That is the job of the subsidiary ledger.

Rather than relying on the chronological list of transactions in the general ledger, accounts like Office Furniture and Equipment are control accounts supported by a matching subsidiary ledger. Suppose the general ledger account showed a balance of $5,000:

- Equipment
  - Balance forward$2,000
    - Purchase of computer$1,600
    - Purchase of desk$1,400
  - Ending balance$5,000

The subsidiary ledger would also show $5,000, but would be listed by item instead of chronological by transaction:

- Equipment subsidiary ledger
  - Computer: $1,600
  - Desk: $1,400
  - Printer: $1,200 (purchased in the prior period)
  - Water cooler: $800 (purchased in the prior period)

What are the equity accounts?

The equity accounts include capital contributions by the owner(s) and withdrawals. In short, equity is the value of the owner's investment in the business. It is made up of all of the owner's contributions to the business (in the form of cash) as well as accumulated earnings that have not been distributed to the owner. In equity accounts, capital contributions increase equity and withdrawals decrease equity

What about business revenues and expenses?

Expenses are the costs of doing business. In fact, the word expense comes from the word expenditure, which means, "used up." So, as resources are used up to generate income, they are recognized as expenses. Common business expenses include rent, salaries, advertising, administrative expenses and insurance. On the other hand, revenues are the income generated by the company. Revenue may be earned by providing goods or services as well as earnings from investments. In short, revenue is the generation of wealth for the owners, and therefore increases owners' equity, while expenses are the consumption of resources, and therefore decrease owners' equity.

Key Takeaways

These categories are summarized below:

- **Assets.** Items of financial value that the business controls ("owns") for the purpose of producing income for the owners.
- **Liabilities.** Monies that the business owes to non-owners.
- **Owners Equity.** The theoretical value of the business that would be distributed to the owners after the assets were sold and the liabilities paid.
- **Revenue.** Payments made to the business by customers for the goods and/or services provided by the business.
- **Expenses.** Costs incurred by the business in providing the goods and/or services purchased by the customers.

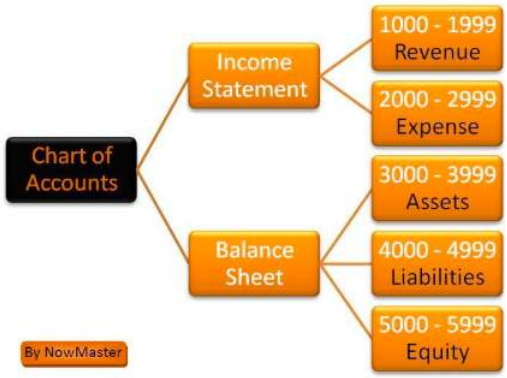
The Chart of Accounts

The following chart of accounts is a summary of various common accounts arranged by classification:

- Assets
  - Current Assets
    - Checking
    - Savings
    - Accounts Receivable
    - Inventory
    - Prepaid Expenses
  - Long-term assets
    - Equipment
    - Land
    - Buildings
      Furniture
    - Vehicles
  - Other long-term assets (intangible)
    - Intellectual property
    - Goodwill
    - Long-term investments
- Liabilities
  - Current Liabilities
    - Accounts Payable
    - Sales Tax Payable

        - Income Tax Payable
        - Wages Payable
        - Unearned Revenue
    - Long-term Liabilities
        - Long-term debt
- Equity
    - Owners' Capital
    - Withdrawals
    - Revenue
        - Sales Revenue
        - Service Revenue
    - Expenses
        - Salaries and Wages
        - Rent
        - Insurance
        - Taxes

Note that every business will have a different chart of accounts based on its business activities.



Practice Questions

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4.26: Double Entry Bookkeeping System

Learning Outcomes

- Describe the double entry bookkeeping system

Double-Entry Bookkeeping

Double-entry bookkeeping, in accounting, is a system of bookkeeping so named because every entry to an account requires a corresponding and opposite entry to a different account. The double entry has two equal and corresponding sides known as debit and credit. The left-hand side is debit and right-hand side is credit. For instance, recording a sale of $100 might require two entries: a debit of $100 to an account named “Cash” and a credit of $100 to an account named “Revenue.”

Debits and Credits, Left and Right



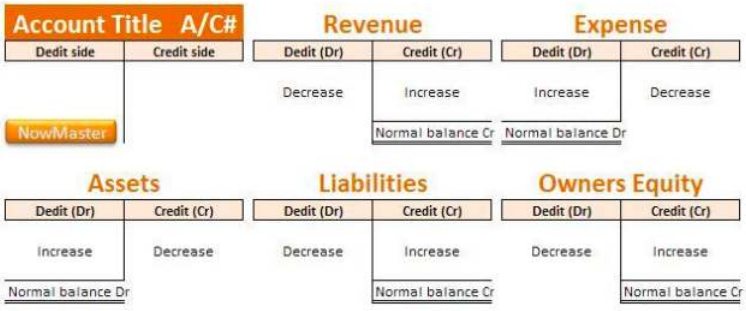
You may hear accountants talk in terms of debits and credits. Debit literally means left, and credit means right. Accountants use a two-column journal to record transactions, so the above bonus would be recorded like this in 2017:

Account	Debit	Credit
Bonus (expense)	5,000	
Accrued Bonus (liability)		5,000

In this entry, the bonus is recognized before the cash payment to the salesperson actually occurs, along with a liability in the same amount. In the following month, when the company pays the bonus, it would record the following entry:

Account	Debit	Credit
Accrued Bonus (liability)	5,000	
Checking Account (asset)		5,000

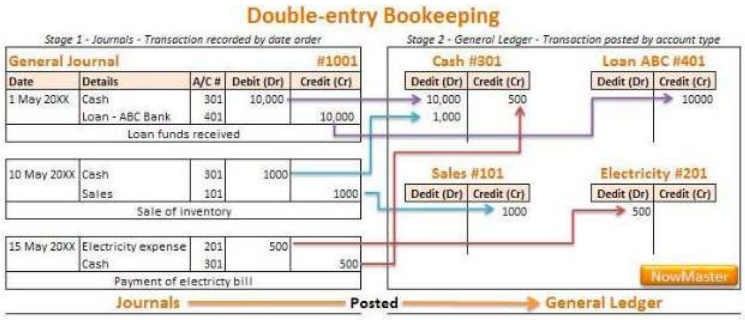
The cash balance declines as a result of paying the commission, which also eliminates the liability. The reason your debit card is called a debit card is because the bank shows your balance as a liability because they owe your money to you—in essence, they are just holding it for you. A liability usually has a credit balance (balance on the right side of the ledger) and so when you spend money and they pay it out on your account, they debit your account (a debit offsets a credit.) The figure below illustrates how debits and credit affect various types of accounts.



The Accounting Cycle

The accounting cycle begins with transactions and ends with completed financial statements. The first step is to journalize the transaction. The journal is a chronological list of each accounting transaction and includes at a minimum the date, the accounts affected, and the amounts to be debited and credited.

Periodically, depending on the business, journal entries are posted to the general ledger. The general ledger is the exact same information as the journal, but sorted by account.



Once all journal entries are posted, the ledger balances are posted to a trial balance, which is a list of all the accounts and balances, checking to see that the total of the debit column is equal to the total of the credit column. Each account is then checked for accuracy and adjusted, if need be, before the financial statements are run. This process is referred to as the "Accounting Cycle."



There are no debits or credits on the financial statements—they are informational reports, not data, so they are built with the user in mind

Summary

The double-entry bookkeeping system is summarized below:

- **Assets.** Items of financial value that the business controls ("owns") for the purpose of producing income for the owners.
- **Liabilities.** Monies that the business owes to non-owners.

- **Owners Equity.** The theoretical value of the business that would be distributed to the owners after the assets were sold and the liabilities paid.
- **Revenue.** Payments made to the business by customers for the goods and/or services provided by the business.
- **Expenses.** Costs incurred by the business in providing the goods and/or services purchased by the customers.

Practice questions

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4.27: Structures of Key Financial Statements

Learning Outcome

- Explain how key financial statements are structured

As you have seen, there are four basic financial statements: the Income Statement, the Statement of Owners' Equity, the Balance Sheet, and the Statement of Cash Flows.

Income Statement

The income statement shows revenues less expenses, also known as net income. In accounting, the word "net" means the combined total of both negative and positive amounts. For financial statement purposes, accountants don't identify account balances by debit and credit—that's part of the internal process of accounting and bookkeeping that has to do with the double-entry system you studied earlier.

Here is the adjusted trial balance we created for our sample company:

Adjusted Trial Balance as of Jan 31, 20XX			
		Debit	Credit
1101	Checking	16,050	
1210	Merchandise Inventory	360	
1320	Prepaid Rent	800	
1620	Furniture and Equipment	2,750	
2101	Accounts Payable		600
2201	Wages Payable		500
2550	Notes Payable		15,000
3310	Capital Contributions		5,000
4510	Merchandise Sales		400
5200	Cost of Goods Sold	240	
5300	Wage Expense	500	
5510	Rent Expense	200	
5520	Insurance Expense	600	
	Total debits must equal total credits	21,500	21,500

The income statement always begins with revenue and then continues with a list of expenses for a period of time, either a month, a quarter, or most commonly, a year. Large companies summarize expenses into major categories, such as Cost of Goods Sold, and a

broad category called Selling, General and Administrative (SG&A). For our sample company, however, we have just a very few accounts, so we can list them out, subtotal the expenses, and subtract that amount from revenue to show net income or net loss.

Your Company		
Income Statement		
For the month ended January 31, 20XX		
Merchandise Sales		$400
Expenses		
Cost of Goods Sold	$240	
Wage Expense	500	
Rent Expense	200	
Insurance Expense	600	
Total Expenses		1,540
Net Income/(Loss)		$ (1,140)

The bottom line on the income statement is either an increase in owners' equity, if it is net income, or a reduction in owners' equity if it is a loss (expenses exceed revenues). It is like a moving picture of the company, showing amounts earned during the regular course of business (revenues) and the matching costs (expenses).

In our example from the previous section, expenses far exceeded revenues, which is common in the first few months of a new business, so the company is showing a net loss.

Statement of Owners' Equity

The statement of owners' equity, or owner's equity if the company is a sole proprietorship, shows beginning owner capital, additions and subtractions to capital, including net income from the Income Statement. This gives the total owners' capital at the end of the same specific time period as the Income Statement. This amount will be the beginning capital for the next Statement of Owners' Equity. Both of the Income Statement and the Statement of Owners' Equity, as well as the Statement of Cash Flows, show activities over a period of time, such as a year.

Your Company	
Statement of Owner's Equity	
For the month ended January 31, 20XX	
Beginning Capital	$–
Owner Contributions	5,000
Net Income/(Loss)	(1,140)
	3,860
Owner Withdrawals	—
Ending Capital	
Ending Capital	$3,860

Notice that the Statement of Owner's Equity reflects the expanded accounting equation:

Equity = Owner Contributions – Owner Withdrawals + Revenues – Expenses.

Balance Sheet

The balance sheet, unlike the previous two statements, shows a snapshot of the business at a moment in time. Notice that the Income Statement and the Statement of Owners' Equity both identify the period of time covered, but the Balance Sheet indicates a specific date that is always the last day of the time period covered by the prior two statements. The balance sheet is based on the accounting equation and show total assets, total liabilities, and owners' equity, and shows as well how they balance.

Your Company	
Balance Sheet	
As of January 31, 20XX	
Assets	
Current Assets	
Cash and Cash Equivalents	$16,050
Merchandise Inventory	360
Prepaid Expenses	800
Total Current Assets	17,210
Property, Plant, and Equipment	2,750
Total Assets	$ 19,960
Current Liabilities	
Accounts Payable	$600
Wages Payable	500
Total Current Liabilities	1,100
Long-term debt	15,000
Total Liabilities	$16,100
Owner's Equity	3,860
Total Liabilities and Owner's Equity	19,960

Notice that total assets of $19,960 is equal to total liabilities and equity of $19,960, and that the owner's equity of $3,860 carried forward from the bottom line of the Statement of Owner's Equity. Finally, the statement of cash flows reconciles beginning cash

and cash equivalents from the balance sheet (ending cash from the prior set of financial statements) to ending cash from the current balance sheet, effectively reconciling accrual basis accounting to cash basis.

Your Company	
Statement of Cash Flows	
For the month ended January 31, 20XX	
Cash provided by operating activities	
Cash receipts from customers	$400
Cash payments to vendors	(1,600)
Cash provided by/(used by)operations	(1,200)
Cash provided by investing activities	
Purchases of fixed assets	(2,750)
Cash provided by/(used by) investing	(2,750)
Cash provided by financing	
Long-term borrowing	15,000
Owner contributions	5,000
Cash provided by/(used by) financing	20,000
Change in cash	16,050
Beginning cash balance	—
Ending cash balance	$16,050

In our sample company, both beginning equity and beginning cash were zero. This statement tells us that operations used $1,200 in cash, as opposed to accrual basis net income from the income statement in the amount of $1,140, and that investing in fixed assets used $2,750 in cash. It also tells us that cash was provided by a combination of borrowing and owner investment in the company.

Other Financial Statements

A Statement of Comprehensive Income is often included along with the Income Statement if the company has certain investments that are adjusted to fair market value. Some smaller companies not subject to the full disclosure of GAAP only prepare the three most basic financial statements, and exclude the Statement of Cash Flows and the Statement of Comprehensive Income, providing instead just the Income Statement, the Statement of Owners' Equity, and the Balance Sheet.

practice questions

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4.28: Introduction to the Bookkeeping Process

What you will learn to do: Discuss the bookkeeping process and the overall effects of transactions



Accurate bookkeeping is essential to the creation of key financial statements.

Where does the information found on financial statements originate? It comes from the bookkeeping process! In the bookkeeping process, every financial transaction, no matter how large or small, is accounted for and entered in a journal. These journals create a permanent record of the financial transactions of the business and are eventually transferred to the key financial statements you learned about in the previous section. Consequently, the importance of accurate and timely bookkeeping cannot be understated.

If a question arises about information on a financial statement it can be answered by examining the bookkeeping entries made in the company's chart of accounts and journals. In this section we will examine an expanded version of the accounting equation and learn how to construct bookkeeping journal entries in order to analyze the relationship among the key financial statements.

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4.29: Expanded Accounting Equation

Learning Outcomes

Illustrate the expanded accounting equation

As you have learned, the accounting equation of Assets = Liabilities + Equity is the foundation of the double-entry accounting system. However, the way it is presented does not really reflect the whole picture. In order to understand how this equation really works, we expand the equation to reflect all of its component parts. We refer to this as the "expanded" accounting equation:

Assets = Liabilities + (Common Stock – Dividends + Revenues – Expenses)

This expanded equation takes into consideration the components of Equity. Equity increases from revenues and owner investments (stock issuances) and decreases from expenses and dividends. These equity relationships are conveyed by expanding the accounting equation to include debits and credits in double-entry form.

The increases (credits) to common stock and revenues *increase* equity; whereas the increases (debits) to dividends and expenses *decrease* equity. Remember, the normal balance of each account (asset, liability, common stock, dividends, revenue, or expense) refers to the side where *increases* are recorded.

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CHAPTER OVERVIEW

5: Managerial Accounting in Business

5.1: Influence on Accounting Decisions
5.2: Putting It Together- Managerial Accounting in Business
5.3: Assignment- Managerial Accounting in Business
5.4: Why It Matters- Managerial Accounting in Business
5.5: Introduction to Financial and Managerial Accounting
5.6: Differentiating Between Financial and Managerial Accounting
5.7: Managerial Accounting
5.8: Relationship Between Financial and Managerial Accounting
5.9: Introduction to Managerial Accounting Perspectives
5.10: Accounting Decision Makers
5.11: Strategy Development
5.12: Risk Management Planning

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5.1: Influence on Accounting Decisions

Learning Objectives

- Explain how accounting decisions are influenced by both employee and leadership beliefs and needs

The decisions made in budgeting and planning for all businesses hinge on the beliefs, culture and leadership of the company. Ethical, value-based leadership is based on a variety of factors, including loyalty and respect, a history of fair dealing and trust among others.

When a company's leadership places value on employees, you may see a different level of importance placed on wages and employee benefits. You may also notice a company that places a high amount of value on the quality of the input for their product, thus having a higher percentage of cost of goods sold or a higher price tag on their product. A focus on an American made product might include a higher price tag for the item, but may be an ethical focus for a company.

The culture of a company begins at the top. If the values and beliefs of leadership focuses on profit at all costs, you will see a very different budgeting and accounting decision making process than a company that values quality and teamwork at all costs.

Values based leadership is an execution in practice of the philosophy of management. Leaders need to encourage employees to embrace the core values of the company, and leadership needs to participate in and model how they want to extend those values. These values will be mirrored in the entire structure of the company. An example here might be the process used to determine commissions for salespeople. If the company culture is such that the main focus is on the happiness and satisfaction of customers, commissions may be budgeted and calculated based on positive customer feedback in addition to sales dollars. If a company focus is on sales at all costs, these commissions may be based solely on the dollars in sales.

The Institute of Management Accountants (IMA) has put together an Ethics in Professional Practice document that outlines the ethical requirements of accountants who work in business. Working with a company who focuses on ethical standards and values based leadership makes the job of budgeting and planning a much easier process.

Practice Questions

https://assessments.lumenlearning.co...sessments/9595

References

http://www.valuesbasedleadershipjournal.com/issues/vol1issue1/dean.php

http://www.ethicssage.com/2012/04/good-leaders-model-underlying-core-ethical-values-in-decision-making.html

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5.2: Putting It Together- Managerial Accounting in Business

Financial accounting is based on historical data and managerial accounting is based on planning ahead, but both are necessary for a company to be successful. The records created by the financial accounting process are needed for regulatory and investment purposes, while the managerial accounting systems are in place for planning, decision making and strategizing.

Learning to take time for managerial accounting is sometimes challenging with all the other required components of running a successful business. Knowing the “why” is an important component of being a good manager. Plan, implement, strategize and continuing to improve business operations through the use of managerial accounting concepts is important to the long term success of a business.

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5.3: Assignment- Managerial Accounting in Business

For this assignment, you will download and complete the following worksheet:

- Assignment: Managerial Accounting in Business (.docx)

You are the product line manager for a snow board manufacturing company based in Provo, Utah. As product line manager for the company's Xtreme line, you are ultimately responsible for all aspects of production as well as the profitability of the line. You have direct authority over the production, marketing and sales of the company's Xtreme line of snowboards. The first quarter sales figures are in and you see that sales are down and in several key markets you no longer hold the #1 position. You are concerned that when you attend the quarterly management meeting that this poor performance is going to be a topic of much discussion. Several months ago, you received information from an overseas manufacturer that can manufacture the bindings for the snow board at a fraction of your current cost to produce them in-house. This will lower the cost to produce the Xtreme line allowing the company to increase their margin, lower prices to customers or some combination of both. Consequently, you believe it is now time to revisit that correspondence and start putting together a plan to address the lackluster Q1 earnings report.

Required:

1. What qualitative and quantitative factors will you have to consider before recommending that the company outsource the production of the binding component of the Xtreme snow boards?
2. What accounting information will you need in order to make the best decision for the company? When identifying the accounting information needed, indicate the following:
    1. Is the information you need financial or managerial in nature?
    2. How will you use the accounting information in evaluating the decision?
3. Identify any potential risks associated with making this decision and how those risks can be addressed.

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5.4: Why It Matters- Managerial Accounting in Business

Why learn about managerial accounting?



There are many differences between financial accounting and managerial accounting. Financial accounting is a requirement, in order to have the information available to prepare tax returns, and financial statements. Outside investors, banks and regulatory agencies need historical information to provide funding and to impose taxes.

Managerial accounting on the other hand is not a regulatory requirement, but it is a requirement for a business to plan and make good decisions. Without managerial accounting, it may be difficult for a business to show a profit, create effective pricing and cost models and overall, be a business that can last.

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5.5: Introduction to Financial and Managerial Accounting

What you'll learn to do: Describe the difference between financial and managerial accounting



What are the differences between financial accounting and managerial accounting? Let's take a look at some of the primary differences.

1. Financial accounting is concerned with reporting historical data to outside sources, while managerial accounting is concerned with reporting data to inside sources for the purpose of planning.
2. Financial accounting must follow generally accepted accounting principles (GAAP), while managerial accounting does not need to follow GAAP.
3. Financial accounting is mandatory, while managerial accounting is not.

There are other differences which we will discuss in this module. Even though managerial accounting is not required, it is a very important component of successful business planning.

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5.6: Differentiating Between Financial and Managerial Accounting

Learning Outcomes

- Compare and contrast financial accounting and managerial accounting

There will be **no** numbers to crunch in this module **at all**! That sounds kind of odd in an accounting course, doesn't it? Well, let's first watch Tony discuss what managerial accounting is:

A link to an interactive elements can be found at the bottom of this page.

You can download a transcript for the video "MA Module 1, Video 1, Intro to Managerial Accounting" here.

Now, with that information, how is managerial accounting **different** from financial accounting? Well, if you remember from the first modules in this course, financial accounting focuses on recording transactions as they occur. So, for example, when you buy something, you record the payable, then you pay the bill. Another example might be, you provided services for a customer. You invoice the customer, await payment, and then deposit the check when it arrives. So essentially, you are recording activities in a historical way. They have happened already.

Now, another big difference is that financial accounting is done for people outside of the company. A bank may want to see your financial statements in order to lend you money. A vendor may want to see your financial statements to extend you credit. The IRS also needs your financial information to access taxes when you file your tax return.

Managerial accounting on the other hand, is done to provide information to managers within the organization. It is used for planning, controlling and decision making. Companies are not required to do the tasks of managerial accounting. You can also do reporting in a segment type of system. This means looking at just one product, one manufacturing line or one segment of your service. These reports don't need to cover the entire operation of the business, and they do not need to follow generally accepted accounting principles (GAAP). You can prepare your reports from a managerial accounting perspective in whatever way is helpful for decision making.

A link to an interactive elements can be found at the bottom of this page.

You can download a transcript for the video "MA Module 1, Video 4, Managerial vs Financial Accounting, Problem 1-1" here.

Summary

So here is the basic overview of how financial accounting differs from managerial accounting.

In small companies, one accountant may be responsible for financial and managerial accounting processes, while larger companies will have multiple people in each role. Because managerial reporting is not required, it can sometimes get put on the back burner at smaller companies who don't see the importance. As you will see in further modules, the importance of managerial accounting can't be overstated. Planning and decision making are important in the long term profitability of the company!

Practice Questions

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5.7: Managerial Accounting

Learning Objectives

- Explain the key components of managerial accounting

Managerial accounting revolves around three primary components:

1. Planning
2. Controlling
3. Decision making

All companies have requirements around these components from the very beginning. Budgeting and business planning are the very first steps in beginning a business, and these are managerial accounting tasks! But what would happen if you just jumped into a business, without planning anything?

Let's look at a small business start-up:

A link to an interactive elements can be found at the bottom of this page.

You can download a transcript for the video "MA Module 1, Video 6, Planning Directing and Controlling, Problem 1-3" here.

The first step is planning. Let's assume we are going to start that restaurant Tony talked about in the video. First, we will create a budget for our new venture. This budget provides us with milestones.

- How much in sales do we need to bring in each month?
- What will our menu look like?
- How many employees do we need and how much will we pay them?
- What will our cost of product be?
- What will we pay for rent and utilities?

Once we have the plan, and we operate our business for a while, we can then move on to the control portion of the managerial accounting process.

- Did we meet our sales goals?
- Did we stay within our budget for payroll?
- Did we meet our cost of product budget and goals?

Then we get to move on to decision making.

- We didn't make our sales goals, so how will we adjust costs?
- Should we adjust costs, or should we rethink our marketing plan to increase sales?
- Are we pricing our product correctly?
- Are we reaching our customer base effectively?
- Do we need to change our menu to better meet customer needs?
- If we didn't meet payroll budget, are we providing the correct training and direction for our employees to do their jobs effectively?

So, hopefully this gives you a better understanding of the importance of planning, controlling and deciding! If you never did the budget, or review it, how would you be able to make decisions that will create a profitable business?

A link to an interactive elements can be found at the bottom of this page.

You can download a transcript for the video "3. Managerial Accounting Ch1 Pt 2: Functions of Managers – Role of Management Accountants" here.

Practice Questions

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5.8: Relationship Between Financial and Managerial Accounting

Learning Outcomes

- Analyze the relationship between financial and managerial accounting and how they are compartmentalized within modern businesses

Companies need to take a look at their numbers in a variety of ways to be successful. Financial accounting records are required, and are the basis for what is used in managerial accounting. In order to have anything to use for decision making, it is necessary to have historical data, right?

Companies who have been around a while will use historical data for budgeting purposes, while new companies need to prepare budgets and business plans based on what they *hope* to happen. As mentioned earlier, most smaller businesses will have only a one or a few people in their accounting department who perform the tasks of both financial accounting (historical) and managerial accounting (future). But larger companies will have separate departments that handle these tasks.

The financial and managerial teams need to work together to create the information needed for planning, controlling and decision making within a company. If they don't work together, neither team will have what they need to create a profitable and successful company! The financial folks need budget numbers from the managerial folks to enter into the accounting software. Then they have the tools needed for comparison to determine if the company is meeting goals.

The managerial team needs historical data from the financial team to prepare their reports. Without that data, it would be impossible to determine which product lines are doing well, when changes need to be made, or how budgets come together. Although the two types of accounting are very different from each other, they work together to create a "strategy" or game plan that fosters this success.

Often falling under one heading of "The Accounting Department," these two very different tasks are needed to insure success of companies, large or small.

Practice Questions

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5.9: Introduction to Managerial Accounting Perspectives

What you'll learn to do: Examine the various managerial accounting perspectives throughout an organization



Within all organizations, various people will need different information from the management accounting systems. Since managerial accounting does not need to follow GAAP and the information prepared is only for internal use, the same information can be manipulated in a variety of ways to help managers to save money, manage costs, price products and make a company more profitable.

Various strategies can be implemented by different companies as well. Not all companies are looking at making the cheapest product at the lowest cost! Some are looking at ways to make a premium product with a very targeted market. The strategies used by these companies will be different.

However a company culture is developed and how strategies are planned, they all start at the top of a company. Leadership style trickles down through the organization and can be seen at all levels.

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5.10: Accounting Decision Makers

Learning Objectives

- Identify the roles and people in a business who take on managerial accounting decisions

In our previous unit we briefly mentioned that different people in a company will use the information prepared by managerial accountants. Managers inside of the organization will need and use different types of information, depending on their job function.

Marketing Department Managers

The managers in the marketing area, need to have an understanding of managerial accounting concepts. Some of the tasks they will use the information for include:

Planning

- How much should we budget for various types of advertising?
- How many salespeople do we need to hire and how should we compensate them?

Controlling

- If we cut the price on our product to increase sales, has that happened as expected?
- Is our inventory too high in various seasons of the year?

Making Decisions

- Should we increase or decrease prices?
- Should we bundle our products at a discount or sell them separately?
- Should we sell directly to customers or work through a distributor?

Manufacturing Department Managers

These are the managers involved in the day to day manufacturing process. These managers will be responsible for determining the manufacturing schedule, staffing, and operating expenses, such as utilities and supplies. They may use managerial accounting information for:

Planning

- How many widgets do we need to produce next quarter?
- What should we budget for gas and electric for next quarter?

Controlling

- Did we spend what we thought we would on production last quarter?
- Are we achieving our utility savings as budgeted?
- Are we making defect free products?

Making Decisions

- Should we make a particular component for our widget in house, or should we have someone else make it?
- Should we buy a newer piece of equipment that can make 100 widgets per hour, or should we stay with the equipment we have that makes 80 widgets per hour?

Human Resources Managers

These folks are tasked with making sure a company has enough trained staff to make all of the product or provide all of the services offered. Planning is huge, especially if training staff takes time. Knowing how many people they need and creating a plan to implement the hiring and training of these people is crucial to excellent product or service delivery.

Planning

- How many employees do we need to hire and how much training is required?
- How much should we budget for recruiting quality talent?

Controlling

- What is our employee retention rate and how can we improve it?
- What is our safety record, and is our safety training effective?

Making Decisions

- Should we hire temporary or full-time employees?
- Should we keep our current health care plan or evaluate going to a self-insured plan?

Top Management

As you can clearly see, each department in any business will use the information provided by managerial accounting data. The CEO may look at the big picture stuff, such as:

- We budgeted sales of $11 million, but only sold $10 million. How can we bring sales up next year?
- We planned for 100 full time employees, but currently employ 110. Is there a way to lower payroll costs, while still meeting sales and production goals?

These questions would then be filtered down to the department responsible. Without comparing budget to actual, and projecting into the future, these questions and knowing how to answer them, would not be available! Managerial accounting data is useful to everyone in an organization for planning, controlling and making decisions.

Practice Questions

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5.11: Strategy Development

Learning Outcomes

- Explain how accounting affects strategy development

A link to an interactive elements can be found at the bottom of this page.

You can download the transcript for “Business and Accounting Terms: How to Define Strategy Development” here.

Accounting affects strategy development in a variety of ways. The tax piece can be a huge factor. Take a look at this short video about Marriott Corporation and how accounting affects their strategy from a tax standpoint:

A link to an interactive elements can be found at the bottom of this page.

You can download the transcript for “How Accounting Impacts Corporate Strategy with Chip Jordan” here.

A strategy is a game plan to help a business be successful. It doesn’t just happen by luck or chance, but by planning for success! Companies need to know how to attract the right customers who choose them over a competitor. It isn’t always about price! Think about Walmart trying to get into the upscale clothing market. Would it work? Probably not. It is not in their strategic plan. Their market is to provide products at a low cost, not a high cost.

But then, look at Trek Bicycles. Their goal was to make high quality bikes in the United States. When someone buys a Trek, it isn’t because it is the cheapest bike they could buy, it is because it is a quality U.S. made product. Their strategy is different from the strategy of Walmart. From an accounting standpoint, it isn’t about making the cheapest product. For example, a decision at Trek would not be whether a component that is currently made in their manufacturing facility should be shifted overseas to save money. The decision may be, should they contract with another U.S. based company to make the component, or keep it in house?

Business strategy development may revolve around several different components:

- **Customer intimacy.** A company such as Trek sets a goal to gain customers because they can customize a bicycle to best meet the customer’s needs. Cost is not a factor.
- **Operational excellence.** A company such as Walmart gains customers by saying they can provide products and services faster and cheaper than the competition. Price is a factor.
- **Product leadership.** A company such as Apple who sets a goal to gain customers based on their ability to provide a higher quality product than the competition. Cost is not a factor.

From a managerial accounting standpoint, it is important to understand the strategy of a company. It isn’t always to sell more product or provide more services at a cheaper price. Quality and customization may play a huge role in many strategic plans. Is it better to sell 1000 bicycles for $1000 each that will last the customer for years, or to sell 50,000 bicycles at $50 each that need to be replaced by the customer every two years? The answer to this question will depend on the strategic plan of the company.

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5.12: Risk Management Planning

Learning Outcomes

- Explain how accounting is tied to risk management planning

Every plan, strategy and decision made by any business involves a certain amount of risk. There are many risks faced by businesses and controls that can be put in place from an accounting perspective to minimize these risks. From a managerial accounting standpoint, companies use controls to reduce the risk that what they planned to happen during the budgeting and planning processes will not happen.

So what is a risk management plan?

A link to an interactive elements can be found at the bottom of this page.

You can download the transcript for the video “What is Risk Management Plan?” here.

Let’s look at a couple of potential risks and how, from an accounting perspective, they might be controlled.

- Budgeting errors in the production requirements have created either excess or insufficient production
- Implement a rigorous review of the budgeting process, along with periodic reviews during the budget term
- Inaccurate reporting of the inventory valuation
- Perform periodic physical inventory counts and compare to the financial accounting records

What if you have budgeted a change from employing staff in your US facility to taking the production of your widgets overseas to save money? This may look like a good thing on paper, with a lowering of the cost of production, but what might be some issues with this change?

- The quality of your product may go down, causing more product returns.
- The lead time from order to production may be longer due to transit issues.
- Employment guidelines may be the same, or might they be employing children or asking employees to work long hours
- Company morale may go down due to this change

As a manager it is important to not just look at the numbers, but to look at the other factors that may change with a change in the budget. These changes may create additional risks that may reduce overall profitability.

These changes may also impact the image of the organization. Imagine if Trek suddenly moved their production overseas, resulting in a lower quality of bicycle, when they clearly state on their website that they build their bikes in the United States Might that create a decline in sales? Perhaps their retail outlets would decide to purchase bikes from other manufacturers? Maybe the employee morale of those still working in the United States would go down, creating lower quality of even the bikes still made here.

There are so many factors to consider when making accounting decisions that may not even relate money. As a manager, make sure to look at all of the potential risks involved in a decision, not just the immediate financial costs or savings.

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CHAPTER OVERVIEW

6: Cost Behavior Patterns

6.1: High-Low Method
6.2: Least Squares Regression Method
6.3: Putting It Together- Cost Behavior Patterns
6.4: Assignment- Cost Behavior Patterns
6.5: Why It Matters- Cost Behavior Patterns
6.6: Introduction to Costs
6.7: Product vs. Period Costs
6.8: Manufacturing Costs
6.9: Fixed vs. Variable Costs
6.10: Relevant Range
6.11: Introduction to Mixed Cost Analysis
6.12: Mixed Costs
6.13: Independent vs. Dependent Variable

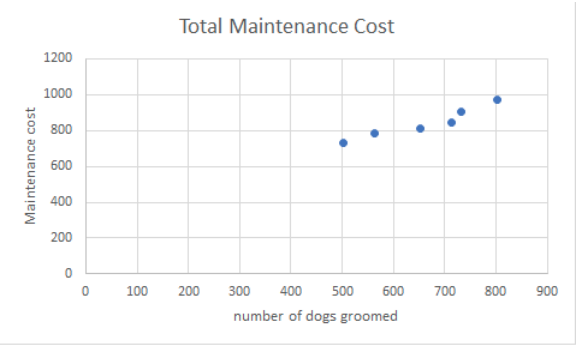
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6.1: High-Low Method

Learning Outcomes

- Analyze mixed costs using the high-low method

In our previous dog groomer example we could clearly see through our scattergram that maintenance costs were related to the number of dogs groomed. Remember that that was our initial diagnostic step before we moved on to more detailed analysis of our costs.



The scattergram above shows a relatively linear relationship between the maintenance costs (cost-Y) and the number of dogs groomed (activity -X) we can use the high-low method to estimate which portion of our expense is the fixed portion and which is the variable portion.

With this method we first look for the period with the lowest level of activity and the highest level. Going back to our chart from 7.2.2 the lowest month 500 dogs were groomed and the maintenance cost was $740. The highest month 800 dogs were groomed and the maintenance cost was $980. Now we can use those numbers in our high-low formula:

Variable cost = Cost at the high activity level-cost at the low level of activity

High activity level − Low activity level

Variable cost = Change in cost

Change in activity

Variable cost = $980 − $740

800 − 500

Variable cost = $240/300 or .80 for each dog groomed

We can now calculate the fixed cost component. We can use the total cost of either the high or the low and subtract the variable component:

Fixed cost = Total cost − Variable cost element

Fixed cost= $980 − .8(800) = $980 − $640 = $340 using the highest month

Fixed cost = $740 − .8(500) = $740 − $400= $340 using the lowest month

Note

This method can **only** be used if the scattergram that you used for your initial testing shows a linear correlation between the costs and the quantity! Also note that although this method is simple to apply it only uses the two points of data. Having only two points of data might produce results that are not accurate. Because of this, the next section on the least squares regression will probably be more useful and reliable for determining the fixed and variable portions of mixed costs.

Practice Questions

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6.2: Least Squares Regression Method

Learning Outcomes

- Use the least-squares regression method to create a regression line on a graph of cost data

This method uses all of the data available to separate the fixed and variable portions of a mixed cost. A regression line is fitted into the data using the following formula:

$$Y = a + bX$$

Y= Maintenance costs

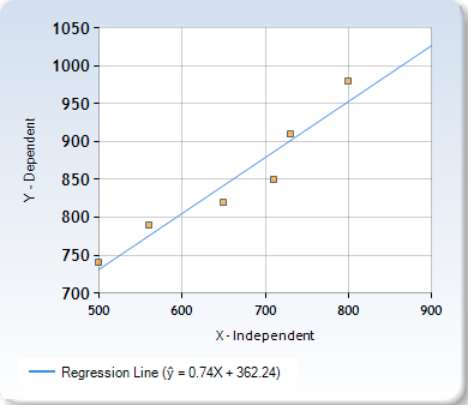
X= Number of dogs groomed

a= the total fixed cost

b= the variable cost per unit of activity

So using a calculator available HERE.

If you use the data from the dog groomer example you should be able to calculate the following chart:



This method is more accurate, using all of the available data. The table below shows the difference in calculation using the two methods:

Costs	High-low	Least Squares Regression Method
Variable cost estimate per dog groomed	$.080	$.074
Fixed cost estimate per month	$340	$362.24

Practice Questions

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6.3: Putting It Together- Cost Behavior Patterns

Product costs, period costs, fixed costs and variable costs and all the combinations are so important to know as a manager. When the accounting department comes to you with a report that shows a higher product cost than budgeted, you will know where to look for discrepancies and ways to save on costs. Not knowing these terms would make analysis of your costs difficult.

In this module we looked at various ways to break down potential mixed costs. In the future, if you notice a correlation between a rise in services or production and a rise in a certain cost, you now have the tools to do an initial analysis and follow up with more details.

Understanding how various costs behave, and how you can manage those costs could mean the difference between a profitable company and an unprofitable one. So let's move on now to learning how costs and volume analysis can help you manage effectively!

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6.4: Assignment- Cost Behavior Patterns

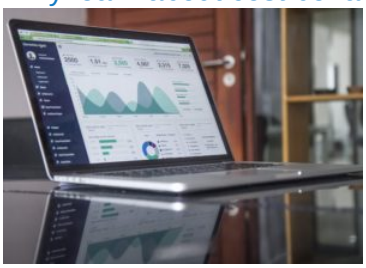
For this assignment, you will download and complete the following worksheet:

- Assignment: Cost Behavior Patterns (.docx)

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6.5: Why It Matters- Cost Behavior Patterns

Why learn about cost behavior patterns?



Knowing how costs behave and why they change is an important component to analyzing pricing, reducing costs and managing expenses. There are a variety of costs that go into the production of a product or the performance of a service. In this module we will define produce and period costs, and review examples of fixed and variable costs.

Mixed costs are also discussed, as well as ways to break these costs into the fixed and variable components. Various methods can be used depending on the accuracy you need. Knowing these terms and how these costs interrelate can help you to be an effective manager and know how to understand the reports prepared by the managerial accounting department.

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6.6: Introduction to Costs

What you'll learn to do: Classify costs to better understand the business expenses



Managers need to analyze cost behavior for many reasons. Costs can be used in different ways in managerial accounting to glean the needed information. Understanding how costs behave can help managers control those costs, saving money for the company and increasing the profits.

Cost behavior is the concept of how costs change when there is a change in the level of activity in the company. Some costs, variable costs, will change with additional production and activity, while fixed costs occur, regardless of the level of production. Knowing how these costs, along with sunk costs, opportunity costs and other costs will affect the break-even point and profitability of a company.

We will be discussing cost-volume-profit analysis in future units, along with many costing techniques that will help you, as a manager, make good decisions.

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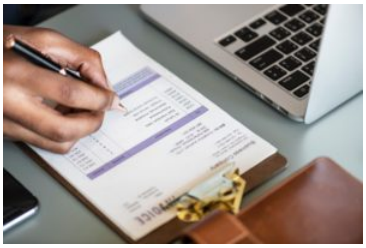
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6.7: Product vs. Period Costs

Learning Outcomes

- Differentiate between product costs and period costs

When preparing financial statements, companies need to classify costs as either product costs or period costs. We need to first revisit the concept of the matching principle from financial accounting.



As a general rule, costs are recognized as expenses on the income statement in the period that the benefit was derived from the cost. So if you pay for two years of liability insurance, it wouldn't be good to claim all of that expense in the period the bill was paid. Since the expense covers a two year period, it should be recognized over both years. This is an example of the accrual basis of recording costs.

The matching principle operates on the accrual basis of accounting and states: Costs incurred to generate a particular revenue, should be recognized as expense in the same period that the revenue is recognized. If a cost is incurred to acquire or produce a product that will ultimately be sold, then the cost should be recorded as an expense when the sale takes place because that is when the benefit occurs. These costs are called product costs.

Product Costs

Product Costs include any cost of acquiring or producing a product. If you manufacture a product, these costs would include direct materials and labor along with manufacturing overhead. Most of the components of a manufactured item will be raw materials that, when received, are recorded as inventory on the balance sheet. Only when they are used to produce and sell goods are they moved to cost of goods sold, which is located on the income statement. When the raw materials are brought in they will sit on the balance sheet. When the product is manufactured and then sold a corresponding amount from the inventory account will be moved to the income statement. So if you sell a widget for $20 that had $10 worth of raw materials, you would record the sale as a credit (increasing) to sales and a debit (increasing) either cash or accounts receivable. The $10 direct materials would be a debit to cost of goods sold (increasing) and a credit to inventory (decreasing).

Period Costs

Period costs include any costs not related to the manufacture or acquisition of your product. Sales commissions, administrative costs, advertising and rent of office space are all period costs. These costs are not included as part of the cost of either purchased or manufactured goods, but are recorded as expenses on the income statement in the period they are incurred. Remember, when expenses incurred may **not** be when cash changes hands. If advertising happens in June, you will receive an invoice, and record the expense in June, even if you have terms that allow you to actually pay the expense in July. Remember back to our insurance situation in the first paragraph. The cash may actually be **spent** on an item that will be incurred later, like insurance. It is important to understand through the accrual method of accounting, that expenses and income should be recognized when incurred, not necessarily when they are paid or cash received.

Practice Questions

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6.8: Manufacturing Costs

Learning Outcomes

- Classify a variety of manufacturing costs

A cost object, or cost driver, is anything you would like cost data on. This can include products, customers, job or subunits of the company. The costs are assigned to these cost objects for multiple purposes, including pricing, spending control and profitability studies.

Take a look at this video for a review of cost drivers and costs:

A link to an interactive elements can be found at the bottom of this page.

You can download the transcript for the video "What are Cost Drivers? (Cost Accounting Tutorial #2)" here.

When we assign these costs to a cost object, we need to differentiate between direct and indirect costs.

Direct costs can be easily traced to a specific cost object, such as a product or service. An example would be the person who runs the cutting machine in a print shop, or the paper for brochures that are printed.

Indirect costs cannot be easily traced to a specific cost object. An example here might be the oil for a piece of equipment or custodial wages for cleaning the manufacturing plant.

Costs can be direct or indirect, depending on the cost object. Let's look at the wages paid to the plant manager who oversees the entire manufacturing process at a print shop. The manager's wages are a direct expense of manufacturing, if we are using manufacturing as our cost object. If we are using a customer order of 1000 flyers as our cost object, then the manager's wages are an indirect expense of that cost object.

The product costs includes:

- **Direct materials:** These costs can be directly and easily traced to a specified cost object. If you make running shoes, the materials that are in the shoes are direct materials. If you create printed flyers, the paper they are printed on are direct materials.
- **Indirect materials:** This includes items of materials that are not easily traceable to a specific cost object. The oil for a machine, needles for a sewing machine or glue for the running shoes may be too small to worry about tracking for each item. These materials may be lumped into manufacturing overhead.
- **Direct labor:** The labor cost that can be directly and easily traced to a specified cost object. The employees who run the presses in a printing company, or those who attach the soles to the shoes are considered direct labor.
- **Indirect labor:** This includes the wages for custodial work, security guards and supervisors. These wages can't be directly linked to a particular product, but are needed for the overall operation of the company. These costs, like indirect materials, might be put into the manufacturing overhead calculation.
- **Manufacturing overhead:** This is a catch-all category and it includes any costs of manufacturing other than materials and labor. Incidental materials and labor, maintenance on machinery or custodial wages would be included here. Any expense incurred for the manufacture or acquisition of the product a company makes or sells, that is NOT direct labor or direct materials, will be put here, and then later allocated.

There are two final types of manufacturing costs that may be used in discussion.

1. Prime cost is the total of direct labor plus direct materials.
2. Conversion cost is the sum of direct labor plus manufacturing overhead costs. These are the costs required to turn (convert) a raw material into a finished product.

Let's look at an example to better clarify the differences between the different manufacturing costs.

SunRize, an organic sports drink company has incurred the following costs:

SunRize Manufacturing Costs	
Direct materials	$60,000
Direct labor	$30,000
Manufacturing overhead	$15,000
Selling expenses	$22,000
Administrative expenses	$45,000

We can categorize these costs in many ways including the following:

Product Cost

$$\begin{aligned}\text{Product cost} &= \text{direct materials} + \text{direct labor} + \text{manufacturing overhead} \\ &= \$60,000 + \$30,000 + \$15,000 = \$105,000\end{aligned}$$

Period Cost

$$\begin{aligned}\text{Period cost} &= \text{Selling expenses} + \text{Administrative expenses} \\ &= \$22,000 + \$45,000 = \$67,000\end{aligned}$$

Conversion Costs

$$\begin{aligned}\text{Conversion costs} &= \text{Direct labor} + \text{Manufacturing overhead} \\ &= \$30,000 + \$15,000 = \$45,000\end{aligned}$$

Prime Costs

$$\begin{aligned}\text{Prime costs} &= \text{Direct material} + \text{Direct labor} \\ &= \$60,000 + \$30,000 = \$90,000\end{aligned}$$

These are the basic classifications of costs in businesses. Each serves a purpose in helping to make decisions as a manager. Knowing how these costs interact and respond with changing levels of activity is an important management task.

Practice Questions

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6.9: Fixed vs. Variable Costs

Learning Outcomes

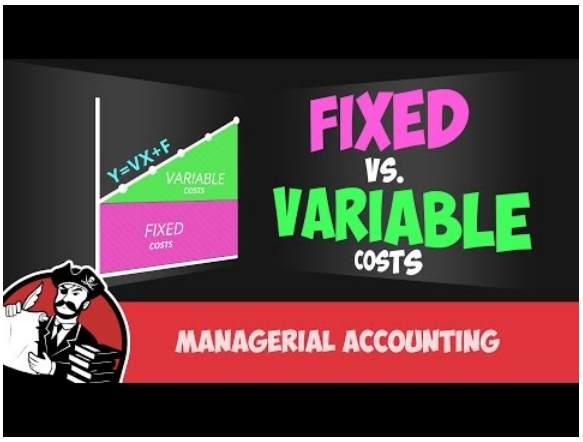
- Define and give examples of fixed and variable costs

Fixed costs happen, regardless of the manufacturing or sales level. Costs such as rent, property taxes, utilities and administrative wages will need to be paid whether you manufacture one item or thousands of items. They may differ some based on output. For example, if your sales get to a point where you need to add an additional manufacturing facility your rent, property taxes and other fixed costs may rise. During planning and budgeting, it is important to know what your fixed costs are and how they affect the profitability of the company.

Fixed costs can be further identified as:

1. **Committed fixed costs:** These are multiyear organizational investments that cannot be easily changed. Examples of committed fixed costs include investments in assets such as buildings and equipment, real estate taxes, insurance expense and some top-level manager salaries.
2. **Discretionary fixed costs:** These arise from annual decisions by management and could include advertising, research, management development programs or large scale public relations plans. These fixed costs can be cut out with no real damage to the long-term goals of the company.

Variable costs will change depending on how many products you buy or manufacture. For a cost to be considered variable, it needs to vary based on some activity base. An activity base may also be called a cost driver. Units produced, units sold, direct labor hours and machine hours are all possible activity bases or cost drivers in a manufacturing facility. Using units sold as a cost driver, you wouldn't need to buy raw materials for 1,000 widgets if you only have orders for 500. These costs include direct materials, direct labor and some of the manufacturing overhead items.



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Let's look at a restaurant example. If we serve 100 customers, we will need to purchase food (direct materials) for the 100 meals we serve. So if our cost of goods sold per meal is $4, we would spend $400 on food if we serve 100 meals, but only $200 if we serve 50 meals. This is a variable cost.

Now, whether we serve 100 meals or 10 meals, the cost of the building will remain the same. If rent on our building is $1,000 a month, and we serve 1,000 customers, then our average cost per customer is $1. If we serve 500 customers, then our average cost per customer is $2. The amount paid for rent does not change, but the cost per customer does.

Up to this point, we have been talking primarily about manufacturing businesses. What if we manage a retail store? Walmart and Target also have fixed and variable expenses that are incurred in the operation of their business, as do all other retail outlets, including online stores.

Variable costs are those that will vary depending on the output of the store. In a retail setting, these costs might include sales commissions, inventory purchased for resale, cash register tape and packaging materials such as bags. These costs will all depend on how much product is being sold.

Fixed costs will be similar to those in a manufacturing facility. Administrative wages, rent, property taxes and utilities are all going to be fixed. These will exist whether the retail store sells one item or thousands!

So all business operations will have fixed and variable costs. Regardless of the type of business, these costs need to be evaluated, managed and controlled to create the best net profit for the company.

Practice Questions

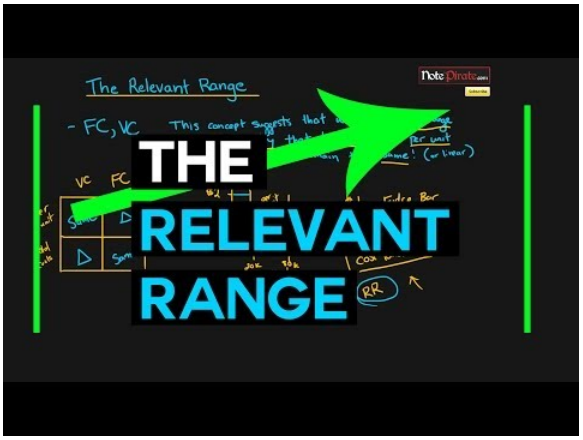
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6.10: Relevant Range

Learning Outcomes

- Describe the relevant range and its use in managerial accounting



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The relevant range is the range of activity where the assumption that cost behavior is a straight line (linear) is reasonably valid. Managerial accountants like to assume that the relationship between a cost and an activity run in a straight line. As an example, if you make 10 widgets, and the direct materials in the widget cost $1, then the assumption would be that for each widget above 10, you would need to purchase another $1 worth of direct materials.

What might make this **not** be the case? Perhaps, there is a discount on additional direct material at a given point. So from a relevant range standpoint, we need to determine at what point that number will change. Perhaps we get a discount after we purchase 100 components, at which time the cost of direct material will drop to .80 per widget. With variable costs then, the relevant range will be the range where the cost of adding one more, will be the same as the last. In this example, from 0-100 widgets, each additional widget will add $1 in cost to our direct materials. Once we go above 100, we are outside of the relevant range.

In fixed expenses, if our facility is designed to build 5,000 widgets per month, what will happen when we reach sales of 5,001 widgets? We will need to **add** to our space, thus increasing our fixed expenses.

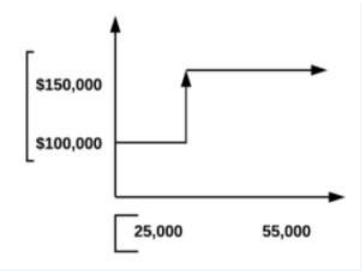
Example

Frank's Bikes manufacturers children's bikes. They store the finished inventory in a rented warehouse which is designed to accommodate 25,000 bikes at one time. The warehouse rent per annum is $100,000 regardless of the number of bikes parked there, so it is a fixed cost.

During the financial year 2014, sales dropped but they kept producing bikes so they ended up with too many bikes to store in the rented space. Their ending inventory was 35,000 bikes! They had to rent another space for $50,000 to store the extra finished goods inventory.

The new warehouse will be big enough until they reach 55,000 bikes, so the total rent will remain at $150,000 until that time. Hopefully, they get manufacturing and sales aligned before that happens, but for now, that is the new relevant range.

The following graph explains the concept of relevant range. X-axis plots the number of units while Y-axis shows cost.



If they have 25,001 motor bikes in stock, they need the second warehouse! So the relevant range for the cost of $100,000 for rent would be from 0-25,000 bikes. From 25,001 to 55,000 bikes their rent would jump to $150,000. What would happen if they had 55,001 bikes that needed to be stored?

Practice Questions

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6.11: Introduction to Mixed Cost Analysis

What you'll learn to do: Summarize the key elements of mixed cost analysis

Mixed costs contain some variable cost elements along with some fixed cost elements. We will define mixed costs and look at various methods to analyze this type of cost. We will look at both retail and manufacturing facilities in this unit.

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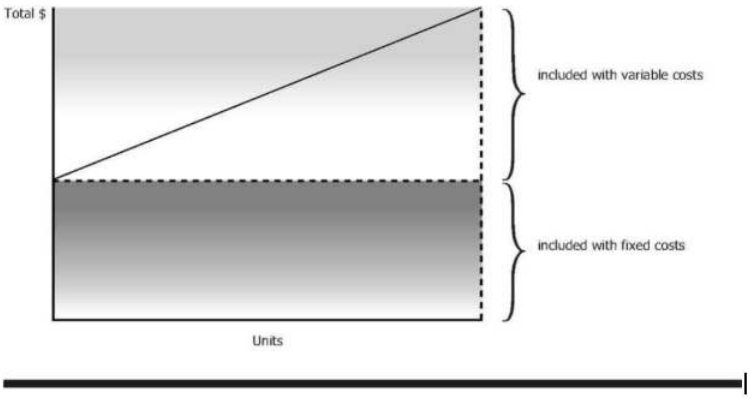
6.12: Mixed Costs

Learning Outcomes

- Define and outline examples of mixed costs in retail and manufacturing business

Mixed costs are those costs that are a combination of fixed and variable costs with elements of both. In a graph form, mixed costs would look like this:

Illustration 21.2 Separation of Mixed Costs into Fixed and Variable Parts



Let's assume that we have a licensing situation, where our base fee is $500 for the first 1,000 widgets, but for each additional widget over 1,000 we sell, we need to pay an additional $1. Looking at the illustration above, the amount included with fixed costs would be $500, since that needs to be paid whether we produce one widget or 5,000 widgets. The variable portion is the $1 per widget.

The equation for mixed costs looks like this:

Y= The total mixed costs

a= The total fixed costs

b= The variable cost per unit of activity (the slope of the line above)

X= The level of activity.

The steeper the slope on the variable line, the higher the variable cost per unit.

What might be a mixed cost in a retail environment? Rent might be a mixed cost. In some leasing situations, there is a base rent, and then a percentage of sales on top of the base. Let's imagine that you rent a space for a small retail location in your local mall. You are charged a base rent of $500 per month, plus 2% of sales. The fixed portion of this expense is $500, because you pay that amount even if your sales are zero. The variable portion of this expense will be the 2% of sales. For each dollar in sales, you will add .02 to your rent. If you look at the graph above you can see how you apply this graph to our rent example.

Practice Questions

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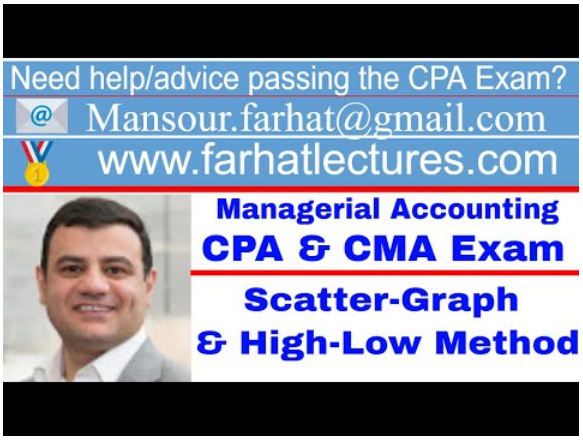
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6.13: Independent vs. Dependent Variable

Learning Outcomes

- Define dependent variable and independent variable

Here is an overview of mixed costs, and creating a scattergraph to test our theory of the behavior of the costs.



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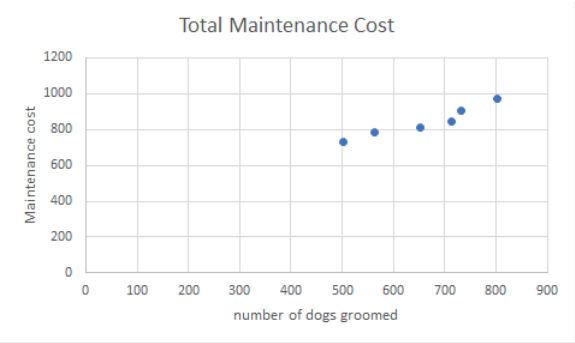
You are the maintenance supervisor at the local dog groomer. It is budget time, and you are working on your maintenance budget for the year. In an effort to work through your numbers, you notice that the maintenance cost has a fixed component to it. The hypothesis is that for each additional dog groomed, there is additional maintenance cost incurred. Let's look at a few months worth of activity:

Month	Number of Dogs Groomed	Total Maintenance Cost
July	560	790
August	710	850
September	500	740
October	650	820
November	730	910
December	800	980

Going back to our mixed cost formula:

Y= total maintenance cost and will be plotted on the vertical axis of our graph. This cost is the dependent variable since the amount depends on the activity for the period.

X= the activity or number of dogs groomed. This will be plotted on the horizontal axis and is the independent variable, because it is the factor that causes the variations in the cost.



So from this graph, you can see that the more dogs groomed, the higher the maintenance cost, and it is rising in a somewhat linear manner too. This step, creating a scattergraph is done as a first step to see if our theory is correct, before we move on and do further analysis.

Practice Questions

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CHAPTER OVERVIEW

7: Costing Methods

7.1: Introduction to Process Costing
7.2: Job Order Costing vs Process Costing
7.3: Flow of Costs (Process Costing)
7.4: Equivalent Unit Calculations
7.5: Cost Reconciliation
7.6: Direct and Step-Down Methods
7.7: Introduction to Cost Accounting Methods
7.8: Activity-Based Costing
7.9: Traditional Costing vs. ABC
7.10: Putting It Together- Costing Methods
7.11: Why It Matters- Costing Methods
7.12: Assignment- Costing Methods
7.13: Introduction to Cost Management
7.14: Value Chain
7.15: Direct and Indirect Costs
7.16: Introduction to Job Order Costing
7.17: Job Order Costing
7.18: Calculating Costs
7.19: Flow of Costs (Job Order Costing)
7.20: Recording Job Order Costs

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7.1: Introduction to Process Costing

What you'll learn to do: Examine the process cost accounting system



There are some similarities and differences between job-order costing and process costing. Both are common costing methods for companies. We will look at the differences between the two methods, when process costing is used, and how costs flow through the system. We will also examine how process costs are recorded in the accounting system.

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7.2: Job Order Costing vs Process Costing

Learning Outcomes

- Compare and contrast job order and process costing

You have just been hired as an accountant at a local manufacturing company. They are a small start-up and are unsure how to enter costs into their accounting system. Having just purchased Quickbooks software, it is time to decide how they get it set up to work most effectively for their needs. Currently, the company makes one product, the Ultimate Planner. The Ultimate Planner is a printed planner designed to make every small business owner's life just a bit easier. Sales have been great, but they are now in a position to really get down to ensure that they are making money on each planner they sell.

You sit down and take a look at the two possible costing methods; Job order costing and process costing. Let's first compare the two:

Job Order Costing	Process Costing
1. Lots of jobs are worked on during a given period, and each job requires different things from production. 2. The costs are accumulated by job. 3. Unit costs are recorded by job on a cost sheet that follows the job through the production department.	1. One product is produced all the time, or for an extended period of time and every unit is identical. 2. Costs are accumulated by department. 3. Unit costs are calculated by department.

Let's think about our product. We produce, **one thing** on a **continuous basis**: the planner. If you look at the two types of costing, which one makes more sense?

Both of the systems are alike in that they are designed to accumulate costs such as materials, labor and manufacturing overhead, and assign them to a product. We will also be using the same accounts, regardless of which costing method we use. So remember from our previous unit, we will use:

1. Manufacturing overhead
2. Raw materials
3. Work in process (WIP)
4. Finished goods

The costs will also flow through the system in a similar way. But what are the differences?

In the process costing, we are making one product either *all* the time or for an extended period of time. So in the case of our Ultimate Planner, since we make one product, it seems to make more sense to use process costing, right?

What would happen, if down the line, they decide to do special custom planners for different customers? For example, an order comes in to make a planner in a certain color for a large employer to give to all employees. This may create a "job-order costing" situation, rather than a "process costing" situation. But for right now, they are only creating one product in their facility and they are producing it all the time—let's move forward with process costing.

Practice Questions

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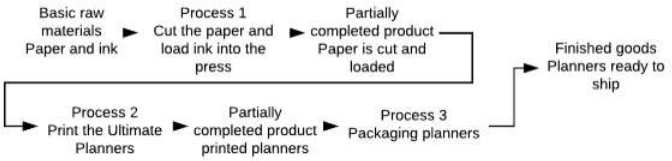
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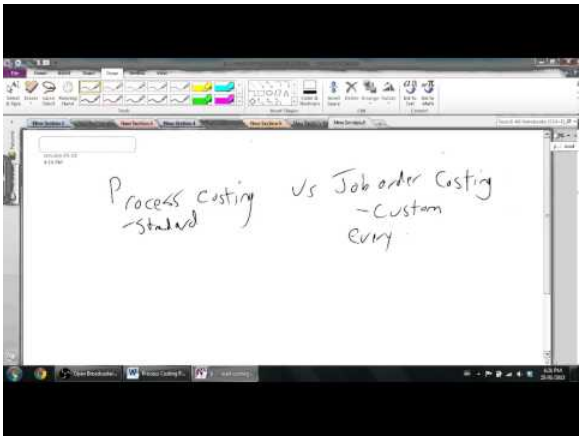
7.3: Flow of Costs (Process Costing)

Learning Outcomes

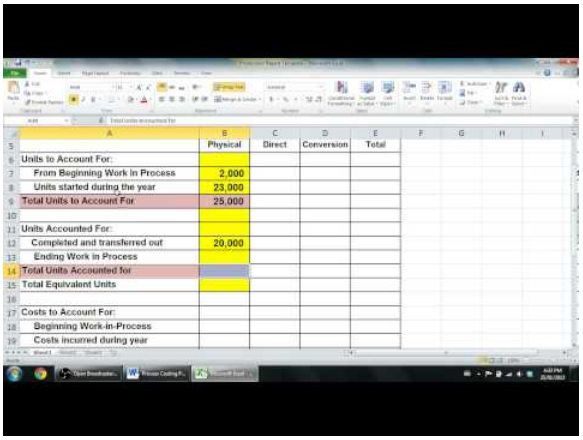
- Explain the flow of costs in a process costing system

The flow of costs in the process costing system is similar to in a job-costing system, but let's review with our Ultimate Planner example:



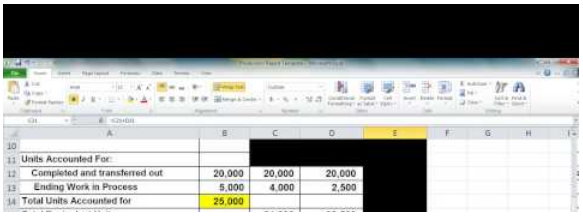


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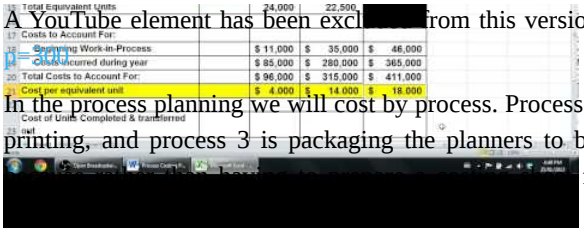
	A	B	C	D	E	F	G	H	I
5		Physical	Direct	Conversion	Total				
6	Units to Account For:								
7	From Beginning Work In Process	2,000							
8	Units started during the year	23,000							
9	Total Units to Account For	25,000							
10									
11	Units Accounted For:								
12	Completed and transferred out	20,000							
13	Ending Work in Process								
14	Total Units Accounted for								
15	Total Equivalent Units								
16									
17	Costs to Account For:								
18	Beginning Work-in-Process								
19	Costs incurred during year								

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	A	B	C	D	E	F	G	H
10								
11	Units Accounted For:							
12	Completed and transferred out	20,000	20,000	20,000				
13	Ending Work in Process	5,000	4,000	2,500				
14	Total Units Accounted for	25,000						

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In the process planning we will cost by process. Process 1 involved preparing the raw materials for printing, process 2 is the actual printing, and process 3 is packaging the planners to be moved to finished goods inventory. Costing is simpler in this system for many products, we only need to do costing for three departments or

We start with the basic inputs:

1. Raw materials
2. Wages
3. Manufacturing overhead

Manufacturing overhead will be estimated, just as in the job costing method, but will need to be recorded as incurred. The clearing account will be used to accumulate the actual costs, and a reconciliation will be done at the end of each period.

A processing department is a unit where work is performed on a product and where materials, labor or overhead are added to the product. In the case of our planner, we first add the raw materials, then we add labor to process the raw materials, next conclude with additional labor to package the finished product to prepare it for shipment. These will be the three processes used for costing. Each business will have different processing departments, depending on the product they are making.

Each of these processing departments will be a work-in-process center. So a job costing system may have only one work-in-process, while a process costing system will have several. In the Ultimate Planner example, there will be three WIP accounts.

Raw materials, labor and overhead can be added during any process. So the costs in Process 2 will include everything happening in that process, plus the costs that are attached to the partially completed product transferred in from Process 1. These are called transferred-in costs.

Practice Questions

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7.4: Equivalent Unit Calculations

Learning Outcomes

- Calculate equivalent units of production and cost per equivalent unit using the weighted average and FIFO methods

So the Ultimate Planner goes through three departments on its way to finished goods inventory. In each department raw materials, labor and overhead are being added to the planners. In order to calculate a product unit cost, those costs need to be accumulated, as the planner isn't finished. Each department has an ending inventory of unfinished planners. How can we figure out the costs at each stage of production? The easiest way is to figure out what percentage of the planner is completed, as to the work in that department. We call this the equivalent units of production method of costing:

equivalent units = number of partially completed units × Percentage completed

At the end of process 1, our planners have their paper and ink ready to be printed. Let's assume we figure the ending WIP inventory to be 35% complete as to the process. If we have 1000 units in the ending WIP inventory after process 1, this would equal 350, using the formula for equivalent units. We could then add these equivalent units to the ending WIP inventory for process 1. Any units that have been moved into process 2, will be subtracted from the WIP inventory for process 1.

There are two ways we can calculate the equivalent units of production for a department or process: **weighted-average** or **FIFO** (first in, first out).

Weighted Average

In this method we use the following equation:

$$\begin{array}{rr} & \text{Units transferred to the next department or to finished goods} \\ + & \text{Equivalent units in ending work in process inventory} \\ \hline & \text{Equivalent units of production} \end{array}$$

One thing to keep in mind when using the weighted average method, we don't need to compute the equivalent units for the ones transferred out. Those are considered 100% complete for the work done in that department, otherwise they wouldn't be moving forward to the next process.

Example

In the current period, we transferred 500 units to process 2, and have 350 equivalent units in our WIP inventory. So our equivalent units of production for the period would be 850 units. Essentially saying, that process 1 completed 850 units to completion of process 1 in this period.

Example

700 units were transferred from process 1 to process 2. We also have 1000 partially completed units that are 50% complete.

We would have 500 equivalent units in our WIP inventory. (1000 × 50%) + 700 units that were transferred out. Our equivalent units of production for the period is 1,200 units (700 + 500).

FIFO

Equivalent units can also be calculated using the FIFO method. In this method, the units that have been moved to the next process are divided into two parts:

1. The units that were in beginning inventory and completed
2. The units that were both started and finished in the current period.

In this method, both the beginning and ending inventory is converted into equivalent units, so there is a bit more work to do. For those units that were in the beginning inventory, we need to figure out how much work was DONE on them in this period to get

them to the point of being transferred to the next process. For those items in the ending inventory, it is the same as the weighted-average method, where we need to calculate how much work has been done to them already.

Example

We have 500 units in our beginning inventory that needed 50% more done to them yet = 250 units

We also completed 500 units that were started and finished in this period = 500 units

And we have 1000 units that are 25% complete at the end of the period = 250 units

So how many units did we complete during the period? 250 + 500 +250 = 1000 units were completed through process 1 for the period.

In our next section, we will do a comparison and reconciliation of the same number of products through one process with each of the two methods.

Practice Questions

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7.5: Cost Reconciliation

Learning Outcomes

- Prepare sample cost reconciliation journals for both the weighted average and FIFO methods

The costs per equivalent unit are used to value the units in the ending inventory and the ones that have been moved to the next process. When calculating the equivalent units with the weighted average method and the FIFO method we will end up with a different quantity, using the same data.

Let's first look at the equivalent units of production using the weighted average method.

The Ultimate Planner: Weighted Average Method		
	Qty	% Complete
Beginning WIP Inventory	500	30%
Units started and completed	4300	100%
Units started and NOT completed	500	25%
Units completed and moved to process 2	4800	
Ending WIP *x*% complete	125	
Equivalent units of production	4925	

Now, let's look at the same information using the FIFO method:

The Ultimate Planner: FIFO Method		
	Qty	% Complete
Beginning WIP Inventory	500	30%
Units started and completed	4300	100%
Units started and NOT completed	500	25%
Beginning WIP 500x 70% yet to complete	350	
Units completed and moved to process 2	4300	
Ending WIP *x* % complete	125	
Equivalent Units of Production	4775	

Remember, in the weighted average method, we add the beginning WIP and the product started and finished in the period, adding the units started, but not completed based on the percentage completed.

With the FIFO method, we need to adjust the beginning WIP by the amount that was needed to complete yet to get that beginning WIP finished and moved on.

Figuring the costs per unit is our next task. Now that we have figured out how many equivalent units of production via each method, let's apply the costs. Costs consist of raw materials, direct labor and overhead for each item produced. Sometimes, a great deal of the raw materials have already been put into a product, but it still needs a chunk of labor to move it to the next department. In this case, we may have a different percentage of completion for the raw materials and the conversion costs. Conversion costs are defined as direct labor plus manufacturing costs needed to finish a product.

Note: For the purposes of this course, we will assume one percentage of completion that is both the materials and conversion costs. Just a reminder, that these may be different in a real world application.

So let's look at a cost computation using the two methods:

Using the Weighted Average Method

Cost per equivalent unit = Cost of beginning WIP inventory + Cost added during the period

Equivalent units of production

So from our example above, we have 4925 equivalent units of production using the weighted average method. If our total cost of our beginning WIP inventory was $1,000 and we added $10,000 during the period.

$1,000 + $10,000 = $2.2335/ unit

4925 units

A reconciliation of the initial costs, plus costs added using the weighted average method:

Costs to be accounted for:	
Cost of beginning WIP inventory	$1,000
Costs added during the period	$10,000
Total costs to be accounted for	**$11,000**
Costs accounted for:	
Cost of ending WIP inventory	$279
Cost of units transferred out	$10,721
Total cost accounted for	**$11,000**

Using the FIFO Method

We only use the costs incurred during the current period. So in our example, we incurred $10,000 in the current period and our equivalent units of production from our example above is 4775, so

$10,000 = $2.0942/ unit
4775 units

So to reconcile the costs using the FIFO method:

Costs to be accounted for:	
Cost of beginning WIP inventory	$1,000
Costs added during the period	$10,000
Total costs to be accounted for	**$11,000**
Costs accounted for:	
Cost of ending WIP inventory	$262
Cost of units transferred out	$10,738
Total cost accounted for	**$11,000**

(note: you need to not round intermediate calculations to get here!)
The cost of the ending WIP inventory is 125 units × $2.0942

The cost of the units transferred out is calculated:

4800 units × $2.09 plus the $658 of costs incurred for the beginning inventory that was transferred out.

The cost of the products initially in the beginning WIP need to be added in since in the FIFO method, we had not yet accounted for those costs.

The take-away here is that either method will end up with the same costs being moved forward with the completed units to the next process. These costs will be added to additional costs as the product moves through each of the processes until it arrives in the finished goods inventory.

Practice Questions

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7.6: Direct and Step-Down Methods

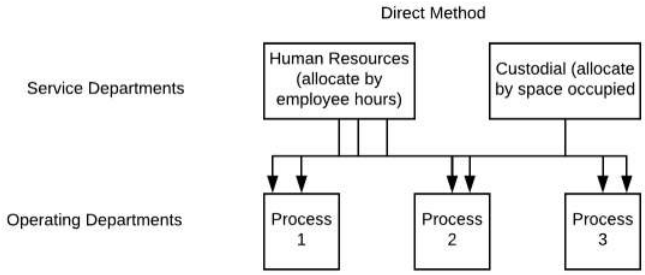
Learning Outcomes

- Discuss how to allocate service costs as operations costs using the direct and step-down methods

In process costing, all of the processing departments are classified as operating departments. Other departments, called service departments are needed for the business to operate, but do not directly engage in operating processes. Service departments include accounting, human resources and purchasing. These departments all provide services to each of the operating departments.

So with our Ultimate Planner business, the product itself is produced in the production/manufacturing department, but in order for that department to run, payroll needs to be prepared, employees need to be hired and product needs to be purchased. There are two main ways to allocate these service costs to the operating departments to make sure we are including all of the costs when we price our products.

The first method is the direct method. This is the simplest and most commonly used method of allocation.

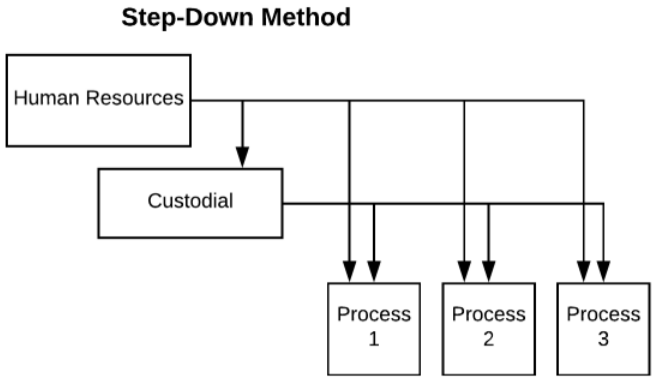


In this method, we will be ignoring the fact that one service department may offer services to another service department. For example, the HR department will offer services to the accounting department by hiring staff and providing training. Instead, we will allocate ALL of the services of each of these departments to the operating departments.

We can allocate using a couple of different methods of allocation. Some costs may be allocated based on employee hours. Administration costs are a good example here. So the hours incurred by administrative departments such as payroll, purchasing, accounting and HR, would be allocated, based on the number of hours worked in each of the operating departments and allocated accordingly. Here, if process 1 of manufacturing our Ultimate Planner takes 5,000 hours per period, while packaging (process 3) only takes 1,000 hours per period, then allocation based on employee hours would be the most effective way to allocate service costs.

Custodial services on the other hand, may be better allocated based on the square footage of each of the operating departments. If the press area (process 1) of the Ultimate Planner business occupies 10,000 square feet, while the packaging area only occupies 2,000 square feet, it probably takes more custodial effort in the press area! So allocation on space would work best.

The second method is called the step-down method. This method is more complicated than the direct method, as it also takes into account the services that one service department offers another.



Note in this method, the human resources costs are allocated between custodial and all of the operational processes, while in the direct method, human resources and custodial are directly allocated to the operational processes.

So if the custodial department cleans the HR department, some costs from the custodial department should be allocated to the HR department, right? Also, the HR department provides services to the custodial department, by hiring and training the employees, so some of the HR costs should be allocated to the custodial department.

There are many reasons companies may use each of these allocation methods. HERE is another explanation of this concept if you would like further clarification.

Practice Questions

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7.7: Introduction to Cost Accounting Methods

What you'll learn to do: Examine the benefits and limitations of both cost accounting methods

Traditional cost accounting and activity based absorption based costing vary in several ways, primarily in the complexity of implementation. We will discuss the pros and cons of both methods, along with situations where one may be more reflective of the actual allocation that the other.

Each business needs to decide which system will work best for them, based on analysis of their product, activities and systems. Let's take a look at these two costing methods.

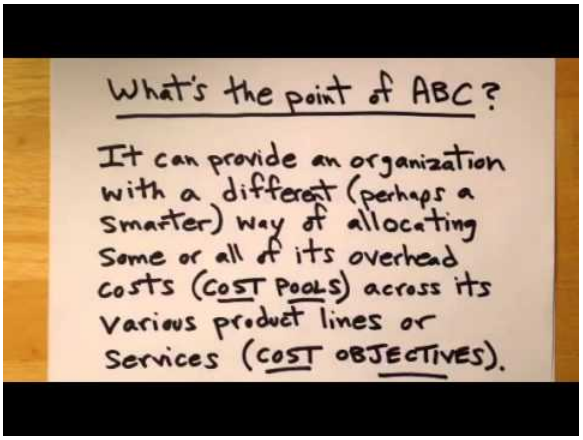
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7.8: Activity-Based Costing

Learning Outcomes

- Describe situations in which activity-based absorption costing is used

Activity-based absorption costing assigns all manufacturing overhead costs to products based on the activities performed to make those products.



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In this method, we look only at non-direct costs. Direct costs are easily traced to an activity, so we don't need to do anything further with those costs. Non-direct costs are the overhead costs, such as rent, property taxes, accounting and administrative costs and all other costs not directly related to the production of our product.

Activity-based absorption costing (ABC) is much more complicated that traditional costing, but can give you a much better allocation picture. Let's look at an example where ABC may produce a better picture for a company.

Example

You are a manager at a company that makes two kinds of kayaks: the basic model and the deluxe. Currently, you are using a traditional costing method and assigning manufacturing overhead based on direct labor hours. So all of the direct labor and materials are being charged to each of the models, and then the overhead is allocated. But what if the deluxe kayak is consuming three times as much machine time due to more frequent setups? Or what if there are more parts in the deluxe model requiring a great deal more time in the purchasing department? These activities could cause traditional costing to be "off" compared to costing based on each activity.

This is a situation, where ABC may be more reflective of the actual cost allocation. It is necessary to determine if the benefits of implementing the ABC method outweigh the costs. After doing an evaluation of your situation, then the decision can be made regarding which method to utilize.

Practice Questions

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7.9: Traditional Costing vs. ABC

Learning Outcomes

Illustrate the difference between traditional costing and activity-based absorption costing

Managers are always looking for more effective ways to figure out the cost of their products. In the case of the Ultimate Planner, that we have been discussing during this module, getting all of the costs, from direct materials, direct labor and overhead, into the cost of the product will allow managers to appropriately price the product so the company can make a profit on each sale. If we miss allocating one of the indirect costs to our products, we are missing out on a cost, thus lowering our potential profit. So when we look at traditional costing versus activity based costing, how can we decide which one makes the most sense for our business?

Traditional costing will have one rate for allocation of overhead for the entire business operation, while activity-based absorption costing creates multiple cost pools. The ABC system can be extremely complicated and difficult to implement. Traditional costing is easy to implement and is the most common costing method used.

Activity-based costing has pros and cons:

Advantages

1. Activity-based costing provides more detailed measures of costs than traditional allocation methods.
2. Activity-based costing can help marketing people by providing more accurate product cost numbers for decisions about pricing and which unprofitable products the company should eliminate.
3. Production also benefits because activity-based costing provides better information about the cost of each activity. In practice, ABC helps managers identify cost-causing activities. To manage costs, production managers learn to manage the activities that cause costs.
4. Activity-based costing provides more information about product costs than traditional methods but requires more record-keeping. Managers must decide whether the benefits or improved decisions justify the additional record-keeping cost.

Disadvantages

1. The allocation of indirect costs is at least somewhat arbitrary, even using sophisticated accounting methods.
2. Installing activity-based costing requires teamwork among accountants, production managers, marketing managers, and other non-accounting people.

Some organizations with several product lines might believe that the benefits of implementing ABC will outweigh the costs. But management needs to be willing to use the ABC information to benefit the company. Chrysler Group LLC tried ABC, but the managers resisted. It is pointless to incur the costs if the managers refuse to use the information to make improvements in operations.

Practice Questions

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7.10: Putting It Together- Costing Methods

Product costs are those costs that go into the actual production of our product, while period costs are incurred as part of the selling and administrative process. Even though the selling and administrative components do not directly make a profit, they are important parts of the business process. These costs need to be allocated to the manufacturing departments to insure that when we price our product, we include all the costs of doing business.

Various methods were discussed to help with the allocation of all expenses, from the raw materials that go into our product, to the person preparing the payroll checks and ordering the raw materials. Different companies will require different types of costing processes to effectively manage their business in a profitable way.

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7.11: Why It Matters- Costing Methods

Why learn about costing methods?



Properly allocating costs to your products is a crucial part of making sure they are priced correctly to make a profit. Things like payroll, custodial work and human resources are departments that do not make their own revenue, but support the departments that do.

These costs are important and do need to be added to the manufacturing costs when preparing detailed cost information about your products. Imagine a company without a payroll or custodial department! These are not costs to be avoided, as they are vital to the operation of the company. There are many ways to allocate the costs that cannot be directly tied to the production of a product. We will examine the methods, along with pros and cons of various costing methods.

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7.12: Assignment- Costing Methods

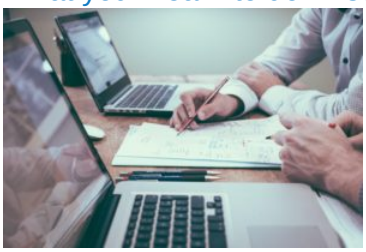
For this assignment, you will download and complete the following worksheet:

- Assignment: Costing Methods (.docx)

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7.13: Introduction to Cost Management

What you'll learn to do: Discuss the importance of cost management



Managing the costs in a business are crucial to success. There are many different ways to classify costs, which will be discussed in this module. When we discuss costs from a managerial accounting standpoint, the same cost may be classified differently depending on what information is needed.

Being aware of the different cost classifications and ways to look at costs will be an important skill as a manager. It will give you the skills to budget and plan effectively for your department or company.

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7.14: Value Chain

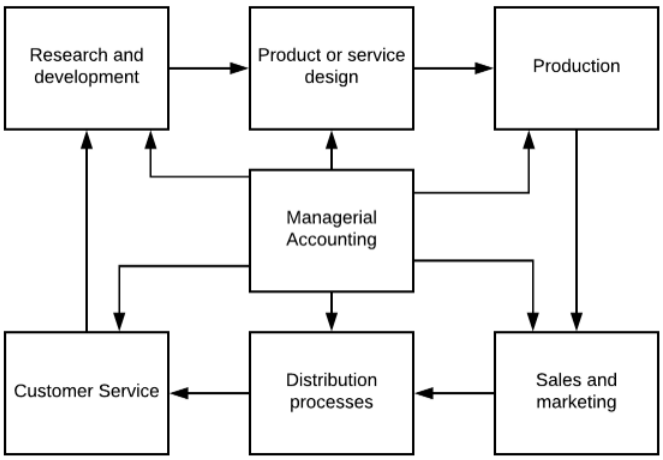
Learning Outcome

Describe the relationship between cost management and managerial accounting relating to the value chain

Managing costs in a business is an important component of the work done by managers and accountants. Even if you, as a manager, are not directly involved in the accounting system processes, you will need to have a firm foundation in how the costs are budgeted and expended to make good planning decisions.

Costs are assigned to different “pots” in order to figure out product pricing, figure out profitability of a certain product line and to control spending. A cost object is anything that you might need cost data for, like a product, customers, jobs or an organizational subunit. At this point, costs will be divided up by direct costs (those directly relating to the production of a product or service) and indirect costs (those costs that cannot be directly related to a particular product).

The value chain is the process of business functions that add value to the customer user of a particular product. Each of these processes involves costs, that need to be incorporated into the price of the product or service. There are many business processes that add usefulness for the end user. Managerial accounting is a component in many of these processes.



This diagram shows how each step in the process adds value for the customer. Production in a service business would be the performance of the service. Managerial accounting is a part of each step! So in our previous unit, we discussed how managerial accounting is not a mandatory activity for a business. Can you see now how important the process is? Without determining the costs of development and design, and incorporating them into the production, sales and distribution of the product or service, figuring out how much to charge customers would be a huge challenge.

Each department must communicate with the others in the value chain. If engineering is looking at designing a new product, marketing and manufacturing both need to be involved in the process. If the manufacturing department is unable to produce it, or there is no market for the product, why should engineering spend time and money designing it?

Let’s imagine a purchasing department that doesn’t discuss the quality of components with engineering or manufacturing departments. If they look only at the lowest priced component, without regard to quality, might the company end up with more scrap in manufacturing, or a higher number of customer complaints?

As you can clearly see, each step in the value chain is important, each works with the other, and managerial accounting ties them all together.

Practice Questions

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7.15: Direct and Indirect Costs

Learning Outcomes

- Differentiate between direct and indirect costs

Direct costs are those that are directly attributable or traceable to the manufacture of a product or performance of a service, while an indirect cost cannot be directly attributable or traceable to a product or service.



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There are some items that are difficult to determine how much goes into each product. Let's say we have two products that we build in our manufacturing plant and one plant manager.

Widget 1: plastic is the main component

Widget 2: steel is the main component

A plant manager who manages the entire factory.

Allocating the cost of the plastic and steel is pretty simple! Since there is no plastic in widget 2 and no steel in widget 1, those two products are clearly attributable or traceable to one product right? But how do we allocate the plant manager's salary when we are figuring out how much it costs us to produce each widget? We can't! Unless we had him track every minute of his day to one product or the other, which doesn't sound very effective from a time management standpoint.

Let's look at another example from a service business.

CPA Firm

A CPA firm employs a bookkeeper and a receptionist. The bookkeeper works on a variety of tasks during the day, but tracks her time by client. The **direct cost** that can be attributed or traced directly to one client, would be the time spent by the bookkeeper on that client's work. The receptionist on the other hand, is not directly involved with client work, but answers the phones, files and makes appointments. His time would be an **indirect cost**. Other possible indirect costs in this service business would include computer software, printer ink and pens. None of these can be directly traced to one client.

Direct costs go **directly** into a product or service, and indirect costs cannot be directly linked to one product or service. We will go into much more detail about different classifications of direct and indirect costs in future modules, but just make sure to remember how we determine direct vs. indirect costs!

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7.16: Introduction to Job Order Costing

What you'll learn to do: Examine the job order cost accounting system



Job order costing is used when many different products with different features are produced during a particular period. This process allows companies to allocate all of the costs incurred in a business, whether direct or indirect to jobs. We will discuss service and manufactured jobs, and follow a couple jobs from the beginning to end.

We will discuss the meaning of absorption costing, and how it helps businesses to see a clearer picture when figuring out prices for the products or services they offer.

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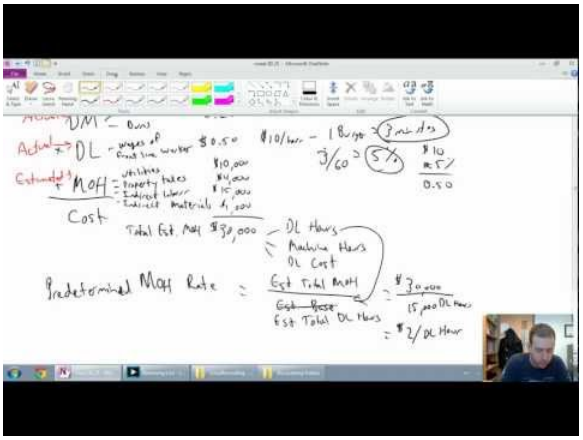
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7.17: Job Order Costing

Learning Outcomes

- Describe a situation in which job order costing is used

Let’s take a look at when job order costing is used and how it is used.



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Different types of business use job order costing. Manufacturing companies use the process to track each product they build, while service businesses including law offices and CPA firms utilize a job order costing system for invoicing individual clients.

Example

Mitchell Manufacturing is a small company that produces specialty bicycles. Each bicycle is made to order per customer specifications. Orders are taken by the customer service department, and handed off to an engineering support person to configure the job. A parts list is made and then job is moved to production. Every Monday morning, the engineering group, manufacturing supervisor and accounting manager meet to go over the orders for the week.

A job number is assigned to each order. Then a bill of materials, or list of the direct materials needed for each bicycle is created. From this list, the purchasing department can get all of the items on order, using a materials requisition form.

The accounting department needs to ensure that the job cost sheet is generated, that it includes all of the materials for the job, and that the labor involved and manufacturing overhead is added (this will be discussed in a future module). As the job goes through the manufacturing process, each step in the process is added to the job cost sheet which accumulates all of the costs involved in the building of this one job. When the job is completed, the accounting department has all of the information necessary to total the costs involved in making this bike, thus knowing whether the initial price quoted was accurate.

This process helps ensure that customers are charged correctly, and allows the company to adjust pricing on future similar jobs if needed.

Job costing is used by a variety of businesses for a variety of reasons and can be an effective method to price products and services.

Practice Questions

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7.18: Calculating Costs

Learning Outcomes

- Calculate an overhead rate, manufacturing overhead, and unit costs

Overhead costs are all of those costs that a business incurs that cannot be directly related to a particular product. Remember our discussion about indirect costs—these costs fall into our overhead.

Rent, utilities, mortgage interest, production supervisors and maintenance staff all are costs that will need to be allocated by calculating an overhead rate. We can use historical data to calculate a predetermined overhead rate which can be applied based on an allocation base. An allocation base is defined as the measure used to assign overhead costs to products and services. The most commonly used allocation bases are direct-labor hours, direct labor cost, units of product (if there is only one product made) or machine hours.

Once the total overhead cost has been calculated, it is then divided between the production based on whichever allocation base the company has determined most effective.

$$\text{Predetermined overhead rate} = \frac{\text{Estimated total manufacturing overhead cost}}{}$$

Estimated total amount of the allocation base:

There are four steps to determine this rate, and it is done prior to the start of the period.

1. Estimate the allocation base that will be required for next period's estimated production level.
2. Estimate the total fixed manufacturing overhead costs for the coming period and the variable manufacturing overhead cost per unit of the allocation base.
3. Use the cost formula** to estimate the total manufacturing overhead cost for the next period.
4. Finally compute the predetermined overhead rate.

So let's do a little practice!

Overhead applied to a particular job =

predetermined overhead rate × Amount of the allocation base incurred by the job

Let's assume we calculated our estimated total manufacturing overhead cost at $50,000 for the coming period and our estimated total amount of the allocation base in direct labor hours at 10,000 hours.

$50,000/ 10,000= $5 per hour. Our predetermined overhead rate would be $5 per direct labor hour.

If a widget takes 2 hours to make, we would then allocate 2 × $5 or $10 to the costs involved in making the widget as our overhead costs.

What would happen if the widget took .5 hours to make? Then we would use our $5 per direct labor hour, × .5 = $2.50 per hour

Practice Questions

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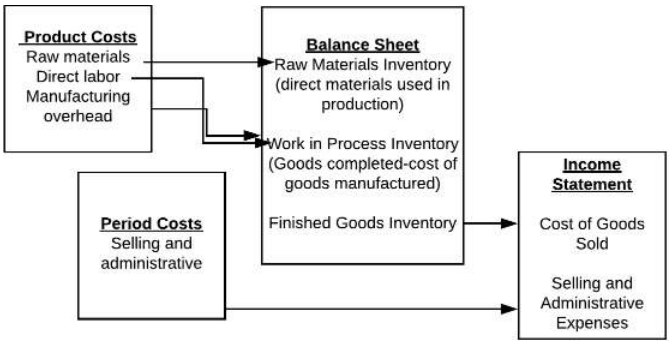
7.19: Flow of Costs (Job Order Costing)

Learning Outcomes

- Explain the flow of costs in a job order costing system

Let's go back to Mitchell Manufacturing. They just received a new job for two custom bikes that are identical. The team has met and they have made their materials list. Purchasing has created a materials requisition form and they are bringing in the components needed to build the bikes. Accounting has created a job cost sheet that will follow the bikes through from production to delivery.

The flow of costs will look like:



So where will they start on their job costing system? Let's start at the beginning:

1. Materials requisition form is prepared with the items from the bill of materials (all the items needed for the job), quantities and costs that will go into the job. These are the **direct materials** from the cost flow diagram:

Materials Requisition Number	1800			Date	6/28/2018
Job Number to be charged	2912				
Department	Production				
Description	Qty	Unit Cost	Total Cost		
Spokes	24	$1	$24		
Wheels	4	$25	$100		
Frames	2	$110	$220		
Screws and bolts	16	$1	$16		
			$360		

2. Set up the **job costing sheet**:

This is where the numbers really start to come together. The job cost sheet includes a variety of information.

1. Measure your direct labor cost—Remember that any labor not directly tracked to the manufacturing of a given item is included in your overhead. Most companies track their direct labor with a "time ticket" system, either on paper or electronically. With this system, the employee notes the time they are on each job.
2. Add the manufacturing overhead that you already calculated.
3. Total your costs, and you are all set!

The paper trail through the production process is helpful to track all of your expenses in one place. This can be provided to the accounting department, who can then properly allocate all of the costs to a job.

If you are a service business, most keep track of direct labor through a time tracking system, again, either manual or computerized. Companies use different systems based on their size and need.

An example of tracking direct labor and materials can be found HERE. This link provides another example, following an electrician through a job process. Each business is very different in the format that they use. Material requisition sheets, job tracking and numbering systems are all individual to the business. When you work as a manager the business you work for will introduce you to their system. The end result is the same, to find out how much it cost to produce the finished product for the job. As a reminder—this process is only used when there is more than one product being manufactured. Job costing would not be used at a plant that makes only one widget!

Practice Questions

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7.20: Recording Job Order Costs

Learning Outcomes

- Prepare a sample journal entry that records job order costs

We need to enter all of this information into our accounting system. Most of the newer accounting software allows for the direct entry of the expenses, thus tying them to a certain job. But what does it look like behind the scenes?

Journal entries need to be prepared for each step of the process. As each cost is incurred, we will record it into our accounting system. Imagine you are the accountant for a small manufacturing company. Every day raw materials are purchased, people work and provide you with time sheets, and products move from work-in-process to finished goods inventory. Every single time product moves or people work, there will be a journal entry to create. Let's watch as the entries are created!

Step 1

The first purchase is a purchase of raw materials. Both of these accounts sit on the balance sheet. The raw materials account is like an inventory account. As the materials come in, they are recorded here. Then, as you will see shortly, when they are moved to the production line, they are taken out of raw materials and moved to work-in-process (WIP).

Direct materials − Purchase $10,000 in raw materials		
	DR	CR
Raw Materials	$10,000	—
Accounts Payable	—	$10,000

Step 2

Here is what we were talking about above: When the production floor requests raw materials, we need to move them to the WIP account. Here some of the materials were direct materials, which go into WIP. Some of the materials were indirect materials, which will be classified as manufacturing overhead. Raw materials were requisitioned for use in production. Both direct and indirect materials were requisitioned:

	DR	CR
Work in Process	$6,000	—
Manufacturing Overhead	$1,000	—
Raw Materials	—	$7,000

Step 3

The timesheets from the employees are all in, so it is time to post the labor costs. Some of the payroll costs were direct, and recorded into the work in process, while the indirect costs were recorded to manufacturing overhead.

	DR	CR
Work in Process	$5,000	—
Manufacturing Overhead	$1,500	—
Wagest Payable	—	$6,500

Step 4

Manufacturing overhead costs have been incurred. The general costs incurred in the factory this month included $5,000 of utilities, $3,000 building rent and $2,000 of misc overhead costs. So the month totaled $10,000 in overhead costs that need to be paid. We

will be putting the costs into manufacturing overhead as they happen, which is a clearing account. We will talk a bit more about that shortly, but for now, know that is a place where we "hold" the amounts as they are incurred. Remember that we estimated manufacturing overhead so that we could cost it to the jobs. When the period is over, we will reconcile these accounts.

	DR	CR
Manufacturing Overhead	$10,000	—
Accounts Payable	—	$10,000

Step 5

Depreciation, property taxes and prepaid insurance all need to be recorded as well. These are all manufacturing overhead costs and will be recorded to that account:

	DR	CR
Manufacturing Overhead	$4,000	—
Property Taxes Payable	—	$2,500
Prepaid Insurance	—	$1,500
Manufacturing Overhead	$5,000	—
Accumulated Depreciation		$5,000

Each step in the process from the Flow of Costs (Job Order Costing) page is recorded into the accounting records through a journal entry. We will then need to apply the manufacturing overhead, since we have put it all into an account called "Manufacturing Overhead." This is considered a clearing account. All of the costs have been placed there, but if you recall, we calculated a per hour manufacturing overhead rate from estimates. Due to this, the actual costs that go into the manufacturing overhead account might be different from what we estimated them to be. This is why we use a clearing account.

We put all of the actual expenses there when they are incurred, then we will apply it to production, and the jobs, at the predetermined rate. We will talk more about this later, and what to do with what is left in the account, but for now, just remember, we use an estimated manufacturing overhead rate that we apply to each job, but the costs do need to be recorded when incurred.

Practice Questions

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CHAPTER OVERVIEW

8: Cost Volume Profit Analysis

8.1: Statement of Variable Costs and Sales Volume
8.2: Statement of Fixed Cost, Selling Price, and Sales Volume
8.3: Statement of Variable Cost, Fixed Cost, and Sales Volume
8.4: Introduction to Break-Even Point Analysis
8.5: Break-Even Point
8.6: Methods to Determine the Break-Even Point
8.7: Target Profit Analysis
8.8: Margin of Safety
8.9: The Break-Even Point and the Sales Mix
8.10: Introduction to Cost-Volume-Profit and Cost Structures
8.11: Why It Matters- Cost Volume Profit Analysis
8.12: Cost Structures
8.13: Operating Leverage
8.14: Putting It Together- Cost Volume Profit Analysis
8.15: Assignment- Cost Volume Profit Analysis
8.16: Introduction to Cost-Volume-Profit Elements
8.17: Cost-Volume-Profit Analysis
8.18: Contribution Margin Model
8.19: Net Operating Income
8.20: Contribution Margin Ratio
8.21: Introduction to the Application of Cost-Volume-Profit Concepts
8.22: Cost-Volume-Profit Analysis and Decision Making
8.23: Statement of Fixed Cost and Sales Volume

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8.1: Statement of Variable Costs and Sales Volume

Learning Outcome

- Prepare a statement that shows a change in variable costs and sales volume

Ok, so we know what our choices are if our landlord raises the rent. But what if our supplier raises the cost of one of the components in our widget by $1 each? Unfortunately, this has happened and now you need to deal with it! This part is the most costly in the entire widget and isn't made by many suppliers. Of course you know to call around and get pricing from *everyone* on this part, but what if you can't get a lower price? How is this price increase in variable costs going to affect the profitability of the company?

Cost-Volume-Profit (Pre-Price Increase)					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$10	$500	$1,000	$1,500	$2,000
Variable cost per item	$4	$200	$400	$600	$800
Contribution Margin	$6	$300	$600	$900	$1,200
Fixed Costs	$400	$400	$400	$400	$400
Profit (loss)	($394)	($100)	$200	$500	$800

We needed to sell 100 widgets to show a nice profit!

Cost-Volume-Profit (Post-Price Increase)					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$10	$500	$1,000	$1,500	$2,000
Variable cost per item	$5	$250	$500	$750	$1,000
Contribution Margin	$5	$250	$500	$750	$1,000
Fixed Costs	$400	$400	$400	$400	$400
Profit (loss)	($395)	($150)	$100	$350	$600

Look! A $1 per widget change in variable costs lowers your profit on the sale of 100 widgets by $100! That is a huge change in profit for a seemingly small change in cost. The company is still showing some profit, but something will probably need to change. What can you do?

If you are the buyer for Monte Corporation and your vendor increased this price, you have a few options again.

1. Raise the price of your widgets to compensate for the additional cost per item (probably **not** the first course of action!).
2. Search for a new vendor for the component (remember, there aren't many suppliers who make this particular component).

3. Try to negotiate with the vendor for a lower price (if this is a popular part, this may **not** be possible, but it is worth a try!).

Can you think of any other ways to deal with variable cost increases?

Practice Questions

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8.2: Statement of Fixed Cost, Selling Price, and Sales Volume

Learning Outcomes

- Prepare a statement that shows a change in fixed cost, selling price, and sales volume

Your boss just walked in, and she looks angry and somewhat concerned. Your competitors just released a product identical to your widget, but they are selling it for *20% less* than your current selling price. Not only that, but their widget comes in nine different colors, and you only have two! This could cause problems on more than one level.

1. Your volume of sales may go down with the increased competition.
2. Your pricing will need to be changed to meet the new competitive environment.
3. You may need to make some changes to your product line to stay competitive.

What if, at the same time, you get word that your fixed expenses are increasing 10% this next month due to increased insurance costs? How in the world are you going to deal with all of these changes, not only in the marketplace, but in your costing process? Well it is time to do some number crunching, and see how to make changes that will keep your department and your company profitable.

Back to Monte and their current CVP analysis.

Let's first look at our current situation on pricing, fixed and variable costs:

Number Sold	1	50	100	150	200
Price per Item/sales	$10	$500	$1,000	$1,500	$2,000
Variable cost per item	$5	$250	$500	$750	$1,000
Contribution Margin	$5	$250	$500	$750	$1,000
Fixed Costs	$400	$400	$400	$400	$400
Profit (loss)	($395)	($150)	$100	$350	$600

So we need to determine a price that is competitive with the new widget that just hit the market. Do we want to meet or beat their price? Well, for now, let's look at meeting their price. Our boss said we are looking at a 20% lower cost for our widget to meet them. So, if we are currently selling at $10 each we will need to discount those widgets:

$10 − $2 (20% of $10) = $8 per widget as our new selling price.

But don't forget, we also got handed a 10% increase in our fixed costs:

$400 + 10%($400) = $400 + $40= $440 per month fixed costs. Let's see what this does to our CVP analysis:

Cost-Volume-Profit					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$8	$400	$800	$1,200	$1,600
Variable cost per item	$5	$250	$500	$750	$1,000
Contribution Margin	$3	$150	$300	$450	$600
Fixed Costs	$440	$440	$440	$440	$440
Profit (loss)	($437)	($290)	($140)	$10	$160

We now need to sell 150 widgets before we start to show a profit. So a combination of pricing changes and additional costs shifts the number of widgets we need to sell to begin to make a profit. Before these changes, we needed to sell **less** than 100 to show a profit. This is a challenge that you may face as a manager. Can you think of any ways to combat this problem?

Practice Questions

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8.3: Statement of Variable Cost, Fixed Cost, and Sales Volume

Learning Outcomes

- Prepare a statement that shows a change in variable cost, fixed cost, and sales volume

As if competition and fixed cost increases weren't enough, now we just found out our best supplier is raising the cost of a component of our best-selling widget. With the new company also using parts, there is a shortage, giving our supplier the opportunity to get a little more for his parts. Your boss is now in major crisis mode, trying to figure out a way to continue to show a profit with potential lower sales volumes and increasing prices for every imaginable thing! Of course this lands on your shoulders, so let's get busy.

So now we have:

1. A lower selling price at $8 per widget
2. Higher fixed costs at $440 per month
3. Higher variable costs at $5.50 per widget

It looks as if everything that could go wrong, has gone wrong! Here is the bad news in chart form:

Cost-Volume-Profit					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$8	$400	$800	$1,200	$1,600
Variable cost per item	$6	$275	$550	$825	$1,100
Contribution Margin	$3	$125	$250	$375	$500
Fixed Costs	$440	$440	$440	$440	$440
Profit (loss)	($438)	($315)	($190)	($65)	$60

Let's expand our chart a bit now, and see how we can improve profits:

Cost-Volume-Profit							
Monte Corporation							
Number Sold	1	50	100	150	200	250	300
Price per Item	$8	$400	$800	$1,200	$1,600	$2,000	$2,400
Variable cost per item	$6	$275	$550	$825	$1,100	$1,375	$1,650
Contribution Margin	$3	$125	$250	$375	$500	$625	$750
Fixed Costs	$440	$440	$440	$440	$440	$440	$440
Profit (loss)	($438)	($315)	($190)	($65)	$60	$185	$310

If we sell more product, we can make more money! Now, you will need to figure out how to make that happen!

Practice Questions

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8.4: Introduction to Break-Even Point Analysis

What you'll learn to do: Examine various methods of break-even analysis

Finding the point where sales less variable and fixed costs is equal to zero is defined as break even analysis. Let's examine various ways to calculate the break even point. It can also be important to calculate the amount of sales in dollars we need to meet a certain profit point. Most companies wish to show a profit, so that investors get a return on their investment.

Calculating the break-even point, target profits and margin of safety are all important concepts to help managers and investors make good decisions.

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8.5: Break-Even Point

Learning Outcomes

- Define the break-even point

How many apples does Farmer Joe need to sell to break even?



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The break even point can be defined as the exact point where sales-expenses = zero. So essentially, you are not making money, but you are not losing money either. This is the point where selling one less item would create a loss and selling one more item would create a profit situation. There are two methods we can use to figure out our break even point:

1. The equation method
2. The formula method

We will discuss both methods in detail, but let's start with a new company and a new product! The widgets are starting to get boring. Whether we are talking about apples, widgets or kayaks, the process is the same.

The Minnesota Kayak Company has come to you to help them determine the break even point on a new line of racing kayaks they plan to introduce to the market. These are some pricy kayaks and they want to insure that the use of their manufacturing facility will make sense for this new line.

Are you ready to get busy?

Practice Questions

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8.6: Methods to Determine the Break-Even Point

Learning Outcomes

- Determine the break-even point using the equation method, the formula method, and in dollar sales and sales units

So the Minnesota Kayak Company has these awesome new kayaks they are going to introduce to the market. They are a new company and need help in determining pricing, costs and how many kayaks they will need to sell in a month to break even. They are looking to you to help them determine if the selling price and costs will help them to reach their goals. They give you the following information to work with:

Price per kayak	$500
variable costs per kayak	$225
Contribution margin per kayak	$275
Fixed costs/month	$7,700

With this information, it is your task to find the breakeven point using the three different methods. Let's look first at the equation method:

The equation method utilizes the profit equation introduced earlier.

$$\text{Profit} = \text{Selling price} - \text{Variable Expenses} - \text{Fixed Expenses}$$

Also, let's revisit the contribution margin concept and some shortcuts.

- $\text{Contribution margin} = \text{Selling price} - \text{Variable expenses}$
- Profit= P
- Contribution Margin= CM
- Quantity= Q
- Fixed Expenses = F
- Variable Expenses = V

So in our kayak example we are looking for a break even point meaning that the profit = $0

We can then put together our break even point utilizing the equation method as follows:

$$\begin{aligned} \$0 &= \text{Unit CM} \times \text{Q} - \text{F} \\ \$0 &= \$275 \times \text{Q} - \$7,700 \\ \$7,700 &= \$275 \times \text{Q} \\ \frac{\$7,700}{275} &= \text{Q} \\ 28 &= \text{Q} \end{aligned}$$

Minnesota Kayak needs to sell 28 kayaks at $500 each to break even.

The formula method gets to the same answer in a different way. It is kind of a shortcut to the equation method:

$$\begin{aligned} \text{Unit Sales to Break Even} &= \frac{\text{F}}{\text{Unit CM}} \\ \frac{\$7,700}{\$275} &= 28 \text{ kayaks} \end{aligned}$$

So regardless of the method used, you get to the same result!

Practice Questions

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8.7: Target Profit Analysis

Learning Outcomes

- Define target profit analysis and use it to make sales volume calculations

Minnesota Kayak has a few investors who are interested in getting a return on their investment. They have talked with your supervisor, and between them all, would like to get $30,000 a month in profit to divide between them. You have been tasked with figuring out how many kayaks need to be sold in order to get the investors their return!

Target profit analysis helps us to know how much in dollar sales a company will need to reach a certain profit point. This is one of the key uses of the CVP analysis. Once the basic data is calculated, it can offer a great deal of insight and help in planning.

Minnesota Kayak Company needs to sell 28 kayaks in our example to break even. The equation method or the formula method can be used with the same result. Remember the formula method is simply a shortened version of the equation method, so both ways should come to the same conclusion.

With the previous information you can then figure out, the dollar sales needed to break even:

$$28 \text{ kayaks} \times \$500 \text{ per kayak} = \$14,000 \text{ in sales}$$

What if they now want to show a $30,000 a month profit?

So with that information we now have the following:

Price per kayak	$500
variable costs per kayak	$225
Contribution margin per kayak	$275
Fixed costs/month	$7,700

With this information, how many kayaks do we need to sell to show a $30,000 profit at the end of the month? It is the same exact formula we used to calculate the break-even point! Remember, we put -0- for the profit in when we were looking to break-even. We simply replace the -0- with $30,000 and now we can calculate how many kayaks we need to sell to meet our profit goal. Pretty neat huh?

Using the equation method:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times \text{Q} - \text{Fixed Expense} \\ \$30,000 &= \$275 \times \text{Q} - \$7,700 \\ \$30,000 + \$7,700 &= \$275 \times \text{Q} \\ \frac{\$37,700}{275} &= \text{Q} \end{aligned}$$

So we now need to sell 138 kayaks to profit $30,000! How much in sales do we need?

138 × $500 each= $69,000 in sales.

How would we get there using the formula method?

$$\text{Unit Sales to attain the target profit} = \frac{\text{Target Profit} + \text{Fixed expenses}}{\text{Unit CM}}$$

So in our kayak case

$$\begin{aligned} \text{Unit sales needed} &= \frac{\$30,000 + \$7,700}{\$275} \\ &= \frac{\$37,700}{\$275} \end{aligned}$$

So again, we need 137 kayaks sold to make a $30,000 profit!

137 kayaks × $500 selling price per kayak = $68,500 in sales.

We can now plug in any amount of desired profit and calculate how many units we need to sell! This is amazing information for business owners and managers to have available. But see the importance of good numbers for your fixed and variable costs? Remember from our CVP analysis in early lessons, how much a small difference in costs can affect our profit!

Practice Questions

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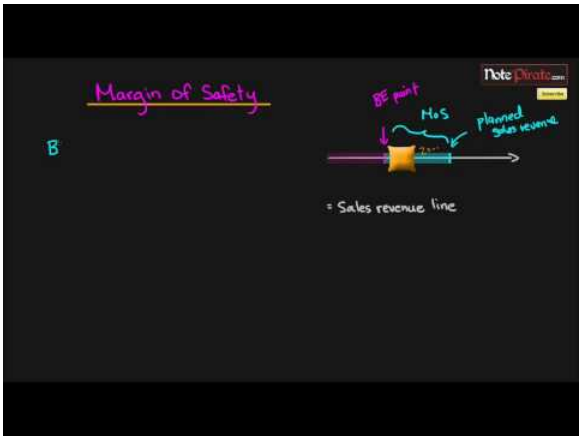
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8.8: Margin of Safety

Learning Outcomes

- Compute the margin of safety

The margin of safety is the difference between actual sales and the break even point. Now that we have calculated break even points, and also done some target profit analysis, let's discuss the importance of the margin of safety. This amount tells us how much sales can drop before we show a loss. A higher margin of safety is good, as it leaves room for cost increases, downturns in the economy or changes in the competitive landscape.



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If you remember back to our example with our friends at Monte Corporation and the widgets, when a new competitor came into the market, it created a crisis!

The formula used to calculate the margin of safety

$$\text{Margin of safety} = \text{actual (or budgeted) sales} - \text{sales required to break even}$$

We can take this formula one step further to figure the margin of safety percentage

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{total actual (or budgeted) sales in dollars}}$$

Now let's look at an example:

Let's go back to our kayaks. Remember our basic information:

Price per kayak	$500
variable costs per kayak	$225
Contribution margin per kayak	$275
Fixed costs/month	$7,700

Also, remember, Minnesota Kayak Company needs to sell 28 kayaks at $500 each to break even. So in this example, $14,000 in sales is their break even point.

Let's assume their current sales of kayaks is 50 kayaks per month at $500 each, so $25,000. Using the formulas above, what is their margin of safety?

$\$25,000 - \$14,000 = \$11,000$ is their margin of safety.

What is their margin of safety percentage?

$\frac{\$11,000}{\$25,000} = 44\%$ is their margin of safety percentage.

We can check our calculations, by multiplying the margin of safety percentage of 44% by actual sales of $25,000 and we end up with $11,000.

So the margin of sales percentage tells us that Minnesota Kayak Company can sell 44% fewer dollars worth of kayaks and still break even. The higher the margin of safety percentage, the better!

Practice Questions

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8.9: The Break-Even Point and the Sales Mix

Learning Outcomes

- Analyze the break-even point data for a company that wants to adjust its sales mix

What if your company sells more than one product (which most companies do!). How do we go about figuring the break even point when we decide to adjust our sales mix? This is a complex question.



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After watching the video, take a look at an additional example, with three products in the mix.

Let's say your company makes three products:

- **Product 1:** Sells for $40 with variable costs of $20 each.
- **Product 2:** Sells for $10 with variable costs of $2 each
- **Product 3:** Sells for $20 with variable costs of $15 each.

Note the difference in contribution margin for each product.

- Product 1 contributes $20 to cover fixed expenses per item sold.
- Product 2 contributes $8 to cover fixed expenses per item sold.
- Product 3 contributes $5 to cover fixed expenses per item sold.

So, let's look at the current sales mix, contribution margins and fixed costs.

Product Type	Product #1	Product #2	Product #3	Total
Quantity	500	1500	750	2750
Total Sales	$20,000	$15,000	$15,000	50000
Variable Costs	$10,000	$3,000	$11,250	24250
Contribution Margin	$10,000	$12,000	$3,750	25750
Fixed Costs				$19,000
Net Profit				$6,750

Now, let's also assume that this mix uses *all* of the manufacturing space, all of the time!! What happens if we suddenly have a huge demand for product #3, the one contributing the **least** to the contribution margin? We look at reallocating space to produce **more** of product #3, but that means we need to produce less of products #1 and #2 that contribute more to our contribution margin

Let’s take a look at what happens if our sales mix shifts. We are making a couple of assumptions

1. We have production space and labor for 2750 products total.
2. Variable costs remain the same per item, regardless of quantity.

So, if we shift our production to making **more** of product #3

Product Type	Product #1	Product #2	Product #3	Total
Quantity	125	1000	1625	2750
Total Sales	$5,000	$10,000	$32,500	47500
Variable Costs	$2,500	$2,000	$24,375	28875
Contribution Margin	$2,500	$8,000	$8,125	18625
Fixed Costs				$19,000
Net Profit				$375

We are still making the **exact same** number of products, but due to the contribution margin being lower on product #3, we are now showing a **net loss** rather than a profit!

Companies make these kinds of decisions on a daily basis. As a manager, you may be asked to determine a product mix that is profitable for your company. Keep the contribution margin, manufacturing space and labor in mind as you work through this process.

Practice Questions

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8.10: Introduction to Cost-Volume-Profit and Cost Structures

What you'll learn to do: Identify cost-volume-profit considerations for choosing a cost structure

Cost structure refers to the proportion of fixed and variable costs within an organization. Managers may have some control over the proportion based on responsibilities. An example might be an investment in automated equipment that saves variable labor costs. This shifts the cost from a variable cost (labor for production) to a fixed cost (purchase and depreciation of equipment).

In this unit, we will discuss how various costs structures may affect contribution margin and net income of companies based on various factors.

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8.11: Why It Matters- Cost Volume Profit Analysis

Why do managers need to understand the CVP relationship and analysis?

As a manager, you have tons of important decisions to make regarding what products to make, how to price them and market them. You may also be charged with figuring out whether to stick with manual labor or purchase a big piece of equipment that lowers variable costs, but raises fixed costs.

Making these kinds of decisions is easier if you implement an analysis of selling prices, variable and fixed costs to make decisions to help your company remain profitable.

What if you took a product to market, and later, after selling the product for a while, you discovered that your costs far outweighed the selling price? Do you think your boss would be happy, knowing that every product that went out the door was costing her money rather than making her money?

Learning some valuable analysis skills can help you to make good decisions in your job.

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8.12: Cost Structures

Learning Outcomes

- Compare and contrast sample cost structures for company strengths and weaknesses

Your boss just stopped in your office with a flyer for a new piece of equipment that promises to replace ten of your manufacturing employees at a fraction of the cost you are paying now for labor. He is pretty excited about this opportunity and wants you to make the call and get it on order right away! You are hesitant for a few reasons, but the biggest is the huge price tag of $500,000! You need to do some analysis and put together a proposal for your boss showing the pros and cons of this big purchase, along with the effects it may have on your employees. This would be a shift from variable costs, those of the employees and the related costs, to a machine that has only one use. How are you going to prepare this proposal? Let's first define cost structure and then look at some ideas and options.

How do we define cost structure? The percentage of sales that is related to fixed costs or variable costs is a component of cost structure. Let's take a look at cost structure defined.



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Cost structure refers to the proportion of fixed and variable costs within an organization. Managers may have some control over the proportion based on responsibilities. An example might be an investment in automated equipment that saves variable labor costs. This shifts the cost from a variable cost (labor for production) to a fixed cost (purchase and depreciation of equipment).

Let's look at how a shift from labor to equipment may look.

Currently, an employee on your manufacturing floor can produce 800 items in a standard 8 hour shift. If your employee costs $25 an hour, then the variable labor cost per item is 25 cents. What if the automated equipment that costs $500,000 can produce 100 items per hour, and has a 10 year life? It can also operate 365 days per year, does not require paid time off, sick leave or insurance, and probably doesn't complain about working conditions!

In 10 years, this piece of equipment can make 8,760,000 items. You think you are pretty smart because now the cost per item looks like 5.7 cents per item, rather than the 25 cents per item that your employee would cost. Oh, and your employee would probably want some wage increases over that time period as well. Essentially, the way you look at it, this machine will replace roughly 5 employees, and save a ton of money in the long run.

What flaws can you see in your plan? Well, one is a shift from the labor which is a variable expense (you can send your employee home if you aren't busy), to a fixed cost (the machine is there, and will cost $50,000 a year, whether you make 1 item or 8,760,000 items).

Here are some things to consider as you contemplate a change in cost structure of this type:

1. Will this machine be able to make a different item if the item it is designed to make becomes obsolete?

2. What is the resale value of this machine if we determine we no longer need it?
3. What is the maximum sales we can expect for this item? Just because the machine **can** make almost 9 million units, doesn't mean we can sell that many!

Whether to invest in the expensive machine to make your item, or to keep paying the labor costs depend on many factors. Without having a crystal ball, it can be hard to make these decisions. As a manager, it is your job to look at various options and make the best decision for your company.

Practice Questions

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8.13: Operating Leverage

Learning Outcomes

- Describe operating leverage

So you, as a manager, just got word that one of your best selling products has new competition. It is anticipated that sales will drop by 20 percent. How will that affect your net profit? Well, if you remember from our cost-volume-profit analysis, it isn't a dollar for dollar change. It depends on a few factors.

Operating leverage can be defined as a measure of sensitivity of net income to changes in sales. In other words, sales may only go up a small amount, but it can have a large effect on our net income, depending on our variable and fixed costs..

Degree of operating leverage is a measure, at a given level of sales, of how a change in sales will affect the net profit.

The formula for operating leverage:

$$\text{Degree of operating leverage} = \frac{\text{Contribution Margin}}{\text{Net Operating Income}}$$

Let's look at two companies, one who has higher variable costs and is using labor to create a product, and a second company who purchased an expensive piece of equipment to automate their manufacturing process. Both companies manufacture bicycles and their selling price per bicycle is $200. Jen's Bike Co. pays $50 in labor and $20 in other variable costs for each bicycle made. Steve's Bike Co. has the $20 in variable costs, but invested $250,000 in a machine that will replace the employees for 5 years, no matter how many bikes they make. Both Jen and Steve pay $50,000 a year in other fixed expenses.

	Jen's Bike Co.	Steve's Bike Co.
Sales	$200,000	$200,000
Variable Expenses	$70,000	$20,000
Contribution Margin	$130,000	$180,000
Fixed Expenses	$50,000	$100,000
Net Profit (loss)	$80,000	$80,000

In our example, each Jen and Steve sell 1000 bikes per year. At this volume, they each have a net profit of $80,000. Jen's operating leverage is $\frac{\$130,000}{80,000} = 1.625$ while Steve's operating leverage is 2.25.

With this information, we can calculate how fast net income will rise with a certain rise in income.

% change in net operating income = degree of operating leverage x % change in sales.

So in our example, if Jen's sales went up by 10%, she could expect an increase in net profit of 16.25%, while Steve, with the same increase in sales would show a net profit increase of 22.5%.

But what happens if there is a year where they each only sell 800 bikes instead of 1000?

	Jen's Bike Co.	Steve's Bike Co.
Sales	$160,000	$160,00
Variable Expenses	$56,000	$16,000
Contribution Margin	$104,000	$144,000
Fixed Expenses	$50,000	$100,000
Net Profit (loss)	$54,000	$44,000

Note that Jen is now making **more** in net profit than Steve, even though sales went down by the exact same amount. What happens to the operating leverage when the sales changes?

Jen's operating leverage is $\frac{\$104,000}{\$54,000}$ so 1.93 and Steve's is now $\frac{\$144,000}{44,000}$ so 3.28. Now, for each 10% rise in sales, Jen will see a 19.3% increase in net profit, while Steve will see a 32.8% rise in net profit with the same increase in sales.

Ok, now the market for bicycles *tanks* and each Jen and Steve have a year where they only sell 500 bicycles!

	Jen's Bike Co.	Steve's Bike Co.
Sales	$100,000	$100,000
Variable Expenses	$35,000	$10,000
Contribution Margin	$65,000	$90,000
Fixed Expenses	$50,000	$100,000
Net Profit (loss)	$15,000	($10,000)

Wow! Now Steve is showing a loss. This has to do with **operating leverage.**

One last example here. What if the demand for bicycles goes *nuts* and each Jen and Steve have sales increases to 1500 bikes per year!

	Jen's Bike Co.	Steve's Bike Co.
Sales	$300,000	$300,000
Variable Expenses	$105,000	$30,000
Contribution Margin	$195,000	$270,000
Fixed Expenses	$50,000	$100,000
Net Profit (loss)	$145,000	$170,000

Now Steve, with his automated equipment has the higher net profit.

So, hopefully this helps you, as a manager, to understand how changes in sales volume affect net profit or loss, depending on the cost structure. A piece of equipment can be a great thing or it can hinder a company's bottom line. Careful planning is needed.

Practice Questions

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8.14: Putting It Together- Cost Volume Profit Analysis

Wow! Module 8 included a ton of awesome information to help you figure out net profit, contribution margin, fixed costs and how product mix can affect your net profit.

You also learned the importance of changes in income, and how, due to operating leverage, can have a huge affect on net profit.

The breakdown between types of cost structures is helpful when trying to make decisions between variable and fixed costs. It becomes especially important when planning a potential automation system that involves a large capital investment.

So to review, here are the basic formulas we have discussed in this module:

$$\text{Profit} = (\text{Sales} - \text{variable expenses}) - \text{Fixed Expenses}$$

$$\text{Contribution Margin} = \text{Sales} - \text{Variable expenses}$$

$$\text{Contribution margin ratio} = \frac{\text{Contribution margin}}{\text{sales}}$$

$$\text{Unit sales to break-even} = \frac{\text{fixed expenses}}{\text{unit contribution margin}}$$

$$\text{Dollar sales to break-even} = \text{Unit sales} \times \text{selling price}$$

$$\text{Margin of safety in dollars} = \text{total budgeted or actual sales} - \text{break-even sales}$$

$$\text{Margin of safety percentage} = \frac{\text{margin of safety in dollars}}{\text{total budgeted or actual sales}}$$

$$\text{Degree of operating leverage} = \frac{\text{contribution margin}}{\text{net operating income}}$$

$$= \text{degree of operating leverage} \times$$

Note how many interconnect, to give you different information. Make sure to make note of these formulas to help you figure out selling prices and profitability!

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8.15: Assignment- Cost Volume Profit Analysis

This assignment is available for download as a Word Document.

Read the following scenario and complete the questions and tasks below.

Mirabel Manufacturing is a small but growing company that manufactures and sells marine sonar equipment. They employee a national sales force and their primary customers are marine retailers and boat dealerships. The company has expanded over the last 5 years and Paul Mirabel, the founder and CEO has become concerned that he no longer has a clear picture of their cost structure. He calls his CFO, Mary Jane Montgomery in for a meeting.

“Mary Jane, I am concerned that I am not current on our cost structure and how that is impacting our bottom line,” Paul begins.

“Well, Paul, the company has grown considerably over the past 5 years, so I’m not surprised that you feel a little disconnected with how things are going,” Mary Jane replied. She continued “In fact, I’ve been meaning to talk to you about a couple of big items such as increasing the sales commission to 15%. We’ve lost two of our best account managers in the last 9 months. It seems like we are behind the curve paying only 12% on gross sales.”

“What do you mean we are behind the curve,” Paul replied angrily. “We have always been the leader in every aspect of our business.”

“Well, that may have been the case in the past, Paul, but frankly we need to step up our compensation package to stay competitive,” Mary Jane replied. She continued, “And that’s not everything. I met with Frank Jacobs from marketing and he said we need to have a bigger presence at the trade show in March. He told me he would need about $650,000 added to the marketing budget to support new marketing materials.”

“Come on, Mary Jane, how can we do that when we are going to have to increase commission?” He continued, “I spoke with Dan Clark in production and he indicated that we have two pieces of equipment that need to be replaced by the end of the quarter and that’s going to set us back almost $1.2 million.”

Mary Jane shook her head. “Paul, I hate to bring this up but while we are talking costs, but Bob in purchasing stopped by the office and dropped off some revised cost information – it looks like several of our suppliers are talking about significant price increases by the end of the year.”

Paul slumped in his chair. “This is a mess, Mary Jane. Increasing commissions, new equipment, materials price increases and marketing expenses all at once. Even if Frank Mallow is correct that we should see a 10% increase in sales for the coming year, I just don’t see how we can make this work. We have to maintain enough profit to keep the shareholders happy and I can’t sleep when we dip below that $2 million margin of safety.”

Mary Jane gathered up her papers. “Before you get too distressed, let me put together some figures and let’s see what this looks like on paper. I’ll get back to you by the end of the week. In the meantime, stay positive, we’ll find the best solution.”

The following income and cost data for Mirabel is provided:

Mirabel Manufacturing			
Budgeted Income Statement			
For the Year Ending December 31			
Sales			$ 36,750,000
Cost of goods sold:			
	Variable	$ 13,300,000	
	Fixed	$ 9,300,000	
Gross Margin			$ 14,150,000
Selling & Administrative			
	Commissions	$ 4,410,000	
	Fixed Marketing Expenses	$ 1,350,000	
	Fixed Administrative	$ 6,000,000	
Net Operating Income		$ 2,390,000	

	Model 101	Model 201	Model 301
Normal Annual Sales Volume	16,000	19,000	11,000
Unit Selling Price	$ 650	$ 750	$ 1,100
Variable expense per unit	$ 250	$ 200	$ 500

(Note: Each of the following questions is independent of the others)

1. What is Mirabel's over-all break-even point in sales dollars?
2. Assume that sales revenue remains constant, what is the impact on break-even and the margin of safety if Paul takes Mary Jane's advice and increases sales commission to 15%?
3. If Mirabel purchases the new equipment for $1,200,000, it will increase fixed costs by 10% but will decrease the variable cost per unit for all 3 models by 5%. What will Mirabel's new break-even point be?
4. If Mirabel invests the additional $650,000 in fixed marketing expenses, sales of the Model 301 are expected to increase by 8%. What is the break-even and margin of safety under these circumstances?
5. If the projection is that sales will increase by 10% in the coming year, can the company afford to also increase commission from 12% to 15%? Why or why not.
6. Assume that sales volume remains fixed but there is a 5% increase in variable expenses (materials cost) for the Model 101 and 301, and a 10% increase in variable expenses for Model 201. What is the new break-even?

Report:

Prepare a report from Mary Jane to Don explaining how these changes will affect Mirabel's overall cost structure. For those changes that are controllable, make a recommendation considering the uncontrollable cost changes. Be certain to consider not only the company's break-even point, but also the desired margin of safety.

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8.16: Introduction to Cost-Volume-Profit Elements

What you'll learn to do: Describe the key elements of cost-volume-profit analysis

Determining pricing as it relates to the costs involved to manufacture a product or provide a service are crucial to the profitability of a company. As a manager, you may be tasked with pricing products or managing the many costs involved in the production process or service delivery.

Learning these skills will help you to improve the overall functioning of the company and your skills as a manager. Whether you are involved directly with preparing this type of analysis or not, it is important to understand the concepts to be an effective manager.

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8.17: Cost-Volume-Profit Analysis

Learning Outcomes

- List the factors associated with cost-volume-profit analysis

As a manager, a component of your job may include monitoring costs, pricing or both. The cost-volume-profit (CVP) analysis helps you to better understand the relationships between costs, volumes (quantities) and profits by focusing on how pricing products, activity volume, fixed and variable costs interact. Analyzing the CVP can give you the information needed to price, market and make products to maximize the profit of the company.

The cost-volume-profit formula is:

$$\text{selling price} - \text{variable costs} - \text{fixed costs} = \text{profit}$$

Let's review the definition of the components of the CVP formula.

1. **Profit**: The dollars left over after all expenses have been paid.
2. **Fixed costs**: The expenses that exist regardless of the quantity of product sold. These costs include things like rent. For example, your rent may be $500 a month. Whether you spend 5 nights a week there or one night a week, your rent remains constant.
3. **Variable costs**: These are the costs that are dependent on how many products you produce. An example might include, if you build bicycles. You need two tires per bicycle. If you only build 10 bicycles, you only need to purchase 20 tires. These costs will be incurred per product produced.

When doing a CVP analysis we make several assumptions:

1. The selling price is constant.
2. If more than one product is manufactured the mix of sales is constant
3. Costs are assumed to be linear (rise at the same rate regardless of quantity) and can be divided accurately into the variable and fixed components. It is also assumed that the variable element stays the SAME for each unit and that the fixed costs are constant over the entire relevant range of the analysis. This can be further clarified by the following example:

Selling Price per unit = $3
Variable costs per unit = $1
Fixed Costs for the range of 0-100 widgets = $150
So if we sell 100 units:
Sales = $3 x 100 units $300
Variable costs= $1 x 100 units = $100
Fixed costs = $150
Profit = Sales- Variable costs-fixed costs so $50 PROFIT

So using the same information as the example, what would happen if we only sold 70 units?

Selling Price per unit = $3
Variable costs per unit = $1
Fixed Costs for the range of 0-100 widgets = $150
So if we sell 70 units:
Sales = $3 x 70 units $210
Variable costs= $1 x 70 units = $70
Fixed costs = $150
Profit = Sales- Variable costs-fixed costs so -$10 LOSS

This example shows the clear interaction between our costs (fixed and variable), the volume of sales and how we price our products. The calculation can make or break a business, so it is important to clearly identify the components of the CVP analysis. In the example note that even though none of our costs changed, when we sell less items, our profit is affected greatly!

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Would you love to see this explanation in a video? The Accounting Tutor has a great resource for CVP and break even analysis. Between these two videos, you will get a great overview of these concepts to help you better understand as we move through this module.

Click Here for part 1

Click Here for part 2

Practice Questions

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8.18: Contribution Margin Model

Learning Outcomes

- Outline the contribution margin model

As we delve deeper into the CVP analysis, we need to note how much each additional product we sell brings to the contribution margin for the company.

Contribution margin is defined as the sales less the variable expenses.

$$\text{sales} - \text{variable expenses} = \text{contribution margin}$$

When we calculate the contribution margin, we ignore the fixed costs. We are simply looking at how much each additional item we sell, contributes to the funds available for use by the company. This contribution margin is used **first** to pay fixed expenses, such as rent and administrative overhead. Any dollars left over after covering the fixed expenses contributes to profits.

So if we go back to the previous examples our contribution margins would be as follows:

Sales 100 units x $3 per unit = $300
Variable cost per unit = 100 units x $1 per unit= $100
Contribution margin = ($300- $100)= $200
Sales =70 units x $3 per unit = $210
Variable Costs per unit= 70 units x $1 per unit= $70
Contribution margin = ($210- $70)= $140

So you can see from these examples, what we have left to cover our fixed expenses. If we sell 100 units, we have $200 left, after covering the variable costs to cover our fixed expense. If we only sell 70 units, we have $140 remaining to cover these expenses. We can start to see the importance of pricing effectively and keeping our costs under control as we look at making sure our company shows a profit.

Practice Questions

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8.19: Net Operating Income

Learning Outcomes

- Calculate net operating income using the profit equation

Profit is important to every single business. It wouldn't make sense to sell your products for less than it costs you to produce them, yet some companies unwittingly do this, simply because they haven't calculated their profit by using the profit equation.

The profit equation:

$$\text{profit} = \text{sales} - \text{variable expenses} - \text{fixed expenses}$$

Net operating income is defined as sales less all ordinary expenses of a business, before interest and taxes. Ordinary expenses of a business include the variable costs used in creating each product, along with all of the general fixed expenses. This number is useful , as it is pretty consistent from month to month and year to year in identifying growth in your business.

Now that we have our equations and definitions, let's look at some examples of calculating net operating income utilizing the profit equation:

1. Let's assume that Monte Corporation sells their widgets for $10 each. The variable cost per widget is $4. Fixed expenses for the company are $400 per month. What would be Monte Corporation's profit if they sold 200 units?
   - (200 × $10)= Sales $2000
   - (200 × $4) = Variable costs of $800
   - Fixed costs of $400 are incurred
   - So $2000 − $800 − $400 = $800 PROFIT or net operating income
2. But what if Monte Corporation only sold 100 units?
   - (100 × $10) = Sales $1000
   - (100 × $4) = Variable costs of $400
   - Fixed costs of $400 are incurred
   - So $1000 − $400 − $400 = $200 **profit** or net operating income
3. Now finally, what if Monte Corporation only sold 50 units?
   - (50 × $10)= Sales $500
   - (50 × $4)= Variable costs $200
   - Fixed costs of $400 are incurred.
   - $500 −$200 − $400= −$100, so Monte Corporation lost money when they sold only 50 units.

So even though the selling price of the widget has not changed, the profit goes down. As a manager, it may be your responsibility to monitor costs or selling prices to insure that a profit is being made on sales. Watching this profit, or net operating income, over time is a useful tool to assess the health of the company. If you are a sales manager, it might be your responsibility to keep sales numbers at a certain level. Using CVP analysis helps you to better understand the importance of selling more product.

Practice Questions

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8.20: Contribution Margin Ratio

Learning Outcomes

- Compute the contribution margin ratio

It is Thursday morning and your boss just called you into her office. “Why is our net profit down 10% this quarter? It looks like our cost of goods sold has gone up dramatically! Can you check into this and get back to me before the end of the day?” You need to put on your thinking cap and figure out why net profit has dipped. She mentioned that our cost of goods sold was higher. Could there have been a price increase on one of the components of our product? Off to visit purchasing to do some research!

The contribution margin ratio is the difference between a company’s sales and variable costs, expressed as a percentage. This ratio shows the amount of money available to cover fixed costs. It is good to have a high contribution margin ratio, as the higher the ratio, the more money per product sold is available to cover all the other expenses.

Contribution margin ratio formula:

$$\frac{\text{sales} - \text{variable expenses}}{\text{sales}}$$

If we go back to our Monte Corporation example, we can calculate their contribution margin ratio as follows:

$\text{sales} = \$2000$, and $\text{variable expenses} = \$800$, so

$$\frac{\$2000 - \$800}{\$2000} = 60\%$$

For every additional widget sold, 60% of the selling price is available for use to pay fixed costs.

What would happen if a supplier raised their price by $1 per unit on a part for the widget? This would increase the variable costs by $1 per unit, bringing the variable cost per unit to $5. How would this affect the contribution margin ratio for Monte Corporation?

$\text{sales} = \$2000$, and $\text{variable expenses} = \$1000$, so

$$\frac{\$2000 - \$1000}{\$2000} = 50\%$$

The addition of $1 per item of variable cost lowered the contribution margin ratio by a whopping 10%. You can see how much costs can affect profits for a company, and why it is important to keep costs low.

As a manager, you may be asked to negotiate or talk with vendors and perhaps even to ask for discounts. Small differences in prices of your supplies can make a huge difference in the profitability of a company.

Practice Questions

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8.21: Introduction to the Application of Cost-Volume-Profit Concepts

What you'll learn how to do: Illustrate the application of cost-volume-profit concepts

Now that you have some basic knowledge of the components of CVP analysis, let's go a bit deeper and show how we can apply those concepts to business decisions. Since slight changes in costs, sales or pricing can have a profound impact on the net profit of a company, it is important to be able to analyze the data when it is received.

The contribution margin becomes very important, as it is the amount of funds available from each product, after the variable expenses are covered, to cover the fixed costs of the company. Being able to pay the rent, utilities and administrative wages are crucial to company success!

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8.22: Cost-Volume-Profit Analysis and Decision Making

Learning Outcomes

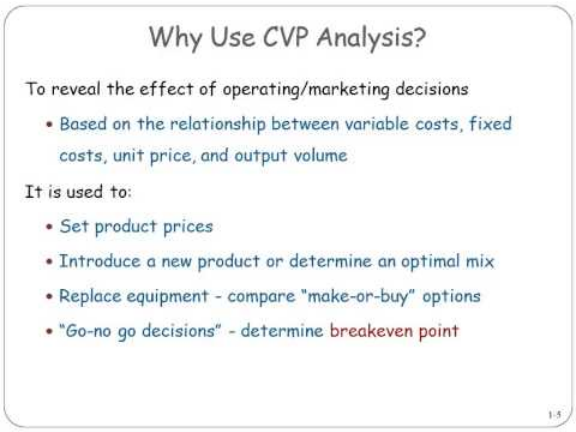
- Explain why changes to key cost-volume-profit factors can significantly affect planning and decision making

You just got a message from purchasing that the main component in your dry erase markers has gone up by 50 percent! You get out your calculator and start working on how this will affect your contribution margin this quarter. How are you going to explain this one to your supervisor? What are your options to keep your contribution margin high enough to cover the rest of your company's expenses without a massive price increase in the product? Let's get to work figuring out what to do.

So we talked about the key components of how many products we sell, what costs are involved in making those products and how they interrelate to create a profit or a loss. As a manager, you may be responsible for making sure that costs are kept under control, or sales numbers are kept at a certain level to keep your company profitable.

Even a slight change in costs can have a significant effect on the profitability of a company. Looking back at the contribution margin from the Monte Corporation example, let's look at how small cost changes might affect the overall profitability of the company. An increase from a supplier of $1 per widget seems insignificant when you look at one widget, but what happens as sales volume goes up and down? What if your rent goes up or you are hit with a sales slump?

Maybe you choose to take production overseas, or purchase a machine to replace employees. CVP analysis helps you to make these decisions.



A YouTube element has been excluded from this version of the text. You can view it online here: http://pb.libretexts.org/afm-2/?p=334

Monte Corporation has the following information available to you:

- Selling price of the widget- $10
- Current variable expense per widget $4.00
- Fixed costs $400 per month

They are notified by a vendor that the cost for the main component is going from $1.00 each to $2.00 each, which will bring their variable expense per widget to $5. How will this affect their contribution margin?

$10.00 − $4.00= $6.00 is now going to be $10.00 − $5.00= $5.00

Remember the contribution margin is how many dollars are available from the sale of each widget to cover fixed expenses.

The contribution margin ratio was 60% and is now going to be 50%. This is a huge difference for a $1.00 increase in component price. As we work through this module, keep in mind ways to possibly decrease costs, increase price, or other ways to save money on manufacturing. As a manager, you will have many decisions to make, sometimes they may be tough ones.

Practice Questions

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8.23: Statement of Fixed Cost and Sales Volume

Learning Outcomes

- Prepare a statement that shows a change in fixed cost and sales volume

Monday is not starting off well. The landlord of your building just called, and effective next month, your rent has increased by $200 a month. Net profit was already low and you are not sure how to approach your boss with this piece of information. You get out your CVP chart and get to work.

When the fixed costs change, it can also have a huge effect on profits. What if the space you are renting is all of a sudden $200 more per month that you were paying? Or maybe health insurance premiums for your employees double? These are situations that we sometimes cannot change or anticipate, but we need to know how to manage.

Let's take a look at Monte Company when their rent goes up!

Cost-Volume-Profit: BEFORE rent increase					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$10	$500	$1,000	$1,500	$2,000
Variable cost per item	$4	$200	$400	$600	$800
Contribution Margin	$6	$300	$600	$900	$1,200
Fixed Costs	$400	$400	$400	$400	$400
Profit (loss)	($394)	($100)	$200	$500	$800

In this chart, they are still at $400 a month for fixed costs.

Cost-Volume-Profit: AFTER rent increase					
Monte Corporation					
Number Sold	1	50	100	150	200
Price per Item	$10	$500	$1,000	$1,500	$2,000
Variable cost per item	$4	$200	$400	$600	$800
Contribution Margin	$6	$300	$600	$900	$1,200
Fixed Costs	$600	$600	$600	$600	$600
Profit (loss)	($594)	($300)	$0	$300	$600

Look what happens when their fixed costs go to $600 per month due to the rent increase! They used to show a net profit of $200 when they sold 100 widgets, and now they show no profit at all.

How can we adjust for this change in fixed costs?

1. We can raise the price of our product to compensate for the increased expenses.

2. We can try to source less expensive components for our widgets to lower our variable costs.
3. We could move to a less expensive facility.
4. We can work on increasing the sales of our product.

As a manager, you may need to make some difficult decisions. What would be your recommendations in this situation?

Practice Questions

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CHAPTER OVERVIEW

9: Operating Budgets

9.1: Production Budget
9.2: Direct Materials Budget
9.3: Direct Labor Budget
9.4: Manufacturing Overhead Budget
9.5: Ending Inventory Budget
9.6: Selling and Administrative Budget
9.7: Cash Budget
9.8: Budgeted Income
9.9: Budgeted Balance Sheet
9.10: Introduction to Flexible Budgeting
9.11: Why It Matters- Operating Budgets
9.12: Shortcomings of Static Budgets
9.13: Flexible Budget Report
9.14: Flexible Budget Reports and Multiple Cost Drivers
9.15: Putting It Together- Operating Budgets
9.16: Assignment- Operating Budgets
9.17: Introduction to the Master Budget
9.18: Budgeting and Business
9.19: Responsibility Accounting
9.20: Alternative Budget Periods
9.21: Self-Imposed Budgeting
9.22: Introduction to Preparing a Master Budget
9.23: Sales Forecast and the Master Budget
9.24: Components of the Master Budget

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9.1: Production Budget

Learning Objectives

- Create a production budget

Once we get the sales budget prepared, you can see on the flow chart that the next budget we need to work on is the production budget. This budget is necessary to provide all of the details we need to prepare direct materials, direct labor and manufacturing overhead budgets that come next.

The production budget outlines the number of units that we need to produce to meet the requirements we put together in the sales budget. This information needs to be completed prior to moving forward. Without knowing how many of our products we need to make, it would be impossible to move forward with the remaining budgets!

So remember our sales numbers for Hupana Running Company from our sales budget. We plan to sell 2,000 pairs of shoes, evenly distributed between the four quarters of the year. Armed with this information, we can create our production budget.

We had 100 pairs of shoes in our finished goods inventory at the end of the previous year, so we can use that number as we start our production budget. We also want to always have at least 50 pair in our finished goods inventory at the end of each quarter, but would like to end the year with 150 pair in inventory to start the next year.

Hupana Running Company Production Budget					
Quarter	Q1	Q2	Q3	Q4	Totals
Budgeted unit sales (pairs)	500	500	500	500	2000
Desired finished goods inventory	50	50	50	150	300
Total need	550	550	550	650	2300
Less beginning finished goods inventory	100	50	50	50	250
Required production units	450	500	500	600	2050

So taking a look at our production budget, what do you notice?

Even though we intend to sell 2000 pairs of shoes this year, we are producing 2050! Why? Because we would like to have a larger ending inventory at the end of this year. This could be for a few reasons. Perhaps we anticipate higher sales in the first quarter, or maybe we want to have a plant shut down in the early part of the year. This higher ending finished goods inventory would allow us to cover those two situations.

Also notice, that in the first and fourth quarters, we are actually producing either **fewer** or **more** pairs of shoes than we intend to sell. This is to adjust for finished goods inventory.

Note: So Hupana Running Company is a manufacturer. What might be different if they were a merchandising company who simply purchased finished goods to sell? Well, instead of a **production budget**, they would have a **merchandise purchases budget**. It would be similar in layout to the production budget, but the wording would be different. Rather than a required production in units, we would simply have required purchases. Oh, and we could skip some of the additional budgets, like production, direct labor and manufacturing overhead! Why? Well, if we aren't actually *manufacturing* anything, those budgets aren't needed. A merchandising company is a bit easier to budget for, but let's keep plugging away at our manufacturing company!

Now let's practice!

Practice Questions

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9.2: Direct Materials Budget

Learning Outcomes

- Create a direct materials budget

Hupana Running Company is off to a great budgeting start!! We have put together a sales budget, so we know how many pairs of our amazing running shoes we intend to sell, then we created a production budget, so now we know how many we need to produce each quarter to meet sales and finished inventory needs!

Ok, so next, we will need to figure out, based off the information in our production budget, what we need for direct materials! Remember, the number of pairs of shoes we **sell** each quarter, does not necessarily match the number of pairs we need to **produce** each quarter. Keeping that information in mind, let's move on to our direct materials budget.

In order to complete this budget, let's look at a few pieces of important information.

1. How many units of raw materials are required for each pair of shoes?
2. How many units do we need to meet our production budget?
3. How many units of raw materials would we like to have in our ending inventory?
4. What do we currently have in our raw materials inventory?
5. How many units of raw materials do we need to purchase?
6. How much does each unit of raw material cost?

Let's assume we are showing 250 units of raw material in our ending inventory coming into the new year. Each pair of shoes we make requires 5 units of raw materials. Let's also note that our buyer has secured a price for our raw material of $2 per unit for the entire year! Yeah to our buyer for doing great work on an annual contract! This will certainly help us in our budgeting process right?

This information will help our buyers to purchase raw materials, especially if it has a long lead time to receive, or if we like to receive it close to needing it (this might be called JIT or just-in-time inventory!).

Hupana Running Company Direct Materials Budget					
Quarter	Q1	Q2	Q3	Q4	Total
Required production in pairs	450	500	500	600	2050
Units of raw material needed per pair	5	5	5	5	5
Units of raw material needed to meet production	2250	2500	2500	3000	10250
Plus desired ending raw material inventory	500	500	500	500	500
Total units of raw materials needed	2750	3000	3000	3500	10750
Less units in beginning raw material inventory	250	500	500	500	250
Units of raw materials to be purchases	2500	2500	2500	3000	10500
Cost of raw material per unit	$2	$2	$2	$2	$2
Cost of raw material to be purchased	$5,000	$5,000	$5,000	$6,000	$21,000

What information is helpful? We now know how much money we need to have each quarter to cover the cost of our raw materials. Our buyer is happy and so is our production manager, knowing that we will have raw material in stock for production!

We can use this information to start working on the **next** part of our budget! What comes next? Well labor of course!

Practice Questions

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9.3: Direct Labor Budget

Learning Outcomes

- Create direct labor budget

Ok, so Hupana Running Company is getting all set for the new year. We have our sales budget, and know how many pairs of shoes we plan to sell. From that information we created our production budget, so we know how many pairs we need to produce each quarter, and how many we want in finished goods inventory at the end of each quarter. We also then figured out how much raw materials we need to bring in each quarter to keep our production facilities humming along.

So now we need to determine our direct labor needs. Direct labor includes all of the employees who are required to actually manufacture the shoes. These are the people working on the production floor. This information is important, so they don't run into a labor shortage and can plan for potential adjustments in their labor needs. Another use for this budget is to schedule plant shutdowns for cleaning and maintenance. Without the completion of the other budgets we have done, we couldn't fill in all the blanks in the direct labor budget!

So what new information might we need to complete this budget? Well the biggest one is how much time does it take to complete a pair of shoes? Then we need to know our cost per hour for our direct labor. This cost per hour includes wages, payroll taxes and fringe benefits for each of our production employees. Don't forget those things, as they can make a huge impact on the cost of an employee per hour!

So let's figure out our labor information.

One pair of shoes takes .5 labor hours @ $20/ hour average

We already know how many pairs we need to make each quarter, so let's get started on our direct labor budget!

Hupana Running Company Direct Labor Budget					
Quarter	Q1	Q2	Q3	Q4	Total
Required production in pairs	450	500	500	600	2050
Direct labor hours-pair	0.5	0.5	0.5	0.5	0.5
Total direct labor hours needed	225	250	250	300	1025
Direct labor cost per hour	$20	$20	$20	$20	$20
Total direct labor cost	$4,500	$5,000	$5,000	$6,000	$20,500

So we used the required production in pairs from our previous budgets. We noted above the time needed and the cost per hour for our manufacturing employees. With that information in hand, we can calculate our direct labor costs. We now know, how much we will spend each quarter on labor, and can staff properly!

Is all this budgeting fun starting to make sense? Let's go over what we know so far.

We know our sales, production schedule, raw materials cost, direct labor cost **and** what we will have in finished goods and raw materials inventory at the end of the year! Are we having fun yet?

Practice Questions

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On to manufacturing overhead!

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9.4: Manufacturing Overhead Budget

Learning Outcomes

- Create a manufacturing overhead budget

Well, we are working through these budgets, but now we got to an interesting one. There is more that goes in to the production of our shoes that just the raw materials and the people working. We have equipment, and small supplies, as well as repairs and utilities. These things can get costly, so we need to make sure we are on top of them as we work through this budget!

Manufacturing overhead includes all the costs of production other than labor and raw materials. This can include some variable and some fixed components.

Variable manufacturing overhead is based on direct labor hours. This can include things like electricity, production supplies (perhaps needles for the machines that sew together the shoe components) and other miscellaneous items needed to produce the shoes.

Fixed manufacturing overhead includes depreciation on the equipment, rent or mortgage on the facility and costs to process purchase orders, customer calls and such. There may come a point where the current facility, equipment or customer reps can't handle the volume. If this occurs, the fixed costs may change. For our purposes, let's assume that the current facility and equipment can handle the budgeted output!

So let's assume our variable manufacturing overhead to be $3 per labor hour. Let's further assume our monthly **fixed** manufacturing overhead is $2050 per month. So, included in our **fixed** overhead is $500 of depreciation. Remember depreciation is not a cash outlay, so we can **deduct** it from our total manufacturing overhead for cash purposes!! We will talk more about that when we get to our cash budget in a bit.

So plugging the information above into our manufacturing overhead budget, we can come up with a predetermined overhead rate for the year. We also have figured out the cash outlay, as well as the total manufacturing overhead.

Hupana Running Company Manufacturing Overhead Budget					
Quarter	Q1	Q2	Q3	Q4	Total
Budgeted direct labor hours	225	250	250	300	1025
Variable manufacturing overhead rate	$3	$3	$3	$3	$3
Variable manufacturing overhead	$675	$750	$750	$900	$3,075
Fixed manufacturing overhead	$2,050	$2,050	$2,050	$2,050	$8,200
Total manufacturing overhead	$2,725	$2,800	$2,800	$2,950	$11,275
Minus depreciation	$500	$500	$500	$500	$2,000
Cash disbursements for manufacturing overhead	$2,225	$2,300	$2,300	$2,450	$9,275
A. Total manufacturing overhead					$11,275
B. Budgeted direct labor hours					$1,052
Predetermined overhead rate for the year A/B					$11

So if you look at our previous budget for direct labor, the hours shown here on our manufacturing overhead budget come directly from that budget! The variable manufacturing overhead total is simply the hours multiplied by the rate. We now have the information needed to continue moving forward in our budgeting process! We also calculated our predetermined overhead rate for the year. Since manufacturing overhead i s an indirect cost, we can't assign it to a particular product or job. Because we are using our direct labor hours as our allocation base, dividing the entire manufacturing overhead by the direct hours, gives us a dollar amount we can use, as an addition to the direct labor cost, for each hour worked.

So, as an example, our direct labor cost per hour is $20 (as you remember from our direct labor budget). We an now add the $11 per hour manufacturing overhead to each hour worked as we price our products. This is a helpful calculation to spread out those costs that we cannot directly tie to a given product. This comes in very handy when more than one product line is manufactured. So if Hupana Running Company had 12 lines of shoes with varying labor and material costs, we could use this standard amount per hour of labor to allocate all of the manufacturing overhead costs!

Okay, so now we can move on!! We have all kinds of information now to complete our budgeting tasks!

Practice Questions

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9.5: Ending Inventory Budget

Learning Outcomes

- Create an ending inventory budget

As the senior accountant at Hupana, it is your job to oversee the preparation of the master budget. You have been waiting on the manufacturing overhead budget, so you can complete the finished goods inventory budget. Having the balance for finished goods inventory is needed before you can move on to the budgeted financial statements that are part of your job! Luckily, you now have all of the information needed to move forward. Your managers have provided you with the details to fill in all of the blanks in this finished goods inventory budget!

Ok, so we have completed the first five budgets needed to help us figure out the value of our ending inventory among other things!

Calculating the per unit cost of our finished goods inventory is an important figure. We will need it to calculate the cost of goods sold. How much was spent to manufacture the remaining items in inventory will also give us the value of what we still have in our stock. This is an asset on our balance sheet, so getting the calculation right is important.

Hupana Running Company Ending Finished Goods Inventory Budget					
Item	Quantity		Cost		Total
Production cost per pair	5	unit	$2	unit	$10
Direct materials (from direct materials budget)	0.5	hour	$20	hour	$10
Direct labor (from direct labor budget)	0.5	hour	$11	hour	$6
Manufacturing overheard (from manufacturing overhead budget)					$26
Unit production					
Budgeted finished goods inventory					
Ending finished goods inventory (in pairs)-from production budget					150
Unit product cost (from above)					$26
Ending finished goods inventory in dollars					**$3,825**

The finished goods inventory budget, references several other budgets we have prepared. Without those budgets, we would not have had a good number to use for our balance sheet that included all of the costs involved in the manufacture of the shoes left in our ending inventory.

So we now have a ton of information about our production schedule, our costs of manufacturing and a really good handle on our inventory. This is a great start, but there is a lot more to the overall business than what happens in manufacturing. There are costs relating to administration and selling expenses that are necessary to get the orders to make the products that we sell.

Let's get started!

Practice Questions

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9.6: Selling and Administrative Budget

Learning Outcomes

- Create a selling and administrative expense budget

So Hupana Running Company knows all about production, and we have a good handle on how many pairs of shoes we are going to make, and how much raw materials and overhead go into each pair. But how do we get those orders? Well, there are sales commissions, marketing plans, data entry personnel, insurance, property taxes and all the other stuff that goes into operating a business.

Some of these expenses are variable, like sales commissions, and data entry personnel, while other expenses, like insurance and property taxes happen no matter how many pairs of shoes we make or sell. These are our fixed expenses. So we are going to make some assumptions so we can start work on this budget.

1. Based on prior year's actual expenses, let's assume that the variable selling and administrative expenses are $5 per pair of shoes.
2. Let's assume that executive salaries, insurance,marketing, property taxes and depreciation are our fixed expenses.
3. All of the expenses are equally distributed over the four quarters of the year.

Hupana Running Company Selling and Administrative Expense Budget					
Quarter	Q1	Q2	Q3	Q4	Total
Budgeted unit sales	500	500	500	500	2000
Variable selling and administrative expense per case	$5	$5	$5	$5	$5
Variable selling and administrative expense-total	**$2,500**	**$2,500**	**$2,500**	**$2,500**	**$10,000**
Fixed selling and administrative expense					
Marketing	$1,500	$1,500	$1,500	$1,500	$6,000
Executive salaries	$5,000	$5,000	$5,000	$5,000	$20,000
Insurance	$500	$500	$500	$500	$2,000
Property taxes	$250	$250	$250	$250	$1,000
Depreciation expense	$500	$500	$500	$500	$2,000
Total fixed selling and administrative expenses	$7,750	$7,750	$7,750	$7,750	$31,000
Total selling and administrative expenses	$10,250	$10,250	$10,250	$10,250	$41,000
Less depreciation	$500	$500	$500	$500	$2,000
Cash disbursements for selling and administrative expense	**$9,750**	**$9,750**	**$9,750**	**$9,750**	**$39,000**

Note: because depreciation expense is a non-cash expense, we can subtract it for our cash budget preparation, but we still need the number for our overall budget and financial statements to get an overall picture of the health of our company!

What do you notice about our selling and administrative budget? First, we use the budgeted unit sales off of the sales budget we created first! So you can start to see how everything is tied together.

Practice Questions

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9.7: Cash Budget

Learning Outcomes

- Create a cash budget

The cash budget will look a lot like a budget you would do for your personal budget. It includes income and expenses, as well as any cash overages or deficiencies. If you borrow money to purchase equipment you may also have a financing section. In your personal budget, this would be things like mortgages and car loans.

Hupana Running Company doesn't have any outstanding loans, so we don't need to worry about that section, but just be aware that it might exist. There also may be instances where a company has a short term cash flow issue. This can occur when a huge production run may be needed prior to a big selling season. So, if Hupana needed to make 1000 pair of shoes in October for December sales, they may run short of operating cash due to needing to bring in raw materials, labor and the other manufacturing costs prior to receiving the income for the shoes.

When this happens, it is possible to take out what is called a working capital line of credit to cover those short term shortfalls of cash. These are typically very short term notes, where the money is used to pay expenses until the revenue comes from the sales and then immediately repaid. Unlike a mortgage or equipment loan with set monthly payments, these short term notes can be paid off quickly with large payments. They are helpful to even out cash flow.

So back to our cash budget. We are going to need a bunch of information from our previous work to complete this one! If you haven't already, you might want to either print those prior budgets or have them pulled up in multiple tabs. It will make it much easier to find the information you need!

Practice Questions

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9.8: Budgeted Income

Learning Outcomes

- Create a budgeted income statement

"How much money will we make this year, if we meet all of our budgets?" asked your supervisor. Well, we still don't have that number, even with all of the work we have done so far to create budgets for each area of our company. We do know that cash flow looks good, and it feels like we have our pricing and production in a good place. So you tell your supervisor, "Let me finish up a couple of things here, and I will get you that information. It looks like we are in for a good year though!" As your supervisor walks out of your office, you begin to compile all of the details needed to complete a budgeted income statement.

Ok, wow, we have all the information we need to see what our income statement will look like if how we have budgeted our income and expenses happens. This is kind of like the frosting on the cake! Seeing it all put together, and finding out if we have done a good job of costing our products.

So what numbers are we going to need off our other budgets?

Hupana Running Company Budgeted Income Statement	
Sales	$200,000
Cost of goods sold	$52,000
Gross margin	$148,000
Selling and administrative expenses	$41,000
Net operating income	$107,000
Interest expense	$ –
Net income	$107,000

*Cost of goods sold = 2000 pairs at #26 per pair (assuming same costs on the 100 beginning balance in inventory as this year's production costs

Did you print the budgets yet? If you did, let's go back through and see where all of our numbers are coming from!

- Sales: Sales Budget
- Cost of Goods Sold: The beginning inventory of 100 pair (assuming a cost per pair of $26 each), plus 1900 produced this year at a cost of $26 per pair from our finished goods inventory budget unit production cost. So 2000 × $26 = $52,000

The gross margin is simply the difference between our sales and our cost of goods sold.

The selling and administrative expenses come off the budget of the same name. We subtract those from our gross margin to come to a net operating income.

If we would have needed to borrow money, we may have had interest expense! We had an awesome year at Hupana Running Company, so no loans needed!

Think about how this income statement might look different, if competition stepped in and we had to drop the cost of our shoes to $60 per pair?

Practice Questions

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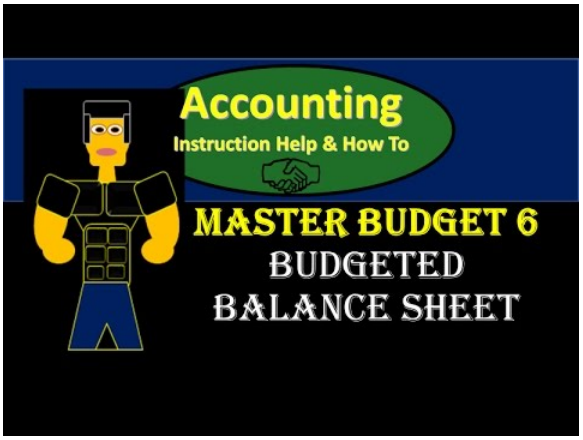
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9.9: Budgeted Balance Sheet

Learning Outcomes

- Create a budgeted balance sheet

Ok, one more piece of our puzzle to finish up! The balance sheet gives us a snapshot in time. In this case, a snapshot in our budgeted time. There are lots of pieces of the puzzle, so let's take a few minutes to review:



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One more reminder: $\text{assets} = \text{liabilities} + \text{stockholder's equity}$

This accounting equation may come in handy as we work through this process.

If sales, costs and expenses all follow the budget, here is what our year end balance sheet will look like!

Hupana Running Company Budgeted Balance Sheet		
Assets		
Current Assets		
Cash	$112,275	
Raw Materials Inventory	$1,000	
Finished Goods Inventory	$3,825	
Total Current Assets		$117,050
Plant and Equipment		
Land	$25,000	
Buildings and Equipment	$50,000	
Accumulated Depreciation	$(4,000)	
Plant and Equipment, Net		$71,000
Total Assets		**$188,050**

Hupana Running Company Budgeted Balance Sheet		
Liabilities and Owner's Equity		
Current Liabilities		
Accounts payable	$ –	
Stockholder's Equity		
Common stock	$50,000	
Retained earning	$138,050	
Total stockholder's equity		$188,050
Total liabilities and stockholder's equity		**$188,050**

Note: We made some beginning balance assumptions here: the land and buildings were already there, along with the stock and a beginning retained earnings of $31,050.

So overall, Hupana Running Company is in great shape if the budget goes as planned. But, budgets don't always go as planned, so having a cash cushion is a great thing! They could have reduced sales, or price reductions and still be ok. They did a great job of creating a cushion, where if things happen, they will still be fine.

Most businesses make some changes during the year to the budget. The budget is a guide, and must be considered a fluid document, that can be changed as new information or situations occur.

Practice Questions

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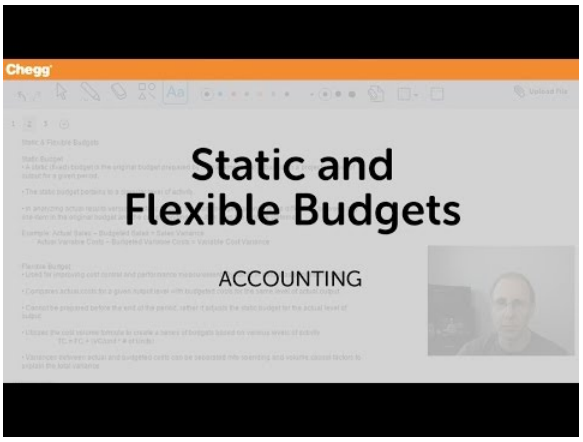
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9.10: Introduction to Flexible Budgeting

What you'll learn to do: Outline the effects of flexible budgeting on budgetary control

In the previous section, we discussed the preparation of a master budget, which is a static budget. We now want to look at the advantages of preparing a flexible budget, since markets change, competition changes and the quantities we initially determined in our sales budget may flex over time.

Take a few minutes to watch this video before moving on.



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Then, let's examine the preparation of a flexible budget.

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9.11: Why It Matters- Operating Budgets

Why learn about operating budgets?

Why do budgets matter? It seems like a ton of work to put together all of the information needed to complete a master budget. We need to know how many units we are going to produce, and all of the costs that go into each of those units. We also have to have all of our payroll information, and overhead costs. Hours and hours of work may go into creating the master budget, even for a small company!

The budget matters for a variety of reasons:

1. We can see if the company will make money or lose money at our anticipated level of sales.
2. We can analyze our expenses based on expectations. This will help us know when costs are high or where we can save money in our processes or purchases.
3. We can hold staff accountable for their departments. This is especially true if they participated in putting the budget together for their own department!
4. It creates a living document to help grow the business and become more profitable over time.

It would be tough to run your household without an idea of the interaction between what is coming in for income, and what is going out for expenses right? Let's think about the business master budget as a big household with a few more moving parts!

Ready to get started?

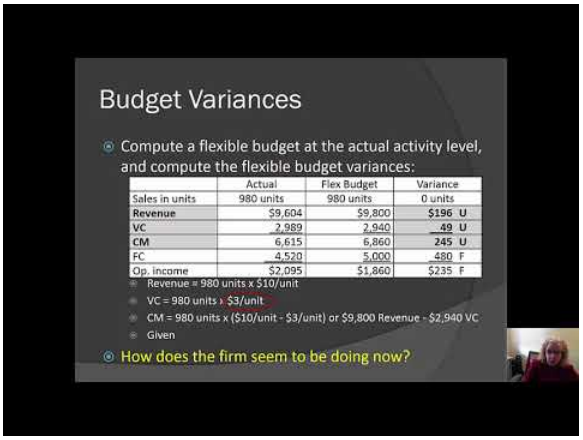
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9.12: Shortcomings of Static Budgets

Learning Objectives

- Describe the shortcomings of a static budget

Your supervisor walks into your office and looks very upset. “John, why are our electric bills 50% higher than we have budgeted in our manufacturing overhead budget?” You take a look at that portion of the master budget, and notice a problem. The sales budget was for 50,000 units to be produced, but you have now produced 85,000 units. The electric service, since the machinery to create your product has been running almost twice as many hours per day as originally budgeted, is higher. It is your job to explain this budget variance to your supervisor!



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One of the biggest pitfalls to a static budget, is the inability to adjust for changes to sales levels. So here is an example:

Jake is the sales manager at a large computer store. His salespeople are paid 10% of their sales as a commission. Jake, using information from the previous year, is asked to prepare his budget. His static budget looks like this:

Sales	$10,000,000
Sales Commissions	$1,000,000

Jake is pretty excited about the year ahead, and submits this budget to his supervisor. In the end of his budget year, Jake takes a look at his numbers, and is *thrilled* to see sales of $20,000,000! His sales are double what he anticipated. But, he also sees commissions of $2,000,000, which are double what his static budget numbers were. He sees a big UNFAVORABLE next to this number.

Where do you see the problem here? Because the master budget as prepared was a **static** budget, it can’t be adjusted later for increases or decreases in sales numbers. This is a huge problem, since additional sales is typically a good thing. Preparing a flexible budget, which adjusts based on changes in sales, would have helped Jake to see the true picture here. If his sales doubled, it only makes sense that his commissions would double as well.

So now that we know the limitations of a static budget, let’s work on flexible budgets.

Practice Questions

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9.13: Flexible Budget Report

Learning Outcomes

- Create a flexible budget report that shows sales, activity, labor, or cost variances

Jake is now working on a flexible budget for his sales department! His supervisor gave him to green light to keep selling and keep paying his sales people! It looks to be a record year. As he works on his budget, he notices that even though increased sales cause increases in some of the expenses in his department, others, such as rent, stay the same. This makes Jake really happy, as the net profit for his department is rising along with the increase in sales! Let's take a look at how a flexible budget can help businesses grow, and offer a better picture of where budgeted expenses should be.

In the previous section, we started to talk about how the budget needs to be a fluid document. Flexible budgeting is important for businesses, as the world isn't static!

The budget we prepared is called a planning budget. This budget is put together before the year starts, and is a static budget. We can't use it for accessing if costs are being effectively controlled. It doesn't let us compare apples to apples.

So what if instead of selling 2000 pair of shoes, we sold 3000? Would it be fair to hold our production manager responsible for going over costs when he manufactured 1000 more pair of shoes? The answer to this is obviously **no**, so how can we fix this problem? On the other hand, if we produce less, and our electricity bill is lower, it would note be fair to give kudos for reducing energy costs!

Flexible budgets take into account how changes in production affect costs. So if production goes up, costs with go up. In converse, if we were to sell fewer shoes, our costs would go down!

So, a flexible budget lets us see what the costs should have been at a particular level of activity. Let's look at an example:

	Planning Budget	Flexible Budget	Activity Variance	Favorable or Unfavorable
Classes taken	500	600		
Revenue ($14/class)	$7,000	$8,400	$1,400	Favorable
Expenses				
Wages and Salaries	$3,500	$4,200	$700	Unfavorable
Yoga Supplies	$250	$300	$50	Unfavorable
Utilities	$500	$600	$100	Unfavorable
Rent	$500	$500		
Insurance	$100	$100		
Other Expenses	$250	$300	$50	Unfavorable
Total Expense	$5,100	$6,000	$900	Unfavorable
Net Operating Income	**$1,900**	**$2,400**	**$500**	Favorable

So let's look at Simply Yoga. If their planning budget assumed 500 classes to be taken, but there were actually 600 classes taken in the time period, how would expenses react? Well, in this case, it looks like wages area based on a per class cost of $7 $\left(\frac{\$3500}{500} = \$7\right.$, and so does $\left.\frac{\$4200}{600} = \$7\right)$. So if more classes are taken, it is a **favorable** revenue variance, meaning the studio made more money, but an unfavorable wages and salaries variance, as they spent more on wages than budgeted. But was it a good thing to spend

more? Yes! Even though expenses were higher, the net operating income is higher. So this is a good thing! This flexible budget allows us to make changes in the expense accounts as the number of classes taken changes.

So why did rent and insurance not change? Remember back to our Hupana Running Company example. Those kinds of expenses are fixed, so it doesn't matter how many shoes we sell or classes are taken, they remain the same. This type of budgeting helps us to see how increases in revenue affect net profit.

Practice Questions

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9.14: Flexible Budget Reports and Multiple Cost Drivers

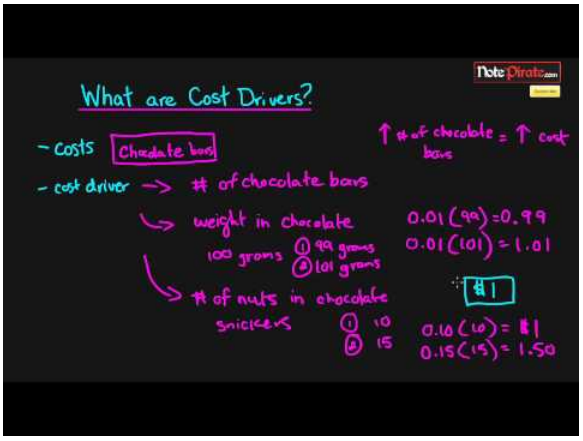
Learning Outcomes

- Create a flexible budget report that shows multiple cost drivers

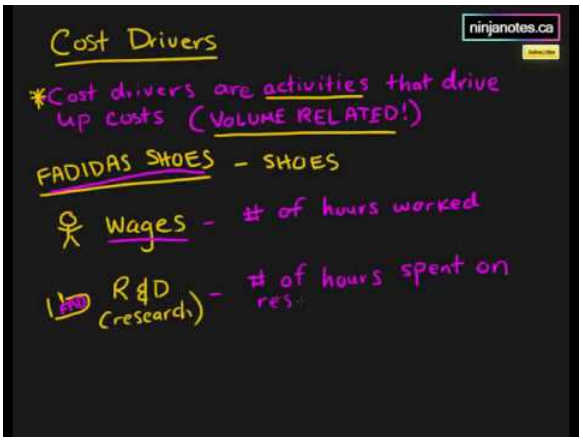
You are the manager at Simply Yoga. In an effort to figure out **how many** classes you should put on the schedule and how many students should be in each class, you are wondering what things to look at. Labor, number of classes taught or number of participants could all be cost drivers. Well, direct labor is going to be a driver for you, since you currently pay per student, but have a minimum amount of $84 per class. Let's assume you teach heated classes. If you teach 20 classes, the rooms only need to be heated for those hours, but if you teach 50 classes, your hours of needing heat in the building has gone up considerably, causing an increase in utility costs! Which driver is most important in this example?

So for our example, Simply Yoga, we only assumed that one thing would change the budget: The number of classes taken. Some of the costs of the yoga studio may depend on other factors, like, how many hours the studio is open?

A cost driver is defined as the unit of activity that causes a change in the activity's cost. In our Simply Yoga example, we first just looked at the number of students through the door as a cost driver. But, then we also need to look at how many classes are taught and how that may affect wages and other costs.



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This additional cost driver may affect utilities, as if we need to have the heat at a certain temperature for classes, this cost may not depend on how many students take classes.

Let's say we had 20 classes with 25 students each, so the studio was heated for 20 hours. What if we had 50 classes with 10 students each? The studio would then need to be heated for 50 hours! This could have a huge effect on our electricity bill, even though we have the same number of students through the space!

Another thing that could be an additional cost driver, may be wages. At Simply Yoga, the instructors are paid $7 per student, as we figured out when we were working on our budget. But what if they were guaranteed $84 per class, and paid $7 over this amount? Then we could have a huge fluctuation, depending on the number of students in each class.

Do you see how just looking at costs based on the number of classes taken, might not give you the true picture?

Let's look closer:

If Simply Yoga still has 500 students come through their doors, but offers 50 classes instead of 20 and pays each instructor a minimum of $84 per class with $7 for each additional student, look how that affects the net income?

Classes taken	500	500
Number of classes offered	20	50
Revenue ($14/class)	$7,000	$7,000
Expenses		
Wages and salaries ($7/person or $84/class)	$3,500	$4,200
Yoga supplies	$250	$300
Utilities (300+$10/hour)	$500	$800
Rent	$500	$500
Insurance	$100	$100
Other Expenses	$250	$300
Total Expense	$5,100	$6,200
Net Operating Income	**$1,900**	**$800**

When multiple cost drivers are present, we need to look at each one to determine our net operating income. Determining the most important cost driver, is crucial as a component of budgeting. As we can see from this example, a change in the number of students through the door may have an effect, but the number of classes offered, and how many students participate in each one will also come into play.

Practice Questions

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9.15: Putting It Together- Operating Budgets

So how much fun is budgeting? Hopefully, you have a better understanding of the working parts of a master budget. The master budget is the central planning tool used by companies to assess performance of each individual component of the business.

If you remember, when we looked at the sales budget, we determined how many pair of shoes Hupana Running Company would produce. We can now hold our sales department responsible, since they had a hand in preparing that information, for sales numbers. They have a goal to reach!

Then, we pass that information off to our production folks! With a sales number in hand, they can determine how best to use the facilities to meet sales projections. Then the purchasing department gets the information to determine a raw materials budget. This budget allows them to work with suppliers to secure the best pricing.

Now onto labor! Once we know how many we are making, and when we plan to make them, staffing plans can be made to most effectively use our payroll dollars. Then we can figure out, based on our labor hours, how much of our overhead (both fixed and variable costs) are allocated to each pair of shoes we produce.

There are those pesky administrative expenses. Without the office and sales people, we would have no business, right? So we now have the data to put that information together.

With all of these smaller components in hand, we can put together a cost flow plan, and and income statement and balance sheet to see the income and overall financial health of the company.

One missing piece and we can't get good numbers!! See why a budget is so important?

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9.16: Assignment- Operating Budgets

This assignment is available for download as a Word Document.

Read the following scenario and complete the questions and tasks below.

Don Flowers, CEO of Burbage Manufacturing looked around the conference room as his management team chatted and settled in for the monthly meeting.

“Let’s get started,” Don said, “we have a lot to cover today, and frankly it’s not all good news.” The room fell quiet. Don continued, “As you know we recently experienced a cash shortage despite last quarter’s record sales. We can’t keep going back to the bank to borrow money to support operations. I am counting on each of you to figure out a way to keep this from happening in the future.”

Brian Mitchell, the newest member of the team raised his hand somewhat sheepishly. “Sir, perhaps if we looked at the Master Budget for last month we could begin to identify areas for improvement.”

Don looked to Alex, his CFO. “Well, Alex that’s your area of expertise and Brian’s suggestion makes sense. Let’s have a look at that Master Budget.”

Alex looked down at the desk and began shuffling through his paperwork. “Well Don, we don’t exactly have a Master Budget per se. I mean we have budgets for different areas within the company, but I really rely on the managers to know what they need to do in their areas.”

Terri, the production manager spoke up, “Hey, wait a minute Alex. You’re the CFO. I’m doing everything I can just to keep up with demand down there on the floor. I don’t have time to worry about that kind of thing. We had a press go down last week and I had an entire shift of down time. Besides, that’s your job, Alex.”

“You know she has a point there Alex. You are the CFO. I need Terri to put all of her time towards keeping the production line running smoothly,” Don said.

“Look, Don, Alex replied, “In January I asked everyone to send me their budgets for the year and the only thing I got was a sales budget from Peter with a note attached that asked for a pay increase for his account managers.”

Brian raised his hand to speak. “Well, I know I’m new here, but at my last company we had budgets for sales, finished goods, cash – pretty much everything was budgeted. It seemed to work pretty well, and everyone had a good grasp of where we were financially.”

Alex, the CFO gave Brian an icy stare.

Don turned to Alex. “Alex, I think this young man has a point. Is there some reason why we aren’t budgeting like he described?”

“Well”, Alex began, “It’s really complicated, Don. Marjorie in materials is short two people and she’s paying overtime to her remaining people just to meet supply requisitions from the shop floor. And then there’s the problem with the corporate office. Every time I turn around I am getting an invoice from them for some piece of office equipment or another. Last week I got a bill from some company that Jessica hired to water the plants. How am I supposed to keep track of all of this? And then ….”

Don raised his hand to cut Alex off. “Look, I know we are a complex organization – but the fact of the matter is that I can’t keep going to the bank every month, borrowing money to pay the suppliers. For heaven’s sake – we are a multi-million-dollar company.” By this time Don was red in the face and everyone around the table was showing an intense interest in the conference table. He continued, “What am I going to tell the shareholders at the annual meeting when we don’t have enough cash to pay a dividend – that Jessica spent their money on potted plants?”

“This is going to end, today. Brian, you seem like a smart young man. You are going to work with Alex and anyone else in this company to get us on board with establishing and using budgets to correct this situation,” Don explained. “Further, as for the rest of you -when Brian comes and asks you for information treat him as if it was me making the request. Understood?”

Everyone nodded their heads in agreement.

“Meeting adjourned,” Don declared.

Questions:

1. Identify the problems that appear to exist in Burbage's budgetary control system and explain how these problems are contributing to the company's poor cash position.
2. Identify the budgets that Brian and Alex will need to create to resolve these issues, including the information that is needed to construct each budget.
3. Once you have identified the problems and necessary budgets, prepare a report for Don and the rest of the management team outlining your plan for establishing a budgetary control system, making certain to include how each component of the system will benefit the overall financial health of the company.

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9.17: Introduction to the Master Budget

What you'll learn to do: Discuss the purpose of an master budget

Every company needs a master budget! The components of this budget are outlined in this unit, along with the order in which they need to be completed. Certain data is needed before the next set of budgets can be completed. Giving the responsibility of the budget to the employees involved in each component of the work can be helpful in insuring that you have set reasonable and attainable budgeting goals.

Let's take a look at the components of a master budget and how they interrelate.

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9.18: Budgeting and Business

Learning Outcomes

- Describe the advantages of budgeting to a business

Just like your household, a business has debts and expenses they are responsible for. In an effort to make sure the funds exist to cover these expenses, businesses need to put together a budget.

Some of the common expenses that a business may have include:

- Rent or mortgage
- Utilities
- Telephone
- Insurance
- Advertising
- Materials for product production
- Payroll
- Taxes

Budgeting makes it possible for a business to plan into the future, attract investors, set sales goals, obtain financing. Businesses also need a properly prepared budget to set goals and to answer questions of existing investors or board members. Comparing actual expenditures to a budgeted amount is helpful to notice things like an increase in the cost of electricity or a mistake in the invoice from your advertising agency!

The budget can be seen as a benchmark document, to help staff define goals and stay within the parameters of the budget. Even the smallest businesses should put together a budget! Watching income and expenses can help managers notice small changes and fluctuations before they become problems.

The process of budgeting helps managers learn to allocate resources effectively, and in larger companies, the budget can put together different components of the business into one document. This may show areas where bottlenecks might occur in spending, again, before this becomes a problem.

Budgets are a big deal, and not a task to put off. If you are a manager, chances are you will be asked to help prepare a budget, or run a department based on a budget. Whatever your role is, a budget will most likely be part of your job.

Practice Questions

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9.19: Responsibility Accounting

Learning Outcomes

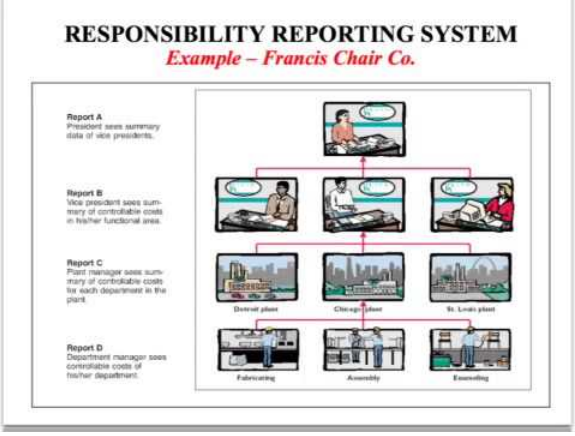
- Define responsibility accounting

What if your boss came into your office on a Friday afternoon asking why the phone bill is so high? What if you have no control over the phone bill, and don't even have a company phone? Would it be fair to expect you to know what was up?

This is where responsibility accounting comes in. You, as a manager, can only be held responsible for the things you can control. If you are the sales manager, you may have control over company sales in your product line, but you may not have control over the salary budget line for the plant manager.

In larger companies, it may be impossible for one person to have responsibility for the entire budget, thus the responsibility gets broken down by department, production line or some other segment, so that variances can be noticed and reviewed.

As a manager, it is also important to take the initiative to review the budget and analyze variances to determine a plan of corrective action. The point of an effective responsibility accounting plan is to insure that things don't fall through the cracks, but someone is reacting quickly to deviations from the budget.



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Practice Questions

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9.20: Alternative Budget Periods

Learning Outcomes

- Differentiate between alternative budget periods

The year has come to a close and you are sitting at your desk evaluating the budget for your business. Although how you prepared the budget seemed to make sense at the beginning of the year, you are now seeing some things that could have been done better, or improved by working ahead on your budget, so you didn't feel like you are starting from scratch. Also, since you run a school aged child care program, it really makes more sense to budget from May to April, rather than January to December, but you aren't sure if it is ok to budget that way. The standard quarterly budget doesn't seem to fit your needs, but what can you do? Well, let's examine some ideas for budgeting that may be a better fit for you!

There are various ways to set up a budget and to choose a budget period. First and foremost, set a budget period that works for your business! The two primary budget periods you will see are:

1. **One Year budgets.** Most companies prepare a one year budget, that is divided into quarters and then months. Depending on the fiscal year of the company the quarters may vary, but in a standard calendar year company, January–March, April–June, July–September, and October–December would be the four quarters. Many companies budget by month, some even by week or day! This will depend on the size of the company.
2. **Continuous budget (also called a perpetual budget).** This kind of budget will continually add on to the end of the period, with a perpetual 12-month budget. So, as an example, at the close of a month or a quarter, the next month or quarter is added on. The advantage to this type of budget, is that managers always have a year in front of them, regardless of when they are looking at the budget. This helps with long term planning for managers, as they don't have a narrow, short term goal, but can see into future periods.

When setting up a budget for your company or department, make sure to check to see what the company prefers, or currently uses. It is also important in smaller companies to decide on a budget period that makes sense from a business standpoint. An example might be a school, where most of the expenses are incurred from August to May. In this case, having a budget that covers the school year may be much more important than having a calendar year budget. Different businesses will work best with different budgeting periods.

Practice Questions

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9.21: Self-Imposed Budgeting

Learning Outcomes

- Identify the benefits of self-imposed budgeting

Why in the world would someone self-impose the work of a budget on themselves? Well, we do it personally, creating a budget so that we don't spend more than we make. Businesses need to do the same thing. A business won't be in business long if they continually spend more than they have in revenue, causing late or missed payments to vendors!

If a budget is imposed from higher levels of management, with little contribution from lower-level managers and staff can cause resentment. This can happen particularly when a manager is reprimanded or penalized for a budget issue they had no part in preparing. The most effective budgets are prepared with input from the managers who are actively involved in the work. Taking ownership is an important aspect of a successful budgeting process.

Self-imposed budgets can also be called participatory budgets. These types of budgets assume that there was cooperation and participation from managers at all levels of the organization. It creates a much more harmonious work environment when everyone gets to have a say in the operation of the business. Plus, who knows better the needs of a department than the people working in it?

The advantages of a self-imposed or participatory budget can include:

1. The creation of a team environment where everyone knows their views and judgements are valued by company management.
2. When a front-line manager assists in the preparation of their own budget, they have working knowledge and are able to more accurately estimate expenses for their area.
3. When you, as a manager, get to prepare your own budget, you are more motivated to set goals that are attainable, yet challenging. There is a higher level of commitment when participation is involved.
4. If you as a manager try to attain a goal set by someone else, especially if that someone does not know the intricate workings of your department, it can be easy to just say that the goals were unattainable. When you set your own goals, you can't make that claim!

Many companies still do not use this type of budgeting, but instead impose profit targets and encourage department managers to work within those parameters. This can cause lots of motivation issues. The takeaway here is that it is important for employees and lower level managers to have some responsibility in setting goals. It helps everyone take ownership and feel like they are part of the team!

Practice Questions

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9.22: Introduction to Preparing a Master Budget

What you'll learn to do: Illustrate the use of accounting data in a prepared master budget

Master budgets can be based off of historical accounting data for established companies or forecasts for new companies. The accounting data is a crucial component of a master budget as it can provide historical information in order to build a budget with attainable goals.

Let's go through the sequence of budget preparation and see how accounting data can assist us in the process.

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9.23: Sales Forecast and the Master Budget

Learning Outcomes

- Summarize the impact of the sales forecast on the master budget

It is December again, and you know your supervisor is going to start asking you to work on the annual budget. It is such a pain to try to accumulate all of the numbers he is requesting, and you don't understand why he is so picky about the whole process. Begrudgingly you begin putting together the seemingly endless spreadsheets, and accounting documents he is asking for, but why? How can what feels like a waste of time be so important to the company?

The master budget will offer guidance to every department in the company, knowing, starting at the sales forecast, where product needs to be priced, how to manage floor space and staff each step of the process. It can be hard to see the benefit of this large process, if you only work in one department of a company, so let's take a look, from the first step forward.

The master budget contains multiple components, so let's take a look at each one of them individually first, then we will start putting the pieces together.

What would you, as a manager, think is the most important number to know, before you start any budgeting process?

If you answered **sales**, you are right! We can't do anything from a budgeting standpoint until we have the sales forecast as a beginning number. We are going to call this forecast, the **sales budget**, and it is the first piece of a somewhat large puzzle.

Having accurate sales figures is the key to the entire budgeting process. If this budget is inaccurate, it kind of rolls downhill and the rest of the budgets will be off as well. In big companies, there might be mathematical models and statistics involved in figuring out these numbers. Don't worry. We won't be doing that in this course, but knowing the importance of this information is the key.

This budget will affect the variable portions of the selling and administrative budgets and will also feed into the production budget. The production budget is needed to figure out direct materials, direct labor and manufacturing overhead budgets. Once these are all done, then comes the finished goods inventory budget.

Once all of these budgets are done, we can do a cash budget, income statement and balance sheet to finish off the process. Information from all of the previous budgets go into creating the cash budget, so you can see the importance of an effective and accurate sales budget!

So let's get started with our Sales Budget! Our company, Hupana Running Company makes the best running shoe ever. They have tasked you with creating a sales budget for the shoe. Let's start with some basic assumptions, so we can start to build a budget.

Hupana plans to sell 2,000 pairs of shoes this year. The selling price of the shoes is $100 per pair. For simplicity, we are going to assume that all of the sales are cash sales, and that sales is even each quarter.

So armed with that information, here is the sales budget for Hupana Running Company!

	All 4 Quarters	Q1	Q2	Q3	Q4
Budgeted sales in pairs	2000	500	500	500	500
Selling price per pair	$100	$100	$100	$100	$100
Sales in $	$200,000	$50,000	$50,000	$50,000	$50,000

What is next? On to the production budget!

Practice Questions

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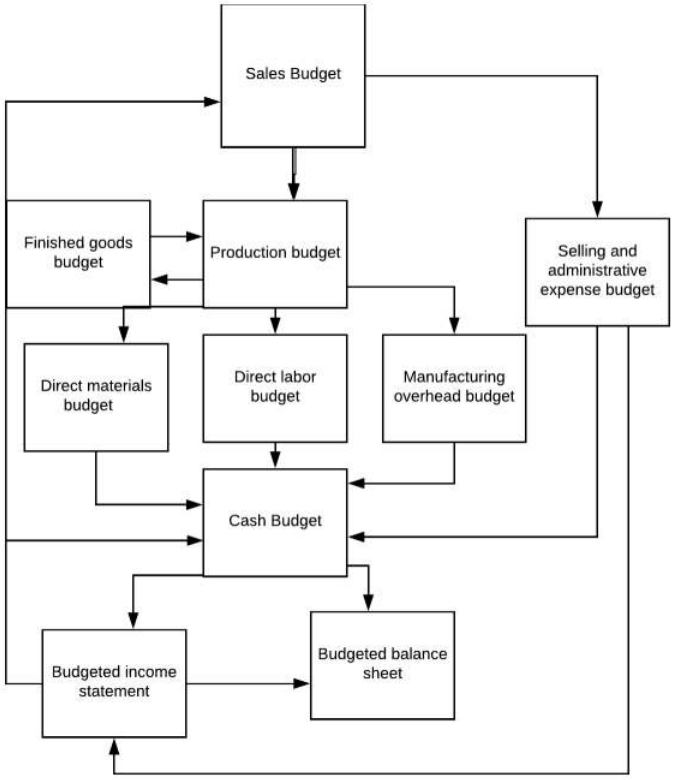
9.24: Components of the Master Budget

Learning Outcomes

- Outline the sequence of components of the master budget

So, the sales budget is the starting point, as we discussed in the previous section. We also discussed some of the other components of the master budget that can happen once we have solid sales numbers to work from.

The components of the master budget interrelate, and it is important to prepare them in order, as information from one component is needed to complete the next! Take a look at this crazy flow chart for a manufacturing business!



So this gives you an overview of how each of the components of the entire budget work together. As a reminder, that this is a master budget for a manufacturing business. Also note, that we would be setting up the budgets in an Excel workbook with a sheet for each budget.

Now let's look at the production budget!

Practice Questions

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CHAPTER OVERVIEW

10: Cost Variance Analysis

10.1: Reducing Material Variances
10.2: Introduction to Labor Variances
10.3: Expected Labor Rate
10.4: Labor Rate Variance
10.5: Reducing Labor Variances
10.6: Introduction to Variable Manufacturing Overhead Variances
10.7: Variable Manufacturing Rate Variances
10.8: Variable Manufacturing Overhead Rate Variances
10.9: Reducing Variable Manufacturing Overhead
10.10: Putting It Together- Cost Variance Analysis
10.11: Why It Matters- Cost Variance Analysis
10.12: Assignment- Cost Variance Analysis
10.13: Introduction to Variance Basics
10.14: Steps of Cost Variance Analysis
10.15: Favorable versus Unfavorable Variances
10.16: Significant Variance
10.17: Introduction to Material Variances
10.18: Material Cost Variance
10.19: Price Variance
10.20: Quantity Variance

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10.1: Reducing Material Variances

Learning Outcomes

- Discuss strategies to limit and reduce material variances

Ben and Mary want to get Ray in the room so they can hash this out. You are the manager and need to get to the bottom of this issue with the material variances.

Most companies create practical material quantity standards, that allow for scrap, spoilage, inefficiencies and rejected material. The situations we have discussed go outside of what is already built in to our budget.

Example

So back to Ben, Mary, and Ray. You, as the manager, need to sit down with these three and get this problem figured out. Let's strategize ways to get closer to our budgeted material quantities.

1. Ben might want to compare the quality of a previous batch of raw materials against the newer batches. Maybe it is a quality issue that needs to be addressed with the supplier. If this is the case, Ben and Mary can work together with the production staff who use the product to outline the problems. Perhaps Ben could get a discount on the raw materials if it was in fact, a lower quality, to help offset the additional costs incurred by the company.
2. Mary can review procedures with the production staff. Mary may need to set some standard procedures, so all employees are doing things in the same way. She may need to spend time on the floor, watching the machines and people work, and noting areas of inefficiency. It might be good to get Ray in on this process as well, just in case there are equipment issues that need to be fixed.
3. Invest in newer or better equipment. This may be an option, if analysis shows that the efficiency of the new equipment will improve processes, reduce material or labor usage, improving the production process overall.
4. Once the potential issues are identified, bring everyone together to discuss the findings, and determine if the material quantities budgeted are accurate, or need to be modified.

Good systems in place from budgeting to purchasing to production are necessary to insure the best quality product is produced at the lowest cost.

Learn More

For another example, take a look at THIS ARTICLE. No matter what the raw material input, managing waste is a big deal. Whether you are buying a $1 component or $100 per pound product, saving money on raw materials will help to improve the bottom line, as long as the quality is good and waste is minimized.

Practice Questions

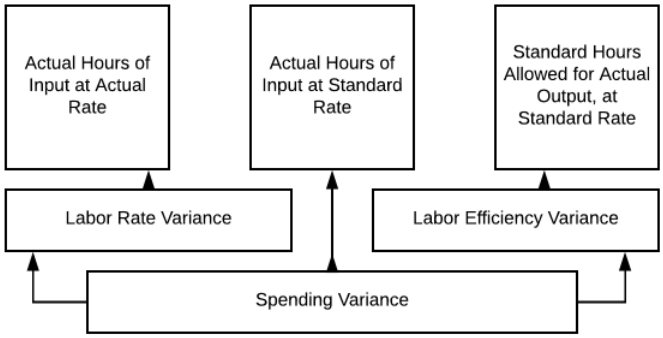
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10.2: Introduction to Labor Variances

What you'll learn to do: Discuss different types of labor variances

Variances in labor, like variances in materials are multifaceted. We might have the same number of hours at a different hourly rate, or more hours at the same rate, or some combination of these factors. Why would the hourly rate vary from budget? Why might the hours change? Let's first look at the standard cost variance analysis chart for labor variances.



At Hupana Running Company, our budget allows for .5 hours of direct labor per pair of shoes produced. The cost of each hour is budgeted at $20 per hour.

If we use more hours at the same rate of pay, it would be called a labor efficiency variance.

If we used the same hours at a higher rate of pay it is called a labor rate variance.

A combination of these may happen as well! We could have fewer hours, but a higher rate of pay. Let's see what difference these variances make in our direct labor budget!

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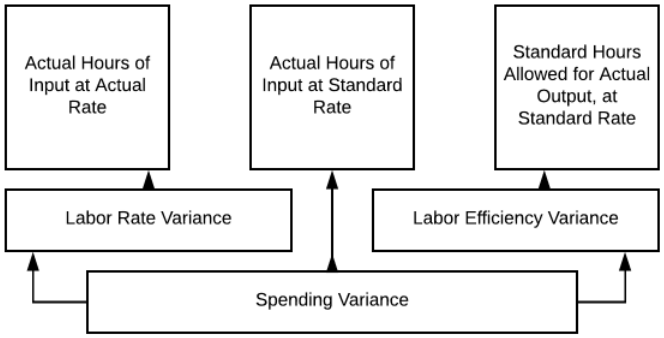
10.3: Expected Labor Rate

Learning Outcomes

- Estimate expected labor costs

The chief financial officer is not happy. Labor is at an all time high, and something needs to give to be able to continue pricing your product competitively in a tight market. You go to your production manager to discuss options for reducing labor, but it seems as if she has the process down, and she can't see a way to reduce the time per pair of shoes to anything lower than it is. Putting on your thinking caps, you work together to go through the process step-by-step, to see if there are ways to decrease the labor time, automate steps or have a lower wage employee complete certain steps. But then you get the news, that your best guy is leaving. Are you ready to take on this task of replacing him?

Take a look at this chart again and then watch this video for a review of variance analysis.



Hupana Running Company has a great direct labor budget prepared by their experienced production manager, Mary. She has production hours down like a well oiled machine. Once she got the sales and production numbers, she prepared her direct labor budget:

	Q1	Q2	Q3	Q4	Total
Required Production in Pairs	450	500	500	600	2050
Direct labor hours-pair	0.5	0.5	0.5	0.5	0.5
Total direct labor hours needed	225	250	250	300	1025
Direct labor cost per hour	$20	$20	$20	$20	$20
Total direct labor cost	$4,500	$5,000	$5,000	$6,000	$20,500

Mary has a great bunch of people working for her and is confident that they can stay on task from a labor perspective. But then she gets the fateful news. Her best machine operator is leaving for another opportunity. She is going to need to replace him, and that won't be an easy task.

Mary interviews a few people, and settles on hiring Jake. He has some similar experience, but the labor market is tight, so she needs to pay him $22 per hour instead of $20. Bringing him on at that rate, requires raises all around, so now, the direct labor cost per hour is $22, an increase of $2 per hour.

How will that affect the direct labor budget? This could cause a couple of things to happen.

1. Your hourly labor rate **will** go up since you are paying Jake more than you were paying the previous operator.
2. You may see a production slow down as Jake learns his new job.
3. You could see a lower employee engagement or satisfaction rate, with the departure of a long-term employee.

How do you handle all of these situations?

Practice Questions

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10.4: Labor Rate Variance

Learning Outcomes

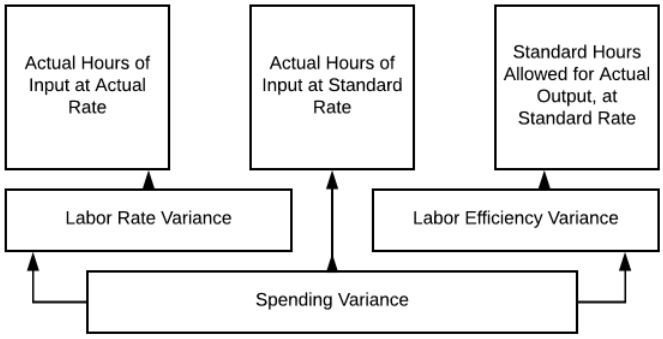
- Analyze the variance between expected labor cost and actual labor costs

So Mary needs to figure out her labor variance with the changes in staffing and wage rate. She is hopeful that Jake will be able to step up to the plate and there won't be any changes in the .5 hours per pair of shoes that she initially budgeted. Here is a quick review of what is included in **direct** labor!

So here is Mary's new direct labor costs:

	Total
Required Production in Pairs	2050
Direct labor hours-pair	0.5
Total direct labor hours needed	1025
Direct labor cost per hour	$22
Total direct labor cost	$22,550

So going back to our chart:



Actual hours of input at actual rate= 1025 × $22 *f*= $22,550

Standard hours of input allowed for actual output at standard rate = 1025 × $20 = $20,000

There is a labor rate variance of $2,550 unfavorable.

So Mary takes this information to her boss, explaining that she was unable to find a qualified employee at the old rate. She also wanted to make sure her staff were happy employees, so she needed to bring them all up to that rate as well. It didn't seem fair to have the new guy making more than her faithful staff. Good management can keep good staff. Mary made a great decision! The decisions we make as managers, may be difficult. Sometimes budgets need to be adjusted, or pricing needs to be changed to continue.

It is always important, as you are starting to see, to look at all options as we work through management decisions. Are we using good materials? Is there more efficient piece of equipment? Do we have properly trained and happy staff members? Let's continue our discussions surrounding labor rates and hours.

So Jake started work, and it isn't going as well as expected. The change in staffing has had challenges. The time it takes to make a pair of shoes has gone from .5 to .6 hours. Mary hopes it will better as the team works together, but right now, she needs to reevaluate her labor budget and get the information to her boss.

Here is what the actual looks like now:

	Total
Required Production in Pairs	2050
Direct labor hours-pair	0.6
Total direct labor hours needed	1230
Direct labor cost per hour	$22
Total direct labor cost	$27,060

So if we go back to our chart on 10.3, we can calculate our labor variance:

- Actual Hours of Input at Actual Rate = 1230 × $22= $27,060
- Actual Hours of Input at Standard Rate = 1230 × $20= $24,600
- Standard Hours Allowed for Actual Output at Standard Rate = 1025 × $20 = $20,500

So our labor **rate** variance is $27,060 − $24,600 = $2,460 **unfavorable**

- Actual Hours of Input at Standard Rate = 1230 × $20= $24,600
- Standard Hours Allowed for Actual Output at Standard Rate = 1025 × $20= $20,500

So our labor **efficiency** variance is $24,600 − $20,500= $4,100 **unfavorable**

Our Spending Variance is the sum of those two numbers, so $6,560 **unfavorable** ($27,060 − $20,500).

Mary is **not** excited about taking this information to her boss, but what can she do?

So as we discussed, we can analyze the variance for labor efficiency by using the standard cost variance analysis chart on 10.3.

Mary's new hire isn't doing as well as expected, but what if the opposite had happened? What if adding Jake to the team has speeded up the production process and now it was only taking .4 hours to produce a pair of shoes? Let's examine this situation further.

Even with a higher direct labor cost per hour, our total direct labor cost went **down**! Let's take that apart.

- Actual Hours of Input at Actual Rate = 820 × $22= $18,040
- Actual Hours of Input at Standard Rate = 820 × $20= $16,040
- Standard Hours Allowed for Actual Output at Standard Rate = 1025 × $20= $20,500 (our original budget)

So now, our labor rate Variance = $18,040 − $16,040= $2000 **unfavorable**

(NOTE: We are still paying more per hour than budgeted)

Our labor efficiency variance = $16,040 − $20,500 = $4,460 **favorable**

And our overall spending variance = $2,460 **favorable**

We are still spending **less** on labor, even at a higher rate per hour, so our overall variance is favorable. Now Mary is a happy production manager!

Practice Questions

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10.5: Reducing Labor Variances

Learning Outcomes

- Discuss strategies to limit and reduce labor variances

So Hupana had some ups and downs with the transition to hiring Jake and getting their systems back in place. There are many things that can contribute to labor variances, and figuring out first the "why" and then the "how do we fix this?" can have multiple components. Mary works hard to keep her staff happy and well-trained. But when a long-time employee leaves, it can ripple throughout the company. Let's look at some ways Mary, and the rest of the management staff at Hupana, can work to keep labor variances to a minimum.

How can Mary limit and reduce labor variances? Mary has done a pretty good job with her staff. Let's look at some of the ways she has helped to keep her labor costs on track:

1. Proper training of all staff, but particularly **new** staff to make sure they are efficient at their jobs!
2. Keeping up morale of her staff to insure they feel happy and valued within the company!
3. Insure that equipment is maintained and working at peak efficiency (Mary may need to work with Ray on this one. Remember Ray?)
4. Make sure the raw materials the employees are working with are of good quality. This falls back to the purchasing department to insure quality materials!
5. Proper supervision
6. Inaccurate or unattainable standards. Unfortunately, if the production department did not have some control over the preparation of the direct labor budget, the goals that were set up may not even be feasible. Getting the people who do the work involved in the budgeting process, which we discussed earlier, is a great way to help your staff feel part of the team!

Another situation that may lead to an unfavorable labor variance in the short run, is a lack of market for a company's products. What if suddenly, the market for Hupana shoes dropped by 20%? What if we also thought this would be a temporary drop? Would it be wise to let go of employees, or might it be favorable in the long run to keep employees busy on other tasks, to keep up company morale? This can be a tough question, and one that companies need to address. Another way to keep employees busy during this type of slump in sales may be to build up inventory.

There are a myriad of ways to limit or reduce labor variances. Can you think of any others?

Practice Questions

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10.6: Introduction to Variable Manufacturing Overhead Variances

What you'll learn to do: Discuss the variable manufacturing overhead variances

Remember back when we figured out our manufacturing overhead budget? It seems like a really long time ago, but here we are, back looking at that information again!! Just a reminder of how important the budgeting process is. We have used those pesky budgets during every step of the variance calculation process.

So guess what? One more standard cost variance analysis for variable manufacturing overhead!

Take a look at this video for a review of flexible budgeting, and calculating variances.

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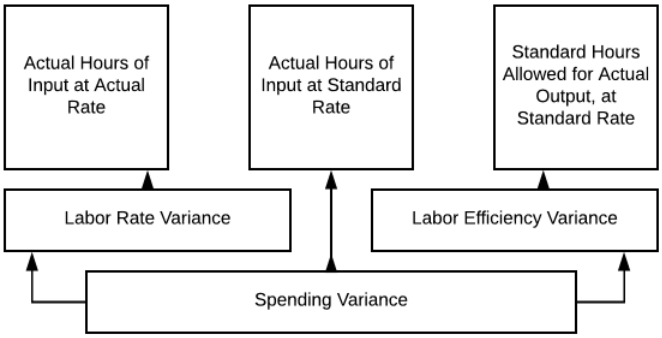
10.7: Variable Manufacturing Rate Variances

Learning Outcomes

- Analyze the variance between expected variable manufacturing overhead cost and actual variable manufacturing overhead costs

As a manager in the accounting department, you have been tasked with determining the overhead rate for your manufacturing department. This information is important, as when you price your product or bid jobs, if you don't include the cost of things like electricity and rent and depreciation on your equipment, you will be underpricing your stuff! Let's take a look at an explanation of the **why** and **how** to calculate the variable manufacturing rate and understand why it is so important! Then we will talk about when this number **varies** from what we had originally calculated.

So we are again looking at two components: The manufacturing overhead **rate** variance and the manufacturing overhead **efficiency** variance. The rate variance happens when there is a change in the components of the variable hourly rate.



A rate variance may occur if the cost of one of the components of this rate goes up. An example might be the cost of the needles for the machines that sew together the shoes, or a steep hike in the electricity rate.

A difference in the efficiency rate occurs when it takes more hours than budgeted to manufacture the budgeted number of pair of shoes.

We figured out our expected variable manufacturing overhead for Hupana Running Company back when we were working on our master budget. Here is a reminder for you!

Since we already figured out our variable rate in a previous unit (remember, it was way back when we were working on our master budget), we can use this number in our calculations.

So Mary, our production manager, has noticed an increase in the cost of some of the supplies that go into the manufacturing of our shoes. Apparently, there is a thread shortage, and our supplier has raised the price. That, along with more needles breaking in the machines, has raised our variable overhead cost from $3 per hour to $3.25 per hour. Let's take a look at how that may affect our variable overhead cost for Hupana:

Here is our budget:

	Total
Budgeted direct labor hours	1025
Variable manufacturing overhead rate	$3
Variable manufacturing overhead	$3,075

And here is what actually happened:

	Total
Budgeted direct labor hours	1025
Variable manufacturing overhead rate	$3.25
Variable manufacturing overhead	$3,331.25

So you can see, this change has caused an increase in our variable manufacturing overhead. This is a **rate** change, so let's analyze it using what we know. (You can refer back to the diagram on 10.4 if needed)

- Actual Quantity of Input at Actual Cost = 1025 × $3.25 = $3331.25
- Actual Quantity of Input at Standard Cost= 1025 × $3.00 = $3075.00
- Price Variance = $3331.25 − $3075.= $256.25 **unfavorable** variance. We spent **more** than anticipated.

So, if the direct labor hours remain the same, our **spending** variance will be $256.25—**unfavorable**. So, a reduction in the variable manufacturing overhead rate would create a **favorable** price variance.

So, a **rise** in the variable manufacturing overhead rate will cause an **unfavorable** variance in the price variance. But might that be a good thing? It could, if the increase in price causes a corresponding increase in efficiency!

Practice Questions

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10.8: Variable Manufacturing Overhead Rate Variances

Learning Outcomes

- Analyze the variance between expected variable manufacturing overhead efficiency and actual variable manufacturing overhead efficiency

In our previous discussion, we talked about how even if the price of a component of our variable manufacturing overhead is higher, it **might** actually cause our spending variance to be favorable. Sometimes, higher quality of input creates such a time savings that it is a good thing. Of course the opposite could be true. Remember back when we talked about direct labor and direct materials, cheaper is not always better. If a savings on one component of our costs causes additional costs in another area, we need to examine what the best course of action would be. So let's go back to Mary at Hupana and her new needles and thread!

So now, what happens if Mary notices that the needles and thread we are buying, even though they cost more, are actually creating better efficiency, thus lowering the time it takes to make our amazing shoes? She has been doing a time tracking system, and noticed that rather than 1025 hours that were budgeted, it is now only taking 928 hours to make the same number of shoes! This is awesome news, so let's see what the numbers look like.

	Total
Budgeted direct labor hours	928
Variable manufacturing overhead rate	$3.25
Variable manufacturing overhead	$3,016.00

So remember our budgeted amount of variable manufacturing overhead was 1025 hours at $3 per hour for a total cost of $3075. Let's analyze the change.

- Actual Hours of Input at Actual Rate = 928 × $3.25= $3016
- Actual Hours of Input at Standard Rate = 928 × $3= $2784
- Standard Hours of Input allowed for Actual Output at Standard Rate= 1025 × $3= $3075

So with that information the **price variance** can be calculated as follows:

- Actual Hours of Input at Actual Rate= $3016
- Actual Hours of Input at Standard Rate= $2784
- So we have a PRICE variance of $3016 − $2784= $232 **unfavorable** (we spent **more** per hour than budgeted)

But look at the **efficiency** variance:

- Actual Hours of Input at Standard Rate = $2784
- Standard Hours of Input Allowed for Actual Output at Standard Rate= $3075

So we have an **efficiency** variance of $3075 − $2784= $291 **favorable** (We spent **less** total that we budgeted)

Our overall **spending variance** can then be calculated at $3075 − $3016= $59 **favorable**.

So the takeaway here is, the product may **cost** more, but if it increases **efficiency** the extra cost may be worth it! The cheapest product does not always bring us the best outcome!

Practice Questions

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10.9: Reducing Variable Manufacturing Overhead

Learning Outcomes

- Discuss strategies to limit and reduce variable manufacturing overhead variances

So how can Mary insure that the spending variance is minimized for her variable manufacturing overhead? There are a few good ways to make this happen. You may notice some similarities here between reducing labor, materials and overhead variances. They all work together to create the best scenario for the business budget!

1. Make sure to get **high quality** supplies! Spending more is not always a bad thing. If buying the good stuff reduces the **time** to produce the product, then it is worth the extra expense.
2. Train your employees well and continue the training process. Less waste and higher efficiency will keep your variable manufacturing overhead low!
3. Be a proactive manager. If you start to notice a "creep" in the time it is taking to manufacture your product, take notice! Talk with the employees involved in the process and get their input. The people actually working on the manufacturing process are invaluable resources! They may be able to offer valuable insight into why it may be taking longer or costing more to manufacture your product.

Managing costs is a big job! It takes the whole team, working together to make good decisions. Engage the team in the budgeting process and then keep them involved!

So, as you can see, the calculation of the variances is just step **one** in the process. Once we have determined our variances, we need to **look** at each one and see how we can minimize, reduce or eliminate those variances. Keeping the business profitable is the key! As a manager, you may be held responsible for part of this process. Let's look at some potential problems, and how, as a manager, you may create solutions!

Remember when Mary was having materials issues? What happens when the **cost** of the materials rose, but the time to make the shoes stayed the same? What are some ways Mary may need to work to solve this variance?

1. If the cost of materials increases due to market increases, it may be necessary to look at ways to streamline the production process to reduce production time.
2. It may be possible that we, as a company, need to **rethink** pricing! If the cost of materials is rising, and we don't see the pricing going back, raising the **price we charge** for our shoes might be the only option.
3. Mary may need to talk with the purchasing department, and see if it is possible to find alternate sources for our raw materials.

So what about additional production time? Remember when Mary needed to hire a new employee? Jake had skills, but the process was still taking longer than budgeted to make each pair of shoes. What steps can she take to get back on budget?

1. **Train, Train, Train.** Additional employee training, effective onboarding of new employees and practice are all necessary to get new employees up to speed. Make sure as well to have a good team environment, where existing employees are involved in the training and onboarding process.
2. **Listen to your employees.** Are the raw materials of a quality to limit waste? Are the machines kept in good working order? Is there a cog in the wheel of production that isn't working well? Maybe it is taking to much time to get materials from the warehouse to the production floor. Or perhaps one machine, in the middle of the process is slowing things down. It cannot be stressed enough, how important listening to the people who do the work is!
3. **Have you set unreasonable expectations?** Sometimes, the budgeted amount of time isn't reasonable. If your staff is trying to meet an expectation that isn't reasonable, it could actually increase your costs by creating waste or even causing injuries! Make sure the budgeted time aligns with historical data and **again**, that you have involved your staff in the budgeting process. Time studies (evaluating through tracking) may be needed here to really get a handle on preparing your time budget.

So, again, getting the numbers is the beginning. Evaluating the numbers to improve costs, production time and profitability is the goal!

Practice Questions

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10.10: Putting It Together- Cost Variance Analysis

So in Module 9 we prepared the budgets for Hupana Running Company. In Module 10, we put those budgets to work, as Mary, our production manager and Ben, our purchasing manager worked through a variety of issues and challenges to maintain profitability.

So, as you may now see, the budget is the **first** step of a very important process. Without using experience and analysis, the budget is just a piece of paper. What we do with that piece of paper, and how we use it to improve our company is the goal.

How can we make that happen?

- Finding the best raw materials at the best price (even if it is higher than budgeted, but reduces production time).
- Hiring great people and training them well. Keeping them involved in the processes of budgeting and analyzing. They **know** what they do and how they do it!
- Maintaining the equipment to limit downtime.
- Using the budget as a living tool, that we can use to evaluate the health and profitability of our company!

So how important is analyzing costs, processes and systems?

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10.11: Why It Matters- Cost Variance Analysis

Why learn about cost variance analysis?

Budgeting is step one of the process of effectively running a profitable business. After we get the budget ready, it is time to analyze the actual costs, time and efficiency! In this unit, we will be going back to the budget we created for Hupana Running Company and analyzing how different changes affect the profitability of the company.

Small changes, such as an increase in our raw materials, or needing to hire new employees can have a profound effect on our budgeted numbers, requiring you, as the manager, to evaluate and analyze to find ways to keep costs in line!

Sometimes, we have to make hard decisions. We will talk about some of those as we work through this module. We will also discuss ways we need to work as a team to find solutions to those problems.

Variance analysis helps us to see where we need improvement, where we are doing well, and allows companies to become or remain profitable.

Let's jump in and see how our team at Hupana analyzes and corrects potential variances from their budget!

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10.12: Assignment- Cost Variance Analysis

Read the following scenario and complete the questions below.

The entire poultry industry is working hard to keep up with demand, but egg production is falling behind. According to the USDA's Economic Research Service, the price of eggs in the U.S. is expected to rise more than 35 percent in 2018. The cause of this egg price increases? An uptick in foreign demand for US eggs is partly to blame. When the avian influenza devastated Europe this past year, egg suppliers in the U.S. stepped in to help fill the demand in these countries. Another problem arose in late 2017 where some egg supplies were contaminated with a dangerous insecticide, affecting countries including Germany, France and Belgium. With millions of eggs being pulled from the shelves in Europe, US exports of eggs rose 663 percent between 2016 and 2017. Domestic demand has increased as well. In the United States, 2017 saw a 20-year record in egg consumption at 275.2 eggs per person per year. When you multiply that by 325 million Americans, that's a lot of eggs.

Now, consider the commercial use of eggs in the production of grocery items such as bread, ice cream, pasta, cakes and waffles. Let's focus on the Sara Lee® All Butter Pound Cake® found in the freezer section of your local grocery store. The first ingredient listed on the package is, you guessed it – eggs. The pound cake sells for around $3.97 at the grocery store. However, with the price of eggs on the rise, it is likely that $3.97 price may change.

1. Which of Sara Lee's variances will be affected by the increase in egg prices? Why?
2. Will the increase in egg prices result in favorable or unfavorable variances for Sara Lee? Why?
3. What is Sara Lee® likely to do to its standards based on this increase in price and which standards will be impacted?
4. What, if anything, can Sara Lee® do to mitigate the impact of the rising cost of eggs on its manufacturing costs?

This assignment is available for download as a Word Document.

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10.13: Introduction to Variance Basics

What you'll learn to do: Discuss the basic principles of cost variance analysis

In our last unit, we started to discuss the flexible budget variances. This process helps us to understand how well our company performed, based on budgeted numbers. When we look at revenue or spending variances, or how different our actual revenue and costs were from our budgeted, we can then start to analyze how well revenues and costs were controlled with that actual revenue and expense information.

So in our Simply Yoga example, when utilities went up with the additional class offerings, it may be that we were not effectively scheduling classes, or it may be that students want those options. In either case, we will need to look at how costs are affected by the various cost drivers, and how to best minimize these variances to run the business profitably.

In our Hupana Running Company budget, we set benchmarks and goals based on historical data. We will be using their budget to do cost variance analysis on materials, labor and variable manufacturing overhead.

We will discuss standards, which are our benchmarks for measuring performance. We will also look at the steps needed to effectively calculate our variances and use the information to improve company performance.

Let's get started with the four steps to simple cost variance!

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10.14: Steps of Cost Variance Analysis

Learning Outcome

- Identify the four steps of simple cost variance analysis

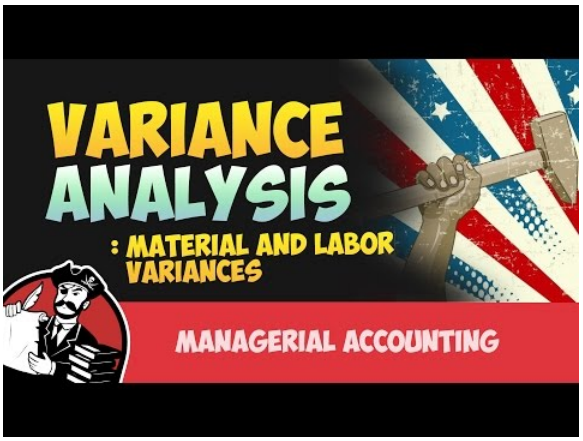
As sales manager, you submitted your expense report, which was 20 percent more than budgeted. As you review your report, you note for your supervisor that you went on 100 sales calls rather than 75 as were originally budgeted. As you further investigate the difference, you notice that your mileage was budgeted at 1000 miles, but you actually ended up driving 1500 miles. While doing this analysis you see that although you completed more sales calls, you may have been more efficient with setting up your schedule to reduce the mileage driven. This would have saved a substantial amount for your company and gotten you much closer to your budgeted amount. As you put together this analysis, you include a note with your expense report, letting your supervisor know your plan to get your costs more in line with your next expense report! Did you properly take all four steps in the process? Will this help to improve your ability to meet your budget going forward?

So cost variance analysis will help us to understand how well our costs were controlled compared to our budgeted numbers. There are four steps involved in this process:

1. Calculate the difference between what we spent and what we budgeted to spend.
2. Investigate why there is a difference.
3. Put the information together and talk to management.
4. Put together a plan to get costs more in line with the budget.

Let's start with calculating the difference. In our Simply Yoga example, our planned number of classes taken was 500. In reality, we had 600 people through the doors. Our labor was higher than budgeted, by $700, which was considered an unfavorable variance. What happens when we investigate that difference?

Some examples may be helpful as you begin to navigate variance analysis:



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Our revenue was higher, due to more classes taken, so the additional revenue more than offset the addition to our labor. When we put that information together to offer to management, how would you proceed? In this case, we really just need to let them know, that we had more classes than we budgeted, so it makes sense and we really don't need to do anything, right?

But what about when the classes taken remained stable? We were offering **more** class opportunities, but had the same number of students through our door. So now how do we put the information together? Here is the information again, so we can figure out our strategy!

Classes taken	500	500
Number of classes offered	20	50
Revenue ($14/class)	$7,000	$7,000
Expenses		
Wages and salaries ($7/person or $84 class)	$3,500	$4,200
Yoga supplies	$250	$300
Utilities (300+$10/hour)	$500	$800
Rent	$500	$500
Insurance	$100	$100
Other Expenses	$250	$300
Total Expense	$5,100	$6,200
Net Operating Income	$1,900	$800

Let's walk through the four steps.

1. The difference in wages from what we budgeted to spend ($3,500) and what we spent ($4,200) is $700.
2. This difference occurred, because we ended up offering 50 class opportunities, rather than the 20 we had budgeted, but fewer people attended each class. Because of our $84 per class minimum wage per class, our wages were higher, but our revenue remained the same.
3. We put together the information for management, and let them know that we offered more classes than were budgeted, but did not increase participation. We just had fewer people in each class.
4. How could we fix this? We could take classes off the schedule, intending to funnel more people into each class offered. We could also remove the $84 per class minimum wage per class, and simply pay the instructors $7 per participant. So an instructor could only be compensated $14 for a class if only two students showed up.

What route might you take in this example? Fewer class opportunities could backfire and you may have fewer students overall. But changing the compensation plan may lower morale among the instructors. These can be tough choices!

Practice Questions

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10.15: Favorable versus Unfavorable Variances

Learning Outcomes

- Differentiate between favorable and unfavorable variances

Favorable and unfavorable variances can be confusing. As a manager at a local movie theatre, you notice the expense for popcorn was way higher than budgeted, causing an unfavorable variance in that expense line. But, you also see a much higher revenue line for popcorn! So, the revenue variance is favorable. How can you calculate whether the increase in expense and the increase in revenue make sense?

Let's go back now to our Simply Yoga example. Remember we have some variances we identified as favorable, and some unfavorable. Here is the flexible budget as a reminder:

Simply Yoga Flexible and Planning Budget

	Planning Budget	Flexible Budget	Activity Variance	Favorable or Unfavorable
Classes taken	500	600		
Revenue ($14/class)	$7,000	$8400	$1400	Favorable
Expenses				
Wages and Salaries	$3500	$4200	$700	Unfavorable
Yoga supplies	$250	$300	$50	Unfavorable
Utilities	$500	$600	$100	Unfavorable
Rent	$500	$500		
Insurance	$100	$100		
Other Expenses	$250	$300	$50	Unfavorable
Total Expense	$5,100	$6,000	$900	Unfavorable
Net Operating Income	$1900	$2400	$500	Favorable

Favorable variances are defined as either generating more revenue than expected or incurring fewer costs than expected. Unfavorable variances are the opposite. Less revenue is generated or more costs incurred. Either may be good or bad, as these variances are based on a budgeted amount.

As an example, when Simply Yoga had more students attend classes, their wages and salaries line went up, creating an unfavorable variance. As you can see, their revenue was substantially higher, so that favorable variance more than offsets the unfavorable variance of the additional wages!

So you can see here, that Simply Yoga showed some unfavorable variances in their expenses, but had an overall favorable change in their net operating income! So favorable or unfavorable variances don't mean much if you look at them individually. We need to look at the whole picture!

If the number of classes had remained at 500, and we still saw the increase in wages, there would be more cause for concern., right? But, what if the wages had gone up, **more** than the increase in revenue? Each favorable and unfavorable variance needs to be examined individually, as noted in the popcorn example in the video! Analysis is the key to making sure that increases (favorable variances) in revenue or increases (unfavorable variances) in expenses are appropriate.

We need to review what would be the expected increase in expense, based on the increase in classes, or popcorn sales or item sales. In the Simply Yoga example, for each $14 increase in revenue (one additional class taken), we would expect a $7 increase in payroll expense, since we pay our instructors $7 per student for each class taken. If we would have seen a different increase in expense, it would have been cause for concern, and further review. Thinking back to our example, where each instructor is paid a minimum of $84 per class (12 students), if we had increased our number of classes, thus more classes were attended, but each of those classes was only getting 8 students, we may have seen the following:

10 additional classes x 8 students each	$1,120 additional revenue
10 classes x $84/instructor	$840 additional payroll expense

We would have **expected** and additional $560 in payroll expense, so we have an **unfavorable** variance of $280 of additional expense, even adjusting for the additional revenue.

In this case, we would need to examine which classes we would like to keep on the schedule, and which to eliminate. More decisions will need to be made with this new information!

Practice Questions

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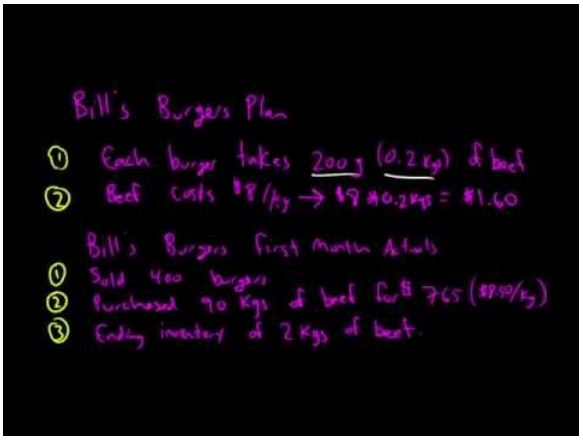
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10.16: Significant Variance

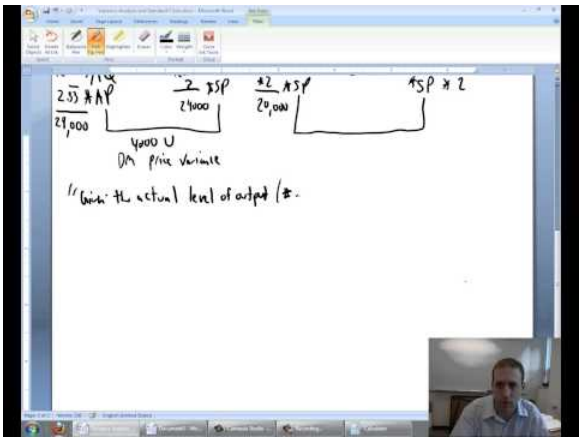
Learning Outcomes

- Determine if a variance is significant

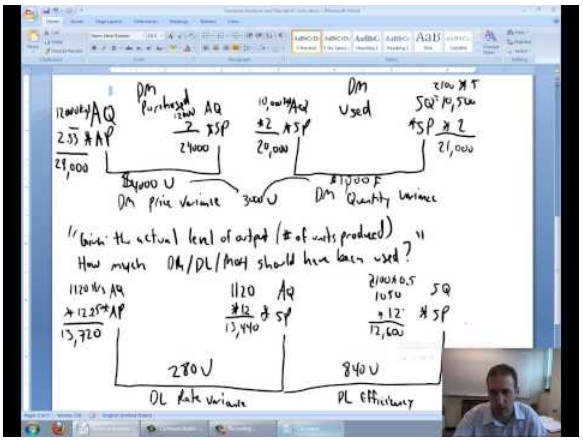
How do we know if a variance is significant? Looking at history can be a good start. Let's take a look at some examples and review variance analysis:



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You might want to save these videos to favorites as we will be working with them again in the next few learning outcomes!

Now back to our old standby. What if Simply Yoga had the following information available to you?

- **2010:** Sales $7000, wages $3500
- **2011:** Sales $7000, wages $3400
- **2012:** Sales $7000, wages $3600
- **2013:** Sales $7000, wages $5000

What do you notice? Would you consider the wage variances between 2010 and 2012 to be significant? What about 2013? With stable sales, each variance would need to be examined to insure that payroll was prepared correctly, but the variance in 2013 when comparing wages year to year is significant. This could happen if there was a teacher shortage, and a higher wage was needed to get enough staff. Can you think of any other reasons that a wage difference this significant might happen?

Let's look at another example with our old friends at Hupana Running Company:

Hupana Running Company's direct labor information is as follows:

Year	Direct Labor Budgeted	Direct Labor Actual
2010	$20,500	$20,400
2011	$21,000	$21,155
2012	$22,000	$28,500
2013	$23,000	$23,900

Which years would you not worry about from a variance perspective and which would be of concern?

When we look at various years, we can see that small variances happen. It might relate to unanticipated overtime in the case of small unfavorable variances or a particularly quick worker in the case of small favorable variances. But look at 2012. This is a variance that needs to be investigated. Maybe there was a machine breakdown that left employees standing around for a week, or perhaps high turnover led to a period of time needed to train new employees, thus slowing production.

What is another answer for the higher labor in 2012? We don't see a very important number that could help answer this question: **sales**. What if we had a banner year, and sales were through the roof? Then this variance makes perfect sense.

Whatever the case, it is important to look at history and determine if a variance is significant or a normal variance.

Practice Questions

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10.17: Introduction to Material Variances

What you'll learn to do: Discuss different types of material variances

As the production manager at Z-Corp, a manufacturer of computer circuit boards, you are reviewing your direct material costs and notice a variance in the amount spent this year compared to the budgeted amount. Your manager is concerned about this increase and has asked you to analyze it to find out what has happened. You check in with your purchasing department to get some information, and find that not only did you purchase a higher quantity of one particular component for your boards, but strangely, the price for this component was lower than you had budgeted. How could this happen? Your purchasing department purchased at a lower price, but ended up needing to order a larger quantity?

Let's look at some scenarios and examples of how these types of variances might occur, and what we can do to fix the problem.

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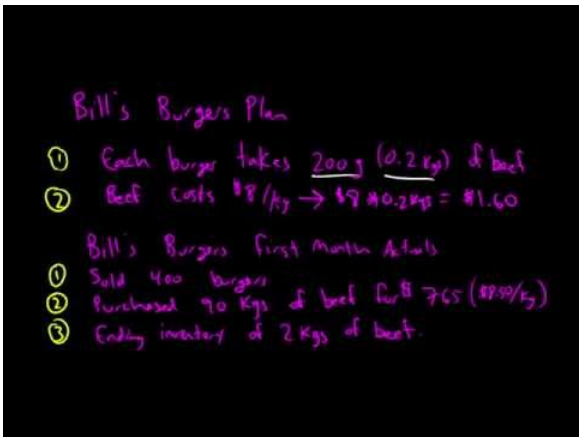
10.18: Material Cost Variance

Learning Outcomes

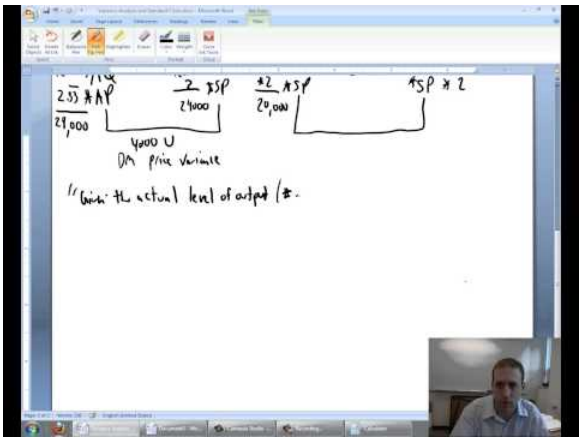
- Analyze the variance between expected material cost and actual material costs

So let's head back to our Hupana Running Company and review their raw materials by cost and quantity to see where differences might occur, and how we calculate spending variances or quantity variances. Both are important and are used to calculate the overall spending variance.

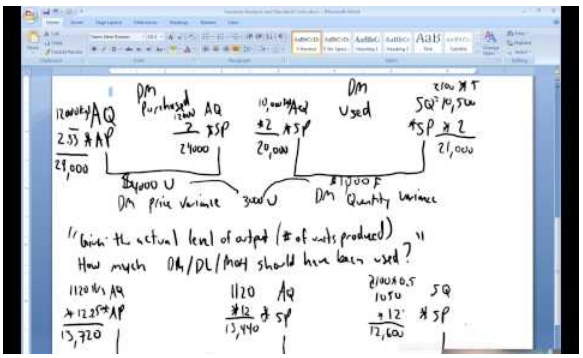
You might want to revisit these video tutorials before we get started here!

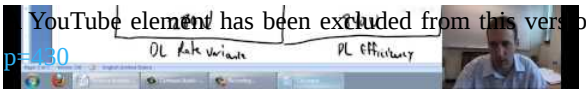


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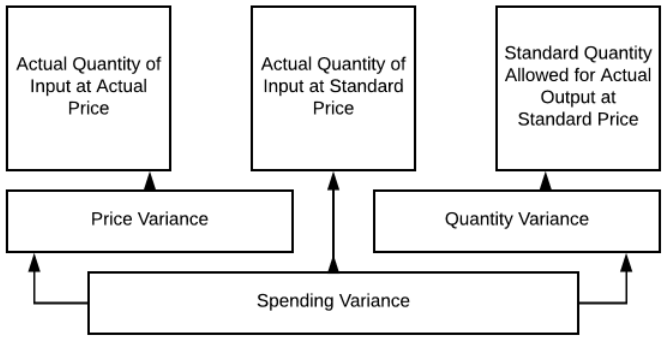
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Material variance can vary based on material quantity, material cost or both. Standard cost variance analysis for direct materials can be shown like this:



So we will use this chart to look at some different scenarios for Hupana Running Company. Our original direct materials budget calls for 10,250 units of raw materials at $2 per unit to meet our manufacturing requirements. So, we budgeted to spend $21,000 on our raw materials (we wanted a little beginning inventory for the new period!!). What happens if the price, quantity or both change?

When we talk about expected material costs and actual material costs we need to consider a couple of factors. First, there is the quantity of material that goes into each unit. Then there is the cost per unit of material. These two pieces of information are important to consider when analyzing the variance between expected and actual material costs.

Let's go back to Hupana Running Company. Their direct material cost budget is as follows:

	Total
Required production in pairs	2050
Units of raw material needed per pair	5
Units of raw material needed to meet production	10250
Plus desired ending raw material inventory	500
Total units of raw materials needed	10750
Less units in beginning raw material inventory	250
Units of raw materials to be purchased	10500
Cost of raw material per unit	$2
Cost of raw material to be purchased	$21,000

Keeping the required production in pairs at 2050, What would happen if there was a ton of waste in production and we used 7.5 units of raw material per pair, instead of 5?

	Total
Required production in pairs	2050
Units of raw material needed per pair	7.5
Units of raw material needed to meet production	15375
Plus desired ending raw material inventory	500
Total units of raw materials needed	15875
Less units beginning raw material inventory	250
Units of raw materials to be purchased	15625
Cost of raw material per unit	$2
Cost of raw material to be purchased	$31,250

This results in a change in **quantity** of product, but the price remains the same. So using our chart from 10.2, we can calculate as follows:

- Actual quantity allowed for actual output at standard price = 10,500 × $2= $21,000
- Actual quantity of input at actual price = 15,625 × $2 = $31,250

So our spending variance is $10,250

We now have spent $31,250 on our raw materials, when we had budgeted $21,000. Waste, scrap, production issues or improper training could all have been at fault for this variance issue. This definitely needs to be reviewed.

So, what would happen if the **cost** per unit of input went down to $1.25, but our waste remained high?

Now we would still need to purchase 15,625 units, but at a cost of $1.25/unit so $19,531.25 would be our total spent on direct materials. Now the variances become more clear, right?

We purchased **more** units, but at a **lower** price. So we had a quantity variance **and** a price variance. There can be **either** a price variance or a quantity variance, but there can also be a combination that creates the spending variance.

Taking this information to management might be a bit uncomfortable if the first scenario happens, right? Do your homework before putting together your report. Check with your production manager and see if she can shed some light on the problem. But, in the second scenario, the lower price per unit compensates for the additional units used!

Whichever direction this takes, you may find your production department laying blame on the purchasing team for buying substandard product. The purchasing team might blame production for sloppy work! You may need to do some sleuthing to figure this one out!

Practice Questions

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10.19: Price Variance

Learning Outcomes

- Analyze the variance between standard unit price and actual price of materials purchased

You own a woodworking shop and have figured out a price you will pay and how many pounds of wood you will need to make tables. What happens if you use more or less wood, or it costs more or less than you budgeted at standard price and quantity?

What might cause a variance between the standard unit price and the actual price? Quality of product purchased, market issues including unavailability of product or competition for the same materials could all be factors here. Let's look at a couple of examples.

So what if we go back to our original budget, our total raw material cost should be $21,000, but when we compare to the actual, we see this:

	Total
Required production in pairs	2050
Units of raw material needed per pair	5
Units of raw material needed to meet production	10250
Plus desired ending raw material inventory	500
Total units of raw materials needed	10750
Less units in beginning raw material inventory	250
Units of raw materials to be purchased	10500
Cost of raw material per unit	$3
Cost of raw material to be purchased	$31,500

Now we can calculate our variance as follows:

- Standard quantity allowed for actual output at standard price = 10,500 × $2 = $21,000
- Actual quantity of input at actual price = 10,500 × $3= $31,500

Creating a spending variance of $10,500.

So now, our units remained the same at 5 per pair, but our **cost** went up by $1 per unit! So our production department did good work, but perhaps our purchasing department either had problems finding the raw material and had to pay a higher price, **or** they may not have done proper negotiating with suppliers!

How would you go about providing this information to management? What things might you do to fix these problems?

Practice Questions

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10.20: Quantity Variance

Learning Outcomes

- Analyze the variance between the expected amount of materials purchased and the actual amount of materials purchased

You are the purchasing manager at a large tent manufacturer. Your production manager just walked in your office fuming! “What is this fabric you are buying? We are using twice as much per tent as we budgeted for, and labor is going to be through the roof!” You had gotten a deal on the fabric, but it was the same quality you had always been buying, so you tell the production manager, “the fabric is fine. It must be a lack of training on your production floor!” The CEO walks in to mediate the problem. Is it a quality problem? A training problem? An equipment problem? How do we know? This is a common issue that may come up in the manufacturing environment.

Take a look at this video for further examples:



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In our previous examples, we **expected** to purchase 10,500 units of raw materials. When we purchase an amount different from our expected amount we call it a material yield variance. This can happen for a variety of reasons:

1. We buy **more** because the quality is low and we have waste or production scrap.
2. We buy **less** because the quality is high and we have less waste and scrap.
3. We buy **more** because there are production issues.
    1. Poor training of production workers.
    2. Problems with the production equipment causing waste.
    3. New workers who are just learning their job, so a learning curve produces more waste.
4. We buy **less** because of production issues.
    1. Our production workers are experienced and know how to make the best use of the materials.
    2. Our production equipment was upgraded recently giving a better yield than the old equipment.
    3. We invest in training employees and get ideas from them to improve production processes.

What else can you think of that may create a material yield variance? Who do we look at when we need to buy **more**?

Example

Let’s look at an example:

> Mary, Production Manager: We needed more raw material because the quality of the last batch was terrible. There was waste, and we couldn’t even use parts of it. It is Ben—Purchasing Manager—fault.

Ben, Purchasing Manager: There is nothing wrong with the raw materials we brought in. We ordered from the same supplier, and it is the same you have been getting all along. You just aren't training your workers well, and they are creating the waste.

Mary, Production Manager: Wait, the machines have been breaking down a lot, and we have to scrap material every time it shuts down. It is Ray—the Maintenance Manager's—fault.

Ben, Purchasing Manager: Yes, let's get Ray in here. It is his fault we have needed to purchase more raw materials for production.

Well that got out of hand fast! Poor Ray hasn't even had a chance to defend himself! How might you tackle this situation?

Practice Questions

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CHAPTER OVERVIEW

11: Relevant Revenues and Costs

11.1: Make or Buy Decisions
11.2: Special Order Decisions
11.3: Introduction to Constrained Resources
11.4: Constrained Resource
11.5: Putting It Together- Relevant Revenues and Costs
11.6: Assignment- Relevant Revenues and Costs
11.7: Why It Matters- Relevant Revenues and Costs
11.8: Introduction to Cost Types
11.9: Differential Cost
11.10: Avoidable Costs
11.11: Sunk Costs
11.12: Opportunity Costs
11.13: Analyzing Costs
11.14: Introduction to Relevant Costs
11.15: Add or Drop Decisions

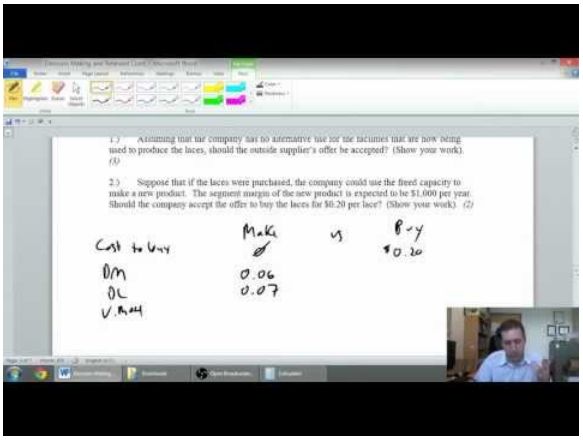
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11.1: Make or Buy Decisions

Learning Outcomes

- Identify the data needed to support a make or buy decision

So we talked previously about a make or buy decision with Hupana and the soles of their shoes. Sometimes a second example is helpful, so let's take a look at another shoe company! Snazzy Jazzi is thinking about buying laces for their shoes instead of making them. Let's take a look at their decision making process:



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Let's revisit our Hupana scenario:

Hupana currently buys the soles that go on their awesome running shoes from a supplier premade and ready to attach to their shoes. The supplier is charging $5.00 per sole. Hupana wants to look at the option of making the soles in house, because they have some empty space in their building, that would be a perfect fit for the equipment needed to make the soles. Just to make this simple, let's assume Hupana already owns the equipment to make the soles.

We know that Hupana makes 2,000 pairs of shoes per year. So they pay their supplier $10,000 for the premade soles.

Let's take a look.

Hupana Make or Buy Decision		
	Relevant Costs: Make	Relevant Costs: Buy
Direct Materials ($2.50 per sole × 2000 soles)	$5,000.00	
Direct Labor (.1hr/sole at $20/hour)	$4,000.00	
Variable Overhead (.1hr/sole at $3/hour x 2000 soles)	$600.00	
Depreciation of equipment (not relevant)		
Allocation of fixed overhead (not relevant)		
Cost of buying		$10,000.00
Total cost	$9,600.00	$10,000.00
Difference in favor of MAKING	$400	

So if the space we would use to make the soles is sitting idle right now, then, this analysis would suggest we should start to make the soles in house, right?

But what if the space used to make the soles, could also be used to expand to add another line of shoes? And what if, that additional line of shoes would add $5000 to the net income of the company?

	Make	Buy
Total annual cost	$9,600.00	$10,000.00
Opportunity Cost-Additional Shoe Line	$5,000.00	
Total Cost	$14,600.00	$10,000.00
Difference in FAVOR of continuing to buy from the supplier		$4,600

So did that change the plan? Yes—Hupana would be better off adding a shoe line, and continuing to purchase their soles from their supplier!

Knowing what you know now about relevant costs, might there be some additional items you would ask about in this scenario? I can think of at least **one**!

If they add a shoe line, they will need **more** soles for the shoes! What if the supplier was willing to lower the price per sole with the higher quantity? That could save the company even **more** money by adding the line and continuing to purchase soles from their supplier!

But on the other hand, what if the supplier cannot make soles for the new line, as they are at capacity, how might this affect the opportunity cost of the new line?

There are, as we have discussed, so many variables to each decision we make. The examples are simplified, but think through some of the other situations that may arise with each decision you are asked to make!

Practice Questions

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11.2: Special Order Decisions

Learning Outcomes

- Identify the data needed to support a special order decision

A call just came in to Hupana for a special order shoe. A basketball team would like Hupana to make 50 pair of their shoes, with the awesome soles, but a high top version in fuschia! They have never made high tops before, nor do they have the material in fuschia. The team is willing to pay $150 a pair for these custom shoes. What information does Hupana need to decide if taking this special order is a good idea or not?

When you first look at this interesting order, it looks good right? Hupana can make a quick $7,500 for 50 pair of shoes! That is $50 per pair **more** than they currently charge, and it shouldn't take long to make 50 pair.

Ben, the purchasing manager, starts to make some calls about the fuschia material for the shoes. He finds out that this particular color is hard to come by. The raw material is going to cost $3 per unit, and it will take 7 units per pair, since they are high tops.

Cost for a regular pair of shoes $2 per unit × 5 units= $10 per pair

Cost for the fuchsia high tops $3.50 per unit × 7 units= $24.50 per pair.

Ben also finds out that to cut the new pattern for the high tops will require a die for their material cutter. The cost of this special die is $1200. Oh, Mary let us know that the production workers would need to work overtime to make the special order, so the direct labor cost would be $30 an hour, since they would be paid time and a half for the hours, and they are going to take an hour per pair to make, as opposed to the half hour for the regular shoes.

So let's take a look at where we are at with our Special Order-Fuschia High Tops

Revenue (50 pair @ $150 each)	$7,500
Expenses	
Material-fuschia-(50 x 7 unites x $3.5 per unit)	$1,225
Direct labor (50 x .8 x $30)	$1,200
Variable overhead (30 hours x $3 per hour)	$150
Total variable expenses	**$2,575**
Fixed Expense	
Dye for material cutter	$1,200
Total expenses for special order	$3,775
Incremental net operating income	**$3,725**

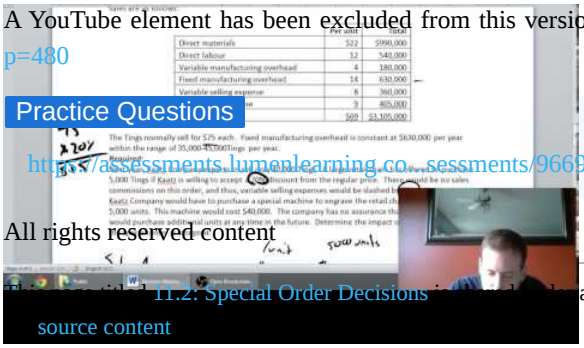
So even with all the extra costs, the special order fuschia high tops will add $3725 to the net income! So it is a **go** for the high tops!

What else might happen because of this special order? It is like really great advertising for Hupana! Their shoes will be on the basketball court for all the world to see!

Kaatz Company sells one product and received a call about a special order. Take a look at their decision process:



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11.3: Introduction to Constrained Resources

What you'll learn to do: Determine the profitability of making changes to a constrained resource

A constraint is anything that keeps you from getting more of what you want. What if you only have so much space to use? Or your machines can only run so many hours of the day?

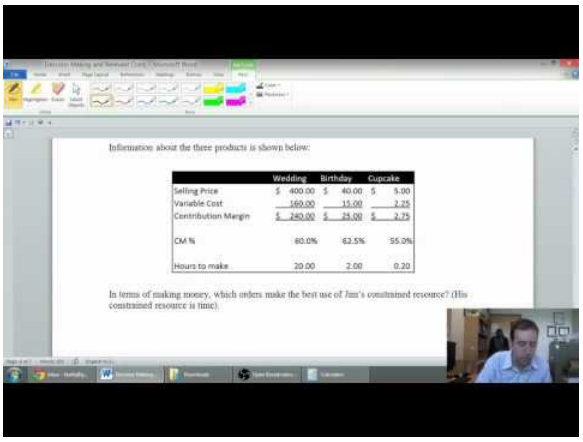
Every company can identify at least one constraint, so it comes down to a manager to do some analysis and find out how to best use the limited resources available. A constraint can also be a bottleneck in the system. Perhaps you have five machines in your production line, but one of them does not keep up with the one before it. This can be a constraint too. Maybe you have two products that use the same piece of equipment at some point in the process, but it can only run for 24 hours a day, right?

How do you make the decision as to how to use a constrained resource? We need to analyze the best way to use the constrained resource. It may not be the product with the largest contribution margin to your net income. We have to look closer, and identify the usage of the constrained resource to find the answer.

Constrained resources can also happen in a retail business, since there is only so much floor space.

Let's look at some examples of constrained resources and how to figure out how best to use them.

Let's first watch this video and listen to an example:



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11.4: Constrained Resource

Learning Outcomes

- Describe a constrained resource in retail business

A constrained resource is something that you have a limited amount of. In a manufacturing business it may be machine time, labor hours or raw materials. Whenever there is a constrained resource, as a manager, you need to determine the best way to use the limited (constrained) resource to bring the most money to your net profit (bottom line).

So you are the manager of a small retail clothing store. You have 1000 square feet of space to use for inventory (excluding walkways, register area and fitting rooms), and you need to use it in the most effective manner to create the best net income for your store.

You have the following inventory:

- **Jeans:** Each pair contributes $40 to net income and you can get two in one square foot of space.
- **Shirts:** Each shirt contributes $10 to the net income, but you can get five in one square foot of space.

If your entire store was jeans you would have 2,000 pair of jeans contributing $40 per pair or $80,000 to your net income.

If your entire store was shirts, you would have 5,000 shirts each contributing $10 or $50,000 to your net income.

How would you stock your store? Well, if you were simply looking at using your space to maximize net income, and you thought jeans would work by themselves, you would stock it with jeans right?

What else may you want to look at in your retail space? Perhaps for every pair of jeans you sell, you also sell two shirts. Is one more difficult to prepare for sale? Maybe shirts need to be pressed and hung, while jeans are simply folder on a shelf.

There are many things to think about when you stock a small retail store, with space constraints you will need to experiment with the best product mix!

So what if our constrained resource is manufacturing space or time? How do we figure out the best usage of a constrained resource? We obviously want to use that resource to generate the most profit for the company.

Let's go back and look at two pair of shoes made by Hupana. The Runner and the Slogger.

	The Runner	The Slogger
Selling price per unit	125	100
Variable cost per unit	55	55
Contribution margin per unit	70	45
Contribution margin ratio	56%	45%

If we just look at the contribution margin, it looks like the Runner is contributing more to the net income, right?

But let's look a little further at this. The Runner, take 40 minutes of machine time to produce, and the Slogger only take 30. The machine can run for 1,200 minutes per day.

So with that information, the machine can make 30 pair of the Runner per day, but can make 40 pair of the Slogger.

Market analysis says we could sell 20 pair of the Runner each day, and 30 pair of the Slogger, which would be a total number of machine minutes of

- The Runner= 40 minutes x 20 pair = 800 minutes
- The Slogger= 30 minutes x 30 pair = 900 minutes

So we have demand that would use 1,700 minutes of machine time, but our machine can only run 1,200 minutes a day!! What do we do? This machine is our bottleneck in the process, so we need to dig deeper yet to decide how to best use our machine time. We

need to figure out the contribution margin **per minute of machine time** for each pair of shoes!

	The Runner	The Slogger
Contribution margin per unit	$70.00	$45.00
Machine time to complete	$40.00	$30.00
Contribution margin per minute	$1.75	$1.50

(CM per unit/machine time to complete)

So which pair should we make first to maximize our profit? The Runner—we can use the first 800 minutes to make 20 pair of Runners. This will leave us with 400 minutes to make Sloggers, so we can make 13 pair before we run out of machine time.

We won't meet the total demand for our shoes, but we will maximize our profits using our machine in the most cost effective way, within the constraints.

What might be another option? Since our demand is high, we could buy another machine or we could raise our prices! That is a whole different calculation for another day.

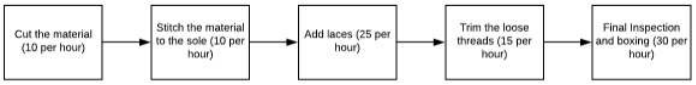
So, now, what if some parts of your process can produce higher output than another? This is called a bottleneck, and is another constrained resource.

A bottleneck happens when one machine can't keep up with the one before it. Or it might be a process in a service business that holds up the rest of the process. A bottleneck is essentially the step that limits total output because it has the smallest capacity. Essentially, a bottleneck could be called a constrained resource, right?

Let's look at a a dental office. The front desk staff might be able to make 100 appointments per day, but if you only have dentists to see 20 patients per day, and dental hygienists to see another 30 per day, you have a bottleneck. The office will not be able to get past the 50 patient per day total, no matter how hard they try.. We identified the weakest link in the chain at the dental office, as patients the dentist can see in a day.

We can't put more strain on the system than this weakest link can handle, so we need to make sure the office staff is not making more appointments!

Let's look at a machine example. If you have five machines, and each one does a task, you might have a chain that looks like this:



Where is your constraint? Well, in this example it is right at the beginning of the process right? The cutting and stitching machines can only accommodate 10 pair of shoes per hour, even though the lacing, trimming, inspecting and boxing could handle more. How could you fix this problem? You could add an additional machine at each the cutting and stitching phase of the process. You could look for newer, faster equipment. Or, you could just move at the pace of the constrained resource.

The bottleneck might occur at other areas of the process. Then you, as a manager, would need to decide which approach to take. Another option would be to outsource the task of the constrained resource. In the case of our shoes, you might outsource the cutting and stitching to another company, and then finish the rest on your equipment. There are options to fix a bottleneck, and the solution will depend on your individual business needs.

Practice Questions

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11.5: Putting It Together- Relevant Revenues and Costs

Everyday managers may be tasked with a new challenge. Module 11 just gave you a whole new set of tools to use to improve the profits your department or company. Keep in mind that only the costs that vary between different options matter. Those that stay the same are irrelevant to your decision making process, and ignoring them will save you tons of time while you evaluate options and make decision.

Relevant costs can be different depending on the decision you need to make. What was completely irrelevant in one scenario might be really important in the next. So how to best use your machine that you can only use for 20 hours per day to create the highest profit, or determining whether to continue a product line should all be easy now right?

Keep practicing your decision making skills by reviewing the examples, and thinking through which costs will be important as you decide.

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11.6: Assignment- Relevant Revenues and Costs

This assignment is available for download as a Word Document.

Read the following scenario and complete the questions and tasks below.

Brad Winston is the owner and operator of Fishing Unlimited, a charter fishing business operated out of Oregon Inlet, NC. Brad has been taking groups of guests offshore to fish for tuna and marlin for over 15 years. He purchased his current fishing boat when he started the business, but now believes that a larger and better outfitted vessel would allow him to increase the rate he charges per charter. Currently he can carry a maximum of 6 guests while the larger boat will carry up to 8. The larger boat would also require him to take 2 deck hands on each outing, providing better service to his customers. Cost data for Brad's business is shown in the table below.

Fishing Unlimited Cost Data

Cost	Amount
Annual straight-line depreciation on boat ($175,000 original cost – $90,000 estimated resale value/20 years)	$ 8,300
Fuel Cost (per hour)	$ 50
Insurance Premium (annual)	$ 1,900
Maintenance and Repairs (annual)	$ 3,500
Fishing Tackle and Gear (original cost)	$ 7,000
Tackle and Bait (per guest)	$ 20
Deck Hand wages (per hour)	$ 20
Dock Fees (annual)	$ 2,400
Captain's License (annual)	$ 200
Food and Beverages (per guest)	$ 25
Professional Fees (per year)	$ 750
Dock Utilities (annual)	$ 1,200

Brad has someone interested in purchasing his existing boat for $80,000. He could use this cash as a deposit on the new boat which will cost him $225,000. His banker estimates the payments on the new boat will be about $1,500. The new boat is more fuel efficient and he believes he can cut his fuel costs by 10% but the more expensive boat will increase his insurance premium by 12%. He is also concerned that he will have to change to a larger boat slip which would increase his dock fees by 5%. The good thing about the new boat is that he should save on maintenance and repairs, at least for the first 3 years. The only other expense Brad would incur with the new boat is adding some additional fishing tackle and gear to accommodate larger parties that he estimates would cost him about $1,500.

His fees for both the old and the new boat are as follows:

Boat Fee Comparison

	Old Boat	New Boat
4 hours	$ 550	$ 600
6 hours	$ 650	$ 700
Full Day (9 hours)	$ 1,100	$ 1,200

Questions:

1. Which costs are relevant to Brad's decision to purchase a new, larger boat?
2. If Brad decides to purchase a larger boat, what costs will be affected by this decision? Will they increase or decrease?
3. Identify any unavoidable costs associated with the operation of Fishing Unlimited.
4. Calculate the revenue generated by a 6-hour trip with the old boat (6 guests) and the new boat (8 guests) and compare the two figures. Identify the costs that changed. What conclusion can you draw based on your analysis?

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11.7: Why It Matters- Relevant Revenues and Costs

Why learn to determine relevant revenues and costs?

Knowing which costs are important and which we can ignore when making decisions will save time in the decision making process and also make it more effective. Some costs don't make a difference, but unfortunately, there is no clear guide for which ones matter and which ones don't.

Only with experience and practice, can a manager learn which costs are relevant to a decision. Learning the process is important for the profitability of your company and to make the best use of resources.

Sunk costs, opportunity costs and avoidable and unavoidable costs all need to be understood to determine what the differential costs are when you make decisions about adding or dropping a product line, making or buying a component part or figuring out how to best use a constrained resource.

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11.8: Introduction to Cost Types

What you'll learn to do: Explore cost types that affect decision making

There are a variety of costs that affect how managers make decisions. Whether a cost is relevant or irrelevant is important as we start to look at how we decide which costs we need to pay attention to.

Relevant costs are those that are relevant to the decision. While irrelevant costs won't change, regardless of which decision we make. We can ignore irrelevant costs when we start the decision making process. This can save a ton of time when going through the decision making process. Also, really bad decisions can be made if irrelevant costs are kept in the mix while analyzing the data.

It is important, as a manager, that you understand which costs are relevant to a particular decision and which are not. We will be discussing avoidable costs, sunk costs and opportunity costs, determining which ones we need to consider in a variety of decisions.

Hopefully, this module will help you to make good financial decisions not only in your business life, but your personal life as well!

Are you ready?

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11.9: Differential Cost

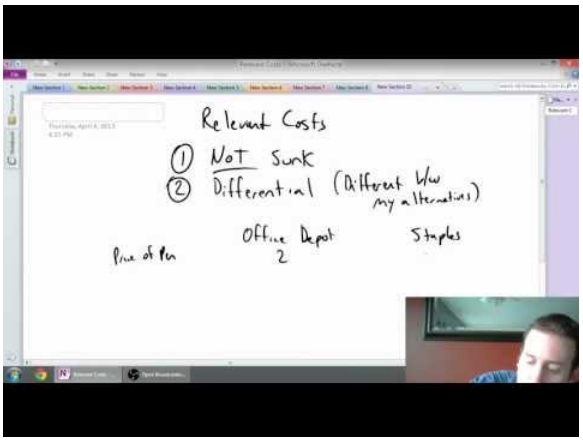
Learning Outcomes

- Define differential cost

Managers have a multitude of decisions to make. Which product to make, how much to sell it for, to make or buy raw materials and components, how and where to distribute the product and so forth. Each of the decisions has at least two options.

When we work to make decisions, we need to look at the pros and cons of each option. The key to making these decisions is called differential analysis-focusing on the pros and cons (costs and benefits) that **differ** between the two options.

Differential cost can then be defined as the difference in cost between any two alternative choices.



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So if we go back to Mary and Ben's choices for Hupana Running Company:

1. Lower quality raw material that is the budgeted price, but will raise the units needed per pair of shoes
2. Higher quality raw material that costs more than the budgeted price, but will use the budgeted number of units per pair on budget.

How do we choose? We need to look at the overall difference in cost between the two options!

So let's put it into numbers:

- Raw material 1: $2.50 per unit × 5 units per pair = $12.50 per pair
- Raw material 2: $2.00 per unit × 6 units per pair = $12.00 per pair

Both options are higher than the direct materials budget per pair, but which one is the better option? What other factors may come into play here? Let's think back to our production time, and how they correlate to direct labor. Might that be an issue as well? What if raw material 2, at its lower cost, ends up adding to the direct labor time per pair?

Raw Material 1

$2.50 per unit × 5 units per pair = $12.50 per pair

Direct labor per pair = .45 hr, @ $20 per hour = $9 per pair so a total of $21.50 per pair

Raw Material 2

$2.00 per unit × 6 units per pair = $12.00 per pair

Direct labor per pair = .5 hr @ $20 per hour= $10 per pair so a total of $22.00 per pair.

So how does that change our decision? We now have to look at the differential cost between the two choices. The best choice now, is raw material 1, right? It has a higher cost per unit, but it saves production time.

In this example, which costs are relevant costs? The raw material price and the direct labor cost both make a difference, so both of these costs would be relevant as you looked at your options. What if there was no change in the direct labor needed, regardless of the cost of the raw material? Then the direct labor cost would be come in irrelevant cost. If that was the case, we could disregard that option to save us time in our decision making process.

Now onto costs we can avoid!

Practice Questions

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11.10: Avoidable Costs

Learning Outcomes

- Describe avoidable costs

It is Thursday night and you are deciding whether you should go out for dinner or stay in and make a pizza. If you decide on the pizza, a quick run to the grocery store would be needed. But dinner at your local Mexican restaurant is sure sounding nice. What costs could be avoided if you chose to eat the pizza at home? What if you chose to go out for dinner?

By choosing to go out to eat, you can avoid the cost of groceries, so the cost of groceries is an avoidable cost. Conversely, by choosing to eat at home, you can avoid the cost of the restaurant meal, so the cost of the meal is an avoidable cost. But whether you decide to eat at home or at the local restaurant, you still need to pay for your house right? The mortgage on your house is not an avoidable cost, as whether you choose to eat at a restaurant, or eat at home, the mortgage payment is still due.

So we would all like to avoid costs, right? But what is an avoidable cost?

An avoidable cost is one that can be eliminated completely depending on the alternative we pick.

An avoidable cost is a relevant cost, while unavoidable costs are irrelevant costs. Since we have to pay the mortgage no matter what, we can disregard that cost when we make decisions, right?

Let's look at another example. Let's revisit our friends at Simply Yoga.

Simply Yoga is looking at streamlining its class schedule. Currently, they have 50 classes running, with 10 students each. They would like to streamline to 20 classes with 25 students each to save money. What would be an avoidable cost in this situation?

Classes taken	500	500
Number of classes offered	20	50
Revenue ($14/class)	$7,000	$7,000
Expenses		
Wages and salaries ($7/person or $84/class)	$3,500	$4,200
Yoga supplies	$250	$300
Utilities (300 + $10/hour)	$500	$800
Rent	$500	$500
Insurance	$100	$100
Other expenses	$250	$300
Total expense	$5,100	$6,200
Net operating income	**$1,900**	**$800**

The additional wages, supplies, utilities and other expenses could be avoided by reducing the number of classes. Rent and insurance are unavoidable costs, as they will happen regardless of how many classes happen or how many students attend.

So we can disregard rent and insurance as we figure out how to make Simply Yoga more profitable, right? Those costs will make no difference in the decision we ultimately make or how many classes we hold.

Practice Questions

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11.11: Sunk Costs

Learning Outcomes

- Recognize sunk costs

There is a piece of machinery sitting in your warehouse. No matter what product your company decides to make, that piece of machinery is worthless. It is old, broken and outdated. But your supervisor comes to you and says “but it cost $50,000.” So what? No matter what decision you come to, that $50k is gone! We call that a sunk cost.

From a personal financial standpoint, here are some examples of sunk cost to help make the concept make more sense:



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Sunk costs are those costs that happened and there is not one thing we can do about it. These costs are **never** relevant in our decision making process because they already happened!

These costs are never a differential cost, meaning, they are always irrelevant. Let’s look at an example:

Hupana Running Company bought a machine for $50,000 that was used to make water bottles. The water bottle line never really took off, so Hupana decided to discontinue the line, and focus their efforts on the running shoes that were the profitable portion of the business. Even though, in hindsight, they should have never added a line of water bottles to their product line, the $50,000 they spent on the machine is a sunk cost.

It would be senseless for Hupana to keep making the water bottles to try to recoup the already spent $50,000, but they could try to sell the machine to another company who already makes water bottles!! No matter what they do with the machine, the 50K is a sunk cost, not to be recovered, and irrelevant to any decisions the company makes now. So we need to just let it go.

Practice Questions

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11.12: Opportunity Costs

Learning Outcomes

- Identify opportunity costs

What is an opportunity cost?



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You have a part-time job while you are attending school. It is spring break and you would **love** to take a week off and lay on the beach and not do anything! However, if you take the week off, you won't get a paycheck. So what is the cost of taking that week off?

The loss of wages for that week is called an opportunity cost. It is the cost of what is lost if one decision is made over another. These costs won't show up anywhere in your accounting records, but as a manager, you need to be very aware of the missed opportunities for decisions you make!

Take a look at this example:



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Investopedia defines **opportunity cost** as follows:

Opportunity cost refers to a benefit that a person could have received, but gave up, to take another course of action. Stated differently, an opportunity cost represents an alternative given up when a decision is made.[1]

Although that definition relates to opportunity costs in investing, in the business operations, it has a similar meaning. We can talk about opportunity costs when we think about making a component needed for our product as opposed to buying it from a supplier already made. Let's look at an example:

Hupana currently buys the soles that go on their awesome running shoes from a supplier premade and ready to attach to their shoes. The supplier is charging $5.00 per sole. Hupana wants to look at the option of making the soles in house, because they have some empty space in their building, that would be a perfect fit for the equipment needed to make the soles. Just to make this simple, let's assume Hupana already owns the equipment to make the soles.

We know that Hupana makes 2,000 pairs of shoes per year. So they pay their supplier $10,000 for the premade soles.

Let's take a look.

Hupana Make or Buy Decision		
	Relevant Costs: Make	Relevant Costs: Buy
Direct Materials ($2.50 per sole × 2000 soles)	$5,000.00	
Direct Labor (.1hr/sole at $20/hour)	$4,000.00	
Variable Overhead (.1hr/sole at $3/hour x 2000 soles)	$600.00	
Depreciation of equipment (not relevant)		
Allocation of fixed overhead (not relevant)		
Cost of buying		$10,000.00
Total cost	$9,600.00	$10,000.00
Difference in favor of MAKING	$400	

So if the space we would use to make the soles is sitting idle right now, then, this analysis would suggest we should start to make the soles in house, right?

But what if the space used to make the soles, could also be used to expand to add another line of shoes? And what if, that additional line of shoes would add $5000 to the net income of the company?

	Make	Buy
Total annual cost	$9,600.00	$10,000.00
Opportunity Cost-Additional Shoe Line	$5,000.00	
Total Cost	$14,600.00	$10,000.00
Difference in FAVOR of continuing to buy from the supplier		$4,600

So did that change the plan? Yes—Hupana would be better off adding a shoe line, and continuing to purchase their soles from their supplier!

This opportunity cost would be **lost** if they decided to make the soles in-house. Remember, they already own the equipment to make them, but that is a sunk cost, as there is no way to recoup that cost anyway.

Practice Questions

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1. https://www.investopedia.com/terms/o/opportunitycost.asp ↵

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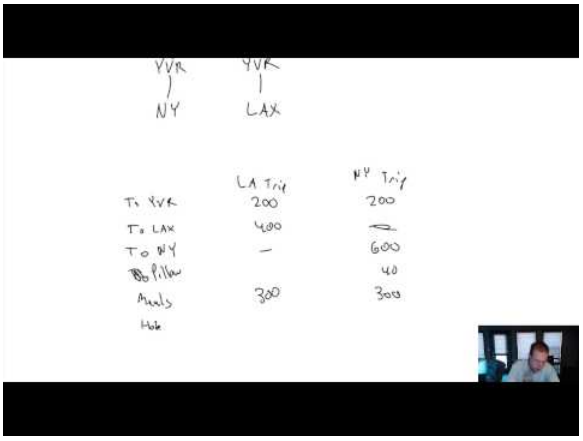
11.13: Analyzing Costs

Learning Objectives

- Summarize the concept of different costs analyzed for different purposes

So what matters in one decision, may make no difference at all in another decision. As a manager, you will have the opportunity to make many decision.

Let's watch some examples:



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Now, you can see, that what may be relevant in one decision, will **not** be in another. We need to use ours skills we have been working on throughout this course to determine whether a particular cost matters when we are looking at different decisions.

You will need different costs for different purposes. But how will you decide which ones are relevant? Every time you come to a new situation, it will be important to evaluate, to get those irrelevant costs, that may cloud your decision making skills, out of the way.

Let's practice identifying relevant costs. Are you ready? Let's say you're taking a fishing trip to Canda and you're deciding whether it's better to drive your own car or to fly and ship your fishing equipment. What would we need to look at to determine which made more sense? Might there be other costs besides the actual monetary costs?

- **Car:** Gas, insurance, maintenance and repairs, and depreciation
- **Fly:** Cost of the ticket, plus the cost of shipping the fishing stuff.

Which costs do we need to worry about? Well, the flying, both costs are relevant!! If we fly, those happen. But what about the car? Well, what costs would happen whether we drive to Canada or not? The insurance is gonna happen, whether we drive or fly, right? So that cost is **irrelevant**! We could figure out the *exact* amount of depreciation and repairs related to the miles we would be driving to Canada, and factor those in as well while working on that decision.

What might a non-monetary (qualitative) cost be to driving? The hours it takes to get there, as opposed to the flight? If you fly you will get more time to fish! So even if driving is cheaper, you might decide to fly, right? The **quality** of the trip may be improved by flying!

So what is the take-away here?

Every single decision you need to make as a manager, will require you to analyze the costs, decide which ones are relevant or irrelevant, and then analyze the remaining costs, including the non-monetary (qualitative) ones and come to a conclusion!

We, as managers, need to look at the total cost, then decide what the differential costs are. We then need to reconcile those two sets of costs, to come to the best decision in a given situation! Are you ready to take on that challenge?

Practice Questions

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11.14: Introduction to Relevant Costs

What you'll learn to do: Recognize relevant costs for common business decisions

Knowing if a cost is relevant to the decision at hand is an important part of making good financial decisions. Taking time to leave costs in the mix that will not affect the outcome of the decision will waste valuable time. We have looked at some examples of relevant costs in some decision making situations, but let's take a look at a few more:

In this section, we will talk about how to decide whether to add or drop a product or service. We will also discuss a "make it" or "buy it" decision. There may also be a sell it, or process it further decision to make, ending with special order decisions. All of these situations are real, and happen everyday in businesses. Having the ability to identify relevant costs and discard the ones that won't change the outcome of a decision is crucial to success!

Remember, different costs are relevant for different decisions. So even if depreciation didn't matter in one decision, it may weigh heavily in another! Let's take a look at some decisions you may have to make!

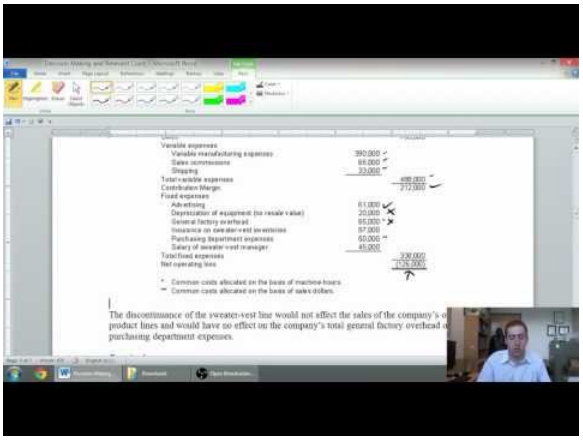
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11.15: Add or Drop Decisions

Learning Outcomes

- Identify the data needed to support an add or drop decision

Adding, retaining or dropping a product or service can be a tough decision. Before we get back to Hupana Running Company and their situation with the water bottles, let's take a look at Jen's Sweaters:



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Ok, so we talked in a previous module about Mary, the production manager. Let's say her boss came to her and said "Mary, we are thinking about dropping the recovery sandal line we are currently producing. We would love you to sit down with us and look at the data to decide if this is a decision that makes good sense or not. When can we meet?"

So Mary sets up a time to meet with management and they show her the following income statement information.

Let's further assume the following:

1. All of the salaries assigned to each product line, belong to that product line, and will go away if the product line goes away.
2. The advertising is an avoidable cost. If the product line is dropped, those ads won't be needed any longer.
3. The utilities is the total for the entire company and is merely allocated by space. It won't change if we drop a product line.
4. The depreciation is on the displays for the particular product line. We just got them, but they are custom made, so they won't have any resale value if we drop the line.
5. The mortgage interest won't change, we will just need to reallocate it if we drop the line.
6. The insurance is company wide, and will simply be reallocated.
7. The general administrative expenses are for accounting, order entry and general management. Currently, these costs are allocated based on sales dollars for each product line, but they won't go away if a line is dropped.

So what now? How do we determine which costs will be avoided if we drop the recovery sandal line?

Fixed Expenses	Totals Assigned to Recovery Sandals	Not Avoidable	Avoidable
Salaries	$22,500		$22,500
Advertising	$5,000		$5,000
Utilities	$1,000	$1,000	
Depreciation	$1,000	$1,000	
Interest expense (mortgage)	$2,000	$2,000	
Insurance	$500	$500	
General administrative	$2,000	$2,000	
Total fixed expenses	$34,000	$6,500	
Net operating income (loss)	$18,500	$13,000	$27,500

So the recovery sandals were bringing $18,500 to our operating net income. The contribution margin for the sandals is $52,500, but some costs will be avoidable if we discontinue the line.

- So Contribution margin that is lost if we discontinue the line: ($52,500)
- Fixed Expenses that will be avoided if we discontinue the line: $27,500
- Decrease in our overall net operating income: $25,000

So should we discontinue the line? It is still contributing $25,000 to our net operating income.

Mary suggests keeping the line, unless a more profitable line is located. Might they want to look at discontinuing the water bottle line? I think we talked about that in a previous module, didn't we?

Practice Questions

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CHAPTER OVERVIEW

12: Managerial Decisions

12.1: Special Order Decisions
12.2: Cost-Plus or Target Costing Decisions
12.3: Putting It Together- Managerial Decisions
12.4: Assignment- Managerial Decisions
12.5: Why It Matters- Managerial Decisions
12.6: Introduction to Managerial Decision-Making
12.7: Differential Analysis
12.8: Qualitative Factors
12.9: Introduction to the Role of Data in Business
12.10: Customer Elimination Decisions
12.11: Add or Drop Decisions
12.12: Make or Buy Decisions
12.13: Sell or Process Further Decisions

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12.1: Special Order Decisions

Learning Outcomes

- Create a report outlining the data to support a special order decision

In Module 11: Relevant Revenues and Costs, we went through a special order question with Hupana Running Company. Remember, they got a call to make those awesome fuchsia high tops? Here is a reminder:

Special Order: Fuchsia High Tops	
Revenue (50 pair @ $150 each)	$7,500
Expenses	
Material: Fuschia (50 × 7 units x $3.5 per unit)	$1,225
Direct Labor (50 × .8 × $30)	$1,200
Variable overhead (30 hours × $3 per hour)	$150
Total variable expenses	**$2,575**
Fixed Expense	
Dye for material cutter	$1,200
Total Expenses for Special Order	$3,775
Incremental net operating income	**$3,725**

So a special order is a one-time order, that is not part of a company's regular business operation. Effective analysis needs to be done to insure that a special order will bring additional revenue to a company and not use space or time that would have been better used for the regular product lines. As a manager, it may be your responsibility to figure out if a special order should be taken, and if so, how much should be charged for the order.

In Hupana Running Company's case, the revenue for the special order high-tops is sufficient to cover the additional costs incurred to make them. Make sure to account for things like special equipment or materials that might increase the costs. Also, make sure that you have the time available in your production schedule to handle the extra work.

Hupana needs to pay overtime to complete this order, but still made a nice profit on this special order. There may be additional things to consider from the qualitative standpoint (remember, it isn't always about the money!). Perhaps the exposure will bring additional sales of the regular line of shoes, or other teams may want to order shoes!

Practice Questions

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12.2: Cost-Plus or Target Costing Decisions

Learning Outcomes

- Create a report outlining the data to support a cost-plus pricing or target costing decision

REview

A good overview of our pricing decisions can be found here.

Cost-Plus pricing and Target Costing defined.

Cost-plus pricing, is when a company figures out their total cost of a product and adds the profit as a "mark-up" above the cost. If a company has a more unique item, that consumers are willing to pay a premium for, cost-plus pricing can be effective. These companies are called PRICE-MAKERS. They get to decide, based on the fact that their item can be differentiated from other products on the market, and priced based on this justification.

So, if a company's cost to make a widget is $5.00 and they want a 50% profit, they will charge $7.50 for the widget calculated as follows:

We can also look at cost plus pricing like this:

Total Costs + Desired Profit = Desired Revenue

$5.00 + ($5.00 x 50%)= $7.50

Target costing, involves looking at what the company wants for a profit, the price for the product that the market will bear, and then determines how to potentially cut costs to reach the desired profit. Products with a lot of competition, or that are not unique, may need to be priced in this manner. These companies are called PRICE-TAKERS. They need to price based on a market average, or to meet the pricing that the market will bear, due to other substitute products being available at the same or lower prices.

So in our widget example, it would be calculated in this way:

This concept looks like this:

Revenue − Desired Target Profit = Costs

($7.50 − $2.50 = $5.00)

When we look at this process, the pressure is put on the buyers at the company to find the lowest priced components in order to lower costs and create the desired profit for the company.

There is a great deal of pressure to keep costs low and profits high. In a competitive market, it may not be possible to get the desired profit without competitively pricing the item and then lowering costs through an effective purchasing system.

Some items, such as the fuchsia Hupana Running Company high tops, won't have that pressure, but what if you sell paper clips? People may not be willing to pay more for a paper clip no matter how much you spend on your components, right?

Picking how to price your products, **cost-plus pricing** or **target pricing** will depend on the market for your product and what price the consumers are willing to pay.

Practice Questions

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12.3: Putting It Together- Managerial Decisions

So you had the opportunity to look at a lot of different decisions you may need to make as a manager. Navigating the costs, which are relevant and which don't matter in multiple different situations, will be helpful in your job.

Learning how to price your product may also be an important component of your work! Do you have a unique item that you can price for maximum profit? Or do you make an item that the market will only pay a certain price for? You can make the best copy paper ever, but if the people buying the paper are not willing to pay extra, you need to reassess your pricing structure!

As you worked through the examples, there were instances where a company was **losing** money with every item sold! *Knowing*, as a manager, what products to keep, which processes to outsource, can help make a company more profitable!

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12.4: Assignment- Managerial Decisions

This assignment is available for download as a Word Document.

Read the following scenario and complete the questions and tasks below.

Marquette Manufacturing produces “invisible” electric dog fences, sold through retail locations nationwide. The selling price of the fence is $150 per unit. The cost to manufacture and market the fences is shown below. These figures represent the cost at the company’s normal volume of 3,000 units per month.

Breakdown of unit costs (manufacturing and marketing) for 3000 units

Unit Manufacturing Costs	
Variable materials	$ 15.00
Variable labor	$ 17.50
Variable overhead	$ 12.50
Fixed overhead	$ 16.00
Total unit manufacturing costs	$ 61.00
Unit Marketing Costs	
Variable	$ 12.00
Fixed overhead	$ 17.00
Total unit marketing costs	$ 29.00
Total Unit Costs	**$ 90.00**

(NOTE: Unless otherwise stated, assume that no connection exists between the situation described in each question; each is independent. Also, ignore taxes or other costs not specifically mentioned in the questions.)

1. The company’s marketing team estimates that sales volume could be increased to 5,000 units per month if the sales price was lowered from $150 to $125 per unit. The production manager has confirmed that they have the capacity to increase production to this level. Assume that the cost pattern will not vary at the increased level of production. If management decreases the price, what would the impact on monthly sales, income and costs be? For each figure, indicate whether the change will result in an increase, decrease or no change in the sales, income and cost. Would you recommend the reduction in sales price? Why or Why not? (Show all supporting calculations).
2. At the end of the year the production manager is taking inventory and finds 600 units of an older model of invisible fencing that the company no longer manufactures. These obsolete units can be disposed of through their regular channels, thereby incurring variable marketing expenses. What is the lowest price that they should accept for these obsolete units, realizing that if they do not sell them these units will have to be thrown away. (Show all supporting calculations).
3. Marquette receives a proposal from an outside contractor who offers to make and ship 1,500 fences directly to Marquette’s customers as orders arrive from Marquette’s sales force. When managers meet to discuss this proposal, Product Manager Will Hansen brings up the fact that they have the design for an electric fence that can be used for large animals that has never been produced. Will suggests that this may be the perfect time to launch this new product and at a selling price of $225 per unit it is sure to increase sales revenue. The production manager calculates that the idle time created by accepting the contractors offer would allow them to produce 1,000 of the new fence. The cost to produce the new fence would be $175 in variable manufacturing expense but fixed manufacturing and marketing costs would remain unchanged. The product mix would now be 1,000 of the new fence and 1,500 of the old fence. If Marquette wants to seriously consider taking the contractors offer, what in-house cost should be used to evaluate the outside contractor’s bid. If the payment to the outside contractor is $90 per unit, should they accept the offer? Why or why not? (Show all supporting calculations).

4. On March 1, Marquette is approached by the developer of a large subdivision who wants to install an invisible fence in the yard of 1,200 homes he is constructing. The developer will contract with Marquette for the 1,200 fences on the condition that they are delivered within 30 days (March 31). This is not good timing for Marquette since they have recently signed a contract with Home Warehouse, a national home improvement chain and have been working at 100% capacity for several months. If Marquette accepts the builder's order, it will lose 1,200 units that would normally be sold to one of its existing customers. When they tell the developer that they do not believe they can fill his order, he offers to reimburse the company for his "share" of the fixed manufacturing costs and will pay a $5,000 "bonus" on delivery. Since the sale to the developer will not incur any variable marketing costs, Marquette reconsiders accepting the developer's order. What impact will accepting this order have on Marquette's income in March? Should Marquette accept the order from the developer? Why or Why not? (Show all supporting calculations).
5. Marquette has an opportunity to sell its product through an online retailer. To begin selling through this online platform, they are required to ship 2,000 units to the retailers' order fulfillment warehouse. The other condition of this offer is that they pay a one-time vendor marketing fee of $5,000. To get the units to the fulfillment warehouse by the deadline Marquette will need to pay for expedited shipping at a cost of $10 per unit. What is the minimum price Marquette should charge the retailer for this initial order of 2,000 units? (Show all supporting calculations).

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12.5: Why It Matters- Managerial Decisions

Why learn to make managerial decisions based on costs?

The ability to make good decisions based on costs is a huge part of a manager's job. Learning to understand which costs are relevant to a decision will help you to insure that the decisions you make used the best available knowledge.

Different costs will be important in different decisions, so practice is the key to learning how to navigate the process. Whether you need to figure out if you should keep or drop a product, make or buy components or sell or process further, we will take a look at what information may be important in your decision making process!

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12.6: Introduction to Managerial Decision-Making

What you'll learn to do: Discuss the process of managerial decision-making and the factors involved.

As a manager you are forced to make countless decisions on a day to day basis, many of which have a lasting impact on the success of your company and its employees. Some decisions will require an analysis of the literal monetary costs and their relevance in the decision. Other choices will be made by examining the qualitative factors of the potential outcomes. Most decisions will require a balance of both. Knowing what to look for on both the quantitative and qualitative sides of each situation will help you as a manager make the decision that is best for your company and its employees.

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12.7: Differential Analysis

Learning Outcomes

- Explain the process of differential analysis

Remember back to Module 11: Relevant Revenues and Costs where we discussed relevant and irrelevant costs and defined differential costs. We went into some discussion of differential analysis, but let's take a closer look.

Differential cost is defined as the difference in cost between any two alternative choices, so differential analysis will look at **all possible** scenarios to make a decision!

Differential analysis involves looking at all possible scenarios of a decision, but ignoring some costs that are not relevant to the decision itself. We started talking in Module 11: Relevant Revenues and Costs, about costs that should not play in to the choices we need to make. We, as managers, simply need to focus on the costs and revenues that **differ** between the two choices.

So, reviewing some key terms in the process is important:

1. **Differential cost (relevant cost):** the difference in cost between two choices.
2. **Differential revenue (relevant benefits):** the difference in revenue between two choices
3. **Sunk cost:** a cost that has already been incurred, so won't be avoided no matter what decision is made.
4. **Avoidable cost:** a cost that CAN be eliminated depending on the decision made.
5. **Opportunity cost:** the potential benefit that is given up if an alternative decision is made.

So we need to ignore those things that remain constant, regardless of the decision we make. An example could be the rent paid on the building. It won't matter whether you are making widget A, B or C, you still have to pay for the building, right? So rent would **not** be relevant to the decision regarding which product to make or sell.

As managers, we need to look at all of the costs, and then determine which ones matter for the decision we are making. The relevant costs can differ for different decisions, so it is important to look at all of the costs involved, and look at each one independently for each decision!

We will look at a variety of decisions in this module to help you practice your differential analysis skills!

Practice Questions

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12.8: Qualitative Factors

Learning Outcomes

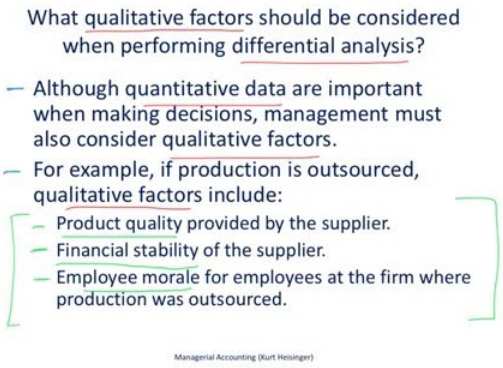
- Analyze qualitative factors that can also affect managerial decisions

Your boss just walked into your office and offered you a new position within the company! The money is great, including a 20 percent raise and a company car. The position includes 50 percent travel and at least 10 more hours per week than you are currently working. Oh, and you get to work from home, rather than coming into the office! You call your spouse and explain this great opportunity to him! He is less than excited, even with the raise in income. Why? Well, let's look at the non-monetary components of this offer:

1. Less time at home with the additional hours and travel.
2. Home office reduces the commute time, but also takes up space in your home.

So, these are decisions that are called qualitative. They affect the quality of your life, rather than your bank account. Sometimes a decision that looks great from a financial standpoint, may cause quality changes that make the choice not as attractive. We talked a bit about this in our unit about a vacation or working. Sometimes, even with a loss of a week's paycheck, the vacation is better!

Qualitative decisions are different from quantitative decisions. Let's first define those terms to clarify.



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Qualitative decisions are based more on the quality of a particular situation. For example, if you were planning to drive or fly when you go on your next vacation, you might not make your final decision based on which option is cheaper. Flying may have the qualitative advantage of being a quicker way to get to your destination, even though it costs more. On the other hand, driving may let you see many more sites on the way, even though it takes longer.

So you can see, sometimes we have to look beyond the cost savings to other factors when we make our decisions.

Quantitative decisions are just about the money. So, if it is cheaper to drive, and you are only concerned about the dollars spent, then you will drive!

So let's practice our skills.

Example

You are graduating from college, and would like to have a party for 50 of your closest friends. You are trying to decide between having your party at a restaurant, or making the meal at your home. Let's look at the details of each option to see what makes the most sense. Here are the details.

Option 1

Restaurant meal with one drink per guest: $30 x 50 guests = $1,500.00

Home meal with one drink per guest : $12 (groceries) x 50 guests = $600.00

Option 2

Savings to cook dinner at home $900.00

However, there are some qualitative advantages be to choosing the restaurant even though it costs more:

1. More time to talk with your friends if you have the meal prepared at the restaurant.
2. Less time involved if you go the restaurant, as you won't have to cook and clean up after.
3. You won't need to clean your house, after just finishing finals and doing all the cooking if you have the party at the restaurant.

So which would you pick?

Practice Questions

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12.9: Introduction to the Role of Data in Business

What you'll learn to do: Analyze data to create reports and make business decisions.

In the previous module, we talked about different options and decisions. Another resource helpful for making a decision as a manager is data. Almost any choice you are forced to make can be made a little easier by examining the data and choosing accordingly. Let's dig a little further into analyzing our decisions in a variety of situations.

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12.10: Customer Elimination Decisions

Learning Objectives

- Create a report outlining the data to support a customer elimination decision

Not all customers are good customers. Unfortunately, some, regardless of how much you charge for your services, do not add to your net profit. Let's look at an example from the service industry:

So, you are the manager at a local CPA firm. You have three large clients, but you are determining if each of these clients are creating a profit for your firm, or if one should be eliminated. This is a tough decision to make, and there are lots of pieces of the puzzle to review. Let's look first at the **revenue** brought in to the firm for each client.

- Customer A: $25,000.00 in revenue
- Customer B: $32,000.00 in revenue
- Customer C: $37,500.00 in revenue

You might be looking at this, thinking, "why would we eliminate any of these customers? Look how much revenue they are bringing in to the firm?" But remember, there are other things we need to consider.

Let's say we were talking to our administrative assistant. She let us know that Customer C calls every single day needing a copy of a document that they lost, or a form they need to submit. Customer C also stops in to the office frequently to chat with the front desk staff, keeping them from their work.

On the other hand, customer A is the ideal client. Their books are all in order when they bring them in for tax preparation. They only call if they have a question to help streamline their processes, which helps us with the work we do for them.

So, let's look at the quantitative (the money part) now:

Elimination Decision: Evaluation of Customers				
	Totals	Customer A	Customer B	Customer C
Revenue	$94,500.00	$25,000.00	$32,000.00	$37,500.00
Expenses				
Rent	$5,000.00	*Not relevant*	*Not relevant*	*Not relevant*
Utilities	$2,000.00	*Not relevant*	*Not relevant*	*Not relevant*
Copies	$1,000.00	$50.00	$250.00	$700.00
Admin Staff	$15,000.00	$1,000.00	$5,000.00	$9,000.00
Front Desk Staff	$15,000.00	$1,000.00	$5,000.00	$9,000.00
Accounting Staff	$35,000.00	$8,259.00	$7,556.00	$19,185.00
Net Income	$21,500.00	$14,691.00	$14,194.00	$(385.00)

So, now you can see, Customer C is really not bringing in anything at all! They are actually **costing** the firm money.

Now, you might ask, would we get rid of those staff people if we got rid of the client? We would not. We then have several options. We could fill in with a new client. We could develop a different component of the business, such as expanding our tax preparation or bookkeeping services with that extra time. Essentially, we will need to secure replacement business, but does it make sense to keep a client who is costing us money? Oh, and if you go back and take a look at those qualitative issues, it makes more sense yet to get rid of Client C!

Practice Questions

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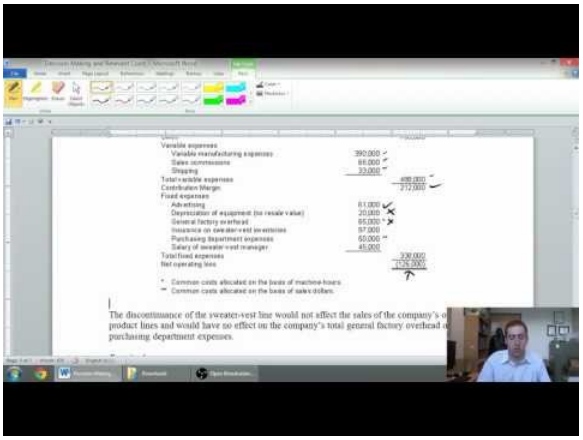
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12.11: Add or Drop Decisions

Learning Outcomes

- Create a report outlining the data to support an add or drop decision

Remember our Jen's Sweaters add or drop question? Here is a review:



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Managers need to decide which product lines to continue, add or drop. An add or drop decision is based only on the relevant costs involved in the process. As we have discussed earlier, some costs are not relevant to a decision, so as we look at options between our product lines, we need to decide which costs should be considered as decisions are made. It isn't always the item we sell for the highest price! Costs **can** outweigh revenues, and in those cases, we need to evaluate and analyze to determine what items to manufacture, offer as services or stock on our shelves.

Let's look at a grocery store example. We have five flavors of ice cream in our freezer, but would like to determine how to best utilize the freezer space. Our accounting department gives us the following information regarding revenues and costs for our ice cream freezer:

Morrie's Grocery: Ice Cream Cooler—What Should We Stock?					
	Vanilla	Chocolate	Strawberry	Neapolitan	Butter Pecan
Sales	1000	1200	900	700	1050
Variable Costs	400	720	270	490	577.5
Contribution Margin	**600**	**480**	**630**	**210**	**472.5**
Direct Fixed Costs	100	180	90	105	105
Allocated Fixed Costs	150	180	135	140	157.5
Net Income	**350**	**120**	**405**	**-35**	**210**

From this spreadsheet, it would look like dropping the Neapolitan would be a good idea, right?

Let's look a little closer at this situation to determine if that is the right decision.

So, if we get rid of the Neapolitan flavor, what expenses will be relevant to our decision?

Variable costs would go away, as that cost is directly related to the Neapolitan ice cream. Direct fixed costs would also go away, as those costs are directly attributed to that flavor too. But what happens to the allocated fixed costs? Those costs would need to be distributed among the remaining flavors. Remember things like rent and utilities will occur regardless of what products we carry.

Drop the Neapolitan?		
Variable Costs Avoided	490	
Direct Fixed Costs Avoided	105	595
Less: Sales Revenue Lost		700
Decrease in Net Income		105

The variable costs and direct fixed costs are called avoidable costs. These are the costs that would go away by eliminating this flavor.

So you can see now, that eliminating the Neapolitan would have a negative effect on the net income. What if we drop chocolate?

Drop the Chocolate?		
Variable Costs Avoided	720	
Direct Fixed Costs Avoided	180	900
Less: Sales Revenue Lost		1200
Decrease in Net Income		300

So who would drop chocolate anyway, right?

So you can see the decision to add or drop a product isn't as easy as it looks! They may increase the sales of chocolate, if they eliminated another flavor. Remember that is called an opportunity cost!

Now let's practice:

Practice Questions

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12.12: Make or Buy Decisions

Learning Outcomes

- Create a report outlining the data to support a make or buy decision

Ok, so back in Module 11: Relevant Revenues and Costs we talked about the make or buy decision. This decision has several components. Hupana could make their awesome soles of the shoes they sell, or they can continue to buy them from the supplier they currently use. The supplier charges $5.00 per pair and is a great vendor! They deliver on time, and have excellent customer service! Hupana needs to look at the costs and make a decision.

Hupana Make or Buy Decisions	Relevant Costs	
	Make	Buy
Direct Materials ($2.50 per sole x 2000 soles)	$5,000.00	
Direct Labor (.1hr/hole at $20/hour)	$4,000.00	
Variable Overhead (.1hr/sole at $3/hour x 2000 soles)	$600.00	
Depreciation of Equipment (not relevant)		
Allocation of fixed overhead (not relevant)		
Cost of buying		$10,000.00
Total Cost	$9,600.00	$10,000.00
Difference in favor of **making**	$400	

At first glance, it looks like bringing the making of the soles in house would save Hupana money! The total costs to make them, is less than continuing to buy them. Remember the fixed overhead happens whether we make or buy the soles, thus that is not a relevant expense. Also, if you think back to the budget for Hupana, they already had the equipment purchased, so that is a sunk cost (a cost we can't recoup no matter which decision we make), so again, it isn't relevant to this decision.

There are other things to think about though. Is Hupana missing another opportunity, such as adding a product line, by manufacturing in house? What about a potential learning curve to make them? The numbers don't always tell the entire story, so management will need to look at all of the options before making this decision.

Practice Questions

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12.13: Sell or Process Further Decisions

Learning Outcomes

- Create a report outlining the data to support a sell or process further decision

So, what should we do with each grind of flour? The purchase price of the wheat, and grinding it into flour are joint costs. We have to get it this far to sell it. But what happens if we decide to bag it for retail sale? Well, let's look at this information in an excel spreadsheet:

Flower Power, Inc			
Sell or Process Further			
	Coarse Flour	Fine Flour	Bread Flower
Sales value after all processing	$34,000	$50,000	$31,000
Less: sales value at the split-point	$30,000	$40,000	$20,000
Incremental revenue from further processing	$4,000	$10,000	$11,000
Less: cost of bagging	$5,000	$5,000	$5,000
Profit (loss) from bagging the flour	($1,000)	$5,000	$6,000

So, where do you think we should sell each of our grinds of flour?

Course flour should probably be sold in bulk, since the cost of continuing to process it, is **more** than the incremental revenue we will gain. But processing and bagging the fine grind and bread flour looks like a good idea!! Again, there may be other issues, such as equipment purchases or opportunity costs that come into play, but if we look just at the incremental revenue and expenditures from the continued processing,

LEarn More

If you would like to see an additional explanation of selling or processing further, take a look at this video.

Practice Questions

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CHAPTER OVERVIEW

13: Statement of Cash Flows

13.1: Introduction to Preparing a Statement of Cash Flow
13.2: Net and Gross Cash Flows
13.3: Preparing a Statement of Cash Flow
13.4: Cash Flow Analysis
13.5: Putting It Together- Statement of Cash Flows
13.6: Assignment- Statement of Cash Flows
13.7: Why It Matters- Statement of Cash Flows
13.8: Introduction to Key Concepts in Cash Flows
13.9: Non-Cash Activities
13.10: Operating Activities
13.11: Investing Activities
13.12: Financing Activities
13.13: Introduction to Direct Method versus Indirect Method
13.14: The Indirect Method
13.15: The Direct Method

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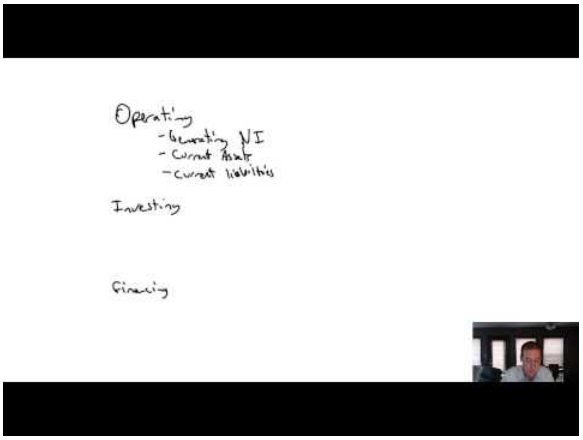
13.1: Introduction to Preparing a Statement of Cash Flow

What you'll learn to do: Describe how cash flow factors can be used to improve or evaluate a business

Now we are ready to put it all together! There will be three sections to our statement of cash flow:

- Operating section
- Investing section
- Financing section

We have the two ways we can do this, using either the direct or indirect method. Watch this video for a quick review of the entire cash flow statement process:



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13.2: Net and Gross Cash Flows

Learning Outcomes

- Differentiate between net and gross cash flows

Gross cash flows don't exist in the operating portion of the cash flow statement. GAAP (generally accepted accounting principles) and IFRS (international financial reporting standards) for foreign companies, require us to disclose the gross cash flows for the investing and financing sections of the cash flow statement.

Gross cash flows essentially include the purchase price in cash of a new piece of property or equipment, and the cash gain of the sale of a piece of property or equipment.

So if a company purchased $25,000 of new equipment and sold $10,000 of equipment, the net cash flow would be $15,000. But in the investing and financing sections, we need to keep those separate. It is still important to note the difference in balance netted, then backing it out to the gross calculation!

Here is an outline of how noncash balance sheet accounts affect the investing and financing sections of your cash flow statement:

	If the account balance increases	If the account balance decreases
Non-Current Assets (Investing Activities)		
Property, Plant, and Equipment (P,P,&E)	Subtract	Add
Long-term investments	Subtract	Add
Loans to others	Subtract	Add
Liabilities and Equity (Financing Activities)		
Bonds payable	Add	Subtract
Common stock (our own company)	Add	Subtract
Retained earnings	*	*

*Retained earnings will need more analysis

So you will notice, this chart looks at the overall change in the balance, but to calculate the gross cash flow by looking at the detail in all of the each of the accounts to fill out the cash flow analysis to meet the requirements of GAAP and IFRS reporting requirements.

Practice Questions

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13.3: Preparing a Statement of Cash Flow

Learning Objectives

- Prepare a statement of cash flow using the indirect method

Ok, so let's put together all of the great stuff we have learned about cash flow! A reminder the indirect method is working from the bottom of the income statement and adjusting it to the cash basis. So we would take the net income, and work from there.

So here is our income statement on the accrual basis:

Income Statement	
Month ended 1/31/XX	
	Accrual Basis
Income	
Sales	25000
Expenses	
Rent	1000
Utilities	1000
Supplies	1250
Payroll	5000
Depreciation	4000
Other Expenses	2500
	10250

Our net income is $10,250, so we will start there and work up to our cash flow statement

The first step is to add back our depreciation, because that is a non-cash expense!

Net Income	10250
Add: Depreciation (non-cash expense)	4000
Total	14250

This balance will move to the cash flow statement!

The second step is to analyze the net changes in the balance sheet accounts that we discussed earlier. Accounts receivable, accounts payable and the other current assets and liabilities will also affect the cash flow of the company.

So let's assume the following changes:

	1/1/XX	1/31/XX	
Accounts Receivable	5000	4000	decrease
Inventory	3000	5000	increase
Accounts payable	2500	3850	increase
Income taxes payable	1000	500	decrease

This information will come in handy in the next step!

So how do these items affect cash? Going back to our chart from our discussion about indirect cash flow analysis we know that:

	If the account balance increases	If the account balance decreases
Current Assets		
Accounts Receivable (money from customers)	Subtract	Add
Inventory (buy or pay for inventory)	Subtract	Add
Prepaid expenses (insurance)	Subtract	Add
Current Liabilities		
Accounts Payable (pay your bills)	Add	Subtract
Accrued Liabilities (payroll)	Add	Subtract
Income taxes payable (tax payments)	Add	Subtract

So, here is the final deal!

Cash Flow Statement: Operating Activities-Indirect Method

	1/1/XX	1/31/XX	
Accounts receivable	$5,000	$4,000	decrease
Inventory	$3,000	$5,000	increase
Accounts payable	$2,500	$3,850	increase
Income taxes payable	$1,000	$500	decrease
Beginning cash	$14,250		
Decrease in accounts receivable	$1,000	increase cash	
Increase in inventory	($2,000)	decrease cash	
Increase in accounts payable	$1,350	increase cash	
Decrease in income tax payable	($500)	decrease cash	
Net change in cash	($150)		
Ending cash	**$14,100**		

So the income statement and balance sheet only show part of the picture. A company can have awesome sales, but if they struggle to collect on their accounts receivable, they may have issues with their cash flow! It is important as a manager to look at the big picture, in order to find ways to increase profits and create a positive cash flow!

Practice Questions

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13.4: Cash Flow Analysis

Learning Outcomes

- Describe how cash flow factors can be used to improve or evaluate a business

So, why is all of this information so important? What would happen if your company has sales of $100,000 a month, but they only collect $50,000 a month in cash, and their accounts receivable has a high balance in the 90+ days outstanding column?

What if in addition to the issues with your accounts receivable, the balance sitting in accounts payable is really high, and the company is very far behind in payments. The cash account is perpetually at zero or less, and there have been problems with payroll checks bouncing.

The boss calls you in to discuss how to improve cash flow. You look over the income statement. Sales are great, and the expenses are low. Payroll is in line with where it has always been, so if you just looked at the accrual based income statement you wouldn't have any concerns.

Ah, but then you wander over to the balance sheet. Cash in the negative, $200,000 in receivables, and $200,000 in payables. What is going on?

Let's go back to the first sentence of this learning outcome. Only $50,000 a month is being collected on $100,000 in sales. The ball is being dropped here, right? But do we blame the folks in collections, or might the problem be earlier in the ordering cycle?

Perhaps going back to the customer acquisition system is required here. What is the process to give terms to your customers? Is there a formal system for checking the credit on new customers? Do you require cash payments from new customers until their credit application can be processed? Do you have an online payment system, so customers can easily pay their outstanding invoices with a credit card?

Once the customer acquisition process and collection procedures are corrected, cash flow will improve, bills will be paid on time, and the cash balance with be positive!

Easy to see how important analyzing the cash flow is and how it can be used to improve or evaluate your business processes and procedures.

When we look at cash flow, we can also look at a forecasted cash flow to help us see where our company is at from a cash standpoint, and where we could make improvements. This forecasting can also be helpful for a new business or to evaluate cash needs in an existing business during periods of growth or slumps.

Learn More

If you are interested in starting a business, or the business you work for is in need of some great resources, Score is a great place to start! They have a ton of resources available at their site.

A forecasted cash flow statement can be created based on historical data, or, in a new company, can be created from budgeted amounts that include intended collections processes for accounts receivable and expenditure payments for accounts payable.

By preparing a forecasted cash flow, you can see where problems are before they become big problems!

Practice Questions

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13.5: Putting It Together- Statement of Cash Flows

The importance of cash flow analysis and forecasting cannot be stressed enough. As a manager, you may be tasked with preparing this analysis, or understanding it in order to improve the operation of the business you work for. Two methods exist to prepare the cash flow statements, including the direct method, which simply takes the income statement to a cash based format, or the indirect method, which starts with net income and adds and subtracts the items from the income statement that were not cash.

Depreciation is automatically added back, as it is a non-cash expense. Then each account is analyzed to come to the net change in cash for a given period. Both methods will get you to the same answer, and this answer should match the cash balance on your balance sheet when you are finished!

As noted at the beginning of this module, there are great resources out there with templates, and assistance in preparing cash flow statements. The module also has some charts and examples to help you better understand how to determine and improve cash flow.

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13.6: Assignment- Statement of Cash Flows

For this assignment, you will download and complete the following worksheet:

- Assignment: Statement of Cash Flows (.docx)

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13.7: Why It Matters- Statement of Cash Flows

Managing cash flow is a key to business success. A business that looks profitable on the income statement, may have serious cash issues if they are not collecting from their customers in a timely manner or if sales fluctuates widely month to month.

Cash flow preparation and projection needs to be part of your regular business planning practice. Learning how to not only prepare these statements, but to understand them, will help you as a manager to operate on a solid foundation of profit and positive cash flow!

Learn More

The Small Business Administration has some amazing resources, once you have gone through this module and understand the basics of preparing and reading the statements. The SBA provides great information to start projecting your business cash flow, along with links to Excel templates and other great resources!

Remember, a company can't run without cash! If we don't have a good handle on our cash flow, success with be a challenge.

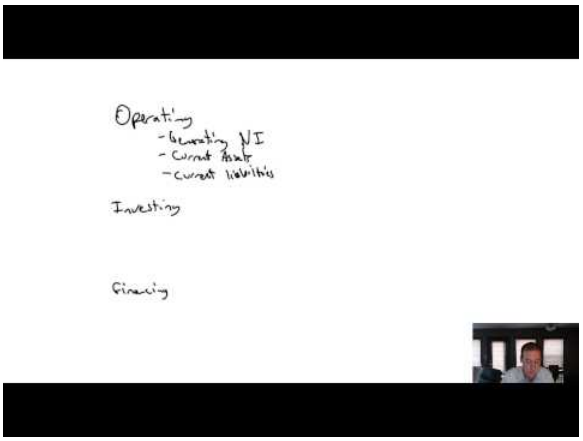
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13.8: Introduction to Key Concepts in Cash Flows

What you'll learn to do: Discuss key financial principles needed to produce and analyze a statement of cashflows

The cash flow statement goes through where are cash comes from in our company. We need to look a little deeper than just cash-in and cash-out to find out if we are managing our cash in the best way possible! We will go through two methods, the direct and indirect method. Most companies use the direct method, but it is good to be familiar with both.

Take a look at this video for an introduction to the cash flow statement and analysis of cash:



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This statement allows us to better see where our money is coming from, how quickly we are collecting cash and where our cash is being spent!

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13.9: Non-Cash Activities

Learning Outcomes

- Explain the nature of non-cash activities

What business activities are considered non-cash activities? In order to prepare a cash flow statement, we need to understand which items on our income statement and balance sheet may not involve the transfer of cash, thus will not have a place on our statement of cash flows.

These non-cash activities may include depreciation and amortization, as well as obsolescence. Property, plant and equipment resides on the balance sheet. These items are taken on the income statement in small increments called depreciation or amortization.

If we purchase a new dump truck, we don't take the entire purchase price as an expense when we purchase it. We put it as an asset on our balance sheet, and then take depreciation expense over the life of the dump truck.

These non-cash items need to be properly recorded on the income statement, but disregarded for the cash flow statement.

Learn More

Visit Accounting for Management's website for some additional information about non-cash investing and financing activities to keep in mind as we work through the cash flow statement process.

Cash and cash equivalents are those items on the balance sheet that are liquid assets. Cash can be spent, so it is the most liquid of the assets.

Cash equivalents might include money market accounts, treasury bills or commercial paper. It is essentially a place to sit money, to make a return on it. Cash sitting in a checking account may get no interest, but a money market account will earn interest while it sits. In this way, a company can put its idle cash to work.

These cash equivalents are pretty easy to move to a checking account if the cash becomes needed, but getting interest rather than just letting it sit there is a smart step!

Practice Questions

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13.10: Operating Activities

Learning Outcomes

- Identify cash flows that result from operating activities

You have been asked to figure out cash flow for your company. Luckily, your supervisor has only asked you to do the operating activities section! But what items are included here? As you look through the income statement and balance sheet, what stuff do you need to be looking for? Also, what the heck is coming in (inflows) and going out (outflows)? Let's watch a few examples first and then tackle the operating activities portion of our cash flow statement.

Learn More

Visit this site for an example and explanation of cash flow from operating activities indirect method.

Learn More

Also note, there are two methods to compute a cash flow statement. Direct and indirect. Take a look at this video for an explanation of the two methods. Remember companies only use **one** of these methods, and it is typically the **direct** method, but you should be familiar with both!

There are several sections that comprise the cash flow statement. The first portion of the cash flow statement includes what are called operating activities. These are cash transactions that happen in the normal course of business, affecting the revenue and expense accounts on your income statement. Operating activities can include the following items:

Description	**Inflow**	**Outflow**
Collect cash from your customers	X	
Pay for inventory		X
Pay your bills! (utilities, rent, insurance)		X
Pay your employees		X
Pay interest on loans		X
Pay your taxes		X

Collecting cash if the only cash inflow here! The other items are all cash leaving your business, also called outflows. So from now on, money coming **in** will be called an **inflow** and money going **out** will be called an **outflow**.

This portion of the cash flow statement can help you to better understand the need to have an effective accounts receivable system! If you sell product, but can't collect the cash in a timely fashion, it may become difficult to meet your bill payment deadlines. If you don't pay your bills on time, vendors, your employees and the government (especially the government) might not be happy with you.

In our budgeting module, we put together a cash budget. A cash budget is an important component of the financial health of all companies. Having enough cash coming in from customers and clients to cover the cash going out to meet payment responsibilities is crucial to successfully running or managing a business.

Practice Questions

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13.11: Investing Activities

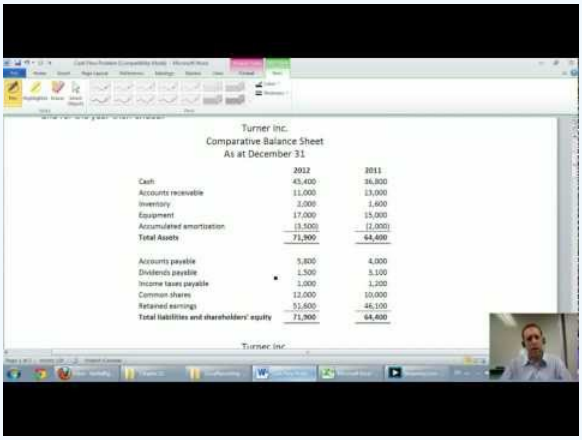
Learning Outcomes

- Identify cash flows that result from investing activities

The second section of the cash flow statement involves investing activities. We will again be chatting about **inflows** and **outflows** as it relates to investments.

Learn More

Watch this video to get an explanation of the investing activities part of the cash flow statement:



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What happens when we buy an asset? Let's say we buy a truck for our business. As we discussed earlier, we put the purchase price of the truck as an asset on our balance sheet, then we take small amounts as an expense each month as depreciation to spread the expense out over time. If we purchased the truck for $25,000, from a cash perspective, we had a $25,000 **outflow**, right? So even though the truck goes to the balance sheet, we need to note the **entire purchase** price (if we paid cash) on our cash flow statement.

Now we sold a truck for cash! We will remove the truck from the balance sheet, and stop the depreciation, but whatever we received in cash for the truck will show up on our investing section on our cash flow statement. This will be an **inflow**.

We might also buy stock (cash outflow) or sell stock (cash inflow). Maybe we lend money to another company (cash outflow) or collect money on a loan we previously gave (cash inflow).

So if you invest in property, plant, equipment, stocks, bonds or another company, these are all investment activities on your cash flow statement. Here is a little chart to help make this a little easier:

Description	**Inflow**	**Outflow**
Buy assets (property, plant, or equipment)		X
Sell assets	X	
Buy stocks, bonds, or other investments		X
Sell stocks, bonds, or other investments	X	
Lend money		X
Collect principal on money you lent	X	

Practice Questions

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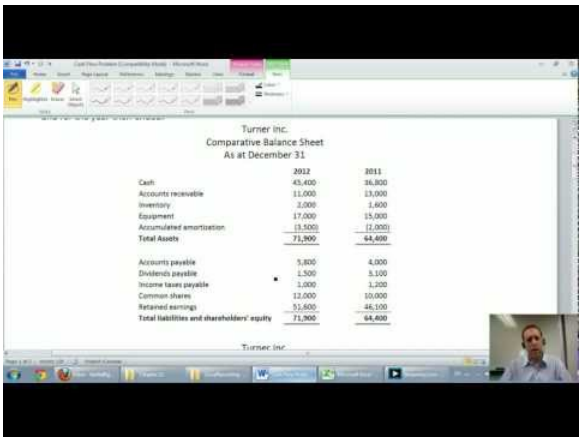
13.12: Financing Activities

Learning Outcomes

- Identify cash flows that result from financing activities

So the third part of the cash flow statement involves financing activities. If a company borrows money, this is a financing activity. There are some inflows from financing activities including borrowing money or selling common stock. Outflows from financing activities include paying the principal part of debt (a loan payment), buying back your own stock or paying a dividend to investors.

Ready to jump in? Let's start with this video explanation:



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If a company borrows money, the entire amount of the cash comes in at one time, right? So that entire amount will be reflected on your cash flow statement.

Let's look at inflows and outflows from financing activities:

Description	Inflow	Outflow
Borrow money	X	
Repay the principal amount on a loan		X
Sell your own common stock	X	
Buy back your own common stock		X
Pay a stockholder dividend		X

Can you think of any other activities that may be considered financing activities? If you look at your personal expenditures, a car loan or mortgage might be a financing activity!

Practice Questions

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13.13: Introduction to Direct Method versus Indirect Method

What you'll learn to do: Distinguish between the Direct and Indirect methods of preparing a statement of cash flow

There are two ways we can build a cash flow statement. Both ways end up at the same answer, but in a different way.

The direct method, the income statement is reformulated on a cash basis, rather than an accrual basis from the top of the statement (the income part) to the bottom (the expense part).

The indirect method works from net income, so the bottom of the income statement, and adjusts it to the cash basis. We will look at both methods with the same data, so you can see the differences in analysis, but the same ending number.

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13.14: The Indirect Method

Learning Outcomes

- Calculate cash flows from operating activities by the indirect method

Let's look at the indirect method first. Remember from our previous conversations, companies only use **one** method and typically they use the direct method! We just want to talk about the indirect method so you understand the concept!

The indirect method starts with your net income and adds or subtracts the items based on changes in their balances. Remember the operating activities that affect cash flow:

Description	**Inflow**	**Outflow**
Collect cash from your customers	X	
Pay for inventory		X
Pay your bills! (utilities, rent, insurance)		X
Pay your employees		X
Pay interest on loans		X
Pay your taxes		X

There are related accounts on the balance sheet, that when changes happen, we need to know how they affect the statement of cash flows:

	If the account balance increases	If the account balance decreases
Current Assets		
Accounts Receivable (money from customers)	Subtract	Add
Inventory (buy or pay for inventory)	Subtract	Add
Prepaid expenses (insurance)	Subtract	Add
Current Liabilities		
Accounts Payable (pay your bills)	Add	Subtract
Accrued Liabilities (payroll)	Add	Subtract
Income taxes payable (tax payments)	Add	Subtract

This can be a really confusing concept, so let's look at some examples.

- 1/1/20XX Accounts Receivable Balance $5000
- 1/31/20XX Accounts Receivable Balance $4000

The account balance **decreased**, so we need to **add** $1000 to our cash for the month **because** we received that much more in cash from our customers.

Let's look at another one!

- 1/1/20XX Accounts Payable Balance $8000

- 1/31/20XX Accounts Payable Balance $5000

The account balance **decreased** so we need to **subtract** $3000 from our cash for the month **because** we paid down our accounts payable balance?

Hopefully this is making more sense! If you are working on a cash flow statement, you can keep the little chart with you!

Practice Questions

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13.15: The Direct Method

Learning Outcomes

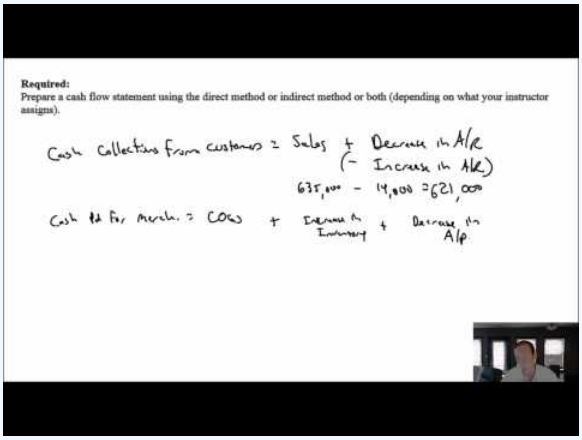
- Calculate cash flows from operating activities by the direct method

Sales are great at your company, but cash flow is a mess! You are working on your cash flow statement trying to figure out what is going on. When you look at your income statement, you see sales of $20,000, which is an increase of 50 percent over last month! This is amazing. Why then, are you needing to take money out of your working capital line of credit to cover payroll? These are the questions a good cash flow statement can answer.

When working from the income statement and taking it back to cash basis from the accrual basis, some of the answers to these questions become very clear. Once you take a look you notice that payroll expense was higher to meet the higher sales demand. But since you offer net30 day terms to your customers, you are waiting on payment from them. The hope is this is a short term blip while your cash received from customers comes in to cover your line of credit payment. So what looks good on an income statement, could create temporary or long term cash flow issues!

Learn More

Let's dig in a little further and discuss the direct method of preparing your cash flow statement. Stop back over and review this video for a quick reminder:



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So the direct method, starts with the income statement and rebuilds it on the cash basis. Most companies operate on the accrual basis, where income is recognized when it is earned and expenses are recognized when they occur, so in order to see how much cash we spent or earned, we need to adjust those amounts to the actual cash we spent or received.

This is the method that will typically be used. Feel free to go back and watch the videos again for a review here!

In this method, we wouldn't be concerned with changes in the accounts receivable balance. We would simply look at how much cash was paid by customers for the month. So, in our conversation about the indirect method, you noticed that the accounts receivable balance went down. If we look at this from a direct method:

- Cash received by customers: $10,000
- Cash spent on bills/expenditures: $5,000
- Cash paid for payroll: $3,000
- Net increase in cash for period: $10,000 − $5,000 − $3,000 = $2,000

So it wouldn't matter if sales for the month was $20,000, purchases were $2,000 and payroll was $3,000 for the month right? What might that show? Well, if sales was $20,000 but we only received $10,000 in cash we either have difficulties collecting our

accounts receivable, or we have net 30 and the sales last month was much lower than this month, right?

Cash flow can be a huge challenge, especially for small businesses. So, if we struggle with collection on our receivables, or if we have a low sales month, or an unexpected expense. This is where the cash flow statement can be very important to the health of a company.

Practice Questions

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CHAPTER OVERVIEW

14: Performance Evaluation in Organizations

14.1: For-Profit Organizations
14.2: Non-Profit Organizations
14.3: Putting It Together- Performance Evaluation in Organizations
14.4: Assignment- Performance Evaluation in Organizations
14.5: Why It Matters- Performance Evaluation in Organizations
14.6: Introduction to Non-Financial Performance Measures
14.7: Balanced Scorecard
14.8: Performance Reports
14.9: Introduction to Financial Performance Measures
14.10: Trend Analysis of Financial Statements
14.11: Common-Size Analysis of Financial Statements
14.12: Ratio Analysis of Financial Information
14.13: Introduction to Evaluating an Organization

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14.1: For-Profit Organizations

Learning Outcomes

- Evaluate a for-profit organization's performance using financial and non-financial data

We have looked at a variety of financial and non-financial ways to evaluate an organization's performance. Businesses use these types of information to manage their businesses and to create reports to share the data with others. As a manager, it is important to understand the meaning of both types of information and how they might impact your business operations (Adams, 2017).

If you are only responsible for your own cost center, perhaps the accounting department, there will be no revenue, only the expense side meeting a budget or benchmarks. In this case, your report will only include the expense portion, but you will still be looking at similar situations, but revenue and net income will not be included in your report.

Performance evaluation can be done using both financial and non-financial information. You, as a manager, may be held responsible for a certain level of sales in your department, which is a financial measure. Another area you may be responsible for, could be defect free units produced per shift by those you manage. This is a non-financial measure of performance. Both are important components of your work, and are reflective of performance.

Marketing evaluations also include both types of data. If you work in the marketing area, you may look at the breakdown of sales by different industries or product lines. But from a non-financial standpoint, noticing the demographics of your customers may be important. We could look at Simply Yoga as an example. When they market, it would be important to know WHO their primary student base is, to effectively spend their marketing dollars. Then, they could evaluate from there, how effective the ad campaigns were from a financial standpoint by looking at each style of class offered, which ads were targeted to those classes, and who ultimately attended. There is a correlation of the financial and non-financial data that when looked at in whole, creates a picture for business improvement.

Monthly, quarterly and yearly evaluations are used to determine the health of a company. Financial information may include the income statement, balance sheet, cash flow analysis and comparisons to static or flexible budgets. Non-financial information could include sales quantities by item, number of customers, defect free production, lowered inventory waste or a myriad of other benchmarks depending on the business.

Setting **goals** is crucial to any business, and financial and non-financial data is used to create realistic and manageable goals, which can create an environment to promote business growth. As a manager, you may set a goal for your employees of reducing machine downtime by 10% in the next month or increasing the sales calls per day as a non-financial goal. You may also look at financial goals such as increasing sales by 5% or reducing utility costs.

As you can see, there are as many different ways to evaluate a business for performance as there are businesses! Taking a look at the financial information, and then evaluating non-financial benchmarks are important!

Practice Questions

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References

Adams, Kathy. (2017, September 26). Nonfinancial Vs. Financial Information. Bizfluent. Retrieved from https://bizfluent.com/info-7758431-n...formation.html

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14.2: Non-Profit Organizations

Learning Outcomes

- Evaluate a non-profit organization's performance using financial and non-financial data

Since non-profit accounting systems are beyond the scope of this course, we will briefly discuss financial and non-financial performance goals.

Non-profit organizations may have different goals and needs than for-profit organizations as they work towards a mission or goal that is not profit driven. Financial aspects will include meeting budgets and following granting and funding organization's reporting requirements. This process too, will vary by organization.

Non-financial goals are many in non-profits. Serving a specified number of clients is typically a very important goal in most agencies. Agencies also need "inkind" or non financial support through volunteer hours and donated supplies. Many agencies have requirements through funders, to obtain a certain amount of match to meet goals. Let's look briefly at a small non-profit organization that operates a food shelf and retail thrift store.

	Budget	Actual	Over/(under) budget	% Over/(under) budget
Income				
Retail Sales	$5,000	$6,120	$1,120	22%
Donations	$1,250	$286	($424)	−34%
Grants	$1,250	$1,250	$0	0%
Total Income	$7,500	$8,196	$696	
Expenses				
Rent	$500	$500	0	0
Utilities	$225	$280	$55	24
Payroll	$5,000	$5,125	$125	3
Supplies	$500	$700	$200	40
Marketing	$500	$400	($100)	−20%
Fundraising	$500	$250	($250)	−50
Total Expenses	$7,225	$7,225	$30	0
Net Position	$275	$941	$666	242

So what would some issues be that this little agency would need to look at from a financial standpoint? The first thing that stands out is a pretty large difference in donation levels compared to what was budgeted. This leads to a potential non-financial issue as well. We could then evaluate **how** donations are being requested. Are there a certain number of phone calls to be made each month by volunteers? Is the clerk at the retail store asking for donations at the conclusion of a sale?

Payroll was a bit high, so evaluating that expense line from a financial perspective would include looking at the hours worked to determine if overtime was a factor. Non-financial aspects might include analyzing the time used for opening and closing the store, or looking at procedures that may help to reduce hours worked.

As you can see, the non-profit organization brings a whole different set of challenges that are not within the scope of this course. This agency is not interested in making a profit, but in meeting the goals of the organization, by providing food to families in need

through the sale of donated items. It is a mission driven organization rather than profit driven!

Practice Questions

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14.3: Putting It Together- Performance Evaluation in Organizations

When we start to look at the financial statements of an organization, many questions come to mind to help improve operations and improve profitability. The numbers only tell part of the story, so we must dig deeper, looking at ratios, comparing budget to actual, evaluating trends and then looking at non-financial information as well.

The ability to analyze not only the financial data, but the non-financial data as well, is a crucial skill to being an effective manager. Customer and employee satisfaction, along with the internal business processes all will have an effect on the operation of a business. As an example, overlooking the number of complaint calls from customers may have a long term effect on sales. High employee turnover may affect the budgeted payroll numbers. So, the financial and the non-financial intertwine.

Learning these skills will be important in your work as a manager, so taking the time to practice and understand how to analyze is crucial!

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14.4: Assignment- Performance Evaluation in Organizations

For this assignment, you will download and complete the following worksheet:

- Assignment: Performance Evaluation in Organizations (.docx)

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14.5: Why It Matters- Performance Evaluation in Organizations

Financial data such as sales and expenditures are crucial to managing and improving business operations. Comparing sales from year to year, or expenditures as a percentage of sales can give you excellent information about operations. Budgetary analysis will help managers see if they are on track with projections, or if they need to improve.

Just as important are non-financial markers such as number of customer complaints or machinery downtime. These markers can be use to help improve operations as well.

Understanding the myriad of financial and non-financial pieces of information that go into analysis of business operations will bake work as a manager easier. Knowing what benchmarks you have in place, and where you are on a weekly, monthly, quarterly or yearly basis can make for higher profitability, happier employees and satisfied customers!

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14.6: Introduction to Non-Financial Performance Measures

What you'll learn to do: identify common non-financial measures of performance and discuss their impact on an organization

There are many non-financial performance measures that companies can use to examine how well their business is doing. There are common ones, and ones that are industry of business specific. We will discuss these measures in this unit. Let's look at something called the "balanced scorecard."

The balanced scorecard includes 4 levels of performance measures:

1. Financial
2. Customers
3. Internal business processes
4. Learning and growth

We have talked a lot about financial measures, so let's take a look at the other components of a successful business.

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14.7: Balanced Scorecard

Learning Outcomes

- Discuss non-financial components of the balanced scorecard

Practice Questions

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14.8: Performance Reports

Learning Outcomes

- Describe what a performance report is

You are the manager at Simply Yoga. The owner just walked in and asked you "How are we doing? How are we performing?" What reports can you offer her that can help her see the big company picture? Well, the financial statements are a start. Are you showing a net profit? Is there cash in the checking? Are all of your payments going out on time and are customers paying on time? In addition, the non-financial stuff is important. Are customers coming back time after time? Are they bringing friends with them? How are complaints handled?

A performance report will help you, as a manager, compare "apples to apples," by expanding the budget documents to include revenue, spending and activity variances to clarify why differences happened, and whether they are truly unfavorable, or if the variances make sense! In addition, customer and employee surveys will help you to know if you are meeting all of those non-financial benchmarks that will keep you growing!

So let's take a look at their budget, flexible budget and variances to show how changes in quantities or breakdowns can affect the budget:

	Planning Budget	Flexible Budget	Activity Variance	Favorable/Unfavorable
Classes taken	500	600		
Revenue ($14/class)	$7,000	$8,400	$1,400	F
Expenses				
Wages and Salaries	$3,500	$4,200	$700	U
Yoga Supplies	$250	$300	$50	U
Utilities	$500	$600	$100	U
Rent	$500	$500		
Insurance	$100	$100		
Other Expenses	$250	$300	$50	U
Total Expense	$5,100	$6,000	$900	U
Net Operating Income	$1,900	$2,400	$500	F
F= Favorable				
U= Unfavorable				

See the difference in revenue and number of classes? The increase in classes taken creates additional revenue, which shows as a favorable variance. But when we get down into the expense area, the increased wages, supplies and other expenses, show as unfavorable. Is that really true? Well, the answer to that is, it depends!

If the case of Simply Yoga's planning and flexible budgets, the increase in revenue would lead you, as the manager, to think additional wages make sense! Let's take a closer look comparing the budgets to actual.

So expanding Simply Yoga's budgets and actual to include variance information gives a better picture of the variances so we can determine performance.

	Actual Results	Revenue and Spending Variances		Flexible Budget	Activity Variance		Planning Budget
Classes Taken	650			600			500
Revenue ($14/class)	8190	−210	U	8400	1400	F	7000
Expenses							
Wages and Salaries	4550	350	U	4200	700	U	3500
Yoga Supplies	355	55	U	300	50	U	250
Utilities	500	−100	F	600	100	F	500
Rent	500	0		500	0		500
Insurance	100	0		100	0		100
Other Expense	325	25	U	300	50	U	5100
Total Expense	6330	330	U	6000	900	U	5100
Net Operating Income	1860	−540	U	2400	500	F	1900

Now, with this additional information, how do you view the actual results of the month of classes, compared to the flexible and planning budgets?

Well, the first thing to note is there were more classes taken, but the revenue was lower (unfavorable variance) compared to the flexible budget. After chatting with the studio manager, you find out that she offered a 10% discount on the $14 per class charge this month in an effort to bring in new students! But, also of note, the teachers were still compensated at their $7 per student rate, so we show an unfavorable spending variance in wages too.

How does this more detailed information help you to better understand what happened at the yoga studio? We now know that a lowered cost will bring in more students, but it will also lower our net income. This might be good, if all of these students continue to come. So the next month's performance report will be important to review. We also noted, that utilities don't necessarily go up if class participation goes up! This is also an important budgeting note!

This illustration can help you to get a clearer picture of performance, than a simple budget to actual comparison!

So, income didn't go up but the number of people attending classes did. Why? An explanation can help to clarify the reasons for variances. In our example, a conversation with the studio manager helped us to understand why the student count went to 650, but our income was lower, by $210 than if we had 600 students. What the heck happened?

She let us know that a promotion had been run, offering a 10% discount on classes for the month to encourage more students to try out classes. This offer was extended to current and new students, and it did it's job, by bringing in additional students this month! But, will this be a good plan long term? We will take a look at the variance report in following months to see if those additional students continue to attend, when the price goes back to full price.

Another piece of information that may be important to ask our studio manager, would be how many of those additional classes attended were by **new** students, and how many were current students adding a class? This will further help to determine the efficacy of this promotion. It will also help to determine additional promotions and how to structure them. Perhaps we want to extend a discount to new students only? Or maybe try a discount if you bring a friend promotion?

Building business and understanding the variances in performance reports is a crucial component to effective management! What other ideas can you think of that may be useful for Simply Yoga?

Practice Questions

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14.9: Introduction to Financial Performance Measures

What you'll want to do: Analyze an organization's financial performance

Financial performance measures are outlined in the financial statements of companies. The income statement, balance sheet and cash flow statements can be used in a variety of ways through horizontal, vertical and ratio analysis to determine the best ways for companies to grow, set goals and become more profitable.

We will discuss various performance measures from a financial standpoint and how they can be used to grow businesses.

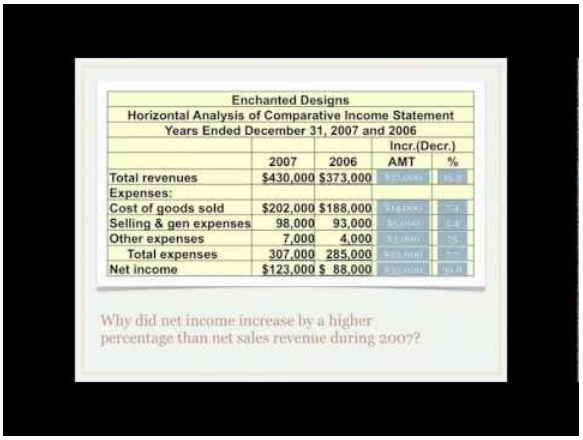
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14.10: Trend Analysis of Financial Statements

Learning Outcomes

- Perform a trend analysis on a financial statement

So back when we were talking about Simply Yoga, and the promotion their studio manager offered to students in an effort to increase class attendance, we mentioned looking at the next months to see if the additional students stayed on taking classes. We also talked about some other ways they may increase participation, including new student or “bring a friend” discounts.



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Let’s take a look now at a “trend analysis” or horizontal analysis. This involves looking at financial data within a set of financial statements. In this case, we are going to look at two actual income statements for Simply Yoga, covering two quarters of sales and expenses. This can help us to better understand if the promotions are helping to build up the student base, or if changes are needed.

	This Quarter	Last Quarter	Amount	Percent
Classes Taken	640	650	−10	−2%
Revenue ($14/class)	$8,960.00	$8,190.00	$770.00	9%
Expenses				
Wages and Salaries	$4,480.00	$4,550.00	($70.00)	−2%
Yoga Supplies	$420.00	$355.00	$65.00	18%
Utilities	$500.00	$500.00	$0.00	0%
Rent	$500.00	$500.00	$0.00	0%
Insurance	$100.00	$100.00	$0.00	0%
Other Expense	$380.00	$325.00	$55.00	17%
Total Expense	$6,380.00	$6,330.00	$50.00	1%
Net Operating Income	$2,580.00	$1,860.00	$720.00	39%

So it looks like our studio manager made a good decision! The quarter she offered the discount brought in more students. Although we lost a little traction in the subsequent quarter, it wasn’t enough to worry about. When we went back, in the new quarter, to full

priced classes, the majority of the students stayed! Also, note, our wages went down a bit, but our net income was still higher! Since we paid our teachers the full rate per class, even with the discount to the students in the previous quarter.

Continued monitoring as time progresses will help us to get an even better understanding of the trends from this promotion. Knowing how promotions affect sales, wages and other expenses will help to be able to more successfully implement further programs to increase participation, and ultimately revenues.

Following up quarterly with trend analysis will help to improve overall business function and keep an eye on any issues with revenues or expenses that may need attention! Can you see how important continually monitoring financial statements can be?

Practice Questions

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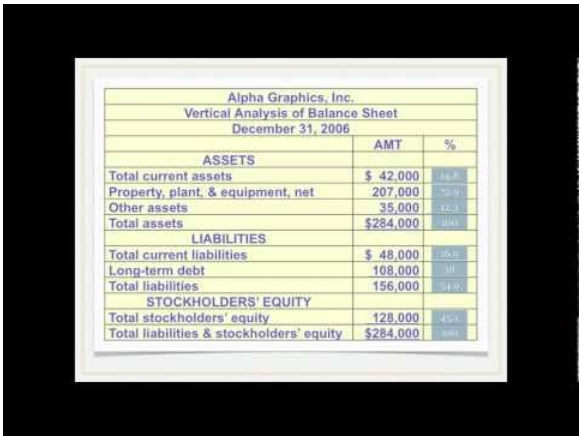
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14.11: Common-Size Analysis of Financial Statements

Learning Outcomes

- Perform a common-size analysis on a financial statement

Common size financial statements look at the relationship among financial statement accounts at a given point in time. This type of analysis is called **vertical analysis,** in contrast to the horizontal analysis we did in the previous section, which looked over time.



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So, we will look at financial statement accounts as a percentage of sales here. This is a helpful means to determine if a company is remaining efficient in expenditures as related to sales. We will again take a look at these same two quarters for Simply Yoga, noting that we will now be looking at how each expense line compares, as a percentage to the sales.

	This Quarter	Last Quarter	This Quarter	Last Quarter
Classes Taken	640	650		
Revenue ($14/class)	$8,960.00	$8,190.00	100%	100%
Expenses				
Wages and Salaries	$4,480.00	$4,550.00	50.00%	55.56%
Yoga Supplies	$420.00	$355.00	4.69%	4.33%
Utilities	$500.00	$500.00	5.58%	6.11%
Rent	$500.00	$500.00	5.58%	6.11%
Insurance	$100.00	$100.00	1.12%	1.22%
Other Expense	$380.00	$325.00	4.24%	3.97%
Total Expense	$6,380.00	$6,330.00	71.21%	77.29%
Net Operating Income	$2,580.00	$1,860	29%	23%

So now we can see how, for example, wages compared as a percentage of sales for the two quarters we are reviewing. Note, that the quarter we had the promotion going on, our wages were a higher percentage of sales. We can also note that our net operating income in this quarter is 6% higher than in the previous quarter. This is a good thing! As we move forward, continuing to add

quarters to this review will help us to see trends we would not see looking simple at budget to actual, no matter which budget we used.

In the case above, we can notice improvements in efficiency, and we may also notice areas needing improvement. An example is the increase in yoga supplies as a percentage of sales in this quarter. This would require a conversation with the studio manager, or any other employees responsible for purchasing supplies. This may be as simple as needing to replace some worn-out equipment, which might be a one-time blip of an increase. But what if it is due to supplies going missing due to theft? Then we would need to search further, to discover ways to keep this from happening.

Since we are paying $7 per class to our instructors, with a $14 per class fee, the wages should be 50% of classes attended as they are in this quarter. Remember, we asked the manager last quarter why our sales was lower on more classes? This common-size statement brings the same question to us, in a different way. With wages being a higher percentage of sales than they should, this is something that should be examined.

Each type of analysis has it benefits and limitations. So bringing in a variety of formats to review helps managers see the bigger picture, and help to improve profitability and operations of the company.

Practice Questions

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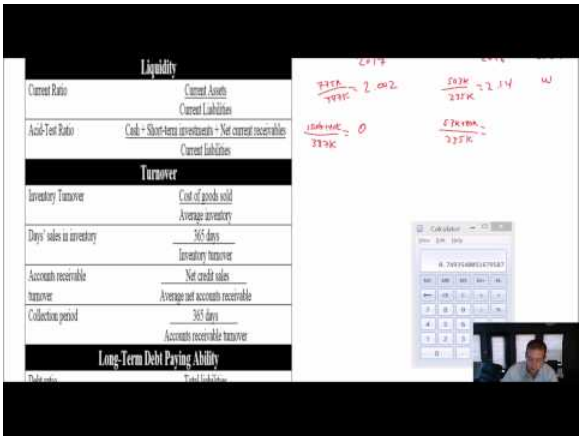
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14.12: Ratio Analysis of Financial Information

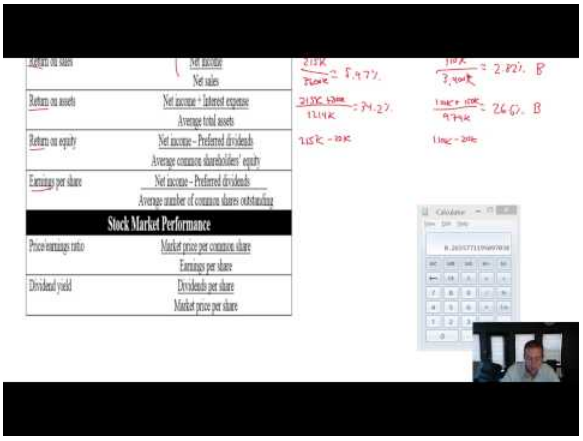
Learning Outcomes

- Perform a ratio analysis on a financial statement

Ratio analysis can be used in a variety of ways to glean information about the financial health of a business.



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Ok, so ratios are another amazing way to notice variances in assets, liabilities, income and expenses. There are tons of different ratios we could look at but let's take a couple and examine them for Simply Yoga. Take a look at their balance sheet.

Current Assets:	
Cash	9550
Accounts Receivable	900
Prepaid Expenses	1100
Total Current Assets	11550
Property and Equipment:	
Yoga Props (less accum depr)	1500
Total property and Equip.	1500
Total Assets	13050
Current Liabilities:	
Accounts Payable	710
Payroll Taes Payable	672
Payroll Taxes Payable	1382
Total Current Liabilities	
Long Term Liabilities	
Loan Payable	6500
Stockholder's Equity	
Common Stock	1000
Retained Earnings	4186
Total Equity	5168
Total Liabilities	13050

Let's talk first about the working capital ratio. The formula is:

Working capital= current assets−current liabilities

$10,168=$11,550−$1382

So, this shows that Simply Yoga has plenty of funds to pay current liabilities, which is a good thing! **But**, it also shows that they are holding more funds in a very liquid account, which may be better used to pay off any higher interest debt, such as their loan payable. This is an area for review, right?

The current ratio is another way to look at the ability of a company to cover short term debt.

Current Ratio = Current assets/Current Liabilities

8.36=$11,550/$1,382

What this tells us is that Simply Yoga has enough current assets to cover their current liabilities 8.36 times. *Again*, this is a good thing, unless they are paying a crazy amount of interest somewhere else. Might that cash be better used to pay off that loan they have sitting on the books?

Learn More

There are tons of ratios out there, that depending on the company and what you are looking for, may be helpful! Check out this great resource for ratio analysis. More ratio formulas can be found here. These ratios may come in handy, so go ahead and print out the list!

What might be some other ratios you would consider for Simply Yoga from the list?

Practice Questions

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14.13: Introduction to Evaluating an Organization

What you'll learn to do: Evaluate an organization's performance using financial and non-financial data

We have discussed many financial and non-financial ways to evaluate the performance of an organization. Whether we are looking at customer satisfaction, current ratios or common-size financial statement analysis, each one has attributes that can help you, as a manager determine company performance. These evaluations can also offer insight into ways to improve company operations and performance.

We will look at some ideas for profit driven companies, and also take a brief look at not-for-profit entities. These types of organizations, due to not being profit driven, may have a completely different need for analysis.

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CHAPTER OVERVIEW

15: Capital Budgeting Decisions

15.1: Simple Rate of Return
15.2: Introduction to Risk and Capital Budgeting
15.3: Risk and Return
15.4: Introduction to Finalizing Capital Budgeting Decisions
15.5: Analyzing a Project
15.6: Postaudit
15.7: Putting It Together- Capital Budgeting Decisions
15.8: Assignment- Capital Budgeting Decisions
15.9: Why It Matters- Capital Budgeting Decisions
15.10: Introduction to Capital Budgeting
15.11: Steps of Capital Budgeting
15.12: When to Make Capital Budgeting Decisions
15.13: Time Value of Money
15.14: Introduction to Budget Methods for Making Decisions
15.15: The Payback Method
15.16: Internal Rate of Return
15.17: Net Present Value

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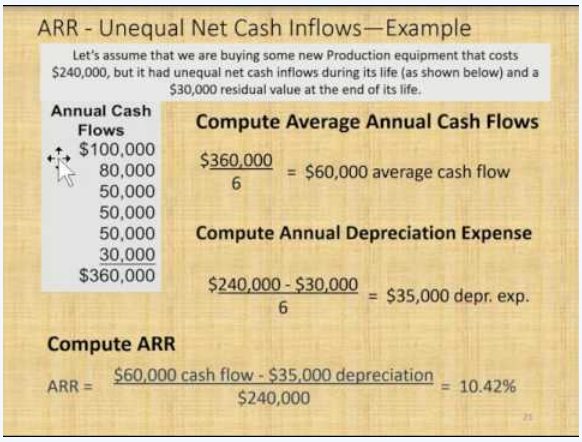
15.1: Simple Rate of Return

Learning Outcomes

- Describe the simple rate of return method

The simple rate of return is calculated by taking the annual incremental net operating income and dividing by the initial investment. When calculating the annual incremental net operating income, we need to remember to reduce by the depreciation expense incurred by the investment.

Watch IT



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Let's take a look at an example.

Hupana Running Company is looking at adding a stitcher that will add $40,000 to the revenues of the company per year. The incremental (additional) cash operating expenses of this piece of equipment would be $5,000 per year, and the equipment has a cost of $100,000 with a 5 year life and no salvage value. So let's pop these numbers into the formula:

Hupana Running Company—Stitcher Purchase	
Annual incremental revenue	$40,000
Annual incremental operating expense	$5,000
Annual depreciation ($100,000/5 years)	$20,000
Annual incremental expenses	$25,000
Annual incremental net operating income/(loss)	$15,000

So the simple rate of return would be: annual incremental net operating income/ initial investment cost

$15,000/$100,000= 15% simple rate of return

So it looks like the stitcher would be a good investment! What if we change up the numbers a bit. The stitcher will still add the $40,000 to revenues, but will add $10,000 to annual operating costs and only have a useful life of three years.

Hupana Running Company—Stitcher Purchase	
Annual incremental revenue	$40,000
Annual incremental operating expense	$10,000
Annual depreciation ($100,000/ years)	$33,333
Annual incremental expenses	$43,333
Annual incremental net operating income/(loss)	−$3,333

We now have a negative rate of return, so would probably pass on making this purchase. This brings home the point of how important it can be to know your numbers and do your research! Also noting, a small difference, can make a huge difference in the decision to make a capital budgeting decision, so as a manager, be clear on your information and perhaps use several of the available methods before making a final decision or before taking your analysis to your supervisor!

Practice Questions

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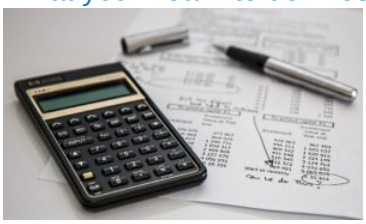
For additional practice look at this exercise on the simple rate of return method.

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15.2: Introduction to Risk and Capital Budgeting

What you'll learn to do: Describe different ways to identify and measure potential risk of investments



There are risks in all investments. When we invest in a capital improvement, piece of equipment or project there are many ways it may not work out in the way we thought it might! Risk is the potential that a chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome). The notion implies that a choice having an influence on the outcome exists (or existed). Potential losses themselves may also be called "risks."

A variety of risks exist in any capital budgeting process; thus, risk analysis is incredibly important when companies make capital budgeting decisions.

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15.3: Risk and Return

Learning Outcomes

- Evaluate a party's risk aversion when proposing investment opportunities

A friend comes to you with an investment opportunity. He gives you the information on the investment and you have some concerns, since you tend to be conservative. He says you have the chance at a 1000% rate of return over the next 10 years if the business does well, or you could lose it all if the business fails. Would you put your money in a savings account and be assured a 5% rate of return, or would you put the same amount of money on the risky investment with your friend? How you decide shows your level of risk aversion! Time is also a factor in this decision. Are you willing to risk your funds for ten years, or will you need the principal returned prior to that time?

If you have a high level of risk aversion you will put that money into the bank and collect your small return. If you have a low level of aversion to risk, you will go with the friend's investment and hope for the best!

Watch It



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Just as some of us are more able to accept risk, businesses have a similar situation. We, as humans, don't like to expose ourselves to unnecessary risks, so when a business is looking at a huge investment, they want to expose themselves to as little risk as possible.

We can look at this with the following example. You have the opportunity to put your money into a savings account at your local bank that will get you a 2% interest rate, every single year, without fail. You know, for sure, beyond any doubt that your $1000 will be worth $1020 after one year, $1040.40 after two years, and $1061.21 after three years.

Now, let's take that same $1000 and invest it in a volatile new start-up company. The forecast for this company shows a possibility of a 12% rate of return over the next few years, but there is also the risk of losing part of your $1000 investment. So now, you look at the possibility of having $1404.93 after three years, maybe . . . or the for sure of the interest rate from your bank!

The decision you make, tells us how adverse to risk you may be! Other reasons why someone may be adverse to risk include the desire to retire after three years. In this case, they may be less willing to risk the for sure scenario for the maybe. In the business world, if a new product line is untested, a company may be less likely to invest $100,000 in a new piece of equipment that has the possibility of a large rate of return, if they have the option to invest the same $100,000 in a tested market with a lower rate of return, but one that is less risky.

How long with an investment take to pay back the initial cash outlay? This factor is important as we discuss risk. The longer it will take to get the initial investment back, the more risk a company may face. There may have been errors in calculating the project initially. Over time, the market may change, creating additional risk for a capital purchase. This is one factor in determining the time horizon for a capital project.

The time horizon will vary based on industry as well. An example may be a pharmaceutical company, which will be looking at a potential investment in a new drug based on the life expectancy of the patient receiving the drug. This could be an extended time period. A software company, may be looking at a short time horizon, as new software comes out quickly and is replaced quickly.

Machinery in a printing company may have a 15 year time horizon, as this equipment does not become obsolete as quickly as a laptop computer does. The company investing in new equipment or facilities to build computer components may only be looking at a one to three year time horizon, thus will need to adjust their risk and rate of return on the investment to the anticipated life of the investment.

There are many complex formulas and calculations necessary when looking at the inherent risks of an investment, particularly a large capital investment. Variation of a percent one direction or the other could expose a company to either a huge loss, or a huge gain! These calculations and decisions cannot be made lightly, and take great skill.

- How many years will it take to get back our initial investment?
- What is the life of the equipment, building or project?
- What will the market be like for this product in five, ten or twenty years?
- Who might jump in as competition after we complete this capital project?
- Will the equipment become obsolete before we can get back our investment?

The questions surrounding capital budgeting and investment choices are staggering. Managers need to evaluate each of these decisions based on a variety of factors, and there is still a great deal of room for error. When calculating net present value, this calculation assumes that we will be investing right now, or not at all. This may not be the only option. It might be possible to do this capital expenditure today or in three years. What are the differences if we make a different decision?

Salvage value or resale of the equipment may be another option that influences an investment decision. We may be able to use it for five years, and sell it to another company to recover some of our investment. But HOW do we know if that is the case? We can't. So we need to make some assumptions and do the best we can in determining if an investment or capital expenditure will be profitable for the company.

Practice Question

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15.4: Introduction to Finalizing Capital Budgeting Decisions

What you'll learn to do: Discuss different influences on making capital budgeting decisions



In this module we will learn how to analyze replacement projects and investment proposals as well as identify the reinvestment assumptions of different capital budgeting methods.

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15.5: Analyzing a Project

Learning Outcomes

- Analyze a possible replacement projects to determine if it should be implemented

Let's assume you, as a manager are presented with two options for projects, and you need to decide which one to implement if any. You have been tasked with analyzing them to determine which may be a good fit for your company, and which one will bring the greatest financial impact to company profits.

This task can seem daunting at first, especially if the options are diverse. Once we have screened all potential projects to make sure they meet the company's minimum requirements to be considered, we can then rank them by preference before deciding. This process is used when there are limited funds, so all potential options cannot be implemented, or when only one project or piece of equipment would be needed. It may also be used to determine which project to implement first. So even if funds exist to implement more than one, ranking them in order of profitability is important in making capital budgeting decision.

So if funds are limited and only one option can be chosen, using either the internal rate of return (IRR) method or the net present value (NPV) method will yield the best results. Actually, do them both! If they conflict, the NPV method will probably be more reliable.

Using the IRR method, if one project has an IRR of 18% and a second project only has an IRR of 12%, then choosing the higher internal rate of return makes the most sense, right? When using the NPV method we need to adjust for differences in the initial investment of the project to be comparing apples to apples. We need to figure out what the project's profitability index is, based on the initial investment amounts. Let's look at an example:

Hupana Running Company — Which Choice??		
	Project	
	Stitcher	Sole Gluer
Initial investment required	$25,000	$15,000
Present value of cash inflows	$20,000	$10,000
Net present value	$5,000	$5,000

So back to Hupana again. They have limited funds and can choose to either purchase a stitcher or a sole gluer this year, but not both. Both pieces of equipment have the same net present value, but what is the project profitability for each choice?

Project profitability index = net present value of the project/initial investment required

Hupana Running Company		
	Project	
	Stitcher	Sole Gluer
Net present value	5000	5000
Initial investment required	25000	15000
Project profitability index	20.00%	33.33%

So which one would we pick? The one with the **higher** profitability index, right? So, the sole gluer it is! Maybe Hupana can revisit the stitcher when they have additional funds!

Practice Questions

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15.6: Postaudit

Learning Outcomes

- Conduct a postaudit on an example case to determine if the expected results were achieved

So you had prepared an analysis for your company of several different projects. One project was chosen based on the analysis. How can you know if the results were achieved? In a capital budgeting process, this is one of the key components because it holds managers accountable and helps to keep them honest in their proposals. Imagine for example, that as a manager, you really want your company to choose your investment proposal. You have worked long and hard on it, but you feel that it is coming up a bit short in the return on investment component. Without the post audit process, it might be too easy to fudge a number, by possibly inflating the benefits or minimizing the pitfalls.

The postaudit process will analyze the **actual** results, using the actual data from the project. Begin with the side-by-side analysis. So if a project was chosen based on net present value analysis, the postaudit should use the identical analysis to insure that you are comparing apples to apples.

If a project comes in very out of line with the original proposal, further analysis may be needed. By comparing the actual data to the estimated data, it will help to insure that submitted proposals in the future are carefully prepared. As a manager, if you are aware that your project will be evaluated you are more likely to make sure that your projected outcomes are accurate.

The postaudit process is an important one for all business decisions, but in the capital budgeting process it is crucial.

Practice questions

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15.7: Putting It Together- Capital Budgeting Decisions

When a company is faced with a large, capital budgeting decision, they have multiple ways to evaluate the potential options.

By first vetting possible projects based on your company guidelines and standards, then using one or more of several methods to analyze the decisions, it is hoped that a company can make the most profitable decision in the long term.

The payback method, net present value method, internal rate of return method and the simple rate of return method are all potential ways to work through these decisions. Learning the steps involved in each of these methods can help you, as a manager, to make good decisions, or to offer other managers insight into capital project decision making.

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15.8: Assignment- Capital Budgeting Decisions

For this assignment, you will download and complete the following worksheet:

- Assignment: Capital Budgeting Decisions (.docx)

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15.9: Why It Matters- Capital Budgeting Decisions

Capital budgeting decisions are big decisions for companies. Many times, they will have limited funds and several project options to consider. By looking at each option using several different methods, managers can get the information they need to spend limited dollars in the way that will bring the greatest rate of return.

We will discuss multiple methods that can be used to analyze various potential projects in a side-by-side way. Beginning with the screening process, which helps to determine if a project should move onto the next step,by meeting predetermined criteria of each individual business, through the post-audit, which evaluates whether the project we ultimately chose to fund, lived up to the expectations.

So these big decisions cannot be taken lightly. Whether you are buying a new piece of equipment, building a new production facility or doing a complete redesign of a website, it is important to analyze not only the cost of the project, but the future benefits of the project as well.

Are you ready?

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15.10: Introduction to Capital Budgeting

What you'll learn to do: Discuss capital budgeting



Capital budgeting is used to describe how managers may deal with huge buying decisions, such as new equipment, new product lines or a new manufacturing facility. Since there might be quite a few options, it is important to evaluate each to determine the most efficient and effective path for a company to choose.

How well a manager can make these kinds of decisions will have a big impact on the financial health, long term, of the organization. We will discuss each of the methods that can be used to evaluate these kinds of decisions.

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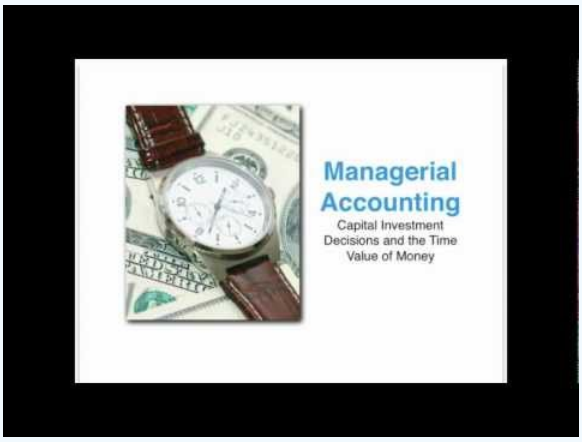
15.11: Steps of Capital Budgeting

Learning Outcomes

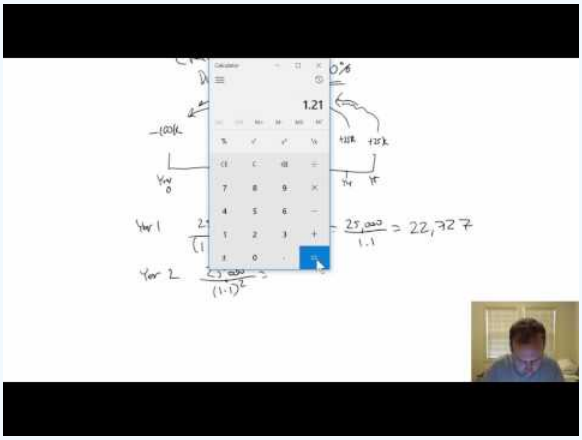
- Discuss the steps in the capital budgeting process

So let's say our supervisor comes to us with the following situation: We need to add a product line, and we have three options. Each option requires capital outlay including new equipment and manufacturing space. They all require a quite substantial initial investment. Where do we start?

Watch It



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The first step will be a screening decision. In this step we will look at all of the projects, and determine whether they meet the company's basic guidelines for consideration. Our company, may for example, require a 20% rate of return on a new investment before it will even be considered as an option. Once we screen all of the potential options, if any meet this guideline, we can move on the the preference decision.

The preference decision takes all of the projects that meet the screening process and then decide which to choose. Perhaps, we have three machines available that would all provide us with a 20% rate of return on the investment each year. Now, we need to decide between the three machines, which one to pick!

We can use a variety of methods once we get to this point to make our choice!

Practice Questions

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15.12: When to Make Capital Budgeting Decisions

Learning Outcomes

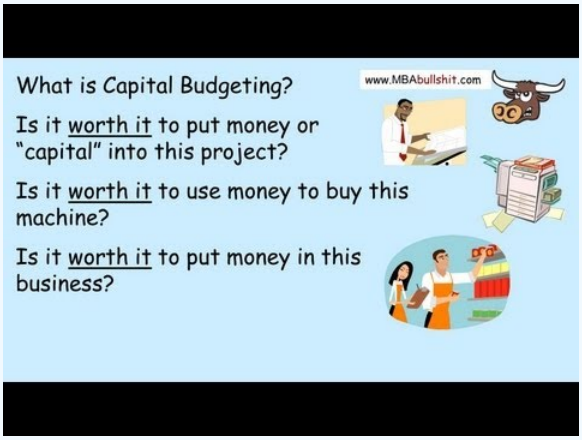
- Identify situations that require capital budgeting decision making

Mary walks into your office and announces, “Our machinery is 20 years old, and has become inefficient. We should think about replacing it with one of the new, faster pieces of equipment.” She has several pieces of paper in her hand showing beautiful and shiny machines will really high price tags!

Your company has a capital expenditure budget of $100,000 available this year and each of these machines has a price that approaches that amount. They also have payment and lease options. But you are thinking “will these new machines create enough in higher efficiency and costs savings to recoup this large investment, or will the ones we have continue to work just fine? Or which of the three would make the most financial sense for us right now?”

Watch It

Capital budgeting can help you to make these decisions.



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Capital budgeting decisions are for the big stuff. When might we need to make such a decision?

1. **Cost reduction:** Should we buy new equipment to reduce manufacturing costs? Might a newer machine save us money even considering the initial capital outlay?
2. **Expansion:** Would a new plant, warehouse or other building help to increase sales and capacity? Are we not making the income we could, by not expanding?
3. **Picking the equipment:** There may be three or more options for equipment at various prices with different options. Which one will make the most sense? We know we need new stuff, but with all of the various options out there, evaluation of all of the options is important.
4. **Leasing or buying:** Should we purchase a new piece of equipment or lease it? Sometimes leasing may be a better option!
5. **Replacement:** Should we replace a machine now, or wait? The machine we are currently using to make widgets still works, but it is slow and frequently breaking down. A new one is a huge investment, but how long will it take to pay for itself?

All of these situations require analysis to figure out which is going to be the best decision in the long run. We make these kinds of decisions personally when we evaluate buying a new car, dishwasher or house. Businesses go through a similar process to determine what will work best, and ultimately create the best financial outcome.

Practice Question

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15.13: Time Value of Money

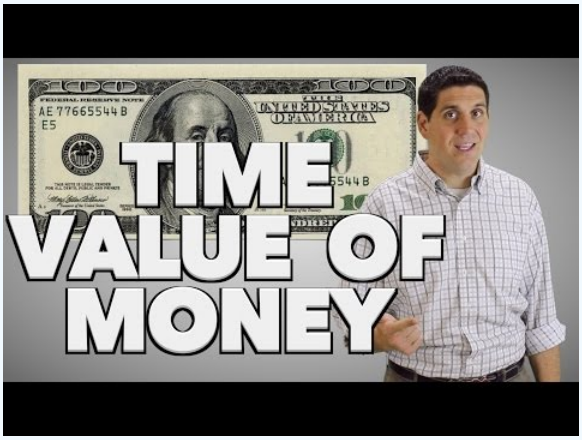
Learning Outcomes

- Discuss the time value of money

A dollar today is worth more than a dollar a year from now. If someone handed you a $1000 today, and you invested it or they offered you $1000 a year from now, which would you choose? The obvious answer is to take it now, right? What will happen when you put that money into an investment account? It will grow because you will get interest on it! If you stick the same $1000 in a drawer, it will not gain that value, and the buying power will be less than today.

The interest rate is an important component of the time value of money.

Watch It



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Present value can be calculated using the following equation:

$$PV = FV\frac{1}{(1+r)^n}$$

$$\begin{aligned} FV &= \text{Future value} \\ r &= \text{rate of return} \\ n &= \text{number of periods} \end{aligned}$$

So if you had the option of taking $1000 today, or $2000 in 10 years, and the interest rate is 8%, which would you take? We can calculate that as follows:

$$\begin{aligned} PV &= 1000 \\ r &= 8\% \\ n &= 10 \text{ years} \end{aligned}$$

Print the chart HERE.

So, if you follow the chart to page 2.This chart is the time value of $1, so we will need to multiply by 1000 to find our value!

Find 10 periods at 8% interest. At the end of the first period, your $1000 would be worth $1080 with the 8% interest, right? At the end of the second year it would be worth $1166.40 and so on. So at the conclusion of the 10 year period, your $1,000 at 8% interest would be worth $2,158.90 based on the time value of money. SO, now, would you take the $1,000 now, or wait and get $2,000 in 10 years?

From this example, it would be better to take the $1,000 NOW and invest it yourself! How would your answer change if the interest rate was 5%? Take a few options and practice with it!!

When we look at money this way, it is important to look at capital budgeting decisions on the basis of WHEN the cash flow will come back to us on an investment. If we invest $1000 today in a new piece of equipment that will not return our investment for 10 years. Is this a good decision? What if we have an alternative that costs $10,000, but we will get our money back on this one in 2 years? Which piece of equipment should we purchase?

Here is an online calculator you can use as well to check your work!!

Practice Questions

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15.14: Introduction to Budget Methods for Making Decisions

What you'll learn to do: Differentiate between the different capital budget methods



There are several methods to determine capital budgeting decisions. The payback method, internal rate of return, net present value and simple rate of return will be discussed. Most methods will use cash flow to determine which capital budgeting decisions to make.

Purchase price and how much we can expect to cash flow each year from various options will be needed to do analysis on these decisions. Let's take a look at these methods in detail.

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15.15: The Payback Method

Learning Objectives

- Describe the pay-back method

When we talk about the payback method, it is important to have a couple of pieces of information. First, we need the initial purchase price. We will also need to know what our net cash flow per year will be with this purchase. With this information, we can figure out how many years it will take to get our initial investment back.

This method, along with the net present value method and the internal rate of return method, all use cash flows to determine decisions. Typical cash outflows include the initial investment in the equipment or project, including any installation costs or additional capital needed. Cash inflows may include the salvage value of the equipment, if any, increase in revenues and decreases in expenditures.

Let's look at an example of the payback method.

Example

We purchase a $50,000 piece of machinery to make our widgets today. We will get $10,000 in net cash flow per year from this piece of machinery. What is our payback period?

5 years = $50,000/$10,000

So if we make this purchase, it will take us five years to get back our initial investment. Let's look at a couple of other options:

- **Machine A:** Purchase price $25,000. Net annual cash flow $5,000
- **Machine B:** Purchase price $36,000. Net annual cash flow $9,000

Machine A would pay back the initial investment in 5 years ($25,000/$5,000 per year) while machine B would pay back the initial investment in 4 years ($36,000/ $9,000 per year). So if we are just looking at the payback period, we would pick machine B, even though it costs **more** than machine A! The initial cash outlay is higher, but the money would be brought back into the company quicker. There may be other factors in play, but this method would encourage purchasing the more costly machine.

Practice Questions

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15.16: Internal Rate of Return

Learning Outcomes

- Describe the internal rate of return method

Your company is looking at purchasing a new machine for the production facility. You have narrowed it down to two choices. Each has a similar cost, but different net cash flows. Which one is a better investment for your company? Remember your time value of money as we work through this process! Are you ready? This might be complicated!!

This method goes back to the time-value of money. By looking at the rate of return we expect on an investment over the life of the investment, we can figure out the internal rate of return. So, this method uses the discount rate that equals the present value of cash outflows with cash inflows, resulting in a net present value of zero. This is a complicated topic, so let's look at an example.

Example

Hupana Running Company is looking at a machine that will attach the soles of the shoes in less time, with less utility cost than the current machine. This machine will cost $20,000, have a useful life of 5 years with zero salvage value. It will save the company $5,500 a year in labor and utility costs. So to calculate the internal rate of return on this purchase, we look at the following formula:

$$\text{Factor of the internal rate of return} = \frac{\text{investment}}{\text{annual net cash flow}}$$

In this case the machine costs $20,000 (the investment) and will save us $5,500 (annual net cash flow) in wages and utilities:

3.6364= $20,000/$5,500 so we can use 3.6364 from our present value table. (**Note:** You are going to want to print this to use for your test questions!)

We need to look at 5 periods, as that is the useful life of our machine, then move across to 3.6364. We find that the internal rate of return on this piece of equipment is between 11% and 12%, since our factor falls between those two. So, we are making between 11% and 12% on our investment with this purchase.

We could then look at various options to determine the best one for Hupana Running Company!

Practice Questions

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Learn More

For additional practice check out this example of the internal rate of return method.

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15.17: Net Present Value

Learning Outcomes

- Describe the net present value method

Net present value is defined as the difference between the present value of cash inflows and the present value of cash outflows over a period of time. It is used in capital budgeting to determine the profitability of a potential investment or project.

A positive net present value is a good thing, and denotes a project that will exceed the anticipated costs, both defined in present dollars. If an investment shows a negative present value, the company would lose money on the investment or project and should not proceed. So with this rule in hand, it would make sense to only follow through with projects with a positive net present value, or those that would make the company more money that the initial investment. It wouldn't make sense to invest money that would not be made back, plus a profit, right?

Using this method can be challenging, as there are many ways to determine the value of future cash flows. As an example, if we are using the savings in labor as a part of the positive cash flow for an equipment purchase, if wages go up substantially due to economic change, it could create a much better positive cash flow. But if over the same time, economic pressure brings down the labor rate, it could have the opposite effect on the potential positive cash flow of the same purchase.

Example

A restaurant is considering the purchase of an additional location in a neighboring town. Looking at potential revenues of the additional location for the next five years, discounted to present value—let's say comes to $250,000. If the owner of the additional location is willing to sell the restaurant for $250,000 or less, the purchase makes sense. If they are not willing to sell for less than $250,000 we would pass on this purchase. The awesome thing would be if the owner offered to sell for $100,000, creating a gain on the investment called intrinsic value.

There are pitfalls to the net present value approach, as there are will any of the methods. In our restaurant example, what if the current owner is selling due to impending competition moving in, or maybe a new highway is coming through that will divert traffic? Also, the payback period is only the five years as noted. Once our investment is earned back, will we continue to make enough money to keep the space open profitably? So many questions when we are making these capital budgeting decisions!

PRactice Questions

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For more practice check out this example on Net Present Value Method.

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Index

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Glossary

Sample Word 1 | Sample Definition 1

Glossary

Sample Word 1 | Sample Definition 1

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    - Table of Contents - *Undeclared*
    - Licensing - *CC BY 4.0*
    - 16.2: Course Contents at a Glance - *CC BY 4.0*
    - About This Book - *CC BY 4.0*
    - Assignments - *CC BY 4.0*
    - Learning Outcomes - *CC BY 4.0*
  - 1: Whole Numbers, Fractions, Decimals, Percents and Problem Solving - *CC BY 4.0*
    - 1.1: Introduction to Decimal Calculations - *CC BY 4.0*
    - 1.2: Place Value in Decimals - *CC BY 4.0*
    - 1.3: Adding and Subtracting Decimals - *CC BY 4.0*
    - 1.4: Multiplying and Dividing Decimals - *CC BY 4.0*
    - 1.5: Convert Between Decimals and Fractions - *CC BY 4.0*
    - 1.6: Introduction to Percent Calculations - *CC BY 4.0*
    - 1.7: Solving Problems Using Ratios - *CC BY 4.0*
    - 1.8: Writing Fractions and Decimals as Percents - *CC BY 4.0*
    - 1.9: Solving Problems Using Percents - *CC BY 4.0*
    - 1.10: Percent Increase and Decrease - *CC BY 4.0*
    - 1.11: Why It Matters- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving - *CC BY 4.0*
    - 1.12: Putting It Together- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving - *CC BY 4.0*
    - 1.13: Assignment- Whole Numbers, Fractions, Decimals, Percents, and Problem Solving - *CC BY 4.0*
    - 1.14: Introduction to Whole Number Calculations - *CC BY 4.0*
    - 1.15: Place Value in Whole Numbers - *CC BY 4.0*
    - 1.16: Rounding Whole Numbers - *CC BY 4.0*
    - 1.17: Adding, Subtracting, Multiplying, and Dividing Whole Numbers - *CC BY 4.0*
    - 1.18: Introduction to Fraction Calculations - *CC BY 4.0*
    - 1.19: Convert Between Types of Fractions - *CC BY 4.0*
    - 1.20: Adding and Subtracting Fractions - *CC BY 4.0*
    - 1.21: Multiplying and Dividing Fractions - *CC BY 4.0*
  - 2: Calculations and Solving Equations - *CC BY 4.0*
    - 2.1: Mark-Up Problems - *CC BY 4.0*
    - 2.2: Discount Problems - *CC BY 4.0*
    - 2.3: Simple and Compound Interest - *CC BY 4.0*
    - 2.4: Solving Formulas for a Specific Variable - *CC BY 4.0*
    - 2.5: Introduction to Reading and Using Graphs - *CC BY 4.0*
    - 2.6: Graphing Points on a Coordinate Plane - *CC BY 4.0*
    - 2.7: Identifying Trends of a Graph - *CC BY 4.0*
    - 2.8: Rate of Change - *CC BY 4.0*
    - 2.9: Analyzing Graphical Data - *CC BY 4.0*
    - 2.10: Putting It Together- Calculations and Solving Equations - *CC BY 4.0*
    - 2.11: Why It Matters- Calculations and Solving Equations - *CC BY 4.0*
    - 2.12: Assignment- Calculations and Solving Equations - *CC BY 4.0*
    - 2.13: Introduction to Solving Equations - *CC BY 4.0*
    - 2.14: Variables - *CC BY 4.0*
    - 2.15: Solving Single-Step Equations - *CC BY 4.0*
    - 2.16: Solving Multi-Step Equations - *CC BY 4.0*
    - 2.17: Introduction to Translating Word Problems into Equations - *CC BY 4.0*
    - 2.18: Translating Words Into Algebra - *CC BY 4.0*
    - 2.19: Algebraic Problem Solving Strategies - *CC BY 4.0*

- 2.20: Introduction to Solving Complex Equations - *CC BY 4.0*

- 3: Accounting Theory - *CC BY 4.0*
  - 3.1: The Annual Report - *CC BY 4.0*
  - 3.2: Introduction to Accounting Principles - *CC BY 4.0*
  - 3.3: The Accounting Entity - *CC BY 4.0*
  - 3.4: Basic Accounting Principles - *CC BY 4.0*
  - 3.5: Accrual Basis Accounting - *CC BY 4.0*
  - 3.6: Putting It Together- Accounting Theory - *CC BY 4.0*
  - 3.7: Assignment- Accounting Theory - *CC BY 4.0*
  - 3.8: Why It Matters- Accounting Theory - *CC BY 4.0*
  - 3.9: Introduction to Accounting - *CC BY 4.0*
  - 3.10: Roles of Accounting in Business - *CC BY 4.0*
  - 3.11: Financial Accounting Standards - *CC BY 4.0*
  - 3.12: Ethics and Accounting - *CC BY 4.0*
  - 3.13: Introduction to Users of Accounting - *CC BY 4.0*
  - 3.14: Users of Accounting Information - *CC BY 4.0*
  - 3.15: Organizational Structure - *CC BY 4.0*
  - 3.16: Forms of Doing Business - *CC BY 4.0*
- 4: Financial Statements of Business Organizations - *CC BY 4.0*
  - 4.1: Bookkeeping Terms and Phrases - *CC BY 4.0*
  - 4.2: Bookkeeping Journal Entries - *CC BY 4.0*
  - 4.3: Relationships Between Financial Statements - *CC BY 4.0*
  - 4.4: Key Information in Financial Statements - *CC BY 4.0*
  - 4.5: Introduction to Analyzing Data from Financial Statements - *CC BY 4.0*
  - 4.6: Reporting Inventories - *CC BY 4.0*
  - 4.7: Reporting Current Assets - *CC BY 4.0*
  - 4.8: Reporting Noncurrent Assets - *CC BY 4.0*
  - 4.9: Reporting Stockholder Equity - *CC BY 4.0*
  - 4.10: Reporting Unearned Revenue - *CC BY 4.0*
  - 4.11: Why It Matters- Financial Statements of Business Organizations - *CC BY 4.0*
  - 4.12: Reporting Expenses - *CC BY 4.0*
  - 4.13: Introduction to Other Financial Components - *CC BY 4.0*
  - 4.14: Core Financial Ratios - *CC BY 4.0*
  - 4.15: Calculating Return on Investment - *CC BY 4.0*
  - 4.16: Calculating Return on Equity - *CC BY 4.0*
  - 4.17: Other Key Ratios - *CC BY 4.0*
  - 4.18: Calculating Profitability Ratios - *CC BY 4.0*
  - 4.19: Limitations of Financial Statements - *CC BY 4.0*
  - 4.20: Putting It Together- Financial Statements of Business Organizations - *CC BY 4.0*
  - 4.21: Assignment- Financial Statements of Business Organizations - *CC BY 4.0*
  - 4.22: Introduction to Financial Statements - *CC BY 4.0*
  - 4.23: Transactions - *CC BY 4.0*
  - 4.24: Accounting Equation - *CC BY 4.0*
  - 4.25: Account Categories - *CC BY 4.0*
  - 4.26: Double Entry Bookkeeping System - *CC BY 4.0*
  - 4.27: Structures of Key Financial Statements - *CC BY 4.0*
  - 4.28: Introduction to the Bookkeeping Process - *CC BY 4.0*
  - 4.29: Expanded Accounting Equation - *CC BY 4.0*
- 5: Managerial Accounting in Business - *CC BY 4.0*
  - 5.1: Influence on Accounting Decisions - *CC BY 4.0*
  - 5.2: Putting It Together- Managerial Accounting in Business - *CC BY 4.0*
  - 5.3: Assignment- Managerial Accounting in Business - *CC BY 4.0*
  - 5.4: Why It Matters- Managerial Accounting in Business - *CC BY 4.0*
  - 5.5: Introduction to Financial and Managerial Accounting - *CC BY 4.0*
  - 5.6: Differentiating Between Financial and Managerial Accounting - *CC BY 4.0*
  - 5.7: Managerial Accounting - *CC BY 4.0*
  - 5.8: Relationship Between Financial and Managerial Accounting - *CC BY 4.0*
  - 5.9: Introduction to Managerial Accounting Perspectives - *CC BY 4.0*
  - 5.10: Accounting Decision Makers - *CC BY 4.0*
  - 5.11: Strategy Development - *CC BY 4.0*
  - 5.12: Risk Management Planning - *CC BY 4.0*
- 6: Cost Behavior Patterns - *CC BY 4.0*
  - 6.1: High-Low Method - *CC BY 4.0*
  - 6.2: Least Squares Regression Method - *CC BY 4.0*
  - 6.3: Putting It Together- Cost Behavior Patterns - *CC BY 4.0*
  - 6.4: Assignment- Cost Behavior Patterns - *CC BY 4.0*
  - 6.5: Why It Matters- Cost Behavior Patterns - *CC BY 4.0*
  - 6.6: Introduction to Costs - *CC BY 4.0*
  - 6.7: Product vs. Period Costs - *CC BY 4.0*
  - 6.8: Manufacturing Costs - *CC BY 4.0*
  - 6.9: Fixed vs. Variable Costs - *CC BY 4.0*
  - 6.10: Relevant Range - *CC BY 4.0*

- 6.11: Introduction to Mixed Cost Analysis - *CC BY 4.0*
- 6.12: Mixed Costs - *CC BY 4.0*
- 6.13: Independent vs. Dependent Variable - *CC BY 4.0*

- 7: Costing Methods - *CC BY 4.0*
  - 7.1: Introduction to Process Costing - *CC BY 4.0*
  - 7.2: Job Order Costing vs Process Costing - *CC BY 4.0*
  - 7.3: Flow of Costs (Process Costing) - *CC BY 4.0*
  - 7.4: Equivalent Unit Calculations - *CC BY 4.0*
  - 7.5: Cost Reconciliation - *CC BY 4.0*
  - 7.6: Direct and Step-Down Methods - *CC BY 4.0*
  - 7.7: Introduction to Cost Accounting Methods - *CC BY 4.0*
  - 7.8: Activity-Based Costing - *CC BY 4.0*
  - 7.9: Traditional Costing vs. ABC - *CC BY 4.0*
  - 7.10: Putting It Together- Costing Methods - *CC BY 4.0*
  - 7.11: Why It Matters- Costing Methods - *CC BY 4.0*
  - 7.12: Assignment- Costing Methods - *CC BY 4.0*
  - 7.13: Introduction to Cost Management - *CC BY 4.0*
  - 7.14: Value Chain - *CC BY 4.0*
  - 7.15: Direct and Indirect Costs - *CC BY 4.0*
  - 7.16: Introduction to Job Order Costing - *CC BY 4.0*
  - 7.17: Job Order Costing - *CC BY 4.0*
  - 7.18: Calculating Costs - *CC BY 4.0*
  - 7.19: Flow of Costs (Job Order Costing) - *CC BY 4.0*
  - 7.20: Recording Job Order Costs - *CC BY 4.0*
- 8: Cost Volume Profit Analysis - *CC BY 4.0*
  - 8.1: Statement of Variable Costs and Sales Volume - *CC BY 4.0*
  - 8.2: Statement of Fixed Cost, Selling Price, and Sales Volume - *CC BY 4.0*
  - 8.3: Statement of Variable Cost, Fixed Cost, and Sales Volume - *CC BY 4.0*
  - 8.4: Introduction to Break-Even Point Analysis - *CC BY 4.0*
  - 8.5: Break-Even Point - *CC BY 4.0*
  - 8.6: Methods to Determine the Break-Even Point - *CC BY 4.0*
  - 8.7: Target Profit Analysis - *CC BY 4.0*
  - 8.8: Margin of Safety - *CC BY 4.0*
  - 8.9: The Break-Even Point and the Sales Mix - *CC BY 4.0*
  - 8.10: Introduction to Cost-Volume-Profit and Cost Structures - *CC BY 4.0*
  - 8.11: Why It Matters- Cost Volume Profit Analysis - *CC BY 4.0*
  - 8.12: Cost Structures - *CC BY 4.0*
  - 8.13: Operating Leverage - *CC BY 4.0*
  - 8.14: Putting It Together- Cost Volume Profit Analysis - *CC BY 4.0*
  - 8.15: Assignment- Cost Volume Profit Analysis - *CC BY 4.0*
  - 8.16: Introduction to Cost-Volume-Profit Elements - *CC BY 4.0*
  - 8.17: Cost-Volume-Profit Analysis - *CC BY 4.0*
  - 8.18: Contribution Margin Model - *CC BY 4.0*
  - 8.19: Net Operating Income - *CC BY 4.0*
  - 8.20: Contribution Margin Ratio - *CC BY 4.0*
  - 8.21: Introduction to the Application of Cost-Volume-Profit Concepts - *CC BY 4.0*
  - 8.22: Cost-Volume-Profit Analysis and Decision Making - *CC BY 4.0*
  - 8.23: Statement of Fixed Cost and Sales Volume - *CC BY 4.0*
- 9: Operating Budgets - *CC BY 4.0*
  - 9.1: Production Budget - *CC BY 4.0*
  - 9.2: Direct Materials Budget - *CC BY 4.0*
  - 9.3: Direct Labor Budget - *CC BY 4.0*
  - 9.4: Manufacturing Overhead Budget - *CC BY 4.0*
  - 9.5: Ending Inventory Budget - *CC BY 4.0*
  - 9.6: Selling and Administrative Budget - *CC BY 4.0*
  - 9.7: Cash Budget - *CC BY 4.0*
  - 9.8: Budgeted Income - *CC BY 4.0*
  - 9.9: Budgeted Balance Sheet - *CC BY 4.0*
  - 9.10: Introduction to Flexible Budgeting - *CC BY 4.0*
  - 9.11: Why It Matters- Operating Budgets - *CC BY 4.0*
  - 9.12: Shortcomings of Static Budgets - *CC BY 4.0*
  - 9.13: Flexible Budget Report - *CC BY 4.0*
  - 9.14: Flexible Budget Reports and Multiple Cost Drivers - *CC BY 4.0*
  - 9.15: Putting It Together- Operating Budgets - *CC BY 4.0*
  - 9.16: Assignment- Operating Budgets - *CC BY 4.0*
  - 9.17: Introduction to the Master Budget - *CC BY 4.0*
  - 9.18: Budgeting and Business - *CC BY 4.0*
  - 9.19: Responsibility Accounting - *CC BY 4.0*
  - 9.20: Alternative Budget Periods - *CC BY 4.0*
  - 9.21: Self-Imposed Budgeting - *CC BY 4.0*
  - 9.22: Introduction to Preparing a Master Budget - *CC BY 4.0*
  - 9.23: Sales Forecast and the Master Budget - *CC BY 4.0*
  - 9.24: Components of the Master Budget - *CC BY 4.0*
- 10: Cost Variance Analysis - *CC BY 4.0*
  - 10.1: Reducing Material Variances - *CC BY 4.0*

- 10.2: Introduction to Labor Variances - *CC BY 4.0*
- 10.3: Expected Labor Rate - *CC BY 4.0*
- 10.4: Labor Rate Variance - *CC BY 4.0*
- 10.5: Reducing Labor Variances - *CC BY 4.0*
- 10.6: Introduction to Variable Manufacturing Overhead Variances - *CC BY 4.0*
- 10.7: Variable Manufacturing Rate Variances - *CC BY 4.0*
- 10.8: Variable Manufacturing Overhead Rate Variances - *CC BY 4.0*
- 10.9: Reducing Variable Manufacturing Overhead - *CC BY 4.0*
- 10.10: Putting It Together- Cost Variance Analysis - *CC BY 4.0*
- 10.11: Why It Matters- Cost Variance Analysis - *CC BY 4.0*
- 10.12: Assignment- Cost Variance Analysis - *CC BY 4.0*
- 10.13: Introduction to Variance Basics - *CC BY 4.0*
- 10.14: Steps of Cost Variance Analysis - *CC BY 4.0*
- 10.15: Favorable versus Unfavorable Variances - *CC BY 4.0*
- 10.16: Significant Variance - *CC BY 4.0*
- 10.17: Introduction to Material Variances - *CC BY 4.0*
- 10.18: Material Cost Variance - *CC BY 4.0*
- 10.19: Price Variance - *CC BY 4.0*
- 10.20: Quantity Variance - *CC BY 4.0*

11: Relevant Revenues and Costs - *CC BY 4.0*

- 11.1: Make or Buy Decisions - *CC BY 4.0*
- 11.2: Special Order Decisions - *CC BY 4.0*
- 11.3: Introduction to Constrained Resources - *CC BY 4.0*
- 11.4: Constrained Resource - *CC BY 4.0*
- 11.5: Putting It Together- Relevant Revenues and Costs - *CC BY 4.0*
- 11.6: Assignment- Relevant Revenues and Costs - *CC BY 4.0*
- 11.7: Why It Matters- Relevant Revenues and Costs - *CC BY 4.0*
- 11.8: Introduction to Cost Types - *CC BY 4.0*
- 11.9: Differential Cost - *CC BY 4.0*
- 11.10: Avoidable Costs - *CC BY 4.0*
- 11.11: Sunk Costs - *CC BY 4.0*
- 11.12: Opportunity Costs - *CC BY 4.0*
- 11.13: Analyzing Costs - *CC BY 4.0*
- 11.14: Introduction to Relevant Costs - *CC BY 4.0*
- 11.15: Add or Drop Decisions - *CC BY 4.0*

12: Managerial Decisions - *CC BY 4.0*

- 12.1: Special Order Decisions - *CC BY 4.0*
- 12.2: Cost-Plus or Target Costing Decisions - *CC BY 4.0*
- 12.3: Putting It Together- Managerial Decisions - *CC BY 4.0*
- 12.4: Assignment- Managerial Decisions - *CC BY 4.0*
- 12.5: Why It Matters- Managerial Decisions - *CC BY 4.0*
- 12.6: Introduction to Managerial Decision-Making - *CC BY 4.0*
- 12.7: Differential Analysis - *CC BY 4.0*
- 12.8: Qualitative Factors - *CC BY 4.0*
- 12.9: Introduction to the Role of Data in Business - *CC BY 4.0*
- 12.10: Customer Elimination Decisions - *CC BY 4.0*
- 12.11: Add or Drop Decisions - *CC BY 4.0*
- 12.12: Make or Buy Decisions - *CC BY 4.0*
- 12.13: Sell or Process Further Decisions - *CC BY 4.0*

13: Statement of Cash Flows - *CC BY 4.0*

- 13.1: Introduction to Preparing a Statement of Cash Flow - *CC BY 4.0*
- 13.2: Net and Gross Cash Flows - *CC BY 4.0*
- 13.3: Preparing a Statement of Cash Flow - *CC BY 4.0*
- 13.4: Cash Flow Analysis - *CC BY 4.0*
- 13.5: Putting It Together- Statement of Cash Flows - *CC BY 4.0*
- 13.6: Assignment- Statement of Cash Flows - *CC BY 4.0*
- 13.7: Why It Matters- Statement of Cash Flows - *CC BY 4.0*
- 13.8: Introduction to Key Concepts in Cash Flows - *CC BY 4.0*
- 13.9: Non-Cash Activities - *CC BY 4.0*
- 13.10: Operating Activities - *CC BY 4.0*
- 13.11: Investing Activities - *CC BY 4.0*
- 13.12: Financing Activities - *CC BY 4.0*
- 13.13: Introduction to Direct Method versus Indirect Method - *CC BY 4.0*
- 13.14: The Indirect Method - *CC BY 4.0*
- 13.15: The Direct Method - *CC BY 4.0*

14: Performance Evaluation in Organizations - *CC BY 4.0*

- 14.1: For-Profit Organizations - *CC BY 4.0*
- 14.2: Non-Profit Organizations - *CC BY 4.0*
- 14.3: Putting It Together- Performance Evaluation in Organizations - *CC BY 4.0*
- 14.4: Assignment- Performance Evaluation in Organizations - *CC BY 4.0*

- 14.5: Why It Matters- Performance Evaluation in Organizations - *CC BY 4.0*
- 14.6: Introduction to Non-Financial Performance Measures - *CC BY 4.0*
- 14.7: Balanced Scorecard - *CC BY 4.0*
- 14.8: Performance Reports - *CC BY 4.0*
- 14.9: Introduction to Financial Performance Measures - *CC BY 4.0*
- 14.10: Trend Analysis of Financial Statements - *CC BY 4.0*
- 14.11: Common-Size Analysis of Financial Statements - *CC BY 4.0*
- 14.12: Ratio Analysis of Financial Information - *CC BY 4.0*
- 14.13: Introduction to Evaluating an Organization - *CC BY 4.0*

15: Capital Budgeting Decisions - *CC BY 4.0*

- 15.1: Simple Rate of Return - *CC BY 4.0*
- 15.2: Introduction to Risk and Capital Budgeting - *CC BY 4.0*
- 15.3: Risk and Return - *CC BY 4.0*
- 15.4: Introduction to Finalizing Capital Budgeting Decisions - *CC BY 4.0*
- 15.5: Analyzing a Project - *CC BY 4.0*
- 15.6: Postaudit - *CC BY 4.0*
- 15.7: Putting It Together- Capital Budgeting Decisions - *CC BY 4.0*
- 15.8: Assignment- Capital Budgeting Decisions - *CC BY 4.0*
- 15.9: Why It Matters- Capital Budgeting Decisions - *CC BY 4.0*
- 15.10: Introduction to Capital Budgeting - *CC BY 4.0*
- 15.11: Steps of Capital Budgeting - *CC BY 4.0*
- 15.12: When to Make Capital Budgeting Decisions - *CC BY 4.0*
- 15.13: Time Value of Money - *CC BY 4.0*
- 15.14: Introduction to Budget Methods for Making Decisions - *CC BY 4.0*
- 15.15: The Payback Method - *CC BY 4.0*
- 15.16: Internal Rate of Return - *CC BY 4.0*
- 15.17: Net Present Value - *CC BY 4.0*

Back Matter - *CC BY 4.0*

- Index - *CC BY 4.0*
- Glossary - *CC BY 4.0*
- Glossary - *Undeclared*
- Detailed Licensing - *CC BY 4.0*