PRINCIPLES OF MANAGERIAL ACCOUNTING 1

HACC, Central Pennsylvania's Community College

LibreTexts™

Principles of Managerial Accounting 1

This text is disseminated via the Open Education Resource (OER) LibreTexts Project (https://LibreTexts.org) and like the thousands of other texts available within this powerful platform, it is freely available for reading, printing, and "consuming."

The LibreTexts mission is to bring together students, faculty, and scholars in a collaborative effort to provide an accessible, and comprehensive platform that empowers our community to develop, curate, adapt, and adopt openly licensed resources and technologies; through these efforts we can reduce the financial burden born from traditional educational resource costs, ensuring education is more accessible for students and communities worldwide.

Most, but not all, pages in the library have licenses that may allow individuals to make changes, save, and print this book. Carefully consult the applicable license(s) before pursuing such effects. Instructors can adopt existing LibreTexts texts or Remix them to quickly build course-specific resources to meet the needs of their students. Unlike traditional textbooks, LibreTexts' web based origins allow powerful integration of advanced features and new technologies to support learning.

LibreTexts is the adaptable, user-friendly non-profit open education resource platform that educators trust for creating, customizing, and sharing accessible, interactive textbooks, adaptive homework, and ancillary materials. We collaborate with individuals and organizations to champion open education initiatives, support institutional publishing programs, drive curriculum development projects, and more.

The LibreTexts libraries are Powered by NICE CXone Expert and was supported by the Department of Education Open Textbook Pilot Project, the California Education Learning Lab, the UC Davis Office of the Provost, the UC Davis Library, the California State University Affordable Learning Solutions Program, and Merlot. This material is based upon work supported by the National Science Foundation under Grant No. 1246120, 1525057, and 1413739.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation nor the US Department of Education.

Have questions or comments? For information about adoptions or adaptions contact info@LibreTexts.org or visit our main website at https://LibreTexts.org.

This text was compiled on 05/07/2026

Preface

Preface

Brief, Focused, Essential

Students want to learn accounting in the most efficient way possible, balancing coursework with personal schedules. They tend to focus on their studies in short intense segments between jobs, classes, and family commitments. Meanwhile, the accounting industry has endured dramatic shifts since the collapse of Enron and WorldCom, causing a renewed focus on ethical behavior in accounting.

Core Themes

This book is aimed squarely at the new learning styles evident in today's students and addresses accounting industry changes as well. Accordingly, three core themes lie at the foundation of this text:

1. **Focused.** Students want to be as efficient as possible in their learning. This book adopts a concise, jargon-free, and easy-to-understand approach. Key concepts are provided in short segments with bullet points and step-by-step instructions to simplify concepts. A thoughtful, stepwise approach helps students avoid distractions and focuses attention on the big picture.
2. **Reinforcement.** Review Problems at the end of each major section offer practical opportunities for students to apply what they have learned. These Review Problems allow students to immediately reinforce what they have learned and are provided within the body of the chapter along with the solutions.
3. **Relevance.** Students perform better when they can answer the "why" question. Why is managerial accounting important? Meaningful references to companies throughout the chapters help students tie the concepts presented in each chapter to real organizations.

In addition, realistic managerial scenarios present an issue that must be addressed by the management accountant. These pique student interest and are designed to show how issues can be resolved using the concepts presented in the chapter.

Finally, Business in Action features in this text link managerial decision making to real business decisions.

Other Key Features

- **A focus on decision making.** This book focuses on the essential managerial accounting concepts used within organizations for decision-making purposes and covers these concepts in 13 straightforward and concise chapters. Knowing that the majority of students taking managerial accounting at the introductory level are general business majors and will not become accountants, this text was written to help students make informed business decisions using managerial accounting concepts.
- **Thorough end-of-chapter coverage.** The Exercises, Problems, and Cases were developed to give student a wide range of reinforcement at different levels of complexity and to help build critical thinking skills.
- **Ethics coverage.** The importance of ethics is evident from the outset since the book begins with an entire segment on ethical issues facing the accounting industry. This segment includes the Institute of Management Accountants' revised standards of ethical conduct and describes professional codes of conduct provided by the American Institute of Certified Public Accountants, Financial Executives International, and International Federation of Accountants. Ethics questions and cases are included throughout the text.
- **Group projects.** The accounting industry and business in general have made it clear employees must be able to work effectively and efficiently in groups. In addition, studies show students learn concepts more effectively when working in groups. To reinforce this idea, we have included group projects throughout the book.
- **Spreadsheet applications.** Computer Application features and End-of-Chapter Exercises emphasize the importance of using Excel spreadsheets for analytical purposes.

TABLE OF CONTENTS

Preface

Licensing

Licensing and Publishing Information

1: What Is Managerial Accounting?

2: How Do Organizations Identify Cost Behavior Patterns?

3: How Is Cost-Volume-Profit Analysis Used for Decision Making?

4: How Are Relevant Revenues and Costs Used to Make Decisions?

5: How Is Capital Budgeting Used to Make Decisions?

6: How Are Operating Budgets Created?

Index

1: Appendix

Index

Glossary

Detailed Licensing

Licensing

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

Licensing and Publishing Information

This text was adapted and published by Jason Nielsen in 2020 under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License from a text that was adapted by Saylor Academy under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License without attribution as requested by the work's original creator or licensor in 2012.

Chapter 1 What Is Managerial Accounting?

Dana Matthews is the president of Sportswear Company, a producer of hats and jerseys for fans of several professional sports teams. Imagine you are the accountant in charge of all accounting functions at Sportswear. Dana just reviewed the financial statements for the most recent fiscal year for the first time and has the following conversation with you:

President (Dana):
I just reviewed our most recent financial statements, and I noticed we did not do as well as we had planned. I would like to look more closely at the profitability of each of our products to determine exactly what happened, but I don't have this information in the financial statements. Is there a reason we don't include this in the financial statements?

Accountant:
Yes, the financial statements are prepared following U.S. Generally Accepted Accounting Principles (U.S. GAAP) and are intended for outside users, such as owners, banks, and suppliers. U.S. GAAP does not require us to disclose profitability by product, and we prefer not to make this information public. Product profitability information stays in-house and is prepared by our managerial accountant, Dave Hicks.

President:
That makes sense. Can you have Dave pull together product profitability information for the past year so we can take a close look at which products are doing well and which are not?

Accountant:
You bet. We'll have the information for you early next week.

1.1 Characteristics of Managerial Accounting

Learning Objectives

1. Compare characteristics of financial and managerial accounting.

Question: The issue facing the president at Sportswear is a common one. Companies prefer not to disclose more information than is required by U.S. GAAP, but they would like to have more detailed information for internal decision-making and performance-evaluation purposes. This is why it is important to distinguish between financial and managerial accounting. What is the difference between information prepared by financial accountants and information prepared by managerial accountants?

Answer: Financial accounting provides historical financial information to external users. focuses on providing historical financial information to external users. External users are those outside the company, including owners (e.g., shareholders) and creditors (e.g., banks or bondholders). Financial accountants reporting to external users are required to follow U.S. Generally Accepted Accounting Principles (U.S. GAAP). A set of accounting rules that must be followed to provide consistency in reporting financial information to external users., a set of accounting rules that requires consistency in recording and reporting financial information. This information typically summarizes overall company results and does not provide detailed information.

Managerial accounting focuses on internal users, including executives, product managers, sales managers, and any other personnel in the organization who use accounting information for decision making. focuses on internal users—executives, product managers, sales managers, and any other personnel within the organization who use accounting information to make important decisions. Managerial accounting information need not conform with U.S. GAAP. In fact, conformance with U.S. GAAP may be a deterrent to getting useful information for internal decision-making purposes. For example, when establishing an inventory cost for one or more units of product (each jersey or hat produced at Sportswear Company), U.S. GAAP requires that production overhead costs, such as factory rent and factory utility costs, be included. However, for internal decision-making purposes, it might make more sense to include non-production costs that are directly linked to the product, such as sales commissions and exclude some overhead costs not so directly linked.

Question: It's clear that financial accounting focuses on reporting to outside users while managerial accounting focuses on reporting to inside users. What specific characteristics would we expect to see in managerial accounting information?

Answer: Managerial accounting often focuses on making future projections for segments of a company. Suppose Sportswear Company is considering introducing a new line of coffee mugs with team logos on each mug. Management would certainly need detailed financial projections for sales, costs, and the resulting profits (or losses). Although historical financial accounting data from other product lines would be useful, preparing projections for the new line of mugs would be a managerial accounting function.

Another characteristic of managerial accounting data is its high level of detail. As noted in the opening dialogue between the president and accountant at Sportswear Company, the financial information in the annual report provides a general overview of the company's financial results but does not provide any detailed information about each product. Information, such as product profitability, would come from the managerial accounting function.

Finally, managerial accounting information often takes the form of non-financial measures. For example, Sportswear Company might measure the percentage of defective products produced or the percentage of on-time deliveries to customers. This kind of non-financial information comes from the managerial accounting function.

Table 1.1 Comparison of Financial and Managerial Accounting

	Managerial Accounting	Financial Accounting
Users	Inside the organization	Outside the organization
Accounting rules	None	U.S. Generally Accepted Accounting Principles (U.S. GAAP)
Time horizon	Future projections (sometimes historical if in detail)	Historical information
Level of detail	Often presents segments of an organization (e.g., products, divisions, departments)	Presents overall company information in accordance with U.S. GAAP
Performance measures	Financial and non-financial	Primarily financial

Follow-Up at Sportswear Company

Question: What did the president at Sportswear Company learn about product profitability from the information provided by the managerial accountant?

Answer: The president at Sportswear, Dana Matthews, learned that the hats product line was much more profitable than expected, accounting for 55 percent of the company's profits even though initial estimates were that the hat segment would account for 40 percent of company profits. Conversely, the jerseys product line was much less profitable than expected, accounting for 45 percent of the company's profits.

There are many issues associated with analyzing product profitability including how to predict cost behavior and how to allocate costs that are not easily traced to each product and whether the product revenue and cost information is accurate enough to make important managerial decisions. Those issues most likely to be considered by management will be discussed in this text while much of the detailed accounting for cost flows will be covered in Principles of Managerial Accounting 2.

Key Takeaway

- Financial accounting provides historical financial information for external users in accordance with U.S. GAAP. Managerial accounting provides detailed financial and non-financial information for internal users who use the information for decision making, planning, and control purposes.

Check Yourself

1. Suppose you are the co-owner and manager of a retail store that sells and repairs mountain bikes. Provide one example of a *financial* accounting report that would be useful to you and your co-owner. Provide two examples of *managerial* accounting reports that would be useful to you as the manager.
2. Provide two examples of non-financial measures used by a pizza eatery that serves food in the restaurant and offers delivery services.
3. For each report listed in the following, indicate whether it relates to financial or managerial accounting. Explain the reasoning behind your answer for each item.
    1. Projected net income for next quarter by division
    2. Defective goods produced as a percentage of all goods produced
    3. Income statement for the most current year, prepared in accordance with U.S. GAAP
    4. Monthly sales broken down by geographic region
    5. Production department budget for the next quarter
    6. Balance sheet at the end of the current year, prepared in accordance with U.S. GAAP

Solution

1. Financial accounting reports provided to owners typically include the income statement, statement of owners' equity, balance sheet, and statement of cash flows. All are prepared in accordance with U.S. GAAP. Managerial accounting reports prepared for managers might include a quarterly budget for revenues and expenses for each segment of the business (e.g., bike sales and bike repairs), returns for defective merchandise as a percent of total monthly sales, income projections to be used in deciding whether to open a new store, and projected sales for each bike model. (There are many correct answers to this problem. Use Table 1.1 "Comparison of Financial and Managerial Accounting" as a guide in determining the accuracy of your answer.)
2. Examples of non-financial measures include percentage of on-time deliveries, percentage of burned pizzas, average time required to prepare pizza for restaurant customers (from taking a customer's order to providing the pizza at the customer's table), and results of customer satisfaction surveys. (These are just a few examples. There are many correct answers to this problem.)
3. The answers appear as follows. Be sure you explained your answers.
    1. Managerial accounting—information is for future projections and involves segments of the company
    2. Managerial accounting—nonfinancial detailed measure of defective products
    3. Financial accounting—historical information prepared in accordance with U.S. GAAP
    4. Managerial accounting—detailed information provided monthly
    5. Managerial accounting—information is for future projections and involves a segment of the company
    6. Financial accounting—historical information prepared in accordance with U.S. GAAP

1.2 Planning and Control Functions Performed by Managers

Learning Objectives

1. Describe the planning and control functions performed by managers.

Question: Managers of most organizations continually plan for the future, and after the plan is implemented, managers assess whether they achieved their goals. What are the two functions that enable management to go through the process of continually planning and evaluating?

Answer: The two important functions that enable management to continually plan for the future and assess implementation are called planning and control. Planning is the process of establishing goals and communicating these goals to employees of the

organization. Controlling is the process of evaluating whether the organization's plans were effectively implemented – comparing the plan to what actually happened.

Planning

Question: Continually planning for the future is an important quality of many successful organizations, such as Southwest Airlines (discussed in Note 1.11 "Business in Action 1.1"). How do organizations formalize their strategic plans?

Answer: Organizations formalize their plans by creating a budget. A series of reports used to quantify an organization's plan for the future., which is a series of reports used to quantify an organization's plans for the future. For example, **Ernst & Young**, an international accounting firm, plans for the future by establishing a budget indicating the labor hours required to perform specific services for each client. The process of creating a budget for each client enables the firm to plan for future staffing needs and communicate these needs to employees of the company. Rather than simply hoping it all works out in the end, **Ernst & Young** projects the labor hours required in the future, hires accounting staff based on these projections, and schedules the staff required for each client.

A budget can take a variety of forms. A budgeted income statement indicates a profit plan for the future. A capital budget shows the long-term investments planned for the future. A cash flow budget outlines cash inflows and outflows for the future. We provide more information about how budgets can be used for planning purposes in chapter 5 and 6.

Business in Action 1.1

Plans for the Future

Review the annual report or 10K for just about any company, and you are likely to find information regarding plans for the future. Here are some examples:

- **Southwest Airlines.** "We expect to take delivery of 28 MAX 8 aircraft this year, and plan to end 2021 with 69 MAX 8 aircraft and 729 total aircraft. We reached agreement with The Boeing Company (Boeing) to extend our order book through 2031, and selected the MAX 7 aircraft as the successor to the 737-700 model—reaching agreement on 100 firm orders for MAX 7 aircraft. This agreement with Boeing underscores our commitment to the continued modernization of the fleet with more fuel-efficient and climate-friendly aircraft, and it also positions Southwest to capitalize on growth opportunities, when they arise. We are expanding the number of airports served and pursuing new revenue streams"
- **Disney** "In November 2019, the Company launched Disney+, a subscription-based DTC video streaming service with Disney, Pixar, Marvel, Star Wars and National Geographic branded content in the U.S. and four other countries and has expanded to select Western European countries in the Spring of 2020. In April, our Hotstar service in India was converted to Disney+Hotstar, and in June 2020, current subscribers of the Disney Deluxe service in Japan were converted to Disney+. In September 2020, Disney+ was launched in additional European countries and Disney+Hotstar was launched in Indonesia. In November 2020, Disney+ was launched in Latin America. Additional launches are planned for various Asia-Pacific territories in calendar 2021.
- **Tesla** We also intend to bring additional all-electric vehicles to market in the future, including Model Y, the Tesla Semi truck, a pickup truck and a new version of the Tesla Roadster. The production of fully electric vehicles that meet consumers' range and performance expectations requires substantial design, engineering, and integration work on almost every system of our vehicles. Our design and vehicle engineering capabilities, combined with the technical advancements of our powertrain system, have enabled us to design and develop electric vehicles that we believe overcome the design, styling, and performance issues that have historically limited broad adoption of electric vehicles.

As these companies go through the process of making decisions about the future, developing plans based on their decisions, and controlling the implementation of their plans, managerial accounting information will play a key role in all phases of the process.

Control

Question: Although planning for the future is important, plans are only effective if implemented properly. How do organizations assess the implementation of their plans?

Answer: The control function evaluates whether an organization's plans were implemented effectively and often leads to recommendations for the future. Many organizations compare actual results with the initial plan (or budget) to evaluate performance of employees, departments, or the entire organization.

For example, assume **Ernst & Young** creates a budget indicating the labor hours needed to perform tax services for a particular client (this is the *planning* function). After the work is performed, actual labor hours used to complete the work are compared to budgeted labor hours. This analysis is then used to evaluate whether employees were able to complete the work within the budgeted time and often results in recommendations for the future. Recommendations might include the need for adding more labor hours to the budget or obtaining better support documents from the client.

Planning and controlling operations are critical functions within most organizations. In today's business environment, effective planning and control by managers can be the key to survival.

Key Takeaway

- Managers continually plan and control operations within organizations. Planning involves establishing goals and communicating these goals to employees of the organization. The control function assesses whether goals were achieved and is often used to evaluate the performance of employees, departments, and the organization as a whole.

Check Yourself

Assume you are preparing a personal budget of all income and expenses for next month.

1. Describe the planning and control functions of this process.
2. What benefits might be derived from performing the planning and control functions for a personal budget?

Solution to Check Yourself

1. The planning function would involve establishing income and expense goals for next month. Possible sources of income include wages, scholarships, or student loans. Expenses might include rent, textbooks, tuition, food, entertainment, and transportation.

   The control function occurs after the end of the month and involves comparing actual income and expenses with budgeted income and expenses. This allows for the evaluation of whether income and expense goals were achieved.

2. There are several benefits to using a planning and control process. The planning function establishes income and expense goals and helps to identify any deviations from these goals. For example, planned expenditures are clearly outlined in the budget and provide guidelines for making expenditure decisions throughout the month. Without clear guidelines, money might be spent on items that are not needed.

   The control function allows for an evaluation of how well you met the goals established in the planning process. Perhaps some goals were achieved (e.g., food expenditures were close to what was budgeted) while other goals were not (e.g., transportation expenditures were higher than what was budgeted). The control function identifies these areas and leads to refined goals in the future. For example, the decision might be made to carpool next month to save on transportation costs or to earn more income to pay for transportation by working additional hours.

1.3 Key Finance and Accounting Personnel

Learning Objectives

1. Describe the functions of key finance and accounting personnel.

Question: From the previous discussion, we know that planning and control functions are often designed to evaluate the performance of employees and departments of an organization. This often includes employees overseeing financial information. Thus it is important to understand how most large companies organize their accounting and finance personnel. What are the accounting and finance positions within a typical large company, and what functions do they perform?

Answer: Let's look at an example to answer this question. Suppose you are the president of Sportswear Company, mentioned earlier in the chapter, which produces hats and jerseys for fans of professional sports teams. Assume this is a large public company.

(The term public company – A company whose shares of stock are publicly traded—that is, the general investing public can purchase and sell ownership in the company.) As president of Sportswear, you ask the following questions:

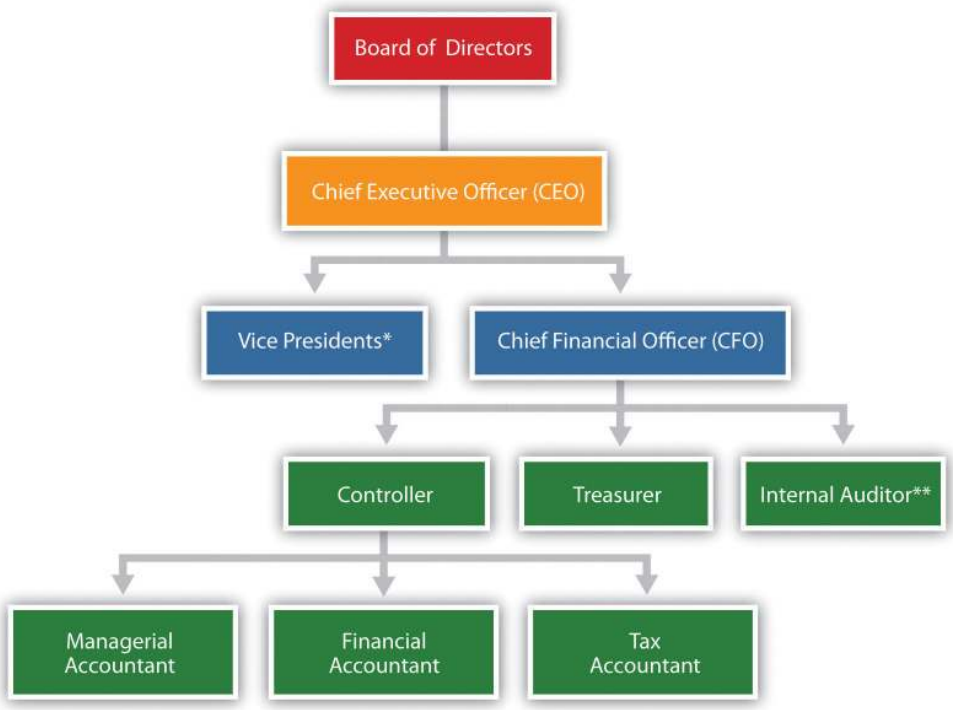
1. How much will we owe the government in income taxes for the year?
2. What was total net income for the last fiscal year?
3. Should we expand into new geographic markets?
4. If we do decide to expand into new markets, should we obtain financing by issuing bonds, obtaining a loan from a bank, or issuing common stock?
5. How profitable is each segment of our business (hats and jerseys)?
6. How effective are our internal controls over cash?

The challenge is to determine who within Sportswear would be best suited to answer each of these questions. An organization chart will help in finding a solution.

Organizational Structure

Figure 1.1 "A Typical Organization Chart" is a typical organization chart; it shows how accounting and finance personnel fit within most companies. The personnel at the bottom of the chart report to those above them. For example, the managerial accountant reports to the controller. At the top of the chart are those who control the company, typically the board of directors (who are elected by the owners or shareholders). Review Figure 1.1 "A Typical Organization Chart" before moving on to the detailed discussion of each important finance and accounting position.

Figure 1.1 A Typical Organization Chart



*Represents vice presidents of various departments outside of accounting and finance such as production, personnel, and research and development.

**In addition to reporting to the chief financial officer, the internal auditor typically reports independently to the board of directors and/or the audit committee (made up of select members of the board of directors).

Chief Financial Officer

The chief financial officer (CFO) is the person in charge of all finance and accounting functions within the organization and typically reports to the chief executive officer.

Controller

The controller is the person responsible for managing the accounting staff that provides managerial accounting information used for internal decision making, financial accounting information for external reporting purposes, and tax accounting information to meet tax filing requirements. The three accountants the controller manages are as follows:

- **Managerial accountant.** The managerial accountant is the person who assists in preparing information used for decision making within the organization, reports directly to the controller and assists in preparing information used for decision making within the organization. Reports prepared by managerial accountants include operational budgets, cost estimates for existing products, budgets for new product lines, and profit and loss reports by division. (Note that some people use the term *cost accountant* interchangeably with *managerial accountant*. Others consider cost accounting a specific function of managerial accounting that focuses on measuring costs. In this text, we use the term *managerial accountant* and assume that cost accountants focus on measuring costs.)
- **Financial accountant.** The financial accountant is the person who assists in preparing financial information in accordance with U.S. GAAP for external users. reports directly to the controller and assists in preparing financial information in accordance with U.S. GAAP, for those outside the company. Reports prepared by financial accountants include a quarterly report filed with the Securities and Exchange Commission (SEC) that is called a 10Q and an annual report filed with the SEC that is called a 10K.
- **Tax accountant.** The tax accountant is the person who assists in preparing tax reports for governmental agencies. reports directly to the controller and assists in preparing tax reports for governmental agencies, including the Internal Revenue Service.

Treasurer

The treasurer is the person responsible for obtaining financing, projecting cash flow needs, and managing cash and short-term investments for the organization. reports directly to the CFO. A treasurer's primary duties include obtaining sources of financing for the organization (e.g., from banks and shareholders), projecting cash flow needs, and managing cash and short-term investments.

Internal Auditor

An internal auditor is the person responsible for confirming that controls within the company are effective in ensuring accurate financial data. reports to the CFO and is responsible for confirming that the company has controls that ensure accurate financial data. The internal auditor often verifies the financial information provided by the managerial, financial, and tax accountants (all of whom report to the controller and ultimately to the CFO). If conflicts arise with the CFO, an internal auditor can report directly to the board of directors or to the audit committee, which consists of select board members.

Not All Organizations Are Alike!

Question: The organization chart in Figure 1.1 "A Typical Organization Chart" is intended to serve as a guide. However, all organizations are not the same, particularly smaller organizations. How might the organizational structure differ for a small organization?

Answer: Smaller organizations tend to have only one or two key finance and accounting personnel who perform the functions described previously. For example, one accountant might perform the financial and managerial accounting duties while another takes care of the tax work (or the tax work might be contracted out to a tax firm). Instead of employing its own internal auditor, an organization might hire one from an outside consulting firm. Some organizations may not have a CFO, or they may have a CFO but not a controller. An organization's structure depends on many different factors, including its size and reporting requirements, as indicated below:

Business in Action 1.2

The Organizational Structure of a Not-for-Profit Symphony

Financial limitations prevent a small not-for-profit symphony in California from hiring full-time finance and accounting employees. In spite of having annual revenues approaching $200,000, all financial transactions are processed and recorded by a part-time bookkeeper hired by the symphony. The bookkeeper also inputs budget information and provides monthly financial reports to the treasurer. The treasurer, a volunteer member of the board of directors, is responsible for establishing the annual

budget and providing monthly financial reports to the board of directors. An outside firm prepares and processes all tax filings, assembles annual financial statements, and performs a review of the accounting operations at the end of each fiscal year.

Notice how the symphony does not have any of the formal positions identified in Figure 1.1 “A Typical Organization Chart”, with the exception of the treasurer. This illustrates how financial constraints and reporting requirements may require an organization to be creative in establishing its organizational structure.

Key Takeaway

- It is important to understand the key accounting and finance positions within a typical company and how each position fits into the organizational structure. The chief financial officer (CFO) oversees all accounting and finance personnel, including the controller, treasurer, and internal auditor. The controller is responsible for the managerial, financial, and tax accounting staff.

Check Yourself

For each of the six questions listed at the beginning of this section for Sportswear Company, determine who within the company would be responsible for providing the appropriate information. Assume Sportswear has the same organizational structure as the one shown in Figure 1.1 “A Typical Organization Chart”.

Solution:

1. The tax accountant is responsible for determining the income taxes to be paid to various government agencies.
2. The financial accountant prepares the annual report, which includes the income statement where net income can be found.
3. Although several personnel would likely be involved, the managerial accountant is responsible for providing financial projections. However, the financial accountant might provide historical information for existing geographic segments, which would form the basis for the managerial accountant’s estimates.
4. The treasurer handles financing decisions.
5. Detailed financial information that goes beyond what is required by U.S. GAAP may be provided by the managerial accountants.
6. The internal auditors are responsible for evaluating the effectiveness of internal controls.

1.4 Ethical Issues Facing the Accounting Industry

Learning Objective

1. Use standards of ethical conduct to resolve ethical conflicts facing accountants.

Imagine you are the accountant for Drive Write, a company that produces computer disk drives, and you are in charge of all accounting functions within the company. The president has informed you that if the company’s profits grow by 20 percent this year, you will receive a $20,000 bonus, and she will receive a $50,000 bonus. No bonuses will be awarded if profit growth is less than 20 percent. Because the company’s profits have grown 20 percent annually for the last 10 years, investors have come to expect significant growth from one year to the next. Near the end of this fiscal year, the president and you have the following conversation:

President:
We are awfully close to hitting our numbers and getting to the 20 percent target. With two weeks remaining, projections show we will come in at 18 percent for the year. What can we do on the accounting side to increase current year profits?

Accountant:
Well, I’m not sure there is anything we can do. Our accounting is squeaky clean, as confirmed by our independent auditors. Perhaps our sales will improve next year.

President:
There has to be something we can do—I could sure use the bonus money, and our investors would appreciate an increase in their

investment! I know we have a large customer order to be filled the first week of next year. Why not include that sale in this year's numbers?

Accountant:
I'm not comfortable recording sales in the wrong fiscal year.

President:
We're only talking about moving sales by a few days! I would like you to consider this carefully. If you can't do this, I may have to find an accountant who can! Let's talk about our options later this week.

Question: The situation at Drive Write creates a serious ethical dilemma. (The Drive Write example is based on a real company called MiniScribe Corporation , subsequently purchased by a competitor.) Companies are constantly under pressure to meet sales and profit goals. Employees who succeed in meeting these goals often reap huge monetary rewards; those who fail may be penalized with lower pay or may even lose their jobs. What would you do if asked to record information in a way that distorts the company's financial results?

Answer: As the accountant for Drive Write, your response to the president's request would likely affect your reputation as a professional and your future as an accountant. The unethical behavior at corporations like **Satyam**, **Enron**, and **WorldCom** in recent years makes it imperative that we know both how to act ethically and how to resolve ethical conflicts.

To help guide accounting professionals through ethical dilemmas like the one at Drive Write, the Institute of Management Accountants (IMA) has established a *Statement of Ethical Professional Practice*, which appears in Figure 1.2 "IMA Statement of Ethical Professional Practice". The standards outlined in this statement are guidelines that can help accountants choose an ethically acceptable course of action. As you review Figure 1.2 "IMA Statement of Ethical Professional Practice", notice that the IMA specifies four core responsibilities (competence, confidentiality, integrity, and credibility) as well as guidelines on how to resolve ethical conflicts. The "Resolution of Ethical Conflict" section provides specific guidance on how to resolve the conflict at Drive Write.

Figure 1.2 IMA Statement of Ethical Professional Practice

IMA Statement of Ethical Professional Practice

Members of IMA shall behave ethically. A commitment to ethical professional practice includes overarching principles that express our values and standards that guide our conduct.

Principles

IMA's overarching principles include honesty, fairness, objectivity, and responsibility. Members shall act in accordance with these principles and shall encourage others within their organizations to adhere to them.

Standards

A member's failure to comply with the following standards may result in disciplinary action.

I. Competence

Each member has a responsibility to

1. Maintain an appropriate level of professional expertise by continually developing knowledge and skills.
2. Perform professional duties in accordance with relevant laws, regulations, and technical standards.
3. Provide decision support information and recommendations that are accurate, clear, concise, and timely.
4. Recognize and communicate professional limitations or other constraints that would preclude responsible judgment or successful performance of an activity.

II. Confidentiality

Each member has a responsibility to:

1. Keep information confidential except when disclosure is authorized or legally required.
2. Inform all relevant parties regarding appropriate use of confidential information. Monitor subordinates' activities to ensure compliance.
3. Refrain from using confidential information for unethical or illegal advantage.

III. Integrity

Each member has a responsibility to:

1. Mitigate actual conflicts of interest. Regularly communicate with business associates to avoid apparent conflicts of interest. Advise all parties of any potential conflicts.
2. Refrain from engaging in any conduct that would prejudice carrying out duties ethically.
3. Abstain from engaging in or supporting any activity that might discredit the profession.

IV. Credibility

Each member has a responsibility to:

1. Communicate information fairly and objectively.
2. Disclose all relevant information that could reasonably be expected to influence an intended user's understanding of the reports, analyses, or recommendations.
3. Disclose delays or deficiencies in information, timeliness, processing, or internal controls in conformance with organization policy and/or applicable law.

Resolution of Ethical Conflict

In applying the Standards of Ethical Professional Practice, you may encounter problems identifying unethical behavior or resolving an ethical conflict. When faced with significant ethical issues, you should follow your organization's established policies on the resolution of such conflict. If these policies do not resolve the ethical conflict, you should consider the following courses of action:

1. Discuss the issue with your immediate supervisor except when it appears that the supervisor is involved. In that case, present the issue to the next level. If you cannot achieve a satisfactory resolution, submit the issue to the next management level. If your immediate superior is the chief executive officer or equivalent, the acceptable reviewing authority may be a group such as the audit committee, executive committee, board of directors, board of trustees, or owners. Contact with levels above the immediate superior should be initiated only with your superior's knowledge, assuming he or she is not involved. Communication of such problems to authorities or individuals not employed or engaged by

Source: Adapted from the Institute of Management Accountants.

Question: The IMA is just one of many professional accounting organizations. Do other professional accounting organizations also provide guidance regarding ethics in accounting?

Answer: Yes, other professional organizations do provide ethical guidance. Several are listed as follows:

- The American Institute for Certified Public Accountants (AICPA) has a *Code of Professional Conduct* (see http://www.aicpa.org).
- Financial Executives International provides a *Model Code of Ethical Conduct for Financial Managers* (see http://www.financialexecutives.org).
- The International Federation of Accountants has a *Code of Ethics and Statement of Policy Implementation & Enforcement of Ethical Requirements* (see http://www.ifac.org).
- The Securities and Exchange Commission (SEC), in compliance with the Sarbanes-Oxley Act of 2002, requires a company to disclose whether it has adopted a code of ethics (see http://www.sec.gov).
- The Institute of Management Accountants even provides an ethics help line to give financial professionals a resource to provide guidance in making the right decisions (see http://www.imanet.org).

Because of alleged wrongdoing, such as that reported in the "Business in Action 1.3", improving ethics is a top priority for most businesses as shown in the "Business in Action 1.4". As a result, professional organizations like those we have cited have become instrumental in providing ethical guidelines.

Business in Action 1.3

Production Firm Employees Charged with Fraud

The Securities and Exchange Commission (SEC) filed three actions against **Diebold, Inc.**, a manufacturer and seller of automated teller machines, for improperly inflating earnings over a five-year period. Three former employees—the CFO, controller, and director of accounting—were accused of improperly inflating revenue on factory orders, improperly recognizing revenue on a lease transaction, manipulating reserves and accruals, improperly capitalizing expenses, and improperly increasing the value of inventory. These actions allegedly resulted in over 40 misstated annual, quarterly, and other reports filed with the SEC, along with numerous inaccurate press releases.

The company agreed to pay a $25,000,000 civil penalty, and the three former employees remain in litigation. Although the CEO was not accused of wrongdoing, he settled with the SEC and agreed to pay back cash bonuses, stock, and stock options received during the periods when the financial fraud was committed.

Source: Securities and Exchange Commission, "SEC Charges Diebold and Former Executives with Accounting Fraud," news release, June 2, 2010.

Business in Action 1.4

The Code of Ethics at **Home Depot** and **Hewlett-Packard**

Ethics policies are becoming increasingly important to organizations. **Home Depot, Inc.**, has an ethics code that states " All associates are expected to act with honesty and integrity. Adhering to the highest ethical standards and doing the right thing are the driving forces behind The Home Depot's success and have been a core component of how we have done business since the beginning."

Hewlett-Packard Company is "Guided by the Integrity at HP (formerly HP's Standards of Business Conduct), program, we apply strong ethics and anti-corruption principles within our operations, across our value chain, and in the communities where we live, work, and do business."

Sources: Home Depot, "Home Page," http://www.homedepot.com; Hewlett-Packard, "Home Page," http://www.hp.com.

Key Takeaway

- Should you encounter ethical conflicts during your career, use the resources provided by internal company policies, by professional organizations such as the IMA and AICPA, and by governmental organizations such as the SEC as a guide to ethical behavior and the resolution of ethical conflicts.

Check Yourself

1. Describe the four key standards of ethical conduct for IMA members outlined in Figure 1.2 “IMA Statement of Ethical Professional Practice”.
2. What steps does the IMA recommend for resolving ethical conflicts?
3. Using Figure 1.2 “IMA Statement of Ethical Professional Practice” as a guide, discuss your options as the accountant at Drive Write.

Solution:

1. The four key standards shown in Figure 1.2 “IMA Statement of Ethical Professional Practice” are outlined as follows:
   - **Competence.** Members of the IMA must maintain an adequate level of skill to perform duties in an accurate and professional manner.
   - **Confidentiality.** Members of the IMA must not disclose confidential information for any reason unless legally obligated to do so.
   - **Integrity.** Members of the IMA must avoid any actual or apparent conflict of interest, including receiving gifts or favors, and must not engage in any activity that would discredit the profession.
   - **Credibility.** Members of the IMA must disclose all relevant information fairly and objectively.
2. Several options exist for resolving ethical conflicts. The IMA suggests the following courses of action:
   - Follow the policies of the organization involving the resolution of ethical conflicts.
   - If following the organization’s policies does not effectively resolve the conflict, discuss the problem with your immediate supervisor unless the supervisor is involved.
   - If the immediate superior cannot reach a satisfactory resolution, the problem should be presented to the next higher managerial level.
   - If all higher levels of management do not reach a satisfactory resolution, an acceptable reviewing authority may be a group, such as the audit committee, executive committee, board of directors, board of trustees, or owners.
   - Another option includes consulting an objective advisor (e.g., IMA ethics counseling service or an attorney).
3. Several options are available. The IMA suggests first following the organization’s policies with regard to resolving ethical conflicts. If Drive Write does not have policies in place or if following the organization’s policies does not resolve the conflict, the next step is to discuss the conflict with the immediate supervisor. However, the president of Drive Write (the immediate supervisor) is involved in the conflict, so approaching the president’s superiors would be best. This could be the audit committee, executive committee, board of directors, or owners. If after pursuing these different courses of action the ethical conflict still exists, it may be appropriate to consult an objective advisor (e.g., the IMA helpline) and perhaps consult an attorney as to legal obligations and rights concerning the ethical conflict. (Many would argue that regardless of the outcome, one would not want to work for a company where this type of unethical behavior occurs at the top, or anywhere within the organization, and that resigning is the best course of action.)

1.5 Computerized Accounting Systems

Learning Objective

1. Understand how accounting systems can help organizations.

Question: Many companies today are growing out of their accounting systems. In the old days, accounting systems were designed primarily to track daily transactions and provide reports to external users on a monthly, quarterly, or annual basis. But times have changed, and companies now need more information internally to make good decisions. Accounting systems are currently used for both external reporting (financial accounting) and internal reporting (managerial accounting). Even relatively small accounting

packages, such as QuickBooks and Sage, provide features that are important for managerial accounting. However, most agree that no single accounting system will meet the needs of every organization and that two important factors must be considered when choosing a system. What are the two factors that must be considered when deciding on an accounting system?

Answer: The two factors are (1) the size of the organization and (2) the information needs of the organization. Each factor is discussed next.

How Big Is Your Company?

Accounting software is designed to serve different-sized companies. The size of a company is commonly measured in sales revenue. Experts express varying opinions on what constitutes a small, mid-sized, or large company. Some believe that small companies have sales up to $10,000,000, mid-sized companies have sales up to $100,000,000, and large companies have sales greater than $100,000,000. Others prefer different amounts. Regardless of the number used, the goal is to find an accounting system that best meets the needs of the organization, and the size of the organization plays a big part in finding the best-fitting system.

What Information Is Needed?

Before selecting an accounting system, an organization must determine its accounting needs. Some organizations simply need the equivalent of a check register, which provides easy tracking of expense codes as checks are issued and makes bank reconciliations a snap. Other organizations require more than a check register; they may demand a system that can create invoices, process payroll, and track inventory. More complex organizations will want the ability to perform more advanced functions. Such organizations might need to customize reports (e.g., create an income statement by division or customer), modify input screens, send financial reports via e-mail, export reports to spreadsheet software such as Excel, and create reports with graphics (e.g., tables, pie charts, and line charts).

Enterprise Resource Planning System

Question: Clearly the size and information needs of a company will drive the selection of an accounting system for the company. As the need for accounting data has become more complex, accounting systems have been developed that perform a wide variety of tasks. These systems are called enterprise resource planning systems. What is an enterprise resource planning system, and how does this system help companies utilize accounting data?

Answer: Enterprise resource planning (ERP) A system designed to record and share information across functional and geographical areas to meet the needs of internal and external users. systems are designed to record and share information across functional areas (e.g., accounting, marketing, human resources, and shipping) and across geographical areas (e.g., from a sales office in California to headquarters in Hong Kong). ERP systems continually update information to provide real-time data to all users, and the data can be organized in different formats to meet the needs of internal and external users. For example, in his book *Onward*, Howard Schultz describes how as CEO of **Starbucks** he reviews comparative financial data for **Starbucks** stores daily. This information comes from the ERP system at **Starbucks**.

The idea behind ERP software, and a central theme in managerial accounting, is that accurate and up-to-date financial information will help organizations make better decisions. Better decisions typically lead to improvements in profitability, efficiency, and customer satisfaction.

ERP systems are expensive. Annual costs for large organizations can easily exceed $10,000,000. However, smaller systems for mid-sized companies are available at a much lower cost. Most ERP software is offered in modules for functional accounting areas, such as accounts receivable, accounts payable, payroll, inventory, and job costing. The more modules included, the higher the cost will be. Popular makers of ERP systems include **Microsoft**, **Oracle**, and **SAP Corporation**.

In deciding whether to upgrade to an ERP system, organizations must be sure that the benefits of using the data from a new system outweigh the costs of implementing the system. If management does not intend to use the information to improve planning and decision making, then going with a less sophisticated accounting system may be the better approach.

Using Spreadsheet Software

Question: ERP systems commonly provide a means to download data to spreadsheets for further analysis. How can spreadsheet software help us to analyze financial information?

Answer: Since managers make extensive use of spreadsheets to organize and analyze data, most computerized accounting systems are designed to export data to spreadsheet software programs such as Excel. For example, Figure 1.3 “Excel Spreadsheet for Southwest Airlines” shows how a spreadsheet was used to import data directly from **Southwest Airlines’** 2020 annual report. This allows the user to analyze the data more easily. Notice that in Figure 1.3 “Excel Spreadsheet for Southwest Airlines” the total operating revenue increased from 2018 to 2019 before dropping significantly in 2020 due to the pandemic. We could use Excel to quickly determine the exact percentage change from 2018 to 2019 and from 2019 to 2020.

Figure 1.3 Excel Spreadsheet for Southwest Airlines

	Year ended December 31,		
	2020	2019	2018
OPERATING REVENUES:			
Passenger	$ 7,665	$ 20,776	$ 20,455
Freight	161	172	175
Other	1,222	1,480	1,335
Total operating revenues	9,048	22,428	21,965
OPERATING EXPENSES:			
Salaries, wages, and benefits	6,811	8,293	7,649
Payroll support and voluntary Employee programs, net	(967)	-	-
Fuel and oil	1,849	4,347	4,616
Maintenance materials and repairs	750	1,223	1,107
Landing fees and airport rentals	1,240	1,363	1,334
Depreciation and amortization	1,255	1,219	1,201
Other operating expenses	1,926	3,026	2,852
Total operating expenses, net	12,864	19,471	18,759
OPERATING INCOME (LOSS)	(3,816)	2,957	3,206
OTHER EXPENSES (INCOME):			
Interest expense	349	118	131
Capitalized interest	(35)	(36)	(38)
Interest income	(32)	(90)	(69)
Other (gains) losses, net	158	8	18
Total other expenses (income)	440	-	42
INCOME (LOSS) BEFORE INCOME TAXES	(4,256)	2,957	3,164
PROVISION (BENEFIT) FOR INCOME TAXES	(1,182)	657	699
NET INCOME (LOSS)	$ (3,074)	$ 2,300	$ 2,465

Question: Let's assume you are asked to prepare an income statement showing revenue and expense projections for next year. How might you use Excel to prepare your projections?

Answer: You could start by exporting this year's results from the accounting system to an Excel spreadsheet. Then you could set up a new column to show estimates for next year. You would likely discuss different aspects of the income statement with various personnel in the organization—making changes as you go—before finalizing your projections.

Imagine the work involved if you did not use a computer but instead had to write the information down by hand. If there were any changes to the information, you would have to make time-consuming calculations, and once the data were finalized, you would be faced with the manual preparation of formal reports. With the relatively recent advances in business technology, the days of preparing information manually are over. Most organizations require their accounting and finance personnel to have advanced computer spreadsheet skills. Our goal is to provide you with an opportunity to use spreadsheets in a way that mirrors the real world.

Key Takeaway

- Throughout this text, you will learn about different methods of recording, sorting, analyzing, and reporting financial information for internal users. Before deciding to implement one of these methods, ask yourself the following question: Will the benefits derived from a new system, such as an ERP system, exceed the costs of putting the system in place? If the answer is "yes," then go for it! If the answer is "no," consider other alternatives.

Check Yourself

Assume you are the CFO for an electronics consulting firm with annual revenues of $30,000,000 and annual profit of $5,000,000. The current accounting system is used for basic functions, such as issuing checks, creating invoices, and processing payroll. The company is considering upgrading its accounting system by purchasing an ERP system. Describe the factors to be considered by the company in making this decision.

Solution:

This company is a mid-sized company with $30,000,000 in revenues, although some would argue that this is a small company. Going to an ERP system is probably not appropriate if management is simply looking for a few reports beyond what most financial accounting systems can provide.

If management has a need for more detailed and complex financial information—other than processing checks, invoices, and payroll—then a low-end ERP system might be appropriate. However, the benefits derived from such a system must outweigh the costs.

1.6 Cost Terminology

Learning Objective

1. Understand the terms used for costing purposes.

Question: Much of what we discuss in this book relates to companies that manufacture products, such as Nike and Apple , and terminology is a key component of accounting for manufacturing companies. The challenge is in classifying costs correctly for items such as production materials, production labor, marketing department labor, rent for production facilities, and rent for the administrative services facilities. These costs must be classified accurately so that they appear correctly in company financial reports. The starting point for learning how to classify costs correctly is in understanding two broad categories of costs. What are the two broad terms used to categorize cost information in a manufacturing setting?

Answer: The two broad categories of costs are *manufacturing costs* and *nonmanufacturing costs*. Each category is described in detail as follows.

Manufacturing Costs

All costs related to the production of goods are called manufacturing costs. All costs related to the production of goods are also called product costs. A manufacturer purchases materials, employs workers who use the materials to assemble the goods, provides a building where the materials are stored and goods are assembled, and sells the goods. We classify the costs associated with these activities into three categories: *direct materials*, *direct labor*, and *manufacturing overhead*.

To help clarify which costs are included in these three categories, let's look at a furniture company that specializes in building custom wood tables called Custom Furniture Company. Each table is unique and built to customer specifications for use in homes (coffee tables and dining room tables) and offices (boardroom and meeting room tables). The sales price of each table varies significantly, from $1,000 to more than $30,000. Figure 1.4 "Direct Materials, Direct Labor, and Manufacturing Overhead at Custom Furniture Company" shows examples of production activities at Custom Furniture Company for each of the three categories.

Direct Materials

Question: Raw materials used in the production process that are easily traced to the product are called direct materials. Raw materials used in the production process that are easily traced to the product. *What materials used in the production process at Custom Furniture would be classified as direct materials?*

Answer: The wood used to build tables and the hardware used to attach table legs would be considered direct materials. Small, inexpensive items like glue, nails, and masking tape are typically not included in direct materials because the cost of tracing these items to the product outweighs the benefit of having accurate cost data. These minor types of materials, often called *supplies* or *indirect materials*, are included in manufacturing overhead, which we define later.

Direct Labor

Question: Workers who convert materials into a finished product and whose time is easily traced to the product are called direct labor. Labor performed by workers who convert materials into a finished product and whose time is easily traced to the product. . *Who represents direct labor at Custom Furniture?*

Answer: Direct labor would include the workers who use the wood, hardware, glue, lacquer, and other materials to build tables.

Manufacturing Overhead

Question: All costs associated with the production process other than direct material costs and direct labor costs are called manufacturing overhead.*Terms synonymous with manufacturing overhead include factory overhead, factory burden, and overhead. What items are included in manufacturing overhead?*

Answer: Manufacturing overhead consists of the following:

- Indirect material costs. The costs of materials necessary to manufacture a product that are not easily traced to the product or that are not worth tracing to the product**.** The cost of materials necessary to manufacture a product that are *not* easily traced to the product or not worth tracing to the product.
- Indirect labor costs. The costs of workers who are involved in the production process but whose time cannot easily be traced to the product**.** The cost of workers who are involved in the production process but whose time *cannot* easily be traced to the product. For example, supervisors in the production process who oversee several different products and are responsible for hiring employees, scheduling employees, and ordering materials are considered indirect labor.
- **Other manufacturing costs.** These are all other costs for items associated with the factory, including equipment maintenance, insurance, utilities, and depreciation. Note that while overhead costs include costs that are indirectly related to the making of our product but they still are at least related to that process.

Table 1.2 Manufacturing Costs at Custom Furniture Company

Direct Materials
• Wood: cherry, maple, oak, and mahogany • Hardware: drawer handles
Direct Labor
• Workers who cut, plane, and glue wood • Workers who fill and sand tables • Workers who stain and finish tables
Manufacturing Overhead
• Indirect materials: glue, screws, nails, sandpaper, stain, and lacquer • Indirect labor: factory supervisors • Other manufacturing costs: equipment maintenance, equipment depreciation, factory utilities, factory insurance, factory building depreciation, and factory property taxes

"Business in Action 1.5" details the materials, labor, and manufacturing overhead at a company that has been producing boats since 1968.

Business in Action 1.5

Photo courtesy of Brian Miller, http://www.flickr.com/photos/13233728@N00/5155012186/

Manufacturing Costs at **MasterCraft**

MasterCraft produces boats for water skiers and wake boarders. Each boat produced incurs significant manufacturing costs. **MasterCraft** records these manufacturing costs as inventory on the balance sheet until the boats are sold, at which time the costs are transferred to cost of goods sold on the income statement.

Examples of direct materials for each boat include the hull, engine, transmission, carpet, gauges, seats, windshield, and swim platform. Examples of indirect materials (part of manufacturing overhead) include glue, paint, and screws. Direct labor includes the production workers who assemble the boats and test them before they are shipped out. Indirect labor (part of manufacturing overhead) includes the production supervisors who oversee production for several different boats and product lines.

Manufacturing overhead includes the indirect materials and indirect labor mentioned previously. Other manufacturing overhead items are factory building rent, maintenance and depreciation for production equipment, factory utilities, and quality control testing.

Source: MasterCraft, "Home Page," http://www.mastercraft.com.

Nonmanufacturing Costs

Costs that are *not* related to the production of goods are called non-manufacturing costs. These costs have two components—*selling costs* and *general and administrative costs*—which are described next. Examples of non-manufacturing costs appear in Figure 1.5 “Examples of Non-manufacturing Costs at Custom Furniture Company”.

Selling Costs

Question: Costs incurred to obtain customer orders and provide customers with a finished product are called selling costs*. (They are also often called marketing costs or selling and advertising costs.) What activities would be classified as selling costs at Custom Furniture?*

Answer: Examples of selling costs include advertising, sales commissions, salaries for marketing and advertising personnel, office space for marketing and advertising personnel, finished goods storage costs, and shipping costs paid by the seller for products shipped to customers.

General and Administrative Costs

Question: Costs related to the overall management of an organization are called general and administrative costs *What activities would be classified as general and administrative costs at Custom Furniture?*

Answer: Examples include personnel and support staff in the following areas: accounting, human resources, legal, executive, and information technology. Depreciation of office equipment and buildings associated with these areas would also be included as general and administrative costs. General and administrative costs are often simply called *administrative costs*.

Figure 1.5 Examples of Nonmanufacturing Costs at Custom Furniture Company

Nonmanufacturing (Period) Costs

Selling

General and Administrative

Although selling costs and general and administrative costs are considered non-manufacturing costs, managers often want to assign some of these costs to products for decision-making purposes. For example, sales commissions and shipping costs for a specific product could be assigned to the product. This would be important if one product had a higher commission rate or was very bulky and thus made shipping difficult. This does not comply with U.S. GAAP because, under U.S. GAAP, only product costs can be assigned to products. However, as we noted earlier, managerial accounting information is tailored to meet the needs of the users and need not follow U.S. GAAP.

Distinguishing between manufacturing and non-manufacturing costs is not always simple. For example, if legal staff works on an issue associated with production personnel and if human resources staff hires assembly line workers, are the costs involved manufacturing or non-manufacturing costs? It is up to each organization to determine how to handle such costs for product costing purposes. The advantage of managerial accounting over financial accounting is that costs can be organized in any manner that helps managers make decisions there are no standards that must be followed. However, in this chapter, to avoid ambiguity, we follow the definitions that most closely follow U.S. GAAP.

Presentation of Manufacturing and Nonmanufacturing Costs in Financial Statements

Question: At this point, you should be able to distinguish between manufacturing costs and non-manufacturing costs. Why is it important to make this distinction?

Answer: Distinguishing between the two categories is critical because the category determines where a cost will appear in the financial statements. All manufacturing costs (direct materials, direct labor, and manufacturing overhead) are attached to inventory as an asset on the balance sheet until the goods are sold, at which point the costs are transferred to cost of goods sold on the income statement as an expense. Non-manufacturing costs are also called *period costs*; that is because they are expensed on the income statement in the time period in which they are incurred.

Table 1.3 "Manufacturing Versus Nonmanufacturing Costs" clarifies the relationship between manufacturing and non-manufacturing costs. It also describes the point at which these costs are recorded as expenses on the income statement. (Remember that the terms *manufacturing cost* and *product cost* are generally interchangeable, as are the terms *non-manufacturing cost* and *period cost*.)

Table 1.3 Manufacturing Versus Nonmanufacturing Costs

Manufacturing Costs (Also Called Product Costs)	Nonmanufacturing Costs (Also Called Period Costs)
• Direct materials • Direct labor • Manufacturing overhead	• Selling • General and administrative
Timing of expense: Costs are expensed when goods are sold.	**Timing of expense:** Costs are expensed during the time period incurred.

"Business in Action 1.6" provides examples of nonmanufacturing costs at **PepsiCo, Inc.**

Business in Action 1.6

Source: Photo courtesy of JeffBedord, http://www.flickr.com/photos/jeffbedford/6218820224/in/photostream/.

Nonmanufacturing Costs at **PepsiCo**

PepsiCo, Inc., produces more than 500 products under several different brand names, including Frito-Lay, Pepsi-Cola, Gatorade, Tropicana, and Quaker. Net sales for 2019 totaled $67.2 billion, resulting in operating profits of $10.3 billion. Cost of sales represented the highest cost on the income statement at $30.1 billion. The second highest cost on the income statement—selling and general and administrative expenses—totaled $26.7 billion. These expenses are period costs, meaning they must be expensed in the period in which they are incurred.

Examples of selling costs for **PepsiCo** include advertising and other marketing activities, reported as selling, general and administrative expenses, totaled
$4.7 billion in 2019, including advertising expenses of $3.0 billion in 2019. Examples of general and administrative costs include salaries and bonuses of top executives and the costs of administrative departments, including personnel, accounting, legal, and information technology.

Source: PepsiCo, "PepsiCo 2019 Annual Report," http://www.pepsico.com.

Key Takeaways

- All manufacturing costs that are easily traceable to a product are classified as either direct materials or direct labor. All other manufacturing costs are classified as manufacturing overhead. All nonmanufacturing costs are not related to production and are classified as either selling costs or general and administrative costs.

Check Yourself

1. The following manufacturing items are for a construction company working on several custom homes. Identify whether each item should be categorized as direct materials, direct labor, or manufacturing overhead.
    1. Nails
    2. Lumber
    3. Drywall
    4. Workers building the house frame
    5. Supervisor responsible for three homes

6. Light bulbs
7. Cabinets
8. Depreciation of construction equipment

2. Identify whether each item in the following should be categorized as a product (manufacturing) cost or as period (nonmanufacturing) cost. Also indicate whether the cost should be recorded as an expense when the cost is incurred or as an expense when the goods are sold.

1. Advertising
2. Shipping costs for raw materials coming from a supplier
3. Shipping costs for goods shipped to a customer
4. Chief executive officer's salary
5. Production supervisor's salary
6. Depreciation on production equipment
7. Raw materials used in production
8. Paper used by the accounting staff
9. Commissions paid to salespeople
10. Janitorial services provided for production facility
11. Supplies used by human resources personnel
12. Utility costs for retail store
13. Insurance costs for production facility
14. Assembly line workers
15. Clerical support for chief executive officer
16. Maintenance of production equipment

3. Identify whether each item listed in item **2** should be categorized as direct materials, direct labor, manufacturing overhead, selling cost, or general and administrative cost.

Solution:

1. Manufacturing overhead
2. Direct materials
3. Direct materials
4. Direct labor
5. Manufacturing overhead
6. Manufacturing overhead (You might call this a direct material, but the benefit of tracking this item as a direct material probably does not outweigh the cost.)
7. Direct materials
8. Manufacturing overhead

1. Period cost, expensed when incurred
2. Product cost, expensed when goods are sold
3. Period cost, expensed when incurred
4. Period cost, expensed when incurred
5. Product cost, expensed when goods are sold
6. Product cost, expensed when goods are sold
7. Product cost, expensed when goods are sold
8. Period cost, expensed when incurred
9. Period cost, expensed when incurred
10. Product cost, expensed when goods are sold
11. Period cost, expensed when incurred
12. Period cost, expensed when incurred

13. Product cost, expensed when goods are sold
14. Product cost, expensed when goods are sold
15. Period cost, expensed when incurred
16. Product cost, expensed when goods are sold

1. Selling
2. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
3. Selling
4. General and administrative
5. Manufacturing overhead
6. Manufacturing overhead
7. Direct materials or manufacturing overhead, depending on if the materials are easily traced to the product (direct) or not (indirect manufacturing overhead)
8. General and administrative
9. Selling
10. Manufacturing overhead
11. General and administrative
12. Selling
13. Manufacturing overhead
14. Direct labor
15. General and administrative
16. Manufacturing overhead

1.7 How Product Costs Flow through Accounts

Learning Objectives

1. Identify how costs flow through the three inventory accounts and cost of goods sold account.

Question: Custom Furniture Company's direct materials include items such as wood and hardware. Direct labor involves the employees who build the custom tables. Manufacturing overhead includes items such as indirect materials (glue, screws, nails, sandpaper, and stain), indirect labor (production supervisor), and other manufacturing costs, such as factory equipment maintenance and factory utilities. What accounts are used to record the costs associated with these items, and where do these accounts appear in the financial statements?

Answer: All the costs mentioned previously for Custom Furniture are product costs (also called *manufacturing costs*). Product costs are recorded as an asset on the balance sheet until the products are sold, at which point the costs are recorded as an expense on the income statement. To record product costs as an asset, accountants use one of three inventory accounts: raw materials inventory, work-in-process inventory, or finished goods inventory. The account they use depends on the product's level of completion. They use one expense account—cost of goods sold—to record the product costs when the goods are sold.

Table 1.4 "Accounts Used to Record Product Costs" summarizes the accounts used to track product costs. Figure 1.6 "Flow of Product Costs through Balance Sheet and Income Statement Accounts" shows how product costs flow through the balance sheet and income statement. Take time to review these items carefully. Your understanding of them will help clarify how product costs flow through the accounts and where product costs appear in the financial statements. The following discussion provides further clarification.

Product Costs on the Balance Sheet

Question: What is the difference between raw materials inventory, work-in-process inventory, and finished goods inventory?

Answer: Each of these accounts is used to record product costs depending on where the product is in the production process, and each account is an asset account on the balance sheet.

Raw Materials

The raw materials inventory. An account used to record the cost of materials not yet put into production. For Custom Furniture Company, this account includes items such as wood, brackets, screws, nails, glue, lacquer, and sandpaper.

Work in Process

The work-in-process (WIP) inventory. An account used to record costs associated with products in the production process that are not yet complete. Suppose Custom Furniture Company has eight tables that are still in production at the end of the year. All manufacturing costs associated with these incomplete eight tables—direct materials, direct labor, and manufacturing overhead—are included in the WIP inventory account.

Once goods in WIP inventory are completed, they are transferred into finished goods inventory. The cost of completed goods that are transferred out of WIP inventory into finished goods inventory is called the cost of goods manufactured.

The finished goods inventory. An account used to record the manufacturing costs associated with products that are completed and ready to sell. Suppose Custom Furniture Company has five completed tables at the end of the year (in addition to the eight partially completed tables in work-in-process inventory). The manufacturing costs of these five tables—direct materials, direct labor, and manufacturing overhead—are included in the finished goods inventory account until the tables are sold. (For the purposes of this example, assume the tables are "sold" when delivered to the customer.)

Product Costs on the Income Statement

Question: The costs of materials not yet put into production are included in raw materials inventory. The costs associated with products that are not yet complete are included in WIP inventory. And the costs associated with products that are completed and ready to sell are included in finished goods inventory. What happens to the product costs in finished goods inventory when the products are sold?

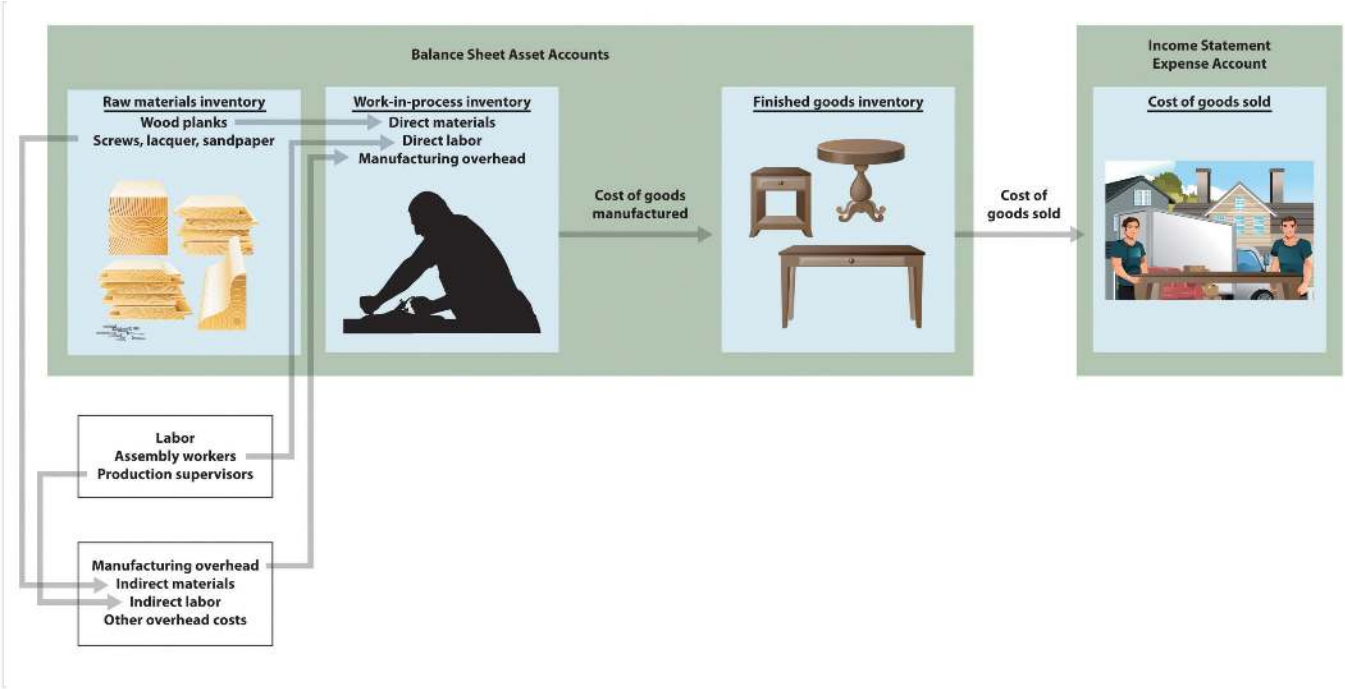
Answer: When completed goods are sold, their costs are transferred out of finished goods inventory into the cost of goods sold. Cost of goods sold is an expense account on the income statement that represents the product costs of all goods sold during the period.

For example, suppose Custom Furniture Company sells one table that cost $3,000 to produce (i.e., direct materials, direct labor, and manufacturing overhead costs incurred to produce the table total $3,000). The $3,000 cost is in finished goods inventory until the entry is made to record the sale, at which time finished goods inventory is reduced by $3,000 (the table is no longer in inventory) and cost of goods sold is increased by $3,000.

Table 1.4 Accounts Used to Record Product Costs

Account Name	Description	Financial Statement
Raw materials inventory	Cost of unused production materials	Balance sheet (asset)
Work-in-process inventory	Cost of incomplete products	Balance sheet (asset)
Finished goods inventory	Cost of completed products not yet sold	Balance sheet (asset)
Cost of goods sold	Cost of products sold	Income statement (expense)

Figure 1.6 Flow of Product Costs through Balance Sheet and Income Statement Accounts



Key Takeaway

- The raw materials inventory account is used to record the cost of materials not yet put into production. The work-in-process inventory account is used to record the cost of products that are in production but that are not yet complete. The finished goods inventory account is used to record the costs of products that are complete and ready to sell. These three inventory accounts are assets accounts that appear on the balance sheet. The costs of completed goods that are sold are recorded in the cost of goods sold account. This account appears on the income statement as an expense.

Check Yourself

Match each of the following accounts with the appropriate description that follows.

- _____ Raw materials inventory
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Used to record product costs of goods that are completed and ready to sell
2. Used to record product costs of goods that have been sold
3. Used to record product costs of goods that are still in production
4. Used to record the cost of materials not yet put into production

Solution

Raw materials inventory	4. Used to record cost of materials not yet put into production.
Work-in-process inventory	3. Used to record product costs associated with incomplete goods in the production process.
Finished goods inventory	1. Used to record product costs associated with goods that are completed and ready to sell.
Cost of goods sold	2. Used to record product costs associated with goods that are sold.

1.8 Income Statements for Manufacturing Companies

Learning Objectives

1. Describe how to prepare an income statement for a manufacturing company.

Question: Companies that provide services, such as Ernst & Young (accounting) and Accenture LLP (consulting), do not sell goods and therefore have no inventory. The accounting process and income statement for service companies are relatively simple. Merchandising companies (also called retail companies) like Macy's and Home Depot buy and sell goods but typically do not manufacture goods. Since merchandising companies must account for the purchase and sale of goods, their accounting systems are more complex than those of service companies. Manufacturing companies, such as Johnson & Johnson and Honda Motor Company , produce and sell goods. Such companies require an accounting system that goes well beyond accounting solely for the purchase and sale of goods. Why are accounting systems more complex for manufacturing companies?

Answer: Accounting systems are more complex for manufacturing companies because they need a system that tracks manufacturing costs throughout the production process to the point at which goods are sold. Since income statements for manufacturing companies tend to be more complex than for service or merchandising companies, we devote this section to income statements for manufacturing companies. Understanding income statements in a manufacturing setting begins with the inventory cost flow equation.

Inventory Cost Flow Equation

Question: How do companies use the cost flow equation to calculate unknown balances?

Answer: We can use the basic cost flow equation to calculate unknown balances for just about any balance sheet account (e.g., cash, accounts receivable, and inventory). The equation is as follows:

Key Equation

Beginning balance *(BB)* + Transfers in *(TI)* – Ending balance *(EB)* = Transfers out *(TO)*

We will apply this equation to the three inventory asset accounts discussed earlier (raw materials, work in process, and finished goods) to calculate the cost of raw materials used in production, cost of goods manufactured, and cost of goods sold.

Raw materials used in production shows the cost of direct and indirect materials placed into the production process. *Cost of goods manufactured* represents the cost of goods completed and transferred out of work-in-process (WIP) inventory into finished goods inventory. *Cost of goods sold* represents the cost of goods that are sold and transferred out of finished goods inventory into cost of goods sold.

Accountants need all these amounts—raw materials placed in production, cost of goods manufactured, and cost of goods sold—to prepare an income statement for a manufacturing company. We describe how to calculate these amounts using three formal schedules in the following order:

1. Schedule of raw materials placed in production
2. Schedule of cost of goods manufactured
3. Schedule of cost of goods sold

Question: The basic cost flow equation can be used in three supporting schedules to help us determine the cost of goods sold amount on the income statement for manufacturing companies. What information is included in these schedules, and what do they look like for Custom Furniture Company?

Answer: Figure 1.7 "Income Statement Schedules for Custom Furniture Company" shows these three schedules for Custom Furniture Company for the month of May. As you review these schedules, note that each schedule provides information required for the next schedule, as indicated by the arrows. Remember the inventory cost flow equation is used for each schedule. This is why you see abbreviations for each element of the equation: beginning balance *(BB)*, transfers in *(TI)*, ending balance *(EB)*, and transfers out *(TO)*.

The goal of going through the process shown in Figure 1.7 "Income Statement Schedules for Custom Furniture Company" is to arrive at a cost of goods sold amount, which is presented on the income statement. Custom Furniture Company's income statement for the month ended May 31 is shown in Figure 1.8 "Income Statement for Custom Furniture Company". As you review Figure 1.7

“Income Statement Schedules for Custom Furniture Company” and Figure 1.8 “Income Statement for Custom Furniture Company”, look back at Figure 1.6 “Flow of Product Costs through Balance Sheet and Income Statement Accounts” to see how costs flow through the three inventory accounts and the cost of goods sold account.

Figure 1.7 Income Statement Schedules for Custom Furniture Company

Custom Furniture Company
Schedule of Raw Materials Placed in Production
Month Ended May 31

Raw materials inventory, beginning balance *(BB)*	$ 25,000[a]
Add current period raw materials purchases *(TI)*	15,000
Raw materials available for production	$ 40,000
Less raw materials inventory, ending balance *(EB)*	19,000[b]
Raw materials placed in production *(TO)*	$ 21,000
Less indirect materials included in manufacturing overhead	3,000
Direct materials placed in production	**$ 18,000**

Custom Furniture Company
Schedule of Cost of Goods Manufactured
Month Ended May 31

WIP inventory, beginning balance *(BB)*		$ 35,000[a]
Add current period manufacturing costs:		
Direct materials	$ 18,000	
Direct labor	40,000	
Manufacturing overhead[c]	96,000	
Total current period manufacturing costs *(TI)*		154,000
Total cost of work in process		$ 189,000
Less WIP inventory, ending balance *(EB)*		28,000[b]
Cost of goods manufactured *(TO)*		**$161,000**

Custom Furniture Company
Schedule of Cost of Goods Sold
Month Ended May 31

[a] From the company's balance sheet at April 30 (April 30 ending balance is the same as May 1 beginning balance).

[b] From the company's balance sheet at May 31.

c **Manufacturing overhead is $3,000 from indirect materials used from the calculation of direct material used in production and $93,000 other overhead costs.**

Figure 1.8 Income Statement for Custom Furniture Company

Finished goods inventory, beginning balance *(BB)*	$ 90,000[a]
Add cost of goods manufactured *(TI)*	161,000
Cost of goods available for sale	$ 251,000
Less finished goods inventory, ending balance *(EB)*	116,000[b]

Custom Furniture Company
Income Statement
Month Ended May 31

Sales	$ 190,000
Cost of goods sold	135,000*
Gross profit	$ 55,000
Less operating (nonmanufacturing) expenses:	
Selling	18,000
General and administrative	26,000
Operating profit	$ 11,000

*$135,000 comes from the schedule of cost of goods sold in Figure 1.7 "Income Statement Schedules for Custom Furniture Company".

Manufacturing Versus Merchandising Income Statements

Question: Manufacturing companies clearly have more complex accounting systems to account for all the costs involved in producing products. However, the income statement for a manufacturing company is not all that much different than the income statement for a merchandising company. What are primary differences between manufacturing and merchandising company income statements?

Answer: The primary differences are as follows:

- Merchandising companies do not calculate the raw materials placed in production or cost of goods manufactured (shown in the top section of Figure 1.7 "Income Statement Schedules for Custom Furniture Company").
- Merchandisers purchase goods from suppliers instead of manufacturing goods. The cost of these purchases from suppliers is often called *net purchases* in the income statement, in contrast to *cost of goods manufactured* in a manufacturer's income statement. The net purchases line consists of purchases, purchases returns and allowances, purchases discounts, and freight in.
- Merchandisers do not use the schedule of cost of goods manufactured (and related schedule of raw materials placed in production).
- Merchandisers use an account called merchandise inventory, or simply inventory, instead of finished goods inventory. This reflects that merchandisers do not produce goods.

Table 1.5 "Income Statement Terminology in Manufacturing and Merchandising Companies" summarizes the differences in income statement terminology between manufacturing companies and merchandising companies.

Table 1.5 Income Statement Terminology in Manufacturing and Merchandising Companies

The following terms are used by manufacturing and merchandising companies: *sales*, *cost of goods available for sale*, *cost of goods sold*, *operating expenses*, *selling*, *general and administrative*, and *operating profit*.	
Finished goods inventory is used by manufacturing companies.	*Merchandise inventory* is used by merchandising companies.
Cost of goods manufactured is used by manufacturing companies.	*Net purchases* is used by merchandising companies.

Figure 1.9 "Merchandising Company Income Statement for Fashion, Inc." presents an income statement for Fashion, Inc., a retail company that sells clothing. Notice that the schedule of cost of goods manufactured (and related schedule of raw materials placed in production) is not needed for merchandising companies, and the terms *merchandise inventory* and *net purchases* are used instead of *finished goods inventory* and *cost of goods manufactured*. Also, the schedule of cost of goods sold is simply included in the income statement. Many companies prefer this approach because it means they do not have to prepare a separate schedule.

Figure 1.9 Merchandising Company Income Statement for Fashion, Inc.

Fashion, Inc.
Income Statement
Month Ended September 30

Sales		$ 450,000
Cost of goods sold:		
Merchandise inventory, beginning balance *(BB)*	$ 350,000	
Add net purchases *(TI)*	260,000	
Cost of goods available for sale	$ 610,000	
Less merchandise inventory, ending balance *(EB)*	$ 320,000	
Cost of goods sold		290,000
Gross profit		$ 160,000
Less operating expenses:		
Selling		90,000
General and administrative		40,000
Operating profit		$ 30,000

Key Takeaways

- Three schedules are necessary to prepare an income statement for a manufacturing company, in the following order:
  - Schedule of raw materials placed in production, which shows cost of direct materials added to work-in-process inventory and cost of indirect materials added to manufacturing overhead
  - Schedule of cost of goods manufactured, which shows cost of goods completed and transferred out of work-in-process inventory into finished goods inventory
  - Schedule of cost of goods sold, which shows cost of goods sold and transferred out of finished goods inventory into cost of goods sold
- The income statements of merchandising companies differ from those of manufacturing companies in several areas. Merchandising companies do not use a schedule of raw materials placed in production or a schedule of cost of goods manufactured, and they use a merchandise inventory account instead of a finished goods inventory account. In addition, they

use the term net purchases instead of cost of goods manufactured and often include the schedule of cost of goods sold in the income statement rather than presenting it separately.

End-of-Chapter Exercises

Questions

1. Describe the characteristics of managerial accounting and financial accounting.
2. What are nonfinancial measures of performance? Provide several examples.
3. Which accountant (financial or managerial) would prepare each of the following reports:
    1. Income statement for the Chevrolet division of **General Motors**
    2. Balance sheet for **PepsiCo** prepared in accordance with U.S. GAAP
    3. **The Boston Symphony Orchestra's** budgeted income statement for next quarter
    4. Defect rate of computer chips produced by **Intel**
    5. Statement of cash flows for **Hewlett-Packard** prepared in accordance with U.S. GAAP
4. Describe the planning and control functions performed by most managers.
5. What is the controller's primary responsibility?
6. How do the treasurer's responsibilities differ from those of the controller?
7. Explain why ethical behavior is so important for finance and accounting personnel.
8. Briefly summarize the Institute of Management Accountants (IMA) *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice". What is the purpose of this statement?
9. Review "Business in Action 1.3" Why would the company's former employees improperly record information as described here?
10. Review "Business in Action 1.4" Why is improving ethics a top priority for businesses, such as **Home Depot** and **Hewlett-Packard**?
11. What is an enterprise resource planning system?
12. Why do manufacturing companies use product costing systems to track costs throughout the production process?
13. Describe manufacturing costs and nonmanufacturing costs. Provide examples of each.
14. Describe the difference between direct materials and direct labor versus indirect materials and indirect labor.
15. Why are the terms *product costs* and *period costs* used to describe manufacturing costs and nonmanufacturing costs?
16. How does the timing of recording expenses differ between product and period costs?
17. Review "Business in Action 1.5" Why are items such as the hull, engine, transmission, carpet, and seats classified as direct materials and items such as glue, paint, and screws classified as indirect materials?
18. Review "Business in Action 1.6" Provide two examples of selling costs and two examples of general and administrative costs at **PepsiCo**.
19. Describe the three inventory accounts used to record product costs.
20. What are the three categories of product costs that flow through the work-in-process inventory account? Describe each one.
21. When is the cost of goods sold account (often called *cost of sales*) used, and how is the dollar amount recorded in this account determined?
22. How does a merchandising company income statement differ from a manufacturing company income statement?

Brief Exercises

23. **Accounting Information at Sportswear Company.** Refer to the dialogue between the president and accountant at Sportswear Company presented at the beginning of the chapter. Why can't the president find information for each product line (hats and jerseys) in the financial statements? Who within the company typically provides this type of information?

24. **Financial Versus Managerial Accounting.** Maria is the loan officer at a local bank that lends money to Old Town Market, a small grocery store. She requests several quarterly financial reports on an ongoing basis to assess the store's ability to repay the loan. Provide one example of a financial accounting report and two examples of managerial accounting reports that Maria might request.

25. **Planning and Control.** Two college graduates recently started a Web page design firm. The first month was just completed, and the owners are in the process of comparing budgeted revenues and expenses with actual revenues and expenses for the month. Would this be considered part of the planning function or the control function? Explain.

26. **Finance and Accounting Personnel.** Determine whether the chief financial officer, controller, treasurer, internal auditor, managerial accountant, financial accountant, or tax accountant would perform the following tasks. (Hint: Some job titles may be used more than once, and others may not be used at all.)

    1. Prepares annual reports for shareholders and creditors
    2. Provides a quarterly summary of financial results to the CEO and board of directors
    3. Provides profit and loss reports by product line
    4. Calculates estimated quarterly tax payments
    5. Oversees the treasurer and internal auditor
    6. Obtains sources of financing and manages short-term investments
    7. Verifies that annual report financial information is accurate

27. **Manufacturing Cost Terms.** Indicate whether each of the following costs associated with production would be classified as direct materials, direct labor, or manufacturing overhead.

    1. Salaried supervisor responsible for several product lines
    2. Hourly workers assembling goods
    3. Grease used to maintain machines
    4. Maintenance personnel
    5. Bike frame used to build a racing bike
    6. Factory property taxes
    7. Glue used to assemble toys

28. **Manufacturing Cost Terms.** Indicate whether each of the following costs associated with production would be classified as direct materials, direct labor, or manufacturing overhead.

    1. Depreciation on production equipment
    2. Paint used to produce wagons
    3. Accounting staff performing tax services for a client
    4. Nails used to assemble cabinets
    5. Fiberglass used to produce a custom boat
    6. Hourly workers assembling goods
    7. Factory utilities

29. **Manufacturing and Nonmanufacturing Cost Terms.** Burns Company incurred costs for the following items.

    Required:

    1. Salary of chief financial officer
    2. Factory insurance
    3. Salary for salespeople
    4. Raw materials used in production easily traced to the product
    5. Computer equipment depreciation for accounting department
    6. Insurance for headquarters building
    7. Production line workers
    8. Clerical support for production supervisors
    9. Indicate whether each item should be categorized as a product or period cost.
    10. Indicate whether each item should be categorized as direct materials, direct labor, manufacturing overhead, selling, or general and administrative.

30. **Manufacturing and Nonmanufacturing Cost Terms.** Leighton, Inc., incurred costs for the following items.

    Required:

1. Janitorial services in the production facility
2. Personnel department supplies
3. Shipping costs for raw materials purchased from a supplier, easily traced to the product
4. Newspaper advertisements
5. Supervisor of several production lines
6. Insurance for factory equipment
7. Production line workers
8. Clerical support for sales staff
9. Indicate whether each item should be categorized as a product or period cost.
10. Indicate whether each item should be categorized as direct materials, direct labor, manufacturing overhead, selling, or general and administrative.

31. **Accounts Used to Record Product Costs.** Match each of the following accounts with the appropriate description that follows.

- _____ Raw materials inventory
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Used to record product costs associated with goods that are sold
2. Used to record the cost of materials not yet put into production
3. Used to record product costs associated with goods that are complete and ready to sell
4. Used to record product costs associated with incomplete goods in the production process

32. **Income Statement Terminology: Manufacturing Versus Merchandising.** Match each of the following terms used in a manufacturing company's income statement with the equivalent term used in a merchandising company's income statement.

Manufacturing Company

Merchandising Company

- _____ Cost of goods manufactured
- _____ Work-in-process inventory
- _____ Finished goods inventory
- _____ Cost of goods sold

1. Merchandise inventory
2. Same term is used by a merchandising company
3. Net purchases
4. Not applicable for a merchandising company.

Exercises

33. **Organizational Structure.** The following list of personnel within organizations comes from Figure 1.2 "IMA Statement of Ethical Professional Practice".

Required:

Match each previous item with the most accurate description as follows.

1. Board of directors
2. Chief financial officer
3. Controller
4. Managerial accountant
5. Financial accountant
6. Tax accountant
7. Treasurer
8. Internal auditor

9. Assists in preparing information used for decision making within the organization
10. Assists in preparing tax reports for governmental agencies, including the Internal Revenue Service
11. Responsible for confirming that controls within the company are effective in ensuring accurate financial data, and serves as an independent link with the board of directors
12. Responsible for all finance and accounting functions within the organization and typically reports to the chief executive officer
13. Elected by the shareholders of the company
14. Oversees the managerial accountant, financial accountant, and tax accountant
15. Responsible for obtaining financing for the organization, projecting cash flow needs, and managing cash and short-term investments
16. Assists in preparing financial information, usually in accordance with U.S. GAAP, for those outside the company

34. **Schedule of Raw Materials Placed in Production.** The balance in Sedona Company's raw materials inventory account was $110,000 at the beginning of September and $135,000 at the end of September. Raw materials purchased during the month totaled $50,000. Sedona used $8,000 in indirect materials for the month.

Required:

Prepare a schedule of raw materials placed in production for the month of September.

35. **Schedule of Cost of Goods Manufactured.** The balance in Reid Company's work-in-process inventory account was $300,000 at the beginning of March and $320,000 at the end of March. Manufacturing costs for the month follow.

Direct materials (from the schedule of raw materials placed in production)	$ 40,000
Direct labor	$ 70,000
Manufacturing overhead	$200,000

Required:

Prepare a schedule of cost of goods manufactured for the month of March.

36. **Schedule of Cost of Goods Sold.** The balance in Blue Oak Company's finished goods inventory account was $25,000 at the beginning of September and $28,000 at the end of September. Cost of goods manufactured for the month totaled $17,000.

Required:

Prepare a schedule of cost of goods sold for the month of September.

37. **Income Statement.** Auto Products, Inc., had the following activity for the month of October.

Sales revenue	$1,100,000
Selling expenses	$ 300,000
General and administrative expenses	$ 230,000
Cost of goods sold	$ 475,000

Required:

Prepare an income statement for the month of October.

Problems

38. **Income Statement and Supporting Schedules.** The following financial information is for Industrial Company. (Note that the most current financial information is presented in the first column.)

	December 31, 2021	**December 31, 2020**
Raw materials inventory	$ 24,000	$ 30,000
Work-in-process inventory	1,800,000	1,650,000
Finished goods inventory	1,050,000	1,230,000

Of the total raw materials placed in production for the year, $36,000 was for indirect materials. Industrial had $3,795,000 in sales for the year ended December 31, 2021. The company also had the following costs for the year:

Selling	$ 270,000
General and administrative	$ 720,000
Raw materials purchases	$ 300,000
Direct labor used in production	$ 375,000
Manufacturing overhead (not indirect materials)	$1,890,000

Required:

1. Prepare a schedule of raw materials placed in production for the year ended December 31, 2021.
2. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2021.
3. Prepare a schedule of cost of goods sold for the year ended December 31, 2021.
4. Prepare an income statement for the year ended December 31, 2021.
5. Describe the three types of costs included in cost of goods sold on the income statement. (Dollar amounts are not necessary in your descriptions.)

39. **Income Statement and Supporting Schedules.** The following financial information is for Danville Company. (Note that the most current financial information is presented in the first column.)

	December 31, 2020	**December 31, 2019**
Raw materials inventory	$ 8,000	$ 10,000
Work-in-process inventory	600,000	550,000
Finished goods inventory	350,000	410,000

Of the total raw materials placed in production for the year, $12,000 was for indirect materials. Danville had $1,265,000 in sales for the year ended December 31, 2020. The company also had the following costs for the year:

Selling	$ 90,000
General and administrative	$240,000
Raw materials purchases	$100,000
Direct labor used in production	$125,000
Manufacturing overhead	$630,000 (not including indirect materials)

Required:

1. Prepare a schedule of raw materials placed in production for the year ended December 31, 2020.
2. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2020.
3. Prepare a schedule of cost of goods sold for the year ended December 31, 2020.
4. Prepare an income statement for the year ended December 31, 2020.
5. Describe the three types of costs included in cost of goods manufactured. (Dollar amounts are not necessary in your descriptions.)

40. **Income Statement and Supporting Schedules.**The following information is for Ciena, Inc., for the year ended December 31, 2020.

Raw materials inventory beginning balance	$ 15,000
Raw materials inventory ending balance	$ 12,000
Work-in-process inventory beginning balance	$ 825,000
Work-in-process inventory ending balance	$ 900,000
Finished goods inventory beginning balance	$ 615,000
Finished goods inventory ending balance	$ 525,000
Raw material purchases	$ 150,000
Direct labor used in production	$ 187,500
Manufacturing overhead (not indirect materials)	$ 945,000
Selling costs	$ 135,000
General and administrative	$ 360,000
Sales revenue	$1,897,500

Of the total raw materials placed in production for the year, $18,000 was for indirect materials.

Required:

1. Prepare a schedule of raw materials placed in production for the year ended December 31, 2020.
2. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2020.
3. Prepare a schedule of cost of goods sold for the year ended December 31, 2020.
4. Prepare an income statement for the year ending December 31, 2020.

41. **Income Statement and Supporting Schedules.** The following information is for Diablo, Inc., for the year ended December 31, 2021.

Raw materials inventory beginning balance	$ 60,000
Raw materials inventory ending balance	$ 48,000
Work-in-process inventory beginning balance	$3,300,000
Work-in-process inventory ending balance	$3,600,000
Finished goods inventory beginning balance	$2,460,000
Finished goods inventory ending balance	$2,100,000
Raw material purchases	$ 600,000
Direct labor used in production	$ 750,000
Manufacturing overhead (not indirect materials)	$3,780,000
Selling costs	$ 540,000
General and administrative	$1,440,000
Sales revenue	$7,590,000

Of the total raw materials placed in production for the year, $72,000 was for indirect materials.

Required:

1. Prepare a schedule of raw materials placed in production for the year ended December 31, 2021.
2. Prepare a schedule of cost of goods manufactured for the year ended December 31, 2021.
3. Prepare a schedule of cost of goods sold for the year ended December 31, 2021.
4. Prepare an income statement for the year ending December 31, 2021.

One Step Further: Skill-Building Cases

42. Ethics: Accounting for Obsolete Inventory. High Tech, Inc., is a public company that produces laser and ink jet printers. Jorge is an accounting staff member who works for the company's controller and is involved in preparing the annual report. One of High Tech's competitors developed a superior color laser jet printer using a less costly production process. Jorge realizes that High Tech's substantial inventory of color laser jet printers is effectively obsolete and will have to be written down to its net realizable value in accordance with U.S. GAAP. This means higher expenses and lower profits.

Jorge's boss, the controller, is aware of the situation but the chief financial officer is not. In fact, the controller told the CFO that High Tech does not have any obsolete inventory. Both Jorge's boss and the CFO receive bonuses tied to the company's profits. The outside auditors are completing the audit and are unaware of the obsolete inventory.

Required:

How should Jorge handle this situation? Use the IMA's *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice" as a guide to answering this question.

43. Internet Project: Institute of Management Accountants. Go to the Web site of the Institute of Management Accountants (http://www.imanet.org). Review various parts of the site (e.g., *About IMA* or *Certification*) and write a one-page summary of your findings.

44. Internet Project: American Institute of Certified Public Accountants. Go to the Web site of the American Institute of Certified Public Accountants (AICPA; http://www.aicpa.org). Review various parts of the site (e.g., *About the AICPA* or *Professional Resources*) and write a one-page summary of your findings.

45. Internet Project: Sarbanes-Oxley Act of 2002. Go to the Securities and Exchange Commission's Web site (http://www.sec.gov) and click on *Laws and Regulations*. Click on the full text of the Sarbanes-Oxley Act of 2002.

Required:

1. Go to section 302, *Corporate Responsibility for Financial Reports*, and summarize the six requirements in this section. Assume you are the chief financial officer of a public company. What concerns might you have about these requirements?
2. Go to section 404, subsection **a**, *Management Assessment of Internal Controls*. Assume you are an executive officer of a public company. What two items are you required to present in the annual report?

46. Ethics: Companies Accused of Committing Fraud. Using a source like *The Wall Street Journal*, *BusinessWeek*, or an Internet search engine, find an article about an organization accused of committing accounting fraud. Write a one-page summary of your findings. Include a copy of the article with your summary.

47. Internet Project: Finding Company with Ethics Policy. Using the Internet, find a company that has standards for ethical behavior. (Some companies refer to these standards as a "code of ethics"; others may use different terminology.) Write a one-page summary of your findings.

48. Group Activity: Inventory Accounts for Manufacturing Company. In groups of two to four students, use the Internet to find a manufacturing company that presents three inventory accounts on the balance sheet or in the notes to the financial statements. Include a printout of your findings, and explain what each account and related dollar amount represents.

Comprehensive Case

49. Ethics: Accounting for Revenues and Expenses. Equipment Group produces excavating equipment for contractors. Equipment Group is working on the annual financial statements for its shareholders, who are expecting profits of $200,000,000 for the year ending December 31. The controller (Jeff) and CFO (Kathy) will receive bonuses totaling 50 percent of their salaries if company profits exceed $200,000,000. Sarah is a staff accountant who works for the controller. One week before the end of the fiscal year, a customer decides to delay a significant purchase of equipment until March of the next year. As a result, Equipment Group's profits will decrease by $2,000,000 to $198,000,000 for the year.

Jeff, the controller, approaches Sarah and asks her to think of a way to increase profits by $2,500,000. He suggests looking at sales occurring in early January and perhaps moving them up to December. He also hints that some December expenses could be pushed back and recorded in January.

Required:

1. Is there a problem with the controller's request? Explain your answer.
2. How should Sarah handle this situation? There are many possible steps, as described in the IMA's *Statement of Ethical Professional Practice* shown in Figure 1.2 "IMA Statement of Ethical Professional Practice".
3. What are the potential consequences for Sarah if she agrees to do what Jeff suggests?

Previous Chapter

Table of Contents

Next Chapter

1: What Is Managerial Accounting? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

Chapter 2 How Do Organizations Identify Cost Behavior Patterns?

Eric Mendez is the chief financial officer (CFO) of Bikes Unlimited, a company that produces mountain bikes and sells them to retail bicycle stores. Bikes Unlimited obtains the bulk of its parts from outside suppliers and assembles them into the mountain bikes prior to shipment. Last month (June), Bikes Unlimited sold 5,000 mountain bikes for $100 each. Last month's income statement shows total revenue of $500,000 and operating profit of $50,000:

Bikes Unlimited
Income Statement
Month Ended June 30

		Percent of Sales
Sales	$500,000	100%
Cost of goods sold	290,000	58
Gross margin	$210,000	42%
Selling and administrative expenses	160,000	32
Operating profit	$ 50,000	10%

Susan Wesley is Bikes Unlimited's cost accountant. Planning for July was completed during June. Senior management is now planning for next month (August) and has asked Eric, the CFO, to obtain some vital financial information for budgeting purposes. Eric arranged a meeting with Susan to discuss the August budget.

Eric:
As you know, we are in the middle of our planning for next month. The senior management group asked me to make some projections based on expected changes to our sales next month.

Susan:
Where do you think sales are headed?

Eric:
We expect unit sales to increase 10 percent, perhaps 20 percent if all goes well.

Susan:
If sales increase 10 percent, I would expect profit to increase by more than 10 percent since some costs are fixed.

Eric:
Sounds reasonable. What's the next step to get a reasonable estimate of profit?

Susan:
First, we have to identify how costs behave with changes in sales and production—whether the costs are variable, fixed, or some other type. Then we can set up the income statement in a contribution margin format and determine if the numbers are within the relevant range.

Eric:
Perhaps you and your staff can discuss this and get me some accurate estimates.

Susan:
I'll meet with them tomorrow and should have some information for you within a few days.

2.1 Cost Behavior Patterns

Learning Objective

1. Identify typical cost behavior patterns.

Question: To predict what will happen to profit in the future at Bikes Unlimited, we must understand how costs behave with changes in the number of units sold (sales volume). Some costs will not change at all with a change in sales volume (e.g., monthly rent for the production facility). Some costs will change with a change in sales volume (e.g., materials for the mountain bikes). What are the three cost behavior patterns that help organizations identify which costs will change and which will remain the same with changes in sales volume?

Answer: The three basic cost behavior patterns are known as variable, fixed, and mixed. Each of these cost patterns is described next.

Variable Costs

Question: We know that some costs vary with changes in activity. What do we call this type of cost behavior?

Answer: This cost behavior pattern is called a variable cost. A variable cost describes a cost that *varies in total* with changes in volume of activity. The activity in this example is the number of bikes produced and sold. However, the activity can take many different forms depending on the organization. The two most common variable costs are direct materials and direct labor. Other examples include indirect materials and energy costs.

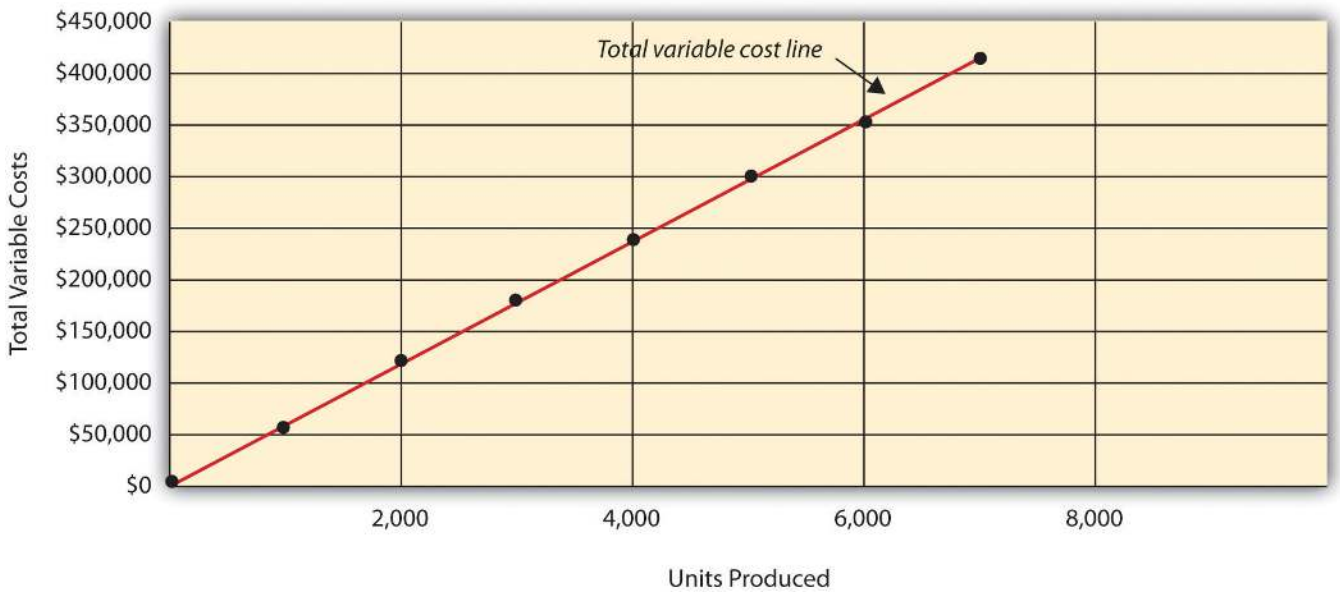
Assume the cost of direct materials (wheels, seats, frames, and so forth) for each bike at Bikes Unlimited is $40. If Bikes Unlimited produces one bike, *total* variable cost for direct materials amounts to $40. If Bikes Unlimited doubles its production to two bikes, total variable cost for direct materials also doubles to $80. Variable costs typically change in proportion to changes in volume of activity. If volume of activity doubles, total variable costs also double, while the cost per unit remains the same. It is important to note that the term *variable* refers to what happens to *total costs* with changes in activity, not to the cost per unit.

Taking it one step further for Bikes Unlimited, let's consider all variable costs related to production. Assume direct materials, direct labor, and all other variable production costs amount to $60 per unit. Table 2.1 "Variable Cost Behavior for Bikes Unlimited" provides the total and per unit variable costs at three different levels of production, and Figure 2.1 "Total Variable Production Costs for Bikes Unlimited" graphs the relation of total variable costs (*y*-axis) to units produced (*x*-axis). Note that the slope of the line represents the variable cost per unit of $60 (slope = change in variable cost ÷ change in units produced).

Table 2.1 Variable Cost Behavior for Bikes Unlimited

Units Produced	Total Variable Costs	Per Unit Variable Cost
1	$ 60	$60
2,000	120,000	60
4,000	240,000	60

Figure 2.1 Total Variable Production Costs for Bikes Unlimited



Using Different Activities to Measure Variable Costs

Question: At Bikes Unlimited, it is reasonable to assume that the activity, number of units produced, will affect total variable costs for direct materials and direct labor. However, companies often use a different activity to estimate total variable costs. What types of activities might be used to estimate variable costs?

Answer: The type of activity used to estimate variable costs depends on the cost. For example, a law firm might use the *number of labor hours* to estimate labor costs. An airline such as **American Airlines** might use *hours of flying time* to estimate fuel costs. A mail delivery service such as **UPS** might use the *number of packages processed* to estimate labor costs associated with sorting packages. A retail store such as **Best Buy** might use *sales dollars* to estimate cost of goods sold.

Variable costs are affected by different activities depending on the organization. The goal is to find the activity that causes the variable cost so that accurate cost estimates can be made.

Fixed Costs

Question: Costs that vary in total with changes in activity are called variable costs. What do we call costs that remain the same in total with changes in activity?

Answer: This cost behavior pattern is called a fixed cost. A fixed cost describes a cost that is *fixed (does not change) in total* with changes in volume of activity. Assuming the activity is the number of bikes produced and sold, examples of fixed costs include salaried personnel, building rent, and insurance.

Assume Bikes Unlimited pays $8,000 per month in rent for its production facility. In addition, insurance for the same building is $2,000 per month and salaried production personnel are paid $6,000 per month. All other fixed production costs total $4,000. Thus Bikes Unlimited has total fixed costs of $20,000 per month related to its production facility (= $8,000 + $2,000 + $6,000 + $4,000). If only one bike is produced, Bikes Unlimited still must pay $20,000 per month. If 5,000 bikes are produced, Bikes Unlimited still pays $20,000 per month. The fixed costs remain unchanged in total as the level of activity changes.

Question: What happens to fixed costs on a per unit basis as production levels change?

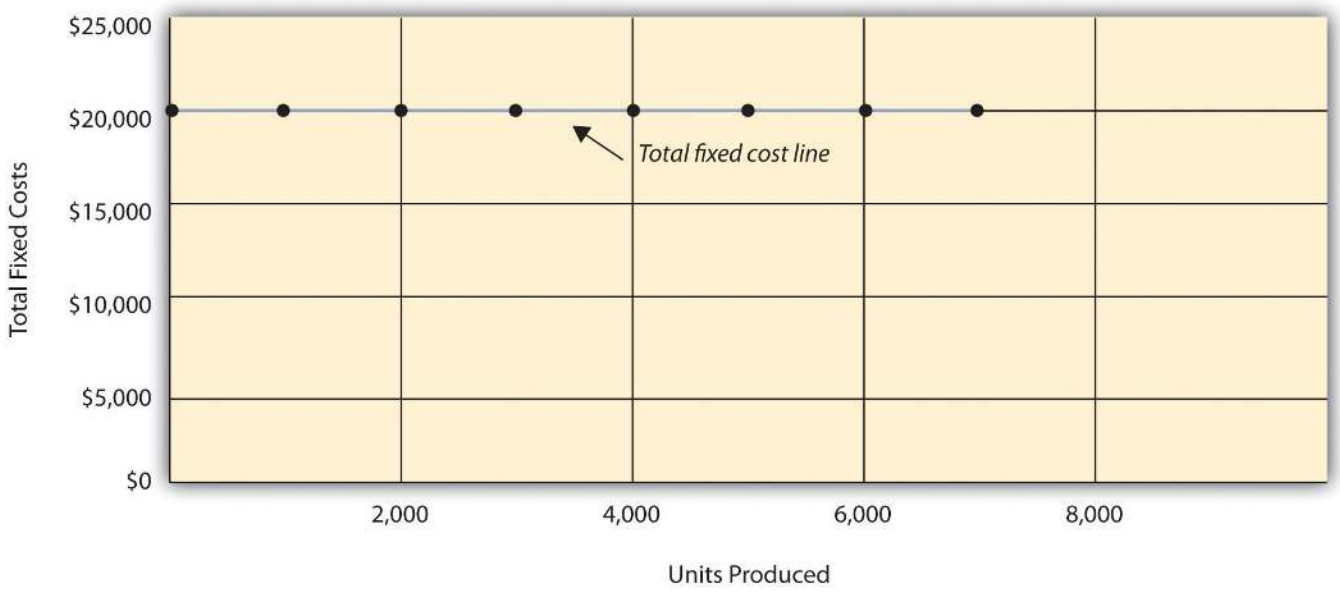
Answer: If Bikes Unlimited only produces one bike, the fixed cost *per unit* would amount to $20,000 (= $20,000 total fixed costs ÷ 1 bike). If Bikes Unlimited produces two bikes, the fixed cost per unit would be $10,000 (= $20,000 ÷ 2 bikes). As activity increases, the fixed costs are spread out over more units, which results in a lower cost per unit.

Table 2.2 “Fixed Cost Behavior for Bikes Unlimited” provides the total and per unit fixed costs at three different levels of production, and Figure 2.2 “Total Fixed Production Costs for Bikes Unlimited” graphs the relation of total fixed costs (*y*-axis) to units produced (*x*-axis). Note that regardless of the activity level, *total* fixed costs remain the same.

Table 2.2 Fixed Cost Behavior for Bikes Unlimited

Units Produced	Total Fixed Costs	Per Unit Fixed Cost
1	$20,000	$20,000
2,000	20,000	10
4,000	20,000	5

Figure 2.2 Total Fixed Production Costs for Bikes Unlimited



Business in Action 2.1

United Airlines Struggles to Control Costs

United Airlines is the second largest air carrier in the world. It has hubs in Chicago, Denver, Los Angeles, San Francisco, and New York and flies to 109 destinations in 23 countries. Destinations include Tokyo, London, and Frankfurt.

Back in 2002, **United** filed for bankruptcy. Industry analysts reported that **United** had relatively high fixed costs, making it difficult for the company to cut costs quickly in line with its reduction in revenue. A few years later, **United** emerged from bankruptcy, and in 2010 merged with **Continental Airlines**. Although financial information was presented separately for each company (**United** and **Continental**) in 2010, both companies are now owned by **United Continental Holdings, Inc.** The following podcast discusses information **United Airlines**' income statement for the year ended December 31, 2019 (amounts are in millions). Review this information carefully. Which costs are likely to be fixed?

https://youtu.be/8j7bimbHwT8

Fixed costs are clearly a large component of total operating expenses, which makes it difficult for airline companies like **United Airlines** to make short-term cuts in expenses when revenue declines.

Source: **United Continental, Inc.**, form 10K for 2019.

Committed Versus Discretionary Fixed Costs

Question: Organizations often view fixed costs as either committed or discretionary. What is the difference between these two types of fixed costs?

Answer: A committed fixed cost is a fixed cost that cannot easily be changed in the short run without having a significant impact on the organization. For example, assume Bikes Unlimited has a five-year lease on the company's production facility, which costs

$8,000 per month. This is a committed fixed cost because the lease cannot easily be broken, and the company is committed to using this facility for years to come. Other examples of committed fixed costs include salaried employees with long-term contracts, depreciation on buildings, and insurance.

A discretionary fixed cost is a fixed cost that can be changed in the short run without having a significant impact on the organization. For example, assume Bikes Unlimited contributes $10,000 each year toward charitable organizations. Management has the option of changing this amount in the short run without causing a significant impact on the organization. Other examples of discretionary fixed costs include advertising, research and development, and training programs (although an argument can be made that reducing these expenditures could have a significant impact on the company depending on the amount of the cuts).

In general, management looks to cut discretionary fixed costs when sales and profits are declining, since cuts in this area tend not to have as significant an impact on the organization as cutting committed fixed costs. Difficulties arise when struggling organizations go beyond cutting discretionary fixed costs and begin looking at cutting committed fixed costs.

Mixed Costs

Question: We have now learned about two types of cost behavior patterns—variable costs and fixed costs. However, there is a third type of cost that behaves differently in that both total and per unit costs change with changes in activity. What do we call this type of cost?

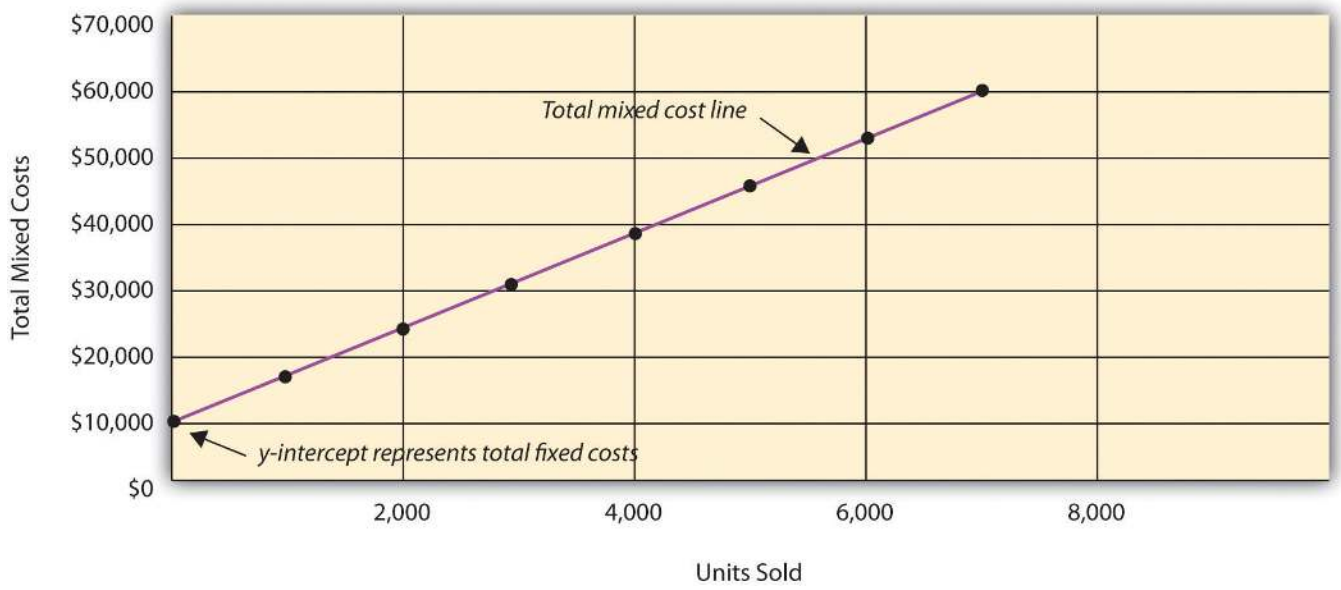
Answer: This cost behavior pattern is called a mixed cost. The term mixed cost describes a cost that has a mix of fixed and variable costs. For example, assume sales personnel at Bikes Unlimited are paid a total of $10,000 in monthly salary plus a commission of $7 for every bike sold. This is a mixed cost because it has a fixed component of $10,000 per month and a variable component of $7 per unit.

Table 2.3 “Mixed Cost Behavior for Bikes Unlimited” provides the total and per unit fixed costs at three different levels of production, and Figure 2.3 “Total Mixed Sales Compensation Costs for Bikes Unlimited” graphs the relation of total mixed costs (*y*-axis) to units produced (*x*-axis). The point at which the line intersects the *y*-axis represents the total fixed cost ($10,000), and the slope of the line represents the variable cost per unit ($7).

Table 2.3 Mixed Cost Behavior for Bikes Unlimited

Units Sold	Total Mixed Costs	Per Unit Mixed Cost
1	$10,007	$10,007.00
2,000	24,000	12.00
4,000	38,000	9.50

Figure 2.3 Total Mixed Sales Compensation Costs for Bikes Unlimited



Because this cost is depicted with a straight line, we can use the equation for a straight line to describe a mixed cost:

Key Equation

Total mixed cost = Total fixed cost + (Unit variable cost × Number of units)

or

$Y = f + vX$

where

Y = total mixed costs (this is the *y*-axis in Figure 2.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited")
f = total fixed costs
v = variable cost per unit
X = level of activity (this is the *x*-axis in Figure 2.3 "Total Mixed Sales Compensation Costs for Bikes Unlimited")

For Bikes Unlimited, the mixed cost equation is Y = $10,000 + $7X. If Bikes Unlimited sells 4,000 bikes (X) in one month, the total mixed cost (Y) for sales personnel compensation would be $38,000 [= $10,000 + ($7 × 4,000 units)].

In math class, you may have learned this same equation where Y = mX + B is the equation of a line. Further, you learned that m = slope of that line and B = the Y intercept. This is really the same concept as above with slope equal to the variable cost per unit and y intercept equal to the total fixed costs.

Short Term Versus Long Term and the Relevant Range

We now introduce two important concepts that must be considered when estimating costs: short term versus long term, and the relevant range.

Short Term Versus Long Term

Question: When identifying cost behavior patterns, we assume that management is using the cost information to make short-term decisions. Why is this short-term decision making assumption so important?

Answer: Variable, fixed, and mixed cost concepts are useful for short-term decision making and therefore apply to a specific period of time. This short-term period will vary depending on the company's current production capacity and the time required to change capacity. In the long term, all cost behavior patterns will likely change.

For example, suppose Bikes Unlimited's production capacity is 8,000 units per month, and management plans to expand capacity in two years by renting a new production facility and hiring additional personnel. This is a long-term decision that will change the cost behavior patterns identified earlier. Variable production costs will no longer be $60 per unit, fixed production costs will no longer be $20,000 per month, and mixed sales compensation costs will also change. All these costs will change because the estimates are accurate only in the short term.

The Relevant Range

Question: Another important concept we use when estimating costs is called the relevant range. What is the relevant range and why is it so important when estimating costs?

Answer: The relevant range is the range of activity for which cost behavior patterns are likely to be accurate. The variable, fixed, and mixed costs identified for Bikes Unlimited will only be accurate within a certain range of activity. Once the firm goes outside that range, cost estimates are not necessarily accurate and often must be reevaluated and recalculated.

For example, assume Bikes Unlimited's mixed sales compensation costs of $10,000 per month plus $7 per unit is only valid up to 4,000 units per month. If unit sales increase beyond 4,000 units, management will hire additional salespeople and the total monthly base salary will increase beyond $10,000. Thus the relevant range for this mixed cost is from zero to 4,000 units. Once the company exceeds sales of 4,000 units per month, it is out of the relevant range, and the mixed cost must be recalculated.

We discuss the relevant range concept in more detail later in the chapter. For now, remember that the accuracy of cost behavior patterns is limited to a certain range of activity called the relevant range.

How Cost Behavior Patterns Are Used

Question: How do managers use cost behavior patterns to make better decisions?

Answer: Accurately predicting what costs will be in the future can help managers answer several important questions. For example, managers at Bikes Unlimited might ask the following:

- We expect to see a 5 percent increase in unit sales next year. How will this affect revenues and costs?
- We are applying for a loan with a bank, and bank managers think our sales estimates are high. What happens to our revenues and costs if we lower estimates by 20 percent?
- What happens to revenues and costs if we add a racing bike to our product line?
- How will costs behave in the future if we increase automation in the production process?

The only way to accurately predict costs is to understand how costs behave given changes in activity. To make good decisions, managers must know how costs are structured (fixed, variable, or mixed). The next section explains how to estimate fixed and variable costs, and how to identify the fixed and variable components of mixed costs.

Business in Action 2.2

Budget Cuts at an Elementary School District

A school district outside Sacramento, California, was faced with making budget cuts because of a reduction in state funding. To reduce costs, the school district's administration decided to consider closing one of the smaller elementary schools in the district. According to an initial estimate, closing this school would reduce costs by $500,000 to $1,000,000 per year. However, further analysis identified only $100,000 to $150,000 in cost savings.

Why did the analysis yield lower savings than the initial estimate? Most of the costs were committed fixed costs (e.g., teachers' salaries and benefits) and could not be eliminated in the short term. In fact, teachers and students at the school being considered for closure were to be moved to other schools in the district, and so no savings on teachers' salaries and benefits would result. The only real short-term cost savings would be in not having to maintain the classrooms, computer lab, and library (nonunion employees would be let go) and in utilities (heat and air conditioning would be turned off).

The school district ultimately decided not to close the school because of the large committed fixed costs involved, as well as a lack of community support, and budget cuts were made in other areas throughout the district.

Check Yourself

Sierra Company is trying to identify the behavior of the three costs shown in the following table. The following cost information is provided for six months. Calculate the cost per unit, and then identify how each cost behaves (fixed, variable, or mixed). Explain your answers.

			Cost 1		Cost 2		Cost 3
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	50	$100	$2.00	$100	$2.00	$100	$2.00
2	100	200	2.00	100	1.00	150	1.50
3	150	300	_____	100	_____	200	_____
4	200	400	_____	100	_____	250	_____
5	250	500	_____	100	_____	300	_____
6	300	600	_____	100	_____	350	_____

Solution:

As shown in the following table, cost 1 is a variable cost because as the number of units produced changes, total costs change (in proportion to changes in activity) and per unit cost remains the same. Cost 2 is a fixed cost because as the number of units produced changes, total costs remain the same and per unit costs change. Cost 3 is a mixed cost because as the number of units produced changes, total cost changes (but not in proportion to changes in activity) and per unit cost changes.

			Cost 1		Cost 2		Cost 3
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit***	**Total Costs**	**Cost per Unit***
1	50	$100	$2.00	$100	$2.00	$100	$2.00
2	100	200	2.00	100	1.00	150	1.50
3	150	300	2.00	100	0.67	200	1.33
4	200	400	2.00	100	0.50	250	1.25
5	250	500	2.00	100	0.40	300	1.20
6	300	600	2.00	100	0.33	350	1.17
							*Rounded.

2.2 Cost Estimation Methods

Learning Objective

1. Estimate costs using account analysis, the high-low method, the scattergraph method, and regression analysis.

Question: Recall the conversation that Eric (CFO) and Susan (cost accountant) had about Bikes Unlimited's budget for the next month, which is August. The company expects to increase sales by 10 to 20 percent, and Susan has been asked to estimate profit for August given this expected increase. Although examples of variable and fixed costs were provided in the previous sections, companies typically do not know exactly how much of their costs are fixed and how much are variable. (Financial accounting

systems do not normally sort costs as fixed or variable.) Thus organizations must estimate their fixed and variable costs. What methods do organizations use to estimate fixed and variable costs?

Answer: Four common approaches are used to estimate fixed and variable costs:

- Account analysis
- High-low method
- Scattergraph method
- Regression analysis

All four methods are described next. The goal of each cost estimation method is to estimate fixed and variable costs and to describe this estimate in the form of Y = *f* + *v*X. That is, Total mixed cost = Total fixed cost + (Unit variable cost × Number of units). Note that the estimates presented next for Bikes Unlimited may differ from the dollar amounts used previously, which were for illustrative purposes only.

Account Analysis

Question: The account analysis *approach is perhaps the most common starting point for estimating fixed and variable costs. How is the account analysis approach used to estimate fixed and variable costs?*

Answer: This approach requires that an experienced employee or group of employees review the appropriate accounts and determine whether the costs in each account are fixed or variable. Totaling all costs identified as fixed provides the estimate of total fixed costs. To determine the variable cost per unit, all costs identified as variable are totaled and divided by the measure of activity (*units produced* is the measure of activity for Bikes Unlimited).

Let's look at the account analysis approach using Bikes Unlimited as an example. Susan (the cost accountant) asked the financial accounting department to provide cost information for the production department for the month of June (July information is not yet available). Because the financial accounting department tracks information by department, it is able to produce this information. The production department information for June is as follows:

Units produced and sold	5,000
Materials used in production	$180,000
Labor used in production (assembly and supervisors)	80,000
Production facility costs (rent, insurance, utilities, etc.)	30,000
Total production cost	$290,000

Susan reviewed this cost information with the production manager, Indira Bingham, who has worked as production manager at Bikes Unlimited for several years. After careful review, Indira and Susan came up with the following breakdown of variable and fixed costs for June:

	Total (=)	Variable (+)	Fixed
Materials used in production	$180,000	$180,000	$ 0
Labor used in production (assembly and supervisors)	80,000	65,000	15,000
Production facility costs (rent, insurance, utilities, etc.)	30,000	15,000	15,000
Total production cost	$290,000	$260,000	$30,000

Total fixed cost is estimated to be $30,000, and variable cost per unit is estimated to be $52 (= $260,000 ÷ 5,000 units produced). *Remember, the goal is to describe the mixed costs in the equation form Y = f + vX.* Thus the mixed cost equation used to estimate future production costs is

Y = $30,000 + $52X

Now Susan can estimate monthly production costs (Y) if she knows how many units Bikes Unlimited plans to produce (X). For example, if Bikes Unlimited plans to produce 6,000 units for a particular month (a 20 percent increase over June) and this level of activity is within the relevant range, total production costs should be approximately $342,000 [= $30,000 + ($52 × 6,000 units)].

Question: Why should Susan be careful using historical data for one month (June) to estimate future costs?

Answer: June may not be a typical month for Bikes Unlimited. For example, utility costs may be low relative to those in the winter months, and production costs may be relatively high as the company prepares for increased demand in July and August. This might result in a lower materials cost per unit from quantity discounts offered by suppliers. To smooth out these fluctuations, companies often use data from the past quarter or past year to estimate costs.

Check Yourself

Alta Production, Inc., is using the account analysis approach to identify the behavior of production costs for a month in which it produced 350 units. The production manager was asked to review these costs and provide her best guess as to how they should be categorized. She responded with the following information:

	Total (=)	Variable (+)	Fixed
Materials used in production	$270,000	$270,000	$ 0
Labor used in production	134,000	130,000	4,000
Production facility costs	103,000	100,000	3,000
Total production cost	$507,000	$500,000	$7,000

1. Describe the production costs in the equation form Y = *f* + *v*X.
2. Assume Alta intends to produce 400 units next month. Calculate total production costs for the month.

Solution:

1. Because *f* represents total fixed costs, and *v* represents variable cost per unit, the cost equation is: Y = $7,000 + $1,428.57X. (Variable cost per unit of $1,428.57 = $500,000 ÷ 350 units.)
2. Using the previous equation, simply substitute 400 units for X, as follows:

   Y=$7,000+($1,428.57×400 units)Y=$7,000+$571,428Y=$578,428

   Thus total production costs are expected to be $578,428 for next month.

High-Low Method

Question: Another approach to identifying fixed and variable costs for cost estimation purposes is the high-low method A method of cost analysis that uses the high and low activity data points to estimate fixed and variable costs. . *Accountants who use this approach are looking for a quick and easy way to estimate costs, and will follow up their analysis with other more accurate techniques. How is the high-low method used to estimate fixed and variable costs?*

Answer: The high-low method uses historical information from several reporting periods to estimate costs. Assume Susan Wesley obtains monthly production cost information from the financial accounting department for the last 12 months. This information appears in Table 2.4 “Monthly Production Costs for Bikes Unlimited”.

Table 2.4 Monthly Production Costs for Bikes Unlimited

Reporting Period (Month)	Total Production Costs	Level of Activity (Units Produced)
July	$230,000	3,500
August	250,000	3,750
September	260,000	3,800
October	220,000	3,400
November	340,000	5,800
December	330,000	5,500
January	***200,000***	***2,900***
February	210,000	3,300
March	240,000	3,600
April	***380,000***	***5,900***
May	350,000	5,600
June	290,000	5,000

Step 1. Identify the high and low activity levels from the data set.

Step 2. Calculate the variable cost per unit (*v*).

Step 3. Calculate the total fixed cost (*f*).

Step 4. State the results in equation form Y = *f* + *v* X.

Question: How are the four steps of the high-low method used to estimate total fixed costs and per unit variable cost?

Answer: Each of the four steps is described next.

Step 1. Identify the high and low activity levels from the data set.

The highest level of activity (level of production) occurred in the month of April (5,900 units; $380,000 production costs), and the lowest level of activity occurred in the month of January (2,900 units; $200,000 production costs). Note that we are identifying the high and low *activity* levels rather than the high and low *dollar* levels—choosing the high and low dollar levels can result in incorrect high and low points.

Step 2. Calculate the variable cost per unit (*v*).

The calculation of the variable cost per unit for Bikes Unlimited is shown as follows:

Unit variable cost (v)=Cost at highest level − Cost at lowest level Highest activity level − Lowest activity level =$380,000−$200,0005,900 units−2,900 units=$180,0003,000 units=$60

Step 3. Calculate the total fixed cost (*f*).

After completing step 2, the equation to describe the line is partially complete and stated as Y = *f* + $60X. The goal of step 3 is to calculate a value for total fixed cost (*f*). Simply select either the high or low activity level, and fill in the data to solve for *f* (total fixed costs), as shown.

Using the low activity level of 2,900 units and $200,000,

Y=f+vX$200,000=f+($60×2,900 units)f=$200,000−($60×2,900 units)f=$200,000−$174,000f=$26,000

Thus total fixed costs total $26,000. (Try this using the high activity level of 5,900 units and $380,000. You will get the same result as long as the per unit variable cost is not rounded.)

Step 4. State the results in equation form Y = *f* + *v* X.

We know from step 2 that the variable cost per unit is $60, and from step 3 that total fixed cost is $26,000. Thus we can state the equation used to estimate total costs as

Y = $26,000 + $60X

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $386,000:

Y=$26,000+($60×6,000 units)Y=$26,000+$360,000Y=$386,000

Question: Although the high-low method is relatively simple, it does have a potentially significant weakness. What is the potential weakness in using the high-low method?

Answer: In reviewing the data above, you will notice that this approach only considers the high and low activity levels in establishing an estimate of fixed and variable costs. The high and low data points may not represent the data set as a whole, and using these points can result in distorted estimates.

For example, the $380,000 in production costs incurred in April may be higher than normal because several production machines broke down resulting in costly repairs. Or perhaps several key employees left the company, resulting in higher than normal labor costs for the month because the remaining employees were paid overtime. Cost accountants will often throw out the high and low points for this reason and use the next highest and lowest points to perform this analysis. While the high-low method is most often used as a quick and easy way to estimate fixed and variable costs, other more sophisticated methods are most often used to refine the estimates developed from the high-low method.

Scattergraph Method

Question: Many organizations prefer to use the scattergraph method A method of cost analysis that uses a set of data points to estimate fixed and variable costs. *to estimate costs. Accountants who use this approach are looking for an approach that does not simply use the highest and lowest data points. How is the scattergraph method used to estimate fixed and variable costs?*

Answer: The scattergraph method considers all data points, not just the highest and lowest levels of activity. Again, the goal is to develop an estimate of fixed and variable costs stated in equation form Y = *f* + *v*X. Using the same data for Bikes Unlimited shown in Table 2.4 “Monthly Production Costs for Bikes Unlimited”, we will follow the five steps associated with the scattergraph method:

Step 1. Plot the data points for each period on a graph.

Step 2. Visually fit a line to the data points and be sure the line touches one data point.

Step 3. Estimate the total fixed costs (*f*).

Step 4. Calculate the variable cost per unit (*v*).

Step 5. State the results in equation form Y = *f* + *v* X.

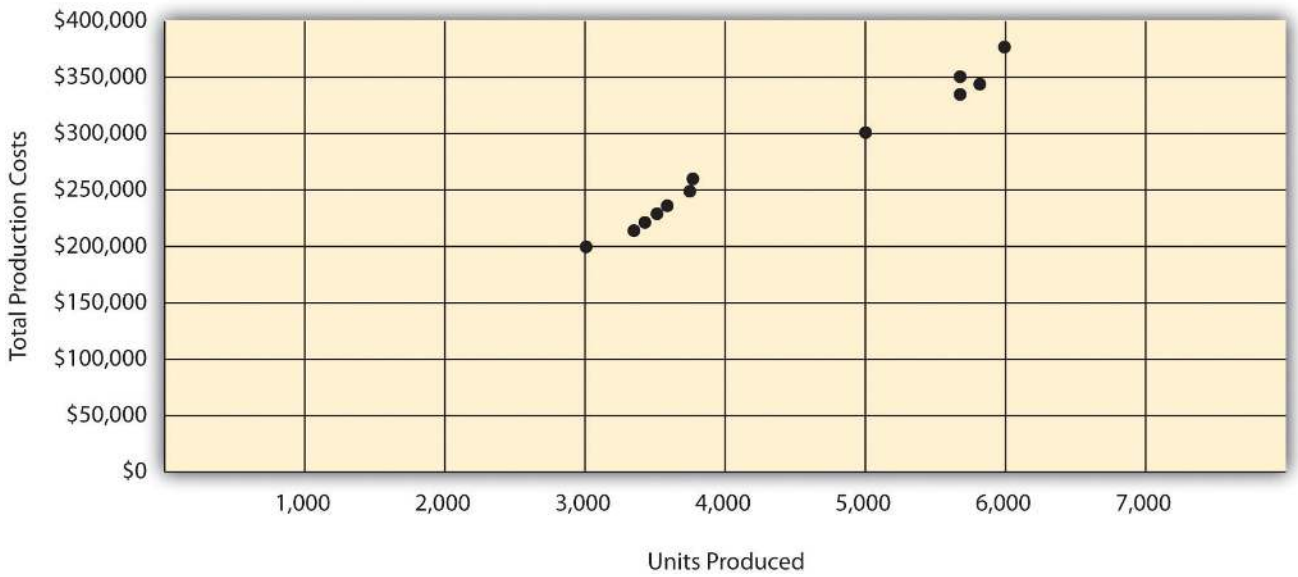
Question: How are the five steps of the scattergraph method used to estimate total fixed costs and per unit variable cost?

Answer: Each of the five steps is described next.

Step 1. Plot the data points for each period on a graph.

This step requires that each data point be plotted on a graph. The *x*-axis (horizontal axis) reflects the level of activity (units produced in this example), and the *y*-axis (vertical axis) reflects the total production cost. Figure 2.5 “Scattergraph of Total Mixed Production Costs for Bikes Unlimited” shows a scattergraph for Bikes Unlimited using the data points for 12 months, July through June.

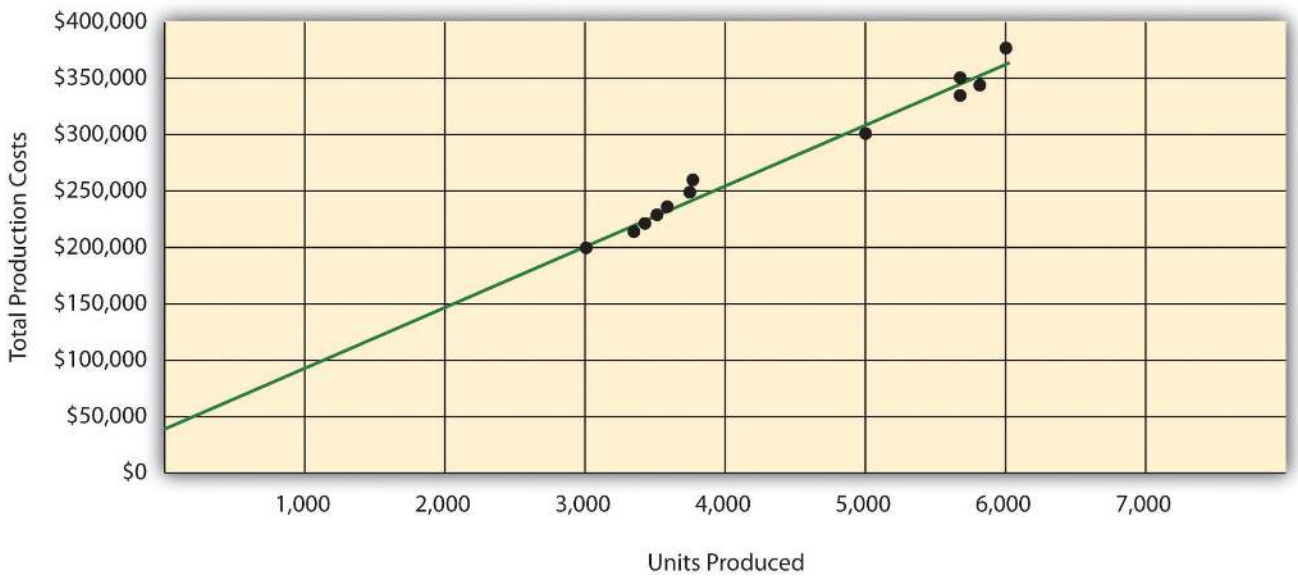
Figure 2.5 Scattergraph of Total Mixed Production Costs for Bikes Unlimited



Step 2. Visually fit a line to the data points and be sure the line touches one data point.

Once the data points are plotted as described in step 1, draw a line through the points touching one data point and extending to the *y*-axis. The goal here is to minimize the distance from the data points to the line (i.e., to make the line as close to the data points as possible). Figure 2.6 "Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method" shows the line through the data points. Notice that the line hits the data point for July (3,500 units produced and $230,000 total cost).

Figure 2.6 Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method



Step 3. Estimate the total fixed costs (*f*).

The total fixed costs are simply the point at which the line drawn in step 2 meets the *y*-axis. This is often called the *y*-intercept. Remember, the line meets the *y*-axis when the activity level (units produced in this example) is zero. Fixed costs remain the same in total regardless of level of production, and variable costs change in total with changes in levels of production. Since variable costs are zero when no units are produced, the costs reflected on the graph at the *y*-intercept must represent total fixed costs. The graph in Figure 2.6 "Estimated Total Mixed Production Costs for Bikes Unlimited: Scattergraph Method" indicates total fixed costs of approximately $45,000. (Note that the *y*-intercept will always be an approximation.)

Step 4. Calculate the variable cost per unit (*v*).

After completing step 3, the equation to describe the line is partially complete and stated as Y = $45,000 + *v*X. The goal of step 4 is to calculate a value for variable cost per unit (*v*). Simply use the data point the line intersects (July: 3,500 units produced and $230,000 total cost), and fill in the data to solve for *v* (variable cost per unit) as follows:

Y=f+vX$230,000=$45,000+(v×3,500)$230,000−$45,000=v×3,500$185,000=v×3,500v=$185,000÷3,500v=$52.86 (rounded)

Thus variable cost per unit is $52.86.

Step 5. State the results in equation form Y = *f* + *v* X.

We know from step 3 that the total fixed costs are $45,000, and from step 4 that the variable cost per unit is $52.86. Thus the equation used to estimate total costs looks like this:

Y = $45,000 + $52.86X

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $362,160:

Y=$45,000+($52.86×6,000 units)Y=$45,000+$317,160Y=$362,160

Question: Remember that the key weakness of the high-low method discussed previously is that it considers only two data points in estimating fixed and variable costs. How does the scattergraph method mitigate this weakness?

Answer: The scattergraph method mitigates this weakness by considering all data points in estimating fixed and variable costs. The scattergraph method gives us an opportunity to review all data points in the data set when we plot these data points in a graph in step 1. If certain data points seem unusual (statistics books often call these points *outliers*), we can exclude them from the data set when drawing the best-fitting line. In fact, many organizations use a scattergraph to identify outliers and then use *regression analysis* to estimate the cost equation Y = *f* + *v*X. We discuss regression analysis in the next section.

Although the scattergraph method tends to yield more accurate results than the high-low method, the final cost equation is still based on estimates. The line is drawn using our best judgment and a bit of guesswork, and the resulting *y*-intercept (fixed cost estimate) is based on this line. This approach is not an exact science! However, the next approach to estimating fixed and variable costs—regression analysis—uses mathematical equations to find the best-fitting line.

Question: Regression analysis is similar to the scattergraph approach in that both fit a straight line to a set of data points to estimate fixed and variable costs. How does regression analysis differ from the scattergraph method for estimating costs?

Answer: Regression analysis uses a series of mathematical equations to find the best possible fit of the line to the data points and thus tends to provide more accurate results than the scattergraph approach. Rather than running these computations by hand, most companies use computer software, such as Excel, to perform regression analysis. Using the data for Bikes Unlimited shown back in Table 2.4 “Monthly Production Costs for Bikes Unlimited”, regression analysis in Excel provides the following output. (This is a small excerpt of the output; see the appendix to this chapter for an explanation of how to use Excel to perform regression analysis.)

	Coefficients
y-intercept	43,276
x variable	53.42

Thus the equation used to estimate total production costs for Bikes Unlimited looks like this:

Y = $43,276 + $53.42X

Now it is possible to estimate total production costs given a certain level of production (X). For example, if Bikes Unlimited expects to produce 6,000 units during August, total production costs are estimated to be $363,796:

Y=$43,276+($53.42×6,000 units)Y=$43,276+$320,520Y=$363,796

Regression analysis tends to yield the most accurate estimate of fixed and variable costs, assuming there are no unusual data points in the data set. It is important to review the data set first—perhaps in the form of a scattergraph—to confirm

that no outliers exist.

Check Yourself

Alta Production, Inc., reported the following production costs for the 12 months January through December. (These are the same data that appear in

Reporting Period (Month)	Total Production Cost	Level of Activity (Units Produced)
January	$460,000	300
February	300,000	220
March	480,000	330
April	550,000	390
May	570,000	410
June	310,000	240
July	440,000	290
August	455,000	320
September	530,000	380
October	250,000	150
November	700,000	450
December	490,000	350

Regression analysis performed using Excel resulted in the following output:

	Coefficients
y-intercept	703
x variable	1,442.97

1. Using this information, create the cost equation in the form Y = *f* + *v*X.
2. Assume Alta Production, Inc., will produce 400 units next month. Calculate total production costs for the month.

Solution to Review Problem 5.5

1. The cost equation using the data from regression analysis is:

   Y=$703+$1,442.97X

2. Using the equation, simply substitute 400 units for X, as follows:

   Y=$703+($1,442.97×400 units)

3. Y=$703+$577,188
4. Y=$577,891

   Thus total production costs are expected to be $577,891 for next month.

Summary of Four Cost Estimation Methods

Question: You are now able to create the cost equation Y = f + vX to estimate costs using four approaches. What does the cost equation look like for each approach at Bikes Unlimited?

Answer: The results of these four approaches for Bikes Unlimited are summarized as follows:

- Account analysis: Y = $30,000 + $52.00X
- High-low method: Y = $26,000 + $60.00X
- Scattergraph method: Y = $45,000 + $52.86X
- Regression analysis: Y = $43,276 + $53.42X

Question: We have seen that different methods yield different results, so which method should be used?

Answer: Regression analysis tends to be most accurate because it provides a cost equation that best fits the line to the data points. However, the goal of most companies is to get close—the results do not need to be perfect. Some could reasonably argue that the account analysis approach is best because it relies on the knowledge of those who are familiar with the costs involved.

At Bikes Unlimited, Eric (CFO) and Susan (cost accountant) met several days later. After consulting with her staff, Susan agreed that regression analysis was the best approach to use in estimating total production costs (keep in mind nothing has been done yet with selling and administrative expenses). Account analysis was ruled out because no one on the accounting staff had been with the company long enough to review the accounts and determine which costs were variable, fixed, or mixed. The high-low method was ruled out because it only uses two data points and Eric would prefer a more accurate estimate. Susan did request that her staff prepare a scattergraph and review it for any unusual data points before performing regression analysis. Based on the scattergraph prepared, all agreed that the data was relatively uniform and no outlying data points were identified.

Susan:
My staff has been working hard to determine what will happen to profit if sales volume increases. So far, we've been able to identify cost behavior patterns for production costs, and we're currently working on the cost behavior patterns for selling and administrative expenses.

Eric:
What do you have for production costs?

Susan:
The portion of production costs that are fixed—that won't change with changes in production and sales—totals $43,276. The portion of production costs that are variable—that vary with changes in production and sales—totals $53.42 per unit.

Eric:
When do you expect to have further information for the selling and administrative costs?

Susan:
We should have those results by the end of the day tomorrow. At that point, I'll put together an income statement projecting profit for August.

Eric:
Sounds good. Let's meet when you have the information ready.

Key Takeaways

- Account analysis requires that a knowledgeable employee (or group of employees) determine whether costs are fixed, variable, or mixed. If employees do not have enough experience to accurately estimate these costs, another method should be used.
- The high-low method starts with the highest and lowest activity levels and uses four steps to estimate fixed and variable costs.
- The scattergraph method has five steps and starts with plotting all points on a graph and fitting a line through the points. This line represents costs throughout a range of activity levels and is used to estimate fixed and variable costs. The scattergraph is also used to identify any outlying or unusual data points.
- Regression analysis forms a mathematically determined line that best fits the data points. Software packages like Excel are available to perform regression analysis. As with the account analysis, high-low, and scattergraph methods, this line is described in the equation form Y = *f* + *v*X. This equation is used to estimate future costs.

- Four methods can be used to estimate fixed and variable costs. Each method has its advantages and disadvantages, and the choice of a method will depend on the situation at hand. Experienced employees may be able to effectively estimate fixed and variable costs by using the account analysis approach. If a quick estimate is needed, the high-low method may be appropriate. The scattergraph method helps with identifying any unusual data points, which can be thrown out when estimating costs. Finally, regression analysis can be run using computer software such as Excel and generally provides for more accurate cost estimates.

2.3 The Contribution Margin Income Statement

Learning Objectives

1. Prepare a contribution margin income statement.

After further work with her staff, Susan was able to break down the selling and administrative costs into their variable and fixed components. (This process is the same as the one we discussed earlier for production costs.) Susan then established the cost equations shown in Table 2.5 "Cost Equations for Bikes Unlimited".

Table 2.5 Cost Equations for Bikes Unlimited

Production costs	Y = $43,276 + $53.42X
Selling and administrative costs	Y = $110,000 + $9.00X

Question: The challenge now is to organize this information in a way that is helpful to management—specifically, to Eric Mendez. The traditional income statement format used for external financial reporting simply breaks costs down by functional area: cost of goods sold and selling and administrative costs. It does not show fixed and variable costs. Panel A of Figure 2.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited" illustrates the traditional format. How can this information be presented in an income statement that shows fixed and variable costs separately?

Answer: Another income statement format, called the contribution margin income statement, shows the fixed and variable components of cost information. This type of statement appears in panel B of Figure 2.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited". Note that operating profit is the same in both statements, but the organization of data differs. The contribution margin income statement organizes the data in a way that makes it easier for management to assess how changes in production and sales will affect operating profit. The contribution margin represents sales revenue left over after deducting variable costs from sales. It is the amount remaining that will *contribute* to covering fixed costs and to operating profit (hence, the name *contribution margin*).

Eric indicated that sales volume in August could increase by 20 percent over sales in June of 5,000 units, which would increase unit sales to 6,000 units [= 5,000 units + (5,000 × 20 percent)], and he asked Susan to come up with projected profit for August. Eric also mentioned that the sales price would remain the same at $100 per unit. Using this information and the cost estimate equations in Table 2.5 "Cost Equations for Bikes Unlimited", Susan prepared the contribution margin income statement in panel B of Figure 2.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited". Assume for now that 6,000 units is just within the relevant range for Bikes Unlimited. (We will discuss this assumption later in the chapter.)

Figure 2.7 Traditional and Contribution Margin Income Statements for Bikes Unlimited

Traditional Income Statement
(external reporting format in accordance with GAAP)

Panel A			
Sales	$600,000		
Cost of goods sold	363,796		[= $43,276* + ($53.42* x 6,000 units)]
Gross margin	$236,204		
Selling and administrative costs	164,000		[= $110,000* + ($9.00* x 6,000 units)]
Operating profit	$ 72,204		

Contribution Margin Income Statement
(internal reporting format for planning and decision making)

Panel B			
Sales		$600,000	
Variable costs:			
Cost of goods sold	$320,520		(= $53.42* × 6,000 units)
Selling and administrative costs	54,000		(= $9.00* × 6,000 units)
Total variable costs		374,520	
Contribution margin		225,480	
Fixed costs:			
Cost of goods sold	$43,276*		
Selling and admin.	110,000*		
Total fixed costs		153,276	
Operating profit		$ 72,204	

*From Table 2.5 “Cost Equations for Bikes Unlimited”.

The contribution margin income statement shown in panel B of Figure 2.7 “Traditional and Contribution Margin Income Statements for Bikes Unlimited” clearly indicates which costs are variable and which are fixed. Recall that the variable cost *per unit* remains constant, and variable costs *in total* change in proportion to changes in activity. Because 6,000 units are expected to be sold in August, total variable costs are calculated by multiplying 6,000 units by the cost per unit ($53.42 per unit for cost of goods sold, and $9.00 per unit for selling and administrative costs). Thus total *variable* cost of goods sold is $320,520, and total *variable* selling and administrative costs are $54,000. These two amounts are combined to calculate total variable costs of $374,520, as shown in panel B of Figure 2.7 “Traditional and Contribution Margin Income Statements for Bikes Unlimited”.

The contribution margin of $225,480 represents the sales revenue left over after deducting variable costs from sales ($225,480 = $600,000 − $374,520). It is the amount remaining that will *contribute* to covering fixed costs and to operating profit.

Recall that total fixed costs remain constant regardless of the level of activity. Thus *fixed* cost of goods sold remains at $43,276, and *fixed* selling and administrative costs stay at $110,000. This holds true at both the 5,000 unit level of activity for June, and the 6,000 unit level of activity projected for August. Total fixed costs of $153,276 (= $43,276 + $110,000) are deducted from the contribution margin to calculate operating profit of $72,204.

Armed with this information, Susan meets with Eric the next day. Refer to panel B of Figure 2.7 “Traditional and Contribution Margin Income Statements for Bikes Unlimited” as you read Susan’s comments about the contribution margin income statement.

Susan:
Eric, I have some numbers for you. My projection for August is complete, and I expect profit to be approximately $72,000 if sales volume increases 20 percent.

Eric:
Excellent! You were correct in figuring that profit would increase at a higher rate than sales because of our fixed costs.

Susan:
Here's a copy of our projected income for August. This income statement format provides the variable and fixed costs. As you can see, our monthly fixed costs total approximately $153,000. Now that we have this information, we can easily make projections for different scenarios.

Eric:
This will be very helpful in making projections for future months. I'll take your August projections to the management group this afternoon. Thanks for your help!

Key Takeaways

- The contribution margin income statement shows fixed and variable components of cost information. Revenue minus variable costs equals the contribution margin. The contribution margin minus fixed costs equals operating profit. This statement provides a clearer picture of which costs change and which costs remain the same with changes in levels of activity.

Check Yourself

Last month, Alta Production, Inc., sold its product for $2,500 per unit. Fixed production costs were $3,000, and variable production costs amounted to $1,400 per unit. Fixed selling and administrative costs totaled $50,000, and variable selling and administrative costs amounted to $200 per unit. Alta Production produced and sold 400 units last month.

Prepare a traditional income statement and a contribution margin income statement for Alta Production. Use Figure 2.7 "Traditional and Contribution Margin Income Statements for Bikes Unlimited" as a guide.

Solution:

Traditional Income Statement

Sales	$1,000,000	(= $2,500 price per unit × 400 units)
Cost of goods sold	563,000	[= $3,000 + ($1,400 × 400 units)]
Gross margin	$ 437,000	
Selling and administrative costs	130,000	[= $50,000 + ($200 × 400 units)]
Operating profit	$ 307,000	

Contribution Margin Income Statement			
Sales		$1,000,000	(= $2,500 price per unit* × 400 units*)
Variable costs:			
Cost of goods sold	$560,000		(= $1,400* × 400 units*)
Selling and administrative costs	80,000		(= $200* × 400 units*)
Total variable costs		640,000	
Contribution margin		360,000	
Fixed costs:			
Cost of goods sold	$ 3,000*		
Selling and administrative costs	50,000*		
Total fixed costs		53,000	
Operating profit		$ 307,000	

*Given.

2.4 The Relevant Range and Nonlinear Costs

Learning Objective

1. Understand the assumptions used to estimate costs.

Question: Bikes Unlimited is making an important assumption in estimating fixed and variable costs. What is this important assumption and why might it be misleading?

Answer: The assumption is that total fixed costs and per unit variable costs will always be at the levels shown in Table 2.5 “Cost Equations for Bikes Unlimited” regardless of the level of production. This will not necessarily hold true under all circumstances.

For example, let’s say Bikes Unlimited picks up a large contract with a customer that requires producing an additional 30,000 units per month. Do you think the cost equations in Table 2.5 “Cost Equations for Bikes Unlimited” would lead to accurate cost estimates? Probably not, because additional fixed costs would be incurred for facilities, salaried personnel, and other areas. Variable cost per unit would likely change also since additional direct labor would be required (either through overtime, which requires overtime pay, or by hiring more employees who are less efficient as they learn the process), and the volume of parts purchased from suppliers would increase, perhaps leading to reductions in per unit costs due to volume discounts for the parts.

As defined earlier, the relevant range is a term used to describe the range of activity (units of production in this example) for which cost behavior patterns are likely to be accurate. Because the historical data used to create these equations for Bikes Unlimited ranges from a low of 2,900 units in January to a high of 5,900 units in April (see Table 2.4 “Monthly Production Costs for Bikes Unlimited”), management would investigate costs further when production levels fall outside of this range. The relevant range for total production costs at Bikes Unlimited is shown in Figure 2.8 “Relevant Range for Total Production Costs at Bikes Unlimited”. It is up to the cost accountant to determine the relevant range and make clear to management that estimates being made for activity outside of the relevant range must be analyzed carefully for accuracy.

Figure 2.8 Relevant Range for Total Production Costs at Bikes Unlimited

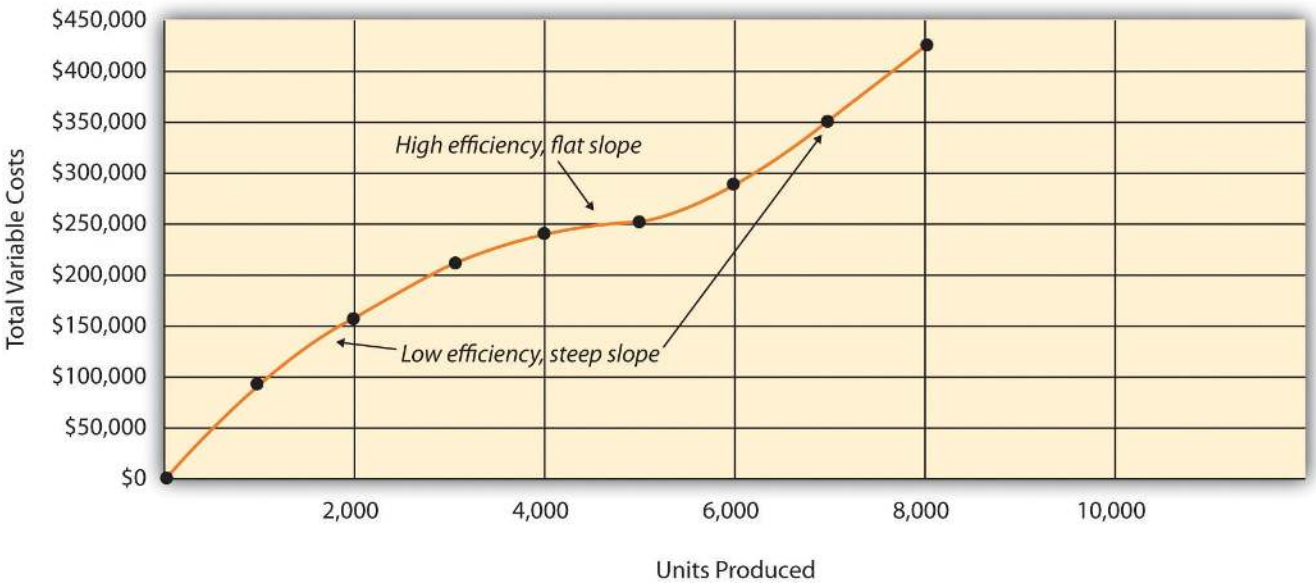
Recall that Bikes Unlimited estimated costs based on projected sales of 6,000 units for the month of August. Although this is slightly higher than the highest sales of 5,900 units in April, Susan (cost accountant) determined that Bikes Unlimited had the production capacity to produce 6,000 units without significantly affecting total fixed costs or per unit variable costs. Thus she

determined that a sales level of 6,000 units was still within the relevant range. However, Susan also made Eric (CFO) aware that Bikes Unlimited was quickly approaching full capacity. If sales were expected to increase in the future, the company would have to increase capacity, and cost estimates would have to be revised.

Question: Another important assumption being made by Bikes Unlimited is that all costs behave in a linear manner. Variable, fixed, and mixed costs are all described and shown as a straight line. However, many costs are not linear and often take on a nonlinear pattern. Why do some costs behave in a nonlinear way?

Answer: Assume the pattern shown in Figure 2.9 "Nonlinear Variable Costs" is for total variable production costs. Consider this: Have you ever worked a job where you were very slow at first but improved rapidly with experience? If a company produces just a few units each month, workers (direct labor) do not gain the experience needed to work efficiently and may waste time and materials. This has the effect of driving up the per unit variable cost. Recall that the slope of the line represents the unit cost; thus, when the unit cost increases, so does the slope. If the company produces more units each month, workers gain experience resulting in improved efficiency, and the per unit cost decreases (both in materials and labor). This causes the total cost line to flatten out a bit as the slope decreases. This is fine until the company starts to reach its limit in how much it can produce (called *capacity*). Now the company must hire additional inexperienced employees or pay its current employees overtime, which once again drives up the cost per unit. Thus the slope begins to increase.

Figure 2.9 Nonlinear Variable Costs



Although this is probably a more accurate description of how variable costs actually behave for most companies, it is much simpler to describe and estimate costs if you assume they are linear. As long as the relevant range is clearly identified, most companies can reasonably use the linearity assumption to estimate costs.

Key Takeaways

- Two important assumptions must be considered when estimating costs using the methods described in this chapter.
  1. When costs are estimated for a specific level of activity, the assumption is that the activity level is within the relevant range.
  2. Costs are estimated assuming that they are linear.

  Both assumptions are reasonable as long as the relevant range is clearly identified, and the linearity assumption does not significantly distort the resulting cost estimate.

2.5 Appendix: Performing Regression Analysis with Excel

Learning Objective

1. Perform regression analysis using Excel.

Question: Regression analysis is often performed to estimate fixed and variable costs. Many different software packages have the capability of performing regression analysis, including Excel. This appendix provides a basic illustration of how to use Excel to perform regression analysis. Statistics courses cover this topic in more depth. How is regression analysis used to estimate fixed and variable costs?

Answer: As noted in the chapter, regression analysis uses a series of mathematical equations to find the best possible fit of the line to the data points. For the purposes of this chapter, the end goal of regression analysis is to estimate fixed and variable costs, which are described in the equation form of Y = *f* + *v*X. Recall that the following Excel output was provided earlier in the chapter based on the data presented in Table 2.4 "Monthly Production Costs for Bikes Unlimited" for Bikes Unlimited.

	Coefficients
y-intercept	43,276
x variable	53.42

The resulting equation to estimate production costs is Y = $43,276 + $53.42X. We now describe the steps to be performed in Excel to get this equation.

Step 1. Confirm that the Data Analysis package is installed.

Go to the *Data* tab on the top menu bar and look for *Data Analysis*. If *Data Analysis* appears, you are ready to perform regression analysis. If *Data Analysis* does not appear, go to the help button (denoted as a question mark in the upper right-hand corner of the screen) and type *Analysis ToolPak*. Look for the *Load the Analysis ToolPak* option and follow the instructions given.

Step 2. Enter the data in the spreadsheet.

Using a new Excel spreadsheet, enter the data points in two columns. The monthly data in Table 2.4 "Monthly Production Costs for Bikes Unlimited" includes *Total Production Costs* and *Units Produced*. Thus use one column (column A) to enter Total Production Costs data and another column (column B) to enter Units Produced data.

	A	B	C	D
1		Total Production Costs	Units Produced	
2		$ 230,000	3,500	
3		$ 250,000	3,750	
4		$ 260,000	3,800	
5		$ 220,000	3,400	
6		$ 340,000	5,800	
7		$ 330,000	5,500	
8		$ 200,000	2,900	
9		$ 210,000	3,300	
10		$ 240,000	3,600	
11		$ 380,000	5,900	
12		$ 350,000	5,600	
13		$ 290,000	5,000	
14				

Step 3. Run the regression analysis.

Using the same spreadsheet set up in step 2, select *Data*, *Data Analysis*, and *Regression*. A box appears that requires the input of several items needed to perform regression. *Input Y Range* requires that you highlight the *y*-axis data, including the heading (cells B1 through B13 in the example shown in step 2). *Input X Range* requires that you highlight the *x*-axis data, including the heading (cells C1 through C13 in the example shown in step 2). Check the *Labels* box; this indicates that the top of each column has a heading (B1 and C1). Select *New Workbook*; this will put the regression results in a new workbook. Lastly, check the *Line Fit Plots*

box, then select *OK*. The result is as follows (note that we made a few minor format changes to allow for a better presentation of the data).

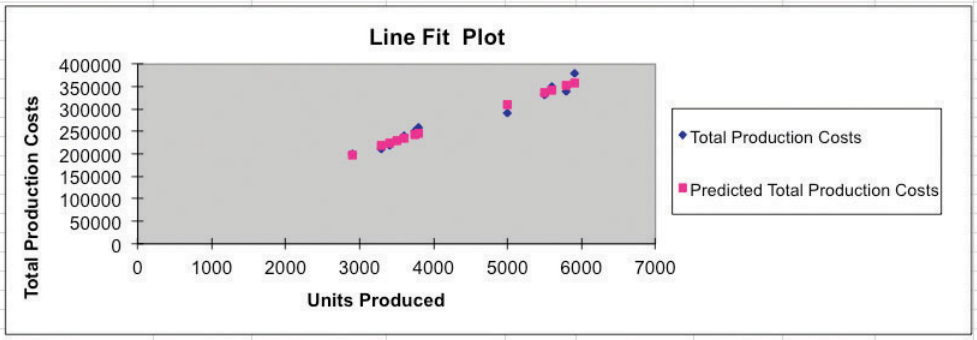
Summary Output

Regression statistics	
Multiple R	0.9813
R square	0.9629
Adjusted R square	0.9591
Standard error	12,355.3793
Observations	12.0000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	39,573,446,022.09	39,573,446,022.09	259.23	0.00
Residual	10	1,526,553,977.91	152,655,397.79		
Total	11	41,100,000,000.00			

	Coefficients	*Standard error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	43,276	14,827.52	2.92	0.02	10,237.85	76,313.42	10,237.85	76,313.42
Units produced	53.42	3.32	16.10	0.00	46.03	60.82	46.03	60.82



Residual Output

Observation	*Predicted total production costs*	*Residuals*
1.00	230,257.83	(257.83)
2.00	243,613.70	6,386.30
3.00	246,284.88	13,715.12
4.00	224,915.48	(4,915.48)
5.00	353,131.85	(13,131.85)
6.00	337,104.80	(7,104.80)
7.00	198,203.74	1,796.26
8.00	219,573.14	(9,573.14)
9.00	235,600.18	4,399.82
10.00	358,474.19	21,525.81
11.00	342,447.15	7,552.85
12.00	310,393.06	(20,393.06)

Step 4. Analyze the output.

Here, we discuss key items shown in the regression output provided in step 3.

- **Cost Equation:** The output shows that estimated fixed costs (shown as the *Intercept* coefficient in cell B17) total $43,276, and the estimated variable cost per unit (shown as the *Units Produced* coefficient in B18) is $53.42. Thus the cost equation is:

  Y = $43,276 + $53.42X
  or
  Total Production Costs = $43,276 + ($53.42 × Units Produced)

- **Line Fit Plot and R-Squared:** The plot shows that actual *total production costs* are very close to *predicted total production costs* calculated using the cost equation. Thus the cost equation created from the regression analysis is likely to be useful in predicting total production costs. Another way to assess the accuracy of the regression output is to review the *R-squared* statistic shown in cell B5. R-squared Measures the percent of the variance in the dependent variable explained by the independent variable. measures the percent of the variance in the dependent variable (*total production costs*, in this example) explained by the independent variable (*units produced*, in this example). According to the output, 96.29 percent of the variance in total production costs is explained by the level of units produced—further evidence that the regression results will be useful in predicting total production costs.

The discussion of regression analysis in this chapter is meant to serve as an introduction to the topic. To further enhance your knowledge of regression analysis and to provide for a more thorough analysis of the data, you should pursue the topic in an introductory statistics course.

Key Takeaways

Software applications, such as Excel, can use regression analysis to estimate fixed and variable costs.

- Once the data analysis package is installed, historical data are entered in the spreadsheet, and the regression analysis is run.
- The resulting data are used to determine the cost equation, which includes estimated fixed and variable costs.

The line fit plot and R-squared statistic are used to assess the usefulness of the cost equation in estimating costs.

End-of-Chapter Exercises

Questions

1. What is a fixed cost? Provide two examples.
2. What is the difference between a committed fixed cost and a discretionary fixed cost? Provide examples of each.
3. What is a variable cost? Provide two examples.
4. What is a mixed cost? Provide two examples.
5. Describe the variables in the cost equation $Y = f + vX$.
6. How is the cost equation $Y = f + vX$ used to estimate future costs?
7. Why is it important to identify how costs behave with changes in activity?
8. Explain how account analysis is used to estimate costs.
9. Describe the four steps of the high-low method and how these steps are used to estimate costs.
10. Why might the high-low method lead to inaccurate results?
11. Describe the five steps of the scattergraph method and how these steps are used to estimate costs.
12. How can the scattergraph method be used to identify unusual data points?
13. Describe how regression analysis is used to estimate costs.
14. How does the contribution margin income statement differ from the traditional income statement?
15. Describe the term *relevant range*. Why is it important to stay within the relevant range when estimating costs?
16. Explain how some costs can behave in a nonlinear way.

Brief Exercises

17. **Planning at Bikes Unlimited.** Refer to the dialogue at Bikes Unlimited presented at the beginning of the chapter. What is the first step to be taken by Susan and her accounting staff to help in estimating profit for August?

18. **Identifying Cost Behavior.** Vasquez Incorporated is trying to identify the cost behavior of the three costs that follow. Cost information is provided for three months.

		Cost A		Cost B		Cost C	
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	1,500	$1,500	_____	$4,500	_____	$3,000	_____
2	3,000	1,500	_____	5,250	_____	6,000	_____
3	750	1,500	_____	3,750	_____	1,500	_____

Required:

1. Calculate the cost per unit, and then identify how the cost behaves for each of the three costs (fixed, variable, or mixed). Explain the reasoning for your answers.
2. How does identifying cost behavior patterns help managers?

19. **Account Analysis.** Cordova Company would like to estimate production costs on an annual basis. Costs incurred for direct materials and direct labor are variable costs. The accounting records indicate that the following production costs were incurred last year for 50,000 units.

Direct materials	$100,000
Direct labor	$215,000
Manufacturing overhead	$300,000 (20 percent fixed; 80 percent variable)

Required:

Use account analysis to estimate the fixed costs per year, and the variable cost per unit.

20. **High-Low Method.** The city of Rockville reported the following annual cost data for maintenance work performed on its fleet of trucks.

Reporting Period (Year)	Total Costs	Level of Activity (Miles Driven)
Year 1	$ 750,000	225,000
Year 2	850,000	240,000
Year 3	1,100,000	430,000
Year 4	1,150,000	454,000
Year 5	1,250,000	560,000
Year 6	1,550,000	710,000

Required:

1. Use the four steps of the high-low method to estimate total fixed costs per year and the variable cost per mile. State your results in the cost equation form Y = *f* + *v*X.
2. What would the estimated costs be if the trucks drove 500,000 miles in year 7?

21. **Regression Analysis.** Regression analysis was run using the data in Brief Exercise 22 for the city of Rockville. The output is shown here:

	Coefficients
y-intercept	441,013
x variable	1.53

Required:

1. Use the regression output to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
2. What would the city of Rockville's estimated costs be if its trucks drove 500,000 miles in year 7?

22. **Contribution Margin Income Statement.** Last year Pod Products, Inc., sold its product for $250 per unit. Production costs totaled $40,000 (25 percent fixed, 75 percent variable). Selling and administrative costs totaled $150,000 (10 percent fixed, 90 percent variable). Pod Products produced and sold 1,000 units last year.

Required:

Prepare a contribution margin income statement for Pod Products, Inc.

23. **Relevant Range.** Jersey Company produces jerseys for athletic teams, and typically produces between 1,000 and 5,000 jerseys annually. The accountant is asked to estimate production costs for this coming year assuming 9,000 jerseys will be produced.

    Required:

    What is meant by the term *relevant range*, and why is the relevant range important for estimating production costs for this coming year at Jersey Company?

Exercises:

24. **Identifying Cost Behavior.** Zhang Corporation is trying to identify the cost behavior of the three costs shown. Cost information is provided for six months.

			Cost 1		Cost 2		Cost 3
Month	**Units Produced**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**	**Total Costs**	**Cost per Unit**
1	18,000	$36,000	_____	$19,800	_____	$5,000	_____
2	16,000	32,000	_____	19,200	_____	5,000	_____
3	14,000	28,000	_____	18,200	_____	5,000	_____
4	12,000	24,000	_____	16,800	_____	5,000	_____
5	10,000	20,000	_____	14,500	_____	5,000	_____
6	8,000	16,000	_____	12,000	_____	5,000	_____

    Required:

    1. Calculate the cost per unit, and then identify how the cost behaves (fixed, variable, or mixed) for each of the three costs. Explain the reasoning behind your answers.
    2. Why is it important to identify how costs behave with changes in activity?

25. **Account Analysis.** Baker Advertising Incorporated would like to estimate costs associated with its clients on an annual basis. Assume costs for supplies and advertising staff are variable costs. The accounting records indicate the following costs were incurred last year for 100 clients:

Supplies	$ 20,000
Advertising staff wages (hourly employees)	$170,000
Manager salary	$ 90,000
Building rent	$ 56,000

    Required:

    1. Use account analysis to estimate total fixed costs per year, and the variable cost per unit. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
    2. Estimate the total costs for this coming year assuming 120 clients will be served.
    1.

26. **Regression Analysis.** Regression analysis was run for Castanza Company resulting in the following output (this is based on the

same data as the previous two exercises):

	Coefficients
y-intercept	445,639
x variable	8.54

Required:

1. Use the regression output given to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
2. What would Castanza Company's estimated costs be if it used 50,000 machine hours next month?
3. What would Castanza Company's estimated costs be if it used 15,000 machine hours next month?

27. **Contribution Margin Income Statement.** Last month Kumar Production Company sold its product for $60 per unit. Fixed production costs were $40,000, and variable production costs amounted to $15 per unit. Fixed selling and administrative costs totaled $26,000, and variable selling and administrative costs amounted to $5 per unit. Kumar Production produced and sold 7,000 units last month.

    Required:

    1. Prepare a traditional income statement for Kumar Production Company.
    2. Prepare a contribution margin income statement for Kumar Production Company.
    3. Why do companies use the contribution margin income statement format?

28. **Regression Analysis Using Excel (Appendix).** Walleye Company produces fishing reels. Management wants to estimate the cost of production equipment used to produce the reels. The company reported the following monthly cost data related to production equipment:

Reporting Period (Month)	Total Costs	Machine Hours
January	$1,104,000	54,000
February	720,000	30,000
March	600,000	24,000
April	1,320,000	108,000
May	1,368,000	114,000
June	744,000	36,000
July	1,056,000	45,600
August	1,092,000	57,600
September	1,272,000	93,600
October	1,152,000	61,200
November	1,680,000	115,200
December	1,176,000	64,800

Required:

1. Use Excel to perform regression analysis. Provide a printout of the results.

2. Use the regression output to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
3. What would Walleye Company's estimated costs be if it used 90,000 machine hours this month?

Problems

29 . Cost Behavior. Assume you are a consultant performing work for two different companies. Each company has asked you to help them identify the behavior of certain costs.

Required:

1. Identify each of the following costs for Hwang Company, a producer of ski boats, as variable (V), fixed (F), or mixed (M):
    1. _____Salary of production manager
    2. _____Materials required for production
    3. _____Monthly rent on factory building
    4. _____Hourly wages for assembly workers
    5. _____Straight-line depreciation for factory equipment
    6. _____Annual insurance on factory building
    7. _____Invoices sent to customers
    8. _____Salaries and commissions of salespeople
    9. _____Salary of chief executive officer
    10. _____Company cell phones with first 50 hours free, then 10 cents per minute
2. Identify each of the following costs for Rainier Camping Products, a maker of backpacks, as variable (V), fixed (F), or mixed (M):
    1. _____Hourly wages for assembly workers
    2. _____Fabric required for production
    3. _____Straight-line depreciation on factory building
    4. _____Salaries and commissions of salespeople
    5. _____Lease payments for factory equipment
    6. _____Company cell phones with first 80 hours free, then 8 cents per minute
    7. _____Invoices sent to customers
    8. _____Salary of production manager
    9. _____Salary of controller (accounting)
    10. _____Electricity for factory building
    11. How might the managers of these companies use the cost behavior information requested?

30. Account Analysis and Contribution Margin Income Statement. Madden Company would like to estimate costs associated with its production of football helmets on a monthly basis. The accounting records indicate the following production costs were incurred last month for 4,000 helmets.

Assembly workers' labor (hourly)	$70,000
Factory rent	3,000
Plant manager's salary	5,000
Supplies	20,000
Factory insurance	12,000
Materials required for production	20,000
Maintenance of production equipment (based on usage)	18,000

Required:

1. Use account analysis to estimate total fixed costs per month and the variable cost per unit. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
2. Estimate total production costs assuming 5,000 helmets will be produced and sold.
3. Prepare a contribution margin income statement assuming 5,000 helmets will be produced, and each helmet will be sold for $70. Fixed selling and administrative costs total $10,000. Variable selling and administrative costs are $8 per unit.

31. High-Low, Scattergraph, and Regression Analysis; Manufacturing Company. Woodworks, Inc., produces cabinet doors. Manufacturing overhead costs tend to fluctuate from one month to the next, and management would like to accurately estimate these costs for planning and decision-making purposes.

The accounting staff at Woodworks recommends that costs be broken down into fixed and variable components. Because the production process is highly automated, most of the manufacturing overhead costs are related to machinery and equipment. The accounting staff believes the best starting point is to review historical data for costs and machine hours:

Reporting Period (Month)	Total Costs	Machine Hours
January	$278,000	1,550
February	280,000	1,570
March	266,000	1,115
April	290,000	1,700
May	262,000	1,110
June	269,000	1,225
July	275,000	1,335
August	286,000	1,660
September	250,000	1,000
October	253,000	1,020
November	260,000	1,025
December	281,000	1,600

These data were entered into a computer regression program, which produced the following output:

	Coefficients
y-intercept	210,766
x variable	45.31

Required:

1. Use the four steps of the high-low method to estimate total fixed costs per month and the variable cost per machine hour. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
2. Use the five steps of the scattergraph method to estimate total fixed costs per month, and the variable cost per machine hour. State your results in the cost equation form Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
3. Use the regression output given to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
4. Use the results of the high-low method (a), scattergraph method (b), and regression analysis (c), to estimate costs for 1,500 machine hours. (You will have three different answers—one for each method.) Which approach do you think is

most accurate and why

Management likes the regression analysis approach and asks you to estimate costs for 5,000 machine hours using this approach (the company plans to expand by opening another facility and hiring additional employees). Calculate your estimate, and explain why your estimate might be misleading.

32. Regression Analysis Using Excel (Appendix). Metal Products, Inc., produces metal storage sheds. The company's manufacturing overhead costs tend to fluctuate from one month to the next, and management would like an accurate estimate of these costs for planning and decision-making purposes.

The company's accounting staff recommends that costs be broken down into fixed and variable components. Because the production process is highly automated, most of the manufacturing overhead costs are related to machinery and equipment. The accounting staff agrees that reviewing historical data for costs and machine hours is the best starting point. Data for the past 18 months follow.

1.

Reporting Period (Month)	Total Overhead Costs	Total Machine Hours
January	$695,000	3,875
February	700,000	3,925
March	665,000	2,788
April	725,000	4,250
May	655,000	2,775
June	672,500	3,063
July	687,500	3,338
August	715,000	4,150
September	625,000	2,500
October	632,500	2,550
November	650,000	2,563
December	702,500	4,000
January	730,000	4,025
February	735,000	4,088
March	697,500	2,900
April	762,500	4,425
May	687,500	2,888
June	705,000	3,188

Required:

1. Use Excel to perform regression analysis. Provide a printout of the results.
2. Use the regression output given to develop the cost equation $Y = f + vX$ by filling in the dollar amounts for f and v.
3. Use the results of the regression analysis to estimate costs for 3,750 machine hours.

4. Management is considering plans to expand by opening several new facilities and asks you to estimate costs for 22,000 machine hours. Calculate your estimate, and explain why this estimate may be misleading.
5. What can be done to improve the estimate made in part d?

One Step Further: Skill-Building Cases

33. **Internet Project: Variable and Fixed Costs.** Using the Internet, find the annual report of one retail company and one manufacturing company. Print out each company's income statement. (Hint: The income statement is often called the *statement of operations* or *statement of earnings*.)

    Required:

    1. Review each income statement, and provide an analysis of which operating costs are likely to be variable and which are likely to be fixed. Include copies of both income statements when submitting your answer.
    2. How would you expect a retail company's mix of variable and fixed operating costs to differ from that of a manufacturing company?
    3. How might the managers of these companies use cost behavior information?

34. **Group Activity: Identifying Variable and Fixed Costs.** To complete the following requirements, form groups of two to four students.

    Required:

    1. Each group should select a product that is easy to manufacture.
    2. Prepare a list of materials, labor, and other resources needed to make the product.
    3. Using the list prepared in requirement b, identify whether the costs associated with each item are variable, fixed, or mixed.
    4. As a manager for this company, why would you want to know whether costs are variable, fixed, or mixed?

35. **Fixed Costs at** United Airlines**.** Review Note 5.4 "Business in Action 5.1".

    1. What is meant by the term *fixed cost*?
    2. Which costs at **United Airlines** were identified as fixed costs?
    3. How might **United Airlines** reduce its fixed costs? Be specific.

Comprehensive Case

36. **Ethics: Manipulating Data to Establish a Budget (Appendix).** Healthy Bar, Inc., produces energy bars for sports enthusiasts. The company's fiscal year ends on December 31. The production manager, Jim Wallace, is establishing a cost budget for the production department for each month of this coming quarter (January through March). At the end of March, Jim will be evaluated based on his ability to meet the budget for the three months ending March 31. In fact, Jim will receive a significant bonus if actual costs are below budgeted costs for the quarter.

The production budget is typically established based on data from the last 18 months. These data are as follows:

Reporting Period (Month)	Total Overhead Costs	Total Machine Hours
July	$695,000	3,410
August	700,000	3,454
September	665,000	2,453
October	725,000	3,740
November	655,000	2,442
December	672,500	2,695
January	687,500	2,937
February	715,000	3,652
March	625,000	2,200
April	632,500	2,244
May	650,000	2,255
June	702,500	3,520
July	730,000	3,542
August	735,000	3,597
September	697,500	2,552
October	762,500	3,894
November	687,500	2,541
December	705,000	2,805

You are the accountant who assists Jim in preparing an estimate of production costs for the next three months. You intend to use regression analysis to estimate costs, as was done in the past. Jim expects that 3,100 machine hours will be used in January, 3,650 machine hours in February, and 2,850 machine hours in March.

Jim approaches you and asks that you add $100,000 to production costs for each of the past 18 months before running the regression analysis. As he puts it, “After all, management always takes my proposed budgets and reduces them by about 10 percent. This is my way of leveling the playing field!”

Required:

1. Use Excel to perform regression analysis using the historical data provided.
    1. Submit a printout of the results.
    2. Use the regression output to develop the cost equation Y = $f + vX$ by filling in the dollar amounts for f and v.
    3. Calculate estimated production costs for January, February, and March. Also provide a total for the three months.
2. Use Excel to perform regression analysis after adding $100,000 to production costs for each of the past 18 months, as Jim requested.

1. Submit a printout of the results.
2. Use the regression output to develop the cost equation Y = *f* + *v*X by filling in the dollar amounts for *f* and *v*.
3. Calculate estimated production costs for January, February, and March. Also provide a total for the three months.

3. Why did Jim ask you to add $100,000 to production costs for each of the past 18 months?
4. How should you handle Jim's request? (If necessary, review the presentation of ethics in Chapter 1 "What Is Managerial Accounting?" for additional information.)

2: How Do Organizations Identify Cost Behavior Patterns? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

Chapter 3 How Is Cost-Volume-Profit Analysis Used for Decision Making?

Recilia Vera is vice president of sales at Snowboard Company, a manufacturer of one model of snowboard. Lisa Donley is the company accountant. Recilia and Lisa are in their weekly meeting.

Recilia:
Lisa, I'm in the process of setting up an incentive system for my sales staff, and I'd like to get a better handle on our financial information.

Lisa:
No problem. How can I help?

Recilia:
I've reviewed our financial results for the past 12 months. It looks like we made a profit in some months, and had losses in other months. From what I can tell, we sell each snowboard for $250, our variable cost is $150 per unit, and our fixed cost is $75 per unit. It seems to me that if we sell just one snowboard each month, we should still show a profit of $25, and any additional units sold should increase total profit.

Lisa:
Your unit sales price of $250 and unit variable cost of $150 look accurate to me, but I'm not sure about your unit fixed cost of $75. Fixed costs total $50,000 a month regardless of the number of units we produce. Trying to express fixed costs on a per unit basis can be misleading because it depends on the number of units being produced and sold, which changes each month. I can tell you that each snowboard produced and sold provides $100 toward covering fixed costs—that is, $250, the sales price of one snowboard, minus $150 in variable cost.

Recilia:
The $75 per unit for fixed costs was my estimate based on last year's sales, but I get your point. As you know, I'd like to avoid having losses. Is it possible to determine how many units we have to sell each month to at least cover our expenses? I'd also like to discuss what it will take to make a decent profit.

Lisa:
We can certainly calculate how many units have to be sold to cover expenses, and I'd be glad to discuss how many units must be sold to make a decent profit.

Recilia:
Excellent! Let's meet again next week to go through this in detail.

Answering questions regarding break-even and target profit points requires an understanding of the relationship among costs, volume, and profit (often called *CVP*). This chapter discusses cost-volume-profit analysis, which identifies how changes in key assumptions (for example, assumptions related to cost, volume, or profit) may impact financial projections. We address Recilia's questions in the next section.

3.1 Cost-Volume-Profit Analysis for Single-Product Companies

Learning Objective

1. Perform cost-volume-profit analysis for single-product companies.

Question: The profit equation *shows that profit equals total revenues minus total variable costs and total fixed costs. This profit equation is used extensively in cost-volume-profit (CVP) analysis, and the information in the profit equation is typically presented in the form of a contribution margin income statement (first introduced in Chapter 2 "How Do Organizations Identify Cost Behavior Patterns?"). What is the relationship between the profit equation and the contribution margin income statement?*

Answer: Recall that the contribution margin income statement starts with sales, deducts variable costs to determine the contribution margin, and deducts fixed costs to arrive at profit. We use the term "variable cost" because it describes a cost that *varies in total* with changes in volume of activity. We use the term "fixed cost" because it describes a cost that is *fixed (does not change) in total* with changes in volume of activity.

To allow for a mathematical approach to performing CVP analysis, the contribution margin income statement is converted to an equation using the following variables:

Key Equation

S = Selling price *per unit*
V = Variable cost *per unit*
F = *Total* fixed costs
Q = Quantity of units produced and sold

Thus

Profit=Total sales−Total variable costs−Total fixed costs or Profit=(S×Q)−(V×Q)−F

Figure 3.1 "Comparison of Contribution Margin Income Statement with Profit Equation" clarifies the link between the contribution margin income statement presented in Chapter 2 "How Do Organizations Identify Cost Behavior Patterns?" and the profit equation stated previously. Study this figure carefully because you will encounter these concepts throughout the chapter.

Figure 3.1 Comparison of Contribution Margin Income Statement with Profit Equation

Contribution Margin Income Statement			Profit Equation
Sales	$xxx,xxx	→	S × Q
Less total variable costs	xxx,xxx	→	V × Q
Contribution margin	$xxx,xxx		
Less total fixed costs	xxx,xxx	→	F
Operating profit	$xxx,xxx		

Recall that when identifying cost behavior patterns, we assume that management is using the cost information to make short-term decisions. Variable and fixed cost concepts are useful for short-term decision making. The short-term period varies, depending on a company's current production capacity and the time required to change capacity. In the long term, all cost behavior patterns could change.

Break-Even and Target Profit

Question: Companies such as Snowboard Company often want to know the sales required to break even, which is called the break-even point. What is meant by the term break-even point?

Answer: The *break-even point* can be described either in units or in sales dollars. The break-even point in units is the number of units that must be sold to achieve zero profit. The break-even point in sales dollars is the total sales measured in dollars required to achieve zero profit. If a company sells products or services easily measured in units (e.g., cars, computers, or mountain bikes), then

the formula for break-even point in *units* is used. If a company sells products or services not easily measured in units (e.g., restaurants, law firms, or electricians), then the formula for break-even point in *sales dollars* is used.

Break-Even Point in Units

Question: How is the break-even point in units calculated, and what is the break-even point for Snowboard Company?

Answer: The break-even point in units is found by setting profit to zero using the profit equation. Once profit is set to zero, fill in the appropriate information for selling price per unit (S), variable cost per unit (V), and total fixed costs (F), and solve for the quantity of units produced and sold (Q).

Let's calculate the break-even point in units for Snowboard Company. Recall that each snowboard sells for $250. Unit variable costs total $150, and total monthly fixed costs are $50,000. To find the break-even point in units for Snowboard Company, set the profit to zero, insert the unit sales price (S), insert the unit variable cost (V), insert the total fixed costs (F), and solve for the quantity of units produced and sold (Q):

Profit=(S×Q)−(V×Q)−F=($250 x Q)−($150 x Q) −$50,000=0

100 x Q – $50,000 = 0

100 x Q = $50,000

Q = 50,000/100 = 500 units

Short cut formula is Fixed Costs / Contribution Margin per unit = Break Even point in units

Contribution margin per unit is Sales price per unit less variable costs per unit.

Thus Snowboard Company must produce and sell 500 snowboards to break even. This answer is confirmed in the following contribution margin income statement.

	Amount	Calculation
Sales	$125,000	(500 units × $250)
Variable costs	75,000	(500 units × $150)
Contribution margin	$ 50,000	(500 units × $100)
Fixed costs	50,000	(given)
Operating profit	$ 0	

Target Profit in Units

Question: Although it is helpful for companies to know the break-even point, most organizations are more interested in determining the sales required to make a targeted amount of profit. How does finding the target profit in units help companies like Snowboard Company?

Answer: Finding a target profit in units. simply means that a company would like to know how many units of product must be sold to achieve a certain profit. At Snowboard Company, Recilia (the vice president of sales) and Lisa (the accountant) are in their next weekly meeting.

Lisa:
Recilia, last week you asked how many units we have to sell to cover our expenses. This is called the break-even point. If each unit produced and sold provides $100 toward covering fixed costs, and if total monthly fixed costs are $50,000, we would have to sell 500 units to break even—that is, $50,000 divided by $100.

Recilia:
What happens once we sell enough units to cover all of our fixed costs for the month?

Lisa:
Good question! Once all fixed costs are covered for the month, each unit sold contributes $100 toward profit.

Recilia:
I think I'm getting the hang of this. It will take 500 units in sales to break even, and each unit sold above 500 results in a $100 increase in profit. So if we sell 503 units for a month, profit will total $300?

Lisa:
You've got it!

Recilia:
So if our goal is to make a profit of $30,000 per month (target profit), how many units must be sold?

Lisa:
It takes 500 units to break even. We also know each unit sold above and beyond 500 units contributes $100 toward profit. Thus we would have to sell an additional 300 units above the break-even point to earn a profit of $30,000. This means we would have to sell 800 units in total to make $30,000 in profit.

Recilia:
Wow, I'm not sure selling 800 units is realistic, but at least we have a better sense of what needs to be done to make a decent profit. Thanks for your help!

Profit Equation

Question: Let's formalize this discussion by using the profit equation. How is the profit equation used to find a target profit amount in units?

Answer: Finding the target profit in units is similar to finding the break-even point in units except that profit is no longer set to zero. Instead, set the profit to the target profit the company would like to achieve. Then fill in the information for selling price per unit (S), variable cost per unit (V), and total fixed costs (F), and solve for the quantity of units produced and sold (Q):

Profit=(S×Q)−(V×Q)−F =$30,000

=($250 x Q)−($150 x Q)−$50,000 = $30,000

=$100x Q−$50,000 = $30,000

=$100 x Q = $80,000

Q=800 units

Thus Snowboard Company must produce and sell 800 snowboards to achieve $30,000 in profit. This answer is confirmed in the following contribution margin income statement:

	Amount	Calculation
Sales	$200,000	(800 units × $250)
Variable costs	120,000	(800 units x $150)
Contribution margin	$ 80,000	(800 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 30,000	

Shortcut Formula

Question: Although using the profit equation to solve for the break-even point or target profit in units tends to be the easiest approach, we can also use a shortcut formula derived from this equation. What is the shortcut formula, and how is it used to find the target profit in units for Snowboard Company?

Answer: The shortcut formula is as follows:

Short cut formula: (Fixed Costs + Target Profit) / Contribution Margin per Unit = Units to be sold to reach the target profit

(50,000 + 30,000) / 100 = 800 units to be sold to reach the target profit

Break-Even Point in Sales Dollars

Question: Finding the break-even point in units works well for companies that have products easily measured in units, such as snowboard or bike manufacturers, but not so well for companies that have a variety of products not easily measured in units, such as law firms and restaurants. How do companies find the break-even point if they cannot easily measure sales in units?

Answer: For these types of companies, the break-even point is measured in sales dollars. That is, we determine the total revenue (total sales dollars) required to achieve zero profit for companies that cannot easily measure sales in units.

Finding the break-even point in sales dollars requires the introduction of two new terms: *contribution margin per unit* and *contribution margin ratio*.

Contribution Margin per Unit

The contribution margin per unit is the amount *each unit sold* contributes to (1) covering fixed costs and (2) increasing profit. We calculate it by subtracting variable costs per unit (V) from the selling price per unit (S).

Key Equation

Contribution margin per unit = S − V

For Snowboard Company the contribution margin is $100:

Contribution margin per unit=S−V or $100=$250−$150

Thus *each unit sold* contributes $100 to covering fixed costs and increasing profit.

Contribution Margin Ratio

The contribution margin ratio measures the amount *each sales dollar* contributes to (1) covering fixed costs and (2) increasing profit; also called *contribution margin percent*. The contribution margin ratio is the contribution margin per unit divided by the selling price per unit. (*Note that the contribution margin ratio can also be calculated using the total contribution margin and total sales; the result is the same.)*

Key Equation

Contribution margin ratio = (S − V) ÷ S

For Snowboard Company the contribution margin ratio is 40 percent:

Contribution margin ratio=(S − V)÷S 40%=($250 − $150)÷$250

Thus *each dollar in sales* contributes 40 cents ($0.40) to covering fixed costs and increasing profit.

Question: With an understanding of the contribution margin and contribution margin ratio, we can now calculate the break-even point in sales dollars. How do we calculate the break-even point in sales dollars for Snowboard Company?

Answer: The formula to find the break-even point in sales dollars is as follows.

Key Equation

Break-even point in sales dollars= Total fixed costs / Contribution margin ratio

For Snowboard Company the break-even point in sales dollars is $125,000 per month:

Break-even point in sales dollars=$50,000 / .4 or 40% = $125,000 in sales=$50,000 / .40

Thus Snowboard Company must achieve $125,000 in total sales to break even. The following contribution margin income statement confirms this answer:

	Amount	Calculation
Sales	*$125,000*	(500 units x $250)
Variable costs	75,000	(500 units x $150)
Contribution margin	$ 50,000	(500 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 0	

Target Profit in Sales Dollars

Key Equation

Target profit in sales dollars = (Total fixed costs + Target profit) / Contribution margin ratio

Question: Finding a target profit in sales dollars *simply means that a company would like to know total sales measured in dollars required to achieve a certain profit. Finding the target profit in sales dollars is similar to finding the break-even point in sales dollars except that "target profit" is no longer set to zero. Instead, target profit is set to the profit the company would like to achieve. Recall that management of Snowboard Company asked the following question: What is the amount of total sales dollars required to earn a target profit of $30,000?*

Answer: Use the break-even formula described in the previous section. Instead of setting the target profit to $0, set it to $30,000. This results in an answer of $200,000 in monthly sales:

Target profit in sales dollars=(Total fixed costs + Target profit) / Contribution margin ratio or $200,000 in sales= ($50,000+$30,000) / 0.40

Thus Snowboard Company must achieve $200,000 in sales to make $30,000 in monthly profit. The following contribution margin income statement confirms this answer:

	Amount	Calculation
Sales	*$200,000*	(800 units x $250)
Variable costs	120,000	(800 units x $150)
Contribution margin	$ 80,000	(800 units x $100)
Fixed costs	50,000	(given)
Operating profit	$ 30,000	

Business in Action 3.1

See the podcast for a visual representation of how breakeven may be considered at Southwest Airlines.

https://youtu.be/vvQt2Ymtfxo

https://floridapanhandle.com/airline...west&seats=156https://floridapanhandle.com/airline-profitability-statistics/?airline=Southwest&seats=156

CVP Graph

Question: The relationship of costs, volume, and profit can be displayed in the form of a graph. What does this graph look like for Snowboard Company, and how does it help management evaluate financial information related to the production of snowboards?

Answer: Figure 3.2 "CVP Graph for Snowboard Company" shows in graph form the relationship between cost, volume, and profit for Snowboard Company. The vertical axis represents dollar amounts for revenues, costs, and profits. The horizontal axis represents the volume of activity for a period, measured as units produced and sold for Snowboard.

There are three lines in the graph:

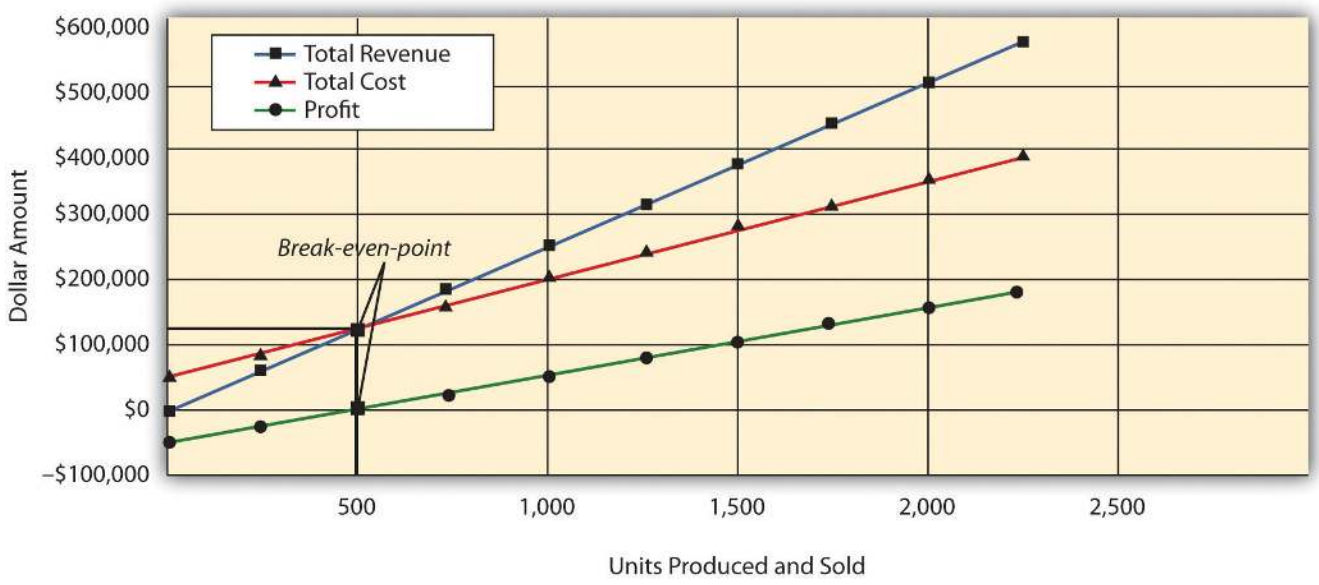
- Total revenue
- Total cost
- Profit

The total revenue line shows total revenue based on the number of units produced and sold. For example, if Snowboard produces and sells one unit, total revenue is $250 (= 1 × $250). If it produces and sells 2,000 units, total revenue is $500,000 (= 2,000 × $250).

The total cost line shows total cost based on the number of units produced and sold. For example, if Snowboard produces and sells one unit, total cost is $50,150 [= $50,000 + (1 × $150)]. If it produces and sells 2,000 units, total cost is $350,000 [= $50,000 + (2,000 × $150)].

The profit line shows profit or loss based on the number of units produced and sold. It is simply the difference between the total revenue and total cost lines. For example, if Snowboard produces and sells 2,000 units, the profit is $150,000 (= $500,000 − $350,000). If no units are sold, a loss is incurred equal to total fixed costs of $50,000.

Figure 3.2 CVP Graph for Snowboard Company



Margin of Safety

Question: Managers often like to know how close projected sales are to the break-even point. How is this information calculated and used by management?

Answer: The excess of projected sales over the break-even point is called the margin of safety. The margin of safety represents the amount by which sales can fall before the company incurs a loss.

Key Equation

Margin of safety (in units) = Projected sales (in units) − Break-even sales (in units)

Assume Snowboard Company expects to sell 700 snowboards and that its break-even point is 500 units; the margin of safety is 200 units. The calculation is

Margin of safety (in units)=Projected sales (in units)−Break-even sales (in units) 200=700−500

Thus sales can drop by 200 units per month before the company begins to incur a loss.

The margin of safety can also be stated in sales dollars.

Key Equation

Margin of safety (in sales $) = Projected sales (in sales $) − Break-even sales (in sales $)

For Snowboard the margin of safety in sales dollars is $50,000:

Margin of safety (in sales $)=Projected sales (in sales $)−Break-even sales (in sales $) $50,000=(700 units×$250)−(500 units×$250)

Thus sales revenue can drop by $50,000 per month before the company begins to incur a loss.

Key Takeaway

- Cost-volume-profit analysis involves finding the break-even and target profit point in units and in sales dollars. The key formulas for an organization with a single product are summarized in the following list. Set the target profit to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations. The margin of safety formula is also shown:
  - Break-even or target profit point measured in *units*:

    (Total fixed costs + Target profit) / (Selling price per unit − Variable cost per unit)

    (The denominator is also called “contribution margin per unit.”)
  - Break-even or target profit point measured in *sales dollars*:

    Total fixed costs + Target profit / Contribution margin ratio
  - Margin of safety in units or sales dollars:

    Projected sales − Break-even sales

Check Yourself

Star Symphony would like to perform for a neighboring city. Fixed costs for the performance total $5,000. Tickets will sell for $15 per person, and an outside organization responsible for processing ticket orders charges the symphony a fee of $2 per ticket. Star Symphony expects to sell 500 tickets.

1. How many tickets must Star Symphony sell to break even?
2. How many tickets must the symphony sell to earn a profit of $7,000?
3. How much must Star Symphony have in sales dollars to break even?
4. How much must Star Symphony have in sales dollars to earn a profit of $7,000?
5. What is the symphony’s margin of safety in units and in sales dollars?

Solution:

Note: All solutions are rounded.

1. The symphony must sell 385 tickets to break even:

   (Total fixed costs + Target profit) / (Selling price per unit − Variable cost per unit)=($5,000+$0) / ($15−$2)=385 tickets (rounded)

2. The symphony must sell 923 tickets to make a profit of $7,000:

(Total fixed costs + Target profit) / (Selling price per unit − Variable cost per unit)= ($5,000+$7,000) / ($15−$2) = 923 tickets (rounded)

3. The symphony must make $5,769 in sales to break even:

   (Total fixed costs + Target profit) / Contribution margin ratio=($5,000+$0) / (($15−$2) ÷$15) = $5,769 (rounded)

4. The symphony must make $13,846 in sales to earn a profit of $7,000:

   (Total fixed costs + Target profit) / Contribution margin ratio= ($5,000+$7,000) / (($15−$2) ÷$15)=$13,846 (rounded)

5. The symphony's margin of safety is 115 units or $1,725 in sales:

   Margin of safety=Projected sales − Break-even sales 115 tickets=500 tickets−385 tickets $1,725 in sales= (500×$15)−(385×$15)

3.2 Cost-Volume-Profit Analysis for Multiple-Product and Service Companies

Learning Objectives

1. Perform cost-volume-profit analysis for multiple-product and service companies.

Question: Although the previous section illustrated cost-volume-profit (CVP) analysis for companies with a single product easily measured in units, most companies have more than one product or perhaps offer services not easily measured in units. Suppose you are the manager of a company called Kayaks-For-Fun that produces two kayak models, River and Sea. What information is needed to calculate the break-even point for this company?

Answer: The following information is required to find the break-even point:

- Monthly fixed costs total $24,000.
- The River model represents 60 percent of total sales volume and the Sea model accounts for 40 percent of total sales volume.
- The unit selling price and variable cost information for the two products follow:

	River	Sea
Selling price	$500	$600
Variable cost	100	450
Contribution margin	$400	$150

Finding the Break-Even Point and Target Profit in Units for Multiple-Product Companies

Question: Given the information provided for Kayaks-For-Fun, how will the company calculate the break-even point?

Answer: First, we must expand the profit equation presented earlier to include multiple products. The following terms are used once again. However, subscript *r* identifies the River model, and subscript *s* identifies the Sea model (e.g., S_r stands for the River model's selling price per unit). CM is new to this section and represents the contribution margin.

Key Equation

S = Selling price *per unit*
V = Variable cost *per unit*
F = *Total* fixed costs
Q = Quantity of units produced and sold
CM = Contribution margin

Thus

Profit=Total sales−Total variable costs−Total fixed costs = Profit

=[(Sr ×Qr)+(Ss ×Qs)]−[(Vr ×Qr)+(Vs ×Qs)]−F

Without going through a detailed derivation, this equation can be restated in a simplified manner for Kayaks-For-Fun, as follows:

Profit=(Unit CM for River×Quantity of River)+(Unit CM for Sea×Quantity of Sea)−F

Profit=$400 x Qr+$150 x Qs − $24,000

One manager at Kayaks-For-Fun believes the break-even point should be 60 units in total, and another manager believes the break-even point should be 160 units in total. Which manager is correct? The answer is both might be correct. If only the River kayak is produced and sold, 60 units is the break-even point. If only the Sea kayak is produced and sold, 160 units is the break-even point. There actually are many different break-even points, because the profit equation has two unknown variables, Q_r and Q_s.

Profit ($0) = ($400 × **30** units of River) + ($150 × **80** units of Sea) − $24,000
Profit ($0) = ($400 × **35** units of River) + ($150 × **67** units of Sea) − $24,000
Profit ($0) = ($400 × **40** units of River) + ($150 × **53** units of Sea) − $24,000

Break-Even Point in Units and the Weighted Average Contribution Margin per Unit

Question: Because most companies sell multiple products that have different selling prices and different variable costs, the break-even or target profit point depends on the sales mix. What is the sales mix, and how is it used to calculate the break-even point?

Answer: The sales mix is the proportion of one product's sales to total sales. In the case of Kayaks-For-Fun, the River model accounts for 60 percent of total unit sales and the Sea model accounts for 40 percent of total unit sales.

In calculating the break-even point for Kayaks-For-Fun, we must assume the sales mix for the River and Sea models will remain at 60 percent and 40 percent, respectively, at all different sales levels. The formula used to solve for the break-even point in units for multiple-product companies is similar to the one used for a single-product company, with one change. Instead of using the contribution margin per unit in the denominator, multiple-product companies use a *weighted average contribution margin per unit*. The formula to find the break-even point in units is as follows.

Key Equation

Total fixed costs + Target profit / Weighted average contribution margin per unit

When a company assumes a constant sales mix, a weighted average contribution margin per unit can be calculated by multiplying each product's unit contribution margin by its proportion of total sales. The resulting weighted unit contribution margins for all products are then added together.

At Kayaks-For-Fun, the weighted average contribution margin per unit of $300 is

$300 = ($400 × 60 percent) + ($150 × 40 percent)

We can now determine the break-even point in units by using the following formula:

Break-even point in units=(Total fixed costs + Target profit) / Weighted average contribution margin per unit

Break-even point in units=($24,000+$0) / $300=80 total kayaks

Kayaks-For-Fun must sell 48 River models (= 60 percent × 80 units) and 32 Sea models (= 40 percent × 80 units) to break even. Again, this assumes the sales mix remains the same at different levels of sales volume.

Target Profit in Units

Question: We now know how to calculate the break-even point in units for a company with multiple products. How do we extend this process to find the target profit in units for a company with multiple products?

Answer: Finding the target profit in units for a company with multiple products is similar to finding the break-even point in units except that profit is no longer set to zero. Instead, profit is set to the target profit the company would like to achieve.

Key Equation

Target profit in units=(Total fixed costs + Target profit) / Weighted average contribution margin per unit

For example, assume Kayaks-For-Fun would like to know how many units it must sell to make a monthly profit of $96,000. Simply set the target profit to $96,000 and run the calculation:

Target profit in units=(Total fixed costs + Target profit) / Weighted average contribution margin per unit

Target profit in units=($24,000+$96,000)/$300=400 total kayaks

Kayaks-For-Fun must sell 240 River models (= 60 percent × 400) and 160 Sea models (= 40 percent × 400) to make a profit of $96,000.

Check Yourself

International Printer Machines (IPM) builds three computer printer models: Inkjet, Laser, and Color Laser. Information for these three products is as follows:

	Inkjet	**Laser**	**Color Laser**	**Total**
Selling price per unit	$250	$400	$1,600	
Variable cost per unit	$100	$150	$ 800	
Expected unit sales (annual)	12,000	6,000	2,000	20,000
Sales mix	60 percent	30 percent	10 percent	100 percent

Total annual fixed costs are $5,000,000. Assume the sales mix remains the same at all levels of sales.

1. How many printers in total must be sold to break even?
2. How many units of each printer must be sold to break even?

Solution:

Note: All solutions are rounded.

1. IPM must sell 20,408 printers to break even:

   (Total fixed costs + Target profit) / Weighted average contribution margin per unit

   Contribution margin for each product is sales price less variable cost per unit
   Weighted Average Contribution Margin = ($150×0.60)+($250×0.30)+($800×0.10)= 245

   ($5,000,000 + 0) / $245=20,408 total units

2. As calculated previously, 20,408 printers must be sold to break even. Using the sales mix provided, the following number of units of each printer must be sold to break even:

- Inkjet: 12,245 units=20,408 × 0.60
- Laser: 6,122 units=20,408 × 0.30
- Color laser: 2,041 units=20,408 × 0.10

Break-Even Point in Sales Dollars and the Weighted Average Contribution Margin Ratio

Question: For companies that have unique products not easily measured in units, how do we find the break-even point?

Answer: Rather than measuring the break-even point in units, a more practical approach for these types of companies is to find the break-even point in sales dollars. We can use the formula that follows to find the break-even point in sales dollars for organizations with multiple products or services. Note that this formula is similar to the one used to find the break-even point in sales dollars for

an organization with one product, except that the contribution margin ratio now becomes the *weighted average* contribution margin ratio.

Key Equation

Break-even point in sales dollars=(Total fixed costs + Target profit) / Weighted average contribution margin ratio

For example, suppose Amy's Accounting Service has three departments—tax, audit, and consulting—that provide services to the company's clients. Figure 3.4 "Income Statement for Amy's Accounting Service" shows the company's income statement for the year. Amy, the owner, would like to know what sales are required to break even. Note that fixed costs are known in total, but Amy does not allocate fixed costs to each department.

Figure 3.4 Income Statement for Amy's Accounting Service

	Tax	Audit	Consulting	Total
Sales	$100,000	$150,000	$250,000	$500,000
Variable costs	30,000	120,000	125,000	275,000
Contribution margin	$ 70,000	$ 30,000	$125,000	$225,000
Fixed costs				120,000
Operating profit				$105,000

The *contribution margin ratio* differs for each department:

Tax	70 percent (= $70,000 ÷ $100,000)
Audit	20 percent (= $30,000 ÷ $150,000)
Consulting	50 percent (= $125,000 ÷ $250,000)

Question: We have the contribution margin ratio for each department, but we need it for the company as a whole. How do we find the contribution margin ratio for all of the departments in the company combined?

Answer: The contribution margin ratio for the company as a whole is the weighted average contribution margin ratio. We calculate it by dividing the *total* contribution margin by *total* sales. For Amy's Accounting Service, the weighted average contribution margin ratio is 45 percent (= $225,000 ÷ $500,000). For every dollar increase in sales, the company will generate an additional 45 cents ($0.45) in profit. This assumes that the sales mix remains the same at all levels of sales. (The sales mix here is measured in sales dollars for each department as a proportion of total sales dollars.)

Now that you know the weighted average contribution margin ratio for Amy's Accounting Service, it is possible to calculate the break-even point in sales dollars:

Break-even point in sales dollars=(Total fixed costs + Target profit) / Weighted average contribution margin ratio

Break-even point in sales dollars=$120,000 / .45 =$266,667 (rounded)

Amy's Accounting Service must achieve $266,667 in sales to break even.The weighted average contribution margin ratio can also be found by multiplying each department's contribution margin ratio by its proportion of total sales. The resulting weighted average contribution margin ratios for all departments are then added. The calculation for Amy's Accounting Service is as follows:45 percent weighted average contribution margin ratio = (tax has 20 percent of total sales × 70 percent contribution margin ratio) + (audit has 30 percent of total sales × 20 percent contribution margin ratio) + (consulting has 50 percent of total sales × 50 percent contribution margin ratio)Thus 45 percent = 14 percent + 6 percent + 25 percent.

Target Profit in Sales Dollars

Question: How do we find the target profit in sales dollars for companies with products not easily measured in units?

Answer: Finding the target profit in sales dollars for a company with multiple products or services is similar to finding the break-even point in sales dollars except that profit is no longer set to zero. Instead, profit is set to the target profit the company would like to achieve.

Key Equation

Target profit in sales dollars= (Total fixed costs + Target profit) / Weighted average contribution margin ratio

For example, assume Amy's Accounting Service would like to know sales dollars required to make $250,000 in annual profit. Simply set the target profit to $250,000 and run the calculation:

Target profit in sales dollars=(Total fixed costs + Target profit) / Weighted average contribution margin ratio

Target profit in sales dollars=($120,000+$250,000) / 0.45=$822,222 (rounded)

Amy's Accounting Service must achieve $822,222 in sales to earn $250,000 in profit.

Important Assumptions

Question: Several assumptions are required to perform break-even and target profit calculations for companies with multiple products or services. What are these important assumptions?

Answer: These assumptions are as follows:

- Costs can be separated into fixed and variable components.
- Contribution margin ratio remains constant for each product, segment, or department.
- Sales mix remains constant with changes in total sales.

These assumptions simplify the CVP model and enable accountants to perform CVP analysis quickly and easily. However, these assumptions may not be realistic, particularly if significant changes are made to the organization's operations. When performing CVP analysis, it is important to consider the accuracy of these simplifying assumptions. It is always possible to design a more accurate and complex CVP model. But the benefits of obtaining more accurate data from a complex CVP model must outweigh the costs of developing such a model.

Key Takeaways

- The key formula used to calculate the break-even or target profit point **in units** for a company with multiple products is as follows. Simply set the target profit to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations.

  Total fixed costs + Target profit / Weighted average contribution margin per unit

- The formula used to find the break-even point or target profit in **sales dollars** for companies with multiple products or service is as follows. Simply set the "Target Profit" to $0 for break-even calculations, or to the appropriate profit dollar amount for target profit calculations:

  Total fixed costs + Target profit / Weighted Average contribution margin ratio

Check Yourself

Ott Landscape Incorporated provides landscape maintenance services for three types of clients: commercial, residential, and sports fields. Financial projections for this coming year for the three segments are as follows:

	Commercial	Residential	Sports Fields	Total
Sales	$2,100,000	$1,000,000	$1,900,000	$5,000,000
Variable costs	1,800,000	800,000	1,400,000	4,000,000
Contribution margin	$ 300,000	$ 200,000	$ 500,000	$1,000,000
Fixed costs				200,000
Operating profit				$ 800,000

Assume the sales mix remains the same at all levels of sales.

1. How much must Ott Landscape have in total sales dollars to break even?
2. How much must Ott Landscape have in total sales dollars to earn an annual profit of $1,500,000?

Solution:

1. Sales of $1,000,000 are required to break even:

   (Total fixed costs + Target profit) / Weighted average contribution margin ratio*=$200,000+$0 / 0.20=$1,000,000 in sales

   *Weighted average contribution margin ratio = $1,000,000 ÷ $5,000,000 = 20 percent or 0.20.

2. Sales of $8,500,000 are required to make a profit of $1,500,000:

   (Total fixed costs + Target profit) / Weighted average contribution margin ratio=($200,000+$1,500,000) / 0.20=$8,500,000 in sales

3.3 Using Cost-Volume-Profit Models for Sensitivity Analysis

Learning Objectives

1. Use sensitivity analysis to determine how changes in the cost-volume-profit equation affect profit.

Question: We can use the cost-volume-profit (CVP) financial model described in this chapter for single-product, multiple-product, and service organizations to perform sensitivity analysis, also called what-if analysis. How is sensitivity analysis used to help managers make decisions?

Answer: Sensitivity analysis shows how the CVP model will change with changes in any of its variables (e.g., changes in fixed costs, variable costs, sales price, or sales mix). The focus is typically on how changes in variables will alter profit.

Sensitivity Analysis: An Example

To illustrate sensitivity analysis, let's go back to Snowboard Company, a company that produces one snowboard model. The assumptions for Snowboard were as follows:

Sales price per unit	$ 250
Variable cost per unit	150
Fixed costs per month	50,000
Target profit	30,000

Recall from earlier calculations that the break-even point is 500 units, and Snowboard must sell 800 units to achieve a target profit of $30,000. Management believes a goal of 800 units is overly optimistic and settles on a best guess of 700 units in monthly sales. This is called the "base case." The base case is summarized as follows in contribution margin income statement format:

Sales	$175,000	(700 units x $250)
Variable costs	105,000	(700 units x $150)
Contribution margin	$ 70,000	
Fixed costs	50,000	(Given)
Operating profit	$ 20,000	

Question: Although management believes the base case is reasonably accurate, it is concerned about what will happen if certain variables change. As a result, you are asked to address the following questions from management (you are now performing sensitivity analysis!). Each scenario is independent of the others. Unless told otherwise, assume that the variables used in the base case remain the same. How do you answer the following questions for management?

1. How will profit change if the sales price increases by $25 per unit (10 percent)?
2. How will profit change if sales volume decreases by 70 units (10 percent)?
3. How will profit change if fixed costs decrease by $15,000 (30 percent) and variable cost increases $15 per unit (10 percent)?

Answer: The CVP model shown in Figure 3.5 "Sensitivity Analysis for Snowboard Company" answers these questions. Each column represents a different scenario, with the first column showing the base case and the remaining columns providing answers to the three questions posed by management. The top part of Figure 3.5 "Sensitivity Analysis for Snowboard Company" shows the value of each variable based on the scenarios presented previously, and the bottom part presents the results in contribution margin income statement format.

Figure 3.5 Sensitivity Analysis for Snowboard Company

		Scenario 1	Scenario 2	Scenario 3
	Base Case	Price Increase 10%	Sales Volume Decrease 10%	Fixed Costs Decrease 30%; Variable Cost Increase 10%
Variable values				
Sales price per unit	$ 250	$ 275	$ 250	$ 250
Variable cost per unit	$ 150	$ 150	$ 150	$ 165
Monthly fixed costs	$ 50,000	$ 50,000	$ 50,000	$ 35,000
Volume of sales	700 units	700 units	630 units	700 units
CVP model results				
Sales	$175,000	$ 192,500	$157,500	$175,000
Variable costs	105,000	105,000	94,500	115,500
Contribution margin	$ 70,000	$ 87,500	$ 63,000	$ 59,500
Fixed costs	50,000	50,000	50,000	35,000
Operating profit	$ 20,000	$ 37,500	$ 13,000	$ 24,500
Dollar change in profit from base case		$ 17,500*	($ 7,000)	$ 4,500
Percent change in profit from base case		87.5%**	(35.0%)	22.5%

[a] $17,500 = $37,500 − $20,000.

[b] 87.5 percent = $17,500 ÷ $20,000.

Carefully review Figure 3.5 “Sensitivity Analysis for Snowboard Company”. The column labeled *Scenario 1* shows that increasing the price by 10 percent will increase profit 87.5 percent ($17,500). Thus profit is highly sensitive to changes in sales price. Another way to look at this is that for every one percent *increase* in sales price, profit will *increase* by 8.75 percent, or for every one percent *decrease* in sales price, profit will *decrease* by 8.75 percent.

The column labeled *Scenario 2* shows that decreasing sales volume 10 percent will decrease profit 35 percent ($7,000). Thus profit is also highly sensitive to changes in sales volume. Stated another way, every one percent *decrease* in sales volume will *decrease* profit by 3.5 percent; or every one percent *increase* in sales volume will *increase* profit by 3.5 percent.

When comparing Scenario 1 with Scenario 2, we see that Snowboard Company’s profit is more sensitive to changes in sales price than to changes in sales volume, although changes in either will significantly affect profit.

The column labeled *Scenario 3* shows that decreasing fixed costs by 30 percent and increasing variable cost by 10 percent will increase profit 22.5 percent ($4,500). (Perhaps Snowboard Company is considering moving toward less automation and more direct labor!)

Computer Application

Using Excel to Perform Sensitivity Analysis

The accountants at Snowboard Company would likely use a spreadsheet program, such as Excel, to develop a CVP model for the sensitivity analysis shown in Figure 3.5 “Sensitivity Analysis for Snowboard Company”. An example of how to use Excel to prepare the CVP model shown in Figure 3.5 “Sensitivity Analysis for Snowboard Company” is presented as follows. Notice that the basic data are entered at the top of the spreadsheet (*data entry section*), and the rest of the information is driven by formulas. This allows for quick sensitivity analysis of different scenarios.

Using the base case as an example, sales of $175,000 (cell D14) are calculated by multiplying the $250 sales price per unit (cell D5) by 700 units (cell D8). Variable costs of $105,000 (cell D15) are calculated by multiplying the $150 variable cost per unit (cell D6) by 700 units (cell D8). Fixed costs of $50,000 come from the top section (cell D7). The contribution margin of $70,000 is calculated by subtracting variable costs from sales, and profit of $20,000 is calculated by subtracting fixed costs from the contribution margin.

	A B	C	D	E	F	G	H I
1				**Data Entry Section**			
2			**Base Case**	**Scenario (1)**	**Scenario (2)**	**Scenario (3)**	
3		**Variable**		**Price Increase 10%**	**Sales volume decrease 10%**	**Fixed costs decrease 30%; variable cost increase 10%**	
5		Sales price per unit	$250	$275	$250	$250	
6		Variable cost per unit	$150	$150	$150	$165	
7		Monthly fixed cost	$50,000	$50,000	$50,000	$35,000	
8		Volume of sales (units)	700	700	630	700	
11				**Snowboard Company**			
12				**Sensitivity Analysis Result**			
14		Sales	$175,000	$192,500	$157,500	$175,000	
15		Variable costs	105,000	105,000	94,500	115,500	
16		Contribution margin	$70,000	$87,500	$63,000	$59,500	
17		Fixed costs	50,000	50,000	50,000	35,000	
18		Operating profit	$20,000	$37,500	$13,000	$24,500	
20		Dollar change in profit from base case		$17,500	($7,000)	$4,500	
22		Percent change in profit from base case		87.50%	(35%)	22.50%	

Expanding the Use of Sensitivity Analysis

Question: Although the focus of sensitivity analysis is typically on how changes in variables will affect profit (as shown in Figure 3.5 "Sensitivity Analysis for Snowboard Company"), accountants also use sensitivity analysis to determine the impact of changes in variables on the break-even point and target profit. How is sensitivity analysis used to evaluate the impact changes in variables will have on break-even and target profit points?

Answer: Let's look at an example for Snowboard Company. Assume the company is able to charge $275 per unit, instead of $250 per unit. How many units must Snowboard Company sell to break even? The following calculation is based on the shortcut formula presented earlier in the chapter:

Q=(F + Target Profit) / (S − V) x Q=($50,000+$0)÷($275−$150) x Q=$50,000 / $125

Q=400 units

Thus if the sales price per unit increases from $250 to $275, the break-even point decreases from 500 units (calculated earlier) to 400 units, which is a decrease of 100 units.

How would this same increase in sales price change the required number of units sold to achieve a profit of $30,000? We apply the same shortcut formula:

Q=(F + Target Profit) / (S − V)Q=($50,000+$30,000) / ($275−$150) x Q=$80,000 / $125

Q=640 units

Thus if the sales price per unit increases from $250 to $275, the number of units sold to achieve a profit of $30,000 decreases from 800 units (calculated earlier) to 640 units, which is a decrease of 160 units.

Business in Action 3.2

Performing Sensitivity Analysis for a Brewpub

Three entrepreneurs in California were looking for investors and banks to finance a new brewpub. Brewpubs focus on two segments: food from the restaurant segment, and freshly brewed beer from the beer production segment. All parties involved in the process of raising money—potential investors and banks, as well as the three entrepreneurs (i.e., the owners)—wanted to know what the new business's projected profits would be. After months of research, the owners created a financial model that provided this information. Projected profits were slightly more than $300,000 for the first year (from sales of $1.95 million) and were expected to increase in each of the next four years.

One of the owners asked, "What if our projected revenues are too high? What will happen to profits if sales are lower than we expect? After all, we will have debt of well over $1 million, and I don't want anyone coming after my personal assets if the business doesn't have the money to pay!" Although all three owners felt the financial model was reasonably accurate, they decided to find the break-even point and the resulting margin of safety.

Because a brewpub does not sell "units" of a specific product, the owners found the break-even point in sales dollars. The owners knew the contribution margin ratio and all fixed costs from the financial model. With this information, they were able to calculate the break-even point and margin of safety. The worried owner was relieved to discover that sales could drop over 35 percent from initial projections before the brewpub incurred an operating loss.

Key Takeaway

- Sensitivity analysis shows how the cost-volume-profit model will change with changes in any of its variables. Although the focus is typically on how changes in variables affect profit, accountants often analyze the impact on the break-even point and target profit as well.

Check Yourself

This problem is an extension of an earlier check yourself. Recall that International Printer Machines (IPM) builds three computer printer models: Inkjet, Laser, and Color Laser. Base case information for these three products is as follows:

	Inkjet	Laser	Color Laser	Total
Selling price per unit	$250	$400	$1,600	
Variable cost per unit	$100	$150	$ 800	
Expected unit sales (annual)	12,000	6,000	2,000	20,000
Sales mix	60 percent	30 percent	10 percent	100 percent

Total annual fixed costs are $5,000,000. Assume that each scenario that follows is independent of the others. Unless stated otherwise, the variables are the same as in the base case.

1. Prepare a contribution margin income statement for the base case. Use the format shown in Figure 3.4 “Income Statement for Amy’s Accounting Service”.
2. How will total profit change if the Laser sales price increases by 10 percent? (Hint:Compare your result with requirement 1.)
3. How will total profit change if the Inkjet sales volume decreases by 4,000 units and the sales volume of other products remains the same?
4. How will total profit change if fixed costs decrease by 20 percent?

Solution

Base Case:

1.

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,400,000	$3,200,000	$8,600,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,500,000	$1,600,000	$4,900,000
Fixed costs				5,000,000
Operating loss				($ 100,000)

2. Laser sales price increases 10 percent:

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,640,000	$3,200,000	$8,840,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,740,000	$1,600,000	$5,140,000
Fixed costs				5,000,000
Operating profit				$ 140,000

Total profit would increase $240,000 (from *loss* of $100,000 in base case to *profit* of $140,000 in this scenario).

3. Inkjet sales volume decreases 4,000 units:

	Inkjet	Laser	Color Laser	Total
Sales	$2,000,000	$2,400,000	$3,200,000	$7,600,000
Variable costs	800,000	900,000	1,600,000	3,300,000
Contribution margin	$1,200,000	$1,500,000	$1,600,000	$4,300,000
Fixed costs				5,000,000
Operating loss				($ 700,000)

Total profit would decrease $600,000 (from *loss* of $100,000 in base case to *loss* of $700,000 in this scenario).

4. Fixed costs decrease 20 percent:

	Inkjet	Laser	Color Laser	Total
Sales	$3,000,000	$2,400,000	$3,200,000	$8,600,000
Variable costs	1,200,000	900,000	1,600,000	3,700,000
Contribution margin	$1,800,000	$1,500,000	$1,600,000	$4,900,000
Fixed costs				4,000,000
Operating profit				$ 900,000

Total profit would increase $1,000,000 (from *loss* of $100,000 in base case to profit of $900,000 in this scenario).

3.4 Impact of Cost Structure on Cost-Volume-Profit Analysis

Learning Objectives

1. Understand how cost structure affects cost-volume-profit sensitivity analysis.

Question: Describing an organization's cost structure helps us to understand the amount of fixed and variable costs within the organization. What is meant by the term cost structure?

Answer: Cost structure is the term used to describe the proportion of fixed and variable costs to total costs. For example, if a company has $80,000 in fixed costs and $20,000 in variable costs, the cost structure is described as 80 percent fixed costs and 20 percent variable costs.

Question: Operating leverage *refers to the level of fixed costs within an organization. How do we determine if a company has high operating leverage?*

Answer: Companies with a relatively high proportion of fixed costs have high operating leverage. For example, companies that produce computer processors, such as **NEC** and **Intel**, tend to make large investments in production facilities and equipment and therefore have a cost structure with high fixed costs. Businesses that rely on direct labor and direct materials, such as auto repair shops, tend to have higher variable costs than fixed costs.

Operating leverage is an important concept because it affects how sensitive profits are to changes in sales volume. This is best illustrated by comparing two companies with identical sales and profits but with different cost structures, as we do in Figure 3.6 "Operating Leverage Example". High Operating Leverage Company (HOLC) has relatively high fixed costs, and Low Operating Leverage Company (LOLC) has relatively low fixed costs.

Figure 3.6 Operating Leverage Example

	High Operating Leverage Company (HOLC)		Low Operating Leverage Company (LOLC)	
Sales	$500,000	100%	$500,000	100%
Variable costs	100,000	20	350,000	70
Contribution margin	$400,000	80	$150,000	30
Fixed costs	300,000	60	50,000	10
Operating profit	$100,000	20	$100,000	20

One way to observe the importance of operating leverage is to compare the break-even point in sales dollars for each company. HOLC needs sales of $375,000 to break even (= $300,000 ÷ 0.80), whereas LOLC needs sales of $166,667 to break even (= $50,000 ÷ 0.30).

Question: Why don't all companies strive for low operating leverage to lower the break-even point?

Answer: In Figure 3.6 "Operating Leverage Example", LOLC looks better up to the sales point of $500,000 and profit of $100,000. However, once sales exceed $500,000, HOLC will have higher profit than LOLC. This is because every additional dollar in sales will provide $0.80 in profit for HOLC (80 percent contribution margin ratio), and only $0.30 in profit for LOLC (30 percent contribution margin ratio). If a company is relatively certain of increasing sales, then it makes sense to have higher operating leverage.

Financial advisers often say, "the higher the risk, the higher the potential profit," which can also be stated as "the higher the risk, the higher the potential *loss*." The same applies to operating leverage. Higher operating leverage can lead to higher profit. However, high operating leverage companies that encounter declining sales tend to feel the negative impact more than companies with low operating leverage.

To prove this point, let's assume both companies in Figure 3.6″Operating Leverage Example" experience a 30 percent *decrease* in sales. HOLC's profit would decrease by $120,000 (= 30 percent × $400,000 contribution margin) and LOLC's profit would decrease by $45,000 (= 30 percent × $150,000 contribution margin). HOLC would certainly feel the pain more than LOLC.

Now assume both companies in Figure 3.6 "Operating Leverage Example" experience a 30 percent *increase* in sales. HOLC's profit would increase by $120,000 (= 30 percent × $400,000 contribution margin) and LOLC's profit would increase by $45,000 (= 30 percent × $150,000 contribution margin). HOLC benefits more from increased sales than LOLC.

Key Takeaways

- The cost structure of a firm describes the proportion of fixed and variable costs to total costs. Operating leverage refers to the level of fixed costs within an organization. The term "high operating leverage" is used to describe companies with relatively high fixed costs. Firms with high operating leverage tend to profit more from increasing sales, and lose more from decreasing sales than a similar firm with low operating leverage.

3.5 Using a Contribution Margin When Faced with Resource Constraints

Learning Objective

1. Use an alternative form of contribution margin when faced with a resource constraint.

Question: Many companies have limited resources in such areas as labor hours, machine hours, facilities, and materials. These constraints will likely affect a company's ability to produce goods or provide services. When a company that produces multiple products faces a constraint, managers often calculate the contribution margin per unit of constraint in addition to the contribution margin per unit. The contribution margin per unit of constraint *is the contribution margin per unit divided by the units of*

constrained resource required to produce one unit of product. How is this measure used by managers to make decisions when faced with resource constraints?

Answer: Let's examine the Kayaks-For-Fun example introduced earlier in the chapter. The company produces two kayak models, River and Sea. Based on the information shown, Kayaks-For-Fun would prefer to sell more of the River model because it has the highest contribution margin per unit.

	River	Sea
Selling price	$500	$600
Variable cost	100	450
Contribution margin	$400	$150

Kayaks-For-Fun has a total of 320 labor hours available each month. The specialized skills required to build the kayaks makes it difficult for management to find additional workers. Assume the River model requires 4 labor hours per unit and the Sea model requires 1 labor hour per unit (most of the variable cost for the Sea model is related to expensive materials required for production). Kayaks-For-Fun sells everything it produces. Given its labor hours constraint, the company would prefer to maximize the contribution margin per labor hour.

	River	Sea
Contribution margin per unit	$400	$150
Divided by labor hours per unit	÷ 4	÷1
Contribution margin per labor hour	$100	$150

Based on this information, Kayaks-For-Fun would prefer to sell the Sea model because it provides a contribution margin per labor hour of $150 versus $100 for the River model. The company would prefer only to make the Sea model, which would yield a total contribution margin of $48,000 (= $150 × 320 hours). If the River model were the only model produced, the total contribution margin to the company would be $32,000 (= $100 × 320 hours).

Analysis such as this often leads to further investigation. It may be that Kayaks-For-Fun can find additional labor to alleviate this resource constraint. Or perhaps the production process can be modified in a way that reduces the labor required to build the River model (e.g., through increased automation). Whatever the outcome, companies with limited resources are wise to calculate the contribution margin per unit of constrained resource.

Key Takeaway

- Many organizations operate with limited resources in areas such as labor hours, machine hours, facilities, or materials. The contribution margin per unit of constraint is a helpful measure in determining how constrained resources should be utilized.

Check Yourself

This knowledge check is based on the information for Kayaks-For-Fun presented previously. Assume Kayaks-For-Fun found additional labor, thereby eliminating this resource constraint. However, the company now faces limited available machine hours. It has a total of 3,000 machine hours available each month. The River model requires 16 machine hours per unit, and the Sea model requires 10 machine hours per unit.

1. Calculate the contribution margin per unit of constrained resource for each model.
2. Which model would Kayaks-For-Fun prefer to sell to maximize overall company profit?

Solution:

	River	Sea
Contribution margin per unit	$400	$150
Divided by machine hours per unit	÷16	÷10
Contribution margin per machine hour	$ 25	$ 15

1.
2. Kayaks-For-Fun would prefer to sell the River model because it provides a contribution margin per machine hour of $25 compared to $15 for the Sea model. If only the River model were sold, the total contribution margin would be $75,000 (= $25 × 3,000 machine hours). If only the Sea model were sold, the total contribution margin would be $45,000 (= $15 × 3,000 machine hours).

3.6 Using Variable Costing to Make Decisions

Learning Objective

1. Understand how managers use variable costing to make decisions.

In Chapter 2, we discussed how to report manufacturing costs and nonmanufacturing costs following U.S. Generally Accepted Accounting Principles (U.S. GAAP). Under U.S. GAAP, all nonmanufacturing costs (selling and administrative costs) are treated as period costs because they are expensed on the income statement in the period in which they are incurred. All costs associated with production are treated as product costs, including direct materials, direct labor, and fixed and variable manufacturing overhead. These costs are attached to inventory as an asset on the balance sheet until the goods are sold, at which point the costs are transferred to cost of goods sold on the income statement as an expense. This method of accounting is called absorption costing because *all* manufacturing overhead costs (fixed and variable) are *absorbed* into inventory until the goods are sold. (The term *full costing* is also used to describe absorption costing.)

Question: Although absorption costing is used for external reporting, managers often prefer to use an alternative costing approach for internal reporting purposes called variable costing. What is variable costing, and how does it compare to absorption costing?

Answer: Variable costing requires that all *variable* production costs be included in inventory, and all *fixed* production costs (fixed manufacturing overhead) be reported as period costs. Thus all fixed production costs are expensed as incurred.

The only difference between absorption costing and variable costing is in the treatment of fixed manufacturing overhead. Using absorption costing, fixed manufacturing overhead is reported as a *product cost*. Using variable costing, fixed manufacturing overhead is reported as a *period cost*. Figure "Absorption Costing Versus Variable Costing" summarizes the similarities and differences between absorption costing and variable costing.

Figure 3.7 Absorption Costing Versus Variable Costing

Absorption Costing		Variable Costing	
Direct materials Direct labor Variable manufacturing overhead Fixed manufacturing overhead	Product costs	Direct materials Direct labor Variable manufacturing overhead	Product costs
Selling and administrative	Period costs	Fixed manufacturing overhead Selling and administrative	Period costs

Impact of Absorption Costing and Variable Costing on Profit

Question: If a company uses just-in-time inventory, and therefore has no beginning or ending inventory, profit will be exactly the same regardless of the costing approach used. However, most companies have units of product in inventory at the end of the reporting period. How does the use of absorption costing affect the value of ending inventory?

Answer: Since absorption costing includes fixed manufacturing overhead as a product cost, all products that remain in ending inventory (i.e., are unsold at the end of the period) include a portion of fixed manufacturing overhead costs as an asset on the balance sheet. Since variable costing treats fixed manufacturing overhead costs as period costs, all fixed manufacturing overhead costs are expensed on the income statement when incurred. Thus if the quantity of units produced exceeds the quantity of units sold, absorption costing will result in higher profit.

We illustrate this concept with an example. The following information is for Bullard Company, a producer of clock radios:

Monthly production		10,000 units
Sales price		$25 per unit
Variable production cost per unit		
Direct materials	$4	
Direct labor	1	$7 per unit
Manufacturing overhead	2	
Fixed production costs		$40,000 each month; $4 per unit at 10,000 units of production
Variable selling and administrative cost		$3 per unit
Fixed selling and administrative cost		$20,000 each month

Assume Bullard has no finished goods inventory at the beginning of month 1. We will look at absorption costing versus variable costing for three different scenarios:

- Month 1 scenario: 10,000 units produced *equals* 10,000 units sold

- Month 2 scenario: 10,000 units produced is *greater than* 9,000 units sold
- Month 3 scenario: 10,000 units produced is *less than* 11,000 units sold

Month 1: Number of Units Produced Equals Number of Units Sold

Question: During month 1, Bullard Company sells all 10,000 units produced during the month. How does operating profit compare using absorption costing and variable costing when the number of units produced equals the number of units sold?

Answer: Figure 3.8 "Number of Units Produced Equals Number of Units Sold" presents the results for each costing method. Notice that the absorption costing income statement is called a traditional income statement, and the variable costing income statement is called a contribution margin income statement.

As you review Figure 3.8 "Number of Units Produced Equals Number of Units Sold", notice that when the number of units produced equals the number sold, profit totaling $90,000 is identical for both costing methods. With absorption costing, fixed manufacturing overhead costs are fully expensed because all units produced are sold (there is no ending inventory). With variable costing, fixed manufacturing overhead costs are treated as period costs and therefore are always expensed in the period incurred. Because all other costs are treated the same regardless of the costing method used, profit is identical when the number of units produced and sold is the same.

Figure 3.8 Number of Units Produced Equals Number of Units Sold

Month 1

Absorption Costing (Traditional Income Statement)		Variable Costing (Contribution Margin Income Statement)		
Sales	$250,000[a]	Sales		$250,000[a]
Cost of goods sold	110,000[b]	Variable costs		
Gross margin	$140,000	Cost of goods sold	$70,000[c]	
Selling and administrative costs	50,000[d]	Selling and administrative costs	30,000[e]	
Operating profit	$ 90,000	Total variable costs		100,000
		Contribution margin		$150,000
		Fixed costs		
		Cost of goods sold	$40,000[f]	
		Selling and administrative costs	20,000[g]	
		Total fixed costs		60,000
		Operating profit		$ 90,000

[a] $250,000 = $25 × 10,000 units sold.

[b] $110,000 = ($4 per unit fixed production cost × 10,000 units sold) + ($7 per unit variable production cost × 10,000 units sold).

[c] $70,000 = $7 per unit variable production cost × 10,000 units sold.

[d] $50,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 10,000 units sold).

[e] $30,000 = $3 per unit variable selling and admin. cost × 10,000 units sold.

[f] Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.

[g] Given.

Month 2: Number of Units Produced Is Greater Than Number of Units Sold

Question: During month 2, Bullard Company produces 10,000 units but sells only 9,000 units. How does operating profit compare using absorption costing and variable costing when the number of units produced is greater than the number of units sold?

Answer: Figure 3.9 "Number of Units Produced Is Greater Than Number of Units Sold" presents the results for each costing method. Notice that absorption costing results in higher profit. When absorption costing is used, a portion of fixed manufacturing overhead costs remains in ending inventory as an asset on the balance sheet until the goods are sold. However, variable costing requires that all fixed manufacturing overhead costs be expensed as incurred regardless of the level of sales. Thus when more units are produced than are sold, variable costing results in higher costs and lower profit.

The difference in profit between the two methods of $4,000 (= $79,000 − $75,000) is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in ending inventory using absorption costing ($4,000 = $4 × 1,000 units).

Figure 3.9 Number of Units Produced Is Greater Than Number of Units Sold

Month 2

Absorption Costing (Traditional Income Statement)		Variable Costing (Contribution Margin Income Statement)		
Sales	$225,000[a]	Sales		$225,000[a]
Cost of goods sold	99,000[b]	Variable costs		
Gross margin	$126,000	Cost of goods sold	$63,000[c]	
Selling and administrative costs	47,000[d]	Selling and administrative costs	27,000[e]	
Operating profit	$ 79,000	Total variable costs		90,000
		Contribution margin		$135,000
		Fixed costs		
		Cost of goods sold	$40,000[f]	
		Selling and administrative costs	20,000[g]	
		Total fixed costs		60,000
		Operating profit		$ 75,000

Absorption costing profit is $4,000 higher. This difference is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in ending inventory on the balance sheet using absorption costing.

[a] $225,000 = $25 × 9,000 units sold.

[b] $99,000 = ($4 per unit fixed production cost × 9,000 units sold) + ($7 per unit variable production cost × 9,000 units sold).

[c] $63,000 = $7 per unit variable production cost × 9,000 units sold.

[d] $47,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 9,000 units sold).

[e] $27,000 = $3 per unit variable selling and admin. cost × 9,000 units sold.

[f] Variable costing always treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.

[g] Given.

Month 3: Number of Units Produced Is Less Than Number of Units Sold

Question: During month 3, Bullard Company produces 10,000 units but sells 11,000 units (1,000 units were left over from month 2 and therefore were in inventory at the beginning of month 3). How does operating profit compare using absorption costing and variable costing when the number of units produced is less than the number of units sold?

Answer: Figure 3.10 "Number of Units Produced Is Less Than Number of Units Sold" presents the results for each costing method. Using variable costing, the $40,000 in fixed manufacturing overhead costs continues to be expensed when incurred. However, using absorption costing, the entire $40,000 is expensed because all 10,000 units produced were sold; an additional $4,000 related to the 1,000 units produced last month and pulled from inventory this month is also expensed. Thus when fewer units are produced than are sold, absorption costing results in higher costs and lower profit.

The difference in profit between the two methods of $4,000 (= $105,000 − $101,000) is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in inventory on the balance sheet at the end of month 2 and recorded as cost of goods sold during month 3 using absorption costing ($4,000 = $4 × 1,000 units).

Figure 3.10 Number of Units Produced Is Less Than Number of Units Sold

Month 3

Absorption Costing (Traditional Income Statement)		Variable Costing (Contribution Margin Income Statement)		
Sales	$275,000[a]	Sales		$275,000[a]
Cost of goods sold	121,000[b]	Variable costs		
Gross margin	$154,000	Cost of goods sold	$77,000[c]	
Selling and administrative costs	53,000[d]	Selling and administrative costs	33,000[e]	
Operating profit	$101,000	Total variable costs		110,000
		Contribution margin		$165,000
		Fixed costs		
		Cost of goods sold	$40,000[f]	
		Selling and administrative costs	20,000[g]	
		Total fixed costs		60,000
		Operating profit		$105,000

Absorption costing profit is $4,000 lower. This difference is attributed to the $4 per unit fixed manufacturing overhead cost assigned to the 1,000 units in inventory on the balance sheet at the end of month 2 that is recorded as cost of goods sold during month 3.

[a] $275,000 = $25 × 11,000 units sold.

[b] $121,000 = ($4 per unit fixed production cost × 11,000 units sold) + ($7 per unit variable production cost × 11,000 units sold).

[c] $77,000 = $7 per unit variable production cost × 11,000 units sold.

[d] $53,000 = $20,000 fixed selling and admin. cost + ($3 per unit variable selling and admin. cost × 11,000 units sold).

[e] $33,000 = $3 per unit variable selling and admin. cost × 11,000 units sold.

[f] Variable costing always treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.

[g] Given.

Advantages of Using Variable Costing

Question: Why do organizations use variable costing?

Answer: Variable costing provides managers with the information necessary to prepare a contribution margin income statement, which leads to more effective cost-volume-profit (CVP) analysis. By separating variable and fixed costs, managers are able to determine contribution margin ratios, break-even points, and target profit points, and to perform sensitivity analysis. Conversely, absorption costing meets the requirements of U.S. GAAP, but is not as useful for internal decision-making purposes.

Another advantage of using variable costing internally is that it prevents managers from increasing production solely for the purpose of inflating profit. For example, assume the manager at Bullard Company will receive a bonus for reaching a certain profit target but expects to be $15,000 short of the target. The company uses absorption costing, and the manager realizes increasing production (and therefore increasing inventory levels) will increase profit. The manager decides to produce 20,000 units in month 4, even though only 10,000 units will be sold. Half of the $40,000 in fixed production cost ($20,000) will be included in inventory at the end of the period, thereby lowering expenses on the income statement and increasing profit by $20,000. At some point, this will catch up to the manager because the company will have excess or obsolete inventory in future months. However, in the short run, the manager will increase profit by increasing production. This strategy does not work with variable costing because all fixed manufacturing overhead costs are expensed as incurred, regardless of the level of sales.

Key Takeaways

- The only difference between absorption costing and variable costing is in the treatment of fixed manufacturing overhead costs. Absorption costing treats fixed manufacturing overhead as a product cost (included in inventory on the balance sheet until sold), while variable costing treats fixed manufacturing overhead as a period cost (expensed on the income statement as incurred).

  When comparing absorption costing with variable costing, the following three rules apply: (1) When units produced equals units sold, profit is the same for both costing approaches. (2) When units produced is greater than units sold, absorption costing yields the highest profit. (3) When units produced is less than units sold, variable costing yields the highest profit.

Check Yourself

Winter Sports, Inc., produces snowboards. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Winter Sports, Inc.,:

Annual production		100,000 units
Sales price		$200 per unit
Variable production cost per unit		
Direct materials	$60	
Direct labor	30	$130 per unit
Manufacturing overhead	40	
Fixed production costs		$500,000 each year; $5 per unit at 100,000 units of production
Variable selling and administrative cost		$10 per unit
Fixed selling and administrative cost		$800,000 each year

1. All 100,000 units produced during year 1 are sold during year 1.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.
2. Although 100,000 units are produced during year 2, only 80,000 are sold during the year. The remaining 20,000 units are in finished goods inventory at the end of year 2.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.

Solution

1. Traditional income statement (absorption costing), year 1:

Sales	$20,000,000[a]
Cost of goods sold	13,500,000[b]
Gross margin	$ 6,500,000
Selling and administrative costs	1,800,000[c]
Operating profit	$ 4,700,000

[a] $20,000,000 = $200 × 100,000 units sold.

[b] $13,500,000 = ($5 per unit fixed production cost × 100,000 units sold) + ($130 per unit variable production cost × 100,000 units sold).

[c] $1,800,000 = $800,000 fixed selling and admin. cost + ($10 per unit variable selling and admin. cost × 100,000 units sold).

2. Contribution margin income statement (variable costing), year 1:

Sales		$20,000,000[a]
Variable costs		
Cost of goods sold	$13,000,000[b]	
Selling and administrative costs	1,000,000[c]	
Total variable costs		14,000,000
Contribution margin		6,000,000
Fixed costs		
Cost of goods sold	$ 500,000[d]	
Selling and administrative costs	800,000[e]	
Total fixed costs		1,300,000
Operating profit		$ 4,700,000

[a] $20,000,000 = $200 × 100,000 units sold.

[b] $13,000,000 = $130 per unit variable production cost × 100,000 units sold.

[c] $1,000,000 = $10 per unit variable selling and admin. cost × 100,000 units sold.

[d] Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.

[e] Given.

1. Traditional income statement (absorption costing), year 2:

Sales	$16,000,000[a]
Cost of goods sold	10,800,000[b]
Gross margin	$ 5,200,000
Selling and administrative costs	1,600,000[c]
Operating profit	$ 3,600,000

[a] $16,000,000 = $200 × 80,000 units sold.

[b] $10,800,000 = ($5 per unit fixed production cost × 80,000 units sold) + ($130 per unit variable production cost × 80,000 units sold).

2. Contribution margin income statement (variable costing), year 2:

Sales		$16,000,000[a]
Variable costs		
Cost of goods sold	$10,400,000[b]	
Selling and administrative costs	800,000[c]	
Total variable costs		11,200,000
Contribution margin		$ 4,800,000
Fixed costs		
Cost of goods sold	$ 500,000[d]	
Selling and administrative costs	800,000[e]	
Total fixed costs		1,300,000
Operating profit		$ 3,500,000

[a] $16,000,000 = $200 × 80,000 units sold.

[b] $10,400,000 = $130 per unit variable production cost × 80,000 units sold.

[c] $800,000 = $10 per unit variable selling and admin. cost × 80,000 units sold.

[d] Variable costing treats fixed manufacturing overhead as a period cost. Thus all fixed manufacturing overhead costs are expensed in the period incurred regardless of the level of sales.

[e] Given.

End-of-Chapter Exercises

Questions

1. Describe the components of the profit equation.
2. What is the difference between a variable cost and a fixed cost? Provide examples of each.
3. You are asked to find the break-even point in units and in sales dollars. What does this mean?
4. You are asked to find the target profit in units and in sales dollars. What does this mean?
5. For a company with one product, describe the equation used to calculate the break-even point or target profit in (a) units, and (b) sales dollars.
6. Distinguish between contribution margin per unit and contribution margin ratio.
7. What does the term *margin of safety* mean? How might management use this information?
8. How does the break-even point equation change for a company with multiple products or services compared to a single-product company?
9. Describe the assumptions made to simplify the cost-volume-profit analysis described in the chapter.
10. What is sensitivity analysis and how might it help those performing cost-volume-profit analysis?
11. If you are asked to review the cost structure of an organization, what are you being asked to do?
12. When might the contribution margin per unit of constraint be more effective than the contribution margin per unit for making decisions?
13. Describe the difference between absorption costing and variable costing.
14. Why do some organizations use variable costing?

Brief Exercises

15. **Planning at Snowboard Company.** Refer to the dialogue at Snowboard Company presented at the beginning of the chapter. What information is Recilia, vice president of sales, requesting from Lisa, the company accountant? How does Recilia plan on using this information?

16. **Contribution Margin Calculations.** Ace Company sells lawn mowers for $200 per unit. Variable cost per unit is $40, and fixed costs total $4,000. Find (a) the contribution margin per unit, and (b) the contribution margin ratio.

17. **Weighted Average Contribution Margin Calculation.** Radio Control, Inc., sells radio controlled cars for $300 per unit representing 80 percent of total sales, and radio controlled boats for $400 per unit representing 20 percent of total sales. Variable cost per unit is $150 for cars and $300 for boats. Find (a) the contribution margin per unit for each product, and (b) the weighted average contribution margin per unit.

18. **Sensitivity Analysis, Sales Price.** Refer to the base case for Snowboard Company presented in the first column of Figure 3.5 "Sensitivity Analysis for Snowboard Company". Assume the unit sales price decreases by 10 percent. Calculate (a) the new projected profit, (b) the dollar change in profit from the base case, and (c) the percent change in profit from the base case.

19. **Sensitivity Analysis, Unit Sales.** Refer to the base case for Snowboard Company presented in the first column of Figure 3.5 "Sensitivity Analysis for Snowboard Company". Assume the number of units sold increases by 10 percent. Calculate (a) the new projected profit, (b) the dollar change in profit from the base case, and (c) the percent change in profit from the base case.

20. **Operating Leverage.** High operating leverage means:

1. The company has relatively low fixed costs.
2. The company has relatively high fixed costs.
3. The company will have to sell *more* units than a comparable company with low operating leverage to break even.
4. The company will have to sell *fewer* units than a comparable company with low operating leverage to break even.
5. Both (2) and (3) are correct.
6. Both (1) and (4) are correct.

21. **Contribution Margin per Unit of Constraint.** Paint Toys Company sells paint ball guns for $100 per unit. Variable cost is $60 per unit. Each paint ball gun requires 1.25 machine hours and 2.00 direct labor hours to produce. Calculate the contribution margin (a) per unit, (b) per machine hour, and (c) per direct labor hour.

22. **Absorption Costing Versus Variable Costing.** Describe the difference between absorption costing and variable costing. Which approach yields the highest profit when the units produced are greater than the units sold? Explain.

Exercises:

23. Break-Even Point and Target Profit Measured in Units (Single Product). Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25.

Required:

1. Calculate the contribution margin per unit.
2. Find the break-even point in units.
3. How many units must be sold to earn a monthly profit of $40,000?

24 . Break-Even Point and Target Profit Measured in Sales Dollars (Single Product). Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25 (these data are the same as the previous exercise):

Required:

1. Calculate the contribution margin ratio.
2. Find the break-even point in sales dollars.
3. What amount of sales dollars is required to earn a monthly profit of $60,000?

25. Margin of Safety (Single Product). Nellie Company has monthly fixed costs totaling $100,000 and variable costs of $20 per unit. Each unit of product is sold for $25 (these data are the same as the previous exercise). Assume Nellie Company expects to sell 24,000 units of product this coming month.

Required:

1. Find the margin of safety in units.
2. Find the margin of safety in sales dollars.

26. Break-Even Point and Target Profit Measured in Units (Multiple Products). Hi-Tech Incorporated produces two different products with the following monthly data.

	Cell	GPS	Total
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$1,800,000

Assume the sales mix remains the same at all levels of sales.

Required:

1. Calculate the weighted average contribution margin per unit.
2. How many units in total must be sold to break even?
3. How many units of each product must be sold to break even?
4. How many units in total must be sold to earn a monthly profit of $180,000?
5. How many units of each product must be sold to earn a monthly profit of $180,000?

27. Break-Even Point and Target Profit Measured in Sales Dollars (Multiple Products). Hi-Tech Incorporated produces two different products with the following monthly data (these data are the same as the previous exercise).

	Cell	GPS	Total
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$1,800,000

Assume the sales mix remains the same at all levels of sales.

Required:

Round your answers to the nearest hundredth of a percent and nearest dollar where appropriate. (An example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $379.)

1. Using the information provided, prepare a contribution margin income statement for the month similar to the one in Figure 3.4 “Income Statement for Amy’s Accounting Service”.
2. Calculate the weighted average contribution margin ratio.
3. Find the break-even point in sales dollars.
4. What amount of sales dollars is required to earn a monthly profit of $540,000?
5. Assume the contribution margin income statement prepared in requirement **a** is the company’s base case. What is the margin of safety in sales dollars?

28. Changes in Sales Mix. Hi-Tech Incorporated produces two different products with the following monthly data (these data are the same as the previous exercise).

	Cell	GPS	Total
Selling price per unit	$100	$400	
Variable cost per unit	$ 40	$240	
Expected unit sales	21,000	9,000	30,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$1,800,000

Required:

1. If the sales mix shifts to 50 percent Cell and 50 percent GPS, would the break-even point in units increase or decrease? Explain. (Detailed calculations are not necessary but may be helpful in confirming your answer.)
2. Go back to the original projected sales mix. If the sales mix shifts to 80 percent Cell and 20 percent GPS, would the break-even point in units increase or decrease? Explain. (Detailed calculations are not necessary but may be helpful in confirming your answer.)

28. CVP Sensitivity Analysis (Single Product). Bridgeport Company has monthly fixed costs totaling $200,000 and variable costs of $40 per unit. Each unit of product is sold for $50. Bridgeport expects to sell 30,000 units each month (this is the base case).

Required:

For each of the independent situations in requirements **2** through **4**, assume that the number of units sold remains at 30,000.

1. Prepare a contribution margin income statement for the base case.
2. Refer to the base case. What would the operating profit be if the unit sales price increases 10 percent?
3. Refer to the base case. What would the operating profit be if the unit variable cost decreases 20 percent?
4. Refer to the base case. What would the operating profit be if total fixed costs decrease 20 percent?

29. CVP Sensitivity Analysis (Multiple Products). Gonzalez Company produces two different products that have the following monthly data (this is the base case).

	Cruiser	Racer	Total
Selling price per unit	$300	$1,200	
Variable cost per unit	$120	$ 720	
Expected unit sales	1,400	600	2,000
Sales mix	70 percent	30 percent	100 percent
Fixed costs			$180,000

Required:

For each of the independent situations in requirements **2** through **4**, assume that total sales remains at 2,000 units.

1. Prepare a contribution margin income statement.
2. Refer to the base case. What would the operating profit be if the Cruiser sales price (1) increases 20 percent, or (2) decreases 20 percent?
3. Refer to the base case. What would the operating profit be if the Cruiser sales volume increases 400 units with a corresponding decrease of 400 units in Racer sales?

4. Refer to the base case. What would the operating profit be if total fixed costs increase five percent? Does this increase in fixed costs result in higher operating leverage or lower operating leverage? Explain.

30. Contribution Margin with Resource Constraints. CyclePath Company produces two different products that have the following price and cost characteristics.

	Bicycle	Tricycle
Selling price per unit	$200	$100
Variable cost per unit	$120	$ 50

Management believes that pushing sales of the Bicycle product would maximize company profits because of the high contribution margin per unit for this product. However, only 50,000 labor hours are available each year, and the Bicycle product requires 4 labor hours per unit while the Tricycle model requires 2 labor hours per unit. The company sells everything it produces.

Required:

1. Calculate the contribution margin per unit of constrained resource for each model.
2. Which model would CyclePath prefer to sell to maximize overall company profit? Explain.

31. Absorption Costing Versus Variable Costing. Technic Company produces portable CD players. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Technic Company.

Required:

1. All 50,000 units produced during year 1 are sold during year 1.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.
2. Although 50,000 units are produced during year 2, only 40,000 are sold during the year. The remaining 10,000 units are in finished goods inventory at the end of year 2.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.

Problems

32. CVP and Sensitivity Analysis (Single Product). Madera Company has annual fixed costs totaling $120,000 and variable costs of $3 per unit. Each unit of product is sold for $15. Madera expects to sell 12,000 units this year (this is the base case).

Required:

1. Find the break-even point in units.
2. How many units must be sold to earn an annual profit of $50,000? (Round to the nearest unit.)
3. Find the break-even point in sales dollars.
4. What amount of sales dollars is required to earn an annual profit of $70,000?
5. Find the margin of safety in units and in sales dollars.
6. Prepare a contribution margin income statement for the base case.
7. What will the operating profit (loss) be if the sales price decreases 30 percent? (Assume total sales remains at 12,000 units, and round to the nearest cent where appropriate.)
8. Go back to the base case. What will the operating profit (loss) be if the variable cost per unit increases 10 percent? (Assume total sales remains at 12,000 units, and round to the nearest cent where appropriate.)

33. CVP Analysis and Cost Structure (Single Product). Riviera Incorporated produces flat panel televisions. The company has annual fixed costs totaling $10,000,000 and variable costs of $600 per unit. Each unit of product is sold for $1,000. Riviera expects

to sell 70,000 units this year.

Required:

1. Find the break-even point in units.
2. How many units must be sold to earn an annual profit of $2,000,000?
3. Find the break-even point in sales dollars.
4. What amount of sales dollars is required to earn an annual profit of $500,000?
5. Find the margin of safety in units.
6. Find the margin of safety in sales dollars.
7. How much will operating profit change if fixed costs are 15 percent higher than anticipated? Would this increase in fixed costs result in higher or lower operating leverage? Explain.

34. CVP Analysis and Sales Mix (Multiple Products). Sierra Books Incorporated produces two different products with the following monthly data (this is the base case).

1.

	Text	**Lecture Notes**	**Total**
Selling price per unit	$100	$12	
Variable cost per unit	$ 60	$ 3	
Expected unit sales	21,000	14,000	35,000
Sales mix	60 percent	40 percent	100 percent
Fixed costs			$750,000

Assume the sales mix remains the same at all levels of sales except for requirement **i**.

Required:

Round to the nearest unit of product, hundredth of a percent, and nearest cent where appropriate. (An example for unit calculations is 3,231.15 = 3,231; an example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $378.98.)

1. Calculate the weighted average contribution margin per unit.
    1. How many units in total must be sold to break even?
    2. How many units of each product must be sold to break even?
    3. How many units in total must be sold to earn a monthly profit of $100,000?
    4. How many units of each product must be sold to earn a monthly profit of $100,000?
2. Using the base case information, prepare a contribution margin income statement for the month
3. Calculate the weighted average contribution margin ratio.
4. Find the break-even point in sales dollars.
5. What amount of sales dollars is required to earn a monthly profit of $80,000?
6. Assume the contribution margin income statement prepared in requirement **d** is the company's base case. What is the margin of safety in sales dollars?
7. If the sales mix shifts more toward the Text product than the Lecture Notes product, would the break-even point in units increase or decrease? Explain. (Detail calculations are not necessary, but may be helpful in confirming your answer.)

35. CVP Analysis and Cost Structure (Service Company). Conway Electrical Services provides services to two types of clients: residential and commercial. The company's contribution margin income statement for the year is shown (this is the base case). Fixed costs are known in total, but Conway does not allocate fixed costs to each department.

	Residential	Commercial	Total
Sales	$600,000	$900,000	$1,500,000
Variable costs	100,000	275,000	375,000
Contribution margin	$500,000	$625,000	$1,125,000
Fixed costs			600,000
Operating profit			$ 525,000

Required:

1. Find the break-even point in sales dollars.
2. What is the margin of safety in sales dollars?
3. What amount of sales dollars is required to earn an annual profit of $750,000?
4. Refer to the base case shown previously. What would the operating profit be if the Commercial variable costs are 20 percent higher than originally anticipated? How does this increase in Commercial variable costs impact the operating leverage of the company?

36. CVP and Sensitivity Analysis, Resource Constraint (Multiple Products). Hobby Shop Incorporated produces three different models with the following annual data (this is the base case).

	Plane	Car	Boat	Total
Selling price per unit	$20	$14	$24	
Variable cost per unit	$ 5	$ 7	$ 8	
Expected unit sales	30,000	50,000	20,000	100,000
Sales mix	30 percent	50 percent	20 percent	100 percent
Fixed costs				$650,000

Assume the sales mix remains the same at all levels of sales except for requirements **i** and **j**.

Required:

Round to the nearest unit of product, hundredth of a percent, and nearest cent where appropriate. (An example for unit calculations is 3,231.151 = 3,231; an example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $378.98.)

1. Calculate the weighted average contribution margin per unit.
    1. How many units in total must be sold to break even?
    2. How many units of each product must be sold to break even?
    3. How many units in total must be sold to earn an annual profit of $500,000?
    4. How many units of each product must be sold to earn an annual profit of $500,000?
2. Using the base case information, prepare a contribution margin income statement for the year
3. Calculate the weighted average contribution margin ratio.
4. Find the break-even point in sales dollars.
5. What amount of sales dollars is required to earn an annual profit of $400,000?
6. Go back to the base case contribution margin income statement prepared in requirement **d**. What would the operating profit be if the Plane sales price (1) increases 10 percent, or (2) decreases 10 percent? (Assume total sales remains at 100,000 units.)
7. Go back to the base case contribution margin income statement prepared in requirement **d**. If the sales mix shifts more toward the Car product than to the other two products, would the break-even point in units increase or decrease? (Detailed calculations are not necessary.) Explain.

8. Assume the company has a limited number of labor hours available in production, and management would like to make efficient use of these labor hours. The Plane product requires 4 labor hours per unit, the Car product requires 3 labor hours per unit, and the Boat product requires 5 hours per unit. The company sells everything it produces. Based on this information, calculate the contribution margin per labor hour for each model (round to the nearest cent), and determine the top two models the company would prefer to sell to maximize overall company profit.

37. Absorption Costing Versus Variable Costing. Wall Tech Company produces wood siding. The company has no finished goods inventory at the beginning of year 1. The following information pertains to Wall Tech Company.

Annual production		200,000 units
Sales price		$30 per unit
Variable production cost per unit		
Direct materials	$8	$15 per unit
Direct labor	3	
Manufacturing overhead	4	
Fixed production costs		$1,000,000 each year; $5 per unit at 200,000 units of production
Variable selling and administrative cost		$2 per unit
Fixed selling and administrative cost		$800,000 each year

Required:

1. All 200,000 units produced during year 1 are sold during year 1.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.
2. Although 200,000 units are produced during year 2, only 170,000 units are sold during the year. The remaining 30,000 units are in finished goods inventory at the end of year 2.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.
3. Although 200,000 units are produced during year 3, a total of 230,000 units are sold during the year. The 30,000 units remaining in inventory at the end of year 2 are sold during year 3.
    1. Prepare a traditional income statement assuming the company uses absorption costing.
    2. Prepare a contribution margin income statement assuming the company uses variable costing.
4. Analyze the results in years 1 through 3 (requirements **a** through **c**).

One Step Further: Skill-Building Cases

38. Internet Project: CVP Analysis. Using the Internet, go to the Web site for **Nordstrom, Inc.**https://investor.nordstrom.com/financial-information/annual-reports . Find the most recent annual report and print the

income statement (called the *consolidated statements of earnings*).

Required:

1. Calculate the gross profit percentage (also called the *gross margin percentage*) by dividing the gross profit by net sales.
2. Explain how the gross profit percentage is different than the contribution margin ratio (no calculations are necessary)?

39. Decision Making: Automated Versus Labor Intensive Production. Wood Furniture, Inc., builds high-quality wood desks. Management of the company is considering going from a labor-intensive process of building desks to an automated process that requires expensive machinery and equipment. If the company moves to an automated process, variable production costs will decrease (direct materials, direct labor, and variable manufacturing overhead) due to improved efficiency, and fixed production costs will increase as a result of additional depreciation costs. The costs predicted for the coming year are shown. The selling price is expected to be $900 per unit for both processes.

	Labor-Intensive Process	**Automated Process**
Variable cost of goods sold	$490 per unit	$290 per unit
Fixed cost of goods sold (annual)	$1,000,000	$2,600,000
Variable selling and administrative	$10 per unit	$10 per unit
Fixed selling and admin. (annual)	$400,000	$400,000

Required:

1. Calculate the break-even point in units assuming that (1) the labor-intensive process is used, and (2) the automated process is used.
2. Explain why there is such a significant difference in break-even points between the labor-intensive process and the automated process.
3. Assume Wood Furniture, Inc., expects to produce and sell 8,000 units this coming year and is certain sales will grow by at least 10 percent per year in future years. Calculate the expected operating profit assuming that (1) the labor intensive process is used, and (2) the automated process is used.
4. Using requirement **c** as a guide, explain whether management should stay with the labor-intensive process or switch to an automated process.

40. Group Activity: Sensitivity Analysis and Decision Making. Performance Sports produces inflatable rafts used for river rafting. Sales have grown slowly over the years, and cost increases are causing Performance Sports to incur losses. Financial data for the most recent year are shown.

Sales		$2,600,000	(= $2,000 x 1,300 units)
Variable costs			
Cost of goods sold	$1,040,000		(= $800 x 1,300 units)
Selling and administrative costs	390,000		(= $300 x 1,300 units)
Total variable costs		1,430,000	
Contribution margin		$1,170,000	
Fixed costs			
Cost of goods sold	$800,000		
Selling and administrative costs	400,000		
Total fixed costs		1,200,000	
Operating loss		($ 30,000)	

Members of the management group at Performance Sports arrived at these three possible courses of action to return the company to profitability (each scenario is independent of the others):

Required:

Form groups of two to four students and assign one of the three options listed previously to each group. Each group must perform the following requirements:

1. Increase the sales price for each raft by 10 percent, which will cause a 5 percent drop in sales volume. Although sales volume will drop 5 percent, the group believes the increased sales price will more than offset the drop in rafts sold.
2. Decrease the sales price for each raft by 10 percent, which will cause an 8 percent increase in sales volume. Although the sales price will drop by 10 percent, the group believes an increase in rafts sold will more than offset the sales price reduction.
3. Increase advertising costs by $200,000, which will increase sales volume by 15 percent. Although fixed selling and administrative costs will increase by $200,000, the group believes the increase in rafts sold will more than offset the increase in advertising costs.
4. Calculate the projected operating profit (loss) for the option assigned, and determine whether the option is acceptable.
5. Discuss and document the advantages and disadvantages of the option assigned.
6. As a class, discuss each option based on the findings of your group.

41. Sensitivity Analysis Using Excel. Refer to the information for Performance Sports in Skill-Building Case 60. Prepare an Excel spreadsheet to calculate the operating profit (loss) for the base case and for each of the three scenarios presented in the case. Using the spreadsheet in the *Computer Application* box in this chapter as a guide, include “data entry” and “sensitivity analysis results” sections, and combine variable cost of goods sold and selling and administrative costs on one line and fixed cost of goods sold and selling and administrative costs on another line.

42. Ethics: Increasing Production to Boost Profit. Hauser Company produces heavy machinery used for snow removal. Over half of the production costs incurred by Hauser are related to fixed manufacturing overhead. Although the company has maximum production capacity of 20,000 units per year, only 2,000 units were produced and sold during year 1, yielding $25 million in operating losses. As required by U.S. GAAP, the company uses absorption costing.

At the beginning of year 2, the board of directors fired the president of the company and began searching for a new president who was willing to make substantial changes to get the company turned around. One candidate, Paul Glezner, indicated he could turn the company around within a year. He felt the company was producing too few products, and could benefit from increased production. The members of the board of directors were impressed and considered Paul’s contract demands: $10,000 in base annual salary, plus 30 percent of operating profit. Paul made it clear he would help the company for year 2, but intended to move on after the year ended.

Management of Hauser Company approached you with Paul's offer and asked you to determine whether the offer is reasonable.

Required:

1. Assume the company's sales will remain close to 2,000 units in year 2. How does Paul intend to "turn the company around" during year 2?
2. Why do you think Paul insists on leaving the company after year 2?
3. What type of costing system would you recommend Hauser Company use during year 2? Explain.

Comprehensive Case

43. CVP and Sensitivity Analysis for a Brewpub. As described in "Business in Action 3.2", three entrepreneurs were looking for private investors and financial institutions to fund a new brewpub near Sacramento, California. This brewpub was to be called Roseville Brewing Company (RBC).

Brewpubs provide two products to customers: food from the restaurant segment, and freshly brewed beer from the beer production segment. Both segments are typically in the same building, which allows customers to see the beer brewing process.

After months of research, the three entrepreneurs created a financial model that showed the following projections for the first year of operations:

Sales		
Beer sales	$ 781,200	
Food sales	1,074,150	
Other sales	97,650	
Total sales		$1,953,000
Cost of sales		525,358
Gross margin		$1,427,642
Marketing and administrative expenses		1,125,430
Operating profit		$ 302,212

In the process of pursuing capital (cash) through private investors and financial institutions, they were asked several questions. The following is a sample of the questions most commonly asked:

It became clear that the initial financial model was not adequate for answering these questions. After further research, the entrepreneurs created another financial model that provided the following information for the first year of operations. (Notice that operating profit of $302,212 is the same as in the first model.)

Sales		
Beer sales (40% of total sales)	$ 781,200	
Food sales (55% of total sales)	1,074,150	
Other sales (5% of total sales)	97,650	
Total sales		$1,953,000
Variable costs		
Cost of sales		
Beer (15% of beer sales)	$117,180	
Food (35% of food sales)	375,953	
Other (33% of other sales)	32,225	
Wages of employees (25% of sales)	488,250	
Supplies (1% of sales)	19,530	
Utilities (3% of sales)	58,590	
Other: credit card and miscellaneous (2% of sales)	39,060	
Total variable costs		1,130,788
Contribution margin		$ 822,212
Fixed costs		
Salaries: manager, chef, brewer, and so on	$140,000	
Equipment and building maintenance	30,000	
Advertising	20,000	
Other: cleaning, menus, and miscellaneous	40,000	
Insurance and accounting	40,000	
Property taxes	24,000	
Depreciation	94,000	
Debt service (interest on debt)	132,000	
Total fixed costs		520,000
Operating profit		$ 302,212

Required:

Round your answers to the nearest hundredth of a percent and nearest dollar where appropriate. (An example for percentage calculations is 0.434532 = 0.4345 = 43.45 percent; an example for dollar calculations is $378.9787 = $379.)

- What is the break-even point?
- What sales dollars will be required to make $200,000? To make $500,000?
- Is the product mix reasonable? (Beer tends to have a higher contribution margin ratio than food, and therefore product mix assumptions are critical to profit projections.)
- What happens to operating profit if the product mix shifts?
- How will changes in price affect operating profit?
- How much does a pint of beer cost to produce?

1. What were potential investors and financial institutions concerned about when asking the questions listed previously?

2. Why was the first financial model inappropriate for answering most of the questions asked by investors and bankers? Be specific.
3. Suppose you are deciding whether to invest in RBC. Which financial ratio would you use to check the reasonableness of RBC's projected operating profit as compared with that of similar businesses?
4. Why is it difficult to answer the question "How much does a pint of beer cost to produce?" Which costs would you include in answering this question?
5. Perform CVP analysis by answering the following questions:
    1. What is the break-even point in sales dollars for RBC?
    2. What is the margin of safety in sales dollars for RBC?
    3. Why is it not possible for RBC to find the break-even point in units?
    4. What sales dollars would be required to achieve an operating profit of $200,000 and of $500,000? What assumptions are made in these calculations?
6. Assume total revenue remains the same, but the product mix changes so that each of the three revenue categories is weighted as follows: food 70 percent, beer 25 percent, other 5 percent. Prepare a contribution margin income statement to reflect these changes. How will this shift in product mix affect operating profit?
7. Although the financial model is important, what other strategic factors should RBC and its investors consider?

Previous Chapter

Table of Contents

Next Chapter

3: How Is Cost-Volume-Profit Analysis Used for Decision Making? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

Chapter 4 How Are Relevant Revenues and Costs Used to Make Decisions?

Bob Lee is president of Best Boards, Inc., a manufacturer of wakeboards. In the face of stiff competition, Best Boards' profits have declined steadily over the past few years. Bob is concerned about the decline in profits and has instructed Jim Muller, the vice president of operations, to do whatever it takes to reduce costs. In fact, Bob offered to pay Jim a bonus equal to 25 percent of any production cost savings the company achieves during the coming year.

Jim Muller thinks he has a way to cut costs and earn his bonus, and he approaches Bob Lee and Amy Eckstrom, the company's accountant, to discuss his plan:

Jim:
Bob and Amy, I hope you've had a chance to review my proposal to outsource production. I think it could save the company thousands of dollars this coming year.

Bob:
I did review your proposal. Give me a quick summary of what you have in mind.

Jim:
Our staff accountants tell me that the average unit product cost for our wakeboards is about $110, and we make 10,000 wakeboards each year.

Amy:
Sounds about right.

Jim:
My thought is that we could save substantial amounts of money by having an outside supplier make our wakeboards rather than doing it ourselves. I contacted one reputable wakeboard manufacturer interested in producing the boards for us.

Bob:
What did you find?

Jim:
They told me the wakeboards could be purchased from them for $70 a board. This amounts to $40 in savings per unit, and $400,000 in total savings! Even after my 25 percent bonus of $100,000, Best Boards would save $300,000.

Amy:
Jim has an interesting idea, but there are some issues that should be considered. Jim, you are correct in stating the average unit product cost for our wakeboards is $110 given production of 10,000 units per year. However, it is not accurate to assume we will eliminate $1,100,000, which is $110 per unit cost times 10,000 units, in total production costs by outsourcing production. The average unit cost includes factory equipment lease payments, along with supervisors' salaries, and factory rent. These costs don't go away quickly if we stop production. The equipment lease is for several years, we are locked into a long-term lease for the factory building, and we would have to look at our supervisors' contracts before letting them go.

Bob:
Can we get a better idea of which costs would be eliminated by outsourcing production, and which costs would remain?

Amy:
Sure. I'll get a team working on this right away.

Best Boards is facing a decision common to many organizations: whether to build its own product or to have another company build the product. We will come back to this scenario after describing how companies facing such decisions can use *differential*

analysis to make wise business decisions.

4.1 Using Differential Analysis to Make Decisions

Learning Objective

1. Describe the format used for differential analysis.

Differential revenues and costs (also called *relevant revenues and costs* or *incremental revenues and costs*) represent the difference in revenues and costs among alternative courses of action. Analyzing this difference is called differential analysis (or *incremental analysis*). We begin with a relatively simple example to establish the format used to perform differential analysis and present more complicated examples later in the chapter. As you work through this example, notice that we also use the contribution margin income statement format presented in Chapter 2 "How Do Organizations Identify Cost Behavior Patterns?" and Chapter 3 "How Is Cost-Volume-Profit Analysis Used for Decision Making?".

Question: Assume Phillips Accountancy provides bookkeeping, tax, and audit services to its clients. Management believes Phillips Accountancy has several unprofitable customers and would like to perform differential analysis to find out how profits would change if Phillips dropped these customers. Alternative 1 includes the annual revenues, costs, and resulting profit if the company keeps all existing customers. Alternative 2 includes the annual revenues, costs, and resulting profit if the company drops what it believes are unprofitable customers. How should management decide whether to keep all existing customers or drop certain customers?

Answer: Figure 4.1 "Differential Analysis for Phillips Accountancy" presents the format used by management to perform differential analysis. In this case, differential analysis is used to evaluate whether Phillips Accounting should keep all customers or drop unprofitable customers. The information in Figure 4.1 "Differential Analysis for Phillips Accountancy" confirms that Phillips Accountancy would be better off dropping the unprofitable customers (Alternative 2), because company profits would increase by $20,000. The general rule is to select the alternative with the highest differential profit. Take a close look at Figure 4.1 "Differential Analysis for Phillips Accountancy" before reading the description of this information that follows.

Figure 4.1 Differential Analysis for Phillips Accountancy

	Alternative 1 (Keep All Customers)		Alternative 2 (Drop Unprofitable Customers)		Differential Amount	*Alternative 1 Is*
Sales revenue	$7,000,000	–	$6,000,000	=	$1,000,000	Higher
Variable costs	5,250,000	–	4,500,000	=	750,000	Higher
Contribution margin	$1,750,000	–	$1,500,000	=	$ 250,000	Higher
Fixed costs	450,000	–	180,000	=	270,000	Higher
Profit	$1,300,000	–	$1,320,000	=	$ (20,000)	Lower

Notice that in Figure 4.1 "Differential Analysis for Phillips Accountancy" the columns labeled *Alternative 1* and *Alternative 2* show revenues, costs, and profit for each alternative. The third column, labeled *Differential Amount*, presents the differential revenues and costs and resulting differential profit. Positive amounts appearing in this column indicate Alternative 1 is higher than Alternative 2. Negative amounts appearing in the *Differential Amount* column indicate Alternative 1 is lower than Alternative 2. The fourth column shows whether Alternative 1 is higher or lower than Alternative 2 for each line item.

For example, the differential amount of $1,000,000 for revenue indicates Alternative 1 produces $1,000,000 more in revenue than Alternative 2. The differential amount of $750,000 for variable costs indicates variable costs are $750,000 higher for Alternative 1 than for Alternative 2. Move to the bottom of Figure 4.1 "Differential Analysis for Phillips Accountancy". Notice that the differential amount for profit is negative ($20,000). This indicates that Alternative 1 results in profits that are $20,000 lower than Alternative 2. Thus Alternative 2 (dropping unprofitable customers) is the desirable course of action.

Notice that the columns labeled *Alternative 1* and *Alternative 2* show information in summary form (i.e., no detail is provided for revenues, variable costs, or fixed costs). Some managers may want only this type of summary information, whereas others may prefer more detailed information. It is important to be flexible with the format, to best meet the needs of managers. We will build upon the differential analysis format shown in Figure 4.1 "Differential Analysis for Phillips Accountancy" throughout this chapter, and show how more detail can easily be provided using the same format.

Next, this chapter focuses on how we use differential analysis to assist in making the following types of decisions:

- Make or buy products
- Keep or drop product lines
- Keep or drop customers
- Accept or reject special customer orders

Key Takeaways

- Differential revenues and costs represent the difference in revenues and costs among alternative courses of action. Analyzing this difference is called differential analysis. Differential analysis is useful in making managerial decisions related to making or buying products, keeping or dropping product lines, keeping or dropping customers, and accepting or rejecting special customer orders.

Check Yourself

Coffee Express is a small coffee shop looking to expand its product offerings beyond coffee. The company is evaluating two alternatives—sandwiches and cookies. Annual projections for sales of sandwiches are as follows: sales, $18,000; variable costs, $13,000; and fixed costs, $500. Annual projections for sales of cookies are as follows: sales, $10,000; variable costs, $3,000; and no additional fixed costs.

Using the format in Figure 4.1 "Differential Analysis for Phillips Accountancy", perform differential analysis to determine which alternative is more profitable, and by how much. Assume adding sandwiches is Alternative 1 and adding cookies is Alternative 2.

Solution

As shown in the differential analysis given, selling cookies is the most profitable alternative. Selling cookies results in profits of $7,000 for the year, which is $2,500 higher than the sandwich alternative. However it could be argued that both should be added and that would increase profit by 11,500. But if the choice needs to be made between one or the other then lining up the alternatives side by side to see the differences would be appropriate.

	Alternative 1 (add sandwiches)		Alternative 2 (add cookies)		Differential Amount	*Alternative 1 Is*
Sales revenue	$18,000	−	$10,000	=	$ 8,000	Higher
Variable costs	13,000	−	3,000	=	10,000	Higher
Contribution margin	$ 5,000	−	$ 7,000	=	$(2,000)	Lower
Fixed costs	500	−	0	=	500	Higher
Profit	$ 4,500	−	$ 7,000	=	$(2,500)	Lower

4.2 Make-or-Buy Decisions

Learning Objective

1. Use differential analysis for make-or-buy decisions.

Question: With the differential analysis format in hand, we can now go back to Best Boards, Inc., introduced at the beginning of the chapter. Recall that Best Boards produces each wakeboard for $110, and Jim Muller, vice president of operations, received a bid for $70 per board from an outside manufacturer. Best Boards' president asked the company's accountant, Amy Eckstrom, to investigate whether it makes sense for Best Boards to hire an outside company to produce the wakeboards. What information should Amy provide that will help management make this decision?

Answer: Table 4.1 "Make-or-Buy Decision" presents the costs that the vice president of operations at Best Boards must evaluate in deciding whether to make the wakeboards or buy them from an outside company. This is called a *make-or-buy* decision because the company must decide whether to *make* the product internally or *buy* the product from an outside firm (often called *outsourcing*).

Table 4.1 Make-or-Buy Decision

	Costs to Make Wakeboard	Costs to Buy Wakeboard
Variable production costs	Direct materials	Wakeboards from supplier
	Direct labor	
	Manufacturing overhead	
Fixed production costs	Factory equipment lease	Factory equipment lease
	Factory building rent	Factory building rent
	Supervisor salaries	Supervisor salaries

Determining Differential Product Costs

Question: What information did Amy find to help Best Boards with the decision whether to make their own wakeboards or buy them from an outside supplier?

Answer: After further research, Amy identified the following product costs associated with wakeboard production at Best Boards:

	Per Unit	Total Annual Cost at 10,000 Units
Variable production costs		
Direct materials	$30	$ 300,000
Direct labor	16	160,000
Manufacturing overhead	10	100,000
Fixed production costs		
Factory equipment lease		110,000
Factory building rent		290,000
Production supervisors' salaries		140,000
Total production costs		$1,100,000

Since Best Boards produces 10,000 wakeboards each year, the product cost per unit is $110 (= $1,100,000 ÷ 10,000 units). However, Amy must identify which of the costs listed previously are *differential* costs if the company acquires the wakeboards from an outside producer. That is, Amy must determine which costs will change and which will remain the same. Here's what she found:

- All variable production costs will be eliminated if Best Boards buys the wakeboards rather than making them. These are differential costs.
- The factory equipment lease will continue for several years whether Best Boards makes or buys the wakeboards. This is *not* a differential cost.
- The factory building lease covers several years, so this cost will continue whether Best Boards makes or buys the wakeboards. This is *not* a differential cost.
- One of Best Boards' two production supervisors was hired recently, is paid $50,000 per year, and can be let go if needed. This is a differential cost.
- The other of Best Boards' two production supervisors has been with the company for several years, is paid $90,000 per year, and has five years remaining on her contract. This is *not* a differential cost.

Question: Amy must now prepare a differential analysis to determine which alternative is best for the company. Her analysis appears in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Because the focus of make-or-buy decisions is on product costs, and because sales revenue is not differential to this decision, it is not necessary to include sales revenue in the analysis. This in turn eliminates the need to show the contribution margin or net income. (Even if sales revenue were included, the outcome would remain the same.) What does Amy's analysis tell us?

Figure 4.2 Make-or-Buy Differential Analysis for Best Boards, Inc.

	Alternative 1 (Make Internally)		Alternative 2 (Buy from Outside)		Differential Amount	*Alternative 1 Is*
Variable costs						
Cost to buy from outside	$ 00		$ 700,000 [a]	=	$(700,000)	Lower
Direct materials	300,000	–	0	=	300,000	Higher
Direct labor	160,000	–	0	=	160,000	Higher
Manufacturing overhead	100,000	–	0	=	100,000	Higher
Fixed costs						
Factory equipment lease	110,000	–	110,000	=	0	
Factory building rent	290,000	–	290,000	=	0	
Production supervisors' salaries	140,000	–	90,000 [b]	=	50,000	Higher
Total production costs	$1,100,000	–	$1,190,000	=	$ (90,000)	Lower

[a] $700,000 = $70 per unit × 10,000 units.

[b] One supervisor must be paid $90,000 per year even if the company buys the product. The other supervisor, who is paid $50,000 per year, can be let go if the company buys the product.

Answer: Realizing that the information shown in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." does not provide the savings initially hoped for, Amy presents the unfavorable analysis to Jim Muller and the company's president, Bob Lee.

Bob:
Hi, Amy, what have you got for us?

Amy:
As you can see from my analysis, outsourcing the production of our wakeboards does not reduce overall production costs.

Jim:
How can that be? I got a bid from an outside supplier for $70 per board, and our cost to produce the very same board is $110.

Amy:
As I mentioned before, the $110 includes costs that do not go away if we outsource production. Let's look at my analysis. Alternative 1 represents the production costs we incur to make the board ourselves, and Alternative 2 represents the costs we incur if we buy the board from an outside supplier using Jim's quote of $70 each.

Jim:
Well, this certainly explains where the $110 product cost per board comes from if we produce the boards ourselves. I see the total cost of $1,100,000. Divide this by 10,000 units produced annually, and the resulting cost per unit is $110.

Amy:
Exactly! Now let's look at Alternative 2 more carefully. Although we eliminate all variable product costs such as direct materials and direct labor by outsourcing production, several fixed product costs remain. We still must lease the factory equipment at a rate of $110,000 per year, and the factory building lease of $290,000 per year is in effect for several more years. Also, one of our factory supervisors has a long-term contract for $90,000 per year and cannot be let go any time soon. None of these costs can be eliminated if we outsource production. Add these costs to the $700,000 cost incurred to purchase the boards from a supplier, and the total cost of $1,190,000 is $90,000 higher than if we produce the boards ourselves.

Bob:
Perhaps we should consider outsourcing in a few years as these long-term commitments expire. Jim, I commend you for your creative approach to reducing costs, but the numbers don't make it feasible for us to discontinue production and buy the products elsewhere.

Using a Summary Format for Differential Analysis

Question: The Differential Amount column presented in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." indicates Best Boards would be better off producing wakeboards internally. However, management may want a more concise explanation of why production costs are $90,000 higher when outsourcing production. How can we present this information in a more concise format?

Answer: We show a more concise presentation in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.", which includes the *Differential Amount* column shown in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." along with a brief description for each item. Look closely at Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." to confirm that the *Differential Amount* column matches Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.", and review the explanation of the difference for each line item. As you compare these two figures, notice that only differential costs are presented in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.", and therefore costs for the factory equipment lease, factory building rent, and a portion of supervisor salaries are excluded from Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.". That is, costs that do *not* differ from one alternative to another are excluded from the summary differential analysis since this information is irrelevant to the decision. The amounts in parentheses in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc." indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 4.3 Summary of Differential Analysis for Best Boards, Inc.

Result of Outsourcing Production of Wakeboards	
Cost increase to buy from outside	$(700,000)
Direct materials cost savings	300,000
Direct labor cost savings	160,000
Manufacturing overhead cost savings	100,000
Supervisor salaries cost savings	50,000
Cost increase from outsourcing	$ (90,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

The analysis shown in Figure 4.3 “Summary of Differential Analysis for Best Boards, Inc.” is particularly useful if *all* costs are not easily identified, and differential costs can be determined. After all, the goal of differential analysis is to analyze the costs that differ from one alternative to the next.

We often use the term avoidable cost to describe a cost that can be avoided, or eliminated, if one alternative is chosen over another. If Best Boards chooses to buy the product from an outside producer, the company avoids such costs as direct materials, direct labor, manufacturing overhead, and the salary of one supervisor. In this context, *avoidable cost* is the same as *differential cost*.

Key Takeaways

- Differential analysis requires the identification of all revenues and costs that differ from one alternative to another. In general, managers select the alternative with the highest profit. If the only differences between the alternatives are with costs (as in the make-or-buy decision for Best Boards), decision makers would select the alternative with the lowest cost.

Check Yourself

Quality Bikes, Inc., currently produces racing bikes. Management is interested in outsourcing production of these bikes to a reputable manufacturing company that can supply the bikes for $600 per unit. Quality Bikes incurs the following annual production costs to produce 2,000 racing bikes internally:

	Per Unit	Total Annual Cost at 2,000 Units
Variable production costs		
Direct materials	$400	$ 800,000
Direct labor	100	200,000
Manufacturing overhead	50	100,000
Fixed production costs		
Factory building and equipment lease		
Factory insurance		180,000
Production supervisors' salary		60,000
Total production costs		70,000
		$1,410,000

Outsourcing production eliminates all variable production costs, the production supervisor's salary, and factory insurance costs. Factory building and equipment lease costs will remain the same regardless of the decision to outsource or to produce internally.

1. Perform differential analysis using the format presented in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the bike internally is Alternative 1, and buying the bike from an outside manufacturer is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of outsourcing production using the format presented in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.".

Solution

	Alternative 1 (make internally)		Alternative 2 (buy from outside)		Differential Amount	*Alternative 1 Is*
Variable costs						
Cost to buy from outside	$ 0		$1,200,000[a]	=	$(1,200,000)	Lower
Direct materials	800,000	–	0	=	800,000	Higher
Direct labor	200,000	–	0	=	200,000	Higher
Manufacturing overhead	100,000	–	0	=	100,000	Higher
Fixed costs						
Factory and equipment lease	180,000	–	180,000	=	0	
Factory insurance	60,000	–	0	=	60,000	Higher
Supervisors' salary	70,000	–	0	=	70,000	Higher
Total production costs	$1,410,000	–	$ 1,380,000	=	$ 30,000	Higher

1.

*$1,200,000 = $600 per unit × 2,000 units.

2. Buying the bikes from an outside supplier is the best alternative. This alternative results in total costs of $1,380,000, providing $30,000 in savings compared to the $1,410,000 cost of producing bikes internally.

Result of Outsourcing Production of Racing Bikes	
Cost increase to buy from outside	$(1,200,000)
Direct materials cost savings	800,000
Direct labor cost savings	200,000
Manufacturing overhead cost savings	100,000
Factory insurance cost savings	60,000
Supervisor's salary cost savings	70,000
Cost savings from outsourcing	$ 30,000

3.

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

4.3 Product Line Decisions

Learning Objective

1. Use differential analysis for product line decisions.

Question: As competitors enter the market and as products go through life cycles, managers often must decide whether to keep or drop product lines. A product line *is a group of related products. The Home Depot, Inc. , has many different product lines such as appliances, flooring, and paint products. Ford Motor Co. produces a variety of products such as compact cars, trucks, and tractors. Companies must continually assess whether they should add new product lines, and whether they should discontinue current product lines. Differential analysis provides a format for these types of decisions. How would differential analysis be used to make a product line decision?*

Answer: Let's look at an example of a product line decision. Assume Barbeque Company has three product lines: gas barbecues, charcoal barbecues, and barbecue accessories. Charcoal barbecue sales have declined in recent years, leading management to question whether this product line is worth keeping. Barbeque Company would like to consider two alternatives. Alternative 1 is to retain all three product lines, and Alternative 2 is to eliminate the charcoal barbecues product line. Figure 4.4 "Product Line Decision" shows the decision facing the manager at Barbeque Company: whether to eliminate or keep the charcoal barbecue product line.

Figure 4.4 Product Line Decision

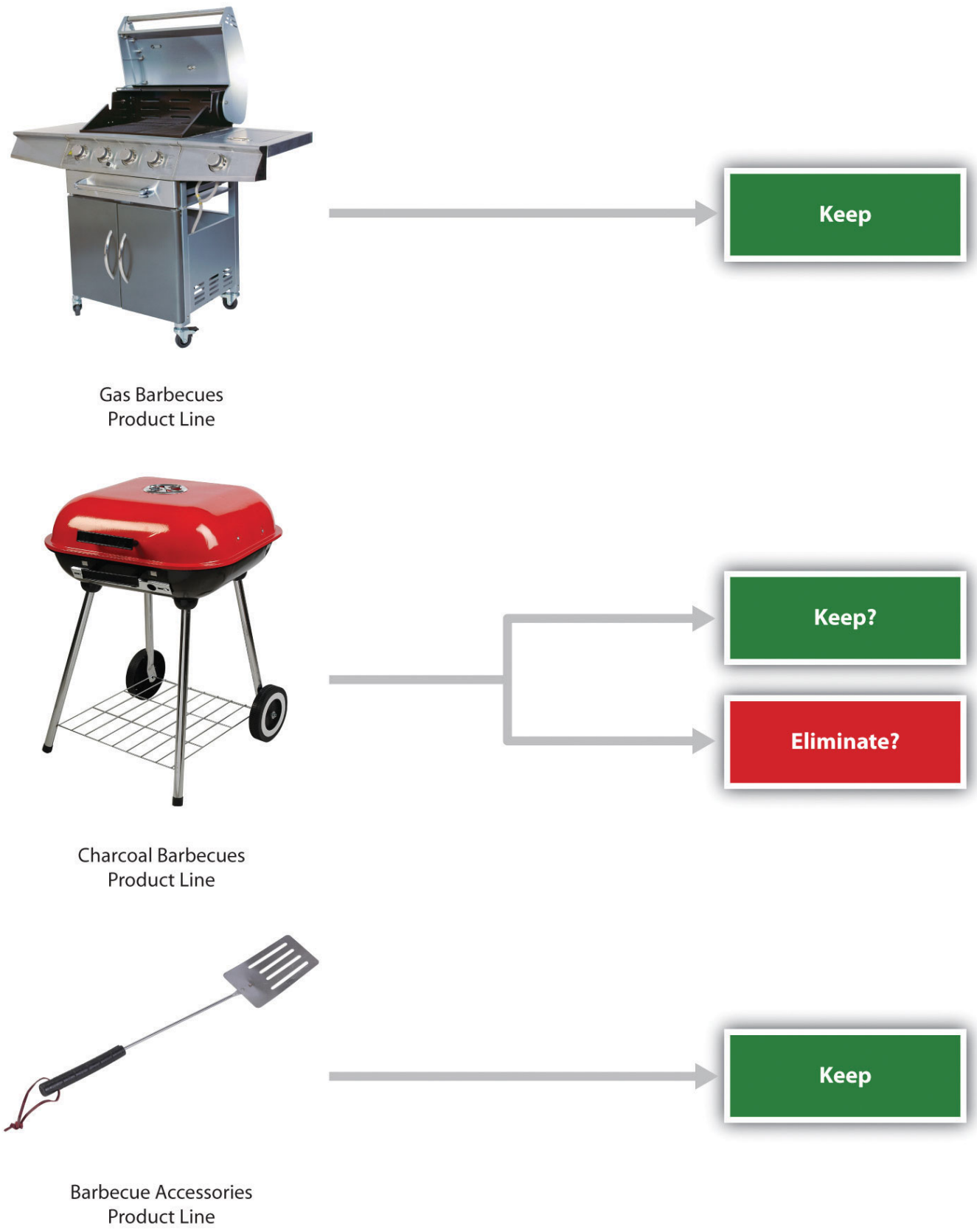


Figure 4.5 “Income Statement for Barbeque Company” presents the income statement for the past year, separated by product line (this is often referred to as a *segmented income statement*). Carefully examine Figure 4.5 “Income Statement for Barbeque

Company". Notice that the charcoal barbecues product line shows a loss of $8,000 for the year. This is the reason management would like to consider dropping this product line.

Figure 4.5 Income Statement for Barbeque Company

	Product Lines			
	Gas Barbecues	Charcoal Barbecues	Barbecue Accessories	Total
Sales revenue	$450,000	$ 90,000	$60,000	$600,000
Variable costs[a]	110,000	40,000	15,000	165,000
Contribution margin	$340,000	$ 50,000	$45,000	$435,000
Direct fixed costs	60,000	40,000	16,000	116,000
Allocated fixed costs	90,000	18,000	12,000	120,000
Profit (loss)	$190,000	$ (8,000)	$17,000	$199,000

*Includes cost of goods sold and other variable costs.

The variable costs in Figure 4.5 "Income Statement for Barbeque Company" are related directly to each product line, and thus are eliminated if the product line is eliminated. That is, all variable costs are differential costs for the two alternatives facing Barbeque Company.

Question: Notice that two lines appear for fixed costs: direct fixed costs and allocated fixed costs. What is the difference between direct fixed costs and allocated fixed costs?

Answer: Direct fixed costs are fixed costs that can be traced directly to a product line. Direct fixed costs are often differential costs. For example, the salary of the manager responsible for charcoal barbecues is easily traced to the charcoal barbecues product line. If this product line is eliminated, the product line manager's salary is also eliminated (unless the product line manager has a long-term employment contract).

Allocated fixed costs (also called *common fixed costs*) are fixed costs that *cannot* be traced directly to a product line, and therefore are assigned to product lines using an allocation process. Allocated fixed costs are typically *not* differential costs. For example, rent paid for Barbeque Company's retail store is allocated to all three product lines because it is not easily traced to each product line. However, the retail store rent likely will not decrease if the charcoal barbecues product line is eliminated (unless the company chooses to move to a smaller, less costly store). The charcoal barbecues' allocation for rent would simply be reallocated to the other two products. Thus rent for the retail store is an example of an allocated fixed cost that is *not* a differential cost for the two alternatives facing Barbeque Company.

Question: How are Barbeque Company's allocated fixed costs assigned to individual product lines?

Answer: Barbeque Company's total allocated fixed costs of $120,000 are allocated based on sales. Sales revenue for gas barbecues totals $450,000, which is 75 percent of total company sales (= $450,000 ÷ $600,000). Thus 75 percent of all allocated fixed costs are assigned to the gas barbecues product line. This amounts to $90,000 (= $120,000 × 0.75).

Question: Will dropping the charcoal barbecues product line result in higher company profit?

Answer: The differential analysis presented in Figure 4.6 "Product Line Differential Analysis for Barbeque Company" provides the answer. Panel A shows the income statement for Alternative 1: keeping all three product lines. Panel B shows the income statement for Alternative 2: dropping the charcoal barbecues product line. And panel C presents the differential analysis for the two

alternatives. The differential analysis in panel C shows that overall profit will *decrease* by $10,000 if the charcoal barbecue product line is dropped.

Figure 4.6 Product Line Differential Analysis for Barbeque Company

Panel A: Alternative 1 (keep all product lines)

	Gas Barbecues	Charcoal Barbecues	Barbecue Accessories	Total
Sales revenue	$450,000	$90,000	$60,000	$600,000
Variable costs	110,000	40,000	15,000	165,000
Contribution margin	$340,000	$50,000	$45,000	$435,000
Direct fixed costs	60,000	40,000	16,000	116,000
Allocated fixed costs	90,000	18,000	12,000	120,000
Profit (loss)	$190,000	$(8,000)	$17,000	$199,000

Panel B: Alternative 2 (drop the charcoal barbecues line)

	Gas Barbecues	Barbecue Accessories		Total
Sales revenue	$450,000	$60,000		$510,000
Variable costs	110,000	15,000		125,000
Contribution margin	$340,000	$45,000		$385,000
Direct fixed costs	60,000	16,000		76,000
Allocated fixed costs	105,882[a]	14,118[b]		120,000
Profit	$174,118	$14,882		$189,000

Panel C: Differential Analysis

	Alternative 1 Total (keep all product lines; panel A)	Alternative 2 Total (drop charcoal barbecues; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$600,000	$510,000	$90,000	Higher
Variable costs	165,000	125,000	40,000	Higher
Contribution margin	$435,000	$385,000	$50,000	Higher
Direct fixed costs	116,000	76,000	40,000	Higher
Allocated fixed costs	120,000	120,000	0	
Profit	$199,000	$189,000	$10,000	Higher

[a] $105,882 = ($450,000 ÷ $510,000) × $120,000.

[b] $14,118 = ($60,000 ÷ $510,000) × $120,000.

The *Differential Amount* column in panel C of Figure 4.6 “Product Line Differential Analysis for Barbeque Company” indicates the company would be better off continuing with all three product lines. However, management may want a more concise explanation of why profit is $10,000 higher when all three product lines are maintained. We provide such an explanation in Figure 4.7 “Summary of Differential Analysis for Barbeque Company”, which presents the *Differential Amount* column shown in panel C of

Figure 4.6 “Product Line Differential Analysis for Barbeque Company” along with a brief description for each item. Take a close look at panel C of Figure 4.6 “Product Line Differential Analysis for Barbeque Company”, confirm that the *Differential Amount* column matches Figure 4.7 “Summary of Differential Analysis for Barbeque Company”, and review the explanation of the difference.

Figure 4.7 Summary of Differential Analysis for Barbeque Company

Result of Dropping Charcoal Barbecues	
Sales revenue lost	$(90,000)
Variable costs eliminated	40,000
Contribution margin eliminated	$(50,000)
Direct fixed costs eliminated	40,000
Loss from dropping product line	$(10,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 4.7 “Summary of Differential Analysis for Barbeque Company” shows that Barbeque Company will lose sales revenue of $90,000 if it drops the charcoal barbecues product line. However, it saves variable costs of $40,000 and direct fixed costs of $40,000 if it drops the charcoal barbecues product line. Because the $80,000 in cost savings is not enough to make up for the $90,000 loss in sales revenue, profit will decline by $10,000 (= $80,000 − $90,000).

Misleading Allocation of Fixed Costs

Question: How can the charcoal barbecues product line show a loss of $8,000 in Figure 4.6 “Product Line Differential Analysis for Barbeque Company”, while the company as a whole is better off keeping this product line?

Answer: The answer lies within allocated fixed costs. Even though total allocated fixed costs of $120,000 cannot easily be traced to each product line, company management wants each product line manager to be aware of these costs. As a result, it uses an allocation process to assign the costs to product lines. Thus the charcoal barbecues product line is assigned $18,000 in allocated fixed costs even though these costs cannot be controlled by the product line. If the charcoal barbecues product line is eliminated, $18,000 in allocated fixed costs is not eliminated. Instead, $18,000 in costs is assigned to the other two product lines.

In many situations, this increased allocation to other product lines may cause other product lines to appear unprofitable. The message here is to be careful when analyzing segmented information containing cost allocations. Allocated costs are typically not differential costs, and therefore are typically not relevant to the decision.

An alternative view of the decision facing Barbeque Company—whether to keep or drop the charcoal barbecues product line—is simply to calculate profitability of this product line *before* deducting allocated fixed costs. Figure 4.6 “Product Line Differential Analysis for Barbeque Company” shows a contribution margin of $50,000 for charcoal barbecues. Deduct direct fixed costs of $40,000 and this product line has a remaining profit of $10,000. This explains why Barbeque Company’s overall profit would be $10,000 lower if the charcoal barbecues product line were eliminated. (As discussed previously, the allocated fixed costs are irrelevant to this decision.)

Including Opportunity Costs in Differential Analysis

Managers must often consider the impact of opportunity costs when making decisions. An opportunity cost For example, assume you have the choice between going to school and working. The opportunity cost of attending school is the lost wages from working.

Question: In the case of Barbeque Company, assume the company can lease the space currently being used by the charcoal barbecues product line for $25,000 per year. Thus the opportunity cost (benefit foregone) of keeping the charcoal barbecues is $25,000. How does this affect Barbeque Company's decision to keep or drop charcoal barbecues?

Answer: Figure 4.8 "Differential Analysis with Opportunity Cost for Barbeque Company" provides the answer by simply adding one item to Figure 4.7 "Summary of Differential Analysis for Barbeque Company". Barbeque Company would increase profits $15,000 by dropping the charcoal barbecues.

Figure 4.8 Differential Analysis with Opportunity Cost for Barbeque Company

Result of Dropping Charcoal Barbecues (with Opportunity Cost)	
Sales revenue lost	$(90,000)
Variable costs eliminated	40,000
Contribution margin eliminated	$(50,000)
Direct fixed costs eliminated	40,000
Loss from dropping product line	$(10,000)
Lease of space formerly used by charcoal barbecues product line	25,000
Profit from dropping product line	$ 15,000

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Opportunity costs can also be included in the differential analysis format presented in Figure 4.6 "Product Line Differential Analysis for Barbeque Company". Panel C of Figure 4.6 "Product Line Differential Analysis for Barbeque Company" is simply modified to reflect the opportunity cost, as shown.

Panel C: Differential Analysis				
	Alternative 1 Total (keep all product lines; panel A)	Alternative 2 Total (drop charcoal barbecues; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$600,000	$510,000	$90,000	Higher
Variable costs	165,000	125,000	40,000	Higher
Contribution margin	$435,000	$385,000	$50,000	Higher
Direct fixed costs	116,000	76,000	40,000	Higher
Allocated fixed costs	120,000	120,000	0	
Opportunity cost	**25,000**	**0**	**25,000**	**Higher**
Profit	$174,000	$189,000	($15,000)	Lower

Sunk Costs and Differential Analysis

Question: What is a sunk cost, and how do sunk costs affect differential analysis?

Answer: A sunk cost is a cost incurred in the past that cannot be changed by future decisions. For example, suppose Barbeque Company must dispose of store equipment related to the charcoal barbecues product line if charcoal barbecues are eliminated. The original cost of this store equipment is a sunk cost and should have no bearing on the decision whether to eliminate charcoal barbecues. As a general rule, sunk costs are not differential costs.

Key Takeaways

- Managers often use differential analysis to determine whether to keep or drop a product line. Direct fixed costs are typically eliminated if a product line is eliminated, and are considered differential costs. Allocated fixed costs are typically not eliminated if a product line is eliminated, and are not differential costs. Managers compare sales revenue and costs for each alternative (keep or drop), and select the alternative with the highest profit.

Check Yourself

The following annual income statement is for Austin Appliances, Inc., a maker of electrical appliances:

	Product Lines			
	Blenders	Coffee Makers	Toasters	Total
Sales revenue	$750,000	$1,000,000	$250,000	$2,000,000
Variable costs	320,000	550,000	100,000	970,000
Contribution margin	$430,000	$ 450,000	$150,000	$1,030,000
Direct fixed costs	390,000	320,000	70,000	780,000
Allocated fixed costs	56,250	75,000	18,750	150,000
Profit (loss)	$(16,250)	$ 55,000	$ 61,250	$ 100,000

Austin Appliances is concerned about the losses associated with the blenders product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on sales. For example, $56,250 in allocated fixed costs is allocated to the blenders product line based on the blenders product line sales as a percent of total sales [$56,250 = $150,000 × ($750,000 ÷ $2,000,000)]. If Austin Appliances eliminates a product line, total allocated fixed costs are assigned to the remaining product lines. All variable costs and direct fixed costs are differential costs.

1. Using the differential analysis format presented in Figure 4.6 “Product Line Differential Analysis for Barbeque Company”, determine whether Austin Appliances would be better off dropping the blenders product line or keeping the product line. Support your conclusion.
2. Assume Austin Appliances can lease the warehouse space currently being used by the blenders product line for $15,000 per year. How does this affect the company’s decision to keep or drop the blenders product line?
3. Summarize the result of dropping the blenders product line and leasing the warehouse space using the format presented in Figure 4.8 “Differential Analysis with Opportunity Cost for Barbeque Company”.

Solution

1. As shown in the differential analysis given here, Austin Appliances would be better off keeping the blenders product line. Dropping this product line would result in a drop in total profit of $40,000.

Alternative 1 (keep all product lines)

	Blenders	Coffee Makers	Toasters	Total
Sales revenue	$750,000	$1,000,000	$250,000	$2,000,000
Variable costs	320,000	550,000	100,000	970,000
Contribution margin	$430,000	$ 450,000	$150,000	$1,030,000
Direct fixed costs	390,000	320,000	70,000	780,000
Allocated fixed costs	56,250	75,000	18,750	150,000
Profit (loss)	$ (16,250)	$ 55,000	$ 61,250	$ 100,000

Alternative 2 (drop the blenders line)

		Coffee Makers	Toasters	Total
Sales revenue		$1,000,000	$250,000	$1,250,000
Variable costs		550,000	100,000	650,000
Contribution margin		$ 450,000	$150,000	$ 600,000
Direct fixed costs		320,000	70,000	390,000
Allocated fixed costs		120,000[a]	30,000[b]	150,000
Profit		$ 10,000	$ 50,000	$ 60,000

Differential Analysis

	Alternative 1 Total (keep all product lines)	Alternative 2 Total (drop blenders)	Differential Amount	*Alternative 1 is:*
Sales revenue	$2,000,000	$1,250,000	$750,000	Higher
Variable costs	970,000	650,000	320,000	Higher
Contribution margin	$1,030,000	$ 600,000	$430,000	Higher
Direct fixed costs	780,000	390,000	390,000	Higher
Allocated fixed costs	150,000	150,000	0	
Profit	$ 100,000	$ 60,000	$ 40,000	Higher

[a] $120,000 = ($1,000,000 ÷ $1,250,000) × $150,000.

[b] $30,000 = ($250,000 ÷ $1,250,000) × $150,000.

2. The $15,000 opportunity cost of keeping all three product lines would not affect the company's decision to keep the blenders product line. If the blenders are dropped, total profit will decrease by $40,000. Lease revenue of $15,000 is not enough to offset the $40,000 decrease in profit. In this scenario, total profit would decrease by $25,000 (= $40,000 − $15,000). This result is presented formally, as follows:

	Alternative 1 Total (keep all product lines)	Alternative 2 Total (drop blenders)	Differential Amount	*Alternative 1 Is*
Sales revenue	$2,000,000	$1,250,000	$750,000	Higher
Variable costs	970,000	650,000	320,000	Higher
Contribution margin	$1,030,000	$ 600,000	$430,000	Higher
Direct fixed costs	780,000	390,000	390,000	Higher
Allocated fixed costs	150,000	150,000	0	
Opportunity cost	15,000	0	15,000	Higher
Profit	$ 85,000	$ 60,000	$ 25,000	Higher

Result of Dropping Blenders and Leasing Warehouse

Sales revenue lost	$(750,000)
Variable costs eliminated	320,000
Contribution margin eliminated	$(430,000)
Direct fixed costs eliminated	390,000
Lease of space formerly used by blender product line	15,000
Loss from dropping product line	$ (25,000)

3.

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

4.4 Customer Decisions

Learning Objective

1. Use differential analysis to decide whether to keep or drop customers.

Question: Much like product line decisions, managers often use profitability as a determining factor to decide whether to keep or drop customers. This is an issue for all types of organizations, including manufacturers, retailers, and service companies. How does the differential analysis format differ for customer decisions compared to product line decisions?

Answer: Instead of tracing revenues, variable costs, and fixed costs directly to *product lines*, we track this information by *customer*. Fixed costs that cannot be traced directly to customers are allocated to customers. Let's look at an example for a company called Colony Landscape Maintenance to identify the similarities and differences between the two formats.

Evaluating Customer Information

Question: Colony Landscape Maintenance provides services to three large customers: Brumfield, Hodges, and Orth. The segmented income statement in Figure 4.9 "Income Statement for Colony Landscape Maintenance" provides annual revenue and cost information by customer. Notice that this information is formatted similarly to the product line information in Figure 4.8 "Differential Analysis with Opportunity Cost for Barbeque Company". However, instead of tracking information by product line, here we track information by customer. Examine Figure 4.9 "Income Statement for Colony Landscape Maintenance" carefully and notice that the Brumfield account shows a loss for the year of $15,000. Should Colony Landscape Maintenance drop the Brumfield account?

Answer: To answer this question we must take a closer look at the information in Figure 4.9 "Income Statement for Colony Landscape Maintenance". The variable costs and direct fixed costs are related directly to each customer, and thus are eliminated if Colony eliminates the Brumfield account. That is, all variable costs and direct fixed costs are differential costs for the two alternatives facing Colony. Colony assigns the allocated fixed costs of $20,000 to Brumfield based on sales revenue, and those costs will continue regardless of Colony's decision. Thus allocated fixed costs are *not* differential costs.

Figure 4.9 Income Statement for Colony Landscape Maintenance

	Customers			
	Brumfield	**Hodges**	**Orth**	**Total**
Sales revenue	$200,000	$500,000	$300,000	$1,000,000
Variable costs	170,000	380,000	200,000	750,000
Contribution margin	$ 30,000	$120,000	$100,000	$ 250,000
Direct fixed costs	25,000	40,000	30,000	95,000
Allocated fixed costs	20,000	50,000	30,000	100,000
Profit (loss)	$ (15,000)	$ 30,000	$ 40,000	$ 55,000

Management of Colony Landscape Maintenance would like to know if dropping the Brumfield account would increase overall company profit. The differential analysis presented in Figure 4.10 "Customer Differential Analysis for Colony Landscape Maintenance" provides the answer. Panel A shows the income statement for Alternative 1: keeping all three customers. Panel B shows the income statement for Alternative 2: dropping the Brumfield account. And panel C presents the differential analysis for both alternatives. The differential analysis presented in panel C shows that overall profit will decrease by $5,000 if Colony drops the Brumfield account.

Figure 4.10 Customer Differential Analysis for Colony Landscape Maintenance

Panel A: Alternative 1 (keep all customers)

	Brumfield	Hodges	Orth	Total
Sales revenue	$200,000	$500,000	$300,000	$1,000,000
Variable costs	170,000	380,000	200,000	750,000
Contribution margin	$ 30,000	$120,000	$100,000	$ 250,000
Direct fixed costs	25,000	40,000	30,000	95,000
Allocated fixed costs	20,000	50,000	30,000	100,000
Profit (loss)	$ (15,000)	$ 30,000	$ 40,000	$ 55,000

Panel B: Alternative 2 (drop Brumfield account)

		Hodges	Orth	Total
Sales revenue		$500,000	$300,000	$800,000
Variable costs		380,000	200,000	580,000
Contribution margin		$120,000	$100,000	$220,000
Direct fixed costs		40,000	30,000	70,000
Allocated fixed costs		62,500[a]	37,500[b]	100,000
Profit		$ 17,500	$ 32,500	$ 50,000

Panel C: Differential Analysis

	Alternative 1 Total (keep all customers; panel A)	Alternative 2 Total (drop Brumfield account; panel B)	Differential Amount	*Alternative 1 Is*
Sales revenue	$1,000,000	$800,000	$200,000	Higher
Variable costs	750,000	580,000	170,000	Higher
Contribution margin	$ 250,000	$220,000	$ 30,000	Higher
Direct fixed costs	95,000	70,000	25,000	Higher
Allocated fixed costs	100,000	100,000	0	
Profit	$ 55,000	$ 50,000	$ 5,000	Higher

[a] $62,500 = ($500,000 ÷ $800,000) × $100,000.

[b] $37,500 = ($300,000 ÷ $800,000) × $100,000.

We show a more concise explanation in Figure 4.11 “Summary of Differential Analysis for Colony Landscape Maintenance”, which presents the *Differential Amount* column shown in panel C of Figure 4.10 “Customer Differential Analysis for Colony Landscape Maintenance” along with a brief description of each item.

Figure 4.11 Summary of Differential Analysis for Colony Landscape Maintenance

Result of Dropping Brumfield Account	
Sales revenue lost	$(200,000)
Variable costs eliminated	170,000
Contribution margin eliminated	$ (30,000)
Direct fixed costs eliminated	25,000
Loss from dropping customer	$ (5,000)

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

An alternative way of handling the decision facing Colony Landscape Maintenance is simply to calculate profitability of the Brumfield account *before* deducting allocated fixed costs. Figure 4.11 "Summary of Differential Analysis for Colony Landscape Maintenance" shows a contribution margin of $30,000 for the Brumfield account. Deduct direct fixed costs of $25,000 and the customer has a remaining profit of $5,000. This explains why Colony's overall profit would be $5,000 lower if it eliminated the Brumfield account.

Key Takeaways

- Managers use differential analysis to determine whether to keep or drop a customer. The format is similar to the differential analysis format used for making product line decisions. However, sales revenue, variable costs, and fixed costs are traced directly to customers rather than to product lines.

Check Yourself

The following annual income statement is for Tatum & Associates, a firm that provides legal services to its customers.

	Customers			
	New Haven Company	Penryn, Inc.	Elko Corporation	Total
Sales revenue	$1,200,000	$750,000	$1,050,000	$3,000,000
Variable costs	700,000	300,000	800,000	1,800,000
Contribution margin	$ 500,000	$450,000	$ 250,000	$1,200,000
Direct fixed costs	200,000	180,000	255,000	635,000
Allocated fixed costs	120,000	75,000	105,000	300,000
Profit (loss)	$ 180,000	$195,000	$ (110,000)	$ 265,000

Tatum & Associates is concerned about the losses associated with the Elko Corporation account and is considering dropping this customer. Allocated fixed costs are assigned to customers based on sales. For example, $105,000 in allocated fixed costs is

assigned to Elko based on this customer's sales as a percent of total sales [$105,000 = $300,000 × ($1,050,000 ÷ $3,000,000)]. If a customer is dropped, total allocated fixed costs are assigned to the remaining customers. All variable costs and direct fixed costs are differential costs.

1. Using the differential analysis format presented in Figure 4.9 "Customer Differential Analysis for Colony Landscape Maintenance", determine whether Tatum & Associates would be better off dropping the Elko Corporation account or keeping the account. Explain your conclusion.
2. Summarize the result of dropping the Elko Corporation account using the differential analysis format presented in Figure 4.11 "Summary of Differential Analysis for Colony Landscape Maintenance".

Solution

1. As shown in the differential analysis provided, Tatum & Associates would be better off dropping the Elko Corporation account. Profit is $5,000 lower if the Elko account is retained.

Alternative 1 (keep all customers)

	New Haven Company	Penryn, Inc.	Elko Corporation	Total
Sales revenue	$1,200,000	$750,000	$1,050,000	$3,000,000
Variable costs	700,000	300,000	800,000	1,800,000
Contribution margin	$ 500,000	$450,000	$ 250,000	$1,200,000
Direct fixed costs	200,000	180,000	255,000	635,000
Allocated fixed costs	120,000	75,000	105,000	300,000
Profit (loss)	$ 180,000	$195,000	$ (110,000)	$ 265,000

Alternative 2 (drop Elko Corporation customer)

	New Haven Company	Penryn, Inc.		Total
Sales revenue	$1,200,000	$750,000		$1,950,000
Variable costs	700,000	300,000		1,000,000
Contribution margin	$ 500,000	$450,000		$ 950,000
Direct fixed costs	200,000	180,000		380,000
Allocated fixed costs	184,615[a]	115,385[b]		300,000
Profit	$ 115,385	$154,615		$ 270,000

Differential Analysis

	Alternative 1 Total (keep all customers)	Alternative 2 Total (drop Elko Corp.)	Differential Amount	*Alternative 1 Is*
Sales revenue	$3,000,000	$1,950,000	$1,050,000	Higher
Variable costs	1,800,000	1,000,000	800,000	Higher
Contribution margin	$1,200,000	$ 950,000	$ 250,000	Higher
Direct fixed costs	635,000	380,000	255,000	Higher
Allocated fixed costs	300,000	300,000	0	
Profit (loss)	$ 265,000	$ 270,000	$ (5,000)	Lower

[a] $184,615 rounded = ($1,200,000 ÷ $1,950,000) × $300,000.

[b] $115,385 rounded = ($750,000 ÷ $1,950,000) × $300,000.

Result of Dropping Elko Account	
Sales revenue decrease	$(1,050,000)
Variable costs decrease	800,000
Contribution margin decrease	$ (250,000)
Direct fixed costs decrease	255,000
Profit increase from dropping Elko account	$ 5,000

2.

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Note: The contribution margin of the customer (Elko) is not enough to cover the direct fixed costs for that customer.

4.5 Review of Cost Terms Used in Differential Analysis

Learning Objective

1. Understand cost terms used in differential analysis.

Question: We've introduced many new terms in this chapter. What are these important terms, and how do they relate to differential analysis?

Answer: The important terms introduced in this chapter are outlined here:

Differential analysis requires that we consider all *differential revenues and costs*—costs that differ from one alternative to another—when deciding between alternative courses of action. *Avoidable costs*—costs that can be avoided by selecting a particular course of action—are always differential costs and must be considered when deciding between alternative courses of action.

Opportunity costs—the benefits foregone when one alternative is selected over another—are differential costs, and must be included when performing differential analysis. *Sunk costs*—costs incurred in the past that cannot be changed by future decisions—are *not* differential costs because they cannot be changed by future decisions.

Direct fixed costs—fixed costs that can be traced directly to a product line or customer—are differential costs and therefore pertinent to making decisions. However, we must review these costs on a case-by-case basis because some direct fixed costs may not be considered differential in spite of being traced directly to a product line. For example, a five-year lease on a warehouse used solely for one product line is a direct fixed cost but not a differential cost because the costs will continue even if the product line is eliminated.

Allocated fixed costs—fixed costs that cannot be traced directly to a product—are typically *not* differential costs. For example, if a product line is eliminated, these costs are simply allocated to the remaining product lines.

Key Takeaways

- When deciding between alternatives, only those revenues and costs that differ from one alternative course of action to another are relevant. Avoidable costs, opportunity costs, and direct fixed costs typically fall into this category. Note that in most cases avoidable costs are also variable costs. Revenues and costs that do **not** differ from one alternative course of action to another are irrelevant to the decision.

Check Yourself

Match each of the following terms with the appropriate definition in the list given.

1. Differential analysis
2. Differential revenues and costs
3. Avoidable costs
4. Sunk costs
5. Direct fixed costs
6. Allocated fixed costs
7. Opportunity costs

a. The benefits forgone when one alternative is selected over another.

b. Fixed costs that can be traced directly to a product line.

c Revenues and costs that differ from one alternative to another.

d Costs incurred in the past that cannot be changed by future decisions.

e Costs that can be avoided by selecting a particular course of action.

f Fixed costs that cannot be traced directly to a product line.

g Analyzing the difference in revenues and costs from one alternative course of action to another.

Solution

1. g
2. c
3. e
4. d
5. b
6. f
7. a

4.6 Special Order Decisions

Learning Objective

1. Use differential analysis for special order decisions.

Question: We have already learned that managers use differential analysis for make-or-buy decisions, product line decisions, and customer decisions. Differential analysis also provides a format that helps managers decide whether to accept special orders made by customers. What is a special order, and how can differential analysis be used to make a special order decision?

Answer: A special order is a unique one-time order made by a customer almost always at a lower than normal price. Differential analysis provides a format that helps managers decide whether to accept or reject special orders, as shown in the example that follows.

Special Order Considerations

Assume Tony's T-shirts makes shirts for local soccer, baseball, basketball, and other sports teams. The owner, Tony, purchases the shirts and prints graphics on the shirts for each team. The graphics were designed several years ago, so design costs are no longer incurred. On average, Tony sells 1,000 shirts each month. Typical monthly financial data follow:

	Per Unit		Total Monthly Data at 1,000 Shirts	
Sales revenue		$20		$20,000
Variable costs				
Direct materials	$8		$8,000	
Direct labor	2		2,000	
Manufacturing overhead	3		3,000	
Total variable costs		13		13,000
Contribution margin		$ 7		$ 7,000
Fixed costs (rent, salaries, etc.)				4,000
Profit				$ 3,000

The monthly information provided relates to the company's routine monthly operations. A representative of the local high school recently approached Tony to ask about a one-time special order. The high school will be hosting a statewide track and field event and is willing to pay Tony's T-shirts $17 per shirt to make 200 custom T-shirts for the event. Because enough idle capacity exists to handle this order, it will not affect other sales. That is, Tony has the factory space and machinery available to produce more T-shirts.

Tony incurs the same variable costs of $13 per unit to produce the special order, and he will pay a firm $600 to design the graphics that will be printed on the shirts. This special order will have no other effect on Tony's monthly fixed costs.

Question: Should Tony accept the special order?

Answer: Let's use differential analysis to answer this question. As shown in Figure 4.12 "Special Order Differential Analysis for Tony's T-Shirts", Alternative 1 assumes Tony rejects the special order, and Alternative 2 assumes he accepts the special order. The differential analysis in Figure 4.12 "Special Order Differential Analysis for Tony's T-Shirts" shows that Tony's would be better off accepting the special order, as profit increases $200.

Figure 4.12 Special Order Differential Analysis for Tony's T-Shirts

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	*Alternative 1 Is*
Sales revenue	$20,000	–	$23,400[a]	=	$(3,400)	Lower
Variable costs	13,000	–	15,600[b]	=	(2,600)	Lower
Contribution margin	$ 7,000	–	$ 7,800	=	$ (800)	Lower
Fixed costs	4,000	–	4,600[c]	=	(600)	Lower
Profit	$ 3,000	–	$ 3,200	=	$ (200)	Lower

[a] $23,400 = $20,000 + ($17 per shirt × 200 shirts).

[b] $15,600 = $13,000 + ($13 × 200 shirts).

[c] $4,600 = $4,000 + $600 cost for special order design.

Figure 4.13 "Summary of Differential Analysis for Tony's T-Shirts" provides an alternative presentation of differential analysis for Tony's T-shirts. As discussed earlier in the chapter, this presentation summarizes the differential revenues and costs.

Figure 4.13 Summary of Differential Analysis for Tony's T-Shirts

Result of Accepting Special Order	
Sales revenue increase	$ 3,400
Variable costs increase	(2,600)
Contribution margin increase	$ 800
Fixed costs increase: graphics design	(600)
Profit increase from accepting special order	$ 200

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

Figure 4.13 "Summary of Differential Analysis for Tony's T-Shirts" shows the differential revenues and costs for the special order being considered. If Tony's T-shirts accepts the special order, sales revenue will increase $3,400 with a corresponding increase in variable costs of $2,600. Fixed costs will increase by $600 because design work is required for the special order. Thus profit will increase by $200 (= $3,400 − $2,600 − $600). The contribution margin for the special order must be enough to cover the change in fixed costs.

Special Order Assumptions

Question: What assumptions were made with the differential analysis performed for Tony's T-shirts?

Answer: We made two important assumptions in the Tony's T-shirts special order example. The first assumption is that Tony's has enough idle capacity to handle the order without disrupting regular customer orders. Suppose Tony's T-shirts is operating at capacity and cannot produce any more T-shirts. Tony must turn away regular customers to make room for the special order. In this scenario, the opportunity cost of turning away existing customers must be considered in the differential analysis.

The second assumption is that this is a one-time order, and therefore represents a short-run pricing decision. If Tony's T-shirts expects future orders from the high school at the $17 per shirt price, the company must consider the impact this might have on long-run pricing with other customers. That is, regular customers may hear of this special price and demand the same price, particularly those customers who have been loyal to Tony's T-shirts for many years. Tony's might be forced to lower prices for regular customers, thereby eroding the company's profits over time. The key point is that companies evaluating special orders can drop prices in the short run to cover differential variable and fixed costs. But in the long run, prices must cover all variable and fixed costs.

Computer Application

Using Excel to Perform Differential Analysis

Managers often perform differential analysis with the help of computer software for several reasons:

- Once the format is established, the template can be used repeatedly for different scenarios.
- Formulas underlie all calculations, thereby minimizing the potential for math errors and speeding up the process.
- Changes can be made easily without having to redo the entire analysis.

An example of how to use Excel to perform differential analysis for the special order scenario presented in Figure 4.12 "Special Order Differential Analysis for Tony's T-Shirts" is shown here. Although many accounting courses do not require the use of

computer spreadsheets, you are encouraged to use spreadsheet software like Excel when preparing homework or working review problems.

	A	B	C	D	E	F	G	H	I	J
1			**Alternative 1**		**Alternative 2**					
2			**(Reject Special Order)**		**(Accept Special Order)**		**Differential Amount**		***Alternative 1 Is***	
3		Sales revenue	$ 20,000	–	$ 23,400	=	$ (3,400)		Lower	
4		Variable costs	13,000	–	15,600	=	$ (2,600)		Lower	
5		Contribution margin	7,000	–	7,800	=	$ (800)		Lower	
6		Fixed costs	4,000	–	4,600	=	$ (600)		Lower	
7		Profit	$ 3,000	–	$ 3,200	=	$ (200)		Lower	
8										

Key Takeaways

- Managers often use differential analysis to decide whether to accept a special one-time order made by a customer. Managers compare sales revenue and costs for each alternative (accept or reject the special order), and select the alternative with the highest profit. Organizations must be careful to consider the long-run implications of reducing prices for special orders.

Check Yourself

The following monthly financial data are for Quicko's, a company that makes photocopies for its customers. On average, Quicko's makes 100,000 copies each month.

	Per Unit	Total Monthly Data at 100,000 Copies
Sales revenue	$0.08	$8,000
Variable costs	0.05	5,000
Contribution margin	$0.03	$3,000
Fixed costs		2,000
Profit		$1,000

Quicko's is approached by a local restaurant that would like to have 20,000 flyers copied. The restaurant asks Quicko's to produce the flyers for 7 cents a copy rather than the standard price of 8 cents. Quicko's can produce up to 130,000 copies a month, so the special order will not affect regular customer sales. Variable costs per copy will remain at 5 cents, but production of the restaurant flyers will require a special copy machine part that costs $250. This special order will have no other effect on monthly fixed costs.

1. Using the differential analysis format presented in Figure 4.12 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Quicko's would be better off accepting or rejecting the special order.
2. Summarize the result of accepting the special order using the format presented in Figure 4.13 "Summary of Differential Analysis for Tony's T-Shirts".
3. Assume Quicko's can only produce 100,000 copies per month, and that regular customer sales would decrease as a result of the special order. Using the differential analysis format presented in Figure 4.12 "Special Order Differential Analysis for Tony's T-Shirts", determine whether Quicko's would be better off accepting or rejecting the special order.

Solution

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	Alternative 1 Is
Sales revenue	$8,000	−	$9400[a]	=	$(1,400)	Lower
Variable costs	5,000	−	6,000[b]	=	(1,000)	Lower
Contribution margin	$3,000	−	$ 3,400	=	$ (400)	Lower
Fixed costs	2,000	−	2,250[c]	=	(250)	Lower
Profit	$1,000	−	$ 1,150	=	$ (150)	Lower

1.

[a] $9,400 = $8,000 + ($0.07 per copy × 20,000 copies);or alternative approach: ($0.08 per copy × 100,000 copies) + ($0.07 per copy × 20,000 copies).

[b] $6,000 = $5,000 + ($0.05 per copy × 20,000 copies); or alternative approach: $0.05 × 120,000 copies.

[c] $2,250 = $2,000 + $250 cost for copy machine part.

This analysis shows that Quicko's would be better off accepting the special order because profit is $150 higher for Alternative 2.

Result of Accepting Special Order

Sales revenue increase	$1,400
Variable costs increase	(1,000)
Contribution margin increase	$ 400
Fixed costs increase: copy machine part	(250)
Profit increase from accepting special order	$ 150

2.

Note: Amounts shown in parentheses indicate a negative impact on profit, and amounts without parentheses indicate a positive impact on profit.

3. Assuming Quicko's has a capacity of 100,000 copies per month, the analysis shows the company would be better off rejecting the special order because profit is $450 higher for this alternative. Of course, making calculations is not really necessary. Accepting a special order with a price lower than normal when there is not excess capacity will always cause profits to drop.

	Alternative 1 (reject special order)		Alternative 2 (accept special order)		Differential Amount	Alternative 1 Is
Sales revenue	$8,000	−	$7,800[a]	=	$200	Higher
Variable costs	5,000	−	5,000[b]	=	0	
Contribution margin	$3,000	−	$ 2,800	=	$200	Higher
Fixed costs	2,000	−	2,250[c]	=	(250)	Lower
Profit	$1,000	−	$ 550	=	$450	Higher

[a] $7,800 = ($0.08 × 80,000 regular customer copies) + ($0.07 × 20,000 special order copies).

[b] $2,250 = $2,000 + $250 cost for copy machine part.

4.7 Cost-Plus Pricing and Target Costing

Learning Objective

1. Understand how to use cost-plus pricing and target costing to establish prices.

The previous section focuses on using differential analysis to assess pricing for special orders. Organizations also use other approaches to establish prices, such as *cost-plus pricing* and *target costing*. We cover these two approaches next.

Cost-Plus Pricing

Questions: Companies that produce custom products, such as homes or landscaping for commercial buildings, often have a difficult time determining a reasonable market price. Prices for these products can be determined using cost-plus pricing. How is cost-plus pricing used to arrive at a reasonable price?

Answer: Cost-plus pricing starts with an estimate of the costs incurred to build a product or provide a service, and a certain profit percentage is added to establish the price. For example, a defense contractor working with the government assumes the cost to build a new fighter jet is $60 million. As there is no open market price for this product, the contractor must come up with an approach to establishing the price that does not rely on market pricing. Based on industry-wide standards and negotiations with the government, the contractor requests a 10 percent markup on cost. If the government accepts this proposal, the contractor will receive $66 million for each plane delivered [$66 million = $60 million + ($60 million × 10 percent)].

The concept of cost-plus pricing sounds simple. However, the difficulty is in determining which costs should be included. Are only variable product costs included? Should fixed manufacturing overhead be included? What about selling costs? The answers to these questions depend on the negotiations between buyer and seller, and should be clearly defined in the agreement. When using cost-plus pricing, it is important to establish in advance which costs are to be included for pricing purposes.

Target Costing

Question: Organizations are constantly trying to find ways to become more efficient and reduce costs. However, once manufacturing firms design a product and begin production, it is difficult to make significant changes that will reduce costs. How can target costing help with this issue?

Answer: Target costing is an approach that mitigates cost efficiency problems associated with introducing new products by integrating the product design, desired price, desired profit, and desired cost into one process beginning at the product development stage. Target costing has four steps:

Step 1. Design a product that provides the features and price demanded by customers.

Step 2. Determine the company's desired profit.

Step 3. Derive the target cost by subtracting the desired profit (from step 2) from the desired price (from step 1).

Step 4. Engineer the product to achieve the target cost (from step 3). If the desired target cost cannot be achieved, the company must go back to step 1 and reevaluate the features and price.

For example, suppose **Hewlett-Packard** designs a laser printer with features that customers have requested and research shows will sell for $240; this is Step 1. Management requires a profit equal to 40 percent of the selling price, or $96 (= $240 × 40 percent); this is Step 2. The target cost is $144 (= $240 − $96); this is Step 3. The product engineers must now design this product in detail to achieve or beat the target cost of $144; this is Step 4.

Target pricing is used for products with lots of competition and easily determined price that customers will pay.

Key Takeaways

- Cost-plus pricing starts with an estimate of the costs incurred to build a product, and a certain profit percentage is added to establish the price. Companies often use this method when it is difficult to determine a reasonable market price. Target costing integrates the product design, desired price, desired profit, and desired cost into one process beginning at the product development stage.

Check Yourself

Suppose **Nike, Inc.**, has developed a new shoe that can be sold for $140 a pair. Management requires a profit equal to 60 percent of the selling price. Determine the target cost of this product.

Solution

The target cost of $56 is found by subtracting the target profit from the target selling price. This calculation is as follows.

Target selling price	$140	
Target profit	84	($140 × 60%)
Target cost	$ 56	

4.8 Identifying and Managing Bottlenecks

Learning Objective

1. Understand the theory of constraints.

Question: As we noted in Chapter 3 "How Is Cost-Volume-Profit Analysis Used for Decision Making?", many companies have limited resources in such areas as labor hours, machine hours, facilities, and materials. These constraints will likely affect a company's ability to produce goods or provide services. Companies facing constraints often use a variation of differential analysis to optimize the use of constrained resources called the theory of constraints. What are constrained resources, and how does the theory of constraints help managers make better use of these resources?

Answer: Constrained resources are often referred to as *bottlenecks*. A bottleneck is a process in which the work to be performed exceeds available capacity. The theory of constraints is a recently developed approach to managing bottlenecks.

We will look at an example to help explain how the theory of constraints works. Assume Computers, Inc., produces desktop computers using six departments. Computers are assembled in departments 1, 2, and 3 and are then sent to department 4 for quality testing. Once testing is complete, products are packaged in department 5. Department 6 is responsible for shipping the products.

Question: The theory of constraints provides five steps to help managers make efficient use of constrained resources. What are these five steps, and how will they help Computers, Inc.?

Answer: The five steps are described here, with a narrative indicating how Computers, Inc., would utilize each step.

Step 1. Find the constrained resource (bottleneck).

In this step, the process that limits production is identified. The management at Computers, Inc., has identified department 4, quality testing, as the bottleneck because assembled computers are backing up at department 4. Quality testing cannot be performed fast enough to keep up with the inflow of computers coming from departments 1, 2, and 3. A limitation of labor hours available to perform testing is causing this backlog.

Step 2. Optimize the use of the constrained resource.

The constrained resource has been identified as the number of labor hours available to perform testing. At this point, Computers, Inc., would like to optimize the labor hours used for quality testing. To assist in this goal, we will calculate the contribution margin per unit of constraint (the unit of constraint is *labor hour* in this example). Production will then focus on products with the highest contribution margin per labor hour. Figure 4.14 "Contribution Margin per Unit of Constrained Resource for Computers, Inc." provides this information for each product. (We first introduced the concept of calculating a contribution margin per unit of constraint in Chapter 3 "How Is Cost-Volume-Profit Analysis Used for Decision Making?".)

Figure 4.14 Contribution Margin per Unit of Constrained Resource for Computers, Inc.

	A100 Model	P120 Model	S150 Model
Price per unit	$500	$600	$750
Variable cost per unit	400	350	510
Contribution margin per unit	$100	$250	$240
Labor hours to perform quality test per unit	÷0.2	÷0.4	÷0.3
Contribution margin per labor hour	$500	$625	$800

Based on the information presented in Figure 4.14 "Contribution Margin per Unit of Constrained Resource for Computers, Inc.", and given that labor hours in department 4 is the constraint, Computers, Inc., would optimize the use of labor hours by producing the S150 model because it provides a contribution margin of $800 per labor hour versus $500 for the A100 model, and $625 for the P120 model.

Step 3. Subordinate all nonbottleneck resources to the bottleneck.

The goal in this step is to shift nonbottleneck resources to the bottleneck in department 4. At this point, improving efficiencies in other departments does little to alleviate the bottleneck in department 4. Thus Computers, Inc., must try to move resources from other areas to department 4 to reduce the backlog of computers to be tested.

Step 4. Increase bottleneck efficiency and capacity.

Management's goal is to loosen the constraint by providing more labor hours to department 4. For example, management may decide to move employees from departments 1, 2, and 3 to the quality testing department. Another option is to authorize overtime for the workers in department 4. Perhaps management will consider hiring additional workers for department 4.

Step 5. Repeat steps 1 through 4 for the new bottleneck.

Once the bottleneck in department 4 is relieved, a new bottleneck will likely arise elsewhere. Going back to step 1 requires management to identify the new bottleneck and follow steps 2 through 4 to alleviate the bottleneck.

Key Takeaways

- Most companies have limited resources in areas such as labor hours, machine hours, facilities, and materials. The theory of constraints is an approach that enables companies to optimize the use of limited resources. Five steps are involved. First, find the constrained resource (or bottleneck). Second, optimize the use of the constrained resource. Third, subordinate all

nonbottleneck resources to the bottleneck. Fourth, increase bottleneck efficiency and capacity. Fifth, repeat the first four steps for the new bottleneck.

Check Yourself

Southside Company produces three types of baseball gloves: child, teen, and adult. The gloves are produced in separate departments and sent to the quality testing department before being packaged and shipped. A machine-hour bottleneck has been identified in the quality testing department. Southside would like to optimize its use of machine hours (step 2) by producing the two most profitable gloves. The machine hours required for each glove follow:

Child glove	0.25 machine hours
Teen glove	0.40 machine hours
Adult glove	0.50 machine hours

Price and variable cost information is as follows:

	Price	Variable Cost
Child glove	$15	$ 5
Teen glove	20	8
Adult glove	35	22

1. Calculate the contribution margin per unit of constrained resource for each glove.
2. Which two gloves would Southside prefer to produce and sell to optimize the use of machine hours in the quality testing department?

Solution

	Child Glove	Teen Glove	Adult Glove
Price per unit	$15	$20	$35
Variable cost per unit	5	8	22
Contribution margin per unit	$10	$12	$13
Machine hours to perform quality test per unit	÷0.25	÷0.4	÷0.5
Contribution margin per machine hour	$40	$30	$26

1.
2. The company would prefer to produce and sell the child and teen gloves, since these products have the highest contribution margin per machine hour.

4.9 Be Aware of Qualitative Factors

Learning Objective

1. Evaluate qualitative factors when using differential analysis.

Question: This chapter has focused on using relevant revenue and cost information to perform differential analysis. Using these quantitative factors to make decisions allows managers to support decisions with measurable data. For example, the idea of

outsourcing production of wakeboards at Best Boards, Inc., presented at the beginning of the chapter, was rejected because it was more costly to outsource production of the boards than to produce them internally. Although using quantitative factors for decision making is important, management must also consider qualitative factors. How might the consideration of qualitative factors improve decisions made by managers?

Answer: Qualitative factors may outweigh the quantitative factors in making a decision. For example, assume management at Best Boards, Inc., believes there will be a decline in the market for wakeboards after next year. Outsourcing production makes it easier to quickly reduce costs in the face of a downturn by simply ordering fewer wakeboards from the supplier. Continuing to build the boards internally takes away this flexibility. The significant fixed costs often associated with manufacturing firms are difficult to reduce in the short run if production declines. Thus the qualitative factor of being able to reduce manufacturing costs quickly by outsourcing production may outweigh the quantitative factors shown in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc." and Figure 4.4 "Product Line Decision".

Question: What if the quantitative differential analysis for Best Boards had a different result, in that it showed the company should outsource? What qualitative factors should management consider before implementing this decision?

Answer: Management must consider whether product quality would remain the same. Financial stability of the producer must be considered as well. It does no good to outsource production and eliminate production facilities and employees if the producer being used suddenly shuts down. Also, employee morale tends to slide if employees in one segment of a company are fired. This can lead to an unhappy and inefficient workforce in other areas of the company, causing costs to rise. These are just a few of the qualitative factors that must be weighed against quantitative factors when performing differential analysis.

Key Takeaways

- Although accountants are responsible for providing relevant and objective financial information to help managers make decisions, qualitative factors also play a significant role in the decision-making process.

Real World Example

https://wtietz.files.wordpress.com/2017/02/laser-tattoos-versus-paper-stickers-relevant-pdf.pdf

End-of-Chapter Exercise

Questions

1. What are differential revenues and costs?
2. What is differential analysis?
3. Define what is meant by a "make-or-buy" decision. Describe how differential analysis can be used to assist in making this type of decision.
4. What is an avoidable cost?
5. How is differential analysis used in deciding whether to keep or drop product lines?
6. Why are direct fixed costs typically differential costs?
7. Why are allocated fixed costs typically not differential costs?
8. What is an opportunity cost? Why is an opportunity cost a differential cost?
9. How is differential analysis similar for customer decisions and product line decisions?
10. What two important assumptions must be considered when evaluating special order scenarios?
11. What is cost-plus pricing?
12. Describe the four steps of target costing.
13. Describe the five steps used to manage constraints according to the theory of constraints.
14. What is a qualitative advantage of keeping unprofitable customers?
15. **Cutting Costs at Best Boards, Inc.** Refer to the dialogue at Best Boards, Inc., presented at the beginning of the chapter. How does the vice president of operations, Jim Muller, expect to reduce costs and earn his bonus? What was the flaw in his plan?

16. **Make-or-Buy Decision.** Coffee Mugs, Inc., currently manufactures ceramic coffee mugs. Management is interested in outsourcing production to a reputable manufacturing company that can supply the cups for $2 per unit. Coffee Mugs produces 100,000 mugs each year. Variable production costs are $0.80 and annual fixed costs are $150,000. If production is outsourced, all variable costs and 40 percent of annual fixed costs will be eliminated.

    Perform differential analysis using the format presented in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc." and explain which alternative is best, Alternative 1 (producing internally) or Alternative 2 (outsourcing).

17. **Product Line Decision.** The following segmented annual income statement is for Flash Drive, Inc.:

	Product Lines			
	1 Gig	2 Gig	4 Gig	Total
Sales revenue	$1,000,000	$4,000,000	$5,000,000	$10,000,000
Variable costs	600,000	2,500,000	3,500,000	6,600,000
Contribution margin	$ 400,000	$1,500,000	$1,500,000	$ 3,400,000
Direct fixed costs	300,000	800,000	1,000,000	2,100,000
Allocated fixed costs	(A)	(B)	(C)	1,100,000
Profit (loss)	$ (D)	$ (E)	$ (F)	$ 200,000

    For items **A**, **B**, and **C**, assign allocated fixed costs to each product line based on sales revenue for each product line as a proportion of total sales revenue. For example, the 1 Gig product will be assigned 10 percent of allocated fixed costs (= $1,000,000 in 1 Gig sales revenue ÷ $10,000,000 total sales revenue), or $110,000 (=$1,100,000 total allocated fixed costs × 10 percent). For items **D**, **E**, and **F**, calculate the profit or loss for each product line.

18. **Customer Decision.** Consulting Group LLC has two customers. Customer One generates $150,000 in income after *direct* fixed costs are deducted, and Customer Two generates $200,000 in income after *direct* fixed costs are deducted. *Allocated* fixed costs total $300,000 and are assigned 30 percent to Customer One and 70 percent to Customer Two based on several different cost drivers. Total allocated fixed costs remain the same regardless of how these costs are assigned to customers.

    Calculate the amount of allocated fixed costs to be assigned to each customer, and determine the profit or loss for each customer. Should Consulting Group drop Customer Two? Explain.

19. **Special Order Decision: Operating with Idle Capacity.** Jerseys, Inc., currently produces 10,000 jerseys a year for its regular customers and charges $10 per jersey. Jerseys, Inc., has capacity to produce an additional 5,000 jerseys if sales grow in the future. Variable costs total $6 per jersey and annual fixed costs total $15,000. The city of Rockville recently approached the company and proposed a one-time purchase of 3,000 jerseys for $8 each. Should Jerseys, Inc., accept the proposal? Explain.
20. **Cost-Plus Pricing.** KJ Home Builders is bidding on a custom home for a potential customer. The company typically charges 15 percent above cost and estimates the home will cost $500,000 to build. Calculate the price bid by KJ Home Builders.

21. **Constrained Resources.** Deal, Inc., produces two types of computers: Vortex and Zoom. The computers are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Deal, Inc., would like to optimize

its use of labor hours by producing the most profitable computer. Based on the information shown, calculate the contribution margin per quality testing labor hour for each product:

	Quality Testing Labor Hours	Contribution Margin
Vortex	0.50	$600
Zoom	0.40	500

22. **Evaluating Qualitative Factors.** Assume your company is considering whether to outsource production. What qualitative factors should be considered before making this decision?

Exercises:

23. **Make-or-Buy Decision.** Wheels, Inc., currently manufactures its own custom rims for automobiles. Management is interested in outsourcing production of these rims to a reputable manufacturing company that can supply the rims for $80 per unit. Wheels, Inc., incurs the following annual production costs to produce 10,000 rims internally.

	Per Unit	Total Annual Cost at 10,000 Units
Variable production costs		
Direct materials	$20	$200,000
Direct labor	10	100,000
Manufacturing overhead	30	300,000
Fixed production costs		
Factory building and equipment lease		70,000
Factory insurance		50,000
Production supervisor's salary		100,000
Total production costs		$820,000

If production is outsourced, all variable production costs, factory building and equipment lease costs, and factory insurance costs will be eliminated. The production supervisor's salary cost will remain regardless of the decision to outsource or to produce internally because the supervisor recently signed a long-term contract with Wheels, Inc.

Required:

1. Perform differential analysis using the format presented in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the rims internally is Alternative 1, and buying the rims from an outside manufacturer is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of outsourcing production using the format presented in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.".
4. Compare the format used in requirement **a** with that of requirement **c**.

24. **Product Line Decision.** The following monthly segmented income statement is for Durango Company.

	Product Lines			
	A	B	C	Total
Sales revenue	$37,500	$50,000	$12,500	$100,000
Variable costs	16,000	27,500	5,000	48,500
Contribution margin	$21,500	$ 22,500	$ 7,500	$ 51,500
Direct fixed costs	19,500	16,000	3,500	39,000
Allocated fixed costs	3,750	5,000	1,250	10,000
Profit (loss)	$(1,750)	$ 1,500	$ 2,750	$ 2,500

Management is concerned about the losses associated with product line A and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on sales. If product line A is eliminated, total allocated fixed costs are assigned to the remaining product lines, and all variable and direct fixed costs for product line A will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.6 “Product Line Differential Analysis for Barbeque Company”. Assume keeping all product lines is Alternative 1, and dropping product line A is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of dropping product line A using the format presented in Figure 4.7 “Summary of Differential Analysis for Barbeque Company”.
4. Explain why the loss shown for product line A in the segmented income statement might be misleading to management.

25. **Customer Decision.** The following customer segmented quarterly income statement is for Accounting Associates.

	Customers			
	Sanchez	Nguyen	Decker	Total
Sales revenue	$300,000	$1,500,000	$200,000	$2,000,000
Variable costs	250,000	1,200,000	160,000	1,610,000
Contribution margin	$ 50,000	$ 300,000	$ 40,000	$ 390,000
Direct fixed costs	15,000	315,000	10,000	340,000
Allocated fixed costs	6,000	30,000	4,000	40,000
Profit (loss)	$ 29,000	$ (45,000)	$ 26,000	$ 10,000

Management is concerned about the significant losses associated with the Nguyen account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Nguyen is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Nguyen account will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.10 “Customer Differential Analysis for Colony Landscape Maintenance”. Assume keeping all customers is Alternative 1, and dropping the Nguyen account is Alternative 2.
2. Which alternative is best? Explain.

3. Summarize the result of dropping the Nguyen account using the format presented in Figure 4.11 “Summary of Differential Analysis for Colony Landscape Maintenance”.
4. Explain what happened to the profitability of the other two customers as a result of dropping the Nguyen account.

26. **Special Order Decision: Operating with Idle Capacity.** The following monthly financial data are for RadioCom, Inc., a maker of handheld VHF radios. RadioCom produces and sells 5,000 radios each month to regular customers.

	Per Unit	Total Monthly Data at 5,000 Radios
Sales revenue	$100	$500,000
Variable costs	60	300,000
Contribution margin	$ 40	$200,000
Fixed costs		135,000
Profit		$ 65,000

RadioCom received an offer from the Coast Guard Auxiliary to purchase 1,000 radios next month for $75 per unit. RadioCom can produce up to 7,000 radios a month, so the special order would not affect regular customer sales. Variable costs per radio will remain at $60. This special order will have no effect on monthly fixed costs.

Required:

1. Using the differential analysis format presented in Figure 4.12 “Special Order Differential Analysis for Tony’s T-Shirts”, determine whether RadioCom would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
2. Summarize the result of accepting the special order using the format presented in Figure 4.13 “Summary of Differential Analysis for Tony’s T-Shirts”.

27. **Special Order Decision: Operating at Full Capacity.** The following monthly financial data are for RadioCom, Inc., a maker of handheld VHF radios. RadioCom produces and sells 5,000 radios each month to regular customers.

	Per Unit	Total Monthly Data at 5,000 Radios
Sales revenue	$100	$500,000
Variable costs	60	300,000
Contribution margin	$ 40	$200,000
Fixed costs		135,000
Profit		$ 65,000

RadioCom received an offer from the Coast Guard Auxiliary to purchase 1,000 radios next month for $75 per unit. RadioCom can only produce up to 5,000 radios a month, so the special order would result in reduced sales to regular customers. Variable costs per radio will remain at $60. This special order will have no effect on monthly fixed costs.

Required:

1. Using the differential analysis format presented in Figure 4.12 “Special Order Differential Analysis for Tony’s T-Shirts”, determine whether RadioCom would be better off rejecting (Alternative 1) or accepting (Alternative 2) the offer received from the Coast Guard Auxiliary.

2. Summarize the result of accepting the special order using the format presented in Figure 4.13 “Summary of Differential Analysis for Tony’s T-Shirts”.

28. **Target Costing.** Quality Sounds, Inc., makes speakers and headphones for high-end sound systems. The marketing department has identified a market for a specific type of headphones that Quality Sounds does not currently produce, and expects to be able to sell each pair for $150. Management requires a profit of 45 percent of the selling price.

    Required:

    Determine the highest cost (target cost) management would be willing to accept to produce this product.

29. **Constrained Resources.** Cycle, Inc., produces three types of bicycles: racer, cruiser, and climber. The bikes are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Cycle, Inc., would like to optimize its use of labor hours by producing the two most profitable bikes. Information for each bike follows.

	Quality Testing Labor Hours	Price	Variable Cost
Racer	1.25	$1,000	$400
Cruiser	1.00	500	300
Climber	1.00	800	450

    Required:

    1. Calculate the contribution margin per unit of constrained resource for each product.
    2. Which two products would Cycle, Inc., prefer to produce and sell to optimize the use of labor hours in the quality testing department?

30. **Qualitative Factors.** For each of the following independent scenarios, identify at least one *qualitative* factor that should be considered before making the decision.

    1. A company sells three types of computers (laptops, desktops, and palmtops), all of which are profitable. The company faces a machine-hour bottleneck and plans to eliminate the palmtop product because it has the lowest contribution margin per machine hour.
    2. A company plans to drop an unprofitable customer.
    3. A maker of high-end stereo equipment would like to shut down its manufacturing facility and outsource production.

Problems

31. **Make-or-Buy Decision.** Vail Door Company currently manufactures doors used in the production of custom homes. Management is interested in outsourcing production of the doors to a reputable manufacturing company that can supply the doors for $90 per unit. Vail incurs the following annual production costs to produce 3,000 doors internally.

	Per Unit	Total Annual Cost at 3,000 Units
Variable production costs		
Direct materials	$30	$ 90,000
Direct labor	15	45,000
Manufacturing overhead	20	60,000
Fixed production costs		
Factory lease		80,000
Equipment lease		40,000
Factory insurance		25,000
Production supervisor's salary		90,000
Total production costs		$430,000

If production is outsourced, all variable production costs, equipment lease costs, and factory insurance costs will be eliminated. The production supervisor's salary cost will remain regardless of the decision to outsource or to produce internally because the supervisor recently signed a long-term contract with the company. The factory lease has five years remaining and cannot be terminated before then.

Required:

1. Perform differential analysis using the format presented in Figure 4.2 "Make-or-Buy Differential Analysis for Best Boards, Inc.". Assume making the product internally is Alternative 1, and buying the product from an outside manufacturer is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of outsourcing production using the format presented in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc.".
4. Assume Vail Door Company can lease the space it currently uses to produce doors for $30,000 per year if production of doors is outsourced. Because the company subleasing this space would also pay for insurance, Vail would not be required to pay for factory insurance. Use the format presented in Figure 4.3 "Summary of Differential Analysis for Best Boards, Inc." to determine if Vail would be better off outsourcing production. (Hint: $30,000 will appear in the analysis as an opportunity cost similar to Figure 4.7 "Differential Analysis with Opportunity Cost for Barbeque Company".)

32. Make-or-Buy Decision and Qualitative Factors. Soda Bottling, Inc., currently bottles its own soda drinks. Management is interested in outsourcing the production of bottles to a reputable manufacturing company that can supply the bottles for $0.04 each. Soda Bottling incurs the following monthly production costs to produce 1,000,000 bottles internally.

	Per Unit	Total Monthly Cost at 1,000,000 Units
Variable production cost	$0.02	$20,000
Fixed production cost		25,000
Total production cost		$45,000

If production is outsourced, all variable production costs and 70 percent of fixed production costs will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.2 “Make-or-Buy Differential Analysis for Best Boards, Inc.”. Assume making the product internally is Alternative 1, and buying the product from an outside manufacturer is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of outsourcing production using the format presented in Figure 4.3 “Summary of Differential Analysis for Best Boards, Inc.”.
4. Assume all the facts of this problem remain the same. However, management of Soda Bottling has an opportunity to lease the space it currently uses to produce bottles for $6,000 per month if production of bottles is outsourced. Use the format presented in Figure 4.3 “Summary of Differential Analysis for Best Boards, Inc.” to determine if Soda Bottling would be better off outsourcing production. (Hint: $6,000 will appear in the analysis as an opportunity cost similar to Figure 4.7 “Differential Analysis with Opportunity Cost for Barbeque Company”.)
5. Identify at least one *qualitative* factor that should be considered before management decides to outsource production.

33. Product Line Decision. The following monthly segmented income statement is for Hal’s Hardware.

	Product Lines			
	Garden Supplies	Tools	Paint	Total
Sales revenue	$20,000	$15,000	$23,000	$58,000
Variable costs	11,000	8,000	9,000	28,000
Contribution margin	$ 9,000	$ 7,000	$14,000	$30,000
Direct fixed costs	3,000	1,500	8,500	13,000
Allocated fixed costs	2,000	5,000	3,000	10,000
Profit	$ 4,000	$ 500	$ 2,500	$ 7,000

Management is concerned about the low profit associated with the tools product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on floor space used by each product line (measured in square feet), resulting in the following percentages for garden supplies, tools, and paint, respectively: 20 percent, 50 percent, and 30 percent. If the tools product line is eliminated, total allocated fixed costs will be assigned as follows: 62.5 percent to garden supplies, and 37.5 percent to paint. All variable and direct fixed costs for the tools product line will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.5 “Product Line Differential Analysis for Barbeque Company”. Assume keeping all product lines is Alternative 1, and dropping the tools product line is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of dropping the tools product line using the format presented in Figure 4.6 “Summary of Differential Analysis for Barbeque Company”.
4. Assume the space available from dropping the tools product line can be used by the paint product line, resulting in increased revenues for paint of $12,000 and increased variable costs for paint of $4,000. No additional direct fixed costs would be incurred, and 80 percent of allocated fixed costs would be assigned to paint and 20 percent assigned to garden supplies. Should Hal’s Hardware drop the tools product line and use the freed-up space to expand the paint product line? (Hint: Prepare a differential analysis using the format presented in Figure 4.5 “Product Line Differential Analysis for Barbeque Company” to find the answer. Alternative 1 assumes all product lines are kept, and Alternative 2 assumes the tools product line is dropped with a corresponding expansion of the paint product line.)

34. Product Line Decision and Qualitative Factors. The following annual segmented income statement is for Wax, Inc., a maker of wax for cars, boats, and floors.

	Product Lines			
	Cars	Boats	Floors	Total
Sales revenue	$400,000	$300,000	$460,000	$1,160,000
Variable costs	220,000	160,000	280,000	660,000
Contribution margin	$180,000	$140,000	$180,000	$ 500,000
Direct fixed costs	85,000	70,000	115,000	270,000
Allocated fixed costs	60,000	50,000	90,000	200,000
Profit	$ 35,000	$ 20,000	$(25,000)	$ 30,000

Management is concerned about the loss associated with the floors product line and is considering dropping this product line. Allocated fixed costs are assigned to product lines based on direct labor hours associated with each product line, resulting in the following percentages for cars, boats, and floors, respectively: 30 percent, 25 percent, and 45 percent. If the floors product line is eliminated, total allocated fixed costs will be assigned to the remaining products as follows: 55 percent to cars, and 45 percent to boats. All variable and direct fixed costs for the floors product line will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.5 “Product Line Differential Analysis for Barbeque Company”. Assume keeping all product lines is Alternative 1, and dropping the floors product line is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of dropping the floors product line using the format presented in Figure 4.6 “Summary of Differential Analysis for Barbeque Company”.
4. Assume the space available from dropping the floors product line can be used by the boats product line, resulting in increased revenues for boats of $200,000 and increased variable costs for boats of $110,000. An additional $10,000 in direct fixed costs would be incurred for the boats product line. Allocated fixed costs would be assigned as follows: 40 percent to cars, and 60 percent to boats. Should Wax, Inc., drop the floors product line and use the freed-up space to expand the boats product line? (Hint: Prepare a differential analysis using the format presented in Figure 4.6 “Product Line Differential Analysis for Barbeque Company” to find the answer. Alternative 1 assumes all product lines are kept, and Alternative 2 assumes the floors product line is dropped with a corresponding expansion of the boats product line.)
5. Identify at least one *qualitative* factor that should be considered before management decides to drop a product line.

35. Customer Decision. The following customer segmented quarterly income statement is for Ciena and Associates, a firm that performs legal services.

	Customers			
	Koontz	Davis	Nello	Total
Sales revenue	$150,000	$750,000	$100,000	$1,000,000
Variable costs	125,000	600,000	80,000	805,000
Contribution margin	$ 25,000	$150,000	$ 20,000	$ 195,000
Direct fixed costs	7,500	157,500	5,000	170,000
Allocated fixed costs	3,000	15,000	2,000	20,000
Profit (loss)	$ 14,500	$(22,500)	$ 13,000	$ 5,000

Management is concerned about the significant losses associated with the Davis account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Davis is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Davis account will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.9 "Customer Differential Analysis for Colony Landscape Maintenance". Assume keeping all customers is Alternative 1, and dropping the Davis account is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of dropping the Davis account using the format presented in Figure 4.11 "Summary of Differential Analysis for Colony Landscape Maintenance".
4. Explain what happened to the profitability of the other two customers as a result of dropping the Davis account.
5. Assume all the facts of this problem remain the same with one exception. As a result of dropping the Davis account, Ciena and Associates is only able to reduce the *direct* fixed costs associated with the Davis account by 90 percent. The remaining 10 percent will not be eliminated for several more years. Does this change Ciena's decision as to whether to drop the Davis customer? Explain. (Hint: Modify one line item in your answer to requirement **c**.)

36. Customer Decision and Qualitative Factors. The following customer segmented monthly income statement is for Quality Web, Inc., a firm that provides Web site maintenance services.

	Customers			
	Anderson	Houston	Murray	Total
Sales revenue	$50,000	$50,000	$25,000	$125,000
Variable costs	40,000	37,000	18,000	95,000
Contribution margin	$10,000	$13,000	$ 7,000	$ 30,000
Direct fixed costs	3,000	4,000	6,500	13,500
Allocated fixed costs	4,000	4,000	2,000	10,000
Profit (loss)	$ 3,000	$ 5,000	$(1,500)	$ 6,500

Management is concerned about the losses associated with the Murray account and would like to drop this customer. Allocated fixed costs are assigned to customers based on sales revenue. If Murray is dropped, total allocated fixed costs are assigned to the remaining customers, and all variable and direct fixed costs for the Murray account will be eliminated.

Required:

1. Perform differential analysis using the format presented in Figure 4.9 “Customer Differential Analysis for Colony Landscape Maintenance”. Assume keeping all customers is Alternative 1, and dropping the Murray account is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of dropping the Murray account using the format presented in Figure 4.11 “Summary of Differential Analysis for Colony Landscape Maintenance”.
4. Explain what happened to the profitability of the other two customers as a result of dropping the Murray account.
5. Assume all the facts of this problem remain the same with one exception. As a result of dropping the Murray account, Quality Web, Inc., is able to reduce total *allocated* fixed costs by 20 percent. The remaining 80 percent will be allocated to the other two products based on sales revenue. Does this change Quality Web’s decision as to whether to drop the Murray customer? Explain. (Hint: Add one line item in the requirement **c** analysis to reflect allocated fixed cost savings.)
6. Identify at least one *qualitative* factor that should be considered before deciding whether to drop the Murray account.

37. Special Order Decision with Idle Capacity and at Full Capacity. The following quarterly financial data are for Pneumatic, Inc., a maker of compressors. On average, Pneumatic makes 20,000 compressors each quarter.

	Per Unit	Total Quarterly Data at 20,000 Compressors
Sales revenue	$300	$6,000,000
Variable costs	100	2,000,000
Contribution margin	$200	$4,000,000
Fixed costs		3,500,000
Profit		$ 500,000

Pneumatic received an offer from a one-time customer to purchase 5,000 compressors this coming quarter for $275 per unit. Pneumatic can produce up to 30,000 units a quarter, so the special order would not affect regular customer sales. Variable costs per unit will remain at $100. This special order will have no effect on fixed costs.

Required:

1. Using the differential analysis format presented in Figure 4.12 “Special Order Differential Analysis for Tony’s T-Shirts”, determine whether Pneumatic would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2).
2. Summarize the result of accepting the special order using the format presented in Figure 4.13 “Summary of Differential Analysis for Tony’s T-Shirts”.
3. Assume Pneumatic is approached with the same special offer, but has limited capacity, and can only produce up to 20,000 units per quarter. Thus any special orders will result in reduced sales to regular customers. Using the differential analysis format presented in Figure 4.12 “Special Order Differential Analysis for Tony’s T-Shirts”, determine whether Pneumatic would be better off rejecting (Alternative 1) or accepting (Alternative 2) the special order.
4. Summarize the result of accepting the special order in requirement **c** using the format presented in Figure 4.13 “Summary of Differential Analysis for Tony’s T-Shirts”.

38. Target Costing. Toolmakers, Inc., produces table saws. The marketing department has identified a market for a specific type of table saw that Toolmakers does not currently produce, and expects to be

able to sell each saw for $800. Management requires a profit of 60 percent of the selling price.

Required:

1. Determine the highest cost (target cost) management would be willing to accept to produce this product.
2. Describe the four steps of target costing, and identify what Toolmakers would do next if it cannot make the product at or below the target cost.

39. Constrained Resources. Instrumental Strings, Inc., produces three types of string instruments: violin, cello, and bass. The instruments are produced in separate departments and sent to the quality testing department before being packaged and shipped. A labor-hour bottleneck has been identified in the quality testing department due to the high skill requirements of the job. Instrumental Strings would like to optimize its use of labor hours by producing the two most profitable instruments. Information for each product follows.

	Quality Testing Labor Hours	Price	Variable Cost
Violin	5.00	$4,000	$ 700
Cello	8.00	4,800	900
Bass	6.25	6,000	1,800

Required:

1. Calculate the contribution margin per unit of constrained resource for each product.
2. Which two products would Instrumental Strings prefer to produce and sell to optimize the use of labor hours in the quality testing department?
3. Assume additional employees are hired and trained for the quality testing department thereby alleviating this constraint. A labor-hour bottleneck has now been identified in the packaging department, which is recognized by management as a crucial department given the fine craftsmanship of each instrument. Of the three instruments produced by the company, identify which two products Instrumental Strings would prefer to produce and sell to optimize the use of labor hours in the packaging department. Assume the following labor hours are required to package each instrument:

Violin:	4.00 hours
Cello:	4.00 hours
Bass:	6.00 hours

One Step Further: Skill-Building Cases

40. Internet Project: Outsourcing. Accenture LLP is a global management consulting, technology services, and outsourcing company with more than $17 billion in annual revenues. Go to Accenture's Web site (http://www.accenture.com) and select *outsourcing*, or type *outsourcing* in Accenture's search feature. Review the information provided about outsourcing, select a specific outsourcing topic, and write a one-page report summarizing your findings.

41. Group Activity: Qualitative Factors. Each of the following scenarios is being considered at three separate companies.

1. A company sells three types of bicycles (racers, cruisers, and climbers), all of which are profitable. The company faces a labor-hour bottleneck and plans to eliminate the cruiser product because it has the lowest contribution margin per labor hour.
2. A company plans to accept a special order at a reduced price from a one-time customer.
3. A maker of car batteries plans to eliminate one of its unprofitable product lines.

Required:

Form groups of two to four students and assign one of the three independent scenarios listed previously to each group. Each group must perform the following requirements:

1. Identify at least two qualitative factors that should be considered before making the decision.
2. Discuss each option, based on the findings of your group, with the class.

42. Special Order Decision Using Excel. The following monthly financial data are for Green Mowers, Inc., a maker of electric lawn mowers. Green Mowers makes and sells 5,000 mowers each month.

	Per Unit	Total Monthly Data at 5,000 Mowers
Sales revenue	$200	$1,000,000
Variable costs	150	750,000
Contribution margin	$ 50	$ 250,000
Fixed costs		160,000
Profit		$ 90,000

Green Mowers received an offer from a one-time customer to purchase 1,000 mowers this coming month for $180 per unit. Green Mowers can only produce up to 5,000 units a month, so the special order would reduce regular customer sales. Variable costs per unit will remain at $150. This special order will have no effect on fixed costs.

Required:

Prepare an Excel spreadsheet, similar to the one shown in the *Computer Application* box, to determine whether Green Mowers would be better off rejecting the special order (Alternative 1) or accepting the special order (Alternative 2). Make a recommendation as to which alternative should be accepted and explain the reasoning for your recommendation.

43. Ethics: Cost-Plus Pricing. JR Engineering recently negotiated a cost-plus contract with Pineville City to provide engineering services at a rate equal to direct labor costs plus 30 percent. On a separate note, the partners at JR Engineering discovered that one of its customers filed for bankruptcy last month and will not be able to pay the $200,000 owed to the firm.

The two partners at JR Engineering, Julie and Ron, decided to include some of the direct labor costs incurred working on the bankrupt company with the direct labor costs associated with Pineville City. As Ron stated, “After all, customers fail from time to time, and it’s only fair that our other customers shoulder some of the burden. This enables us to provide the high-quality service we know is so important to our customers.”

Are JR Engineering’s actions ethical? What are the long-term implications of JR’s actions? Explain.

Comprehensive Cases

44. Make-or-Buy Decision. Keyboard, Inc., a manufacturer of pianos, typically sells each of its pianos for $1,480. The cost of manufacturing and marketing one piano at the company’s usual monthly volume of 6,000 units is shown.

	Per Unit		Total at 6,000 Units	
Manufacturing costs				
Variable	$600		$3,600,000	
Fixed	240		1,440,000	
Total manufacturing		$ 840		$5,040,000
Marketing and administrative costs				
Variable	$100		$ 600,000	
Fixed	280		1,680,000	
Total marketing and administrative costs		380		2,280,000
Total cost		$1,220		$7,320,000

Required:

1. Keyboard, Inc., received a proposal from an independent piano manufacturer that will produce and ship 2,000 pianos each month directly to Keyboard's customers as requested by Keyboard's salespeople, at a cost of $900 each. This will have the effect of reducing total fixed marketing and administrative costs by 5 percent. As a result of reducing production capacity, Keyboard's total fixed manufacturing costs will decrease 30 percent. Total variable manufacturing costs will decrease since only 4,000 pianos will be produced rather than 6,000. Total variable marketing and administrative costs will remain unchanged.

   Perform differential analysis to determine if Keyboard should accept the proposal from the outside supplier. Assume making all 6,000 pianos internally is Alternative 1, and outsourcing the production of 2,000 pianos and producing 4,000 pianos internally is Alternative 2. Explain which alternative is best.

2. Assume the same facts as in requirement **a**, with one additional point. If production of 2,000 pianos is outsourced and 4,000 pianos are produced internally, Keyboard can use the idle capacity to produce an additional 1,400 beginner pianos that can be sold for $1,100 each. Fixed marketing and administrative costs would be unchanged (the 5 percent reduction described in requirement **a** no longer applies). Fixed manufacturing costs would decrease by 10 percent (rather than the 30 percent described in requirement **a**). Per unit variable cost information for the beginner pianos would be as follows:

Variable manufacturing costs	$400
Variable marketing and administrative costs	$ 80

   Perform differential analysis to determine if Keyboard should accept the proposal from the independent supplier. Assume making all 6,000 pianos internally is Alternative 1. Alternative 2 consists of outsourcing the production of 2,000 pianos and producing 5,400 pianos internally (= 4,000 regular pianos + 1,400 beginner pianos). Explain which alternative is best. (Hint: Include a line item for *sales revenue* in your analysis to determine the best alternative.)

45. Product Line Decision. The following monthly segmented income statement is for Thirst Quench, a maker of soda, sports drink, and lemonade.

	Product Lines			
	Soda	Sports Drink	Lemonade	Total
Sales revenue	$800,000	$600,000	$920,000	$2,320,000
Variable costs	440,000	320,000	560,000	1,320,000
Contribution margin	$360,000	$280,000	$360,000	$1,000,000
Direct fixed costs	170,000	290,000	255,000	715,000
Allocated fixed costs	50,000	40,000	110,000	200,000
Profit	$140,000	$(50,000)	$ (5,000)	$ 85,000

Management is concerned about the losses associated with the sports drink and lemonade product lines and is considering dropping all product lines except soda. Allocated fixed costs are assigned to product lines based on direct labor hours associated with each product line resulting in the following percentages for soda, sports drink, and lemonade, respectively: 25 percent, 20 percent, and 55 percent. If the sports drink and lemonade product lines are eliminated, total allocated fixed costs will decrease by $40,000, and variable costs and direct fixed costs for these two product lines will be eliminated. (No allocated fixed cost savings occur if only one product line is dropped.)

Required:

1. Perform differential analysis Assume keeping all product lines is Alternative 1, and keeping only the soda product line is Alternative 2.
2. Which alternative is best? Explain.
3. Summarize the result of keeping only the soda product line.
4. Management has asked you to look at the numbers for each product line and make a recommendation on how to increase overall company profit. What course of action would you recommend? Based on your recommendation, describe the qualitative factors that should be considered.

Previous Chapter

Table of Contents

Next Chapter

4: How Are Relevant Revenues and Costs Used to Make Decisions? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

Chapter 5 How Is Capital Budgeting Used to Make Decisions?

Julie Jackson is the president and owner of Jackson's Quality Copies, a store that makes photocopies for its customers and that has several copy machines. Julie has the following discussion with Mike Haley, the company's accountant:

Julie:
Mike, I think it's time to buy a new copy machine. Our volume of copies has increased dramatically over the last year, and we need a copier that does a better job of handling the big jobs.

Mike:
Do you have any idea how much the new machine will cost?

Julie:
We can purchase a new copier for $50,000, maintenance costs will total $1,000 a year, and the copier is expected to last 7 years. Since the new machine is quicker and will require less attention by our employees, we should save about $11,000 a year in labor costs.

Mike:
Will it have any salvage value at the end of seven years?

Julie:
Yes. The salvage value should be about $5,000.

Mike:
How soon do you want to do this?

Julie:
As soon as possible. From what I can tell, this is a winning proposition. The cash inflows of $82,000 that we will get from the labor cost savings and the salvage value exceed the cash outflows of $57,000 that we expect to spend on the machine and annual maintenance costs. What do you think?

Mike:
Let me take a look at the numbers before we jump into this. We have to consider more than just total cash inflows and outflows. I'll get back to you by the end of the week.

Julie:
Okay, thanks for your help!

Jackson's Quality Copies is facing a decision common to many organizations: whether to invest in equipment that will last for many years or to continue with existing equipment. This type of decision differs from the decisions covered in the previous chapter because long-term investment decisions affect organizations for several years. We will return to Julie's plan to purchase a new copier after we provide background information on long-term investment decisions.

5.1 Capital Budgeting and Decision Making

Learning Objective

1. Apply the concept of the time value of money to capital budgeting decisions.

Question: What is the difference between management decisions made in Chapter 4 "How Are Relevant Revenues and Costs Used to Make Decisions?" and management decisions made in this chapter?

Answer: The types of decisions covered in this chapter and Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?” are similar in that they require an analysis of differential revenues and costs. However, Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?” involves short-run operating decisions (e.g., special orders from customers), while this chapter focuses on long-run capacity decisions (e.g., purchasing long-lived assets to increase capacity for many years).

Organizations make a variety of long-run investment decisions. The **San Francisco Symphony** invests in stage risers for its orchestra members. **McDonald’s** invests in new restaurants. **Honda Motor Co.** invests in new manufacturing facilities. **Bank of America** invests in new branches. These examples have one common feature: all of these companies are investing in assets that will affect the organization for several years.

Question: The process of analyzing and deciding which long-term investments to make is called a capital budgeting decision *, also known as a capital expenditure decision. Capital budgeting decisions involve using company funds (capital) to invest in long-term assets. How does the evaluation of these types of capital budgeting decisions differ from short-term operating decisions discussed in Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?”?*

Answer: When looking at capital budgeting decisions that affect future years, we must consider the time value of money. The time value of money concept is the premise that a dollar received today is worth more than a dollar received in the future. To clarify this point, suppose a friend owes you $100. Would you prefer to receive $100 today or 3 years from today? The money is worth more to you if you receive it today because you can invest the $100 for 3 years.

For capital budgeting decisions, the issue is how to value future cash flows in today’s dollars. The term cash flow refers to the amount of cash received or paid at a specific point in time. The term present value describes the value of future cash flows (both in and out) in today’s dollars.

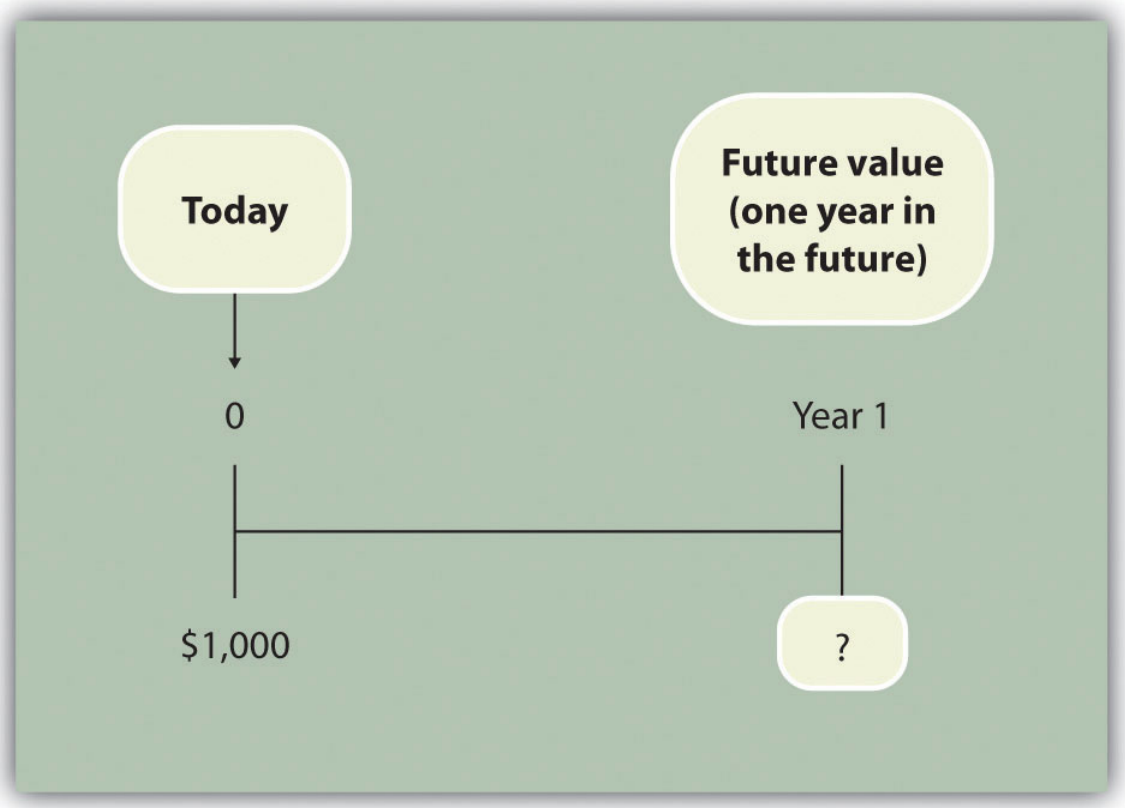
When managers evaluate investments in long-term assets, they want to know how much cash would be spent on the investment and how much cash would be received as a result of the investment. The investment proposal is likely rejected if cash inflows do not exceed cash outflows. (Think about a personal investment. If you would receive only $700 in the future from an investment of $1,000 today, you undoubtedly would not make the investment because you would lose $300!) If cash inflows are expected to exceed cash outflows, managers must consider *when* the cash inflows and outflows occur before taking on the investment. (Again, consider an investment of $1,000 today. If you expect to receive $1,050 in 20 years rather than at the end of 1 year, you would probably think twice before investing because it would take 20 years to make $50!)

Question: We use two methods to evaluate long-term investments, both of which consider the time value of money. What are these two methods?

Answer: The first is called the *net present value (NPV) method*, and the second is called the *internal rate of return method*. Before presenting these two methods, let’s discuss the time value of money (present value) concepts.

The Present Value Formula

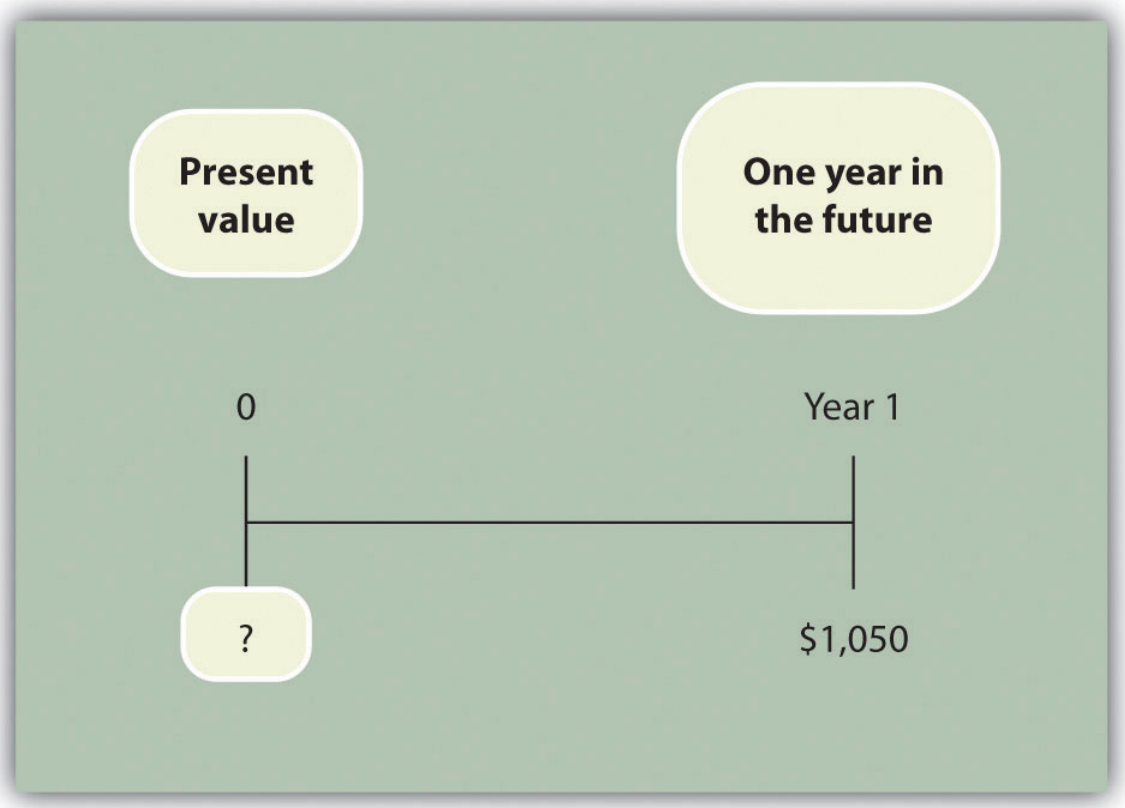
Question: Suppose you invest $1,000 for 1 year at an interest rate of 5 percent per year, as shown in the following timeline. How much will you have at the end of 1 year (or what is the **future value** *of the investment)?*



Answer: You will have $1,050:

$1,050 = $1,000 × (1 + .05)

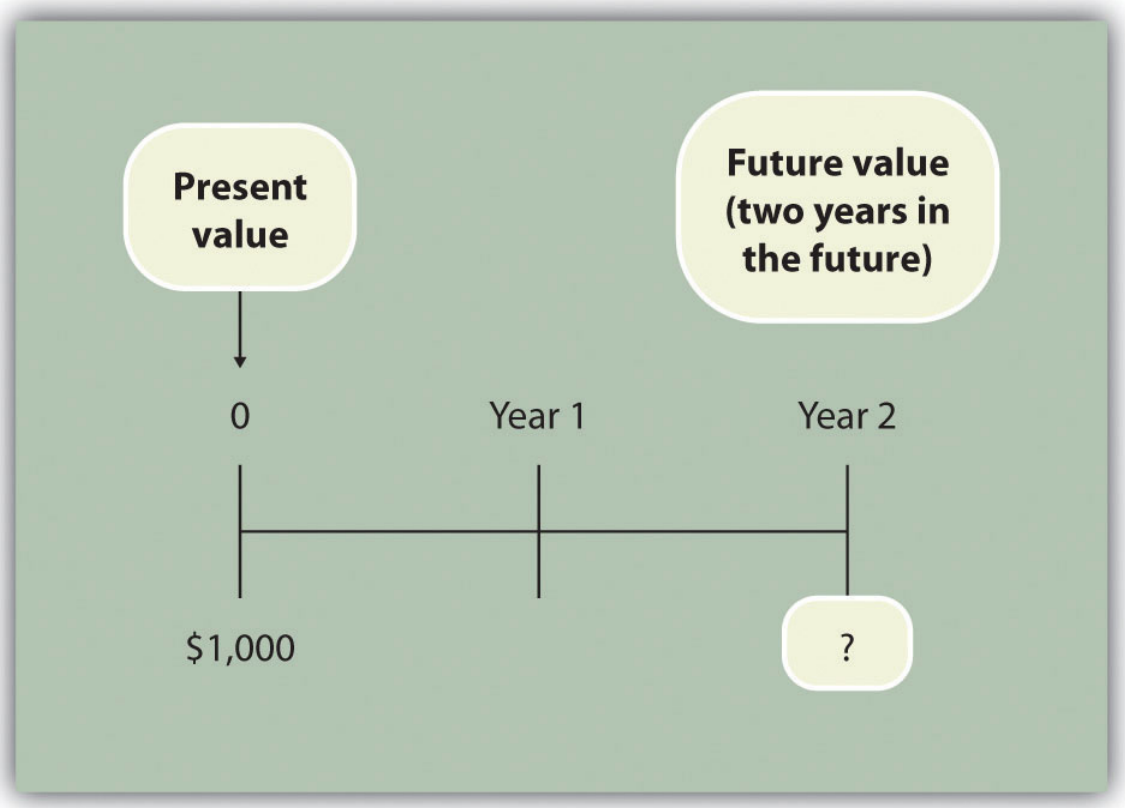
Question: Let's change course and find the present value *of the same future cash flow. If you receive $1,050 in 1 year, how much is that worth in today's dollars assuming an annual interest rate of 5 percent?*



Answer: The present value is $1,000, calculated as follows:

$1,000=$1,050 / (1+.05)

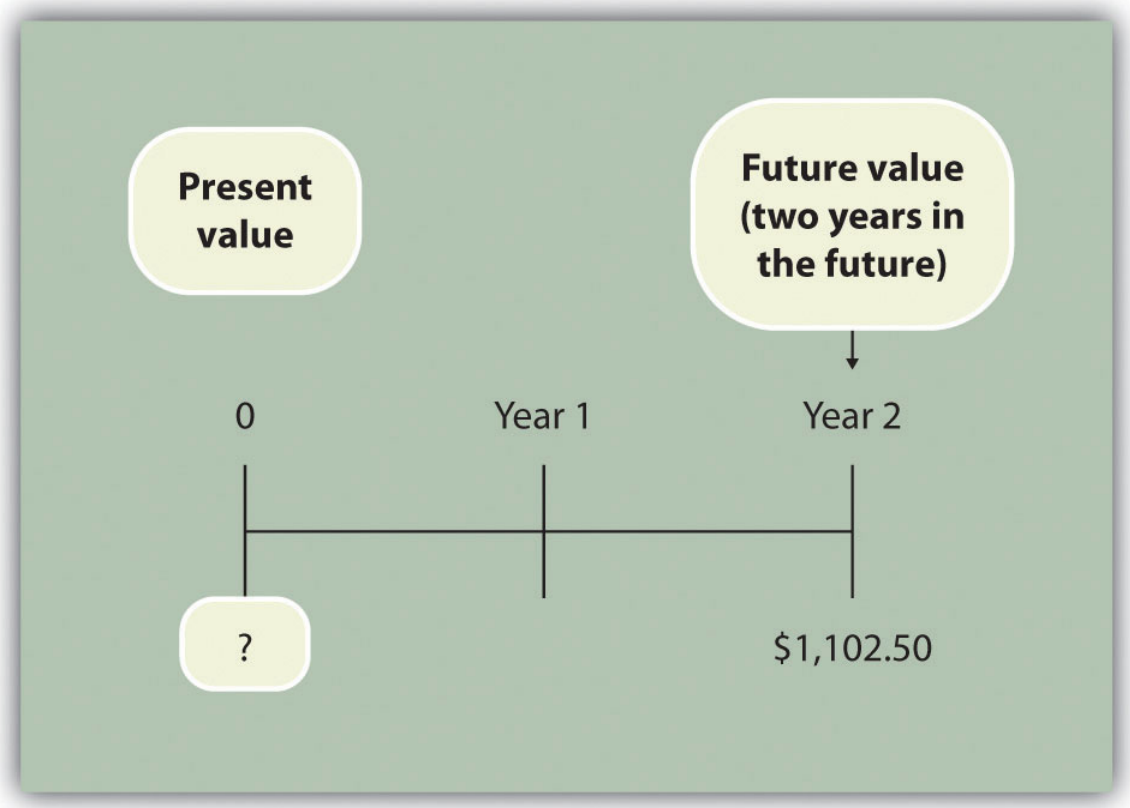
Question: Let's go back to finding a future value. Assume you invest $1,000 today at an annual rate of 5 percent for 2 years. How much will you have at the end of 2 years?



Answer: At the end of 1 year, you will have $1,050 (= $1,000 × [1 + .05]). At the end of the second year, you will have $1,102.50, which is $1,050 × (1 + .05). The equation is

$1,102.50 = $1,000 × (1 + .05) × (1 + .05)
or
$1,102.50 = $1,000 × $(1 + .05)^2$

Question: Again, let's change course and find the present value *of the same future cash flow. If you receive $1,102.50 in 2 years, how much is that worth in today's dollars assuming an annual interest rate of 5 percent?*



Answer: The present value is $1,000, calculated as follows:

$1,000=$1,102.50 / (1+.05)2

These examples show that one equation can be used to find the *present value* of a future cash flow. The equation is

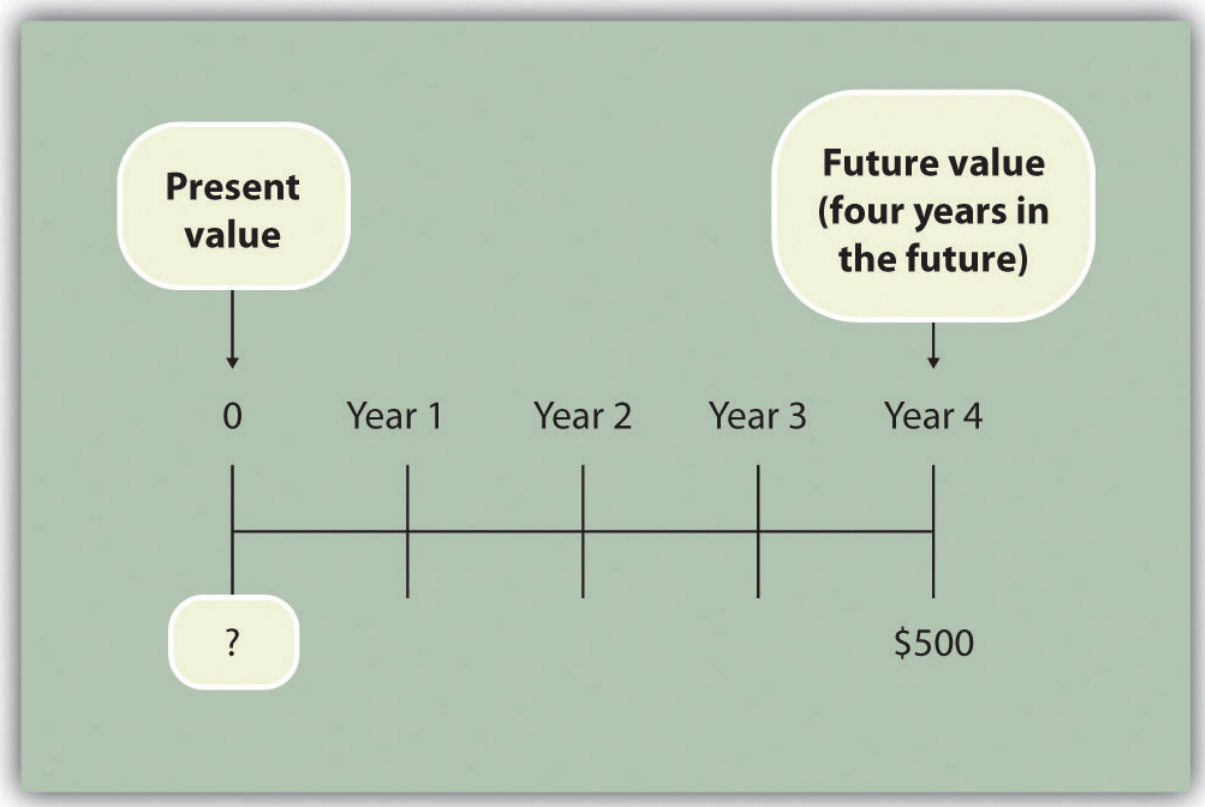
Key Equation

$P=Fn / (1+r)^n$

where

P = Present value of an amount
F_n = Amount received *n* years in the future
r = Annual interest rate
n = Number of years

Question: Let's use this formula to solve for the following: Assume $500 will be received 4 years from today, and the annual interest rate is 10 percent. What is the present value of this cash flow?



Answer: The present value is $341.51, calculated as follows:

$P=Fn / (1+r)^n=\$500 / (1+.10)^4=\$500 / 1.4641=\$341.51$

Present Value Tables

*Question: Although most managers use spreadsheets, such as Excel, to perform present value calculations (discussed later in this chapter), you can also use the present value tables in the appendix to this chapter, labeled Figure 5.9 "Present Value of $1 Received at the End of " and Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for ", for these calculations. Figure 5.9 "Present Value of $1 " simply provides the present value of $1 (i.e., F = $1) given the number of years (*n*) and the interest rate (*r*). How are these tables used to calculate present value amounts?*

Answer: Let's look at an example to see how these tables work. Assume $1 will be received 4 years from today (n = 4), and the interest rate is 10 percent (r = 10 percent). What is the present value of this cash flow? Look at Figure 5.9 "Present Value of $1 Received at the End of " in the appendix. Find the column labeled *10 percent* and the row labeled *4*. The present value is $0.6830, or $0.68 rounded. The table amount given is often called a *factor*. The factor in this example is 0.6830 (note that the formula to find this factor is shown at the top of Figure 5.9 "Present Value of $1 Received at the End of ").

Now assume all the same facts, except that $500 rather than $1 will be received in 4 years. To find the present value, simply multiply the factor found in Figure 5.9 "Present Value of $1 Received at the End of " by $500, as follows:

Present value=Amount received in the future × Present value factor=$500×0.6830=$341.50

Notice that this present value is the same as the one we calculated using the formula $P = F_n \div (1 + r)^n$, with the exception of a small difference due to rounding the factor in Figure 5.9 "Present Value of $1 Received at the End of ". Next, we use present value concepts to evaluate projects with the NPV method.

Key Takeaways

- Present value calculations tell us the value of future cash flows in today's dollars. The present value of a cash flow can be calculated by using the formula $P = F_n \div (1 + r)^n$. It can also be calculated by using the tables in the appendix of this chapter.

Simply find the factor in Figure 5.9 “Present Value of $1 Received at the End of ” given the number of years (n) and annual interest rate (r). Then multiply the factor by the future cash flow, as follows:

Present value = Amount received in the future × Present value factor

Check Yourself

For each of the following independent scenarios, calculate the present value of the cash flow described. Round to the nearest dollar.

1. You will receive $5,000, 5 years from today, and the interest rate is 8 percent.
2. You will receive $80,000, 9 years from today, and the interest rate is 10 percent.
3. You will receive $400,000, 20 years from today, and the interest rate is 20 percent.
4. You will receive $250,000, 10 years from today, and the interest rate is 15 percent.

Solution

Two approaches can be used to find the present value of a cash flow. The first requires using the formula $P = F_n \div (1 + r)^n$. The second requires using Figure 5.9 “Present Value of $1 Received at the End of ” in the appendix to find the present value factor and inserting it in the following formula:

Present value = Amount received in the future × Present value factor (from Figure 5.9 “Present Value of $1 Received at the End of “)

We show both approaches in the following solutions.

1. Using the formula $P = F_n \div (1 + r)^n$, we get

   $3,403=$5,000÷(1+.08)^5

   Using Figure 5.9 “Present Value of $1 Received at the End of “, we get

   Present value=Future value × Present value factor $3,403=$5,000×0.6806

2. Using the formula $P = F_n \div (1 + r)^n$, we get

   $33,928=$80,000÷(1+.10)^9

   Using Figure 5.9 “Present Value of $1 Received at the End of “, we get

   Present value=Future value × Present value factor $33,928=$80,000×0.4241

3. The small difference between the two approaches is due to rounding the factor in Figure 5.9 “Present Value of $1 Received at the End of “.

   Using the formula $P = F_n \div (1 + r)^n$, we get

   10,434=$400,000÷(1+.20)^{20}

   Using Figure 5.9 “Present Value of $1 Received at the End of “, we get

   Present value=Future value × Present value factor$10,440=$400,000×0.0261

4. The small difference between the two approaches is due to rounding the factor Figure 5.9 “Present Value of $1 Received at the End of “.

   Using the formula $P = F_n \div (1 + r)^n$, we get

   $61,796=$250,000÷(1+.15)^{10}

   Using Figure 5.9 “Present Value of $1 Received at the End of “, we get

   Present value=Future value × Present value factor $61,800=$250,000×0.2472

5.2 Net Present Value

Learning Objective

1. Evaluate investments using the net present value (NPV) approach.

Question: Now that we have the tools to calculate the present value of future cash flows, we can use this information to make decisions about long-term investment opportunities. How does this information help companies to evaluate long-term investments?

Answer: The net present value (NPV) is a method of evaluating investments adds the present value of all cash inflows and subtracts the present value of all cash outflows. The term *discounted cash flows* is also used to describe the NPV method. In the previous section, we described how to find the present value of a cash flow. The term *net* in *net present value* means to combine the present value of all cash flows related to an investment (both positive and negative).

Recall the problem facing Jackson's Quality Copies at the beginning of the chapter. The company's president and owner, Julie Jackson, would like to purchase a new copy machine. Julie feels the investment is worthwhile because the cash inflows over the copier's life total $82,000, and the cash outflows total $57,000, resulting in net cash inflows of $25,000 (= $82,000 – $57,000). However, this approach ignores the timing of the cash flows. We know from the previous section that the further into the future the cash flows occur, the lower the value in today's dollars.

Question: How do managers adjust for the timing differences related to future cash flows?

Answer: Most managers use the NPV approach. This approach requires three steps to evaluate an investment:

Step 1. Identify the amount and timing of the cash flows required over the life of the investment.

Step 2. Establish an appropriate interest rate to be used for evaluating the investment, typically called the required rate of return**.** (This rate is also called the *discount rate* or *hurdle rate*.)

Step 3. Calculate and evaluate the NPV of the investment.

Let's use Jackson's Quality Copies as an example to see how this process works.

Step 1. Identify the amount and timing of the cash flows required over the life of the investment.

Question: What are the cash flows associated with the copy machine that Jackson's Quality Copies would like to buy?

Answer: Jackson's Quality Copies will pay $50,000 for the new copier, which is expected to last 7 years. Annual maintenance costs will total $1,000 a year, labor cost savings will total $11,000 a year, and the company will sell the copier for $5,000 at the end of 7 years. Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies" summarizes the cash flows related to this investment. Amounts in parentheses are cash outflows. All other amounts are cash inflows.

Figure 5.1 Cash Flows for Copy Machine Investment by Jackson's Quality Copies

Timeline	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Purchase price	$(50,000)							
Maintenance cost		$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)
Labor savings		11,000	11,000	11,000	11,000	11,000	11,000	11,000
Salvage value								5,000
Total cash in (out)	$(50,000)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 15,000

Step 2. Establish an appropriate interest rate to be used for evaluating the investment.

Question: How do managers establish the interest rate to be used for evaluating an investment?

Answer: Although managers often estimate the interest rate, this estimate is typically based on the organization's *cost of capital*. The cost of capital is the weighted average costs associated with debt and equity used to fund long-term investments. The cost of debt is simply the interest rate associated with the debt (e.g., interest for bank loans or bonds issued). The cost of equity is more difficult to determine and represents the return required by owners of the organization. The weighted average of these two sources of capital represents the cost of capital (finance textbooks address the complexities of this calculation in more detail).

The general rule is the higher the risk of the investment, the higher the required rate of return (assume *required rate of return* is synonymous with *interest rate* for the purpose of calculating the NPV). A firm evaluating a long-term investment with risk similar to the firm's average risk will typically use the cost of capital. However, if a long-term investment carries higher than average risk for the firm, the firm will use a required rate of return higher than the cost of capital.

The accountant at Jackson's Quality Copies, Mike Haley, has established the cost of capital for the firm at 10 percent. Since the proposed purchase of a copy machine is of average risk to the company, Mike will use 10 percent as the required rate of return.

Step 3. Calculate and evaluate the NPV of the investment.

Question: How do managers calculate the NPV of an investment?

Answer: Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" shows the NPV calculation for Jackson's Quality Copies. Examine this table carefully. The cash flows come from Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies". The present value factors come from Figure 5.9 "Present Value of $1 Received at the End of " in the appendix (r = 10 percent; n = year). The bottom row, labeled *present value* is calculated by multiplying the total cash in (out) × present value factor, and it represents total cash flows for each time period in today's dollars. The bottom right of Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" shows the NPV for the investment, which is the sum of the bottom row labeled *present value*.

Figure 5.2 NPV Calculation for Copy Machine Investment by Jackson's Quality Copies

Timeline (n) ⟶	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
Purchase price	$(50,000)								
Maintenance cost		$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	$ (1,000)	
Labor savings		11,000	11,000	11,000	11,000	11,000	11,000	11,000	
Salvage value								5,000	
Total cash in (out)	$(50,000)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 15,000	
PV factor (r = 10%)	× 1.0000	× 0.9091	× 0.8264	× 0.7513	× 0.6830	× 0.6209	× 0.5645	× 0.5132	
Present value	$(50,000)+	$ 9,091 +	$ 8,264 +	$ 7,513 +	$ 6,830 +	$ 6,209 +	$ 5,645 +	$ 7,698 =	$ 1,250

The NPV is $1,250. Because NPV is > 0, accept the investment. (The investment provides a return greater than 10 percent.)

The NPV Rule

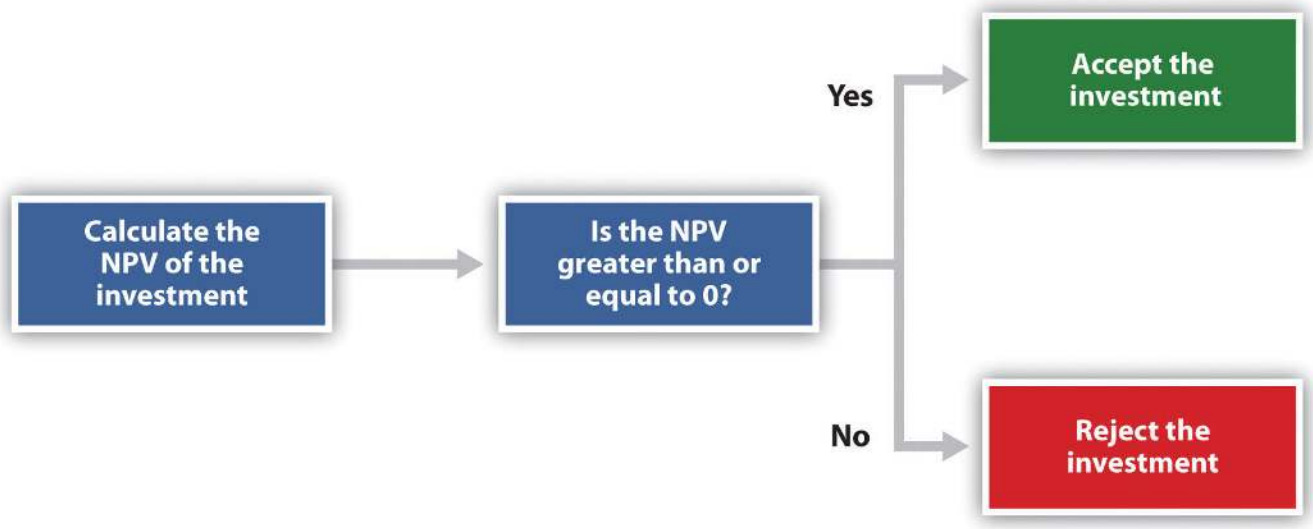
Question: Once the NPV is calculated, how do managers use this information to evaluate a long-term investment?

Answer: Managers apply the following rule to decide whether to proceed with the investment:

NPV Rule: *If the NPV is greater than or equal to zero, accept the investment; otherwise, reject the investment.*

As summarized in Figure 5.3 "The NPV Rule", if the NPV is greater than zero, the rate of return from the investment is higher than the required rate of return. If the NPV is zero, the rate of return from the investment equals the required rate of return. If the NPV is less than zero, the rate of return from the investment is less than the required rate of return. Since the NPV is greater than zero for Jackson's Quality Copies, the investment is generating a return greater than the company's required rate of return of 10 percent.

Figure 5.3 The NPV Rule



Note that the present value calculations in Figure 5.3 “The NPV Rule” assume that the cash flows for years 1 through 7 occur at the end of each year. In reality, these cash flows occur throughout each year. The impact of this assumption on the NPV calculation is typically negligible.

Business in Action 5.1

Cost of Capital by Industry

Cost of capital can be estimated for a single company or for entire industries. **New York University’s Stern School of Business** maintains cost of capital figures by industry. Almost 7,000 firms were included in accumulating this information. The following list shows industries with the highest cost of capital of the industries tracked by NYU. Notice that high-risk industries have relatively high costs of capital.

Transportation (Railroads)	11.17%
Computers/Peripherals	9.90%
Shipbuilding & Marine	9.37%
Software (Internet)	9.29%
Tobacco	8.83%
Precious Metals	8.73%
Drugs (Biotechnology)	8.60%
Drugs (Pharmaceutical)	8.51%
Software (Entertainment)	8.40%
Education	8.30%
Electrical Equipment	8.27%
Engineering/Construction	8.03%
Semiconductor	7.99%
Semiconductor Equip	7.94%
Entertainment	7.83%
Steel	7.82%
Paper/Forest Products	7.80%

Source: http://people.stern.nyu.edu/adamodar/New_Home_Page/datafile/wacc.htm

Annuity Tables

Question: Notice in Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies" that the rows labeled maintenance cost and labor savings have identical cash flows from one year to the next. Identical cash flows that occur in regular intervals, such as these at Jackson's Quality Copies, are called an annuity *. How can we use annuities in an alternate format to calculate the NPV?*

Answer: In Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies", we demonstrate an alternative approach to calculating the NPV.

Figure 5.4 Alternative NPV Calculation for Jackson's Quality Copies

Item Description	(A) Cash Flow In (Out)	(B) Present Value Factor (r = 10%)	(A) × (B) Present Value
Purchase price (today)	$ (50,000)	1.000*	$ (50,000)
Annual maintenance costs (years 1–7)	(1,000)	4.8684**	(4,868)
Annual labor savings (years 1–7)	11,000	4.8684**	53,552
Salvage value (end of year 7)	5,000	0.5132*	2,566
Net present value			$ 1,250

*Because this is not an annuity, use Figure 5.9 "Present Value of $1 Received at the End of " in the appendix.

**Because this is an annuity, use Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for " in the appendix. The number of years (n) equals seven since identical cash flows occur each year for seven years.

Note: the NPV of $1,250 is the same as the NPV in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies".

The *purchase price* and *salvage value* rows in Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies" represent one-time cash flows, and thus we use Figure 5.9 "Present Value of $1 Received at the End of " in the appendix to find the present value factor for these items (these are *not* annuities). The *annual maintenance costs* and *annual labor savings* rows represent cash flows that occur each year for seven years (these are annuities). We use Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for " in the appendix to find the present value factor for these items (note that the number of years, n, equals seven since the cash flows occur each year for seven years). Simply multiply the cash flow shown in column *(A)* by the present value factor shown in column *(B)* to find the present value for each line item. Then sum the present value column to find the NPV. This alternative approach results in the same NPV shown in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies".

Business in Action 5.2

Winning the Lottery

Like many other states, California pays out lottery winnings in installments over several years. For example, a $1,000,000 lottery winner in California will receive $50,000 each year for 20 years.

Does this mean that the State of California must have $1,000,000 on the day the winner claims the prize? No. In fact, California has approximately $550,000 in cash to pay $1,000,000 over 20 years. This $550,000 in cash represents the present value of a $50,000 annuity lasting 20 years, and the state invests it so that it can provide $1,000,000 to the winner over 20 years.

Source: California State Lottery, "California State Lottery Home Page," http://www.calottery.com.

Key Takeaways

- Present value calculations tell us the value of cash flows in today's dollars. The NPV method adds the present value of all cash inflows and subtracts the present value of all cash outflows related to a long-term investment. If the NPV is greater than or equal to zero, accept the investment; otherwise, reject the investment.

Check Yourself

The management of Chip Manufacturing, Inc., would like to purchase a specialized production machine for $700,000. The machine is expected to have a life of 4 years, and a salvage value of $100,000. Annual maintenance costs will total $30,000. Annual labor

and material savings are predicted to be $250,000. The company's required rate of return is 15 percent.

1. Ignoring the time value of money, calculate the net cash inflow or outflow resulting from this investment opportunity.
2. Find the NPV of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies".
3. Find the NPV of this investment using the format presented in Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies".
4. Should Chip Manufacturing, Inc., purchase the specialized production machine? Explain.

Solution

1. The net cash inflow, ignoring the time value of money, is $280,000, calculated as follows:

Timeline (*n*) ⟶	Today 0	Year 1	Year 2	Year 3	Year 4	
Purchase price	$(700,000)					
Maintenance costs		$ (30,000)	$ (30,000)	$ (30,000)	$ (30,000)	
Labor and material savings		250,000	250,000	250,000	250,000	
Salvage value					100,000	
Total cash in (out)	$(700,000) +	$220,000 +	$220,000 +	$220,000 +	$320,000 =	$ 280,000

2. The NPV is $(14,720), calculated as follows:

Timeline (*n*) ⟶	Today 0	Year 1	Year 2	Year 3	Year 4	
Purchase price	$(700,000)					
Maintenance costs		$ (30,000)	$ (30,000)	$ (30,000)	$ (30,000)	
Labor and material savings		250,000	250,000	250,000	250,000	
Salvage value					100,000	
Total cash in (out)	$(700,000)	$ 220,000	$ 220,000	$ 220,000	$ 320,000	
PV factor (r = 15%)	× 1.0000	× 0.8696	× 0.7561	× 0.6575	× 0.5718	
Present value	$(700,000) +	$ 191,312 +	$ 166,342 +	$ 144,650 +	$ 182,976 =	$ (14,720)

3. The alternative format used for calculating the NPV is shown as follows. Note that the NPV here is identical to the NPV calculated previously in part **2**.

Item Description	(A) Cash Flow In (Out)	(B) Present Value Factor (r = 15%)	(A) × (B) Present Value
Purchase price (today)	$(700,000)	1.000*	$ (700,000)
Annual maintenance costs (years 1–4)	(30,000)	2.8550**	(85,650)
Annual labor and material savings (years 1–4)	250,000	2.8550**	713,750
Salvage value (end of year 4)	100,000	0.5718*	57,180
Net present value			$ (14,720)

*Because this is not an annuity, use Figure 5.9 "Present Value of $1 Received at the End of " in the appendix.

**Because this is an annuity, use Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for " in the appendix. The number of years (n) equals four since identical cash flows occur each year for four years.

4. Because the NPV is less than 0, the return generated by this investment is less than the company's required rate of return of 15 percent. Thus Chip Manufacturing, Inc., should *not* purchase the specialized production machine.

5.3 The Internal Rate of Return

Learning Objectives

1. Evaluate investments using the internal rate of return (IRR) approach.

Question: Using the internal rate of return (IRR) to evaluate investments is similar to using the net present value (NPV) in that both methods consider the time value of money. However, the IRR provides additional information that helps companies evaluate long-term investments. What is the IRR, and how does it help managers make decisions related to long-term investments?

Answer: The internal rate of return (IRR) is the rate required (r) to get an NPV of zero for a series of cash flows. The IRR represents the time-adjusted rate of return for the investment being considered. The *IRR decision rule* states that if the IRR is greater than or equal to the company's required rate of return (recall that this is often called the *hurdle rate*), the investment is accepted; otherwise, the investment is rejected.

Most managers use a spreadsheet, such as Excel, to calculate the IRR for an investment (we discuss this later in the chapter). However, we can also use trial and error to approximate the IRR. *The goal is simply to find the rate that generates an NPV of zero.* Let's go back to the Jackson's Quality Copies example. Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies" provides the projected cash flows for a new copy machine and the NPV calculation using a rate of 10 percent. Recall that the NPV was $1,250, indicating the investment generates a return greater than the company's required rate of return of 10 percent.

Although it is useful to know that the investment's return is greater than the company's required rate of return, managers often want to know the exact return generated by the investment. (It is often not enough to state that the exact return is something higher than 10 percent!) Managers also like to rank investment opportunities by the return each investment is expected to generate. Our goal now is to determine the exact return—that is, to determine the IRR. We know from Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies" that the copy machine investment generates a return greater than 10 percent. Figure 5.5 "Finding the IRR for Jackson's Quality Copies" summarizes this calculation with the 2 columns under the 10 percent heading.

The far right side of Figure 5.5 "Finding the IRR for Jackson's Quality Copies" shows that the NPV is $(2,100) if the rate is increased to 12 percent (recall our goal is to find the rate that yields an NPV of 0). Thus the IRR is between 10 and 12 percent. Next, we try 11 percent. As shown in the middle of Figure 5.5 "Finding the IRR for Jackson's Quality Copies", 11 percent provides

an NPV of $(469). Thus the IRR is between 10 and 11 percent; it is closer to 11 percent because $(469) is closer to 0 than $1,250. (Note that as the rate *increases*, the NPV *decreases*, and as the rate *decreases*, the NPV *increases*.)

Figure 5.5 Finding the IRR for Jackson's Quality Copies

Item Description	Cash Flow In (Out)	10% Factor at 10%	10% Present Value	11% Factor at 11%	11% Present Value	12% Factor at 12%	12% Present Value
Purchase price (today)	$(50,000)	1.000*	$(50,000)	1.000*	$(50,000)	1.000*	$(50,000)
Maintenance cost (years 1–7)	(1,000)	4.8684**	(4,868)	4.7122**	(4,712)	4.5638**	(4,564)
Labor savings (years 1–7)	11,000	4.8684**	53,552	4.7122**	51,834	4.5638**	50,202
Salvage value (end of year 7)	5,000	0.5132*	2,566	0.4817*	2,409	0.4523*	2,262
Net present value			$ 1,250		$ (469)		$ (2,100)

*Because this is not an annuity, use Figure 5.9 "Present Value of $1 Received at the End of " in the appendix.

**Because this is an annuity, use Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for " in the appendix. The number of years (*n*) equals seven since identical cash flows occur each year for seven years.

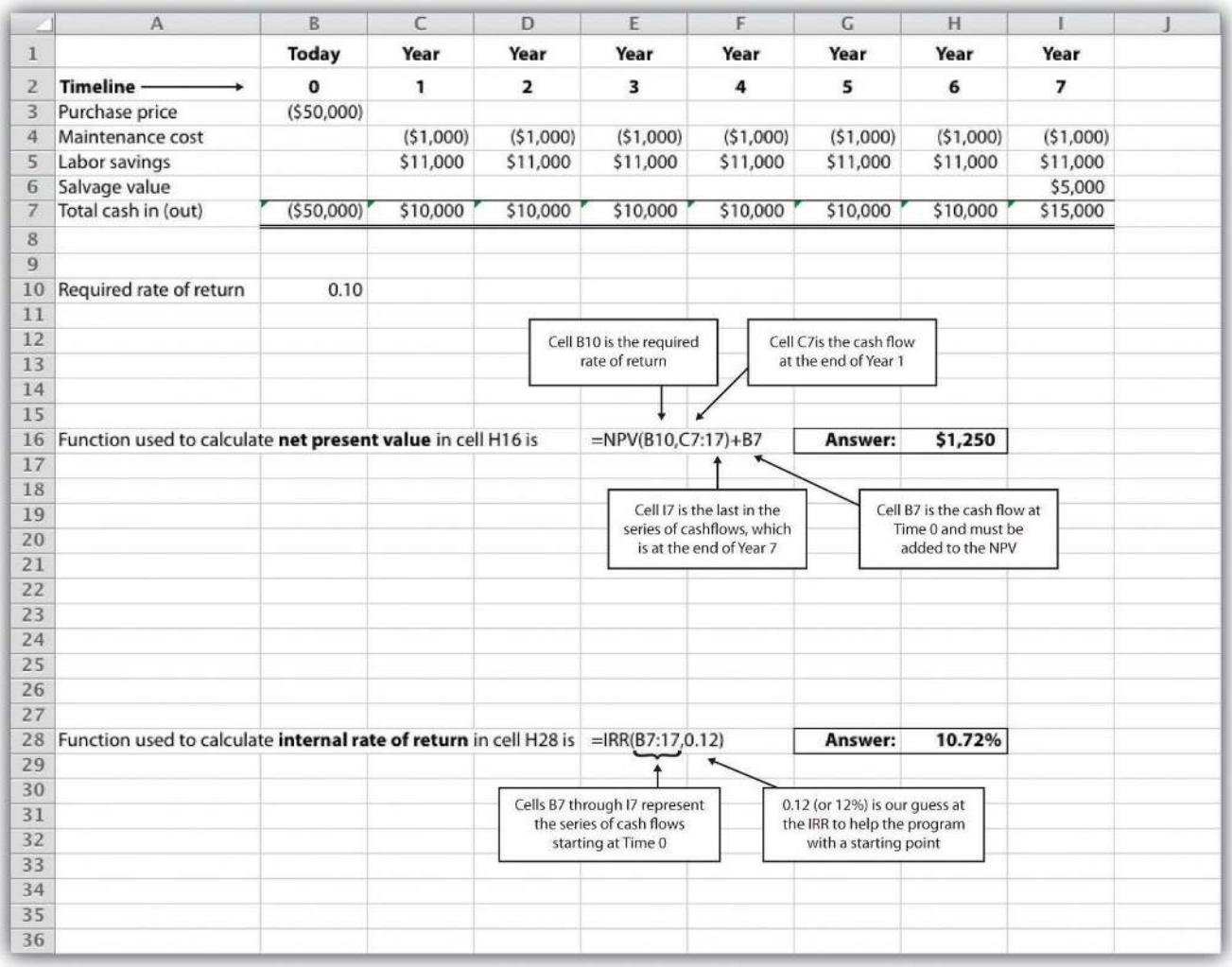
Note: the NPV of $(469) is closest to 0. Thus the IRR is close to 11 percent.

This trial and error approach allows us to approximate the IRR. As stated earlier, if the IRR is greater than or equal to the company's required rate of return, the investment is accepted; otherwise, the investment is rejected. For Jackson's Quality Copies, the IRR of approximately 11 percent is greater than the company's required rate of return of 10 percent. Thus the investment should be accepted.

Computer Application

Using Excel to Calculate NPV and IRR

Let's use the Jackson's Quality Copies example presented at the beginning of the chapter to illustrate how Excel can be used to calculate the NPV and IRR. Two steps are required to calculate the NPV and IRR using Excel. All cell references are to the following spreadsheet shown.



	A	B	C	D	E	F	G	H	I
1		Today	Year	Year	Year	Year	Year	Year	Year
2	Timeline →	0	1	2	3	4	5	6	7
3	Purchase price	($50,000)							
4	Maintenance cost		($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)
5	Labor savings		$11,000	$11,000	$11,000	$11,000	$11,000	$11,000	$11,000
6	Salvage value								$5,000
7	Total cash in (out)	($50,000)	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$15,000
10	Required rate of return	0.10							
16	Function used to calculate **net present value** in cell H16 is				=NPV(B10,C7:17)+B7		**Answer:**	**$1,250**	
28	Function used to calculate **internal rate of return** in cell H28 is				=IRR(B7:17,0.12)		**Answer:**	**10.72%**	

Step 1. Enter the data in the spreadsheet.

Rows 1 through 7 in the spreadsheet show the cash flows associated with the proposal to purchase a new copy machine at Jackson's Quality Copies (first presented in Figure 5.1 "Cash Flows for Copy Machine Investment by Jackson's Quality Copies").

Step 2. Input the functions to calculate NPV and IRR.

We selected cell H16 to calculate the NPV, so this is where the NPV function is input. Cell E16 shows the function in detail with dialogue boxes provided for clarification. Notice that the resulting NPV of $1,250 shown in cell H16 is the same as the NPV calculated in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies" and Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies".

We selected cell H28 to calculate the IRR, so this is where the IRR function is input. Cell E28 shows the function in detail. Notice that the resulting IRR of 10.72 percent shown in cell H28 is very close to our approximation of slightly less than 11 percent shown in Figure 5.5 "Finding the IRR for Jackson's Quality Copies".

As an alternative to entering a function directly into the spreadsheet, the NPV function under the *Formulas* menu in Excel can be used. Simply select the cell in the spreadsheet where you would like the answer to appear (H16 in this case), and go to the *Formulas* menu. Click on the *fx* symbol or *Insert Function* on the formula bar. Search for the function by typing in *NPV*, select *NPV* where it appears in the box, then select *OK*. When asked for the *Rate*, enter the cell where the rate appears (B10). Then under *Value 1* enter the cells containing the series of cash flows, starting with year 1 (shown as C7:I7, which means C7 through I7). Select *OK*. Now go back and add the cash flow at time 0 (B7) to the end of the NPV function. The resulting formula will look like the formula shown in E16, and the answer will appear in the cell where the function is entered (H16).

The IRR function can be inserted into a cell using the same process presented previously. Select the cell in the spreadsheet where you would like the answer to appear (H28), and go to the *Formulas* menu. Click on the *fx* symbol or *Insert Function* on the formula bar. Search for the function by typing in *IRR*, select *IRR* where it appears in the box below, then select *OK*. When asked for *Values*, enter the cells containing the series of cash flows, starting with time 0 (shown as B7:I7, which means B7 through I7 *the amount in the first referenced cell must be negative or excel will give you an error*). When asked for a *Guess*, enter your best guess as to what the IRR might be (this provides the system with a starting point), then select *OK*. The resulting formula will look like the formula shown in E28, and the answer will appear in the cell where the function is entered (H28).

Key Takeaways

- The IRR is the rate required (*r*) to get an NPV of zero for a series of cash flows and represents the time-adjusted rate of return for an investment. If the IRR is greater than or equal to the company's required rate of return (often called the hurdle rate), the investment is accepted; otherwise, the investment is rejected. Excel can be used to easily calculate the NPV and IRR.

5.4 Other Factors Affecting NPV and IRR Analysis

Learning Objectives

1. Understand the impact of cash flows, qualitative factors, and ethical issues on long-term investment decisions.

Question: We have described the net present value (NPV) and internal rate of return (IRR) approaches to evaluating long-term investments. With both of these approaches, there are several important issues that must be considered. What are these important issues?

Answer: These issues include focusing on cash flows, factoring in inflation, assessing qualitative factors, and ethical considerations. All are described next.

Focusing on Cash Flows

Question: Which basis of accounting is used to calculate the NPV and IRR for long-term investments, cash or accrual?

Answer: Both methods of evaluating long-term investments, NPV and IRR, focus on the amount of cash flows and when the cash flows occur. Note that the timing of revenues and costs in financial accounting using the accrual basis is often not the same as when the cash inflows and outflows occur. A sale can be recorded in one period, and the cash be collected in a future period. Costs can occur in one period, and the cash be paid in a future period. For the purpose of making NPV and IRR calculations, managers typically use the time period when the cash flow occurs.

When a company invests in a long-term asset, such as a production building, the cash outflow for the asset is included in the NPV and IRR analyses. The depreciation taken on the asset in future periods is not a cash flow and is *not* included in the NPV and IRR calculations. However, there is a cash benefit related to depreciation (often called a *depreciation tax shield*) since income taxes paid are reduced as a result of recording depreciation expense.

Factoring in Inflation

Question: Is inflation included in cash flow projections when calculating the NPV and IRR?

Answer: Most managers make cash flow projections that include an adjustment for inflation. When this is done, a rate must be used that also factors in inflation over the life of the investment. As discussed earlier in the chapter, the required rate of return used for NPV calculations is based on the firm's cost of capital, which is the weighted average cost of debt and equity. Since the cost of debt and equity already includes the effect of inflation, no inflation adjustment is necessary when establishing the required rate of return.

The important point here is that *cash flow projections must include adjustments for inflation to match the required rate of return, which already factors in inflation.* If cash flows are not adjusted for inflation, managers are likely underestimating future cash

flows and therefore underestimating the NPV of the investment opportunity. This is particularly pronounced for economies that have relatively high rates of inflation.

For the purposes of this chapter, assume all cash flows and required rates of return are adjusted for inflation.

Be Aware of Qualitative Factors

Question: So far, this chapter has focused on using cash flow projections and the time value of money to evaluate long-term investments. Using these quantitative factors to make decisions allows managers to support decisions with measurable data. For example, the investment opportunity at Jackson's Quality Copies presented at the beginning of the chapter was accepted because the NPV of $1,250 was greater than 0, and the IRR of 11 percent was greater than the company's required rate of return of 10 percent. Why do most companies also consider nonfinancial factors, often called qualitative factors, when making a long-term investment decision?

Answer: Although using quantitative factors for decision making is important, qualitative factors may outweigh the quantitative factors in making a decision. For example, a large manufacturer of medical devices recently invested several million dollars in a small start-up medical device firm. When asked about the NPV analysis, the manager responsible for the investment indicated, "My staff did a quick and dirty NPV analysis, which indicated we should not invest in the company. However, the technology they were using for their device was of such strategic importance to us, we could not pass up the investment." This is an example of *qualitative* factors (strategic importance to the company) outweighing *quantitative* factors (negative NPV).

Similar situations often arise when companies must invest in long-term assets even though NPV and IRR analyses indicate otherwise. Here are a few examples:

- Investing in new production facilities may be essential to maintaining a reputation as the industry leader in innovation, even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (It is difficult to quantify the benefits of being the "industry leader in innovation.")
- Investing in pollution control devices for an oil refinery may provide social benefits even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (Although a reduction in fines and legal costs may be quantifiable and included in the analyses, it is difficult to quantify the social benefits.)
- Investing in a new product line of entry-level automobiles may increase foot traffic at the showroom, resulting in increased sales of other products, even though the quantitative analysis (NPV and IRR) points to rejecting the investment. (It is difficult to quantify the impact of the new product line on sales of existing product lines.)

Clearly, managers must look at the financial information and analysis when considering whether to invest in long-term assets. However, the analysis does not stop with financial information. Managers and decision makers must also consider qualitative factors.

Business in Action 5.3 – Nike's financial statements and management explanation

Nike Cash Flow statement

Ethical Issues

Question: Our discussion of NPV and IRR methods implies that managers can easily make capital budgeting decisions once NPV and IRR analyses are completed and qualitative factors have been considered. However, managers sometimes make decisions that are not in the best interest of the company. Why might managers make decisions that are not in the best interest of the company?

Answer: Several examples are provided next.

Short-Term Incentives Affect Long-Term Decisions

Managers are often evaluated and compensated based on annual financial results. The financial results are typically measured using financial accounting data prepared on an accrual basis.

Suppose you are a manager considering an investment opportunity to start a new product line that has a positive NPV. Because the NPV is positive, you should accept the investment proposal. However, revenues and related cash inflows are not significant until after the second year. In the first two years, revenues are low and depreciation charges are high, resulting in significantly lower

overall company net income than if the project were rejected. Assuming you are evaluated and compensated based on annual net income, you may be inclined to reject the new product line regardless of the NPV analysis.

Many companies are aware of this conflict between the manager's incentive to improve short-term results and the company's goal to improve long-term results. To mitigate this conflict, some companies offer managers part ownership in the company (e.g., through stock options), creating an incentive to increase the value of the company over the long run.

Modifying Cash Flow Estimates to Get Approval

Managers often have a vested interest in getting proposals approved regardless of NPV and IRR results. For example, assume a manager spent several years developing a plan to construct a new production facility. Because of the significant work involved, and the projected benefits of building a new facility, the manager wants to see the proposal approved. However, the NPV analysis indicates the production facility proposal does not meet the company's minimum required rate of return. As a result, the manager decides to inflate projected cash inflows to get a positive NPV, and the project is approved.

Clearly, a conflict exists between the company's desire to accept projects that meet or exceed the required rate of return and the manager's desire to get approval for a "pet" project regardless of its profitability. Again, having part ownership in a company provides an incentive for managers to reject proposals that will not increase the value of the company.

Another way to mitigate this conflict is to conduct a postaudit, which compares the original capital budget with the actual results. Managers who provide misleading capital budget analyses are identified through this process. Postaudits provide an incentive for managers to provide accurate estimates.

Key Takeaways

- Although accountants are responsible for providing relevant and objective financial information to help managers make decisions, several important factors play a significant role in the decision-making process as described here:
  - NPV and IRR analyses use cash flows to evaluate long-term investments rather than the accrual basis of accounting.
  - Cash flow projections must include adjustments for inflation to match the required rate of return, which already factor in inflation.
  - Using quantitative factors to make decisions allows managers to support decisions with measurable data. However, nonfinancial factors (often called qualitative factors) must be considered as well.
  - Circumstances sometimes exist that cause managers to make decisions that are not in the best interest of the company. For example, managers may be evaluated on short-term financial results even though it is in the best interest of the company to invest in projects that are profitable in the long term. Thus projects that reduce short-term profitability in lieu of significant long-term profits may be rejected.

5.6 Additional Complexities of Estimating Cash Flows

Learning Objective

1. Evaluate investments with multiple investment and working capital cash flows.

Question: The examples in this chapter are intended to help you learn the basics of evaluating investments using the net present value (NPV), and internal rate of return (IRR). However, there are two additional items related to estimating cash flows that must be considered: investment cash outflows and working capital. How do these two items impact long-term investment decisions?

Answer: These items impact the analysis of long-term investments as described next.

Investment Cash Outflows

The examples thus far have assumed that cash outflows for the investment occur only at the beginning of the investment. However, some investments require cash outflows at varying points throughout the life of the project. For example, suppose the **Walmart**

plans to open a new store, which requires a $10,000,000 investment at the beginning of the project for construction of the building. However, the building will be expanded at the end of year 4, at a cost of $2,000,000, to meet an expected increase in demand. The $2,000,000 cash outflow must be included in the cash flows of the project for year 4 when calculating the NPV and IRR.

Working Capital

Working capital is defined as current assets (cash, accounts receivable, inventory, and the like) minus current liabilities (accounts payable, wages payable, and accrued liabilities, for instance). Many long-term investments require working capital. For example, **Walmart** will need cash in its registers when it opens the new store. Working capital is also required to fund inventory. Working capital necessary for long-term investments should be included as a cash outflow, typically at the beginning of the project.

Some long-term investments have an expected life, at the end of which working capital is returned to the company for investment elsewhere. When this happens, the working capital is included in the cash flow analysis as a cash *outflow* at the beginning of the project and a cash *inflow* at the end of the project.

Key Takeaways

- Investment proposals often include investment cash outflows at varying points throughout the life of the project. These cash flows must be included when evaluating investment proposals using NPV, and IRR. Many investments include working capital cash flows required to fund items such as inventory and accounts receivable. Working capital is included as a cash outflow, typically at the beginning of the project, and is often returned back to the company as a cash inflow later in the project.

Check yourself

The management of Environmental Engineering, Inc. (EEI), would like to open an office for 6 years in a high-growth area of Las Vegas. The initial investment required to purchase an office building is $250,000, and EEI needs $50,000 in working capital for the new office. Working capital will be returned to EEI at the end of 6 years. EEI expects to remodel the office at the end of 3 years at a cost of $200,000. Annual *net* cash receipts from daily operations (cash receipts minus cash payments) are expected to be as follows:

Year 1	$ 60,000
Year 2	$ 80,000
Year 3	$120,000
Year 4	$150,000
Year 5	$160,000
Year 6	$110,000

Although the company's cost of capital is 8 percent, management set a required rate of return of 12 percent due to the high risk associated with this project.

1. Find the NPV of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies".
2. Based on your answer to 1, should EEI open the new office? Explain.

Solution

1. The NPV is $27,571, as shown in the following figure.

Timeline (*n*) ⟶	Today 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	
Building cost	$(250,000)							
Working capital	(50,000)							
Net cash receipts		$ 60,000	$ 80,000	$120,000	$150,000	$ 160,000	$ 110,000	
Remodel cost				(200,000)				
Return of working capital							50,000	
Total cash in (out)	$(300,000)	$ 60,000	$ 80,000	$(80,000)	$150,000	$160,000	$160,000	
PV factor (r = 12%)	× 1.0000	× 0.8929	× 0.7972	× 0.7118	× 0.6355	× 0.5674	× 0.5066	
Present value	$(300,000) +	$ 53,574 +	$ 63,776 +	$(56,944) +	$ 95,325 +	$ 90,784 +	$ 81,056 =	$ 27,571

2. The NPV is $27,571. Because NPV is > 0, accept the investment. (The investment provides a return greater than 12 percent.)

5.8 Appendix: Present Value Tables

Figure 5.9 Present Value of $1 Received at the End of *n* Periods

Periods	Rate per Period														
	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	18%	20%	25%	30%
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8475	0.8333	0.8000	0.7692
2	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.7182	0.6944	0.6400	0.5917
3	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575	0.6086	0.5787	0.5120	0.4552
4	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718	0.5158	0.4823	0.4096	0.3501
5	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972	0.4371	0.4019	0.3277	0.2693
6	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323	0.3704	0.3349	0.2621	0.2072
7	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759	0.3139	0.2791	0.2097	0.1594
8	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269	0.2660	0.2326	0.1678	0.1226
9	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843	0.2255	0.1938	0.1342	0.0943
10	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472	0.1911	0.1615	0.1074	0.0725
11	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149	0.1619	0.1346	0.0859	0.0558
12	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869	0.1372	0.1122	0.0687	0.0429
13	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625	0.1163	0.0935	0.0550	0.0330
14	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413	0.0985	0.0779	0.0440	0.0254
15	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229	0.0835	0.0649	0.0352	0.0195
16	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069	0.0708	0.0541	0.0281	0.0150
17	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929	0.0600	0.0451	0.0225	0.0116
18	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808	0.0508	0.0376	0.0180	0.0089
19	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703	0.0431	0.0313	0.0144	0.0068
20	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611	0.0365	0.0261	0.0115	0.0053
21	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0768	0.0638	0.0531	0.0309	0.0217	0.0092	0.0040
22	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0680	0.0560	0.0462	0.0262	0.0181	0.0074	0.0031
23	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0601	0.0491	0.0402	0.0222	0.0151	0.0059	0.0024
24	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0532	0.0431	0.0349	0.0188	0.0126	0.0047	0.0018
25	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0471	0.0378	0.0304	0.0160	0.0105	0.0038	0.0014
26	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839	0.0663	0.0525	0.0417	0.0331	0.0264	0.0135	0.0087	0.0030	0.0011
27	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763	0.0597	0.0469	0.0369	0.0291	0.0230	0.0115	0.0073	0.0024	0.0008
28	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693	0.0538	0.0419	0.0326	0.0255	0.0200	0.0097	0.0061	0.0019	0.0006
29	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630	0.0485	0.0374	0.0289	0.0224	0.0174	0.0082	0.0051	0.0015	0.0005
30	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0256	0.0196	0.0151	0.0070	0.0042	0.0012	0.0004

Note: Factor=1(1+r)n

Figure 5.10 Present Value of a $1 Annuity Received at the End of Each Period for *n* Periods

Periods	Rate per Period														
	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	18%	20%	25%	30%
1	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.84746	0.8333	0.8000	0.7692
2	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.56564	1.5278	1.4400	1.3609
3	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.17427	2.1065	1.9520	1.8161
4	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.69006	2.5887	2.3616	2.1662
5	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.12717	2.9906	2.6893	2.4356
6	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.4976	3.3255	2.9514	2.6427
7	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	3.8115	3.6046	3.1611	2.8021
8	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.0776	3.8372	3.3289	2.9247
9	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716	4.3030	4.0310	3.4631	3.0190
10	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.4941	4.1925	3.5705	3.0915
11	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	4.6560	4.3271	3.6564	3.1473
12	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	4.7932	4.4392	3.7251	3.1903
13	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	4.9095	4.5327	3.7801	3.2233
14	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.0081	4.6106	3.8241	3.2487
15	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.0916	4.6755	3.8593	3.2682
16	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542	5.1624	4.7296	3.8874	3.2832
17	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.2223	4.7746	3.9099	3.2948
18	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280	5.2732	4.8122	3.9279	3.3037
19	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982	5.3162	4.8435	3.9424	3.3105
20	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.3527	4.8696	3.9539	3.3158
21	12.8212	11.7641	10.8355	10.0168	9.2922	8.6487	8.0751	7.5620	7.1016	6.6870	6.3125	5.3837	4.8913	3.9631	3.3198
22	13.1630	12.0416	11.0612	10.2007	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	5.4099	4.9094	3.9705	3.3230
23	13.4886	12.3034	11.2722	10.3711	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	5.4321	4.9245	3.9764	3.3254
24	13.7986	12.5504	11.4693	10.5288	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	5.4509	4.9371	3.9811	3.3272
25	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	8.4217	7.8431	7.3300	6.8729	6.4641	5.4669	4.9476	3.9849	3.3286
26	14.3752	13.0032	11.8258	10.8100	9.9290	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	5.4804	4.9563	3.9879	3.3297
27	14.6430	13.2105	11.9867	10.9352	10.0266	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	5.4919	4.9636	3.9903	3.3305
28	14.8981	13.4062	12.1371	11.0511	10.1161	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	5.5016	4.9697	3.9923	3.3312
29	15.1411	13.5907	12.2777	11.1584	10.1983	9.3696	8.6501	8.0218	7.4701	6.9830	6.5509	5.5098	4.9747	3.9938	3.3317
30	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.6938	8.0552	7.4957	7.0027	6.5660	5.5168	4.9789	3.9950	3.3321

Note: Factor=1−(1+r)−nr

End-of-Chapter Exercises

Questions

1. What is the difference between capital budgeting decisions covered in this chapter and management decisions covered in Chapter 4 “How Are Relevant Revenues and Costs Used to Make Decisions?”?
2. What concept must be considered when looking at cash flows over several years for a long-term investment? Explain.
3. What is meant by the term *present value*?
4. What is the formula used to calculate the present value of a future cash flow? Describe each component.
5. Describe the three steps required to evaluate investments using the net present value method.
6. How do most firms establish the required rate of return used to calculate the net present value?
7. What is meant by the term *internal rate of return*? Explain the IRR decision rule?

8. For the purpose of calculating net present value and internal rate of return, do companies use the accrual basis of accounting? Explain.
9. Why might a firm choose to accept a long-term investment even if the net present value is below zero?
10. What might cause a manager to reject a long-term investment even though the net present value is positive?
11. Describe the two steps required to calculate net present value and internal rate of return when using Excel.
12. What does the term *working capital* refer to, and how does working capital affect the evaluation of long-term investments?

Brief Exercises

13. Investment Decision at Jackson's Quality Copies. Refer to the dialogue at Jackson's Quality Copies presented at the beginning of the chapter. What is Julie Jackson proposing? What information did Mike, the accountant, get from Julie to evaluate the proposal?

14. Present Value Calculations. For each of the following independent scenarios, use Figure 5.9 "Present Value of $1 Received at the End of " in the appendix to calculate the present value of the cash flow described.

1. $10,000 will be received 4 years from today. The rate is 10 percent.
2. $10,000 will be received 4 years from today. The rate is 20 percent.
3. $50,000 will be received 15 years from today. The rate is 12 percent.
4. $50,000 will be received 15 years from today. The rate is 6 percent.

15. Present Value Calculations (Annuities). For each of the following independent scenarios, use Figure 5.10 "Present Value of a $1 Annuity Received at the End of Each Period for " in the appendix to calculate the present value of the cash flow described. Round to the nearest dollar.

1. $1,000 will be received at the end of each year for 6 years. The rate is 12 percent.
2. $1,000 will be received at the end of each year for 6 years. The rate is 15 percent.
3. $10,000 will be received at the end of each year for 6 years. The rate is 7 percent.
4. $250,000 will be received at the end of each year for 4 years. The rate is 10 percent.

16. Net Present Value Calculations. Freefall, Inc., has two independent investment opportunities, each requiring an initial investment of $65,000. The company's required rate of return is 8 percent. The cash inflows for each investment are provided as follows.

	Investment Y	Investment Z
Year 1	$ 35,000	$ 5,000
Year 2	25,000	15,000
Year 3	15,000	25,000
Year 4	5,000	35,000
Total inflows	$ 80,000	$ 80,000

Required:

1. Without resorting to calculations, which investment will have the highest net present value? Explain.

Calculate the net present value for each investment (remember to include the initial investment cash outflow in your calculation). Should the company invest in either investment? Round to the nearest dollar.

17. Internal Rate of Return Calculation. An investment costing $50,000 today will result in cash savings of $5,000 per year for 15 years. Use trial and error to approximate the internal rate of return for this investment proposal.

18. Evaluating Qualitative Factors. Chem, Inc., produces chemical products. The company recently decided to invest in expensive pollution control devices even though the negative net present value pointed toward rejecting this investment. What qualitative factor likely led the company to make the investment in spite of the negative net present value?

19. Ethical Issues in Making a Capital Budgeting Decision. Assume the manager of a store earns an annual bonus based on meeting a certain level of net income, which has been achieved consistently over the past five years. The company is currently considering the addition of a second store, which is expected to become profitable after two years. The manager is responsible for making the final decision whether the second store should be opened and would receive an annual bonus only if a certain level of net income were achieved for both stores combined.

Why might the manager refuse to invest in the new store even though the investment is projected to achieve a return greater than the company's required rate of return?

20. Net Present Value Calculation Using Excel. An investment costing $200,000 today will result in cash savings of $85,000 per year for 3 years. The company's required rate of return is 11 percent. Use Excel to calculate the net present value of this investment in a format similar to the one in the *Computer Application* box in the chapter.

21. Net Present Value Analysis with Multiple Investments. A project requiring an investment of $20,000 today and $10,000 one year from today, will result in cash savings of $4,000 per year for 15 years. Find the net present value of this investment using a rate of 10 percent. Round to the nearest dollar.

Exercises:

22. Net Present Value Analysis. Architect Services, Inc., would like to purchase a blueprint machine for $50,000. The machine is expected to have a life of 4 years, and a salvage value of $10,000. Annual maintenance costs will total $14,000. Annual savings are predicted to be $30,000. The company's required rate of return is 11 percent.

Required:

1. Ignoring the time value of money, calculate the net cash inflow or outflow resulting from this investment opportunity.
2. Find the net present value of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies". Should the company purchase the blueprint machine? Explain.

23. Internal Rate of Return Analysis. Architect Services, Inc., would like to purchase a blueprint machine for $50,000. The machine is expected to have a life of 4 years, and a salvage value of $10,000. Annual maintenance costs will total $14,000. Annual savings are predicted to be $30,000. The company's required rate of return is 11 percent (this is the same data as the previous exercise).

Required:

1. Use trial and error to approximate the internal rate of return for this investment proposal. Round to the nearest dollar.
2. Should the company purchase the blueprint machine? Explain.

24. Net Present Value Analysis with Multiple Investments, Alternative Format. Conway Construction Corporation would like to purchase a fleet of trucks at a cost of $260,000. Additional equipment needed to maintain the fleet of trucks will be purchased at the end of year 2 for $40,000. The trucks are expected to have a life of 8 years, and a salvage value of $20,000. Annual costs for maintenance, insurance, and other cash expenses will total $42,000. Annual net cash receipts resulting from this purchase are predicted to be $135,000. The company's required rate of return is 14 percent.

Required:

1. Find the net present value of this investment using the format presented in Figure 5.4 "Alternative NPV Calculation for Jackson's Quality Copies".
2. Should the company purchase the new fleet of trucks? Explain.

25. Calculating NPV and IRR Using Excel. Wood Products Company would like to purchase a computerized wood lathe for $100,000. The machine is expected to have a life of 5 years, and a salvage value of $5,000. Annual maintenance costs will total

$20,000. Annual net cash receipts resulting from this machine are predicted to be $45,000. The company's required rate of return is 15 percent.

Required:

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company purchase the wood lathe? Explain.

Problems

26. Evaluating Alternative Investments. Washington Brewery has two independent investment opportunities to purchase brewing equipment so the company can meet growing customer demand. The first option (equipment A) requires an initial investment of $230,000 for equipment with an expected life of 5 years and a salvage value of $20,000. The second option (equipment B) requires an initial investment of $120,000 for equipment with an expected life of 4 years and a salvage value of $15,000. The company's required rate of return is 10 percent. Additional cash flow information for each investment is provided as follows.

	Year 1	Year 2	Year 3	Year 4	Year 5
Equipment A					
Utility savings	$ 12,000	$ 14,000	$ 15,000	$ 16,000	$ 17,000
Additional revenue	45,000	48,000	50,000	55,000	60,000
Maintenance costs	(5,000)	(8,000)	(10,000)	(13,000)	(16,000)
Equipment B					
Utility savings	$ 8,000	$ 9,000	$ 10,000	$ 10,000	–
Additional revenue	35,000	36,000	38,000	42,000	–
Maintenance costs	(6,000)	(8,000)	(9,000)	(11,000)	–

Required:

1. Calculate the net present value for each investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies". (Remember to include the initial investment cash outflow and salvage value in your calculation.) Round to the nearest dollar
2. Which, if any, investment is preferable? Explain.

27. Calculating NPV and IRR Using Excel. Sherwin Moore Paint Company would like to further automate its production process by purchasing production equipment for $660,000. The equipment is expected to have a useful life of 8 years, and will be

sold at the end of 8 years for $40,000. The equipment requires significant maintenance work at an annual cost of $75,000. Labor and material cost savings, shown in the table, are also expected to be significant.

Year 1	$160,000
Year 2	$190,000
Year 3	$200,000
Year 4	$240,000
Year 5	$280,000
Year 6	$220,000
Year 7	$180,000
Year 8	$155,000

The company's required rate of return is 11 percent.

Required:

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company purchase the production equipment? Explain.

28. Calculating NPV and IRR Using Excel. Oil Production, Inc., would like to drill oil from land the company already owns. The equipment is expected to cost $4,000,000, has a useful life of 5 years, and will be sold at the end of 5 years for $400,000. Annual costs for maintenance and other cash expenses will total $550,000. Annual net cash receipts resulting from the sale of oil are predicted to be $1,900,000. Working capital of $270,000 is required at the beginning of the project and will be returned at the end of 5 years. The equipment will require refurbishing at the end of year 3 at a cost of $300,000. Although the company's cost of capital is 15 percent, management established a required rate of return of 20 percent due to the high risk associated with this project.

Required:

1. Use Excel to calculate the net present value and internal rate of return in a format similar to the *Computer Application* spreadsheet shown in the chapter.
2. Should the company accept the proposal? Explain.

29. Net Present Value and Internal Rate of Return; Ethical Issues. Tower CD Stores would like to open a retail store in Houston. The initial investment to purchase the building is $420,000, and an additional $50,000 in working capital is required. Since this store will be operating for many years, the working capital will not be returned in the near future. Tower expects to remodel the store at the end of 3 years at a cost of $100,000. Annual net cash receipts from daily operations (cash receipts minus cash payments) are expected to be as follows.

Year 1	$ 80,000
Year 2	$115,000
Year 3	$118,000
Year 4	$140,000
Year 5	$155,000
Year 6	$167,000
Year 7	$175,000

The company's required rate of return is 13 percent. Assume management decided to limit the analysis to 7 years.

Required:

1. Find the net present value of this investment using the format presented in Figure 5.2 "NPV Calculation for Copy Machine Investment by Jackson's Quality Copies". Round to the nearest dollar.
2. Use Excel to calculate the internal rate of return for this investment proposal.
3. Based on your answer to requirements 1 and 2, should Tower open the new store? Explain.
4. Assume the manager of the company wanted to live in Houston and intentionally inflated the projected annual cash receipts so that the proposal would be accepted. The proposal would otherwise have been rejected. Explain how the company's use of a postaudit would help to prevent this type of unethical behavior.

One Step Further: Skill-Building Cases

30. Internet Project: Capital Expenditures at Intel. Go to **Intel's** Web site (http://www.intel.com) and review the *Consolidated Statements of Cash Flows* portion of the company's financial statements. Find the *Additions to property, plant and equipment* line item in the *Investing Activities* section of the statement, and answer the following questions. Be sure to submit a printed copy of the consolidated statements of cash flows with your answers.

1. How much cash did **Intel** spend on additions to property, plant, and equipment in the most current year? How does this amount compare with amounts spent in the previous two years?
2. Describe two capital budgeting decision techniques that were likely used by **Intel**to make long-term investment decisions.

31.Group Activity: Qualitative Factors. Each of the following scenarios is being considered at three separate companies.

1. A large regional energy company uses coal to produce electricity that is sold to local power companies. Although government regulations will not require a cleaner process for at least five years, the company is considering spending millions of dollars on equipment that will reduce pollutants from its production process. However, the net present value analysis indicates this proposal should be rejected.
2. A producer of mountain bikes known for its expensive, high-quality bikes would like to introduce a less expensive entry-level line of mountain bikes. However, the projected internal rate of return for this proposal is lower than the company's minimum required rate of return.
3. A maker of computer chips with a reputation of staying on the cutting edge of technology would like to invest in a new production facility. However, the net present value analysis indicates this proposal should be rejected.

   Required:

   Your instructor will divide the class into groups of two to four students, and assign one of the three independent scenarios listed previously to each group. Each group must perform the requirements listed here:

   1. Identify at least two qualitative factors that may lead to accepting the proposal.
   2. Discuss each option, based on the findings of your group, with the class.

Comprehensive Cases

32. Ethical Issues in Capital Budgeting. Loomis Nursery grows a variety of plants for wholesale distribution. The company would like to expand its operations and is considering a move to one of two locations. The first location, Wyatville, is one hour from the ocean and therefore attractive for employees who like to travel on weekends. The second location, Kenton, is not as close to the ocean, and much further from desirable vacation destinations.

The company's controller, Lisa Lennox, created a net present value analysis for each location. The Kenton location had a positive net present value, and the Wyatville location had a negative net present value. Upon providing this information to the chief financial officer of the company, Max Madden, Lisa was asked to "review the numbers carefully and make sure all the benefits of moving to Wyatville were included in the analysis." Lisa knew that Max preferred vacationing near the ocean and had a strong desire to move operations to Wyatville. However, she was unable to find any errors in her analysis and could not identify any additional benefits.

Lisa approached Max with this information. Max responded, “There is no way Kenton should have a higher net present value than Wyatville. Redo your analysis to show that Wyatville has the highest net present value, and have it on my desk by the end of the week.”

Required:

1. Is Max Madden’s request ethical? Explain.
2. How should Lisa handle this situation? (It may be helpful to review the presentation of ethics in Chapter 1 “What Is Managerial Accounting?”.)

33. Ethical Issues in Capital Budgeting. Toyonda Motor Company produces a variety of products including motorcycles, all-terrain vehicles, marine engines, automobiles, light trucks, and heavy-duty trucks. Each division manager at Toyonda Motor Company is paid a base salary and is given an annual cash bonus if the division achieves profits of at least 10 percent of the value of assets invested in the division (this is called *return on investment*).

Peggy Parkins, manager of the Light Truck Division, is considering investing in new production equipment. The net present value of the proposal is positive, and Peggy is convinced the new equipment will provide a competitive edge in future years. However, because of the significant up-front cost and related depreciation, short-term profits will be negatively affected by this investment. In fact, the new equipment will reduce return on investment below the 10 percent threshold for at least 3 years, which will prevent Peggy from receiving her annual bonuses for at least 3 years. However, profits are expected to increase significantly after the three-year period. Peggy is planning to retire in two years and therefore would prefer to reject the proposal to invest in new production equipment.

Required:

1. Describe the ethical conflict facing Peggy Parkins.
2. What type of employee compensation system might prevent this type of conflict?

5: How Is Capital Budgeting Used to Make Decisions? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

6: How Are Operating Budgets Created?

Jerry Feltz is the president and owner of Jerry's Ice Cream, a producer of high-quality ice cream sold to specialty grocery stores. Jerry is holding a meeting with the company's managers to discuss plans for this coming year. Managers at the meeting are Tom Benson, the sales manager; Lynn Young, the production manager; and Michelle Hopkins, the treasurer and controller.

Jerry:
It looks as if we are having another great year. Customers love our ice cream, and sales are up. It's time to begin the budgeting process for next year. Tom, do you have any thoughts on what our sales will look like for next year?

Tom:
I think we will continue to see significant sales growth. But it's difficult to predict exactly how much growth. On the low end, I would expect about 10 percent; on the high end, perhaps 25 percent.

Lynn:
Wow! I knew sales were going well, but I had no idea we were expecting to grow 10 percent to 25 percent next year. It will take some serious planning to produce enough ice cream to handle this growth.

Michelle:
I agree. We need to make sure production has enough capacity to handle the growth, and cash flow planning will be critical to ensure we don't run out of cash in the process of ramping up production.

Jerry:
Tom, talk with our salespeople and industry contacts so we can get a solid estimate of quarterly sales for next year. If sales really are expected to grow as you say, we will face a huge challenge!

Tom:
I'll have something for you by the end of next week.

Michelle:
I'll start the budgeting process once we have the sales information from Tom.

Lynn:
The sooner we start the budgeting process, the better, particularly if I have to hire more employees and find more production space.

Jerry:
Let's meet in two weeks to discuss the results of Tom's research and to set up a plan to handle the growth. Thanks for your help!

Many companies encounter the same issue of growing sales that is facing Jerry's Ice Cream. Those that *plan* for growth have a better chance of succeeding than those that sit idle and hope it all works out. Operating budgets are used to (1) plan operations and (2) control operations. We describe both of these objectives next and then devote the remainder of this chapter to the planning phase by creating an operating budget for Jerry's Ice Cream. We cover the control phase in Principles of Managerial Accounting 2.

6.1 Planning and Controlling Operations

Learning Objective

1. Understand how operating budgets are used for planning and control.

Question: If you have established a personal budget, you know the importance of planning to achieve your goals. Assume one of your goals is to purchase a new car. It is not enough to simply state, "I want to buy a new car next year." If you do not plan ahead for a big expense like this, you may find that you don't have enough money for a reasonable down payment or that you have very large monthly payments. If you plan ahead, you may see that working some additional hours, cutting back on entertainment, or a combination of both, allows you to buy the car and avoid these problems. Organizations are no different, except their needs tend to be more involved. How do organizations formally plan for the future?

Answer: Let's look at Jerry's Ice Cream to answer this question. The company wants to increase sales next year, but will have difficulty doing this without some type of plan, often called a *budget*. An operating budget is a short-term budget (typically one year) that focuses on the daily operations of the organization. Before presenting the detailed schedules of an operating budget, we first discuss how organizations use budgets to *plan* and *control* their activities.

The Planning Phase

Question: How are budgets used to help organizations plan future activities?

Answer: Budgets are established in advance to help organizations communicate their plans to employees and to help employees coordinate activities across the entire organization. Imagine Jerry's Ice Cream operating without a budget. If production has no forewarning of an increase in customer demand, Lynn Young, production manager, has no opportunity to plan for an increase in production. Inefficiencies will occur as Lynn struggles to keep pace with demand (e.g., employees working overtime or materials purchased at the last minute at a premium). Cash flow may suffer as spending initially outpaces cash receipts, which would force the company to borrow money quickly at a high interest rate. In the worst case, the company would run out of product, miss out on sales, and perhaps run out of cash.

Turn the example around and assume Jerry's Ice Cream does have a budget in place for the coming year. The budget communicates the organization's plans to Lynn, production manager, and Michelle, treasurer and controller, showing that sales are expected to increase. Lynn can then plan accordingly by hiring additional employees, arranging for the purchase of additional materials, and finding more space for production. Michelle can also plan accordingly by arranging for a short-term loan at a reasonable interest rate to meet short-term cash needs. As described here, the planning phase uses the budget to communicate plans to employees and to help employees coordinate activities across the organization.

The Control Phase

Question: How do organizations use budgets to control operations?

Answer: Organizations use budgets to evaluate performance. By comparing the budget with actual results, companies can determine whether employees, and the company as a whole, have performed as expected.

For example, assume Jerry's Ice Cream estimates sales for the first quarter of next year will be 40,000 units at $6 per unit. Actual sales turn out to be 38,000 units at $6.20 per unit. The company can evaluate sales manager Tom Benson's performance by comparing the budget to actual results. For unit sales, Tom did not perform as well as expected (38,000 units actually sold versus 40,000 in budgeted unit sales). However, Tom exceeded expectations for sales price ($6.20 per unit actual sales price versus budgeted sales price of $6).

We now turn to the process of creating an operating budget to plan a company's operations for the coming year. Creating an operating budget is an essential part of business. Depending on the type of product offered and the size of the company, operating budgets vary widely in complexity. International companies in particular face difficult hurdles when it comes to budgeting, as described below.

Business in Action 6.1

Challenges of Budgeting for International Operations

Companies with operations in several different countries, called *multinational companies*, face numerous challenges in establishing operating budgets. Most experts agree that foreign exchange rates have the biggest impact on budgeting for multinationals. Specific exchange rates are used when the budget is established. However, these rates can fluctuate significantly and are likely to differ when companies compare actual results with the initial budget. This makes the budget control process difficult because exchange rate variations might cause the differences between actual results and the budget.

Exchange rate fluctuations, along with other market characteristics—such as economic uncertainty and unpredictable government activities—make budgeting for multinational companies a challenging task.

Source: Ken Milani and Juan Rivera, "The Rigorous Business of Budgeting for International Operations," *Management Accounting Quarterly* 5, no. 2 (2004): 38–50.

Key Takeaways

- Organizations establish budgets to communicate their plans to employees and to coordinate the activities of employees across the entire organization. Budgets are often compared with actual results to evaluate employee and organizational performance.

6.2 The Budgeting Process

Learning Objective

1. Understand the process used to establish budgets.

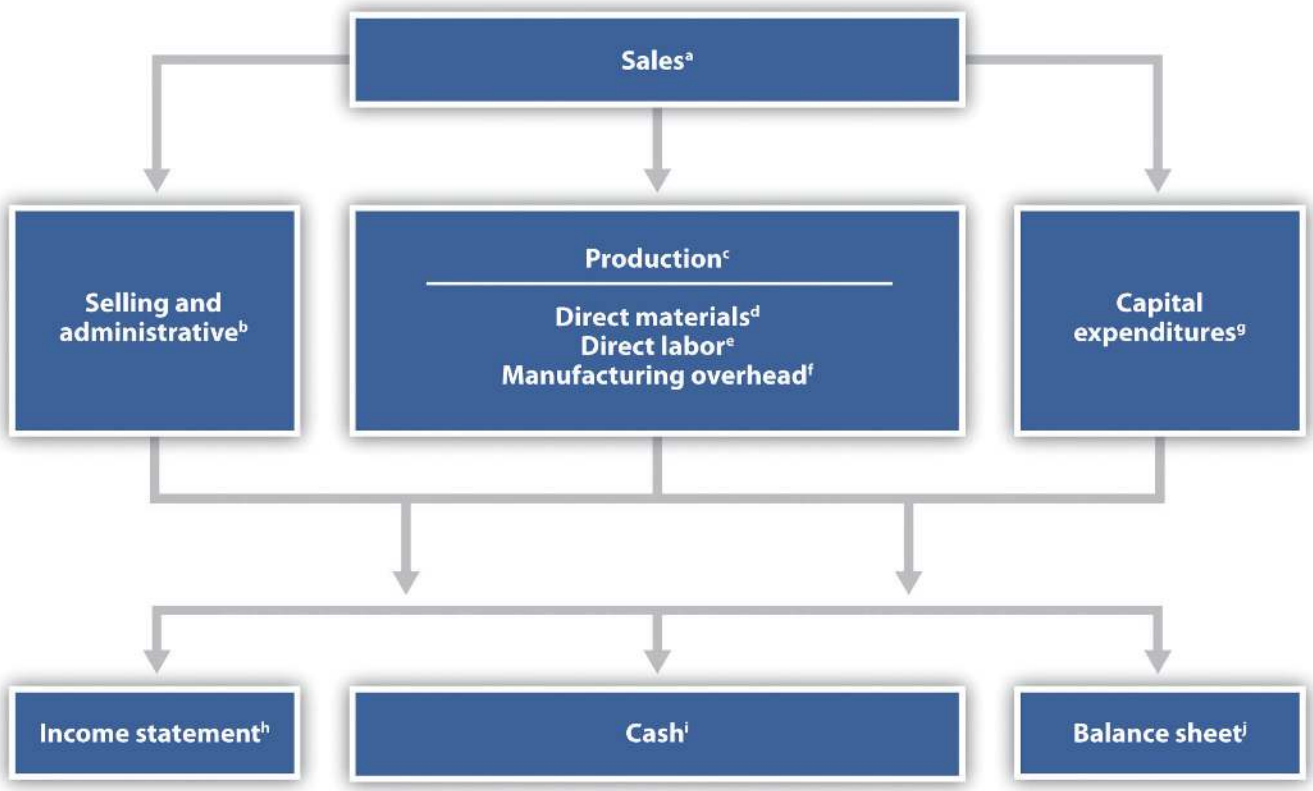
Question: Some companies prefer to take a "top-down" approach to budgeting, in which upper management establishes the budget with little input from other employees. These budgets are imposed on the organization and do little to motivate employees or to gain acceptance by employees. What method of budgeting is more effective than the top-down approach?

Answer: Successful companies approach budgeting from the bottom up. This requires the involvement of various employees within the organization, not just upper management. Lower-level employees often know more about their functional areas than upper management, and they can be an excellent source of information for budgeting purposes. Although getting input from employees throughout the organization can be time consuming, this approach tends to increase employee motivation and acceptance of the budget.

Most organizations have a *budget committee* that supervises the budgeting process. A budget committeeis a group within the organization responsible for overseeing and approving the *master budget*. A master budget is a series of budget schedules outlining the organization's plans for the upcoming period (typically for a year and presented in monthly or quarterly time periods). The master budget can take many different forms but often includes schedules that provide planning for sales, production, selling and administrative expenses, and capital expenditures. These schedules lead to the budgeted income statement, cash flows, and balance sheet (also part of the master budget).

Figure 6.1 "Master Budget Schedules" shows the components of the master budget with references to the figure in which we present each component for Jerry's Ice Cream.

Figure 6.1 Master Budget Schedules



All of these will be illustrated below.

Key Takeaways

- Some companies take a top-down approach to budgeting (upper management establishes the budget with little input from others), while other companies take a bottom-up approach (lower level employees are involved in the budgeting process). The bottom-up approach tends to be more effective as employees are more inclined to accept the budget. Regardless of the approach used, the budget committee (made up of a group within the organization) is responsible for overseeing and approving the master budget.

6.3 The Master Budget

Learning Objective

1. Develop the components of a master budget.

Question: Developing a master budget is a lengthy process. Where do companies start when preparing a master budget?

Answer: Study Figure 6.1 "Master Budget Schedules" carefully, as it serves as the road map for the master budget presented throughout this chapter for Jerry's Ice Cream. Notice that the budgeting process starts with the sales budget. Also, note that the budgets described next are for a manufacturing company. Manufacturing companies tend to have more budget schedules than other types of organizations because their operations are more complex. Once you understand budgeting in a manufacturing environment, you can easily modify the process to perform budgeting in other organizations, as discussed later in the chapter. As we work through the master budget for Jerry's Ice Cream, assume the company prepares quarterly budgets.

Sales Budget

Question: The sales budget is the starting point for the master budget, as shown in Figure 6.1 "Master Budget Schedules". What is a sales budget, and how is it prepared?

Answer: The sales budget is an estimate of units of product the organization expects to sell times the expected sales price per unit. This is perhaps the most important budget as it drives most of the other budgets. For example, the production budget and related

materials, labor, and overhead budgets are based on expected sales.

Forecasting sales often involves extensive research and numerous sources. Companies, such as Jerry's Ice Cream, typically start with their sales staff since salespeople have daily contact with customers and direct information about customer demand. Some companies pay for market trend data to learn about industry and product trends. Many organizations hire market research consultants to obtain and review industry data and ultimately to predict customer demand. Larger companies sometimes employ economists to develop sophisticated models used to project sales. Smaller, less sophisticated organizations simply base their estimates on past trends.

Tom Benson, sales manager at Jerry's Ice Cream, talked with his salespeople and reviewed market trends for ice cream using data obtained from a market research firm. His estimate, shown in Figure 6.2 "Sales Budget for Jerry's Ice Cream", assumes the company will increase sales 15 percent this coming year. Thus, to get projected sales for quarter 1, Tom simply multiplied last year's first quarter sales by 1.15. The average price per unit last year was $6 (1 unit = 1 gallon), and Tom does not expect any change in this price. The sales budget is presented in Figure 6.2 "Sales Budget for Jerry's Ice Cream".

Figure 6.2 Sales Budget for Jerry's Ice Cream

Jerry's Ice Cream
Sales Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Sales in units (1 unit = 1 gallon)	40,000	48,000	60,000	52,000	200,000
Sales price per unit	× $6	× $6	× $6	× $6	× $6
Sales revenue	$240,000	$288,000	$360,000	$312,000	$1,200,000

Production Budget

Question: The production budget is developed next and is based on sales budget projections. What is a production budget, and how is it prepared?

Answer: If the organization uses a just-in-time production system, where production occurs just in time to ship the products to the customer, units produced each quarter would be exactly the same as projected sales. However, most companies, including Jerry's Ice Cream, maintain a certain level of finished goods inventory. Thus production is typically *not* the same as projected sales. The production budget is an estimate of units to be produced and is based on sales projections plus an estimate of desired ending finished goods inventory less beginning finished goods inventory, as summarized in the following:

Key Equation

Units to be produced=Expected sales in units+Desired units of ending inventory−Units in beginning inventory

Jerry's Ice Cream plans to sell 40,000 units in the first quarter, as shown in Figure 6.3 "Sales Budget for Jerry's Ice Cream". For the sake of simplicity, assume work-in-process inventory is insignificant, and therefore beginning and ending work-in-process inventory is zero. (We assume beginning and ending work-in-process inventory is zero throughout this chapter.) The management prefers to maintain 10 percent of next quarter's sales in ending inventory. Thus 4,800 units will be in inventory at the end of the first quarter (= 48,000 unit sales in second quarter × 10 percent). Units needed for the first quarter total 44,800 (= 40,000 unit sales + 4,800 units desired ending inventory). However, Jerry's will not produce 44,800 units because inventory will be left over from

the fourth quarter of last year. This beginning inventory will be 4,000 units (= 40,000 unit sales in first quarter × 10 percent). Thus actual production will total 40,800 units:

40,800=40,000+4,800−4,000 Units to be produced=Expected sales in units+Desired units of ending inventory−Units in beginning inventory

Figure 6.3 “Production Budget for Jerry’s Ice Cream” presents the production budget for each of the 4 quarters of the coming year. Examine this figure carefully, particularly the last line labeled *units to be produced*. Lynn Young, the production manager, will be concerned about the spike in production during the third quarter of 59,200 units. The third quarter, from July 1 through September 30, is the peak sales season for ice cream. It will be difficult for Lynn to plan for this increase in production from the first and second quarters to the third quarter. However, this is exactly why companies prepare budgets—to plan for the future!

Figure 6.4 Production Budget for Jerry’s Ice Cream

Jerry’s Ice Cream
Production Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Sales in units*	40,000	48,000	60,000	52,000	200,000
Add desired ending finished good inventory**	4,800	6,000	5,200	4,400	4,400
Total finished goods inventory needed	44,800	54,000	65,200	56,400	204,400
Deduct beginning finished goods inventory***	(4,000)	(4,800)	(6,000)	(5,200)	(4,000)
Units to be produced	40,800	49,200	59,200	51,200	200,400

*Information from Figure 6.3 “Sales Budget for Jerry’s Ice Cream”.

**Desired ending inventory = 10 percent × Next quarter sales; for the first quarter, 4,800 = 0.10 × 48,000. Fourth quarter desired ending inventory of 4,400 units is based on an estimate of sales in the first quarter of next year.

***Beginning inventory = Inventory at end of previous quarter; for example, second quarter beginning inventory = First quarter ending inventory.

Once Jerry’s Ice Cream knows how many units it must produce each quarter, budgets are established for the individual components of production: direct materials, direct labor, and manufacturing overhead. We present these budgets next.

Check Yourself

Carol’s Cookies produces cookies for resale at grocery stores throughout North America. The company is currently in the process of establishing a master budget on a quarterly basis for this coming fiscal year, which ends December 31. *Prior year* quarterly sales were as follows (1 unit = 1 batch):

First quarter	64,000 units
Second quarter	76,800 units
Third quarter	96,000 units
Fourth quarter	83,200 units

Unit sales are expected to increase 25 percent, and each unit is expected to sell for $8. The management prefers to maintain ending finished goods inventory equal to 10 percent of next quarter’s sales. Assume finished goods inventory at the end of the fourth

quarter budget period is estimated to be 9,000 units.

1. Prepare a sales budget for Carol's Cookies using a format similar to Figure 6.2 "Sales Budget for Jerry's Ice Cream". (Hint: be sure to increase last year's unit sales by 25 percent.)
2. Prepare a production budget for Carol's Cookies using the format shown in Figure 6.3 "Production Budget for Jerry's Ice Cream".

Solution

1. The following is a sales budget:

Carol's Cookies
Sales Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Prior year sales in units (1 unit = 1 batch)	64,000	76,800	96,000	83,200	320,000
Budget increase of 25 percent	× 1.25	× 1.25	× 1.25	× 1.25	× 1.25
Projected sales in units	80,000	96,000	120,000	104,000	400,000
Sales price per unit	× $8	× $8	× $8	× $8	× $8
Sales revenue	$640,000	$768,000	$960,000	$832,000	$3,200,000

2. The following is a production budget:

Carol's Cookies
Production Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Sales in units (from sales budget)	80,000	96,000	120,000	104,000	400,000
Add desired ending finished goods inventory*	9,600	12,000	10,400	9,000	9,000
Total finished goods inventory needed	89,600	108,000	130,400	113,000	409,000
Deduct beginning finished goods inventory**	(8,000)	(9,600)	(12,000)	(10,400)	(8,000)
Units to be produced	81,600	98,400	118,400	102,600	401,000

*Desired ending inventory = 10 percent × Next quarter sales; for the first quarter, 9,600 = 0.10 × 96,000. Fourth quarter desired ending inventory of 9,000 units is given.

**Beginning inventory = Inventory at end of previous quarter; for example, Second quarter beginning inventory = First quarter ending inventory.

Direct Materials Purchases Budget

Question: The number of units of finished goods to be produced each quarter from the production budget is the starting point for the direct materials purchases budget. What is a direct materials purchases budget, and how is it prepared?

Answer: The direct materials purchases budget is an estimate of raw materials needed to achieve a desired level of production. Figure 6.3 "Production Budget for Jerry's Ice Cream", the production budget, shows that 40,800 finished units will be produced in the first quarter. We will now establish a direct materials purchases budget that answers the questions: how many pounds of material must be purchased during the first quarter to achieve this production, and what is the cost of these materials?

Assume two pounds of material are required to produce one unit of product. Thus the amount of materials required to produce 40,800 units of ice cream is 81,600 pounds (= 40,800 units × 2 pounds per unit). This amount is labeled as *materials needed in production* in the direct materials purchases budget shown in Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream". (To simplify this example, assume sugar is the only material used. However, other materials, such as cream and vanilla, are typically required to produce ice cream.)

Figure 6.4 Direct Materials Purchases Budget for Jerry's Ice Cream

Jerry's Ice Cream
Direct Materials Purchases Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced*	40,800	49,200	59,200	51,200	200,400
Materials required per unit (pounds)	× 2	× 2	× 2	× 2	× 2
Materials needed in production	81,600	98,400	118,400	102,400	400,800
Add desired ending inventory**	19,680	23,680	20,480	20,000	20,000
Materials needed in inventory	101,280	122,080	138,880	122,400	420,800
Deduct beginning inventory***	(16,320)	(19,680)	(23,680)	(20,480)	(16,320)
Direct materials to be purchased (pounds)	84,960	102,400	115,200	101,920	404,480
Cost of materials per pound	× $1	× $1	× $1	× $1	× $1
Cost of materials to be purchased	$84,960	$102,400	$115,200	$101,920	$404,480
Direct materials cost per unit****					$ 2.00

*Information from Figure 6.3 "Production Budget for Jerry's Ice Cream".

**Desired ending inventory = 20 percent × Next quarter production needs; for the first quarter, 19,680 = 0.20 × 98,400. Fourth quarter desired ending inventory of 20,000 pounds is based on an estimate of materials needed in production first quarter of next year.

***Beginning inventory = Inventory at end of previous quarter; for example, Second quarter beginning inventory = First quarter ending inventory.

****$2 direct materials cost per unit = 2 pounds of materials required per unit × $1 per pound.

Will the company buy 81,600 pounds of material in the first quarter? Probably not. Jerry's will have materials in *beginning* raw materials inventory and prefers to maintain a certain level of *ending* raw materials inventory. Thus direct materials purchased is based on materials needed in production plus an estimate of desired ending raw materials inventory less beginning raw materials inventory. We summarize this in the following equation. Notice the similarity of this equation to the inventory equation presented earlier for the production budget.

Key Equation

Materials to be purchased=Materials needed in production+Desired materials in ending inventory−Materials in beginning inventory

Assume the management prefers to maintain raw materials ending inventory equal to 20 percent of next quarter's materials needed in production. Thus 19,680 pounds of material will be in inventory at the end of the first quarter (= 98,400 pounds of materials needed in production in second quarter × 20 percent). Materials needed in inventory total 101,280 pounds (= 81,600 pounds of materials needed in production + 19,680 pounds of material in desired ending inventory). However, Jerry's will not purchase 101,280 pounds of materials because inventory will be left over from the fourth quarter of last year. This beginning inventory will be 16,320 pounds (= 81,600 pounds of material needed in production in first quarter × 20 percent). Thus direct materials purchased in the first quarter will total 84,960 pounds:

84,960= 81,600+ 19,680− 16,320 Materials=Materials needed in production+Desired materials in ending inventory−Materials in beginning inventory

To estimate the cost of purchasing 84,960 pounds of material, multiply the number of pounds to be purchased by the cost per pound. Assume the cost per pound of material for Jerry's is $1. This results in a cost of $84,960 for materials to be purchased during the first quarter, as shown at the bottom of Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream" (= 84,960 pounds to be purchased × $1 per pound).

Review the direct materials purchases budget shown in Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream" carefully, particularly the line labeled *direct materials to be purchased*. The purchasing manager at Jerry's Ice Cream uses this information, along with the price per pound, to negotiate the purchase of materials with suppliers.

Direct Labor Budget

Question: The direct materials purchases budget is the first of three supporting budgets for production. The second is the direct labor budget. What is the direct labor budget, and how is it prepared?

Answer: The direct labor budget is an estimate of direct labor hours, and related costs, necessary to achieve a desired level of production. Knowing Jerry's Ice Cream plans to produce 40,800 units of ice cream during the first quarter, this budget answers the questions: how many direct labor hours will be necessary to achieve this production, and what will this labor cost?

Assume it takes 0.10 direct labor hours (or 6 minutes) to produce 1 unit of product. Thus 4,080 hours of direct labor will be required to produce 40,800 units of product (= 40,800 finished units produced × 0.10 direct labor hours per unit). Given an average hourly rate of $13, the direct labor cost for the first quarter totals $53,040 (= 4,080 hours × $13 per hour). This information is shown in the direct labor budget presented in Figure 6.5 "Direct Labor Budget for Jerry's Ice Cream".

Figure 6.5 Direct Labor Budget for Jerry's Ice Cream

Jerry's Ice Cream
Direct Labor Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced*	40,800	49,200	59,200	51,200	200,400
Direct labor hours per unit	× 0.10	× 0.10	× 0.10	× 0.10	× 0.10
Total direct labor hours needed in production	4,080	4,920	5,920	5,120	20,040
Labor rate per hour	× $13	× $13	× $13	× $13	× $13
Total direct labor cost	$ 53,040	$ 63,960	$ 76,960	$ 66,560	$260,520
Direct labor cost per unit**					$ 1.30

*From Figure 6.3 "Production Budget for Jerry's Ice Cream".

**$1.30 direct labor cost per unit = 0.10 direct labor hours per unit × $13 per hour.

Carefully review the direct labor budget shown in Figure 6.5 "Direct Labor Budget for Jerry's Ice Cream". The production manager at Jerry's Ice Cream, Lynn Young, uses this information to ensure the appropriate number of employees is available to meet production goals. Notice that the number of direct labor hours needed in production for the third quarter is significantly higher than each of the two previous quarters. Again, this is why organizations prepare budgets: to plan for these types of events. Lynn will have to start planning for this spike in direct labor hours, either by asking employees to work overtime or by hiring additional employees.

Manufacturing Overhead Budget

Question: The manufacturing overhead budget is the third of three supporting production budgets. What is a manufacturing overhead budget, and how is it prepared?

Answer: The manufacturing overhead budget is an estimate of all production costs, other than direct materials and direct labor, necessary to achieve a desired level of production. This budget is presented in Figure 6.6 "Manufacturing Overhead Budget for Jerry's Ice Cream". Notice that overhead costs are separated into variable and fixed components.

Figure 6.6 Manufacturing Overhead Budget for Jerry's Ice Cream

Jerry's Ice Cream
Manufacturing Overhead Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced*	40,800	49,200	59,200	51,200	200,400
Variable overhead costs					
Indirect materials ($0.15 per unit)	$ 6,120	$ 7,380	$ 8,880	$ 7,680	$ 30,060
Indirect labor ($0.10 per unit)	4,080	4,920	5,920	5,120	20,040
Other ($0.25 per unit)	10,200	12,300	14,800	12,800	50,100
Total variable overhead costs	$ 20,400	$ 24,600	$ 29,600	$ 25,600	$100,200
Fixed overhead costs					
Salaries	15,000	15,000	15,000	15,000	60,000
Rent	10,000	10,000	10,000	10,000	40,000
Depreciation	10,070	10,070	10,070	10,070	40,280
Total fixed overhead costs	$ 35,070	$ 35,070	$ 35,070	$ 35,070	$140,280
Total overhead costs	55,470	59,670	64,670	60,670	240,480
Deduct depreciation^	(10,070)	(10,070)	(10,070)	(10,070)	(40,280)
Cash payments for overhead	$ 45,400	$ 49,600	$ 54,600	$ 50,600	$200,200
Manufacturing overhead per unit**					$ 1.20

*From Figure 6.3 "Production Budget for Jerry's Ice Cream". Note the budget is based on production and not sales.

**$1.20 = $240,480 total overhead cost ÷ 200,400 units to be produced for the year.

^Deduct depreciation to get the actual cash payment for overhead. This information is needed for the cash budget presented in Figure 6.10 "Cash Budget for Jerry's Ice Cream".

By definition, total variable overhead costs change with changes in production and are calculated by multiplying units to be produced by the cost per unit. For example, indirect materials cost for the first quarter of $6,120 is calculated by taking 40,800 units to be produced × $0.15 cost per unit. Fixed costs generally do *not* change with changes in production and therefore remain the same each quarter. (Note: In some situations, fixed overhead costs can change from one quarter to the next. For example, hiring additional salaried personnel during the year would increase fixed overhead costs, and purchasing equipment during the year would increase depreciation costs. In this example, we assume fixed overhead costs do not change during the year.)

Depreciation is deducted at the bottom of the manufacturing overhead budget to determine cash payments for overhead because depreciation is not a cash transaction. We use this information later in the chapter for the cash budget.

Check Yourself

Carol's Cookies, the company featured in the last check yourself and in the next three, is now preparing the budget for direct materials purchases, direct labor, and manufacturing overhead.

Direct Materials Purchases Budget Information

Each unit of product requires 1.5 pounds of direct materials per unit, and the cost of direct materials is $2 per pound. Management prefers to maintain ending raw materials inventory equal to 30 percent of next quarter's materials needed in production. Assume raw materials inventory at the end of the fourth quarter budget period is estimated to be 41,000 pounds.

Direct Labor Budget Information

Each unit of product requires 0.20 direct labor hours at a cost of $12 per hour.

Manufacturing Overhead Budget Information

Variable overhead costs are:

Indirect materials	$0.20 per unit
Indirect labor	$0.15 per unit
Other	$0.35 per unit

Fixed overhead costs each quarter are:

Salaries	$28,000
Rent	$22,000
Depreciation	$16,165

1. Prepare a direct materials purchases budget for Carol's Cookies using the format shown in Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream".
2. Prepare a direct labor budget for Carol's Cookies using the format shown in Figure 6.5 "Direct Labor Budget for Jerry's Ice Cream".
3. Prepare a manufacturing overhead budget for Carol's Cookies using the format shown in Figure 6.6 "Manufacturing Overhead Budget for Jerry's Ice Cream".

Solution

Carol's Cookies
Direct Materials Purchases Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced (from production budget)	81,600	98,400	118,400	102,600	401,000
Materials required per unit (pounds)	× 1.5	× 1.5	× 1.5	× 1.5	× 1.5
Materials needed in production	122,400	147,600	177,600	153,900	601,500
Add desired ending inventory*	44,280	53,280	46,170	41,000	41,000
Materials needed in inventory	166,680	200,880	223,770	194,900	642,500
Deduct beginning inventory**	(36,720)	(44,280)	(53,280)	(46,170)	(36,720)
Direct materials to be purchased (pounds)	129,960	156,600	170,490	148,730	605, 780
Cost of materials per pound	× $2	× $2	× $2	× $2	× $2
Cost of materials to be purchased	$259,920	$313,200	$340,980	$297,460	$1,211,560
Direct materials cost per unit**					$ 3.00

1.

*Desired ending inventory = 30 percent × Next quarter production needs; for the first quarter, 44,280 = 0.30 × 147,600 pounds. Fourth quarter desired ending inventory of 41,000 pounds is given.

**Beginning inventory = Inventory at end of previous quarter; for example, Second quarter beginning inventory = First quarter ending inventory.

***$3 direct materials cost per unit = 1.5 pounds of materials required per unit × $2 per pound.

Carol's Cookies
Direct Labor Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced (from production budget)	81,600	98,400	118,400	102,600	401,000
Direct labor hours per unit	× 0.20	× 0.20	× 0.20	× 0.20	× 0.20
Total direct labor hours needed in production	16,320	19,680	23,680	20,520	80,200
Labor rate per hour	× $12	× $12	× $12	× $12	× $12
Total direct labor cost	$195,840	$236,160	$284,160	$246,240	$962,400
Direct labor cost per unit*					$ 2.40

2.

*$2.40 direct labor cost per unit = 0.20 direct labor hours per unit × $12 per hour.

Carol's Cookies
Manufacturing Overhead Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Units to be produced (from production budget)	81,600	98,400	118,400	102,600	401,000
Variable overhead costs					
Indirect materials ($0.20 per unit)	$ 16,320	$ 19,680	$ 23,680	$ 20,520	$ 80,200
Indirect labor ($0.15 per unit)	12,240	14,760	17,760	15,390	60,150
Other ($0.35 per unit)	28,560	34,440	41,440	35,910	140,350
Total variable overhead costs	$ 57,120	$ 68,880	$ 82,880	$ 71,820	$280,700
Fixed overhead costs					
Salaries	28,000	28,000	28,000	28,000	112,000
Rent	22,000	22,000	22,000	22,000	88,000
Depreciation	16,165	16,165	16,165	16,165	64,660
Total fixed overhead costs	$ 66,165	$ 66,165	$ 66,165	$ 66,165	$264,660
Total overhead costs	123,285	135,045	149,045	137,985	545,360
Deduct depreciation^	(16,165)	(16,165)	(16,165)	(16,165)	(64,660)
Cash payments for overhead	$107,120	$118,880	$132,880	$121,820	$480,700
Manufacturing overhead per unit*					$ 1.36

3.

*$1.36 = $545,360 total overhead cost ÷ 401,000 units to be produced for the year.

^Deduct depreciation to get the actual cash payment for overhead. This information is needed for the cash budget prepared later.

Selling and Administrative Budget

Question: Now that the sales and production-related budgets are complete, it is time to estimate selling and administrative costs. What is a selling and administrative budget, and how is it prepared?

Answer: The selling and administrative budget is an estimate of all operating costs other than production. This budget is presented in Figure 6.7 "Selling and Administrative Budget for Jerry's Ice Cream".

Although many organizations may have variable and fixed costs in this budget, Jerry's Ice Cream treats all selling and administrative costs as fixed costs. Once again, depreciation is deducted at the bottom of this budget to determine cash payments for selling and administrative costs, which we use later in the chapter for the cash budget.

Figure 6.7 Selling and Administrative Budget for Jerry's Ice Cream

Jerry's Ice Cream
Selling and Administrative Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Salaries	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 160,000
Rent	8,000	8,000	8,000	8,000	32,000
Advertising	5,000	5,000	5,000	5,000	20,000
Depreciation	3,000	3,000	3,000	3,000	12,000
Other	2,000	2,000	2,000	2,000	8,000
Total selling administrative costs	$ 58,000	$ 58,000	$ 58,000	$ 58,000	$ 232,000
Deduct depreciation*	(3,000)	(3,000)	(3,000)	(3,000)	(12,000)
Cash payments for selling and administrative**	$ 55,000	$ 55,000	$ 55,000	$ 55,000	$ 220,000

*Deduct depreciation to get the actual cash payment for selling and administrative costs.

**This information is needed for the cash budget presented in Figure 6.10 "Cash Budget for Jerry's Ice Cream".

Budgeted Income Statement

Question: Budgets completed to this point include sales, production, direct materials, direct labor, manufacturing overhead , and selling and administrative. Jerry's Ice Cream now has enough information to prepare the budgeted income statement. What is a budgeted income statement, and how is it prepared?

Answer: The budgeted income statement is an estimate of the organization's profit for a given budget period. Most organizations, including Jerry's Ice Cream, prepare the budgeted income statement using the accrual basis of accounting: revenues are recorded when earned and expenses are recorded when incurred. The budgeted income statement for Jerry's Ice Cream is presented in Figure 6.8 "Budgeted Income Statement for Jerry's Ice Cream". The cash budget we prepare later in the chapter will show when cash is received and paid.

Figure 6.8 Budgeted Income Statement for Jerry's Ice Cream

Jerry's Ice Cream
Budgeted Income Statement
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Sales	$ 240,000	$ 288,000	$ 360,000	$ 312,000	$1,200,000
Deduct costs of goods sold*	(180,000)	(216,000)	(270,000)	(234,000)	(900,000)
Gross margin	$ 60,000	$ 72,000	$ 90,000	$ 78,000	$ 300,000
Deduct selling and administrative costs	(58,000)	(58,000)	(58,000)	(58,000)	(232,000)
Net income	$ 2,000	$ 14,000	$ 32,000	$ 20,000	$ 68,000

	Year
Per unit cost of goods sold calculation:	
Direct materials	$ 2.00
Direct labor	1.30
Manufacturing overhead	1.20
Total cost of goods sold per unit	$ 4.50

*Cost of goods sold = Per unit cost of $4.50 (see above) × Units sold (from Figure 6.2 "Sales Budget for Jerry's Ice Cream"); for the first quarter, $180,000 cost of goods sold = $4.50 unit cost × 40,000 units.

The first line in the budgeted income statement, *sales*, comes from the sales budget. The next line, *cost of goods sold*, is calculated by multiplying unit sales by the cost per unit. The cost per unit calculation is shown at the bottom. Carefully review this calculation. Since Jerry's Ice Cream uses full-absorption costing, all manufacturing costs related to goods sold are included (or fully absorbed) in cost of goods sold. Earlier budget schedules (direct materials, labor and overhead budgets) provide this information on a per unit basis for direct materials, direct labor, and manufacturing overhead, respectively.

The third line, *gross margin*, is simply sales minus cost of goods sold. The fourth line, *selling and administrative costs*, comes from the selling and administrative budget. The bottom line of the budgeted income statement, *net income*, is gross margin minus selling and administrative costs. Income tax expense is not included in this example for the sake of simplicity. However, income taxes can significantly reduce projected net income and cash flows.

Question: How do companies use the budgeted income statement to improve operations?

Answer: The budgeted income statement is perhaps the most carefully scrutinized component of the master budget. The management and employees throughout the organization use this information for planning purposes and to evaluate company performance. The board of directors and budget committee are responsible for approving the budget and often review periodic reports comparing actual net income to budgeted net income to determine if profit goals are being achieved. Lenders and owners often review the budget to ensure the organization is on track to meet its goals. The budgeted income statement answers the question: what profits does the organization expect to achieve?

After completing the budgeted income statement, only three budgets remain: the capital expenditures budget, the cash budget, and the budgeted balance sheet. We discuss the capital expenditures budget next.

Check Yourself

Carol's Cookies estimates that all selling and administrative costs are fixed. Quarterly selling and administrative cost estimates for

the coming year are

Salaries	$60,000
Rent	$ 7,000
Advertising	$10,000
Depreciation	$ 8,000
Other	$ 1,000

1. Prepare a selling and administrative budget for Carol's Cookies using the format shown in Figure 6.7 "Selling and Administrative Budget for Jerry's Ice Cream".
2. Prepare a budgeted income statement for Carol's Cookies using the format shown in Figure 6.8 "Budgeted Income Statement for Jerry's Ice Cream".

Solution

1.

Carol's Cookies
Selling and Administrative Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Salaries	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 240,000
Rent	7,000	7,000	7,000	7,000	28,000
Advertising	10,000	10,000	10,000	10,000	40,000
Depreciation	8,000	8,000	8,000	8,000	32,000
Other	1,000	1,000	1,000	1,000	4,000
Total selling and administrative costs	$ 86,000	$ 86,000	$ 86,000	$ 86,000	$ 344,000
Deduct depreciation*	(8,000)	(8,000)	(8,000)	(8,000)	(32,000)
Cash payments for selling and administrative**	$ 78,000	$ 78,000	$ 78,000	$ 78,000	$ 312,000

*Deduct depreciation to get the actual cash payment for selling and administrative costs.

**This information is needed for the cash budget prepared later.

Carol's Cookies
Budgeted Income Statement
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Sales (from sales budget)	$ 640,000	$ 768,000	$ 960,000	$ 832,000	$3,200,000
Deduct costs of goods sold*	(540,800)	(648,960)	(811,200)	(703,040)	(2,704,000)
Gross margin	$ 99,200	$ 119,040	$ 148,800	$ 128,960	$ 496,000
Deduct selling and administrative costs**	(86,000)	(86,000)	(86,000)	(86,000)	(344,000)
Net income	$ 13,200	$ 33,040	$ 62,800	$ 42,960	$ 152,000

	Year
Per unit cost of goods sold calculation	
Direct materials (from direct materials purchases budget)	$ 3.00
Direct labor (from direct labor budget)	2.40
Manufacturing overhead (from manufacturing overhead budget)	1.36
Total cost of goods sold per unit	$ 6.76

2.

*Cost of goods sold = Per unit cost of $6.76 (see above) × Units sold (from sales budget); for first quarter, $540,800 cost of goods sold = $6.76 unit cost × 80,000 units.

**From selling and administrative budget.

Capital Expenditures Budget

Question: What is a capital expenditures budget, and how is it prepared?

Answer: The capital expenditures budget is an estimate of the long-term assets to be purchased during the budget period. This includes purchases of tangible long-term assets such as property, plant, and equipment, and intangible assets, such as patents, copyrights, and trademarks. This budget can have a significant impact on cash flow and requires careful planning and analysis (Chapter 5 "How Is Capital Budgeting Used to Make Decisions?" presents a detailed discussion of capital budgeting). As shown in Figure 6.9 "Capital Expenditures Budget for Jerry's Ice Cream", Jerry's Ice Cream plans to purchase computers and production equipment at the end of the fourth quarter.

Figure 6.9 Capital Expenditures Budget for Jerry's Ice Cream

Jerry's Ice Cream
Capital Expenditures Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Selling and administrative computers	–	–	–	$ 10,000	$ 10,000
Production equipment	–	–	–	15,000	15,000
Total	–	–	–	$ 25,000	$ 25,000

Note: These acquisitions will have no effect on depreciation expense in the fourth quarter. Items will be purchased at the end of the year. Thus depreciation begins the following year.

Because long-term asset purchases occur at the end of the year, depreciation will begin the following year. Thus depreciation shown in the manufacturing overhead and selling and administrative budgets will not be affected until the following year. The cash outlay required to make these purchases is reflected in the cash budget presented next.

Cash Budget

Question: What is a cash budget, and how is it prepared?

Answer: The cash budget is an estimate of the amount and timing of cash inflows and outflows for the budget period. Although the budgeted income statement provides an estimate of profitability, it stops short of providing cash flow information. For example, some of the $240,000 in first quarter sales revenue will be collected during the first quarter and some will be collected the following quarter. A section of the cash budget will show when cash from sales will be received.

The cash budget has the following sections, each of which is described after Figure 6.10 "Cash Budget for Jerry's Ice Cream":

- Cash collections from sales
- Cash payments for purchases of materials
- Other cash collections and payments

Figure 6.10 "Cash Budget for Jerry's Ice Cream" shows the cash budget for Jerry's Ice Cream. Amounts shown in parentheses represent cash *outflows*; amounts without parentheses represent cash *inflows*.

Figure 6.10 Cash Budget for Jerry's Ice Cream

Jerry's Ice Cream
Cash Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Cash collections from sales*					
Fourth quarter prior year (assumed)	$ 180,000				$ 180,000
First quarter ($240,000 sales)	144,000	$ 96,000			240,000
Second quarter ($288,000 sales)		172,800	$ 115,200		288,000
Third quarter ($360,000 sales)			216,000	$ 144,000	360,000
Fourth quarter ($312,000 sales)				187,200	187,200
Total cash collections	$ 324,000	$ 268,800	$ 331,200	$ 331,200	$1,255,200
Cash payments for purchases of materials**					
Fourth quarter prior year (assumed)	(30,000)				(30,000)
First quarter ($84,960 purchases)	(59,472)	(25,488)			(84,960)
Second quarter ($102,400 purchases)		(71,680)	(30,720)		(102,400)
Third quarter ($115,200 purchases)			(80,640)	(34,560)	(115,200)
Fourth quarter ($101,920 purchases)				(71,344)	(71,344)
Total cash payments for purchases	$ (89,472)	$ (97,168)	$(111,360)	$(105,904)	$ (403,904)
Other cash payments***					
Direct labor	(53,040)	(63,960)	(76,960)	(66,560)	(260,520)
Manufacturing overhead***	(45,400)	(49,600)	(54,600)	(50,600)	(200,200)
Selling and administrative***	(55,000)	(55,000)	(55,000)	(55,000)	(220,000)
Capital expenditures	–	–	–	(25,000)	(25,000)
Total other cash payments	$(153,440)	$(168,560)	$(186,560)	$(197,160)	$ (705,720)
Excess of collections over payments^	81,088	3,072	33,280	28,136	145,576
Beginning cash balance^^	10,000	91,088	94,160	127,440	10,000
Ending cash balance^^^	$ 91,088	$ 94,160	$ 127,440	$ 155,576	$ 155,576

*Based on sales budget shown in Figure 6.2 "Sales Budget for Jerry's Ice Cream". All sales are on credit: 60 percent collected in the quarter of sale and 40 percent collected the following quarter.

**Based on purchases budget shown in Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream". All purchases are on credit: 70 percent paid in the quarter of purchase and 30 percent paid the following quarter.

***Does not include depreciation since depreciation expense does not involve a cash payment. See related figures for calculations.

^Excess of collections over payments = Cash collections from sales – Cash payments for materials purchases – Other cash payments.

^^ Beginning cash balance = Cash balance at end of previous period. Balance for first quarter is given.

^^^ Ending cash balance = Excess of collections over payments for the quarter + Beginning cash balance.

Cash Collections from Sales

Question: Assume all sales at Jerry's Ice Cream are on credit. How long does it take, on average, for Jerry's to collect on credit sales?

Answer: On average, 60 percent of credit sales are collected in the quarter sold and the remaining 40 percent is collected the following quarter. These percentage estimates are based on previous experience and take into consideration credit terms offered to customers. Since Jerry's Ice Cream only sells to customers with an excellent credit record, it anticipates no bad debts.

As you examine the *cash collections from sales* section of Jerry's cash budget, notice that $180,000 in cash will be collected in the first quarter related to credit sales made in the previous quarter (this amount is given). Next, you will see $144,000 in cash collected in the first quarter related to first quarter sales (= 60 percent collected in quarter of sale × $240,000 first quarter sales). The remaining $96,000 will be collected in the second quarter, as shown in Figure 6.10 "Cash Budget for Jerry's Ice Cream" (= 40 percent × $240,000 first quarter sales).

Cash Payments for Purchases of Materials

Question: Assume all purchases at Jerry's Ice Cream are on credit. How long does it take, on average, for Jerry's to pay for these credit purchases?

Answer: On average, 70 percent of purchases are paid in the quarter purchased and the remaining 30 percent is paid the following quarter. These percentage estimates are based on previous experience and take into account credit terms offered by suppliers.

As you look at the *cash payments for purchases of materials* section of Jerry's cash budget, notice that $30,000 in cash will be paid in the first quarter related to purchases made in the previous quarter (this amount is given). Next, you will see $59,472 in cash paid in the first quarter related to first quarter purchases (= 70 percent paid in quarter purchased × $84,960 first quarter purchases). The remaining $25,488 will be paid in the second quarter, as shown in Figure 6.10 "Cash Budget for Jerry's Ice Cream" (= 30 percent × $84,960 first quarter purchases). Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream" shows how cash flows into the company for customer sales and out of the company for purchases of materials.

Other Cash Collections and Payments

Question: What other cash collections and cash payments must be considered at Jerry's Ice Cream?

Answer: Assume Jerry's Ice Cream has other cash payments but no other cash collections. Direct labor cash payments are from Figure 6.5 "Direct Labor Budget for Jerry's Ice Cream". Manufacturing overhead cash payments are from Figure 6.6 "Manufacturing Overhead Budget for Jerry's Ice Cream". Recall that depreciation was subtracted from total overhead costs in Figure 6.6 "Manufacturing Overhead Budget for Jerry's Ice Cream" to calculate the cash payments for overhead. Selling and administrative cash payments are from Figure 6.7 "Selling and Administrative Budget for Jerry's Ice Cream", where a similar depreciation adjustment was made. Capital expenditure cash payments are from Figure 6.9 "Capital Expenditures Budget for Jerry's Ice Cream".

The *other cash collections and payments* section is also where organizations include financing activities such as cash collections from the sale of bonds or cash payments for the repayment of bank loans. Jerry's Ice Cream does not have any of these financing activities.

The bottom section of the cash budget is where the ending cash balance is calculated for each budget period. The manager responsible for cash planning, typically the treasurer, scrutinizes this section carefully. Some organizations must borrow cash to fund the timing difference between when cash is used for production and when cash is received from sales. The cash budget will signal when short-term borrowing is necessary and allows time for the treasurer to arrange for financing. The cash budget presented in Figure 6.10 "Cash Budget for Jerry's Ice Cream" shows that Jerry's will not need to borrow cash in any of the four quarters. In fact, Jerry's Ice Cream will have a hefty reserve of cash totaling $155,576 at the end of the fourth quarter.

Check Yourself

Carol's Cookies has the following information pertaining to the capital expenditures and cash budgets.

Capital Expenditures

The company plans to purchase selling and administrative equipment totaling $20,000 and production equipment totaling $28,000. Both will be purchased at the end of the fourth quarter and will not affect depreciation expense for the coming year.

Cash Budget

All sales are on credit. The company expects to collect 70 percent of sales in the quarter of sale, 25 percent of sales in the quarter following the sale, and 5 percent will not be collected (bad debt). Accounts receivable at the end of last year totaled $200,000, all of which will be collected in the first quarter of this coming year.

All direct materials purchases are on credit. The company expects to pay 80 percent of purchases in the quarter of purchase and 20 percent the following quarter. Accounts payable at the end of last year totaled $50,000, all of which will be paid in the first quarter of this coming year.

The cash balance at the end of last year totaled $20,000.

1. Prepare a capital expenditures budget for Carol's Cookies using the format shown in Figure 6.9 "Capital Expenditures Budget for Jerry's Ice Cream".
2. Prepare a cash budget for Carol's Cookies using the format shown in 6.10 "Cash Budget for Jerry's Ice Cream".

Solution

Carol's Cookies
Capital Expenditures Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Selling and administrative equipment	–	–	–	$ 20,000	$ 20,000
Production equipment	–	–	–	28,000	28,000
Total	–	–	–	$ 48,000	$ 48,000

1.

Note: These acquisitions will have no effect on depreciation expense in the fourth quarter. Items will be purchased at the end of the year. Thus depreciation begins the following year.

Carol's Cookiest
Cash Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Cash collections from sales*					
Fourth quarter prior year (assumed)	$ 200,000				$ 200,000
First quarter ($640,000 sales)	448,000	$ 160,000			608,000
Second quarter ($768,000 sales)		537,600	$ 192,000		729,600
Third quarter ($960,000 sales)			672,000	$ 240,000	912,000
Fourth quarter ($832,000 sales)				582,400	582,400
Total cash collections	$ 648,000	$ 697,600	$ 864,000	$ 822,400	$ 3,032,000
Cash payments for purchases of materials**					
Fourth quarter prior year (assumed)	(50,000)				(50,000)
First quarter ($259,920 purchases)	(207,936)	(51,984)			(259,920)
Second quarter ($313,200 purchases)		(250,560)	(62,640)		(313,200)
Third quarter ($340,980 purchases)			(272,784)	(68,196)	(340,980)
Fourth quarter ($297,460 purchases)				(237,968)	(237,968)
Total cash payments for purchases	$ (257,936)	$ (302,544)	$ (335,424)	$ (306,164)	$ (1,202,068)
Other cash payments					
Direct labor (from direct labor budget)	(195,840)	(236,160)	(284,160)	(246,240)	(962,400)
Manufacturing overhead***	(107,120)	(118,880)	(132,880)	(121,820)	(480,700)
Selling and administrative****	(78,000)	(78,000)	(78,000)	(78,000)	(312,000)
Capital expenditures*****	–	–	–	(48,000)	(48,000)
Total other cash payments	$ (380,960)	$ (433,040)	$ (495,040)	$ (494,060)	$ (1,803,100)
Excess (shortage) of collections over payments^	9,104	(37,984)	33,536	22,176	26,832
Beginning cash balance^^	20,000	29,104	(8,880)	24,656	20,000
Ending cash balance^^^	$ 29,104	$ (8,880)	$ 24,656	$ 46,832	$ 46,832

2.

*Based on sales budget. All sales are on credit: 70 percent collected in the quarter of sale, 25 percent collected the following quarter, and 5 percent bad debt.

**Based on purchases budget. All purchases are on credit: 80 percent paid in the quarter of purchase and 20 percent paid the following quarter.

***From manufacturing overhead budget. Amount does not include depreciation.

****From selling and administrative budget. Amount does not include depreciation.

*****From capital expenditures budget.

^Excess of collections over payments = Cash collections from sales – Cash payments for materials purchases – other cash payments.

^^ Beginning cash balance = Cash balance at end of previous period. Balance for first quarter is given.

^^^ Ending cash balance = Excess of collections over payments for the quarter + Beginning cash balance.

Budgeted Balance Sheet

Question: The budgeted balance sheet is the last piece of the budget process. What is the budgeted balance sheet, and how is it prepared?

Answer: The budgeted balance sheet is an estimate of the ending balances for all balance sheet accounts. Managers use this to assess the impact that budgeted sales and costs will have on the financial condition of the organization. We present the budgeted balance sheet for Jerry's Ice Cream in Figure 6.11 "Budgeted Balance Sheet for Jerry's Ice Cream".

Information needed to prepare the budgeted balance sheet for Jerry's Ice Cream is shown throughout the chapter and is referenced in Figure 6.11 "Budgeted Balance Sheet for Jerry's Ice Cream". Additional information is provided here:

- Plant and equipment (net) expected at the end of the budget period (December 31) is $530,000.
- Common stock issued and outstanding at the end of the budget period (December 31) is expected to be $650,000.
- Actual retained earnings at the end of last year totaled $101,600, and no cash dividends will be paid during the current budget period ending December 31.

Figure 6.11 Budgeted Balance Sheet for Jerry's Ice Cream

Jerry's Ice Cream
Budgeted Balance Sheet
December 31

Current assets		
Cash	$ 155,576	
Accounts receivable*	124,800	
Raw materials inventory**	20,000	
Finished goods inventory***	19,800	
Total current assets		$ 320,176
Plants and equipment (net)^		530,000
Total assets		$ 850,176
Current liabilities		
Accounts payable^^		30,576
Shareholders' equity		
Common stock^	650,000	
Retained earnings^^^	169,600	
Total shareholders' equity		819,600
Total liabilities and shareholders' equity		$ 850,176

*$124,800 = $312,000 in fourth quarter sales × 40 percent to be collected next quarter

**$20,000 = 20,000 pounds × $1 per pound

***$19,800 = 4,400 units (Figure 6.3 "Production Budget for Jerry's Ice Cream") × $4.50 (Figure 6.8 "Budgeted Income Statement for Jerry's Ice Cream").

^Given.

^^ $30,576 = $101,920 in fourth quarter purchases (Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream") × 30 percent to be paid next quarter (Figure 6.10 "Cash Budget for Jerry's Ice Cream").

^^^$169,600 = $101,600 in retained earnings at end of last year (given) + $68,000 budgeted net income for the year (Figure 6.8 "Budgeted Income Statement for Jerry's Ice Cream").

Computer Application

Using Excel to Develop an Operating Budget

Managers often use spreadsheets to develop operating budgets. Spreadsheets help managers perform *what-if* analysis by linking the components of the master budget and automatically making changes to budget schedules when certain estimates are revised. For example, if managers at Jerry's Ice Cream wanted to see *what* would happen *if* sales in units were decreased by 10 percent from the initial projection shown in Figure 6.2 "Sales Budget for Jerry's Ice Cream", they would simply reduce sales by 10 percent, and all budget schedules affected by this change would automatically be updated in the spreadsheet.

An example of how to use Excel to develop an operating budget for Jerry's Ice Cream follows. Notice the tabs at the bottom of the spreadsheet. The first tab is for the sales budget worksheet, the second tab is for the production budget worksheet, the next tab is for the direct materials purchases budget worksheet, and so on. All these worksheets are linked so changes to certain estimates are reflected in the appropriate budget schedules.

	A	B	C	D	E	F	G	H
1		Jerry's Ice Cream						
2		Production Budget						
3		Year Ending December 31						
4								
5				Quarter				
6		1	2	3	4	Year		
7	Sales in units	40,000	48,000	60,000	52,000	200,000		
8	Add desired ending finished goods inventory	4,800	6,000	5,200	4,400	4,400		
9	Total finished goods inventory needed	44,800	54,000	65,200	56,400	204,400		
10	Deduct beginning finished goods inventory	(4,000)	(4,800)	(6,000)	(5,200)	(4,000)		
11	Units to be produced	40,800	49,200	59,200	51,200	200,400		
12								
13								

Spreadsheet programs are not the only way managers use technology to facilitate the budgeting process.

Check Yourself

Assume Carol's Cookies will collect 25 percent of fourth quarter budgeted sales in full next year (this represents accounts receivable at the end of the fourth quarter). The following account balances are expected at the end of the fourth quarter:

- Property, plant, and equipment (net): $320,000
- Common stock: $450,000

Retained earnings at the end of last year totaled $56,180, and no cash dividends are anticipated for the budget period ending December 31.

Prepare a budgeted balance sheet for Carol's Cookies using the format shown in Figure 6.11 "Budgeted Balance Sheet for Jerry's Ice Cream".

Solution

Carol's Cookies
Budgeted Balance Sheet
December 31

Current assets		
Cash (from cash budget)	$ 46,832	
Accounts receivable*	208,000	
Raw materials inventory**	82,000	
Finished goods inventory***	60,840	
Total current assets		$ 397,672
Plant and equipment (net)^		320,000
Total assets		$ 717,672
Current liabilities		
Accounts payable^^		59,492
Shareholders' equity		
Common stock^	450,000	
Retained earnings^^^	208,180	
Total shareholders' equity		658,180
Total liabilities and shareholders' equity		$ 717,672

*$208,000 = $832,000 in fourth quarter sales (from sales budget) × 25 percent to be collected next quarter (given).

**$82,000 = 41,000 pounds × $2 per pound (from direct materials budget).

***$60,840 = 9,000 units (from production budget) × $6.76 cost per unit (from budgeted income statement).

^Given.

^^ $59,492 = $297,460 in fourth quarter purchases (from direct materials budget) × 20 percent to be paid next quarter (given).

^^^ $208,180 = $56,180 in retained earnings end of last year (given) + $152,000 budgeted net income (from budgeted income statement).

Wrap-Up of Chapter Example

The management group at Jerry's Ice Cream is reconvening to discuss sales growth anticipated for the next budget period.

Jerry:
Tom, I recall you saying we should expect growth between 10 percent and 25 percent next year. Have you been able to narrow this down a bit?

Tom:
Yes, I've talked with our salespeople and industry contacts. We also obtained trend data from a market research firm. Based on this information, sales should increase about 15 percent this coming year. Most agree this growth is a result of our high-quality product and our ability to quickly adjust flavors to accommodate consumer tastes.

Jerry:
This is great news. It looks like our ice cream is really catching on!

Michelle:
I received Tom's projection a few days ago and already have a preliminary budget for next year. Lynn, you will have to do some serious planning to guarantee we have enough materials and employees for the third quarter spike in sales.

Lynn:
Yes, I realize we have some work to do to ensure we have enough resources to meet budgeted production levels.

Jerry:
Can't we just hire a few more employees and let our suppliers know we will need more materials?

Lynn:
The problem is that we have a spike in production during the third quarter. Production goes from 49,200 units in the second quarter to 59,200 units in the third quarter and back down to 51,200 units in the fourth quarter. I don't think materials will be an issue—our supplier has already assured me this will not be a problem. But I can't just hire new employees in the third quarter and fire them in the fourth quarter.

Jerry:
Perhaps our existing employees can work overtime, or we can hire temporary employees.

Lynn:
Hiring temporary employees would be my preference, particularly since college students are looking for part-time work during the summer months. Working overtime would really cause problems with our budgeted hourly rate of $13.

Jerry:
Michelle, do we have any cash flow problems with the anticipated growth?

Michelle:
Fortunately not. If all goes as planned, we should have more than $90,000 in the bank at the end of each quarter.

Jerry:
Excellent! Let's do our best to stay on track. Michelle, I'd like an update at the end of the first quarter to see if actual profit meets or exceeds budgeted profit.

Michelle:
No problem. I'll have it for you as soon as the books are closed for the first quarter.

Jerry:
Now that we all have some idea of what to expect this coming year, we can make sure the resources are in place to make it happen. This should be an exciting and challenging year for us. Let's meet again next month to discuss our progress in preparing for next year.

This narrative provides an example of how the master budget is used for planning purposes. It is much more efficient to plan in advance for significant increases in sales and production than to wait and deal with production issues as they occur. The master budget can also be used for control purposes by evaluating company performance.

Key Takeaways

The master budget for a manufacturing company includes budget schedules for sales, production, direct materials, direct labor, manufacturing overhead, selling and administrative, the income statement, capital expenditures, cash, and the balance sheet. The sales budget is most important because sales projections drive the other budgets.

6.4 Budgeting in Nonmanufacturing Organizations

Learning Objective

1. Describe operating budgets for merchandising, service, and not-for-profit organizations.

The examples used thus far to describe a master budget have been limited to manufacturing companies. Manufacturing companies tend to have comprehensive operating budgets and therefore serve as a good starting point in learning how to develop a master budget. However, all types of organizations use operating budgets.

Merchandising Organizations

Question: What do operating budgets look like for merchandising organizations?

Answer: Merchandising organizations typically purchase finished goods and sell them to retail or wholesale customers. Because merchandisers do not produce goods, they do not use production or production-related budgets.

Figure 6.12 “Master Budget Schedules for a Merchandising Organization” provides an overview of the master budget schedules for a merchandising organization. If you compare this diagram with Figure 6.1 “Master Budget Schedules” (master budget schedules for a manufacturing company), you will notice that production and production-related budgets are not applicable to merchandising organizations. Direct materials are not needed, and all labor and overhead costs are included in the selling and administrative budget.

Figure 6.12 Master Budget Schedules for a Merchandising Organization

The most important aspect of budgeting for merchandising organizations is the merchandise purchases budget. The merchandise purchases budget estimates the units of merchandise to be purchased and the cost per unit. Much like the production budget for a manufacturing company, the merchandise purchases budget estimates units to be purchased (instead of units to be produced) and is based on sales projections, as well as an estimate of desired ending merchandise inventory less beginning merchandise inventory.

Service Organizations

Question: What do operating budgets look like for service organizations?

Answer: Service organizations, such as architectural and accounting firms, provide services rather than tangible goods. These organizations do not have raw materials, finished goods, or merchandise inventories, and therefore they do not have production or merchandise purchases budgets. Instead, the focus is on projected sales revenue from services provided and the labor necessary to achieve sales revenue projections. Service organizations must constantly estimate services to be provided and make sure labor force resources are available to meet customer demand.

Not-for-Profit Organizations

Question: Not-for-profit organizations, such as school districts and charitable organizations, also use budgets for planning and control purposes. The budgeting process in most not-for-profit organizations is critical because the approved budget often serves as the legal authority for expenditures. What do operating budgets look like for not-for-profit organizations?

Answer: Because not-for-profit organizations are very diverse in nature—for example, some provide a service, while others collect money to help victims of natural disasters or to promote medical research—it is difficult to generalize about which master budget components apply and which do not. However, with an understanding of the budget components used by manufacturing, merchandising, and service organizations, one can establish a budgeting process for virtually any not-for-profit organization. For an example of how one not-for-profit organization goes about the budgeting process, read “Business in Action 6.2”.

Business in Action 6.2

Budgeting at a Not-for-Profit Organization

Yearly, a small not-for-profit symphony in California establishes an operating budget with revenues totaling $200,000. The symphony’s treasurer oversees the budget committee, which is made up of three board members. The budget committee is responsible for creating, approving, and monitoring the budget.

The budget committee begins the budgeting process by reviewing information from the year before. All board members and office staff are given spreadsheets showing last year’s results and are asked to provide input for the next budget period. For example, the committee responsible for ticket sales estimates sales revenue based on expected ticket sales times the average sales price. Anticipated increases in sales price are considered in the sales budget.

Expenses are also budgeted based on last year’s actual results. Those requesting increases in budgeted expenditures must justify them. Once revenues and expenses are established for the next budget period, the bookkeeper enters the information using QuickBooks software and prints a preliminary budget report, which the budget committee reviews. Once the budget committee has balanced the budget, reviewed it for reasonableness, and approved it, it goes to the board of directors for approval.

The control phase of the budgeting process requires that all expenditures be in accordance with the budget. Any expenditure exceeding the budget by more than $25 must be approved by the board of directors. A financial report comparing *actual* revenues and expenditures with *budgeted* revenues and expenditures (produced using QuickBooks software) is submitted to the board of directors monthly.

Check out another interesting example of budget application in the video below

Zero Based budgeting for Welch’s Foods

Key Takeaways

- Merchandising organizations do not produce goods, and therefore do not have production or production-related budgets. Instead, merchandisers prepare a merchandise purchases budget. Service companies do not have production or merchandise purchases budgets. Instead, service organizations focus on projected sales and labor costs. Not-for-profit organizations also use budgets for planning and control purposes. The format depends on the service being provided.

Check yourself

Patel and Company performs accounting services for its customers. The company had the following net income for the most recent year:

Patel and Company
Income Statement
Most Recent Year Ending December 31

	Quarter				
	1	2	3	4	Year
Service revenue	$135,000	$ 137,500	$ 155,000	$ 165,000	$ 592,500
Deduct operating expenses:					
Manager salaries	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 240,000
Staff salaries	25,000	25,000	25,000	25,000	100,000
Administrative staff wages	10,000	10,000	10,000	10,000	40,000
Supplies	11,500	11,500	11,500	11,500	46,000
Rent	7,000	7,000	7,000	7,000	28,000
Utilities	2,000	2,000	2,000	2,000	8,000
Insurance	14,000	14,000	14,000	14,000	56,000
Miscellaneous	6,500	6,500	6,500	6,500	26,000
Total operating expenses	$136,000	$ 136,000	$ 136,000	$ 136,000	$ 544,000
Net income	$ (1,000)	$ $1,500	$ 19,000	$ 29,000	$ 48,500

The following information was gathered to help prepare next year's budgeted income statement:

- Service revenue will increase 10 percent (e.g., first quarter service revenue for next year will be 10 percent higher than the first quarter shown previously).
- Manager and staff salaries will increase 5 percent, and a new staff accountant will be hired at the beginning of the second quarter at a quarterly salary of $12,000.
- Administrative staff wages will increase 10 percent.
- Supplies and rent will remain the same.
- Utilities will increase 5 percent.
- Insurance will increase 25 percent.
- Miscellaneous expenses will decrease 10 percent.

Prepare a quarterly budgeted income statement for **Patel and Company**; include a column summarizing the year.

Solution

Patel and Company
Budgeted Income Statement
This Coming Year Ending December 31

	Quarter				
	1	2	3	4	Year
Service revenue*	$ 148,500	$151,250	$ 170,500	$ 181,500	$ 651,750
Deduct operating expenses:					
Manager salaries**	$ 63,000	$ 63,000	$ 63,000	$ 63,000	$ 252,000
Staff salaries***	26,250	38,250	38,250	38,250	141,000
Administrative staff wages^	11,000	11,000	11,000	11,000	44,000
Supplies^^	11,500	11,500	11,500	11,500	46,000
Rent^^	7,000	7,000	7,000	7,000	28,000
Utilities^^^	2,100	2,100	2,100	2,100	8,400
Insurance@	17,500	17,500	17,500	17,500	70,000
Miscellaneous@@	5,850	5,850	5,850	5,850	23,400
Total operating expenses	$ 144,200	$156,200	$ 156,200	$ 156,200	$ 612,800
Net income (loss)	$ 4,300	$ (4,950)	$ 14,300	$ 25,300	$ 38,950

*First quarter budget of $148,500 = $135,000 in last year's first quarter revenue × (1 + .10).

**Quarterly budget of $63,000 = $60,000 in last year's quarterly salaries × (1 + .05).

***First quarter budget of $26,250 = $25,000 in last year's first quarter salaries × (1 + .05). Second, third, and fourth quarter budgets include newly hired staff at $12,000 a quarter.

^Quarterly budget of $11,000 = $10,000 in last year's quarterly budget × (1 + .10).

^^ No change from last year.

^^^ Quarterly budget of $2,100 = $2,000 in last year's quarterly budget × (1 + .05).

@ Quarterly budget of $17,500 = $14,000 in last year's quarterly budget × (1 + .25).

@@ Quarterly budget of $5,850 = $6,500 in last year's quarterly budget × (1 – .10).

6.5 Ethical Issues in Creating Operating Budgets

Learning Objective

1. Understand ethical issues associated with budgeting.

Question: Although bottom-up budgeting, in which management elicits input from employees throughout the company, is effective in actively engaging those who have to achieve the budgeted goals, this type of budgeting is not free from problems. Ethical issues often arise in the budgeting process, particularly when employees and managers are evaluated by comparing their actual results to the budget. How might ethical issues arise in the budgeting process?

Answer: To demonstrate how ethical dilemmas might arise, assume you are a manager and you help upper management establish the master budget (this is the planning phase). Furthermore, you are evaluated based on achieving budgeted profit on a quarterly basis (this is the control phase). In fact, you will receive a $10,000 quarterly bonus, in addition to your base salary, if you meet or exceed budgeted profit. There is an inherent conflict between the planning and control phases of this process. You are helping the company plan, but you also want to be sure budgeted profit is as low as possible so you can get the $10,000 bonus.

Establishing a sales and profit budget that is considerably lower than what will likely happen causes problems for the entire organization. Production may be short of materials and labor, causing inefficiencies in the production process. Selling and administrative support may be lacking due to underestimating sales. Customers will not be satisfied if they must wait for the product. The dilemma you face as a manager in this situation is whether to do what is best for you (set a low profit estimate to earn the bonus) or do what is best for the company (estimate accurately so the budget reflects true sales and production needs).

Organizations must recognize this conflict and have processes in place to ensure both the interests of individual employees and the interests of the organization as a whole are served. For example, employees can be rewarded not just for meeting goals but also for providing accurate estimates. Perhaps a long-term stock option incentive system would provide motivation to do what is best for the organization, thereby increasing shareholder value. Whatever incentive system is implemented, organizations must promote honest employee input and beware of fraudulent reporting to achieve financial targets.

Key Takeaways

- An inherent conflict often exists between the planning and control phases of budgeting. During the planning phase, organizations are most concerned about getting accurate estimates that lead to positive results. The control phase requires evaluating performance of employees by comparing actual results to the operating budget. Employees often must decide between doing what is best for the individual employee and what is best for the organization.

End of Chapter Exercises

Questions

1. Describe the planning phase of budgeting.
2. Describe the control phase of budgeting.
3. Refer to "Business in Action 6.1" Describe two characteristics that make budgeting difficult for multinational companies.
4. Why do successful companies tend to use the bottom-up approach to budgeting?
5. Briefly describe the components of a master budget for a manufacturing organization.
6. Why is the sales budget the most important component of the master budget?
7. Describe the information used by companies to estimate sales.
8. Describe how *units to be produced* is calculated in the production budget.
9. How does a production budget help the production manager plan for the future?
10. Why is depreciation deducted at the bottom of the manufacturing overhead budget?
11. Why do companies that prepare a budgeted income statement also prepare a cash budget?
12. How does the master budget for a merchandising organization differ from the master budget for a manufacturing organization?
13. Describe the difference between service organization budgets and manufacturing organization budgets.
14. Refer to "Business in Action 6.2" Describe the two procedures that the symphony uses in the control phase of budgeting.
15. Describe the ethical conflict that can occur between the planning and control phases of the budgeting process.
16. Why might a sales budget that intentionally underestimates sales have a negative impact on the organization?

Brief Exercises

17. Budget Sequence. Indicate the order in which the following budget schedules are prepared.

1. Direct materials purchases
2. Manufacturing overhead
3. Income statement
4. Direct labor
5. Selling and administrative
6. Cash
7. Production
8. Balance sheet
9. Sales
10. Capital expenditures

18. **Sales Budget.** Schwartz and Company expects to sell 100 units in the first quarter, 90 units in the second quarter, 150 units in the third quarter, and 160 units in the fourth quarter. The average sales price per unit is expected to be $3,000. Prepare a sales budget for each quarter and include a column for the year ending December 31.

19. **Production Budget.** Schwartz and Company expects to sell 100 units in the first quarter and 90 units in the second quarter. Assuming the company prefers to maintain finished goods inventory equal to 10 percent of the next quarter's sales, prepare a production budget for the first quarter using Figure 6.3 "Production Budget for Jerry's Ice Cream" as a guide. (Hint: you are preparing a production budget for the first quarter only.)

20. Direct Materials Purchases Budget. The production budget for Kaminski Products shows the company expects to produce 500 units in the first quarter and 600 units in the second quarter. Each unit requires 10 pounds of direct materials at a cost of $2 per pound. The company prefers to maintain raw materials inventory equal to 20 percent of next quarter's materials needed in production. Prepare a direct materials purchases budget using Figure 6.4 "Direct Materials Purchases Budget for Jerry's Ice Cream" as a guide. (Hint: you are preparing a direct materials purchases budget for the first quarter only.)

21.**Direct Labor Budget.** The production budget for Kaminski Products shows the company expects to produce 500 units in the first quarter. Assuming each unit of product requires 3 direct labor hours at a cost of $13 per hour, prepare a direct labor budget for the first quarter using Figure 6.5 "Direct Labor Budget for Jerry's Ice Cream" as a guide. (Hint: you are preparing a direct labor budget for the first quarter only.)

22. Manufacturing Overhead Budget. The production budget for Kaminski Products shows the company expects to produce 500 units in the first quarter. Assume variable overhead cost per unit is $5 for indirect materials, $8 for indirect labor, and $3 for other items. Fixed overhead cost per quarter is $30,000 for salaries, $20,000 for rent, and $8,000 for depreciation. Prepare a manufacturing overhead budget for the first quarter using Figure 6.6 "Manufacturing Overhead Budget for Jerry's Ice Cream" as a guide (Hint: you are preparing a manufacturing overhead budget for the first quarter only.)

23. Sales Cash Collections Budget. All sales for Malik and Associates are on credit. Accounts receivable at the end of last quarter totaled $100,000. Credit sales for the first quarter of the upcoming period are expected to be $300,000. The company expects to collect 70 percent of sales in the quarter of the sale, and 30 percent the quarter following the sale. Prepare a sales cash collections budget for the first quarter of the upcoming period using the top of Figure 6.10 "Cash Budget for Jerry's Ice Cream" as a guide. (Hint: you are preparing a sales cash collections budget for the first quarter only.)

24. Purchases Cash Payments Budget. All direct material purchases made by Keen and Company are on credit. Accounts payable at the end of last quarter totaled $50,000. Purchases for the first quarter of the upcoming period are expected to be $200,000. The company expects to pay 40 percent of purchases in the quarter of purchase and 60 percent the quarter following the purchase. Prepare a purchases cash payments budget for the first quarter of the upcoming period using the middle of Figure 6.10 "Cash Budget for Jerry's Ice Cream" as a guide. (Hint: you are preparing a purchases cash payments budget for the first quarter only.)

25. Sales Budget for Service Organization; Ethical Issues. Rami and Associates is an accounting firm that estimates revenues based on billable hours. The company expects to charge 8,000 hours to clients in the first quarter, 9,000 hours in the second quarter, 7,000 hours in the third quarter and 8,500 hours in the fourth quarter. The average hourly billing rate is expected to be $100.

Required:

1. Prepare a services revenue budget for each quarter and include a column for the year ending December 31. (Hint: this is similar to a sales budget except sales are measured in labor hours rather than in units, and revenue is measured as an average hourly billing rate rather than a sales price per unit.)
2. Since the manager of the company is given a bonus if actual billable hours exceed budgeted billable hours, the manager intentionally underestimated the number of expected billable hours for each quarter. How might this underestimate affect the company?

Exercises:

26. Sales and Production Budgets. Templeton Corporation produces windows used in residential construction. Unit sales last year, ending December 31, are as follow:

First quarter	40,000
Second quarter	50,000
Third quarter	52,000
Fourth quarter	48,000

Unit sales are expected to increase 10 percent this coming year over the same quarter last year. Average sales price per window will remain at $200.

Assume finished goods inventory is maintained at a level equal to 5 percent of the next quarter's sales. Finished goods inventory at the end of the fourth quarter budget period is estimated to be 2,300 units.

Required:

1. Prepare a sales budget for Templeton Corporation (Hint: be sure to increase last year's unit sales by 10 percent.)
2. Prepare a production budget for Templeton Corporation

27. Direct Materials Purchases and Direct Labor Budgets. Templeton Corporation produces windows used in residential construction. The company expects to produce 44,550 units in the first quarter, 55,110 units in the second quarter, 56,980 units in the third quarter, and 52,460 units in the fourth quarter. (This information is derived from the previous exercise for Templeton Corporation.)

With regards to direct materials, each unit of product requires 12 square feet of glass at a cost of $1.50 per square foot. Management prefers to maintain ending raw materials inventory equal to 10 percent of next quarter's materials needed in production. Raw materials inventory at the end of the fourth quarter budget period is estimated to be 65,000 square feet.

With regards to direct labor, each unit of product requires 2 labor hours at a cost of $15 per hour.

Required:

1. Prepare a direct materials purchases budget for Templeton Corporation
2. Prepare a direct labor budget for Templeton Corporation

28. Manufacturing Overhead Budget. Templeton Corporation produces windows used in residential construction. The company expects to produce 44,550 units in the first quarter, 55,110 units in the second quarter, 56,980 units in the third quarter, and 52,460 units in the fourth quarter. (This information is the same as in the previous exercise for Templeton Corporation.) The following information relates to the manufacturing overhead budget.

Variable Overhead Costs	
Indirect materials	$2.50 per unit
Indirect labor	$3.20 per unit
Other	$1.70 per unit

Fixed Overhead Costs per Quarter	
Salaries	$50,000
Rent	$60,000
Depreciation	$36,370

Required:

Prepare a manufacturing overhead budget for Templeton Corporation

29. Budgets for Cash Collections from Sales and Cash Payments for Purchases. Templeton Corporation produces windows used in residential construction. The dollar amount of the company's quarterly sales and direct materials purchases are projected to be as follows (this information is derived from the previous exercises for Templeton Corporation):

	1st	2nd	3rd	4th
Sales	$8,800,000	$11,000,000	$11,440,000	$10,560,000
Direct materials purchases	$ 820,908	$ 995,346	$ 1,017,504	$ 947,352

Assume all sales are made on credit. The company expects to collect 60 percent of sales in the quarter of sale and 40 percent the quarter following the sale. Accounts receivable at the end of last year totaled $3,000,000, all of which will be collected in the first quarter of the coming year.

Assume all direct materials purchases are on credit. The company expects to pay 70 percent of purchases in the quarter of purchase and 30 percent the following quarter. Accounts payable at the end of last year totaled $325,000, all of which will be paid in the first quarter of this coming year.

Required:

1. Prepare a budget for cash collections from sales.
2. Prepare a budget for cash payments for purchases of materials. Round to the nearest dollar.

30. Service Company Budgeted Income Statement and Ethical Issues. Lawn Care, Inc., has two owners who maintain lawns for residential customers. The company had the following net income for the most current year.

Lawn Care, Inc.
Income Statement
Most Recent Year Ending December 31

	Quarter				
	1	2	3	4	Year
Service revenue	$130,000	$135,000	$ 150,000	$ 140,000	$ 555,000
Deduct operating expenses:					
Owner salaries	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 120,000
Crew wages	40,000	40,000	40,000	40,000	160,000
Administrative staff wages	8,000	8,000	8,000	8,000	32,000
Supplies	12,000	12,000	12,000	12,000	48,000
Office rent	2,000	2,000	2,000	2,000	8,000
Utilities	1,000	1,000	1,000	1,000	4,000
Insurance	19,000	19,000	19,000	19,000	76,000
Miscellaneous	5,000	5,000	5,000	5,000	20,000
Total operating expenses	$117,000	$117,000	$ 117,000	$ 117,000	$ 468,000
Income before taxes	13,000	18,000	33,000	23,000	87,000
Income taxes (30% rate)	(3,900)	(5,400)	(9,900)	(6,900)	(26,100)
Net income	$ 9,100	$ 12,600	$ 23,100	$ 16,100	$ 60,900

The following information was gathered from the owners to help prepare this coming year's budgeted income statement:

- Service revenue will increase 15 percent (e.g., first quarter service revenue for this coming year will be 15 percent higher than the first quarter shown previously).
- Owner salaries will increase 8 percent.
- Crew wages will increase 12 percent.
- Administrative staff wages will increase 5 percent, and a new staff member will be hired at the beginning of the third quarter at a quarterly rate of $7,000.
- Supplies will increase 9 percent.
- Office rent, utilities, and miscellaneous expenses will remain the same.
- Insurance will increase 18 percent.
- The tax rate will remain at 30 percent.

Required:

1. Prepare a quarterly budgeted income statement for Lawn Care, Inc., and include a column summarizing the year.
2. The owners of Lawn Care, Inc., have decided to expand and are in need of additional cash to expand operations. Unknown to the owners, the company's accountant intentionally inflated the revenue projections for this coming year to make the company look better when applying for a loan. Is this behavior ethical? Explain. (It may be helpful to review the presentation of ethics in Chapter 1 "What Is Managerial Accounting?".)

Problems

31. Budgeting for Sales, Production, Direct Materials, Direct Labor, and Manufacturing Overhead; Ethical Issues. Sanders Swimwear, Inc., produces swimsuits. The following information is to be used for the operating budget this coming year.

- Average sales price for each swimsuit is estimated to be $50. Unit sales for this coming year ending December 31 are expected to be as follows:

First quarter	3,000
Second quarter	5,000
Third quarter	20,000
Fourth quarter	6,000

- Finished goods inventory is maintained at a level equal to 10 percent of the next quarter's sales. Finished goods inventory at the end of the fourth quarter budget period is estimated to be 400 units.
- Each unit of product requires 3 yards of direct materials, at a cost of $4 per yard. Management prefers to maintain ending raw materials inventory equal to 20 percent of next quarter's materials needed in production. Raw materials inventory at the end of the fourth quarter budget period is estimated to be 9,500 yards.
- Each unit of product requires 0.5 direct labor hours at a cost of $12 per hour.
- Variable manufacturing overhead costs are

Indirect materials	$0.60 per unit
Indirect labor	$3.50 per unit
Other	$2.80 per unit

- Fixed manufacturing overhead costs per quarter are

Salaries	$30,000
Other	$ 5,000
Depreciation	$ 9,330

Required:

1. Prepare a sales budget
2. Prepare a production budget
3. Prepare a direct materials purchases budget
4. Prepare a direct labor budget
5. Prepare a manufacturing overhead budget
6. As the production manager, what concerns, if any, do you have about production requirements for each of the four quarters?
7. Assume the sales budget was developed based on input provided by the company's vice president of sales. The vice president is paid a base salary plus a bonus if actual sales exceed budgeted sales. How might this influence the vice president's estimate of quarterly sales? What effect might this have on the company?

32. Budgeting for Sales, Production, Direct Materials, Direct Labor, and Manufacturing Overhead. Hershel's Chocolate produces chocolate bars and sells them by the case (1 unit = 1 case). Information to be used for the operating budget this coming year follows:

- Average sales price for each case is estimated to be $25. Unit sales for this coming year, ending December 31, are expected to be as follows:

First quarter	80,000
Second quarter	84,000
Third quarter	88,000
Fourth quarter	97,000

- Finished goods inventory is maintained at a level equal to 15 percent of the next quarter's sales. Finished goods inventory at the end of the fourth quarter budget period is estimated to be 13,000 units.
- Each unit of product requires 5 pounds of cocoa beans for direct materials, at a cost of $3 per pound. Management prefers to maintain ending raw materials inventory equal to 10 percent of next quarter's materials needed in production. Raw materials inventory at the end of the fourth quarter budget period is estimated to be 43,000 pounds.
- Each unit of product requires 0.10 direct labor hours at a cost of $14 per hour.
- Variable manufacturing overhead costs are

Indirect materials	$0.20 per unit
Indirect labor	$0.15 per unit
Other	$0.10 per unit

- Fixed manufacturing overhead costs per quarter are

Salaries	$80,000
Other	$70,000
Depreciation	$55,625

Required:

1. Prepare a sales budget
2. Prepare a production budget
3. Prepare a direct materials purchases budget
4. Prepare a direct labor budget
5. Prepare a manufacturing overhead budget
6. As the production manager, what concerns, if any, do you have about production requirements for each of the four quarters?

33. Selling and Administrative Budget and Budgeted Income Statement. (The previous problem must be completed before working this problem.) Hershel's Chocolate produces chocolate bars. Management estimates all selling and administrative costs are fixed. Quarterly selling and administrative cost estimates for the coming year follow.

Salaries	$170,000
Rent	$ 65,000
Advertising	$120,000
Depreciation	$ 75,000
Other	$ 36,000

Required:

1. Use the information presented previously to prepare a selling and administrative budget. R
2. Use the information from the previous problem and from requirement *a* of this problem to prepare a budgeted income statement.
3. How will management use the information presented in the budgeted income statement?

34. Budgeting for Cash Collections and Cash Payments. Hershel's Chocolate produces chocolate bars. The treasurer at Hershel's Chocolate is preparing the cash budget and would like to know when cash collections from sales and cash payments for materials will occur. The dollar amount of the company's quarterly sales and direct materials purchases are projected to be as follows (this information is the result of working the previous problems for Hershel's Chocolate):

	1st	**2nd**	**3rd**	**4th**
Sales	$2,000,000	$2,100,000	$2,200,000	$2,425,000
Direct materials purchases	$1,215,000	$1,276,125	$1,349,400	$1,417,575

- All sales are made on credit. The company expects to collect 60 percent of sales in the quarter of sale and 40 percent the quarter following the sale. Accounts receivable at the end of last year totaled $770,000, all of which will be collected during the first quarter of this coming year.
- All direct materials purchases are on credit. The company expects to pay 80 percent of purchases in the quarter of purchase and 20 percent the following quarter. Accounts payable at the end of last year totaled $257,000, all of which will be paid during the first quarter of this coming year.

Required:

1. Prepare a budget for cash collections from sales.
2. Prepare a budget for cash payments for purchases of materials.
3. How will the treasurer use this information?

35. Services Revenue and Direct Labor Budgets for Service Organization; Ethical Issues. Engineering, Inc., provides structural engineering services for its clients. Billable hours for each month of the first quarter of this coming budget period are expected to be as follows:

January	2,000
February	2,200
March	3,000

The average hourly billing rate is estimated to be $150.

Required:

1. Prepare a services revenue budget for Engineering, Inc., for each month of the first quarter and include a total column for the quarter. (Hint: this is similar to a sales budget except sales are measured in labor hours rather than in units, and revenue is measured as an average hourly billing rate rather than a sales price per unit.)
2. The average cost for each hour of direct labor is expected to be $50. Assume total direct labor hours are expected to be 20 percent higher than billable direct labor hours presented previously. This is caused by employees working on projects that are not billable to clients (e.g., recruiting and community work). Prepare a direct labor budget for each month of the first quarter and include a total column for the quarter. (Hint: this budget will have three lines: *projected direct labor hours*, *labor rate per hour*, and *total direct labor cost*.)
3. Assume the manager of the company is given a monthly bonus if actual billable hours exceed budgeted billable hours. How might this influence the manager's estimate of monthly billable hours for budgeting purposes? What effect might this have on the company?

36. Merchandising Company Master Budget. Big Apple Sporting Goods is a retail store that sells a variety of sports equipment. The company's fiscal year ends on December 31. Information to be used for the operating budget this coming year follows.

Sales and Merchandise Purchases Budget Information

- Sales for this coming year ending December 31 are expected to be as follows:

First quarter	$600,000
Second quarter	$650,000
Third quarter	$660,000
Fourth quarter	$800,000

- Cost of goods sold is 40 percent of sales (this is the first line of the merchandise purchases budget). Merchandise inventory is maintained at a level equal to 20 percent of the next quarter's cost of goods sold. Merchandise inventory at the end of the fourth quarter budget period is estimated to be $55,000.

Selling and Administrative Budget Information

- Management estimates all selling and administrative costs are fixed.

- Quarterly selling and administrative cost estimates for the coming year are

Salaries	$150,000
Rent	$ 25,000
Advertising	$ 40,000
Depreciation	$ 18,000
Other	$ 12,000

Capital Expenditure and Cash Budget Information

- The company plans to pay cash for property, plant, and equipment totaling $35,000 at the end of the fourth quarter. This purchase will not affect depreciation expense for the coming year.
- The company expects to collect 70 percent of sales in the quarter of sale and 30 percent the quarter following the sale. Accounts receivable at the end of last year totaled $200,000, all of which will be collected during the first quarter of this coming year.
- All inventory purchases are on credit. The company expects to pay 80 percent of inventory purchases in the quarter of purchase and 20 percent the following quarter. Accounts payable at the end of last year totaled $68,000, all of which will be paid during the first quarter of this coming year.
- The cash balance at the beginning of this coming year is expected to be $90,000.

Budgeted Balance Sheet Information

- Assume 30 percent of fourth quarter budgeted sales will be collected in full the following year (this represents accounts receivable at the end of the fourth quarter).
- Expected account balances at the end of the fourth quarter are

Property, plant, and equipment (net)	$120,000
Common stock	$175,000

- Actual retained earnings at the end of the last year totaled $252,000, and no cash dividends will be paid during the current budget period ending December 31.

Required:

1. Prepare a quarterly sales budget. (Hint: this budget will not have any units of product, only total sales revenue.)
2. Prepare a quarterly merchandise purchases budget using the following format. All amounts are in dollars.

Big Apple Sporting Goods
Merchandises Purchases Budget
Year Ending December 31

	Quarter				
	1	2	3	4	Year
Budgeted costs of goods sold					
Add desired ending merchandise inventory					
Total merchandise inventory needed					
Deduct beginning merchandise inventory					
Merchandise to be purchased					

3. Prepare a quarterly selling and administrative budget
4. Prepare a quarterly budgeted income statement (Hint: cost of goods sold will be based on a percent of sales rather than a cost per unit.)
5. Prepare a quarterly capital expenditure budget
6. Prepare a quarterly cash budget (Hint: Merchandising companies have merchandise purchases rather than direct materials purchases. Merchandising companies do *not* have direct labor or manufacturing overhead.)
7. Prepare a budgeted balance sheet at December 31 . (Hint: merchandising companies have merchandise inventory rather than raw materials inventory or finished goods inventory.)

One Step Further: Skill-Building Cases

37. Ethics in Budgeting. SportsMax sells sporting goods equipment at 100 stores throughout North America. Robert Manning is the manager of one SportsMax retail store in Chicago. The company is in the planning phase of establishing its operating budget for this coming year and has asked that all store managers submit their estimates of sales revenue, costs, and resulting profit. During the control phase, each store manager is evaluated by comparing budgeted profit with actual profit. Store managers who exceed budgeted profit are given a bonus equal to 10 percent of actual profit in excess of budgeted profit.

Required:

1. Describe the ethical conflict that Robert Manning is facing.
2. As the president and CEO of SportsMax, how might you motivate Robert Manning to provide an accurate operating budget?

Comprehensive Cases

38. Comprehensive Master Budget. Creative Shirts, Inc., produces T-shirts. The company's fiscal year ends on December 31. Information to be used for the operating budget this coming year follows.

Sales and Production-Related Budget Information

- Average sales price for each T-shirt is estimated to be $15. Unit sales for this coming year, ending December 31, are expected to be as follows:

First quarter	20,000
Second quarter	24,000
Third quarter	28,000
Fourth quarter	18,000

- Finished goods inventory is maintained at a level equal to 10 percent of the next quarter's sales. Finished goods inventory at the end of the fourth quarter budget period is estimated to be 2,000 units.
- Each unit of product requires 3 yards of direct materials, at a cost of $2 per yard. Management prefers to maintain ending raw materials inventory equal to 20 percent of next quarter's materials needed in production. Raw materials inventory at the end of the fourth quarter budget period is estimated to be 12,200 yards.
- Each unit of product requires 0.1 direct labor hours at a cost of $14 per hour.
- Variable manufacturing overhead costs are

Indirect materials	$0.70 per unit
Indirect labor	$0.90 per unit
Other	$0.50 per unit

- Fixed manufacturing overhead costs per quarter are

Salaries	$18,000
Other	$20,000
Depreciation	$11,950

Selling and Administrative Budget Information

- Management estimates all selling and administrative costs are fixed.
- Quarterly selling and administrative cost estimates for the coming year are

Salaries	$15,000
Rent	$ 5,000
Advertising	$ 4,000
Depreciation	$ 9,000
Other	$10,000

Capital Expenditures and Cash Budget Information

- The company plans to pay cash for selling and administrative equipment totaling $15,000 and production equipment totaling $9,000. Both will be purchased at the end of the fourth quarter and will not affect depreciation expense for the coming year.
- All sales are made on credit. The company expects to collect 70 percent of sales in the quarter of sale and 30 percent the quarter following the sale. Accounts receivable at the end of last year totaled $80,000, all of which will be collected during the first quarter of this coming year.
- All direct materials purchases are on credit. The company expects to pay 80 percent of purchases in the quarter of purchase and 20 percent the following quarter. Accounts payable at the end of last year totaled $25,000, all of which will be paid during the first quarter of this coming year.
- The cash balance at the beginning of this coming year is expected to be $30,000.

Budgeted Balance Sheet Information

- Assume 30 percent of fourth quarter budgeted sales will be collected in full the following year (this represents accounts receivable at the end of the fourth quarter).

- Expected account balances at the end of the fourth quarter are

Property, plant, and equipment (net)	$100,000
Common stock	$250,000

- Actual retained earnings at the end of last year totaled $42,720, and no cash dividends will be paid during the current budget period ending December 31.

Required:

1. Prepare the quarterly sales and production-related budgets using the figure formats shown earlier:
   - Sales budget
   - Production budget
   - Direct materials purchases budget
   - Direct labor budget
   - Manufacturing overhead budget
2. Prepare a quarterly selling and administrative budget
3. Prepare a quarterly budgeted income statement
4. Prepare a quarterly capital expenditures budget
5. Prepare a quarterly cash budget
6. Prepare a budgeted balance sheet at December 31
7. Why does management at Creative Shirts, Inc., prepare a master budget? Explain.

39. Ethics in Budgeting. Carol Chadwick is the manager of the toys division at Matteler, Inc. Carol is in the process of establishing the budgeted income statement for this coming year, which will be submitted to the company president for approval. The division's current year actual results were slightly higher than the 5 percent growth Carol had anticipated. These results are shown as follows.

Sales revenue	$ 50,000,000
Costs of goods sold	30,000,000
Gross profit	$ 20,000,000
Selling and administrative expenses	15,000,000
Net income	$ 5,000,000

Division managers receive a 20 percent bonus for actual net income in excess of budgeted net income. Carol believes growth in sales this year will be approximately 12 percent. She is considering submitting a budget showing an increase of 5 percent, which will increase her chances of receiving a significant bonus at the end of this coming year. Assume cost of goods sold are variable costs and will increase in proportion with sales revenue. That is, cost of goods sold will always be 60 percent of sales revenue. Assume selling and administrative expenses are fixed costs.

Required:

1. Prepare a budgeted income statement for the toys division assuming sales revenue will increase 5 percent.
2. Prepare a budgeted income statement for the toys division assuming sales revenue will increase 12 percent.
3. How much will Carol potentially have to gain in bonus compensation by submitting a budget showing a 5 percent increase in sales revenue if actual growth turns out to be 12 percent?

4. As the president and CEO of Matteler, how might you motivate Carol Chadwick to provide an accurate budgeted income statement?

Previous Chapter

Table of Contents

Next Chapter

6: How Are Operating Budgets Created? is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts.

Index

D

dire

1: Appendix

Index

D

dire

Glossary

Sample Word 1 | Sample Definition 1

Detailed Licensing

Overview

Title: Principles of Managerial Accounting 1

Webpages: 20

All licenses found:

- Undeclared: 100% (20 pages)

By Page

- Principles of Managerial Accounting 1 - *Undeclared*
  - Front Matter - *Undeclared*
    - TitlePage - *Undeclared*
    - InfoPage - *Undeclared*
    - Preface - *Undeclared*
    - Table of Contents - *Undeclared*
    - Licensing - *Undeclared*
    - Licensing and Publishing Information - *Undeclared*
  - 1: What Is Managerial Accounting? - *Undeclared*
  - 2: How Do Organizations Identify Cost Behavior Patterns? - *Undeclared*
  - 3: How Is Cost-Volume-Profit Analysis Used for Decision Making? - *Undeclared*
  - 4: How Are Relevant Revenues and Costs Used to Make Decisions? - *Undeclared*
  - 5: How Is Capital Budgeting Used to Make Decisions? - *Undeclared*
  - 6: How Are Operating Budgets Created? - *Undeclared*
  - Back Matter - *Undeclared*
    - Index - *Undeclared*
    - 1: Appendix - *Undeclared*
    - Index - *Undeclared*
    - Glossary - *Undeclared*
    - Detailed Licensing - *Undeclared*