CIS 1503 MICROSOFT EXCEL



LueCrecy Ragan
Arkansas State University-Beebe

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CIS 1503 Microcomputer Applications I

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Detailed Licensing

Licensing

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

CHAPTER OVERVIEW

1: Microsoft Excel- Setting a Foundation



Microsoft Excel - Setting a Foundation

This chapter introduces Microsoft Excel as a powerful tool for organizing, analyzing, and managing data in both personal and professional settings. It explains the basic structure and interface, including the Ribbon, workbooks, and worksheets, while guiding users on how to open, save, and organize files effectively. The content covers essential skills such as entering and formatting data, sorting and filtering information, and improving presentation with headers, footers, and templates. It also introduces formulas and functions, showing how they are used for calculations, data analysis, and decision-making. Overall, the chapter focuses on building a strong foundation in Excel to help users work efficiently with data and create clear, organized spreadsheets.

1.1: Microsoft Excel - Setting a Foundation Sections

1.1.1: Introduction to Microsoft Excel
1.1.2: The Excel Ribbon
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SECTION OVERVIEW

1.1: Microsoft Excel - Setting a Foundation Sections



Microsoft Excel - Setting a Foundation

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Topic hierarchy

1.1.1: Introduction to Microsoft Excel

1.1.2: The Excel Ribbon

1.1.3: The Excel Workbook

1.1.4: Text and Numbers in Microsoft Excel

1.1.5: Headers, Footers, and Page Layout

1.1.6: Renaming and Organizing Worksheets

1.1.7: Formatting and Templates in Microsoft Excel

1.1.8: Entering, Selecting, Sorting, and Formatting Data

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1.1.13: Using Arithmetic, Statistical, and Logical Functions

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1.1.1: Introduction to Microsoft Excel

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Excel Scenario

WorldCorp's Portland, Maine, location receives many finished products at their warehouse. Some of the products they sell include LCD TVs, home stereo systems, computer accessories, and tablets. They add these items to the inventory and then ship them to different destinations. Their orders include a wide variety of products, each with a different price, for many clients, and with multiple sales agents. Because WorldCorp's business model includes multiple locations and various business units, they have a large volume of data, so collaboration and sharing of information is necessary for the company to be successful. This is especially true when communicating sales information company-wide. The information needs to be organized and effectively communicated to various entities within the corporation. It will also need to be put into sales reports that follow corporate standards for reporting and be accessible by the appropriate entities for editing. By using spreadsheets, sales agents and upper management at WorldCorp can access the information they need to make informed decisions about inventory levels and distribution channels.

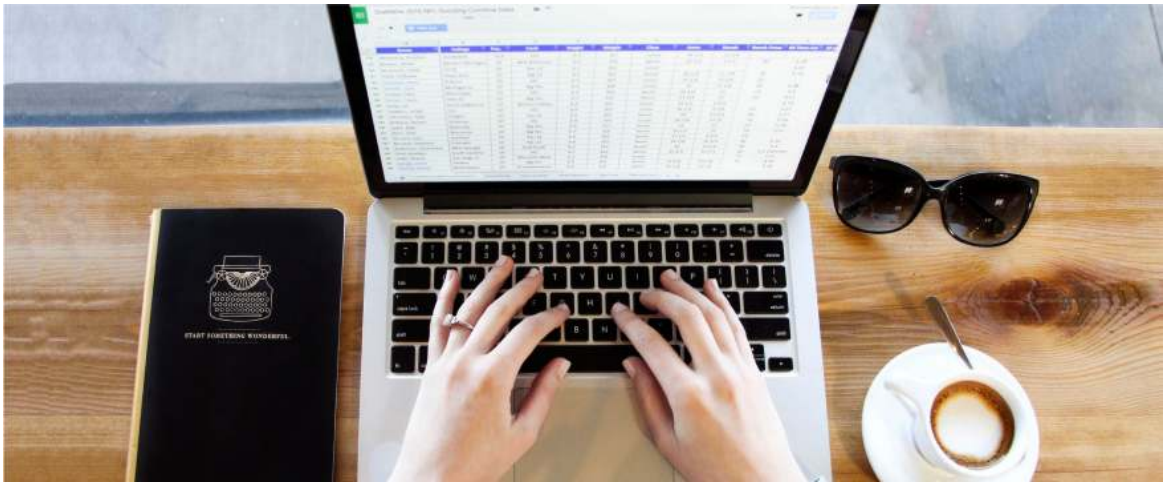


Figure 9.1: A spreadsheet is a useful tool for working with large sets of numerical data. (credit: modification of "Notebook, Typing, Coffee" by Pexels/Pixabay, CC0)

A spreadsheet is a powerful tool to organize, present, and analyze critical information that allows WorldCorp to effectively manage their diverse business. For example, WorldCorp can use a spreadsheet program such as Microsoft Excel or Google Sheets to summarize quarterly sales information for the sales agents in a particular region. A more in-depth review by upper management could be centered on analyzing the performance of sales agents or regions to set targets for the next year. Spreadsheets can be used to track inventory levels that then can be evaluated by product type or price. Generated reports can be used by the accounting department when billing customers and reconciling accounts. Finally, the programs can even be used to make sales projections or to examine the impact of price changes on profits.

An Excel **spreadsheet** is a file with **cells** in **rows** and **columns** and can help arrange, calculate and sort data. Data in a spreadsheet can be numeric values, text, formulas, references and functions. We will even learn how to embed charts and graphs into a spreadsheet. Spreadsheets are used to visualize data in a meaningful way that can be used to make complex decisions. Spreadsheets can take raw data, and tell a story with it.

Common Spreadsheet Software:

Types of Spreadsheet Software

Software Name	Type	Key Features
Microsoft Excel	Commercial and Online	Runs on Windows and Mac. Part of Office 365. Recent features include robust formulas and functions, charts, graphs, and sparklines. Arguably, the most popular spreadsheet software. Compatible with Microsoft OneDrive.
Google Sheets	Online	Included as part of a free, web-based software office suite offered by Google within its Google Drive service, allows users to create, view, and edit files online while collaborating with other users in real-time. Available as a web application supported on Google Chrome, Mozilla Firefox, Internet Explorer, Microsoft Edge, and Apple Safari web browsers. Compatible with Google Drive.
Apple Numbers	Online	Part of the iWork productivity suite and runs on the MacOS, iPadOS, and iOS operating systems. Users feel that it is an easy-to-use application that allows them to quickly create spreadsheets on their Apple devices.

Note

Going forward, we will focus on the commercial Microsoft Excel. The other spreadsheet applications, including Excel online, are good, but have limitations.

Microsoft® Office contains a variety of tools that help people accomplish many personal and professional objectives. Microsoft Excel is perhaps the most versatile and widely used of all the Office applications. No matter which career path you choose, you will likely need to use Excel to accomplish your professional objectives, some of which may occur daily. This chapter provides an overview of the Excel application along with an orientation for accessing the commands and features of an Excel workbook.

Learning Objectives

- Examine the value of using Excel to make decisions.
- Learn how to start Excel.
- Become familiar with the Excel workbook.
- Understand how to navigate worksheets.
- Examine the Excel Ribbon.
- Examine the right-click menu options.
- Learn how to save workbooks.
- Examine the Status Bar.
- Become familiar with the features in the Excel Help window.

Microsoft Office contains a variety of tools that help people accomplish many personal and professional objectives. Microsoft Excel is perhaps the most versatile and widely used of all the Office applications. No matter which career path you choose, you will

likely need to use Excel to accomplish your professional objectives, some of which may occur daily. This chapter provides an overview of the Excel application along with an orientation for accessing the commands and features of an Excel workbook.

Making Decisions with Excel

Taking a very simple view, Excel is a tool that allows you to enter quantitative data into an electronic spreadsheet to apply one or many mathematical computations. These computations ultimately convert that quantitative data into information. The information produced in Excel can be used to make decisions in both professional and personal contexts. For example, employees can use Excel to determine how much inventory to buy for a clothing retailer, how much medication to administer to a patient, or how much money to spend to stay within a budget. With respect to personal decisions, you can use Excel to determine how much money you can spend on a house, how much you can spend on car lease payments, or how much you need to save to reach your retirement goals. We will demonstrate how you can use Excel to make these decisions and many more throughout this text.

Figure 1.1 shows a completed Excel worksheet. The information shown in this worksheet contains sales data for a hypothetical merchandise retail company. The worksheet data can help a retailer analyze the business and determine the number of salespeople needed for each month for example.

	A	B	C	D
1	***Merchandise City, USA Retail Sales***			
2	**Month**	**Unit Sales**	**Average Price**	**Sales Dollars**
3	January	2,670	$ 9.99	$ 26,685
4	February	2,160	$ 12.49	$ 26,937
5	March	515	$ 14.99	$ 7,701
6	April	590	$ 17.49	$ 10,269
7	May	1,030	$ 14.99	$ 15,405
8	June	2,875	$ 12.49	$ 35,916
9	July	2,700	$ 9.99	$ 26,937
10	August	900	$ 19.99	$ 17,958
11	September	775	$ 19.99	$ 15,708
12	October	1,180	$ 19.99	$ 23,562
13	November	1,800	$ 17.49	$ 31,416
14	December	4,560	$ 14.99	$ 75,125
15	**Total Sales**	21,755		$ 313,619
16				
17				

Figure 1.1 Example of an Excel Worksheet

Starting Excel

1. Locate Excel on your computer.
2. Click Microsoft Excel to launch the Excel application where you are presented with workbook options to help get you started.
3. Click the first option; “Blank Workbook”.

Excel for Windows vs Excel for Mac

The Excel for Windows and Excel for Mac software versions are very similar. Most of the features, tools and commands are available in both versions. There are, however, some differences with the Excel interface. There are also a few features that are not available in the Excel for Mac version. The screenshots and step-by-step instructions in this textbook are specific to Excel for Windows. We have attempted to provide alternate screenshots and instructions for the Mac version when the differences are significant. When you see this icon , it means we are providing information specific to Mac users.

The Excel Workbook

A workbook is an Excel file that contains one or more worksheets (referred to as spreadsheets). Excel will assign a file name to the workbook, such as **Book1**, **Book2**, **Book3**, and so on, depending on how many new workbooks are opened. **Figure 1.2** shows a blank workbook after starting Excel. Take some time to familiarize yourself with this screen. Your screen may be slightly different based on the version you're using.

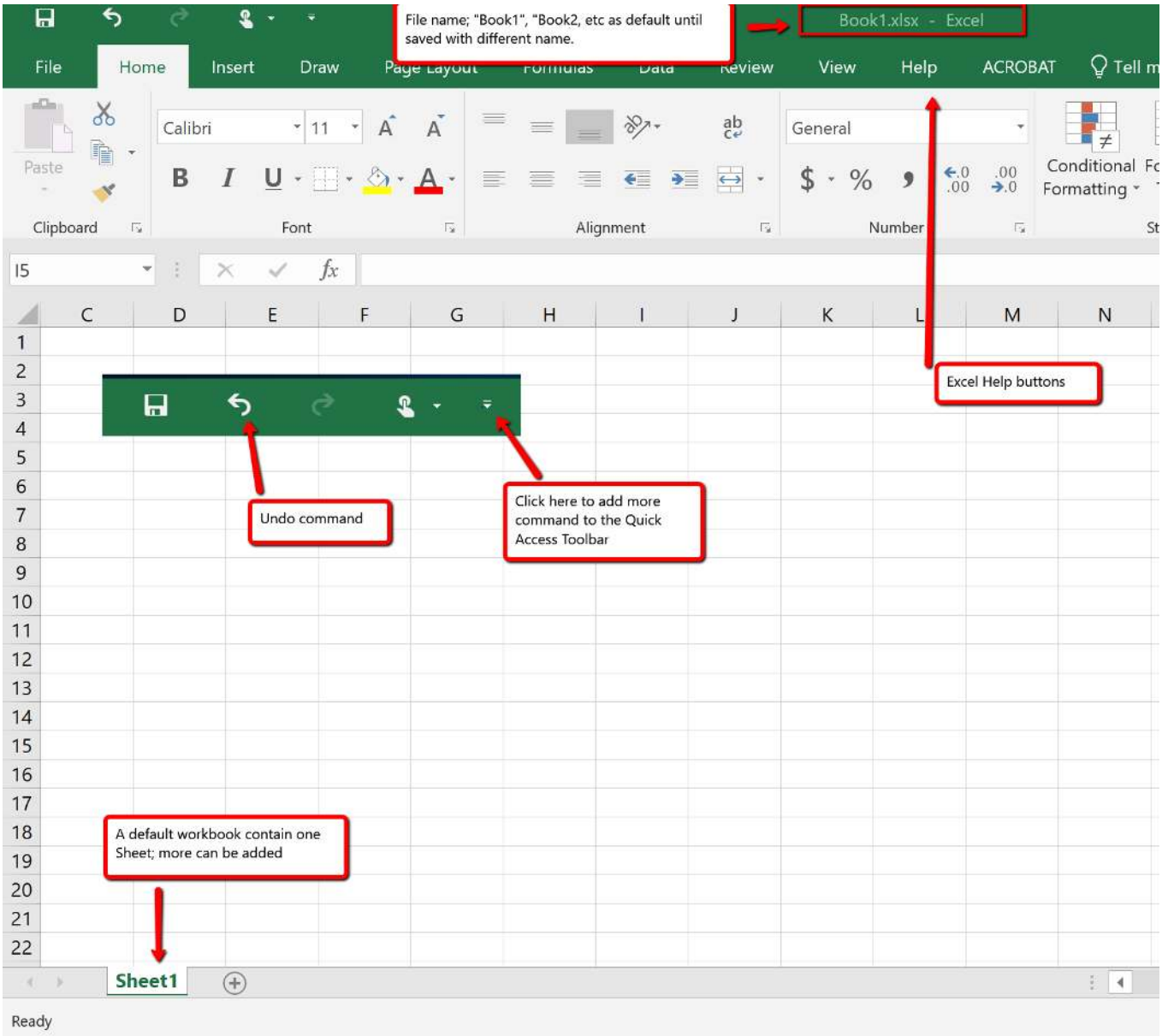


Figure 1.2 Blank Workbook

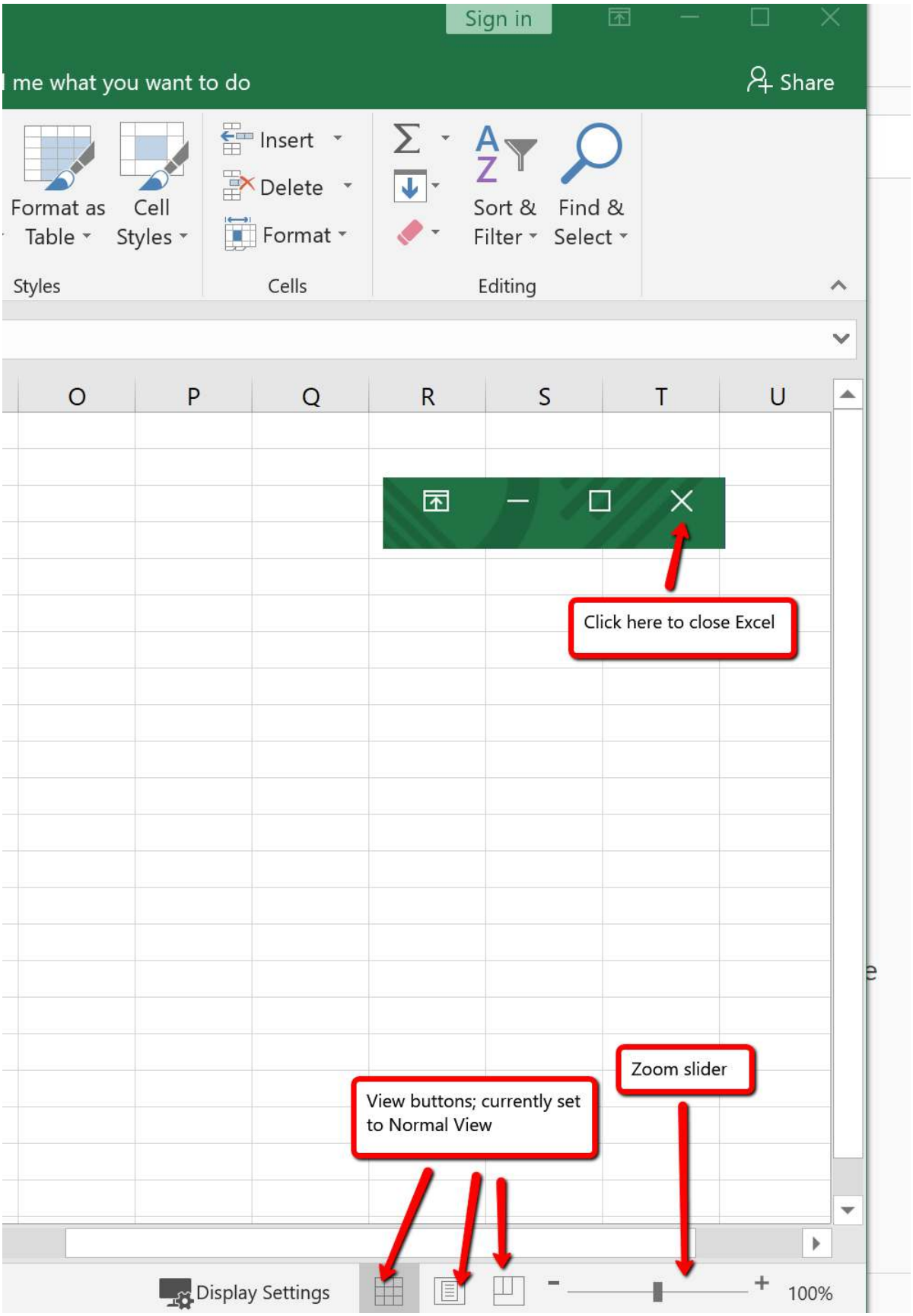


Figure 1.2a Blank Workbook (right-side)

Your workbook should already be maximized (or shown at full size) once Excel is started, as shown in **Figure 1.2**. However, if your screen looks like **Figure 1.3** after starting Excel, you should click the Maximize button, as shown in the figure.

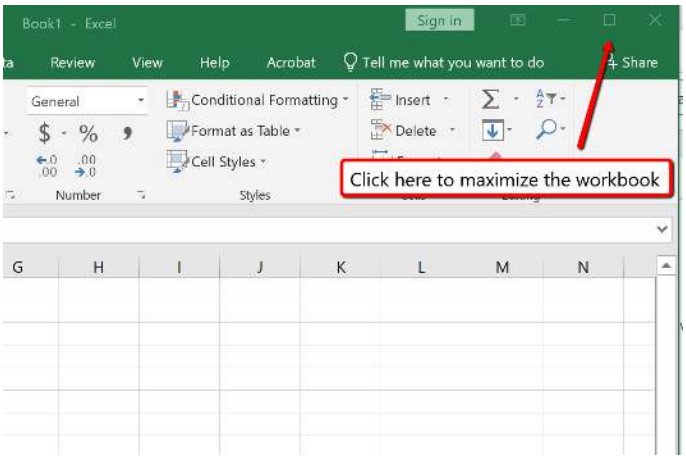


Figure 1.3 Restored Worksheet

Navigating Worksheets

Data are entered and managed in an Excel worksheet. The worksheet contains several rectangles called cells for entering numeric and non-numeric data. Each cell in an Excel worksheet contains an address, which is defined by a column letter followed by a row number. For example, the cell that is currently activated in **Figure 1.3** is **A1**. This would be referred to as cell location A1 or cell reference A1. The following steps explain how you can navigate in an Excel worksheet:

1. Place your mouse pointer over cell D5 and click.
2. Check to make sure column letter D and row number 5 are highlighted, as shown in **Figure 1.4**.

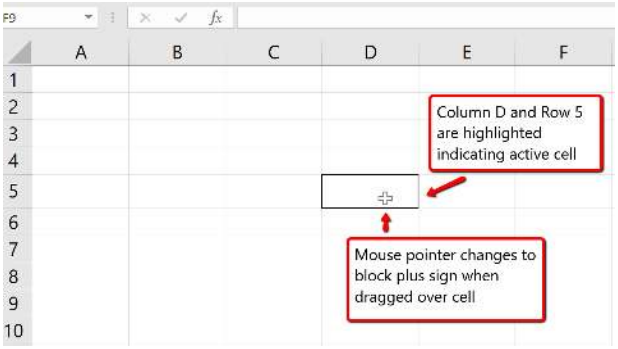


Figure 1.4 Activating a Cell Location

1. Move the mouse pointer to cell A1.
2. Click and hold the left mouse button and drag the mouse pointer back to cell D5.
3. Release the left mouse button. You should see several cells highlighted, as shown in **Figure 1.5**.

This is referred to as a ***cell range*** and is documented as follows: **A1:D5**. Any two cell locations separated by a colon are known as a cell range. The first cell is the top left corner of the range, and the second cell is the lower right corner of the range.

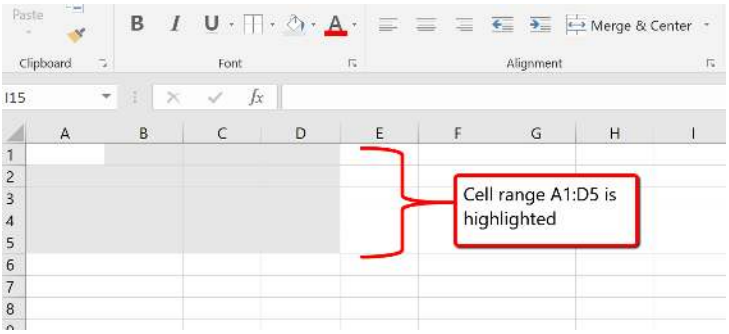


Figure 1.5 Highlighting a Range of Cells

1. At the bottom of the screen, you'll see a sheet tab indicated by "**Sheet1**". Clicking on the + adds additional worksheets. This is how you open or add a worksheets within a workbook. To see how this works, click on the + to add another worksheet so that you now have two sheets
2. Click the Sheet1 worksheet tab at the bottom of the worksheet to return to the worksheet shown in **Figure 1.5**.

Keyboard Shortcuts

Basic Worksheet Navigation

- Use the arrow keys on your keyboard to activate cells on the worksheet.
- Hold the SHIFT key and press the arrow keys on your keyboard to highlight a range of cells in a worksheet.
- Hold the CTRL key while pressing the PAGE DOWN or PAGE UP keys to open other worksheets in a workbook.
- Mac Users: Hold down the Fn and Command keys and press the left or right arrow keys

The Excel Ribbon

Excel's features and commands are found in the Ribbon, which is the upper area of the Excel screen that contains several tabs running across the top. Each tab provides access to a different set of Excel commands. **Figure 1.6** shows the commands available in the Home tab of the Ribbon. **Table 1.1 "Command Overview for Each Tab of the Ribbon"** provides an overview of the commands that are found in each tab of the Ribbon.

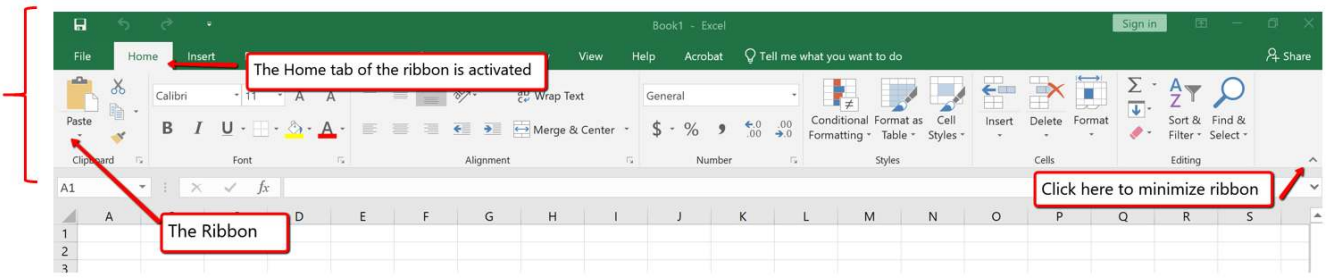


Figure 1.6 Home Tab of Ribbon

The Excel for Mac ribbon, as shown in **Figure 1.6a** below, has two primary differences:

- The older dropdown menu structure is still available with Excel for Mac.
- The specific commands and tools within each tab are slightly different between the two Excel Ribbons. Some of the commands found within the Excel for Windows Ribbon tabs are located within the dropdown menu structure in the Excel for Mac version. So, if you can't find the tool on the Excel for Mac Ribbon, then try to find the tool by looking through the dropdown menu instead.

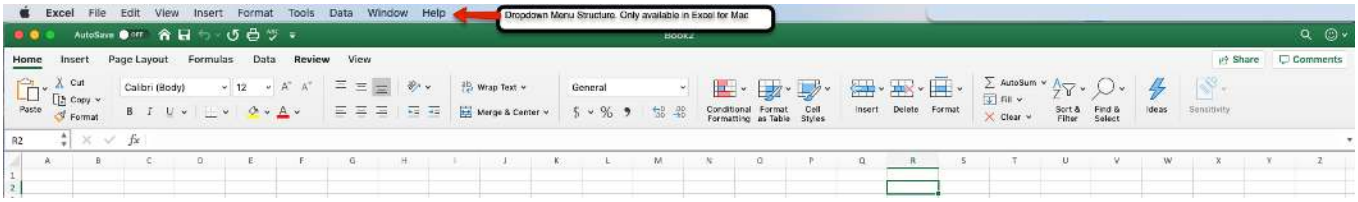


Figure 1.6a Home tab of Excel for Mac Ribbon with dropdown menu structure

Group Title Names on the Ribbon

If you look closely at the Excel Ribbon (See Figure 1.6 above), you will see that the Ribbon is separated in groups of tool buttons, and each group has a title name. On Home tab, the group title names are “Clipboard”, “Font”, “Alignment”, “Number”, “Styles”. “Cells”, “Editing”, etc. The tool buttons within each group are all related to the group title.

Mac Users Only: The default “View” for the Excel for Mac ribbon **does not display** these “group title names”. Notice in Figure 1.6a above, there are no group title names. It is a good idea to change this “view” so you can see the group title names. Here are the steps:

1. Click the **“Excel” menu option at top left above the Ribbon**
2. Choose **“Preferences”**
3. Click the **“View” button**
4. Scroll down and check the box for **“Group Titles”**
5. Close the “View” dialog box. The group title names should now display as shown in Figure 6.1 (not Figure 6.1a) above

Table 1.1 Command Overview for Each Tab of the Ribbon

Tab Name	Description of Commands
File	Also known as the Backstage view of the Excel workbook. Contains all commands for opening, closing, saving, and creating new Excel workbooks. Includes print commands, document properties, e-mailing options, and help features. The default settings and options are also found in this tab.
Home	Contains the most frequently used Excel commands. Formatting commands are found in this tab along with commands for cutting, copying, pasting, and for inserting and deleting rows and columns.
Insert	Used to insert objects such as charts, pictures, shapes, PivotTables, Internet links, symbols, or text boxes.
Page Layout	Contains commands used to prepare a worksheet for printing. Also includes commands used to show and print the gridlines on a worksheet.
Formulas	Includes commands for adding mathematical functions to a worksheet. Also contains tools for auditing mathematical formulas.
Data	Used when working with external data sources such as Microsoft Access, text files, or the Internet. Also contains sorting commands and access to scenario tools.
Review	Includes Spelling and Track Changes features. Also contains protection features to password protect worksheets or workbooks.
View	Used to adjust the visual appearance of a workbook. Common commands include the Zoom and Page Layout view.
Help	This tab provides access to help and support features such as contacting Microsoft support, sending feedback, suggesting a new feature, and community discussion groups. **This tab is not available with Excel for Mac.**
Draw	Provides drawing options for using a digital pen, mouse or finger depending on the type of device (laptop with touch screen, tablet, computer, etc). This tab is not visible by default. See below on how to customize the Ribbon to add or remove tabs.
Developer	Provides access to some advanced features such as macros, form controls, and XML commands. This tab is not visible by default. See below on how to customize the Ribbon to add or remove tabs.

The Ribbon shown in **Figure 1.6 and Figure 1.6a** (above) is full, or maximized. The benefit of having a full Ribbon is that the commands are always visible while you are developing a worksheet. However, depending on the screen dimensions of your computer, you may find that the Ribbon takes up too much vertical space on your worksheet. If this is the case, you can minimize the Ribbon by clicking the button shown in **Figure 1.6**. When minimized, the Ribbon will show only the tabs and not the command buttons. When you click on a tab, the command buttons will appear until you select a command or click anywhere on your worksheet.

To hide the Ribbon with Excel for Mac you can use the keyboard shortcut:

Hold down the “Command and Option” keys and tap the “R” key

The same keyboard shortcut will unhide the Ribbon as well.

How to Customize the Excel Ribbon

Here are the steps to add additional tabs to the Excel Ribbon

1. Click the File tab and choose Options
2. Click on “Customize Ribbon” at the left side of the Options screen
3. Click the checkbox next to the Tab name that you want to add (See Figure 1.7 below)

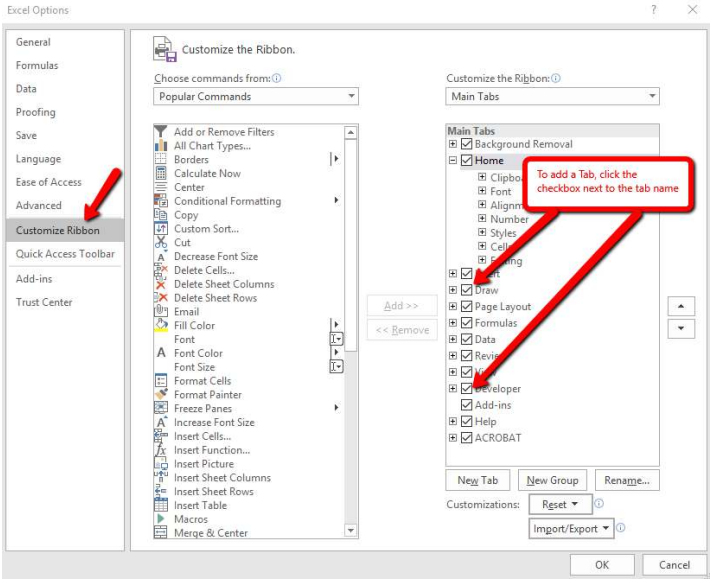


Figure 1.7 Customize the Ribbon Dialog Box

Keyboard Shortcuts

Minimizing or Maximizing the Ribbon

- Hold down the CTRL key and press the F1 key.
- Hold down the CTRL key and press the F1 key again to maximize the Ribbon.
- Mac Users: Hold down the Command and Option keys and press R

Quick Access Toolbar and Right-Click Menu

The Quick Access Toolbar is found at the upper left side of the Excel screen above the Ribbon, as shown in **Figure 1.7**. This area provides access to the most frequently used commands, such as Save and Undo. You also can customize the Quick Access Toolbar by adding commands that you use on a regular basis. By placing these commands in the Quick Access Toolbar, you do not have to navigate through the Ribbon to find them. To customize the Quick Access Toolbar, click the down arrow as shown in **Figure 1.8**. This will open a menu of commands that you can add to the Quick Access Toolbar. If you do not see the command you are looking for on the list, select the More Commands option.

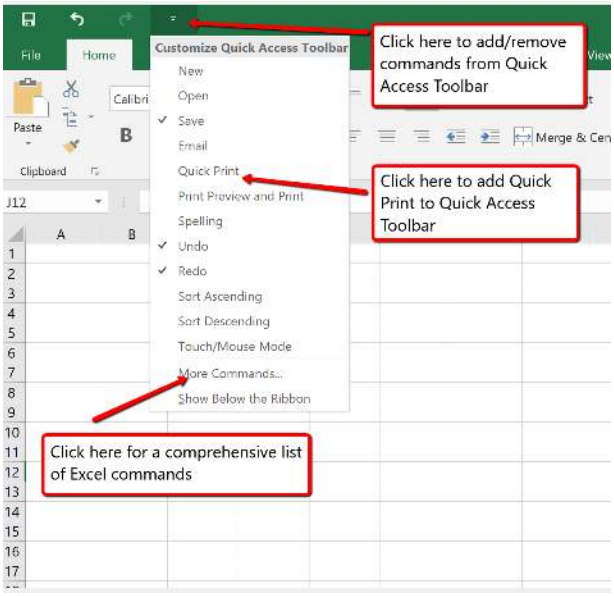


Figure 1.8 Customizing the Quick Access Toolbar

In addition to the Ribbon and Quick Access Toolbar, you can also access many commands by right clicking anywhere on the worksheet. **Figure 1.9** shows an example of the commands available in the right-click menu.

There is no "Right-click" option for Excel for Mac. To access the same commands with Excel for Mac, hold down the Control key and click the mouse button.

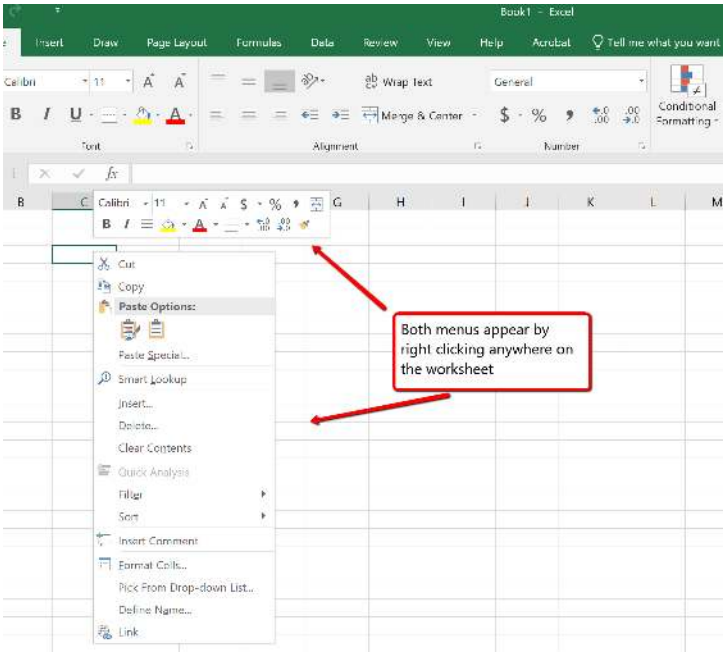


Figure 1.9 Right-Click Menu

The File Tab

The File tab is also known as the **Backstage** view of the workbook. It contains a variety of features and commands related to the workbook that is currently open, new workbooks, or workbooks stored in other locations on your computer or network. **Figure 1.10** shows the options available in the File tab or Backstage view. To leave the Backstage view and return to the worksheet, click the arrow in the upper left-hand corner as shown below.

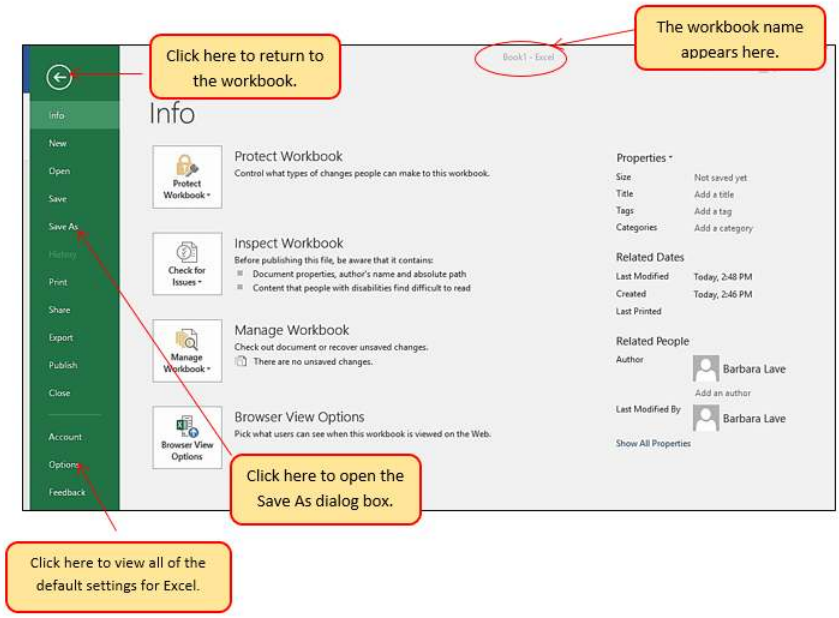


Figure 1.10 File Tab or Backstage View of a Workbook

Included in the File tab are the default settings for the Excel application that can be accessed and modified by clicking the Options button. **Figure 1.11** shows the Excel Options window, which gives you access to settings such as the default font style, font size, and the number of worksheets that appear in new workbooks.

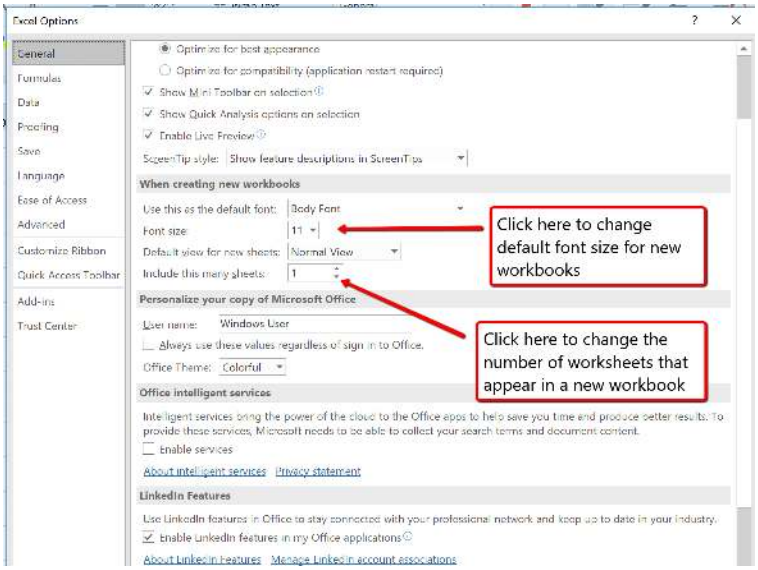


Figure 1.11 Excel Options Window

To access these same options in Excel for Mac, you must click the "Excel" menu option and choose "Preferences" (see **Figure 1.12** below)



Figure 1.12 The Excel for Mac “Excel” menu option

Saving Workbooks (Save As)

Once you create a new workbook, you will need to change the file name and choose a location on your computer or network to save that file. It is important to remember where you save this workbook on your computer or network as you will be using this file in the **Section 1.2 “Entering, Editing, and Managing Data”** to construct the workbook shown in **Figure 1.1**. The process of saving can be different with different versions of Excel. Please be sure you follow the steps for the version of Excel you are using. The following steps explain how to save a new workbook and assign it a file name.

Saving Workbooks in Excel 365

1. If you have not done so already, open a blank workbook in Excel.
2. Click the File tab and then the **Save As** button in the left side of the Backstage view window. This will open the **Save As** dialog box.
3. Determine a location for saving on your computer by clicking **Browse** on the left side to open the **Save As** dialog box.
4. Click in the File Name box near the bottom of the **Save As** dialog box. Type the new file name: **CH1 Merchandise City Sales Data**
5. Review the settings in the screen for correctness and click the Save button.

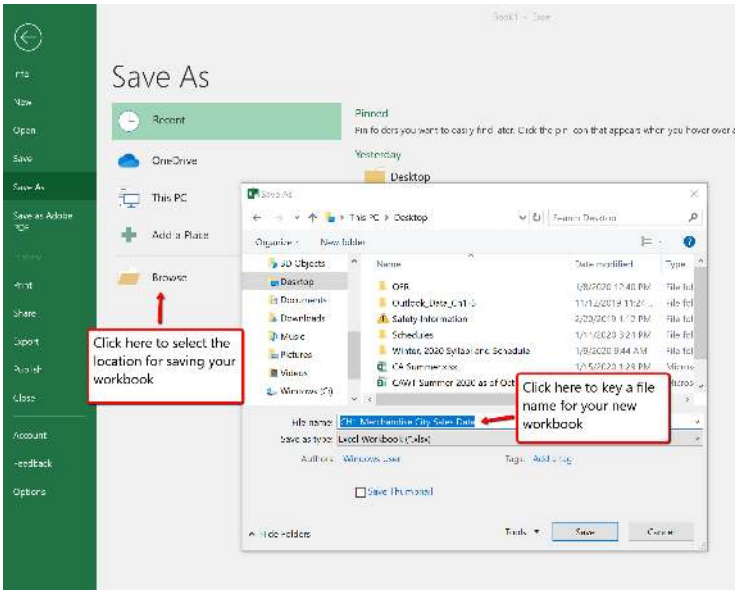


Figure 1.13 Save As Dialog entries for Excel 365

Keyboard Shortcuts

Save As

- Press the F12 key and use the tab and arrow keys to navigate around the Save As dialog box. Use the ENTER key to make a selection.

- Or press the ALT key on your keyboard. You will see letters and numbers, called Key Tips, appear on the Ribbon. Press the F key on your keyboard for the File tab and then the A key. This will open the Save As dialog box.
- The Mac shortcut is: Hold down the Command and Shift keys and press S

Skill Refresher

Saving Workbooks (Save As)

1. Click the File tab on the Ribbon.
2. Click the Save As option.
3. Click on Browse to select a location on your PC to save.
4. Click in the File name box and type a new file name if needed.
5. Click the down arrow next to the "Save as type" box and select the appropriate file type if needed. Excel will default to the file type of .xlsx
6. Click the Save button.

The Status Bar

The Status Bar is located below the worksheet tabs on the Excel screen (**see Figure 1.13**). It displays a variety of information, such as the status of certain keys on your keyboard (e.g., CAPS LOCK), the available views for a workbook, the magnification of the screen, and mathematical functions that can be performed when data are highlighted on a worksheet. You can customize the Status Bar as follows:

1. Place the mouse pointer over any area of the Status Bar and right click to display the "Customize Status Bar" list of options (**see Figure 1.14**).
   Mac Users: use "Control-click" on the Status Bar to display the "Customize Status Bar" options.
2. Select the Caps Lock option from the menu (see **Figure 1.14**).
3. Press the CAPS LOCK key on your keyboard. You will see the Caps Lock indicator on the lower right side of the Status Bar.
4. Press the CAPS LOCK on your keyboard again. The indicator on the Status Bar goes away.

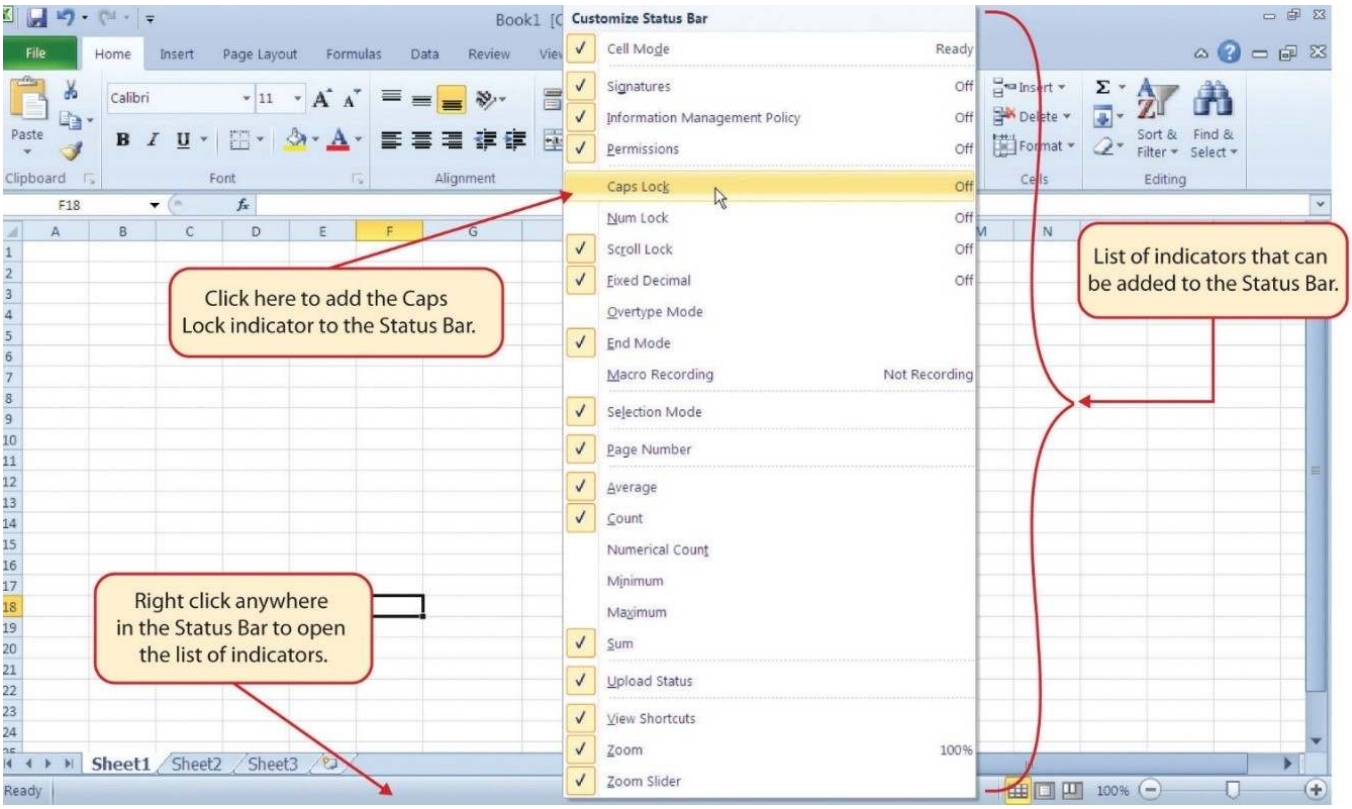


Figure 1.14 Customizing the Status Bar

Excel Help

The Help feature provides extensive information about the Excel application. Although some of this information may be stored on your computer, the Help window will automatically connect to the Internet, if you have a live connection, to provide you with resources that can answer most of your questions. You can open the Excel Help window by clicking the question mark in the upper right area of the screen or ribbon. With newer versions of Excel, use the query box to enter your question and select from helpful option links or select the question mark from the dropdown list to launch Excel Help windows.

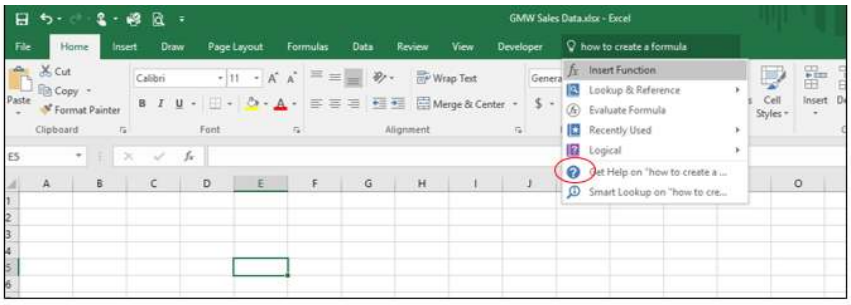


Figure 1.15 Excel Help Window

Keyboard Shortcuts

Excel Help

- Press the F1 key on your keyboard.
- Mac Users: Press F1 or hold down the Command key and press /

Key Takeaways

- Excel is a powerful tool for processing data for the purposes of making decisions.
- You can find Excel commands throughout the tabs in the Ribbon.
- You can customize the Quick Access Toolbar by adding commands you frequently use.
- You can add or remove the information that is displayed on the Status Bar.
- The Help window provides you with extensive information about Excel.

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1.1.2: The Excel Ribbon

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

The Excel Ribbon

Excel's features and commands are found in the Ribbon, which is the upper area of the Excel screen that contains several tabs running across the top. Each tab provides access to a different set of Excel commands. **Figure 1.6** shows the commands available in the Home tab of the Ribbon. **Table 1.1 "Command Overview for Each Tab of the Ribbon"** provides an overview of the commands that are found in each tab of the Ribbon.

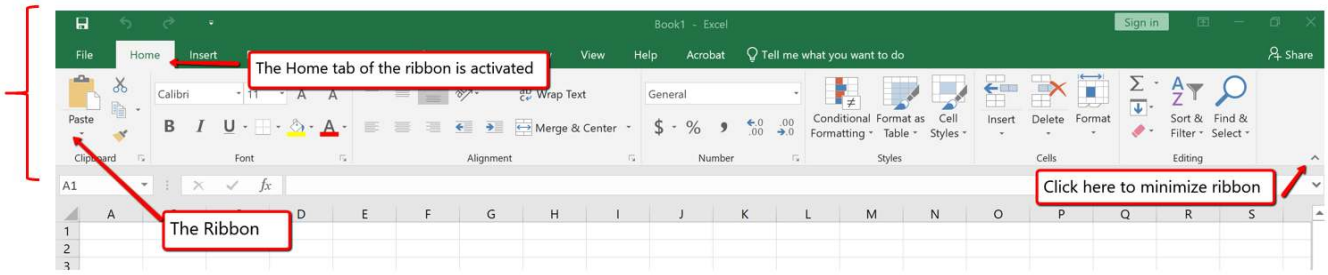


Figure 1.6 Home Tab of Ribbon

The Excel for Mac ribbon, as shown in **Figure 1.6a** below, has two primary differences:

- The older dropdown menu structure is still available with Excel for Mac.
- The specific commands and tools within each tab are slightly different between the two Excel Ribbons. Some of the commands found within the Excel for Windows Ribbon tabs are located within the dropdown menu structure in the Excel for Mac version. So, if you can't find the tool on the Excel for Mac Ribbon, then try to find the tool by looking through the dropdown menu instead.

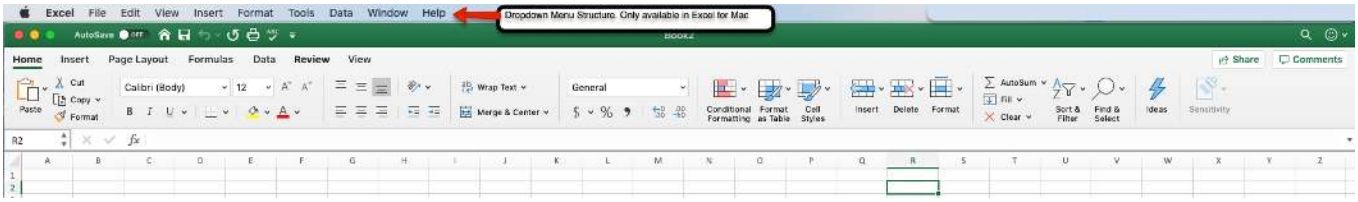


Figure 1.6a Home tab of Excel for Mac Ribbon with dropdown menu structure

Group Title Names on the Ribbon

If you look closely at the Excel Ribbon (See Figure 1.6 above), you will see that the Ribbon is separated in groups of tool buttons, and each group has a title name. On Home tab, the group title names are "Clipboard", "Font", "Alignment", "Number", "Styles". "Cells", "Editing", etc. The tool buttons within each group are all related to the group title.

Mac Users Only: The default "View" for the Excel for Mac ribbon **does not display** these "group title names". Notice in Figure 1.6a above, there are no group title names. It is a good idea to change this "view" so you can see the group title names. Here are the steps:

1. Click the **"Excel" menu option at top left above the Ribbon**
2. Choose **"Preferences"**
3. Click the **"View" button**
4. Scroll down and check the box for **"Group Titles"**
5. Close the "View" dialog box. The group title names should now display as shown in Figure 6.1 (not Figure 6.1a) above

Table 1.1 Command Overview for Each Tab of the Ribbon

Tab Name	Description of Commands
File	Also known as the Backstage view of the Excel workbook. Contains all commands for opening, closing, saving, and creating new Excel workbooks. Includes print commands, document properties, e-mailing options, and help features. The default settings and options are also found in this tab.
Home	Contains the most frequently used Excel commands. Formatting commands are found in this tab along with commands for cutting, copying, pasting, and for inserting and deleting rows and columns.
Insert	Used to insert objects such as charts, pictures, shapes, PivotTables, Internet links, symbols, or text boxes.
Page Layout	Contains commands used to prepare a worksheet for printing. Also includes commands used to show and print the gridlines on a worksheet.
Formulas	Includes commands for adding mathematical functions to a worksheet. Also contains tools for auditing mathematical formulas.
Data	Used when working with external data sources such as Microsoft Access, text files, or the Internet. Also contains sorting commands and access to scenario tools.
Review	Includes Spelling and Track Changes features. Also contains protection features to password protect worksheets or workbooks.
View	Used to adjust the visual appearance of a workbook. Common commands include the Zoom and Page Layout view.
Help	This tab provides access to help and support features such as contacting Microsoft support, sending feedback, suggesting a new feature, and community discussion groups. **This tab is not available with Excel for Mac.**
Draw	Provides drawing options for using a digital pen, mouse or finger depending on the type of device (laptop with touch screen, tablet, computer, etc). This tab is not visible by default. See below on how to customize the Ribbon to add or remove tabs.
Developer	Provides access to some advanced features such as macros, form controls, and XML commands. This tab is not visible by default. See below on how to customize the Ribbon to add or remove tabs.

The Ribbon shown in **Figure 1.6 and Figure 1.6a** (above) is full, or maximized. The benefit of having a full Ribbon is that the commands are always visible while you are developing a worksheet. However, depending on the screen dimensions of your computer, you may find that the Ribbon takes up too much vertical space on your worksheet. If this is the case, you can minimize the Ribbon by clicking the button shown in **Figure 1.6**. When minimized, the Ribbon will show only the tabs and not the command buttons. When you click on a tab, the command buttons will appear until you select a command or click anywhere on your worksheet.

To hide the Ribbon with Excel for Mac you can use the keyboard shortcut:

Hold down the “Command and Option” keys and tap the “R” key

The same keyboard shortcut will unhide the Ribbon as well.

Quick Access Toolbar and Right-Click Menu

The Quick Access Toolbar is found at the upper left side of the Excel screen above the Ribbon, as shown in **Figure 1.7**. This area provides access to the most frequently used commands, such as Save and Undo. You also can customize the Quick Access Toolbar by adding commands that you use on a regular basis. By placing these commands in the Quick Access Toolbar, you do not have to navigate through the Ribbon to find them. To customize the Quick Access Toolbar, click the down arrow as shown in **Figure 1.8**. This will open a menu of commands that you can add to the Quick Access Toolbar. If you do not see the command you are looking for on the list, select the More Commands option.

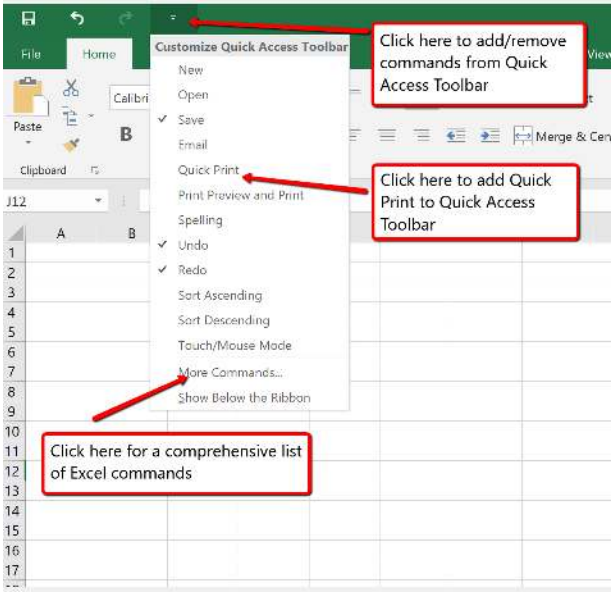


Figure 1.8 Customizing the Quick Access Toolbar

In addition to the Ribbon and Quick Access Toolbar, you can also access many commands by right clicking anywhere on the worksheet. **Figure 1.9** shows an example of the commands available in the right-click menu.

There is no “Right-click” option for Excel for Mac. To access the same commands with Excel for Mac, hold down the Control key and click the mouse button.

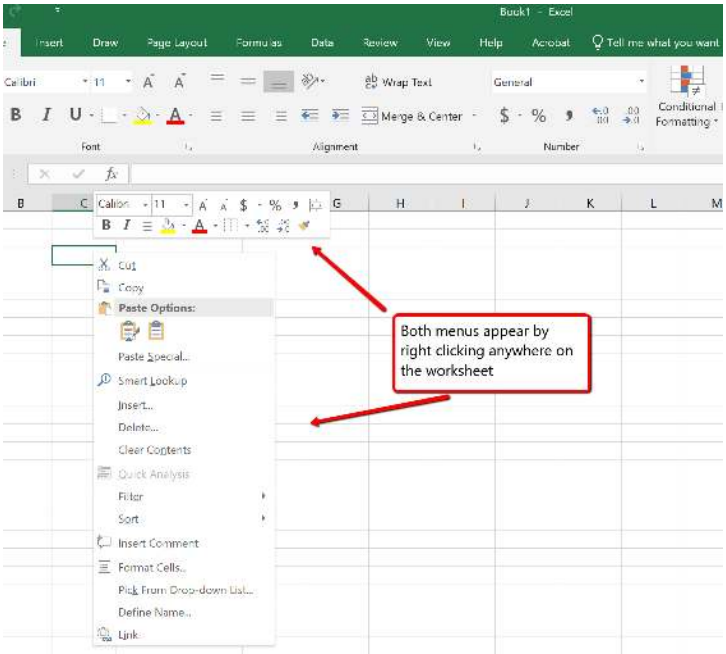


Figure 1.9 Right-Click Menu

The File Tab

The File tab is also known as the **Backstage** view of the workbook. It contains a variety of features and commands related to the workbook that is currently open, new workbooks, or workbooks stored in other locations on your computer or network. **Figure 1.10** shows the options available in the File tab or Backstage view. To leave the Backstage view and return to the worksheet, click the arrow in the upper left-hand corner as shown below.

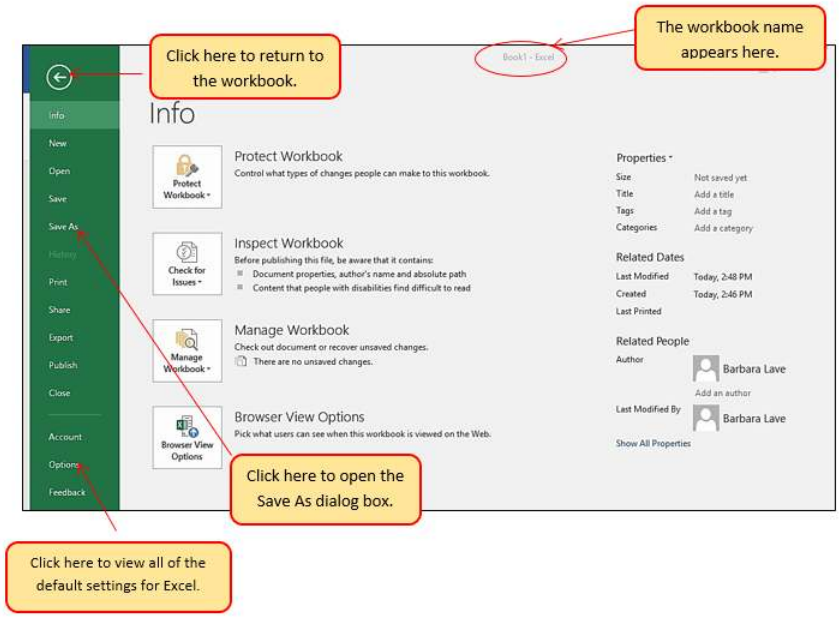


Figure 1.10 File Tab or Backstage View of a Workbook

Included in the File tab are the default settings for the Excel application that can be accessed and modified by clicking the Options button. **Figure 1.11** shows the Excel Options window, which gives you access to settings such as the default font style, font size, and the number of worksheets that appear in new workbooks.

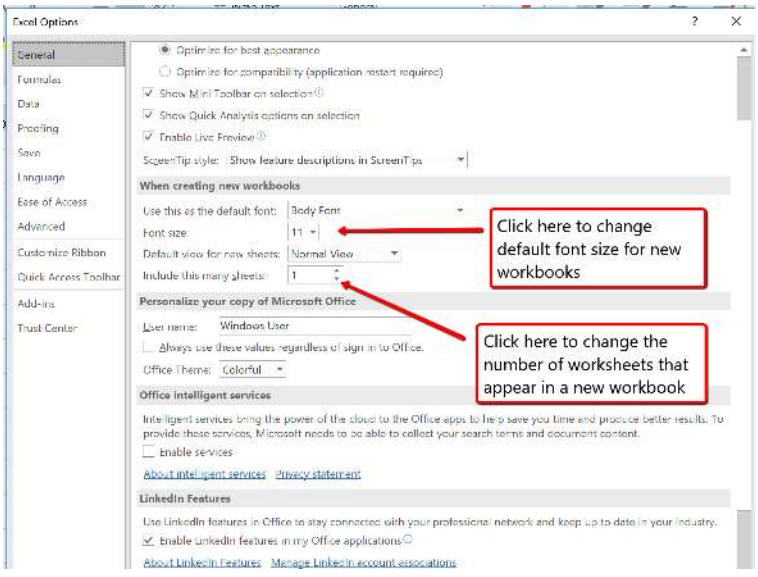


Figure 1.11 Excel Options Window

To access these same options in Excel for Mac, you must click the “Excel” menu option and choose “Preferences” (see **Figure 1.12** below)



Figure 1.12 The Excel for Mac “Excel” menu option

Saving Workbooks in Excel 365

1. If you have not done so already, open a blank workbook in Excel.
2. Click the File tab and then the **Save As** button in the left side of the Backstage view window. This will open the **Save As** dialog box.
3. Determine a location for saving on your computer by clicking **Browse** on the left side to open the **Save As** dialog box.
4. Click in the File Name box near the bottom of the **Save As** dialog box. Type the new file name: **CH1 Merchandise City Sales Data**
5. Review the settings in the screen for correctness and click the Save button.

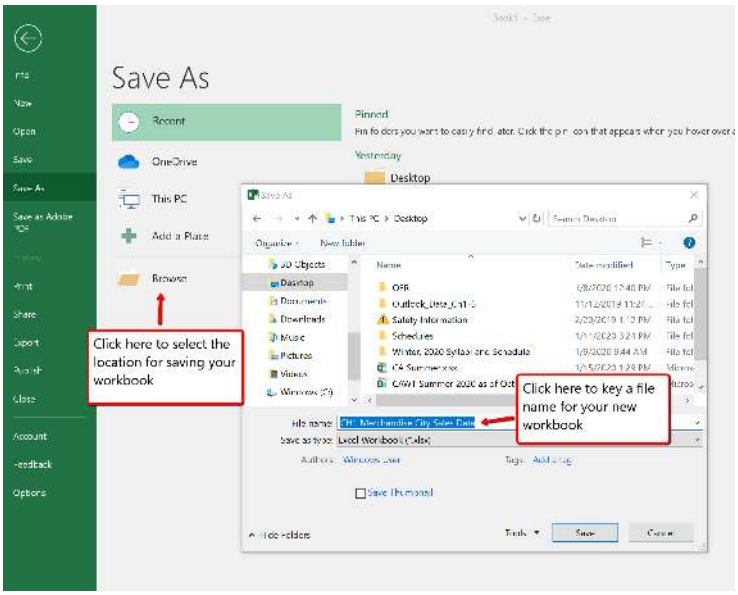


Figure 1.13 Save As Dialog entries for Excel 365

Keyboard Shortcuts

Save As

- Press the F12 key and use the tab and arrow keys to navigate around the Save As dialog box. Use the ENTER key to make a selection.
- Or press the ALT key on your keyboard. You will see letters and numbers, called Key Tips, appear on the Ribbon. Press the F key on your keyboard for the File tab and then the A key. This will open the Save As dialog box.
- The Mac shortcut is: Hold down the Command and Shift keys and press S

Skill Refresher

Saving Workbooks (Save As)

1. Click the File tab on the Ribbon.
2. Click the Save As option.
3. Click on Browse to select a location on your PC to save.
4. Click in the File name box and type a new file name if needed.
5. Click the down arrow next to the “Save as type” box and select the appropriate file type if needed. Excel will default to the file type of .xlsx
6. Click the Save button.

The Status Bar

The Status Bar is located below the worksheet tabs on the Excel screen (**see Figure 1.13**). It displays a variety of information, such as the status of certain keys on your keyboard (e.g., CAPS LOCK), the available views for a workbook, the magnification of the screen, and mathematical functions that can be performed when data are highlighted on a worksheet. You can customize the Status Bar as follows:

1. Place the mouse pointer over any area of the Status Bar and right click to display the “Customize Status Bar” list of options (**see Figure 1.14**).
   Mac Users: use “Control-click” on the Status Bar to display the “Customize Status Bar” options.
2. Select the Caps Lock option from the menu (see **Figure 1.14**).
3. Press the CAPS LOCK key on your keyboard. You will see the Caps Lock indicator on the lower right side of the Status Bar.
4. Press the CAPS LOCK on your keyboard again. The indicator on the Status Bar goes away.

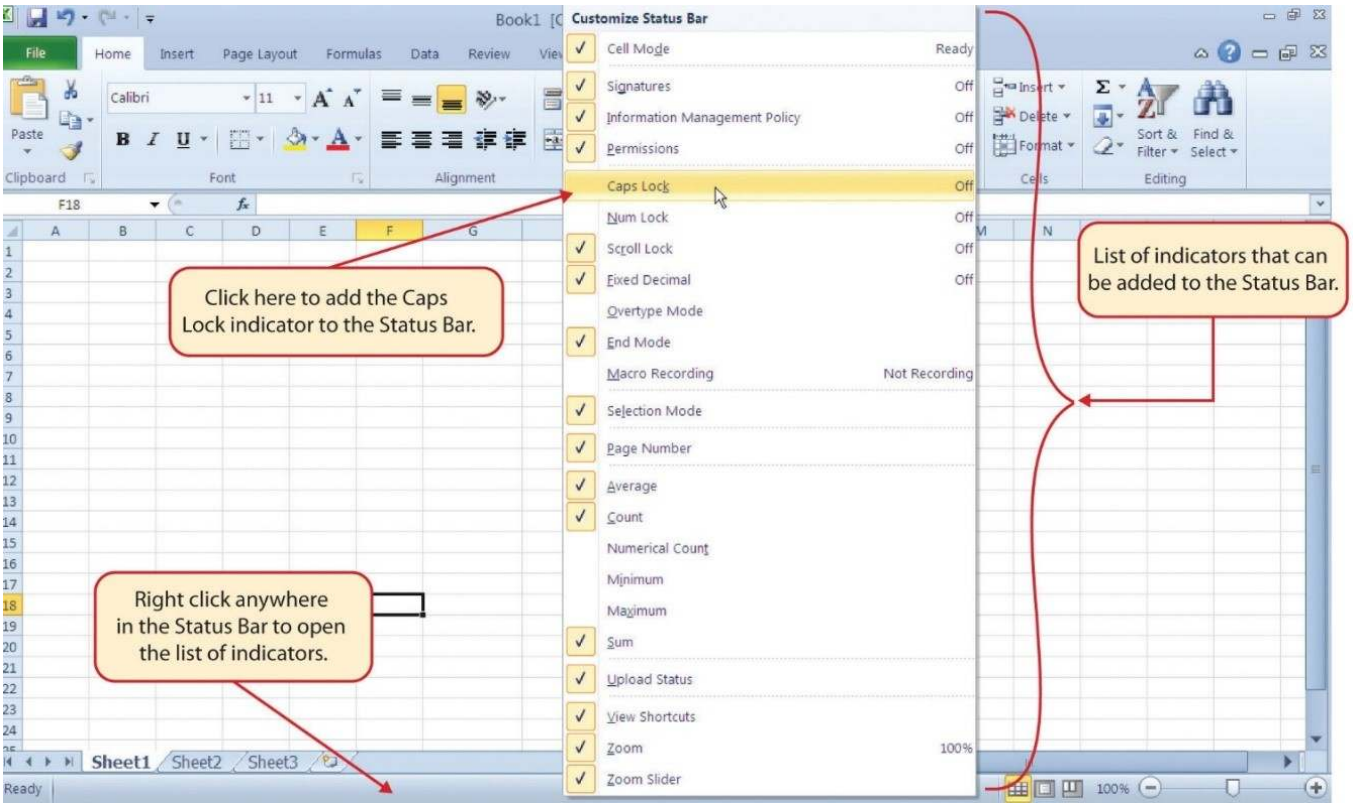


Figure 1.14 Customizing the Status Bar

Excel Help

The Help feature provides extensive information about the Excel application. Although some of this information may be stored on your computer, the Help window will automatically connect to the Internet, if you have a live connection, to provide you with resources that can answer most of your questions. You can open the Excel Help window by clicking the question mark in the upper right area of the screen or ribbon. With newer versions of Excel, use the query box to enter your question and select from helpful option links or select the question mark from the dropdown list to launch Excel Help windows.

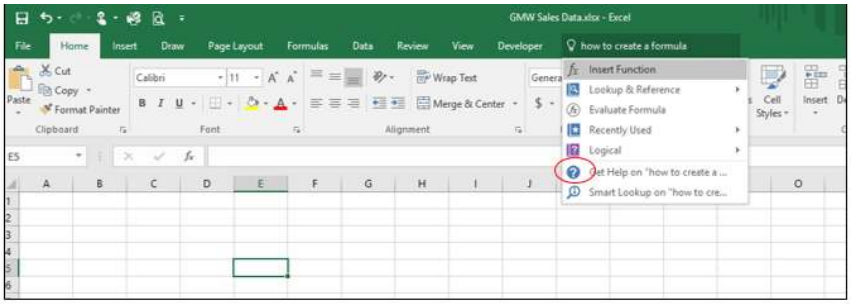


Figure 1.15 Excel Help Window

Keyboard Shortcuts

Excel Help

- Press the F1 key on your keyboard.
- Mac Users: Press F1 or hold down the Command key and press /

Key Takeaways

- Excel is a powerful tool for processing data for the purposes of making decisions.
- You can find Excel commands throughout the tabs in the Ribbon.
- You can customize the Quick Access Toolbar by adding commands you frequently use.
- You can add or remove the information that is displayed on the Status Bar.
- The Help window provides you with extensive information about Excel.

Printing Worksheets

Excel offers two options for printing: either printing each worksheet separately or printing the whole workbook. To do either, first go to the File tab, and then click on Print (Figure 9.9). The default is to print only the currently opened worksheet, so we'll do that first. Choose the number of copies you want for this page, then choose the correct printer. There are other options for printing, include changing the size of the paper, changing vertical or horizontal orientation of the paper, adjusting the margins, and regulating the scaling (i.e., zooming in or not while printing). Once you have chosen your settings, click on the Print icon, and Sheet 1 will come out of the printer. Different printers might have different options for you to choose from.

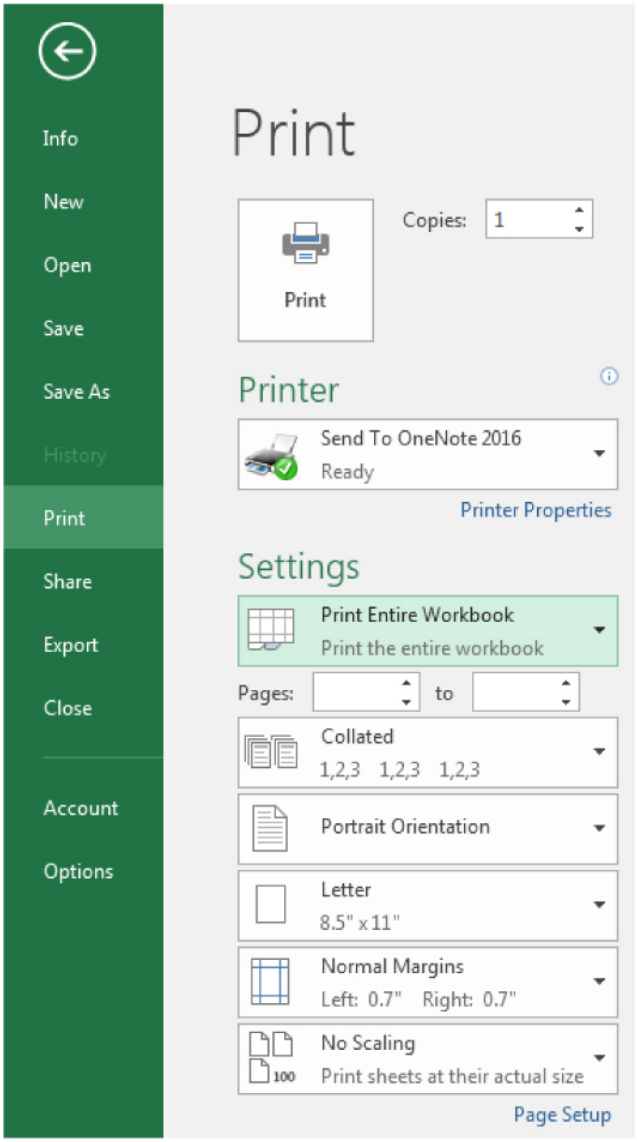


Figure 9.9: The options for printing are on the File tab. Click on Print. To print only a worksheet, leave the default selection of Print Active Sheets and make any necessary changes to the options. To print the whole workbook, select Print Entire Workbook from the first menu in the Settings. On a Mac, the steps are the same, but the appearance will differ slightly. (Used with permission from Microsoft)

It is important to note that, when constructing spreadsheets, what you see on the computer screen is rarely how it looks when you actually print the workbook. When you have large spreadsheets with multiple rows or columns, they may not always fit within the bounds of the printed page. When you print the document, the result could be columns of data split oddly across several pages. Be sure to preview the printed version prior to printing. When you select Print, you will see the print preview on the right of the screen. Double-check that the columns and rows are displayed in the way you would like them to print. If not, you can change the margins of the worksheet or insert a page break as appropriate to print a final, professional workbook. More will be covered about formatting the worksheets and workbook in Formatting and Templates in Excel.

MAC TIP

You can get to the Print menu with Command+P, but you can also use the File tab at the top of the window. There is a separate menu in the File menu to set your print area, and you can select which worksheets to print from the Print menu.

Real-World Application

Excel is a powerful tool for business; however, it can also be a very useful tool for managing personal finances. You can set up Excel to manage all your personal finances, link bank accounts and other financial documents, help with managing documentation for income taxes, and perform many other personal finance tasks. Excel has all the features needed to set up a budget and manage personal and projected income, track expenditures, and analyze investments and other personal revenue trends. You will want to organize your financial information into separate functional worksheets within your budget workbook to ensure you keep your finances organized from the start. For instance, consider keeping separate worksheets to record income, expenditures, savings, and investments. You can start small as you grow in your comfort level in using Excel to record your financial transactions; for instance, you might want to start with a weekly or monthly expenditure sheet to track what you spend your money on, then move into savings and tracking interest accrued. This disciplined approach will ensure data is recorded in a timely manner, reducing the potential for missed information and errors, ultimately helping you maximize your dollars. What's more, there are a number of free templates available online and through Microsoft to help set up your budget workbook with little effort.

What software or other tools do you use now to help you track your budget? Do a Google or template search in Excel and identify a budget template you might adopt. Once you find one you like, set up your monthly budget.

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1.1.3: The Excel Workbook

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WorldCorp sells many consumer electronics, including tablets, HD antennas, headphones, and TVs. The Portland location is in a port city, so it can dispatch orders anywhere in the world, but most of its orders go to the northern United States and Canada. As you receive more and more orders from clients, you need a spreadsheet or database to keep all data flowing so that the warehouse knows where the shipment will be sent, what products are in the order, and how much the total shipment costs. This data, in turn, can be added to the financial statements in the accounting system, which will help the senior managers analyze the sales results of the company. Microsoft Excel is a powerful tool that can be used for creating sales order tables.

Common Uses of Spreadsheets

Excel is a spreadsheet software application type that has rows and columns in a grid pattern. A cell is the intersection of a row and a column, and it looks like a rectangle. You can enter data into the cells to design tables and graphs and perform data analysis. A workbook is a file that contains at least one worksheet, which is a tab within a workbook where you can input data and design tables and graphs that use the data (Figure 9.2). The terms *worksheet* and *spreadsheet* are interchangeable, but Excel uses the *worksheet* terminology.

A workbook may contain several worksheets, similar to taking a hard copy of a set of data and adding it to another hard copy in a file folder. One benefit of using a workbook is that the worksheets within it can communicate with each other. Having multiple worksheets in one workbook gives you flexibility in organizing and analyzing your data. Data analysis grows in complexity as a business grows. Even a simple accounting system for a small business designed in Excel will require many sheets, and each worksheet can feed or receive data from other worksheets. One workbook can contain all of these worksheets together, as in a manila file folder.

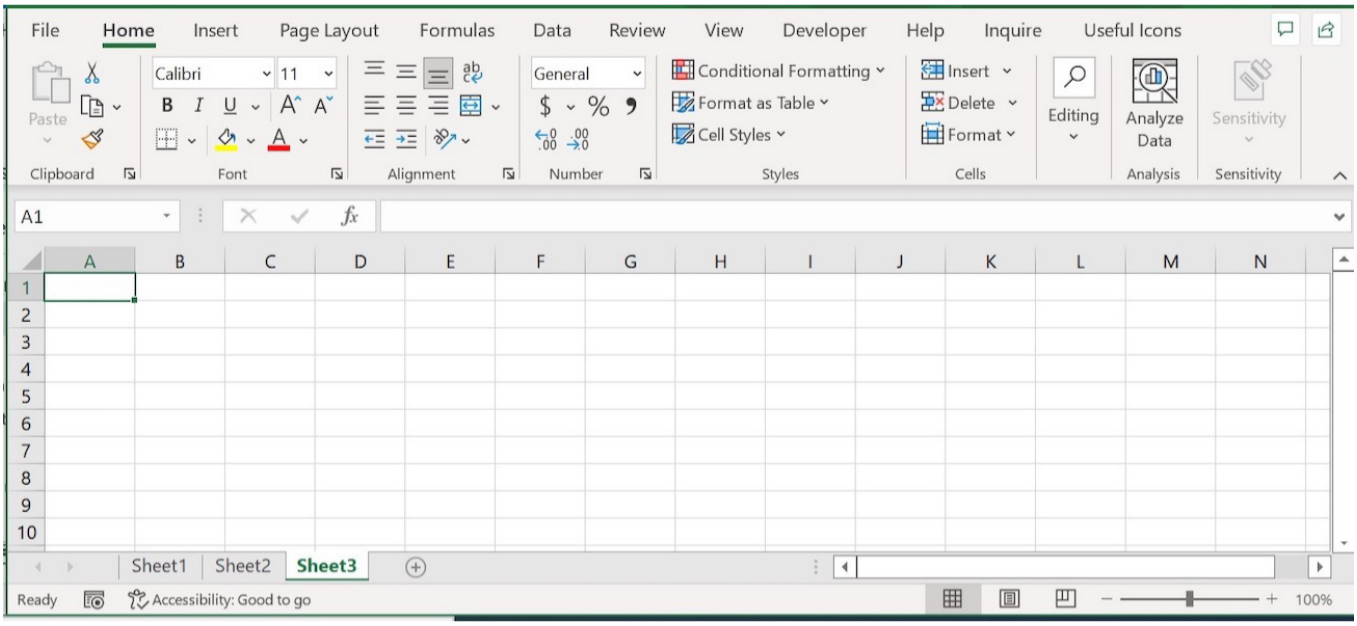


Figure 9.2: An Excel workbook contains individual worksheets made up of cells. (Used with permission from Microsoft)

The cells are named based on their location. For example, the upper-left cell is in column A and row 1, so Excel designates its address relative to the other cells in the worksheet, or its cell reference, as A1. You can use these cell references to perform operations that use either formulas or functions. A formula is a mathematical operation that may use constants or cell references, or a combination of constants and cell references. All formulas must begin with "=." For example, you can calculate 4 + 4 by typing "=4+4" in a cell, or you can add the contents of cell A1 and 4 by typing "=A1+4" or typing "=" and then clicking on cell A1 and then completing the formula.

A function is a mathematical or analytical operation that uses words instead of mathematical operators. All functions must also begin with "=" in Excel. For example, to calculate 4 + 4, you can type "=sum(4,4)." Excel can do the calculations for you just as you would using a calculator. Excel's formulas and functions can take the place of a calculator.

One use for spreadsheets is to create a monthly food budget. You can keep track of how much you spend on groceries by category and on eating out at restaurants. You could list it by the type of product (i.e., milk) and by restaurant. Over time, you can use these numbers to determine your average cost for groceries and for eating out, and you will then be able to predict what you will spend on groceries. This tracking can serve as a control on your budget and will help you save money in the long run. You can use a similar process for all your personal finance and family expenses to enable you to create a budget that works for your situation by tracking expenses.

In business, the same principles apply. If you can track business sales, you will be able to allocate the money more effectively. In other words, by having a better accounting system and dispatching of orders, a manager will be able to see where money is being generated. If the manager realizes that a certain product is generating a higher profit, then the manager can allocate resources to increase the sales of that product. For example, the company could increase the unit production and hire more sales agents to sell that product, which in turn will increase distribution venues, such as corporate retail clients that sell the products in their stores. Not only that, the company may also increase the marketing and advertisement expenses of these products, to gain new clients. All of these actions stemmed from the tracking of sales and analyzing what products sell the most units. In all these layers of actions, there will be many worksheets tracking data, such as an order-dispatching spreadsheet or the unit cost manufacturing sheets.

The Excel Workbook

A workbook is an Excel file that contains one or more worksheets (referred to as spreadsheets). Excel will assign a file name to the workbook, such as **Book1**, **Book2**, **Book3**, and so on, depending on how many new workbooks are opened. **Figure 1.2** shows a blank workbook after starting Excel. Take some time to familiarize yourself with this screen. Your screen may be slightly different based on the version you're using.

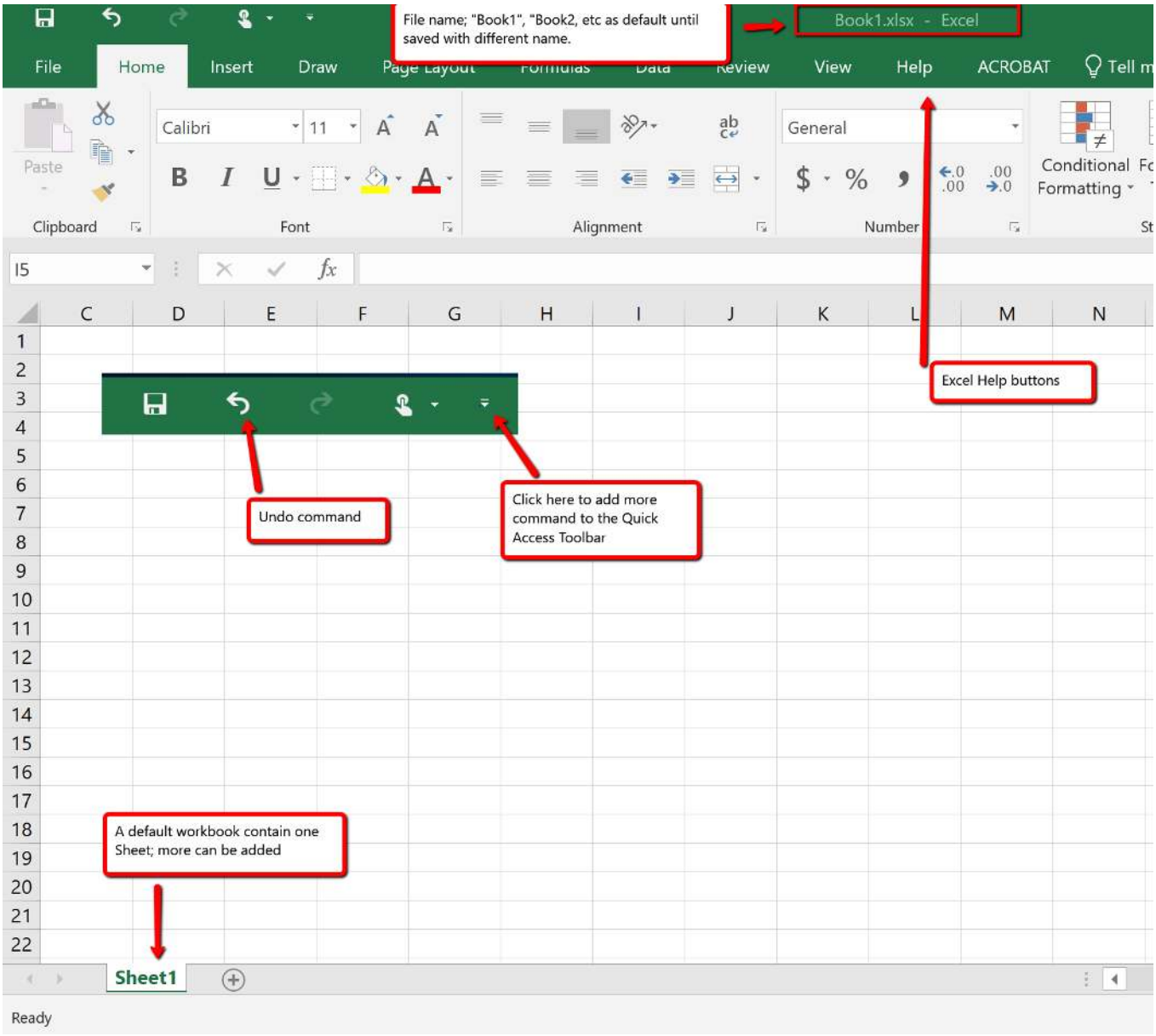


Figure 1.2 Blank Workbook

https://workforce.libretexts.org/@go/page/56163

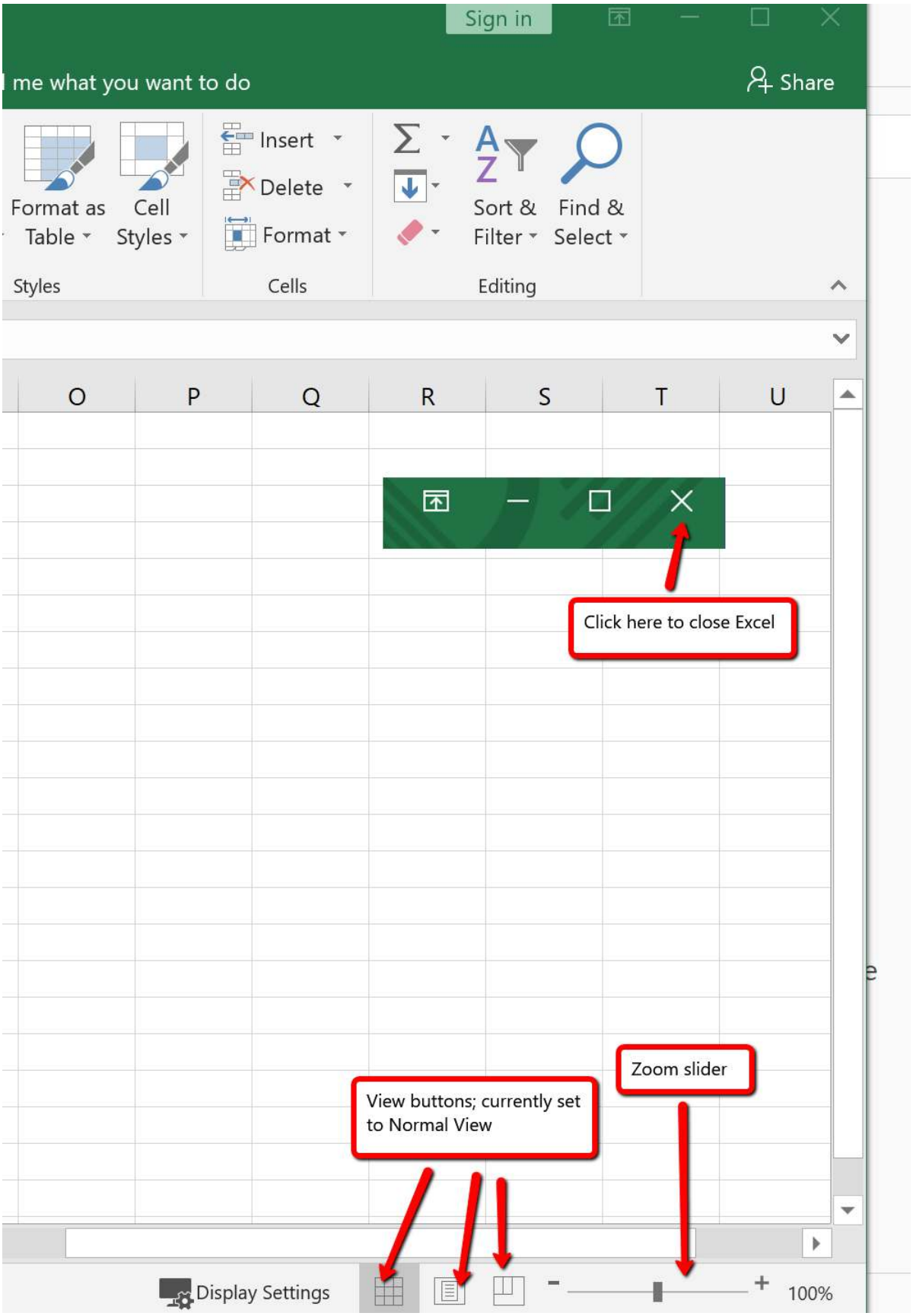


Figure 1.2a Blank Workbook (right-side)

Your workbook should already be maximized (or shown at full size) once Excel is started, as shown in **Figure 1.2**. However, if your screen looks like **Figure 1.3** after starting Excel, you should click the Maximize button, as shown in the figure.

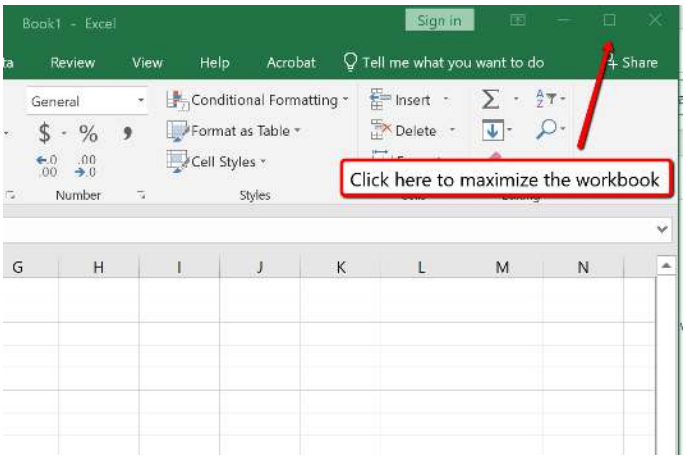


Figure 1.3 Restored Worksheet

Navigating Worksheets

Data are entered and managed in an Excel worksheet. The worksheet contains several rectangles called cells for entering numeric and non-numeric data. Each cell in an Excel worksheet contains an address, which is defined by a column letter followed by a row number. For example, the cell that is currently activated in **Figure 1.3** is **A1**. This would be referred to as cell location A1 or cell reference A1. The following steps explain how you can navigate in an Excel worksheet:

1. Place your mouse pointer over cell D5 and click.
2. Check to make sure column letter D and row number 5 are highlighted, as shown in **Figure 1.4**.

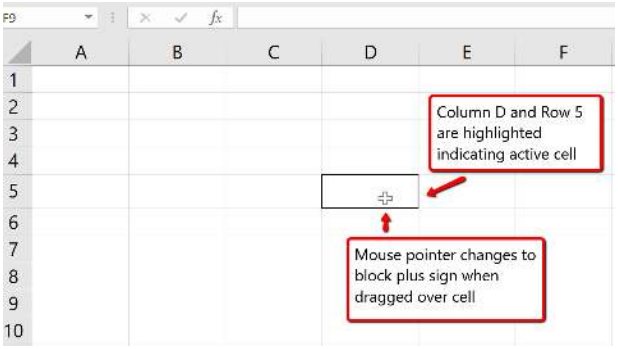


Figure 1.4 Activating a Cell Location

1. Move the mouse pointer to cell A1.
2. Click and hold the left mouse button and drag the mouse pointer back to cell D5.
3. Release the left mouse button. You should see several cells highlighted, as shown in **Figure 1.5**.

This is referred to as a ***cell range*** and is documented as follows: **A1:D5**. Any two cell locations separated by a colon are known as a cell range. The first cell is the top left corner of the range, and the second cell is the lower right corner of the range.

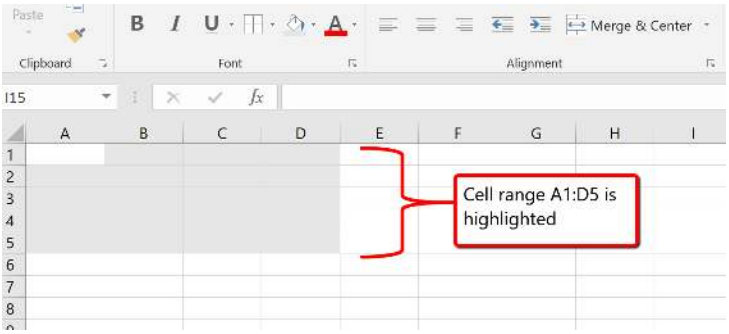


Figure 1.5 Highlighting a Range of Cells

1. At the bottom of the screen, you'll see a sheet tab indicated by "**Sheet1**". Clicking on the + adds additional worksheets. This is how you open or add a worksheets within a workbook. To see how this works, click on the + to add another worksheet so that you now have two sheets
2. Click the Sheet1 worksheet tab at the bottom of the worksheet to return to the worksheet shown in **Figure 1.5**.

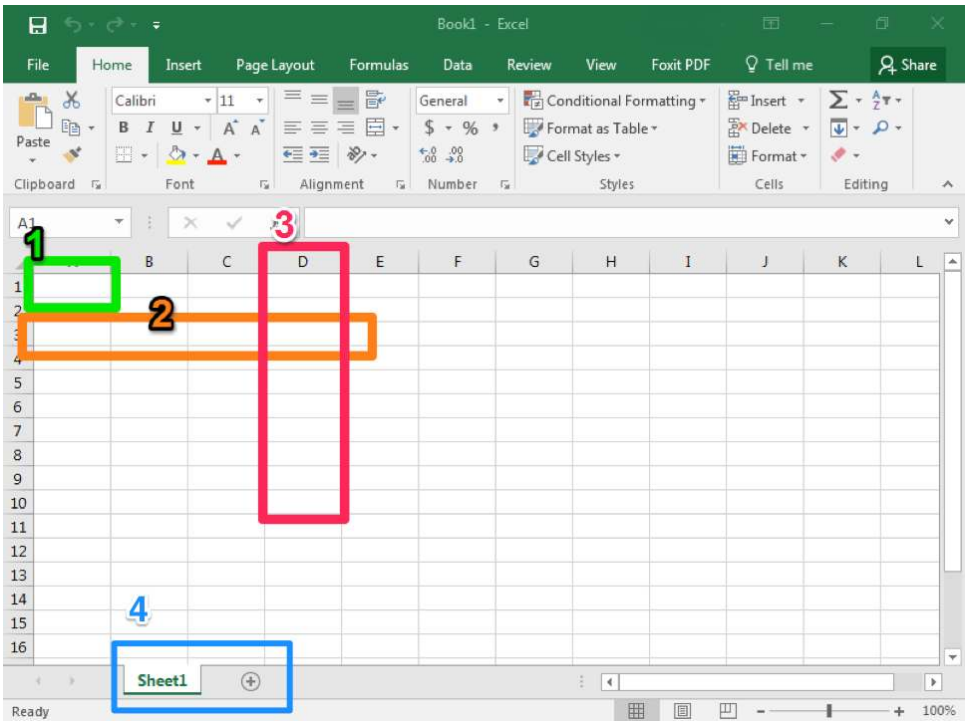
Keyboard Shortcuts

Basic Worksheet Navigation

- Use the arrow keys on your keyboard to activate cells on the worksheet.
- Hold the SHIFT key and press the arrow keys on your keyboard to highlight a range of cells in a worksheet.
- Hold the CTRL key while pressing the PAGE DOWN or PAGE UP keys to open other worksheets in a workbook.
- Mac Users: Hold down the Fn and Command keys and press the left or right arrow keys

Basic Excel Terms

Before using a workbook, it is helpful to know a few key terms.



1. **Cell.** This is the area where you will enter data.
2. **Row.** Rows are cells aligned horizontally.
3. **Column.** Columns are cells aligned vertically.

4. **Worksheet.** A worksheet is a single page within a workbook. Like the tabs in an internet browser, the tabs in an Excel workbook show different pages, or worksheets. A workbook may have many worksheets included in it. In this screenshot, the workbook only has one worksheet and one tab, which is labeled Sheet1. The selected tab shows the selected worksheet. Clicking the + button will add another worksheet. When you save a workbook in Excel, all of the worksheets in that workbook are saved.

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Opening an Excel Workbook

When working with Microsoft Excel, the workbook is the primary file format used to store and organize data. A workbook can contain one or more worksheets (“tabs”), each of which provides a grid of rows and columns for entering, calculating, and analyzing data. Workbooks are versatile and scalable, enabling users to manage everything from small personal budgets to large-scale organizational datasets within a single file.

To open an existing workbook, launch Excel and select a recently used file from the Start screen or use File > Open to browse. Excel supports several file formats, and while .xlsx is the standard default format, it can open .xls, text-based .csv, and macro-enabled workbooks (.xlsm).

When creating a new workbook, you can begin with a blank workbook or select from templates (budgets, calendars, invoices, expense reports). Templates speed up repetitive tasks and reduce formatting errors.

It is best practice to save a new workbook immediately upon creation and to save progress regularly throughout your work session (Ctrl+S). Choose an appropriate location (local drive, external device, or cloud service such as OneDrive) and assign a meaningful file name (e.g., CIS034_GradeTracker_Spring2025.xlsx).

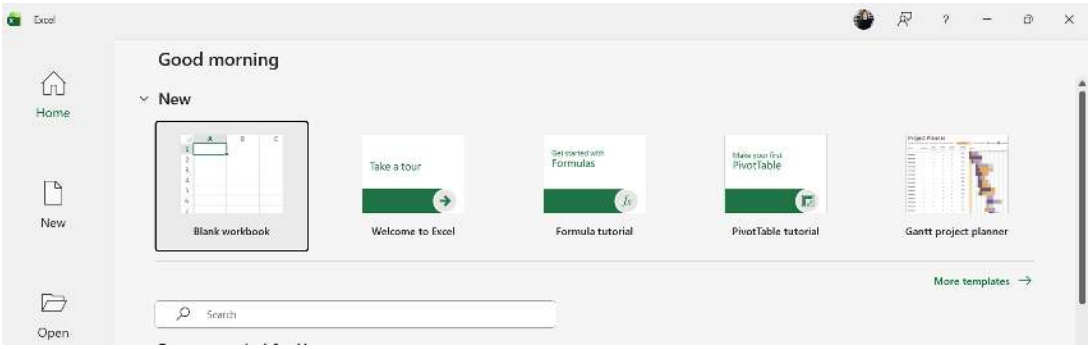


Figure 1.3.1: Excel Opening Page

Common formats and when to use them:

- .xlsx — default workbook with formatting, charts, formulas.
- .xls — legacy compatibility with older Excel versions.
- .csv — plain-text exchange with other systems (no formatting/formulas).
- .xlsm — macro-enabled workbook for recorded or written automations. We will begin using macros in Chapter 8 – Macros & Automation, so saving certain files as .xlsm will be required there.

Managing workbooks effectively also means organizing files systematically. Use consistent naming conventions and store workbooks in clearly labeled folders. For example:

Marketing_Campaigns › 2025 › Q1 › SocialMedia_Jan2025.xlsx

In shared environments, consider including the creator's name or a version tag in the file title (e.g., Inventory_Apr2025_v2_Taylor.xlsx) to minimize confusion and prevent overwrites.

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Summary

A **spreadsheet** is a collection of data that is organized into rows and columns. Microsoft® Excel is a spreadsheet application used to store and analyze quantitative data. An Excel file is called a **workbook**, and it is saved with an .xlsx extension. A workbook file consists of one or more **worksheets** which consists of many columns and rows. **Columns** are the vertical part of a worksheet grid identified by letters. Rows are the horizontal part of a worksheet grid identified by numbers. The intersection of a row and column is called a **cell**. Each cell can store a single item of data. The data can contain text, numbers, formulas, and/or functions. Clicking a cell with the mouse pointer will make the selected cell the **active cell**. The active cell's contents are displayed in the formula bar.

Typical uses for Excel include:

- Accounting reports (Balance Sheets, Income Statements, etc)
- Budgets
- Calendars
- Checklists and task lists
- Contact/Address lists
- Expense tracking
- Inventory control
- Invoices
- Mortgage and other financial calculations
- Operational statistics
- Sales price lists, forecasts and analysis

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1.1.4: Text and Numbers in Microsoft Excel

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Explain the basics of data and data analysis
- Enter and format numeric data in a worksheet cell
- Use the Text and General formats for cell data
- Use the commands in the Page Layout and Review tabs

WorldCorp receives many orders every day, and they rely on databases for recording all data. Large corporations like WorldCorp also keep an inventory of direct materials for manufacturing. These materials, such as bolts and screws, come from many suppliers on multiple orders. They need to store all this inventory information in the accounting system. Finished products—the products that the company packages for shipping and sells—are built with various components and parts, and they record a list of all this information for every item that is manufactured. When a client places an order from a sales agent, these transactions are recorded in a customer relationship management (CRM) database. Although many large corporations use Oracle or SAP databases, many other software companies furnish solutions to big, medium, and small organizations. Medium-sized companies may use Microsoft Access and/or Microsoft Dynamics for their database purposes and for the financial accounting. Organizations of all sizes can utilize Microsoft Excel.

Here, you will learn some of the basic sales order database capabilities in Excel. For WorldCorp, Excel is an appropriate tool to gather, organize, and analyze information within the smaller business units such as by region or product line. The company-wide information might be stored in another type of program suited for large corporations, but at the business-unit level, Excel can be a powerful tool to feed into the corporate information database.

Data Fundamentals

For the purpose of spreadsheet programs, data can be textual (such as a product description) or numerical (such as a price per unit), and it represents what an organization has determined is valuable. If you decide to compare the prices of oranges at different grocery stores, then you are researching and creating data. You can write your data on paper, but a more efficient and common method today for capturing and storing data is with computers. Data is collected primarily to use later in data analysis, a scientific discipline that uses mathematical and statistical tools to measure trends. For example, a company could track the sales trends of three locations over the span of a few months. Watching the data could reveal slumps in sales, which could trigger the company to introduce a corrective action.

There are different kinds of data that businesses like to collect from their clients. Demographic data can segment a growing list of clients so that a company can give them better service based on their likes or dislikes. Financial and accounting data can keep track of a business's sales, unit costs, overhead costs, and so on. In addition to client data, machines are constantly generating data related to their performance. All manufacturing plants have machines that output data to computers for engineers and managers to analyze.

Excel can manage many types of datasets but works better when the dataset is relatively small. Access databases are appropriate for large sets of data or data that will continue to grow. There are other industrial-sized data storage and analysis solutions like SAP and Oracle, as well as others that might work better for larger data files. Programs such as Sage and QuickBooks that are specific to accounting and finance provide additional features for financial analysis that are not offered in Excel.

Entering and Formatting Numeric Data in a Worksheet Cell

The information made of numerals that Excel reads like a calculator to perform mathematical equations is called numeric data. There are many purposes of numerical values in spreadsheets. The numbers can represent quantities, currency, dates, time stamps,

percentages, and more. Table 9.1 summarizes the numerical values Excel uses.

Table 9.1: Numerical Values in Excel

Type of Numerical Value	Description
Number	Data has two decimal places by default, but you can add or remove them, depending on what your needs are. It accepts negative numbers as well. You can add a thousands separator.
Currency	Data has two decimal places by default. It accepts negative numbers and will display them within parentheses or with a negative sign in red or black font. The thousands separator is turned on by default. A zero is displayed with two decimal places. Excel adds the appropriate currency symbol preceding the number, and the numbers are aligned to the right with no spaces to the edges.
Accounting	Data has two decimal places by default. It accepts negative numbers and will display in parentheses only. The thousands separator is given. The zeros are displayed as "-". Excel adds a currency symbol aligned to the left. The difference between Currency and Accounting is that with the Accounting format, all currency symbols are aligned.
Date	Data is displayed in the American format by default (i.e., month/day/year). There are options to change the location or to change the format to one of many different choices, such as day/month/year or year/month/day.
Time	Data uses the 24-hour clock or AM/PM format by default.
Percentage	Data analyzes the portion of a whole and the data is displayed as a percentage with the % symbol and no decimal points by default.
Fraction	Data analyzes the portion of a whole and displays the values as in the percentages. You can convert a fraction to a percentage before entering data.
Scientific	Data can be shortened numbers written in exponential form. To shorten a number, display the first digit, add a decimal point, and then list the next two digits. Then, add "E" and the number of zeros the whole number contains. For example, 644362623 would be 6.44E+9. These truncated forms of numbers are commonly used in all sorts of sciences.

Mac Tip

Percentages are shown with two decimal points by default.

You can choose the type of numerical value appropriate for your data on the Home tab. Figure 9.10 shows the drop-down menu in the Number command group where you can choose the type of numerical data you have. You can also access more details about the number type by selecting the arrow in the lower-right corner of the Number command group. This will open up the Format Cells dialog box that allows you to specify many more types of number formatting, including the number of decimal places. If you're starting from a blank worksheet, you can plan in your mind what kind of values your tables will contain, so that you can design them to be informative and display logical information. You can even do this prewrite of the table on a piece of paper, or as you go through the process of designing the document in Excel.

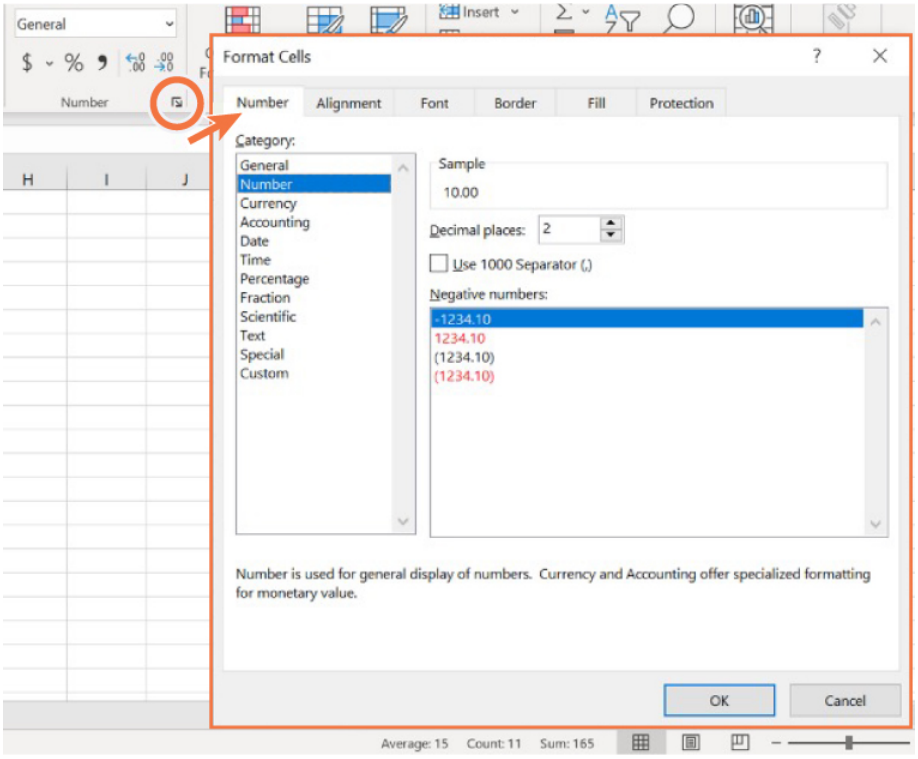


Figure 9.10: You can format numbers on the Home tab. The Number command group contains several buttons for commonly used formats and a drop-down menu. The drop-down menu contains an expanded list of common number formats. More options are available in the Format Cells dialog box. (Used with permission from Microsoft)

The Format Cells dialog box allows you to choose the category and formatting for your cell, based on the data. For example, you can determine the number of decimal places you want to show with your Accounting data. You can also use the Custom formatting category. There are numerous complicated formatting options in the Custom category, such as combining a date with a time, but you can also design your own by modifying an existing one to meet your needs.

Say a sales report table contains a set of orders and the name of the salesperson who fulfilled them. This worksheet contains a variety of types of data: dates, text, general, number, accounting, and more. In order to determine the type of data, click on the cell, and check the drop-down menu in the Number command group. Figure 9.11 shows that cell A2 is a Date. You can convert any number to currency by selecting a cell and then clicking on the "$" button on the Home tab.

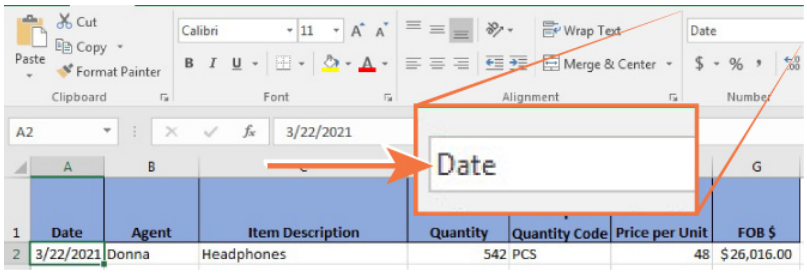


Figure 9.11: When a worksheet has multiple types of data, make sure to format it as the most appropriate type. Column A is formatted as a Date. (Used with permission from Microsoft)

Figure 9.12a shows a summary of the sales figures of all agents. You will notice that the first row is shaded blue and the text is bolded. This is an effective way to differentiate the headings for each column, often referred to as the column header, title row, or header row. More about formatting cells will be covered in Formatting and Templates in Excel. For now, to make the header row stand out, you can highlight (select) the row and use the commands in the Font command group on the Home tab to change the formatting, such as bolding, shading (fill), or text color.

Figure 9.12a includes a column for each agent's percentage of the FOB $ total, but by default, Excel formats cell contents as General, so it displays the calculation as a decimal number. You can format it as a Percentage by selecting the cell and changing the

number format in the drop-down menu or by clicking on the button in the Number command group. We can use the same process to display the next cell as a fraction. Figure 9.12b shows the finished table.

Agent	Quantity Total	FOB $ Total	Percentage	Fraction
Donna	759	$ 43,850.00	0.2197	0.2197
Robert	2680	$ 46,847.00	0.2347	0.2347
Cheryl	3865	$ 108,929.00	0.5457	0.5457
		$ 199,626.00		

(a)

Agent	Quantity Total	FOB $ Total	Percentage	Fraction
Donna	759	$ 43,850.00	21.97%	2/9
Robert	2680	$ 46,847.00	23.47%	1/4
Cheryl	3865	$ 108,929.00	54.57%	5/9
		$ 199,626.00		

(b)

Figure 9.12: By default, Excel formats cells as General, so formatting may require adjustment for numbers to display properly. (a) The unformatted table shows percentages and fractions as decimals. You can choose the Percentage format for the cells in the Percentage column. You can choose the Fraction format for the cells in the Fraction column. (b) The formatted table displays the percentages and fractions correctly. (Used with permission from Microsoft)

Using the Text and General Cell Formats

When your worksheet uses text data, which is information made up of words, letters, numerals, or a combination of those things, you can use the General or the Text cell format. For example, say you have salespersons' names in Text format, and item descriptions in the General format. In a blank worksheet, you can enter your data using the default General format, and Excel will automatically format it according to the type of data you're entering. For example, if you type a date in a cell formatted as General, Excel will identify it as a date and reformat it accordingly. If Excel detects a number or text, it will remain in the General format. General formatting is flexible and can accommodate numbers or text. Because Excel may automatically change the format of your cell contents if you leave the format as General, consider formatting all numbers as Number or Accounting, as appropriate.

If you format your words or letters as Text, then Excel will not try to autoformat them. Figure 9.13 compares the same data formatted as Text and formatted as Number. The Text format is flexible in that it can store numbers, letters, symbols, and words.

Text	Number
0126438796	126438796
0054735474	54735474
0005643573	5643573
=4*5	20

Figure 9.13: Numbers can be stored as text data to retain symbols or leading zeros, which are regularly used in some government reports, identification numbers, and some phone numbers. (Used with permission from Microsoft)

You are not restricted to the autoformatting that occurs when you type your data into a cell with General formatting. If you enter a number using the General format (Figure 9.14a), but you want the number to display as currency, for example, simply select the cell or column and then choose Currency from the Number command group's drop-down menu (Figure 9.14b). Excel will automatically add the currency symbol and two decimal places. All cells in a new workbook are by default set to General format, but you can design your tables with the correct format for your purpose.

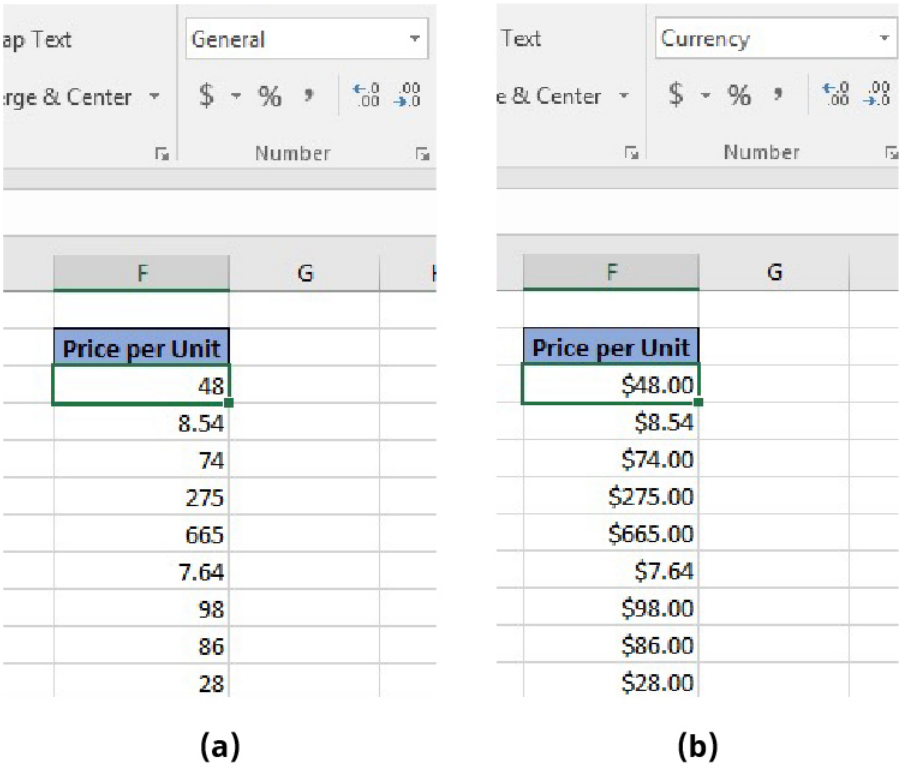


Figure 9.14: The default formatting for cell data is (a) General, but if you change it to (b) Currency, Excel will add two decimal places and a currency symbol. (Used with permission from Microsoft)

Page Layout and Review Tabs

The Page Layout tab (Figure 9.15) lets the user control the page setup for printing, such as the paper size, the vertical or horizontal orientation, and the print margins. It also contains the settings for arranging graphical objects on a worksheet. One of the most useful commands here is the Breaks drop-down menu, where you can insert page breaks, just like in Microsoft Word, so that when you print your worksheet, the page breaks occur where you want them to.

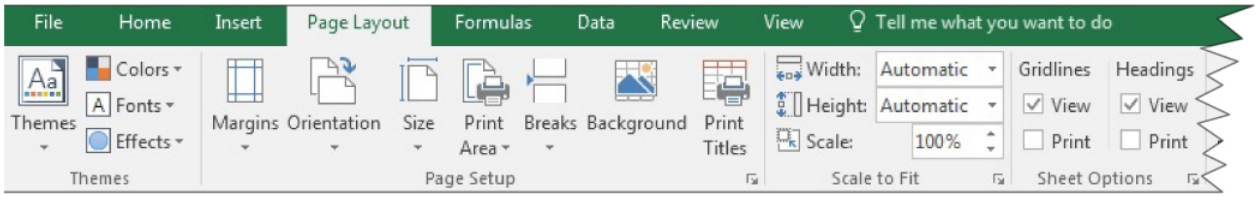


Figure 9.15: The Page Layout tab includes commands for page setup and manipulation of objects. (Used with permission from Microsoft)

The Review tab contains the commands for adding and reviewing comments and activating the track-changes tool, as shown in Figure 9.16. It also has password protection options, where you can restrict others' editing capabilities when you are collaborating on the same project. The spell checker and thesaurus tools are also included in the Review tab. Your Review tab might look somewhat different based on the version of Excel that you are using. If these commands are not included on your ribbon, you can add those using the process outlined in Essentials of Business Software Applications for Business.

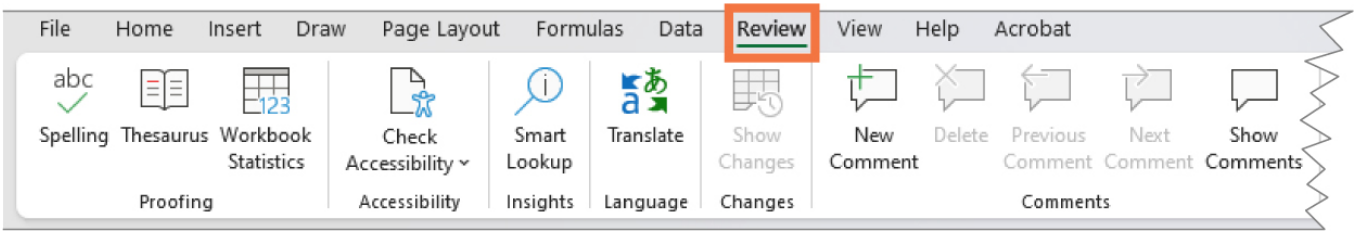


Figure 9.16: The Review tab lets you manage comments, sharing settings, and spelling tools. (Used with permission from Microsoft)

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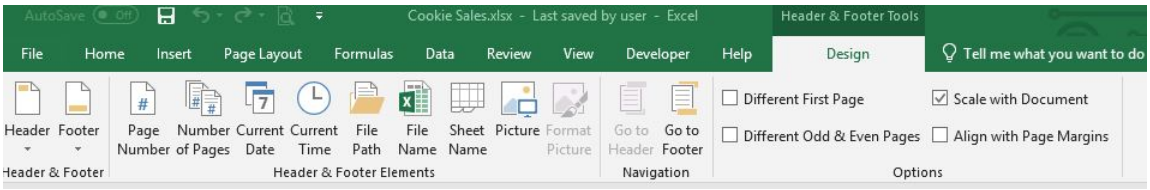
1.1.5: Headers, Footers, and Page Layout

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Adding Headers and Footers

In Excel, **headers** and **footers** are lines of data that print at the top (header) and bottom (footer) of each page in a worksheet to help identify printouts. Headers and footers can contain descriptive text, graphics, and/or fields, such as titles, dates, or page numbers. Header and footer information does not display in Normal view, so to edit a header or footer, click Insert > Header & Footer to open the sheet in Page Layout view, and activate the Header & Footer Tools contextual tab on the ribbon. There are left, center and right sections for both the header and footer areas.

Users have the option to use one or more of the many built-in headers and footers, or they can click any of the buttons in the Header & Footer Elements group on the Header & Footer Tools Design toolbar to create custom fields.

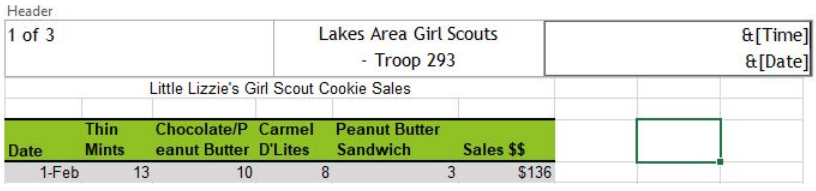


Header and Footer toolbar

Command buttons in the Header & Footer Elements group include:

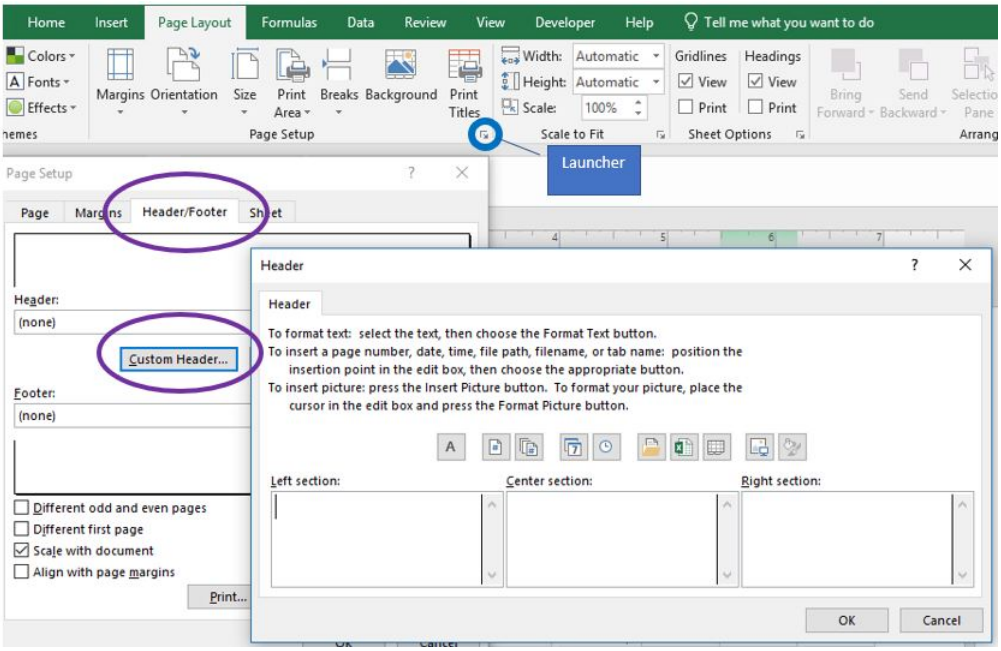
- **Page Number**: Click this button to insert the `&[Page]` code that puts in the current page number.
- **Number of Pages:** Click this button to insert the `&[Pages]` code that puts in the total number of pages.
- **Current Date:** Click this button to insert the `&[Date]` code that puts in the current date.
- **Current Time:** Click this button to insert the `&[Time]` code that puts in the current time.
- **File Path:** Click this button to insert the `&[Path]&[File]` codes that put in the directory path along with the name of the workbook file.
- **File Name:** Click this button to insert the `&[File]` code that puts in the name of the workbook file.
- **Sheet Name:** Click this button to insert the `&[Tab]` code that puts in the name of the worksheet as shown on the sheet tab.
- **Picture:** Click this button to insert the `&[Picture]` code that inserts the image that you select from the Insert Picture dialog box that enables you to select a local image (using the From File option) or download one from an online source using a Bing Image Search.
- **Format Picture:** Click this button to apply the formatting that you choose from the Format Picture dialog box to the `&[Picture]` code that you enter with the Insert Picture button without adding any code of its own.

The following screenshot illustrates fields in each section of the header. The Page Number and Number of Pages fields are in the left section. Manually entered text is in the center section, and finally, the Current Time and Current Date fields are being inserted into the right section.



Sample Excel Header

To create a custom header or custom footer, click the Launcher icon in the Page Setup group of the Page Layout ribbon to open the Page Setup window. Next, click the Header/Footer tab, and then choose to open either the Custom Header… or Custom Footer… buttons.

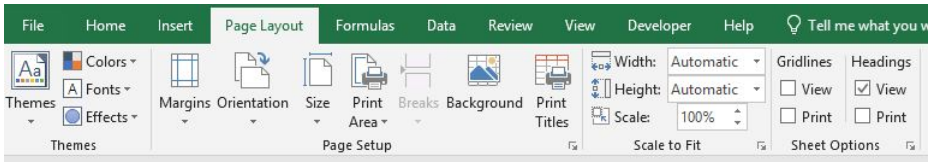


Header Footer dialog windows

Four checkboxes appear at the bottom of the "Header/Footer" tab, and in the Options group of the Design tab of the ribbon. To remove headers and footers from the first printed page, select the **Different First Page** check box. To specify that the headers and footers on odd-numbered pages should differ from those on even-numbered pages, select the **Different Odd & Even Pages** check box. These options are similar to those in Microsoft Word. The other two options are unique to Excel. To specify whether the headers and footers should use the same font size and scaling as the worksheet, select the **Scale with Document** check box. To make sure the header or footer margin is aligned with the left and right margins of the worksheet, select the **Align with Page Margins** check box.

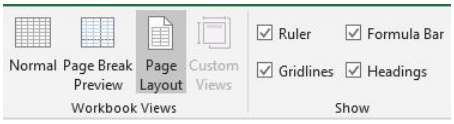
Adjusting Page Layout and Preparing to Print

The size of Excel workbooks tend to grow the more each worksheet is manipulated, typically by adding more columns and rows, and sometimes, more sheets. This added complexity makes physical output of Excel data somewhat challenging. Too many columns will result in the sheet not being able to be printed on one sheet of paper, and too many rows make make it difficult to interpret data on pages beyond the first page. Fortunately, the Page Layout tab can help fit the data on fewer sheets of paper and make each page easier to understand.



Page Layout tab

While themes can help modify the appearance of a spreadsheet's colors and fonts, the other groups in the Page Layout tab can impact the arrangement of data, and streamline the readability of the output. Starting with the Page Setup group, Excel allows tremendous flexibility with the margins of each worksheet. For example, Narrow **margins** allow more data to fit on one page by reducing the amount of white space on the edges of the sheet. A quick and easy way to allow more columns to print on one sheet, is to change the **orientation** from the default Portrait, to Landscape, which allows more columns and fewer rows to print on one sheet. The effects of these Setup decisions can be more easily illustrated by switching from the default Normal workbook view to the Page Layout. The View tab also allows users to to enable/disable the Ruler, Formula Bar, and on-screen gridlines and headings.



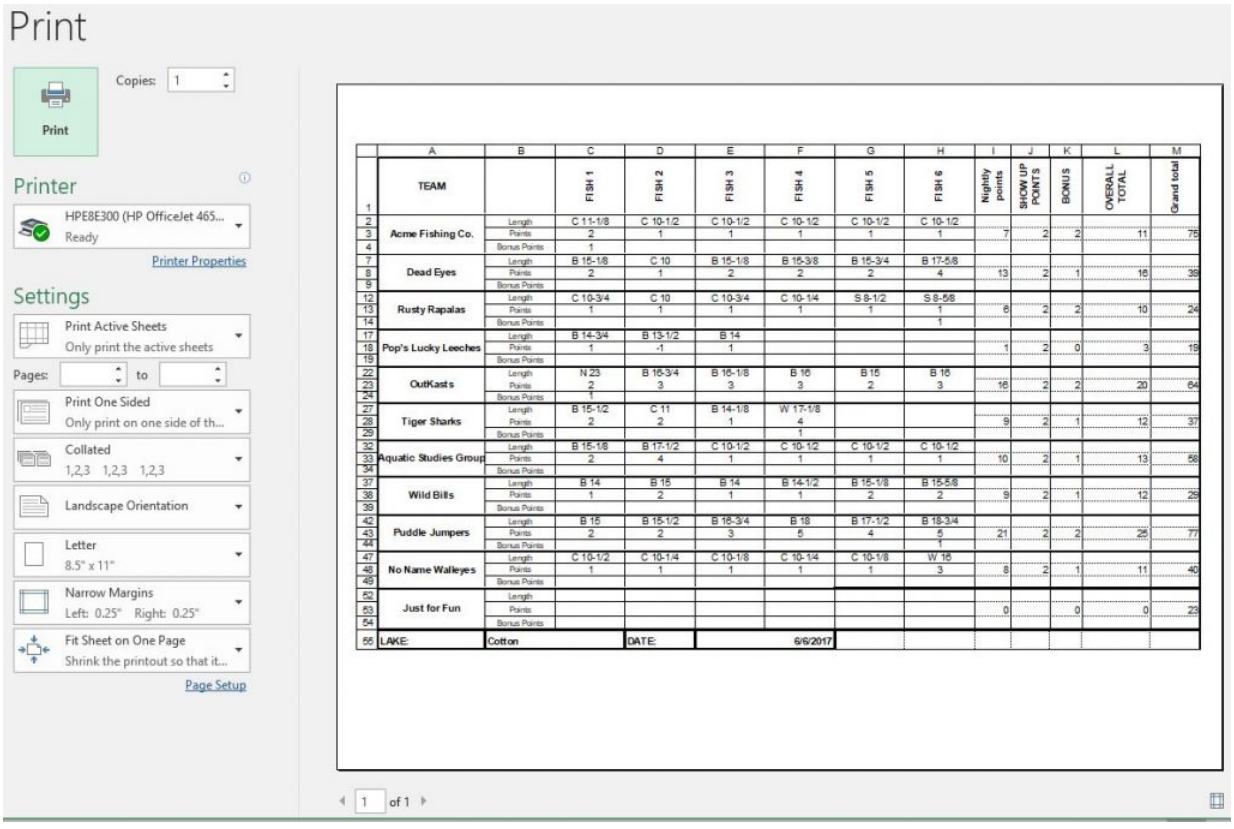
View tab

If changing the margins and/or orientation is not resolving the issue of getting extra columns to print on the same page, an alternative could be changing the paper size. The default printer determines the paper sizes available from the Size drop-down list. To check the range of paper sizes that a printer can print on, consult the printer manual, or view the paper sizes that are currently set for the printer in the **Print Setup** dialog box. Some users have the option of printing to Legal (8.5″ x 14″) or even 11″ x 17″ (tabloid) printers, especially if commonly printing large worksheets.

A final, more drastic option to keep data from overlapping into multiple sheets, is to utilize the scaling feature. Using the Scale to Fit group from the Layout tab, a printed worksheet can be scaled by to modify the font size of printed output by either shrinking or enlarging the output. The options exist to scale the output to fit to 1 page wide (width) by 1 page tall (height). It might make sense to only modify the width, or by choosing a Scale percentage, which adjusts the overall sheet height and width proportionately. Keep in mind the needs of your audience. Too small of font might make the spreadsheet unreadable, and for certain audiences, the output might need to be scaled to a larger font than the editing view.

The Sheet Options group of the Layout tab provides two significant print features for basic Excel printing. These include the options to have gridlines and/or headings appear in printed output. By default, the options appear in the Viewing screen, but do not appear when printed. Without Headings, the output would be very difficult to explain to others, and gridlines, much like banded rows, make it easier for the eye to line up the intersections of rows and columns.

More advanced options exist for enhancing page layout and printing options by clicking the launcher button in each group. Additionally, several print settings can be adjusted in the Print Preview window. The sheet in the screenshot below is modified to print in landscape orientation with Narrow Margins and it is scaled to Fit on One Page. It also has headings included in the print output.



Excel Print Preview

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1.1.6: Renaming and Organizing Worksheets

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Each Excel workbook can contain one or more worksheets, represented by tabs at the bottom of the window. Managing these effectively is critical for organization, especially when building multi-sheet reports or collaborating with others.

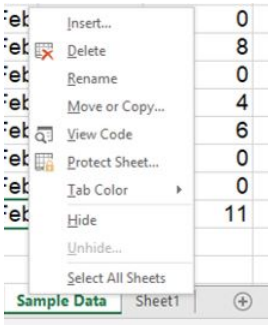


Figure 1.1.6.1: Sheet Shortcut Menu

Much like a binder can have multiple sections of sheets divided by colorful tabs, an Excel workbook can multiple sheets that can be re-arranged, colored and renamed to fit individual organization plans. Inserting and deleting worksheets is similar to the inserting of columns and rows. In addition to using the Insert or Delete buttons from the ribbon, right-clicking an existing sheet tab will produce a Context Menu with a plethora of options.

Just as inserting a new column will add the column to the left of the selected column, the newly inserted worksheet will appear to the left of the selected sheet tab. Options exist to insert a blank worksheet or a new sheet based off of an existing template. Clicking and dragging sheet tabs are easy method to rearrange the order of sheets. However, the Move or Copy… command offers the opportunity to move or place a duplicate sheet within an existing, open workbook. Adding tab colors and the Rename option can help organize sheets to user-specific criteria. Sheets can also be hidden and unhidden. If it is necessary to prevent others from unhiding sheets, the workbook can be protected with a password to be able to modify the sheets. The tab scrolling buttons to the left of the sheet tabs are enabled when too many sheets exist to be displayed above the status bar. To quickly add a new, blank sheet to the workbook, click the plus button ⊕ to the right of the sheet tabs.



(Sheet management) by Nataliya Vaitkevich, CC0 , Pexels [www.pexels.com]

- Renaming Worksheets: Right-click a tab and select *Rename*, or double-click directly on the tab name. Use descriptive titles (e.g., *Sales_Q1*, *Budget_2025*) instead of the generic *Sheet1*.
- Adding/Reordering Worksheets: Click the “+” icon to insert a new sheet. Drag tabs left or right to reorder them, keeping related sheets together (e.g., Q1, Q2, Q3, Q4 in sequence).
- Color-Coding Tabs: Right-click → *Tab Color* to visually distinguish categories (e.g., red for expenses, green for revenue, blue for reports).

Best practices for worksheet management:

- Use underscores or camelCase (e.g., *EmployeeList_2025* or *studentGradesFall*) for readability.
- Avoid unsupported characters such as slashes, asterisks, or question marks.
- Group related sheets by topic or timeframe, so others can navigate quickly. For example, an HR workbook might group sheets by “Recruiting,” “Onboarding,” and “Payroll.”

Organized worksheets reduce confusion, save time when navigating large files, and make collaboration more efficient. A clear structure also ensures that errors are minimized and important data is easy to locate.



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1.1.7: Formatting and Templates in Microsoft Excel

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Learning Objectives

By the end of this section, you will be able to:

- Format and manipulate a cell or group of cells
- Design column and row headers
- Use conditional formatting
- Work with templates to format worksheets

At WorldCorp, there is so much data that it is impossible to look at it all at once. For example, on a long worksheet with several hundred or thousand orders, you might want to see only orders over a certain value. In the previous sections, you learned how to organize the information in a spreadsheet and analyze the data using some basic calculations. These calculations provide the information needed to present the data to other entities in the corporation, but it might not yet be formatted in a professional manner. You may want to ensure the data meets certain criteria; you might want to add additional formatting to highlight certain trends in the data or group the data in a different way to show meaningful differences. With the skills you learned in the previous sections and those to follow, you can create a meaningful report and analysis of the data to effectively communicate company performance. This report can be utilized to measure company progress toward strategic goals or to compare WorldCorp to their competitors.

Formatting Cells

We've discussed formatting cells according to their contents, such as number, percentage, or text, but formatting extends to the visual presentation of a worksheet. In this context, formatting involves applying colors, font types, and borders to cells for styling purposes. It can make a presentation more visually appealing or distinct from other presentations. Another important reason for formatting is to increase the readability and comprehension of data. Formatting can be applied to text and numbers, to cell backgrounds, or to cell borders. It is important to remember that sometimes additional formatting may not be necessary. The goal is to have a professional presentation of the information. Too much formatting such as bright colors or distracting fonts does not enhance the presentation of the information. It is advisable to stick to simple formatting that is not distracting and is in line with company standards for your corporation.

Using Color and Fonts

Colors and fonts can be used to highlight specific parts of a worksheet such as the header row or the total row and to indicate the end of a table. Highlighting values that are outside of a certain range or to show trends in a dataset can also be useful. In accounting, the convention is to have negative numbers in red font and positive numbers in black font. These uses of colors and fonts provide meaningful information to the user at a glance.

In Figure 9.27a, the current header row is gray with white font. Suppose your manager wants to follow the color scheme of the company and wants the header row to be highlighted with a blue cell fill and a larger font. To change the fill color of the cells, first select the cells you want to change (Figure 9.27a) and then click on the paint bucket in the Font command group on the Home tab. The drop-down arrow next to the bucket allows you to choose from many preset colors, or you can create your own by clicking on More Colors. For this table, click on the blue fill box in the middle of the fifth column of colors. Now that the background is blue, the white font is harder to read, so you should change it to a darker color. To change the color of the font, select the cells and click on the text icon next to the paint bucket. You can change the font by clicking on the Font drop-down menu and the size by clicking on the adjacent Font Size drop-down menu (Figure 9.27b). You can also change the formatting of individual cells, but it saves time to highlight all of the header cells and format them at the same time.

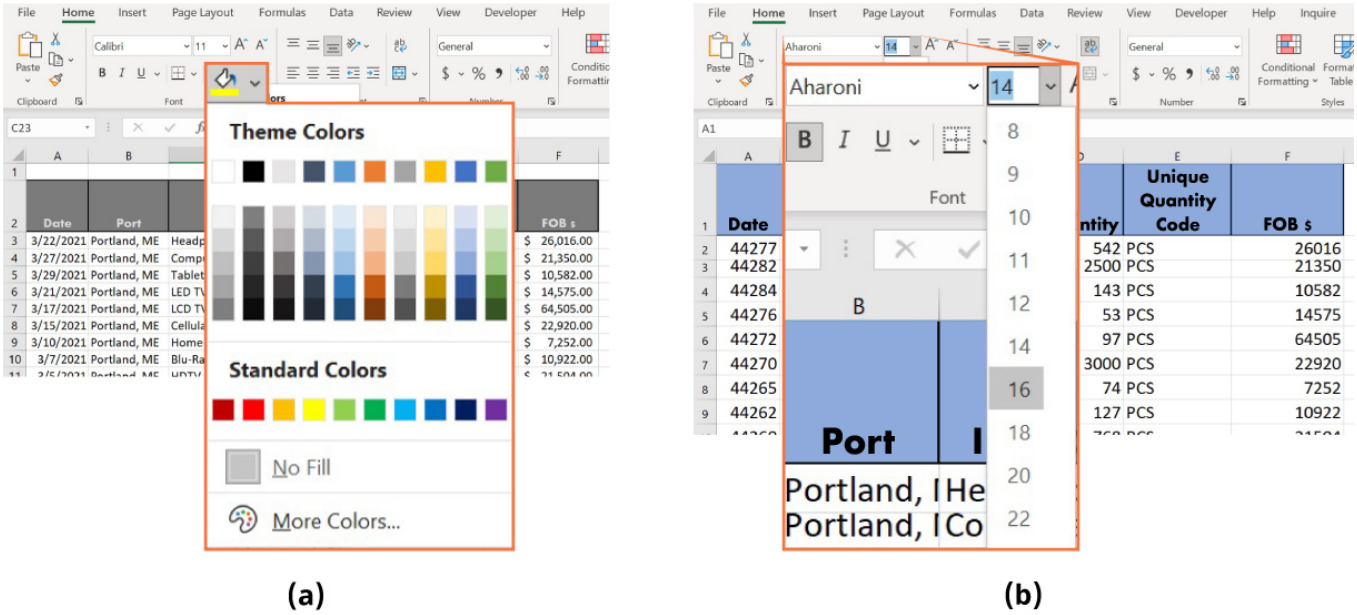
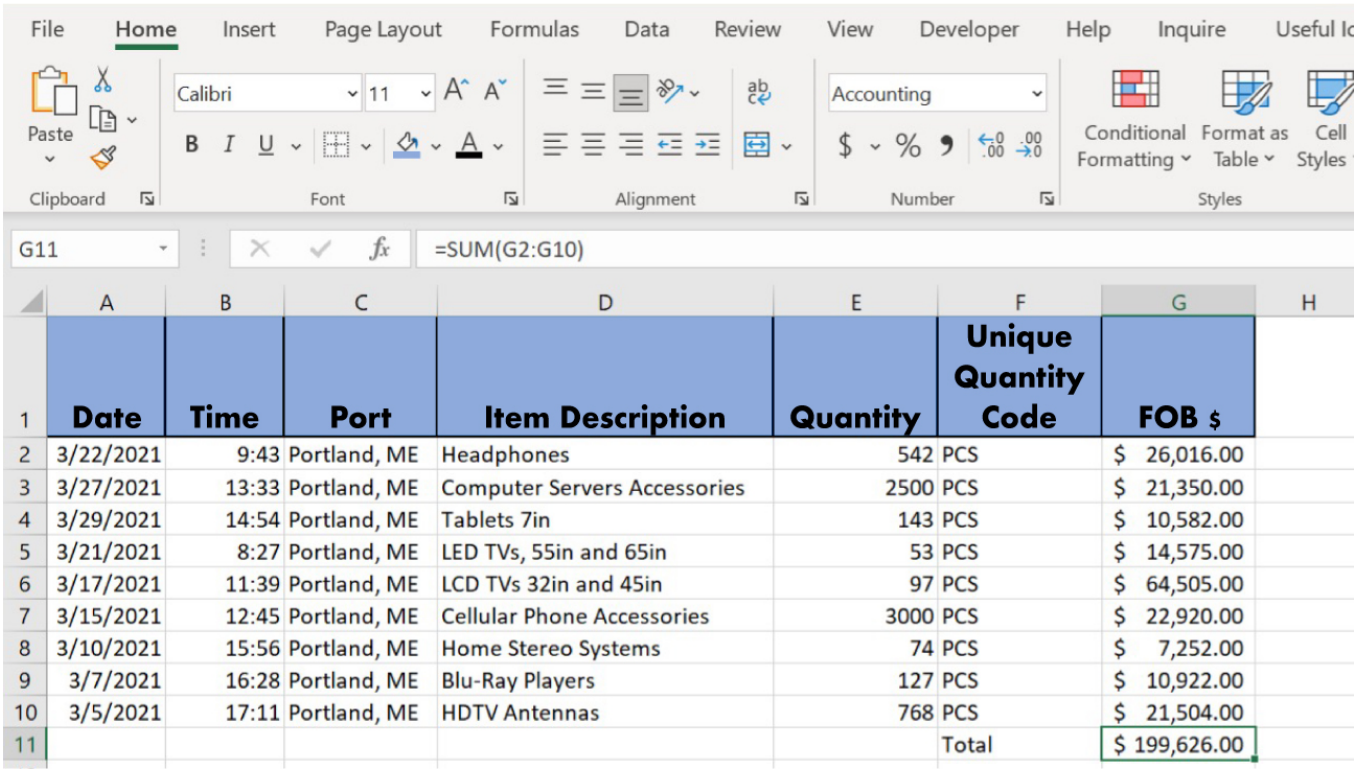


Figure 9.27: You can easily change the cell fill color, font type, and text color. (a) Select the paint bucket from the Home tab to change the color of the background fill. A drop-down menu gives you many options or you can define your own color using More Colors. The new background fill color is more visually appealing, but the text does not stand out as it would in a different color. (b) Font size, type, and color can also be changed using the commands in the Font command group. (Used with permission from Microsoft)

Borders

The default style in Excel is for gridlines to be visible in order to distinguish one cell from another when viewed on the screen. However, there may be times when that distinction could be clearer, or you want to divide groups of columns or rows. You can use borders to make these distinctions. Let's assume you would like to put a border around the total cell. To add this border, first select the cell or cells where you want to add a border (Figure 9.28). Then, from the Home tab, in the Font command group, you will find the Border command drop-down menu. You can also access this by right-clicking after you selected the cells and choosing Format Cells and then the Borders tab (Figure 9.29a). By selecting the down arrow of the Border command, you can choose the appropriate border for the cell or cells. You can change the border style and color. First, select the style and thickness of the outline, change the color if you want it to be a color other than black, then apply it on the preview on the right by clicking on each border (Figure 9.29b). You can choose multiple styles of borders or leave cells without borders, such as if you wanted a border around your table but not within the rows and columns. More border options are available by choosing More Borders at the bottom of the list. This will bring up the Format Cells dialog box, Borders tab. Make sure your header row is now formatted consistently.

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	A	B	C	D	E	F	G	H
1	**Date**	**Time**	**Port**	**Item Description**	**Quantity**	**Unique Quantity Code**	**FOB $**	
2	3/22/2021	9:43	Portland, ME	Headphones	542	PCS	$ 26,016.00	
3	3/27/2021	13:33	Portland, ME	Computer Servers Accessories	2500	PCS	$ 21,350.00	
4	3/29/2021	14:54	Portland, ME	Tablets 7in	143	PCS	$ 10,582.00	
5	3/21/2021	8:27	Portland, ME	LED TVs, 55in and 65in	53	PCS	$ 14,575.00	
6	3/17/2021	11:39	Portland, ME	LCD TVs 32in and 45in	97	PCS	$ 64,505.00	
7	3/15/2021	12:45	Portland, ME	Cellular Phone Accessories	3000	PCS	$ 22,920.00	
8	3/10/2021	15:56	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00	
9	3/7/2021	16:28	Portland, ME	Blu-Ray Players	127	PCS	$ 10,922.00	
10	3/5/2021	17:11	Portland, ME	HDTV Antennas	768	PCS	$ 21,504.00	
11						Total	$ 199,626.00	

Figure 9.28: To add borders, select the cells you want to add a border to. (Used with permission from Microsoft)

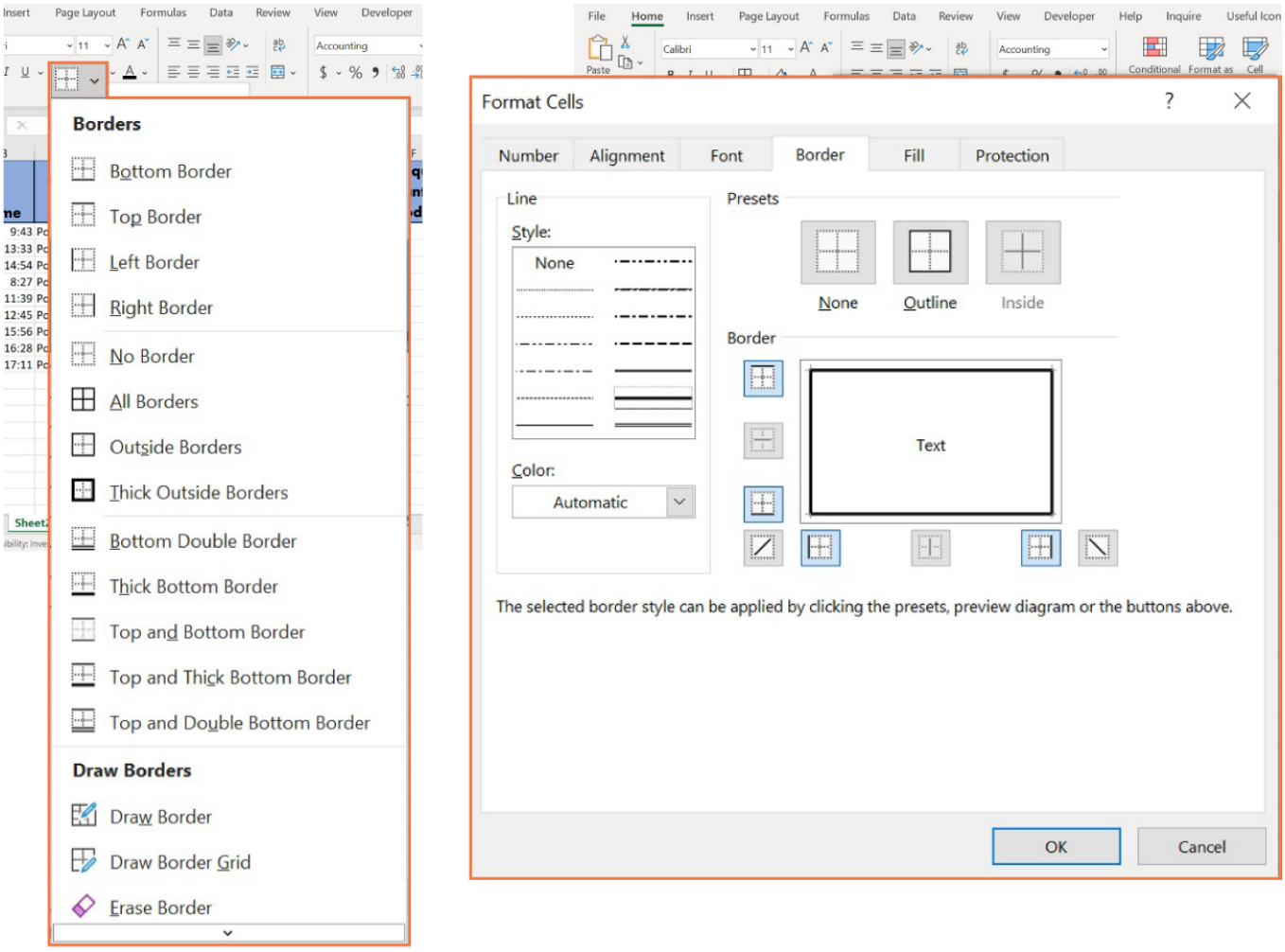
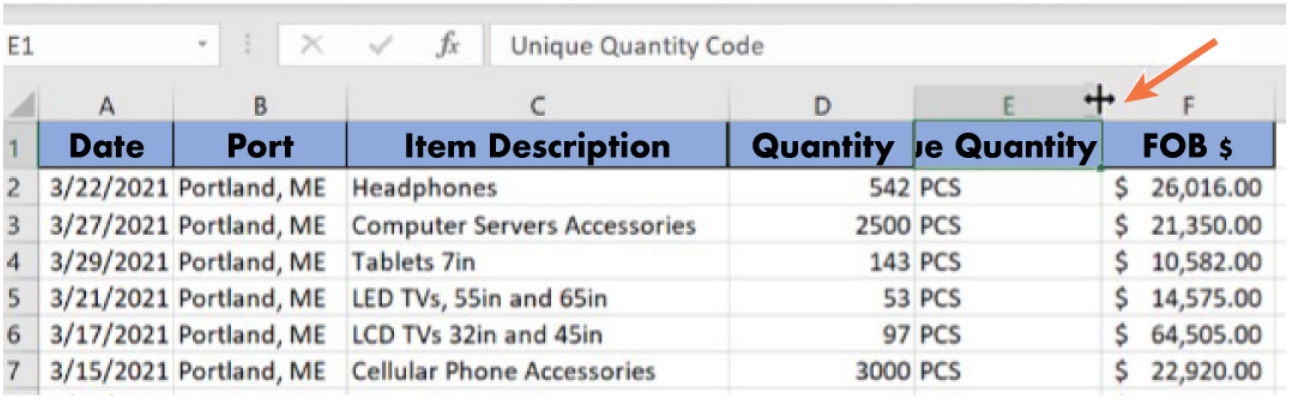


Figure 9.29: (a) You can use the Borders command drop-down menu or right-click and choose Format Cells. (b) You can select various thickness levels of the border around the cell. (Used with permission from Microsoft)

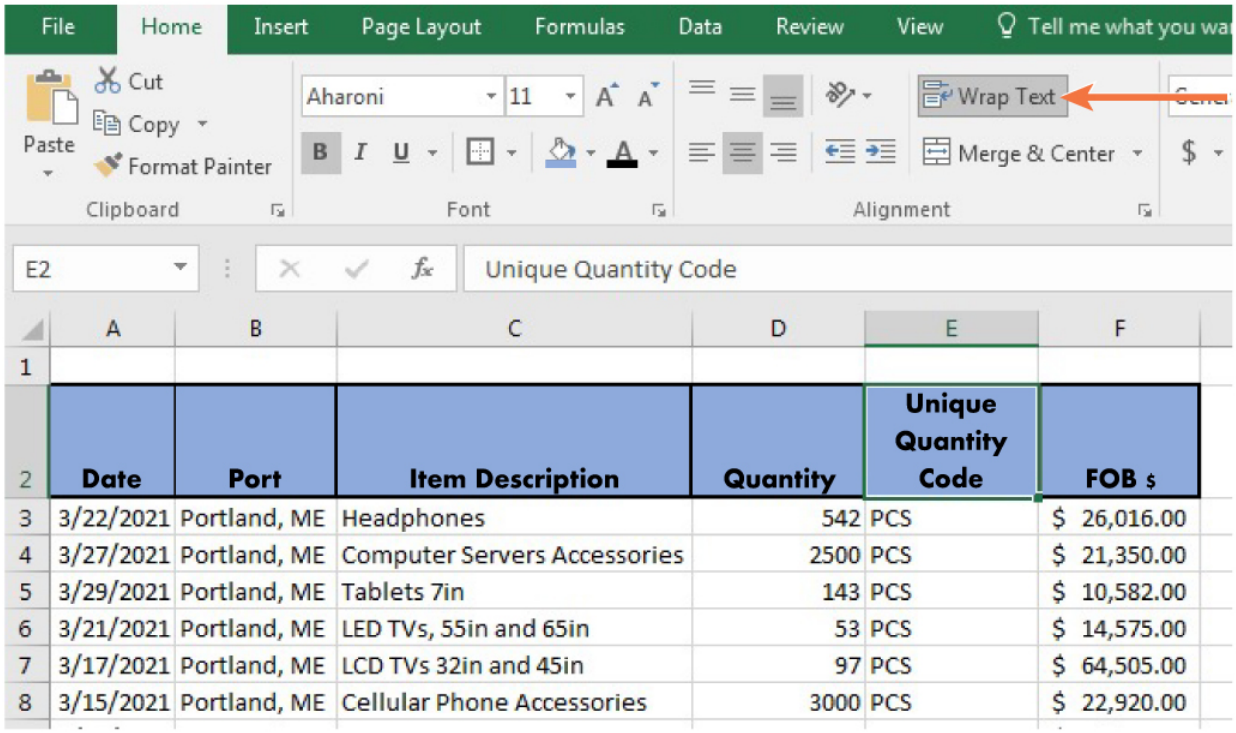
Wrapping Text

When you are working with text that is long, you can extend the width of your columns to fit it all in. One way is to do it manually. Hover over the line between two columns. The cursor will change to a black vertical line with opposite arrows. Click on this line and drag the column to your preferred width. You can also use the AutoFit command to automatically size the columns to fit the data contained in that column (Figure 9.30a). To AutoFit the columns, hover over the line between the columns, as you would to do it manually. Then, double-click on the line, and the column will adjust to the width of the contents. For example, to automatically size column E to the appropriate size for the data in the column, double-click on the line between the D and F columns at the top of the spreadsheet.

Sometimes, the text is so long that the whole width of the column is not visible on your screen; other times, you may not want a column to take up most of the width of your table. In those cases, the text is cut off. In Figure 9.30a, the header for column E is too long to fit in the cell. To fix this, select the cell, then on the Home tab, click on Wrap Text. The Wrap Text feature arranges the text in a cell so that it extends onto another line and increases the height of the row (Figure 9.30b).



(a)



(b)

Figure 9.30: Text wrapping can make long text fit in a column. (a) The header for column E is too long for the width of the column. Double-click or click and drag the line between columns to widen or narrow a column. The Wrap Text feature allows you to see text that is cut off. (b) Text wrapping changes the height of a row to accommodate long text. (Used with permission from Microsoft)

Merging Cells

Borders provided one method of grouping content in a table, but there are other ways to show that some rows or columns of data should be grouped together. The merge feature combines the content from two or more cells. When merging, the content and formatting of the first cell supersedes the content and formatting of the others. Merging cells can increase the readability of the tables. Figure 9.31a shows a row added above the header row to group some of the columns together to identify important sales order information to the port dispatchers. The first two columns tell the port dispatchers when the order was placed, so you want the cell that says “When” to span both columns. First, add “When” to the first cell. Then, select both cells over the columns you want the header to span and click on Merge & Center on the Home tab. Figure 9.31b shows the merged and centered cells. This can be repeated with cells E3 and F3. You can also merge content within a table. At the bottom, merge cell A14 with cells B14, C14,

D14, E14, and F14, to make the Total row more readable. Now that the merging is complete, you can format the border outlines. Format the top row, making sure all cell contents are centered and have borders, and add borders to the bottom row to highlight the totals. Figure 9.31c shows the completed table.

	A	B	C	D	E	F	G
1							
2							
3	When		Where	What	How many		How much
4	**Date**	**Time**	**Port**	**Item Description**	**Quantity**	**Unique Quantity Code**	**FOB $**
5	3/22/2021	9:43	Portland, ME	Headphones	542	PCS	$ 26,016.00
6	3/27/2021	13:33	Portland, ME	Computer Servers Accessories	2500	PCS	$ 21,350.00
7	3/29/2021	14:54	Portland, ME	Tablets 7in	143	PCS	$ 10,582.00
8	3/21/2021	8:27	Portland, ME	LED TVs, 55in and 65in	53	PCS	$ 14,575.00
9	3/17/2021	11:39	Portland, ME	LCD TVs 32in and 45in	97	PCS	$ 64,505.00
10	3/15/2021	12:45	Portland, ME	Cellular Phone Accessories	3000	PCS	$ 22,920.00
11	3/10/2021	15:56	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00
12	3/7/2021	16:28	Portland, ME	Blu-Ray Players	127	PCS	$ 10,922.00
13	3/5/2021	17:11	Portland, ME	HDTV Antennas	768	PCS	$ 21,504.00
14	Total						$199,626.00

(a)

	E	F	G
3	How many		How much
4	**Quantity**	**Unique Quantity Code**	**FOB $**
5	542	PCS	$ 26,016.00
6	2500	PCS	$ 21,350.00
7	143	PCS	$ 10,582.00
8	53	PCS	$ 14,575.00
9	97	PCS	$ 64,505.00
10	3000	PCS	$ 22,920.00
11	74	PCS	$ 7,252.00
12	127	PCS	$ 10,922.00
13	768	PCS	$ 21,504.00
14			$199,626.00

(b)

	A	B	C	D	E	F	G
1						**Unique Quantity Code**	
2							
3	When		Where	What	How		**FOB $**
4	**Date**	**Time**	**Port**	**Item Description**	**Quantity**	**Unique Quantity Code**	**FOB $**
5	3/22/2021	9:43	Portland, ME	Headphones	542	PCS	$ 26,016.00
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13	3/5/2021	17:11	Portland, ME	HDTV Antennas	768	PCS	$ 21,504.00
14				Total			$ 199,626.00

(c)

Figure 9.31: Merging cells is useful for presentation and readability purposes. You can (a) group columns by adding a row above the header row, merge and center cells to create a new label above the date and time, (b) merge and center cells to group the quantity and the code, and merge cells next to the total to create a more readable total. You can also add borders. (c) The final table is clear and readable. (Used with permission from Microsoft)

Link to Learning

Did you know that you can embed Excel objects and components into other Microsoft applications? You can insert all or parts of an Excel worksheet into your presentations and documents, saving time from re-creating the same content in these applications. Embedding content also helps ensure that the content provided in your document or presentation is accurate, as changes in Excel will update in these files as well. Visit this Microsoft page that shows how to embed Excel content in PowerPoint to learn more.

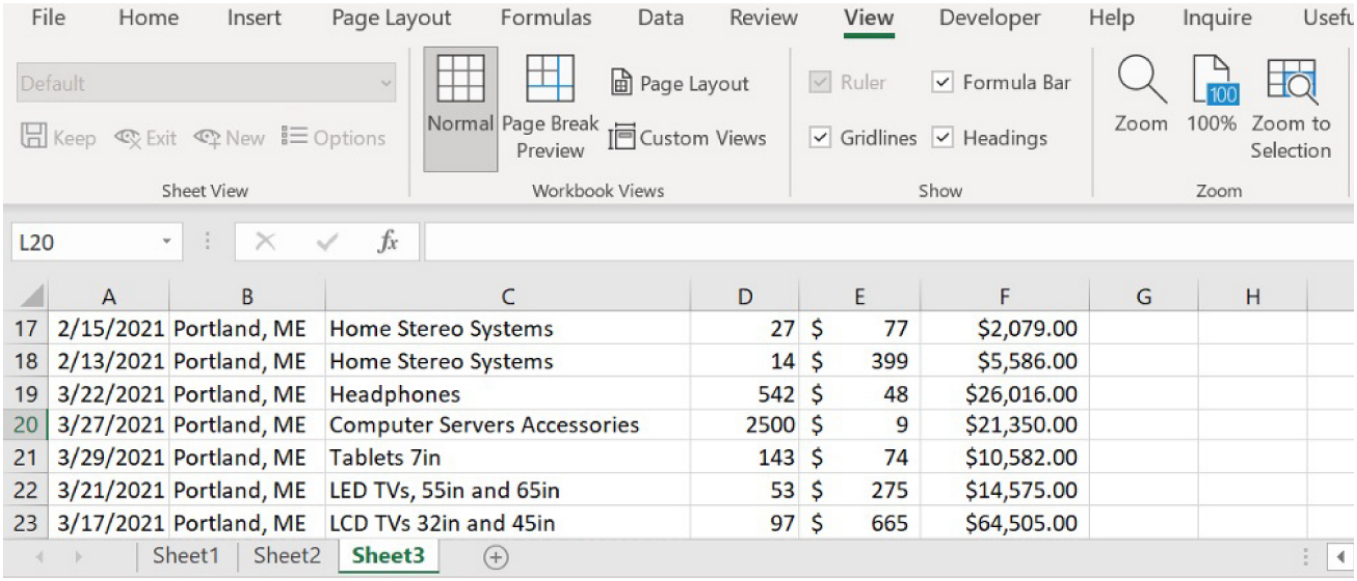
Working with Columns and Rows

The label added to tables at the top of a column or to the left of a row to make the data understandable is called a header. You've already learned to type words at the top of a column and format cells so that the headers look different from the rest of the table. Fonts can be bolded or centered, and background colors or shading applied. You can also freeze columns and rows so that the

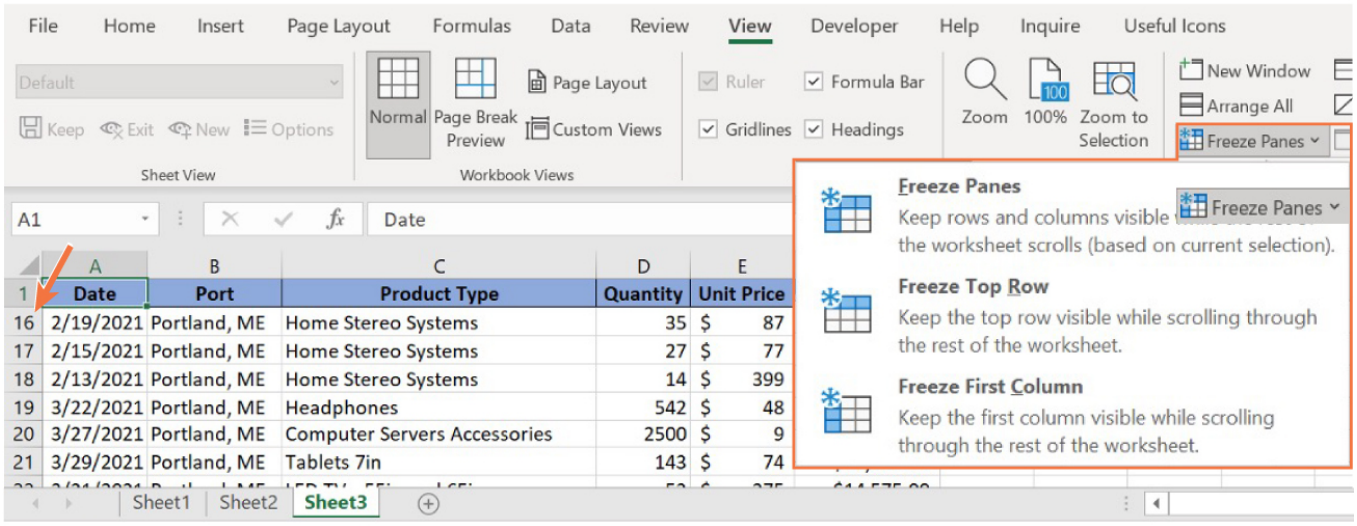
viewer of the document can see the header even if the document extends beyond the screen. Hiding rows and columns can also be useful for reducing the size of a worksheet.

Freezing Columns and Rows

When you have a large set of data, you will need to scroll beyond the edges of your screen to see all of it. You will need to be able to look at the data in each column or row but scrolling can take the header row or column off the screen. To ensure that the column or row headers are visible, you can use a command called Freeze Panes, which fixes the headers on the screen while allowing users to scroll through the rest of the data. The table in Figure 9.32a extends beyond row 22. As you scroll down through the data, notice that you can no longer see the column headers, so you will want to freeze the header row so that you can still see the column headers when you scroll down through the data. Figure 9.32b shows the choices in the Freeze Panes command on the View tab. You can freeze the top row, the first column, or both. For this data, freeze the top row so that scrolling down will keep the column headers in view. Figure 9.32b shows a line below the top row that indicates that the row is frozen. You are not limited to only freezing a header row or column. Excel allows you to use Freeze Panes anywhere in the spreadsheet. Just click on a cell and then on Freeze Panes, and it will freeze everything above and to the left of it.



(a)



(b)

Figure 9.32: Using the Freezing Panes command keeps headers visible when data extends off the screen. (a) Before the header row is frozen, scrolling down removes the header from view. (b) The Freeze Panes options are found on the View tab. Clicking on Freeze Panes allows for freezing the top row, first column, or both. Freezing the header row shows a line that indicates the row is frozen and keeps it in view while scrolling. (Used with permission from Microsoft)

Mac Tip

On a Mac, Excel uses icons for many of the drop-down menus that appear in the Windows version. The Freeze tool, for example, is always visible at the top of your active workbook.

Link to Learning

Go Skills is a company that offers a variety of free or paid online courses. Go to their website to review presentation tips for Excel tables and learn more.

Hiding Columns and Rows

Sometimes when working with data, information may be irrelevant for one use but cannot be deleted. This could be important when formatting spreadsheets for various users or when performing calculations. A user might not need to see all the data that goes into the formula but needs to see the final result of the formula. For example, in Figure 9.32a, column B contains the name of the port, but all of the visible data for the port is the same. If the port of Portland, Maine, is working with this data, they won't need to see the column that contains the port name. Additionally, the workers at the port won't need to know the price per unit. To make the table more usable for these workers, you can use the Hide command, which temporarily removes designated rows or columns from view. To hide a row or column, click on the row or column designation (the number to the left of the row header or the letter above the column header) to select the whole row or column, then right-click and select Hide from the menu (column B in Figure 9.33a). The result is shown in Figure 9.33b. To unhide a column, select the two columns that surround the hidden column, right-click, and select Unhide (Figure 9.34a). The column appears again, as shown in Figure 9.34b.

You can tell when a row or column is hidden by looking at the header, where you can see that letters or numbers are missing and there are two lines between the column or row designations. For example, we can see in Figure 9.33b that the header row goes from column A to column C. B is hidden and is not shown as a header. It is important to watch for that when you are using a spreadsheet that you did not create.



	A	C	D
1	Date	Product Type	Quantity
20	3/27/2021	Computer Servers Accessories	2500
21	3/29/2021	Tablets 7in	143
22	3/21/2021	LED TVs, 55in and 65in	53
23	3/17/2021	LCD TVs 32in and 45in	97
24	3/15/2021	Cellular Phone Accessories	3000
25	3/10/2021	Home Stereo Systems	74
26	3/7/2021	Blu-Ray Players	127
27	3/5/2021	HDTV Antennas	768
28	3/26/2021	Computer Servers and Accessorie	154
29	3/23/2021	Computer Servers and Accessorie	112
30	3/20/2021	Computer Servers and Accessorie	21
31	3/15/2021	Computer Servers and Accessorie	44
32	3/12/2021	Computer Servers and Accessorie	74
33	3/10/2021	Computer Servers and Accessorie	38

Figure 9.33: Using the Hide command makes rows/columns temporarily not visible in a table. (a) Right-click on the column and select Hide. (b) When columns are hidden, double lines and skipped letters are indicated in the letter designation header. (Used with permission from Microsoft)

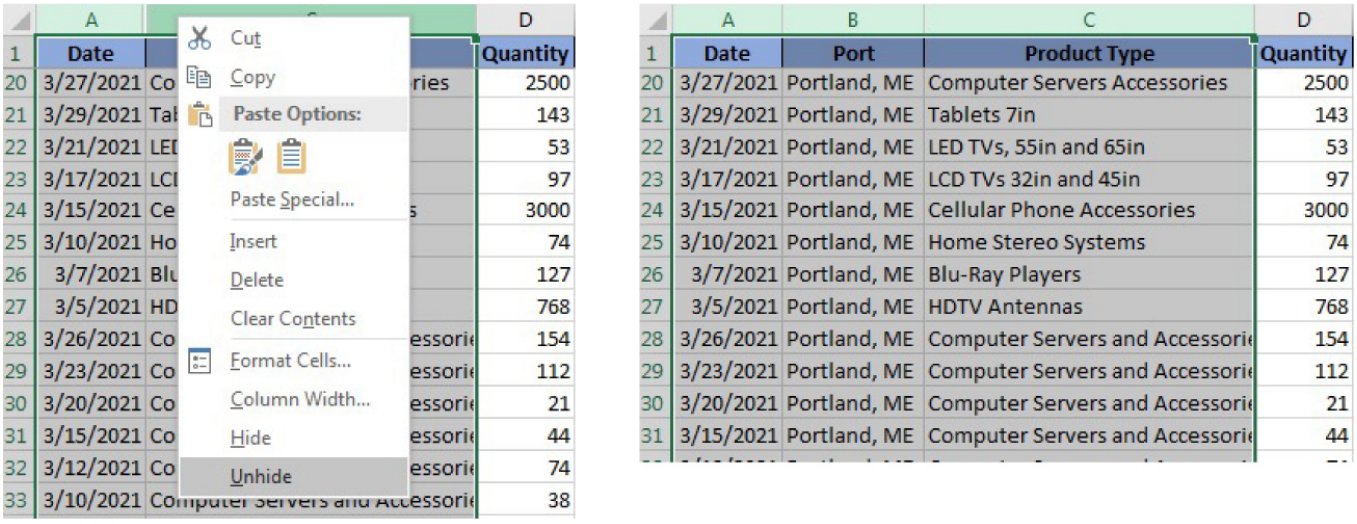


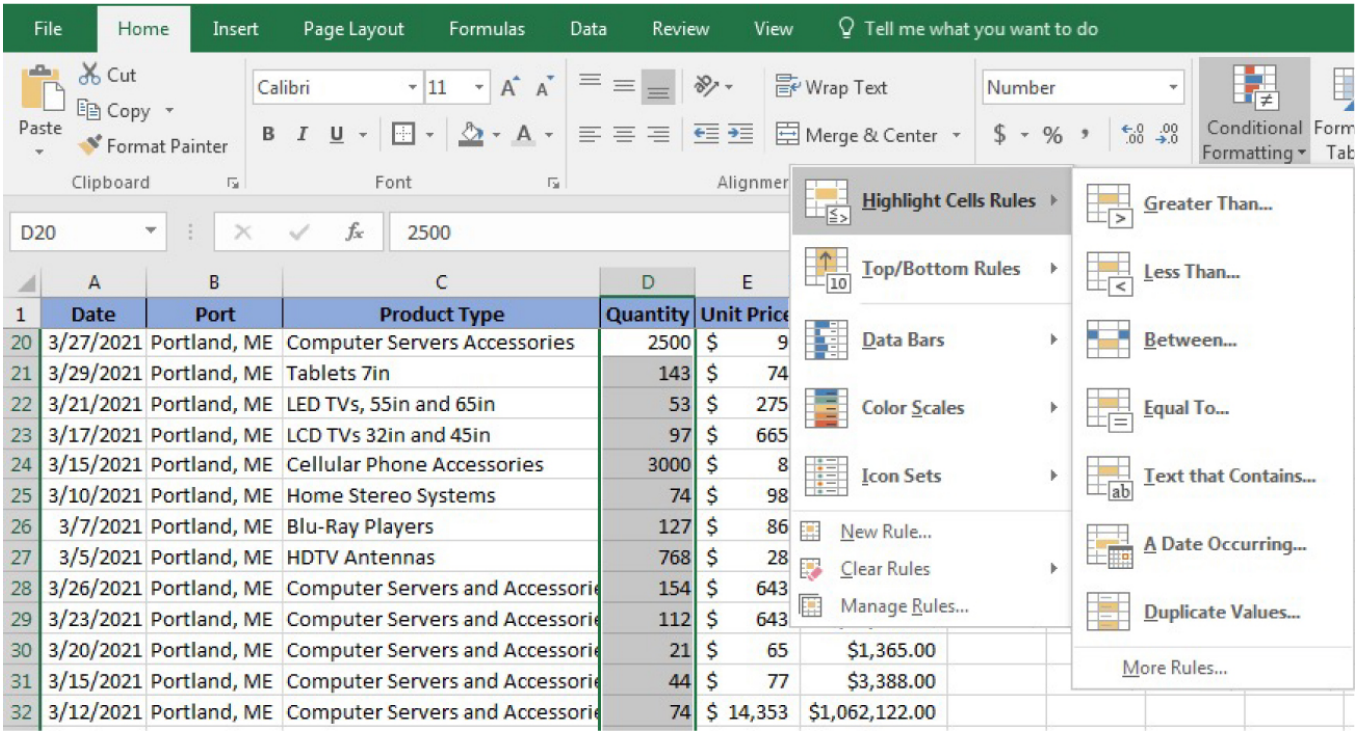
Figure 9.34: (a) To reveal the columns again, select the two columns on either side of the hidden one, right-click, and select Unhide. (b) All columns are visible again. (Used with permission from Microsoft)

Mac Tip

To access the Hide function, hold the Control key and click on the column.

Conditional Formatting

All of the formatting you have learned about so far has involved manually configuring individual cells or groups of cells. Excel has additional formatting features that can save you the time of manual formatting. One of these features, conditional formatting, analyzes the cell contents and applies certain preset designs or layouts based on the content. One example is to change the color of the font if the data is above or below a certain threshold (Figure 9.35). Conditional formatting is not turned on by default, so you will need to apply and customize it. Click on the drop-down menu next to Conditional Formatting on the Home tab and choose the formatting you want to use. You can set up the parameters using the dialog box shown in Figure 9.36a. Figure 9.36b shows another example of conditional formatting: highlighting the top ten FOB $ values.



	A	B	C	D	E	
1	Date	Port	Product Type	Quantity	Unit Price	
20	3/27/2021	Portland, ME	Computer Servers Accessories	2500	$ 9	
21	3/29/2021	Portland, ME	Tablets 7in	143	$ 74	
22	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	$ 275	
23	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	$ 665	
24	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	$ 8	
25	3/10/2021	Portland, ME	Home Stereo Systems	74	$ 98	
26	3/7/2021	Portland, ME	Blu-Ray Players	127	$ 86	
27	3/5/2021	Portland, ME	HDTV Antennas	768	$ 28	
28	3/26/2021	Portland, ME	Computer Servers and Accessorie	154	$ 643	
29	3/23/2021	Portland, ME	Computer Servers and Accessorie	112	$ 643	
30	3/20/2021	Portland, ME	Computer Servers and Accessorie	21	$ 65	$1,365.00
31	3/15/2021	Portland, ME	Computer Servers and Accessorie	44	$ 77	$3,388.00
32	3/12/2021	Portland, ME	Computer Servers and Accessorie	74	$ 14,353	$1,062,122.00

Figure 9.35: Conditional formatting automatically applies designated formatting to values that meet a certain criterion. The Conditional Formatting drop-down menu lists several commonly used choices. (Used with permission from Microsoft)

(a) Cells (2500, 3000) highlighted Red Fill with Dark Red Text (

Figure 9.36: (a) The dialog box allows you to set the parameters. (b) There are numerous preset conditional formatting choices. (Used with permission from Microsoft)

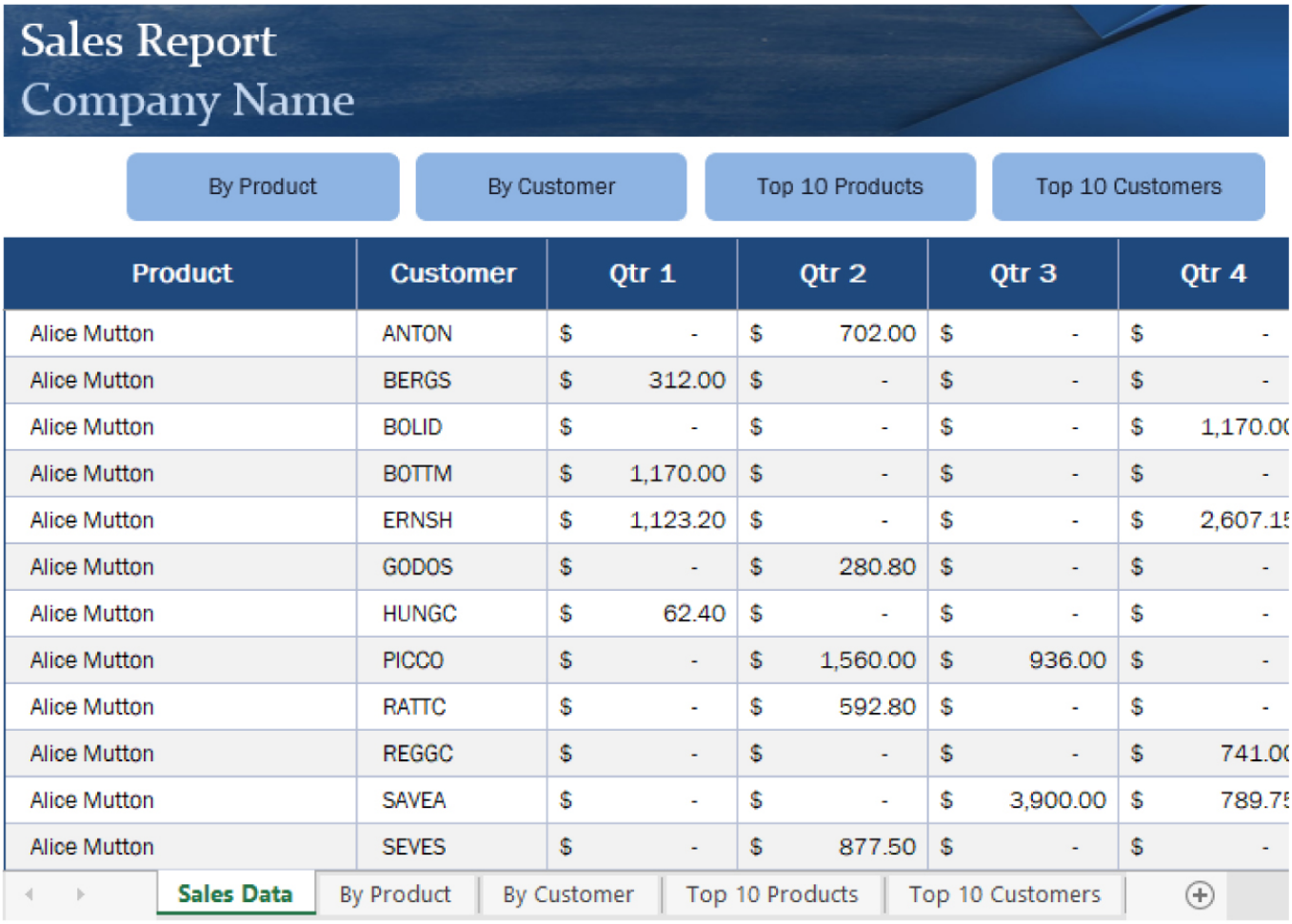
Real-World Application - Excel in the Construction Industry

The construction industry in the United States employs nearly ten million people and contributes over $1 trillion to the economy in structures built each year.[1] Excel can manage all the information needed to share among the various entities involved in a construction project. From building a small home garden shed to constructing an office complex, Excel can help manage the overall progress of a construction project. Excel can be helpful when estimating costs for construction projects to submit bids for particular projects. Items that can be summarized, tracked, and analyzed in Excel include order tracking, calculating needed quantities of materials such as lumber or piping, and payroll. Even for the small construction management company, Excel can be used to effectively manage a large construction project to keep the project on time and within budget. There are many templates available to help set up a construction project from start to finish.

What are some other industries where Excel could be a useful tool?

Working with Templates

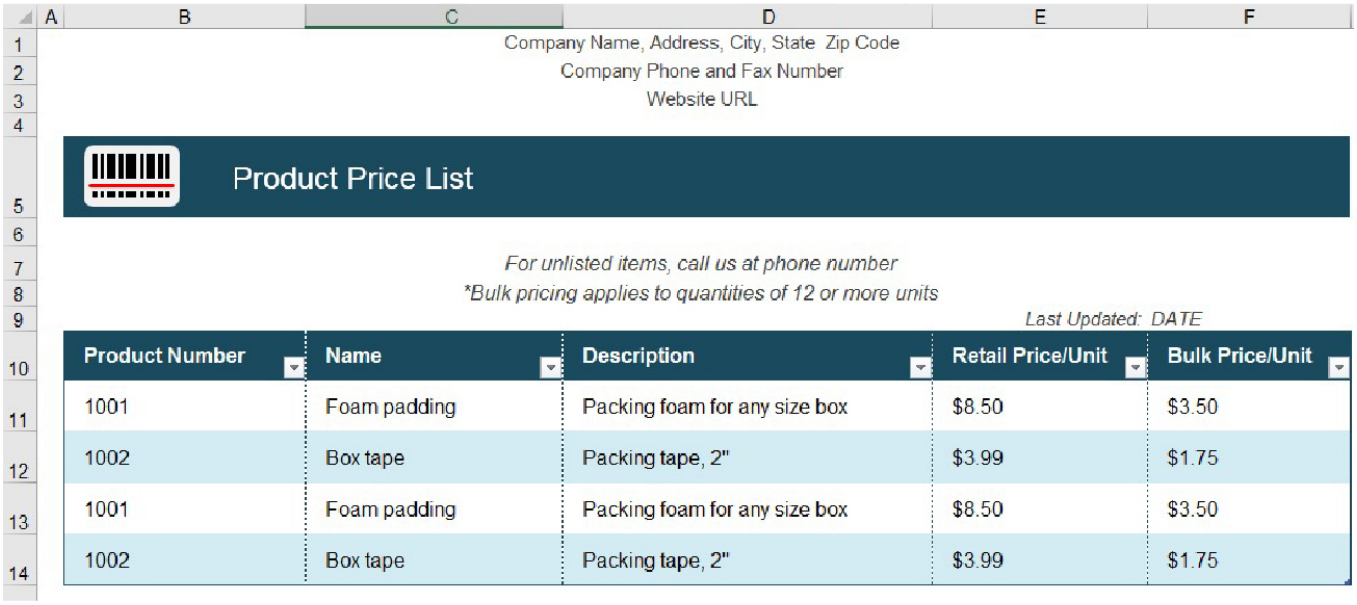
As in the other Office applications, Excel has built-in and online templates. Microsoft has their own online templates for Office, but many other websites offer free Excel templates. Templates are blank, formatted workbooks that you populate with your own data. Microsoft provides some built-in templates. Figure 9.37 shows the selection of a sales report, which has five sheets. This sales report has an order ledger, called “Sales Data,” with the product name, customer code, and quarterly sales figures. The template comes with a few lines of generic data. The other sheets use the data you enter on the first sheet. The second sheet uses the sales data but organizes it by product. The third sheet organizes the same data by customer. The fourth sheet filters the data to show the top 10 products, and the fifth sheet filters the data to show the top 10 customers. You should be able to find a similar template in your version of Excel, but there are many other sales reports templates available. The template library is frequently updated by Microsoft, so the versions you see might look a bit different than what we have shown here. The functionality will be similar, but the colors and the layout could vary.



Product	Customer	Qtr 1	Qtr 2	Qtr 3	Qtr 4
Alice Mutton	ANTON	$ -	$ 702.00	$ -	$ -
Alice Mutton	BERGS	$ 312.00	$ -	$ -	$ -
Alice Mutton	BOLID	$ -	$ -	$ -	$ 1,170.0
Alice Mutton	BOTTM	$ 1,170.00	$ -	$ -	$ -
Alice Mutton	ERNSH	$ 1,123.20	$ -	$ -	$ 2,607.1
Alice Mutton	GODOS	$ -	$ 280.80	$ -	$ -
Alice Mutton	HUNGC	$ 62.40	$ -	$ -	$ -
Alice Mutton	PICCO	$ -	$ 1,560.00	$ 936.00	$ -
Alice Mutton	RATTC	$ -	$ 592.80	$ -	$ -
Alice Mutton	REGGC	$ -	$ -	$ -	$ 741.0
Alice Mutton	SAVEA	$ -	$ -	$ 3,900.00	$ 789.7
Alice Mutton	SEVES	$ -	$ 877.50	$ -	$ -

Figure 9.37: Templates are preformatted and predesigned tables. You can find the templates by clicking on File and New. A sales report has formatting and formulas preset so that all you need to do is enter your data. (Used with permission from Microsoft)

Figure 9.38 shows a product price list downloaded from http://templates.office.com that has columns for a product inventory number, product name, product description, retail price, and volume-selling price. This sort of price list is an information sheet for potential business clients who are considering products from you. These templates are modifiable, so you can update the header with your company's information. You can also add more products or change the headers.



Company Name, Address, City, State Zip Code
Company Phone and Fax Number
Website URL

Product Price List

For unlisted items, call us at phone number
**Bulk pricing applies to quantities of 12 or more units*

Last Updated: DATE

Product Number	Name	Description	Retail Price/Unit	Bulk Price/Unit
1001	Foam padding	Packing foam for any size box	$8.50	$3.50
1002	Box tape	Packing tape, 2"	$3.99	$1.75
1001	Foam padding	Packing foam for any size box	$8.50	$3.50
1002	Box tape	Packing tape, 2"	$3.99	$1.75

Figure 9.38: Although templates come with their own formatting, you can customize them based on your needs. (Used with permission from Microsoft)

Spotlight on Ethics - Ethical Considerations in Using Templates

Templates are a wonderful resource and can save time and money in creating spreadsheets and workbooks in Excel. Templates can come with preset formatting and formulas, with little more to do than enter your own data. There are many templates available online, but you must choose one carefully. You will need to consider the purpose of the template you are using, company policy regarding branding, the version of the software you are using, as well as copyright and licensing of the template itself prior to using it for business purposes. For instance, perhaps you are using a template to create an invoice to provide clients. The template may hold a license that allows you to use the template for commercial use so long as you do not resell the template itself, or the license might prohibit commercial use altogether, restricting its use to nonprofit activities only. If that is the case, you should not use the template for business purposes as it may place the business at risk of litigation. It is always best to carefully read the user agreement and license of a template prior to implementing it.

Where might you find a template's licensing and permissible usage information? How can you be sure you are permitted to use a template in the manner in which you intend?

Footnotes

- 1Ken Simonson. "Construction Data." *Associated General Contractors of America*.

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1.1.8: Entering, Selecting, Sorting, and Formatting Data

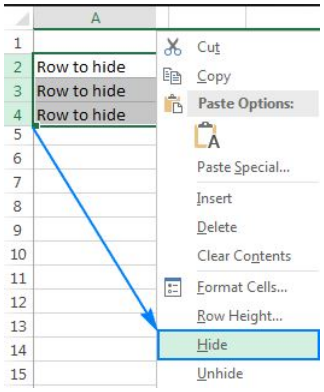
📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

At its core, Excel is a grid of cells (rectangles identified by their column letter and row number, such as A1). Data entry begins by selecting a cell and typing either text, a number, or a date. Press Enter to move down one row or Tab to move across a row—an efficient way to input large lists.

Entering Data

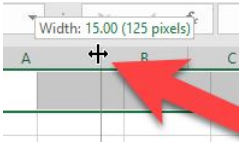
It is usually easy to add data to an existing worksheet, because Excel has seemingly unlimited columns and rows of cells. (There are limits, but this is not Jeopardy!) Nonetheless, sometimes it is necessary to insert a column or row into the middle of an existing range of cells. 

To insert a new column, select the column heading to the right of where you want the new column to appear, and click the top-half of the Insert button from the Home tab. Alternatively, just right-click the column heading to the right of the destination, and choose Insert from the **Context Menu.** Deleting columns is very similar. Whichever column(s) that are selected will be deleted if using the Delete button instead of the Insert button. Inserting and deleting rows is also very similar. Selecting the row below the intended new row and either choosing Insert from the ribbon or from the Context Menu will create a new row above the selection. For example, right-clicking row 10, and choosing Insert from the Context Menu will create a new, blank row 10, and all existing data will move down one row.



Shortcut menu Excel

Using the right-click method is a little faster than clicking the worksheet and then clicking the ribbon, as the shortcut menu avoids the need to move the mouse to the ribbon. The Context Menu, also known as Shortcut Menu, provides added functionality by offering actions that can be taken with the selected item. In addition to inserting and deleting, formatting column widths and row heights, as well as hiding and unhiding columns and rows are options from the Context Menu. Adjusting the column width is a common action since excessively wide columns prohibit efficient worksheet printing. Therefore, it is often preferable to widen a column width by double-clicking the boundary bar that separates the column heading letters. This is known as **auto-fitting** the column width since the column will resize its width to be just wide enough to display the longest data contained in that column.



Column width pointer

Clicking and dragging the double-arrow pointer to the left or right allows users to manually adjust the column width.

To edit existing entries, you can:

- Double-click the cell to make inline changes.

- Click once and use the Formula Bar (above the worksheet grid) to edit longer text or complex formulas.

Selecting Data

After entering data, a common practice is to begin formatting the data. However, before a user can format the data, they must first select the data. Selecting data has multiple techniques based on user intent. Clicking on a single cell makes that cell the active cell. The cell reference appears in the Name box to the left of the formula bar. To select an entire column of data, just click the column letter heading. To select an entire row, click the row number heading. If a user wants to select several cells adjacent to each other, this would be considered selecting contiguous cells. Clicking the middle of the cell and dragging horizontally or vertically will select a **contiguous** range of cells. Another way to select a contiguous range of sequential cells is to click the first cell, hold down the Shift key, and click the last cell in the range. For example, clicking cell A3, and then holding down the Shift key and selecting F7 would select all of the cells from A3 through F7. The range reference would be written as A3:F7.

	A	B	C	D	E	F	G
1	Little Lizzie's Girl Scout Cookie Sales						
2							
3	Date	Thin Mints	Chocolate /Peanut Butter	Carmel D'Lites	Peanut Butter Sandwich	Sales $$	
4	1-Feb	13	10	8	3	$136	
5	2-Feb	11	18	13	7	$196	
6	3-Feb	12	19	8	4	$172	
7	4-Feb	13	18	4	4	$156	
8	5-Feb	15	11	7	3	$144	
9	6-Feb	8	9	2	5	$96	
10	7-Feb	2	3	0	2	$28	

Contiguous Range

Selecting a non-contiguous range of cells requires the use of the Ctrl key. To select **non-contiguous cells**, click the first cell, hold down the Ctrl key, and click each additional cell. This practice is sometimes referred to as “cherry-picking” cells. In the example below, the selected range of cells are A4,A6,A7,F4,F6,F7. This practice can be used for selecting non-adjacent rows or columns as well.

	A	B	C	D	E	F
1	Little Lizzie's Girl Scout Cookie Sales					
2						
3	Date	Thin Mints	Chocolate /Peanut Butter	Carmel D'Lites	Peanut Butter Sandwich	Sales $$
4	1-Feb	13	10	8	3	$136
5	2-Feb	11	18	13	7	$196
6	3-Feb	12	19	8	4	$172
7	4-Feb	13	18	4	4	$156
8	5-Feb	15	11	7	3	$144
9	6-Feb	8	9	2	5	$96

Non-Contiguous cells

To select the entire worksheet, click the triangle box located to the left of column A and above row 1, or by pressing the keyboard shortcut: Ctrl+A.

Sorting Data

Worksheets can have large amounts of data, and it can be overwhelming if it is not sorted correctly. Arranging data in a specified order is called **sorting**. Rows can be sorted in either ascending (low to high) or descending (high to low) order. Ascending order can also be considered *alphabetic* order if the data is text or *chronological* order if the data is dates or times.

Before data can be sorted, Excel needs to know the exact range of cells that is to be sorted. Excel will select areas of related data as long as there are no blank rows or columns in the data range. Blank rows and columns define the outer limits of the data range. To ensure that the correct data is selected, highlight the range before starting the sort.

As Excel determines the defined range of data to be sorted, Excel also determines if field names exist. Users should format the first row of the data range with unique formatting Often, just making the labels bold will help Excel identify the field names. Identifying the field names will prevent Excel from including these fields in the records to be sorted. The field names become the sort keys needed for multiple column sorts. In the image below, the possible sort keys are: Cruise Date, Accommodation Category, Rooms Available, Rooms Rented, Rate, Revenue and Shortfall.

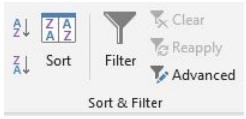


Alaskan Insider Cruises

July Revenue by Accommodation Category

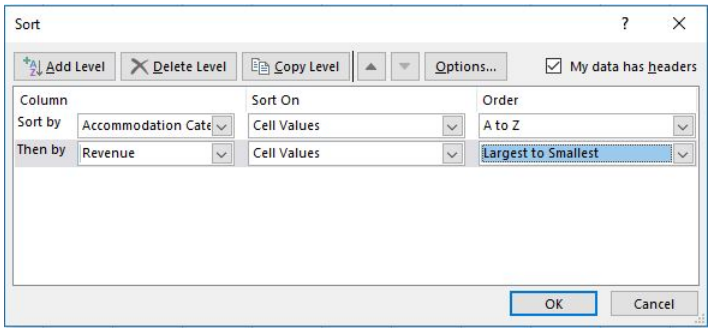
Cruise Date	Accommodation Category	Rooms Available	Rooms Rented	Rate	Revenue	Shortfall
July 5, 2019	Balconies	60	35	$ 5,000	$ 175,000	$ 125,000
July 12, 2019	Balconies	60	45	$ 5,600	$ 252,000	$ 84,000
July 19, 2019	Balconies	60	45	$ 6,000	$ 270,000	$ 90,000
July 26, 2019	Balconies	60	58	$ 6,000	$ 348,000	$ 12,000
July 5, 2019	Inside	50	30	$ 2,500	$ 75,000	$ 50,000
July 12, 2019	Inside	50	50	$ 2,500	$ 125,000	$ -
July 19, 2019	Inside	50	32	$ 3,000	$ 96,000	$ 54,000
July 26, 2019	Inside	50	48	$ 3,000	$ 144,000	$ 6,000
July 5, 2019	Outside Level 1	80	60	$ 4,500	$ 270,000	$ 90,000
July 12, 2019	Outside Level 1	80	72	$ 5,025	$ 361,800	$ 40,200
July 19, 2019	Outside Level 1	80	70	$ 5,375	$ 376,250	$ 53,750
July 26, 2019	Outside Level 1	80	80	$ 5,225	$ 418,000	$ -
July 5, 2019	Outside Level 2	90	75	$ 4,300	$ 322,500	$ 64,500
July 12, 2019	Outside Level 2	90	66	$ 4,800	$ 316,800	$ 115,200
July 19, 2019	Outside Level 2	90	82	$ 5,000	$ 410,000	$ 40,000
July 26, 2019	Outside Level 2	90	89	$ 5,000	$ 445,000	$ 5,000
July 5, 2019	Outside Level 3	100	80	$ 4,000	$ 320,000	$ 80,000
July 12, 2019	Outside Level 3	100	89	$ 4,450	$ 396,050	$ 48,950
July 19, 2019	Outside Level 3	100	78	$ 4,850	$ 378,300	$ 106,700
July 26, 2019	Outside Level 3	100	92	$ 4,750	$ 437,000	$ 38,000
July 5, 2019	Penthouse	3	1	$ 6,000	$ 6,000	$ 12,000
July 12, 2019	Penthouse	3	2	$ 7,000	$ 14,000	$ 7,000
July 19, 2019	Penthouse	3	2	$ 8,000	$ 16,000	$ 8,000
July 26, 2019	Penthouse	3	3	$ 7,500	$ 22,500	$ -

Sort Data Range

The data range above is already sorted in ascending order by the Accommodation Category key field. A single column sort is quite easy. Simply click any cell in the column that represents the key sort. In the above example, any cell from B4 to B28 would be acceptable. Then, click the the A-Z option 

in the Sort & Filter group of the Data tab. The entire row is sorted because each row is a record that should stay grouped together. Be careful NOT to select a single column of data or the records may not be kept together. Excel will warn the user with a warning message. If the user chooses to Continue with the current selection, only the data in the column with change their order, while the data in the other columns remain unchanged. This will most likely destroy the integrity of the data.

Advanced sorting involves multiple key fields from multiple columns. A multi-level sort can be set up by clicking the Sort button from Sort & Filter group from the Data tab (or the Sort & Filter button from the Editing group of the Home tab and choose Custom Sort) to open the Sort dialog window. The first sort criteria, also known as the primary sort, was previously defined to sort by Accommodation Category in ascending order.



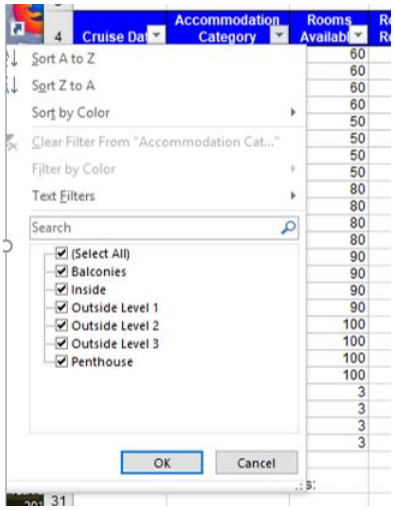
Multi-level sort Excel

To add a second level, also known as a secondary sort, click the Add Level button. After entering additional sort criteria, additional levels can be added. As shown in the graphic to the right, secondary criteria has been added to sort in descending order by Revenue. The data in column B will not appear to change, but the records will reorder. Compare the results below with the table above.

4	Cruise Date	Accommodation Category	Rooms Available	Rooms Rented	Rate	Revenue	Shortfall
5	July 26, 2019	Balconies	60	58	$ 6,000	$ 348,000	$ 12,000
6	July 19, 2019	Balconies	60	45	$ 6,000	$ 270,000	$ 90,000
7	July 12, 2019	Balconies	60	45	$ 5,600	$ 252,000	$ 84,000
8	July 5, 2019	Balconies	60	35	$ 5,000	$ 175,000	$ 125,000
9	July 26, 2019	Inside	50	48	$ 3,000	$ 144,000	$ 6,000
10	July 12, 2019	Inside	50	50	$ 2,500	$ 125,000	$ -
11	July 19, 2019	Inside	50	32	$ 3,000	$ 96,000	$ 54,000
12	July 5, 2019	Inside	50	30	$ 2,500	$ 75,000	$ 50,000
13	July 26, 2019	Outside Level 1	80	80	$ 5,225	$ 418,000	$ -
14	July 19, 2019	Outside Level 1	80	70	$ 5,375	$ 376,250	$ 53,750
15	July 12, 2019	Outside Level 1	80	72	$ 5,025	$ 361,800	$ 40,200
16	July 5, 2019	Outside Level 1	80	60	$ 4,500	$ 270,000	$ 90,000
17	July 26, 2019	Outside Level 2	90	89	$ 5,000	$ 445,000	$ 5,000
18	July 19, 2019	Outside Level 2	90	82	$ 5,000	$ 410,000	$ 40,000
19	July 5, 2019	Outside Level 2	90	75	$ 4,300	$ 322,500	$ 64,500
20	July 12, 2019	Outside Level 2	90	66	$ 4,800	$ 316,800	$ 115,200
21	July 26, 2019	Outside Level 3	100	92	$ 4,750	$ 437,000	$ 38,000
22	July 12, 2019	Outside Level 3	100	89	$ 4,450	$ 396,050	$ 48,950
23	July 19, 2019	Outside Level 3	100	78	$ 4,850	$ 378,300	$ 106,700
24	July 5, 2019	Outside Level 3	100	80	$ 4,000	$ 320,000	$ 80,000
25	July 26, 2019	Penthouse	3	3	$ 7,500	$ 22,500	$ -
26	July 19, 2019	Penthouse	3	2	$ 8,000	$ 16,000	$ 8,000
27	July 12, 2019	Penthouse	3	2	$ 7,000	$ 14,000	$ 7,000
28	July 5, 2019	Penthouse	3	1	$ 6,000	$ 6,000	$ 12,000

Secondary Sort

An Excel **filter**, also known as an AutoFilter, is used to display only the data that meet specific criteria. Data that does not meet the criteria is hidden from view. Excel's basic filter functionality allows users to filter rows by value, by format and by criteria. Filters can reduce a large, complex worksheet of data into meaningful information. With filtering, you can control not only what you want to see, but what you want to exclude. Users can filter based on choices they make from a list, or they can create specific filters to focus on exactly the data that they want to see.



Applied Filter

Clicking the filter button from the Data tab will add drop-down arrows to the column headers in a range of data. Clicking a drop-down arrow provides sorting and filtering options, like filter by color or text filters. A simple AutoFilter will be signified by the clearing of check boxes of the data that should be hidden. After applying a filter, a user can copy, edit, chart or print only visible rows without rearranging the entire list. Like sorting, filters can be applied to multiple columns to further reduce the results that are displayed.

A column that has been filtered will have its drop-down arrow icon switch from an upside-down triangle to a filter icon, as shown highlighted in yellow below. Only the cruises from the Penthouse accommodation category will be displayed after clearing all check boxes except the Penthouse category.

Cruise Da	Accommodation Category	Rooms Availabl	Rooms Rente	Rate	Revenue	Shortfall
July 26, 2019	Penthouse	3	3	$ 7,500	$ 22,500	$ -
July 19, 2019	Penthouse	3	2	$ 8,000	$ 16,000	$ 8,000
July 12, 2019	Penthouse	3	2	$ 7,000	$ 14,000	$ 7,000
July 5, 2019	Penthouse	3	1	$ 6,000	$ 6,000	$ 12,000

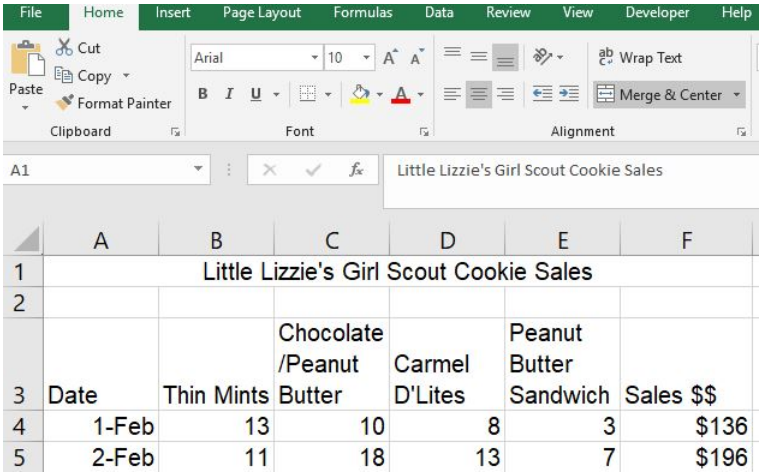
Applied Filter example

To remove a single filter, click the filter icon in the row header and choose Clear Filter from…. To clear all filters quickly, choose the Clear button from the Data tab on the ribbon or to remove filtering functionality, re-click the Filter icon from the Sort & Filter group. For more advanced users there are many more ways to utilize filters in Excel, such as Custom Filters and Advanced Filters. Nonetheless, a lot can be accomplished with the basic AutoFilter feature.

Formatting Data and Worksheets

Formatting data generally makes it easier to comprehend, and more attractive. The goal of formatting a business spreadsheet should be to make it look professional, accurate, and understandable. Options to format worksheet data depends a lot on the type of data. Formatting text in Excel is very similar to formatting text in Word. Using the Font and Alignment group icons on the Home tab of the ribbon, users can manually format all of the data in a cell or in a range of cells. Changing default formats includes things like changing the font color, style, size, text alignment in a cell, or apply formatting effects – all in an effort to make the data appear more visible.

Excel's tabular layout (organized into labeled columns and numbered rows) sometimes limits the amount of data that can be efficiently displayed.



	A	B	C	D	E	F
1	Little Lizzie's Girl Scout Cookie Sales					
2						
3	Date	Thin Mints	Chocolate /Peanut Butter	Carmel D'Lites	Peanut Butter Sandwich	Sales $$
4	1-Feb	13	10	8	3	$136
5	2-Feb	11	18	13	7	$196

Alignment of data

Using the Alignment group options can help format data to make it appear as much like a word processed report as possible. In the screenshot above, two Excel-unique formatting features help make the data more readable. In row 1, the text has been merged and centered across cells A1:F1. This required the cell range A1:F1 be selected before clicking the **Merge & Center** button from the Alignment group. This is very popular for worksheet titles. If the wrong cell range was selected and the Merge & Center is not effective, the user must re-select the Merge & Center button to unmerge the data, so the correct range can be selected before again clicking the Merge & Center button.

Another popular Excel text-formatting feature illustrated above is the **Wrap Text** tool, which will prevent text from being truncated by wrapping the text into multiple rows within the same cell. If a cell has a lot of text, the data will overlap into the next cell to the right of the active cell. However, if the adjacent cell already has data, the text will be truncated (cut-off) without applying this feature. Cells C3:E3 in the above screenshot each have the Wrap Text feature applied.

While Excel has some pretty useful text-formatting functionality, the majority of data entered into Excel is usually numerical data. Therefore, utilizing Excel's number formats effectively is crucial to make the worksheet as professional as possible. Professional formatting relies a lot on consistent formatting. Therefore, using the Format Painter tool (introduced in the Word chapters) and

workbook themes are very helpful to maintain that consistency. Changing the existing **theme** will dynamically update the appearance of all worksheets in a workbook by modifying the fonts, styles, colors and/or effects.

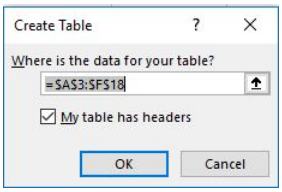
Applying the correct cell format to numerical data is more than just style – it is substance too, because applying the wrong format can impact how other, related cell results are interpreted. The following graphic describes some of the more popular number formats. In addition to the examples provided, there are also other formats, including date & time values, which can be accessed by clicking the Number Format drop-down list.

	A	B	C	D	E	F	G	H	I	J
1	Number Formats									
2	**Format Name**	**Example**	**Ribbon Icon**	**Description**						
3	General	7500		Default format; displays the numbers the way they were typed.						
4	Number	7500.00		Displays the number with two decimal places.						
5	Currency	$7,500.00		Displays the number with a currency symbol and two decimals.						
6	Accounting	$ 7,500.00	$	Similar to Currency format except the currency symbol left aligns.						
7	Percentage	750000.00%	%	Displays the number as a percentage and two decimals.						
8	Comma	7,500.00	,	Displays the number with two decimal places.						

Number Formats

Changing the number of decimals displayed can be manipulated by the Increase Decimal and Decrease Decimal buttons in the Number group. The displayed value could change to a rounded value, however, the actual value stored in the cell has not changed unless a ROUND function has been applied. Formatting only affects how the value is displayed. Applying formats can result in number signs (#####) being displayed in a cell. This is not an error, but an indication that the cell width is not wide enough to display the formatted number.

Excel data can also be formatted as a table. A **table** is a collection of related data, organized into a tabular layout of rows and columns, that can be manipulated via sorting, filtering and formulas. To create a table, select the data and click Insert > Table from the ribbon to open the Create Table dialog window.



Create table

Applying a table style will format the table with a predefined set of special table properties that includes options to define a header row or total row, and to band the row and/or columns to make the data easier to read. The filter buttons can also be removed. If the table functionality is no longer desired, click the Convert to Range option in the Tools group of the Design tab to convert the table to a normal range.

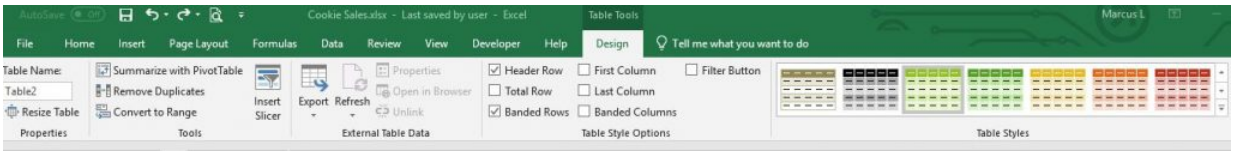


Table Tools Design tab

	A	B	C	D	E	F
1	Little Lizzie's Girl Scout Cookie Sales					
2						
3	Date	Thin Mints	Chocolate/ Peanut Butter	Carmel D'Lites	Peanut Butter Sandwich	Sales $$
4	1-Feb	13	10	8	3	$136
5	2-Feb	11	18	13	7	$196
6	3-Feb	12	19	8	4	$172
7	4-Feb	13	18	4	4	$156
8	5-Feb	15	11	7	3	$144
9	6-Feb	8	9	2	5	$96
10	7-Feb	2	3	0	2	$28

Table style Blue, Table Style Medium 16 with banded rows, a header row, and filter buttons.

There are many additional formatting tools available within Excel, but it is important to consider that sometimes, less is more! Too much formatting can be overkill and reduce the readability of a worksheet. Try to limit the use of multiple colors, fonts, and background colors/graphics. Format with a design purpose, not to entertain, and don't forget to use the Spell Check tool (F7) to proof your workbook before printing or sharing!

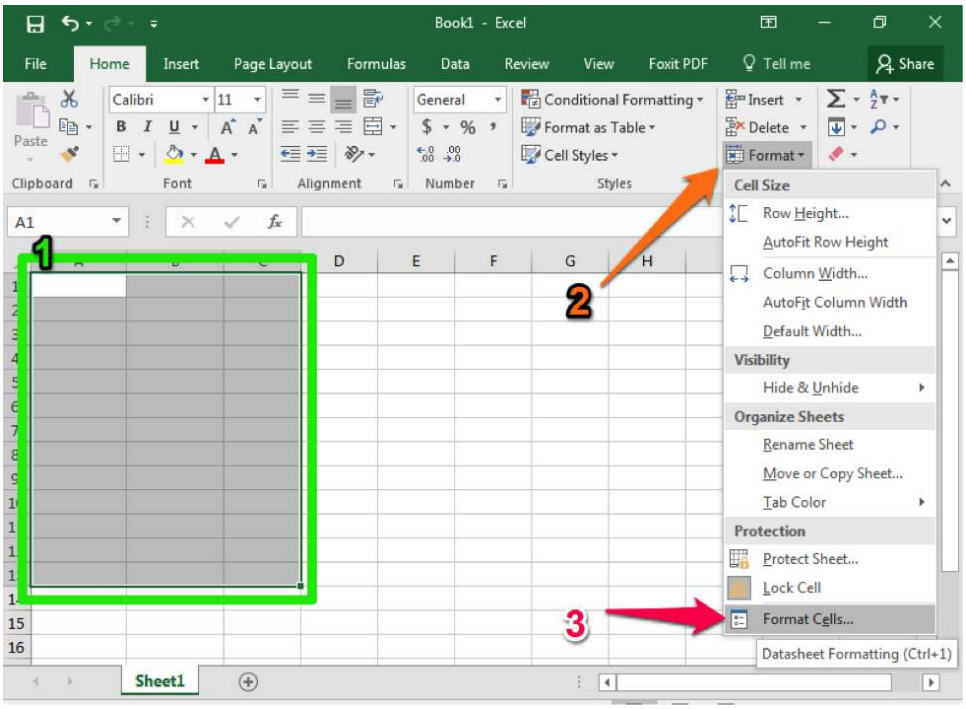
> Proper data formatting improves clarity and ensures data is interpreted correctly.

Cell Format

As mentioned previously, Excel will default to certain styles when you create a new worksheet. In particular, this includes the way that numbers are displayed and whether or not commas are automatically included. In this section, we will take a look at changing these defaults.

When you type numbers into an Excel workbook, it will often default to a specific format. For example, if you type "12/15/17," Excel will convert this to read "12/15/2017," assuming you were entering month, day, and abbreviated year. Similarly, "3/4" will display at "4-Mar," the fourth day of March. However, it is possible that you may have been entering fractions, so "3/4" was meant to indicate three-quarters instead.

If this is the case, you will need to format your cells to properly display the information you are entering. When possible, consider formatting your cells before you enter the data. Otherwise, Excel may convert some of the entries and you will need to re-enter that information.



1. Begin by highlighting the cells you plan to use.
2. Select the Format dropdown from the Cells group of the ribbon.
3. Select the Format cells option at the bottom of the dropdown menu.

Number Group

The Home tab → Number group provides built-in number formats:

- Currency and Accounting for financial data.
- Percentage for ratios or growth rates.
- Date/Time for schedules and timelines.
- Comma Style to add thousand separators for large numbers.

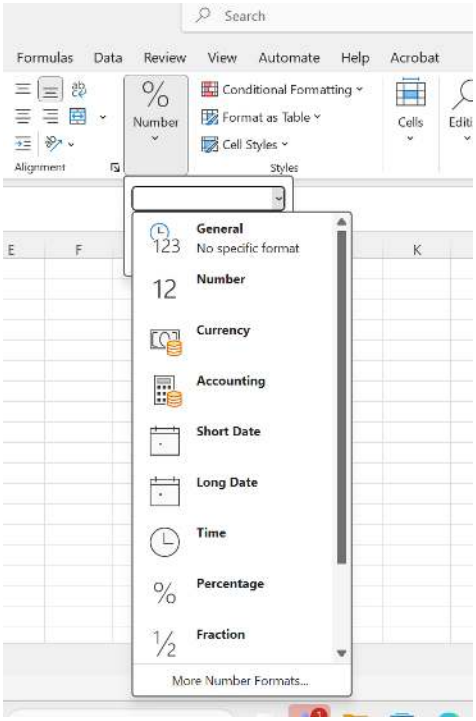
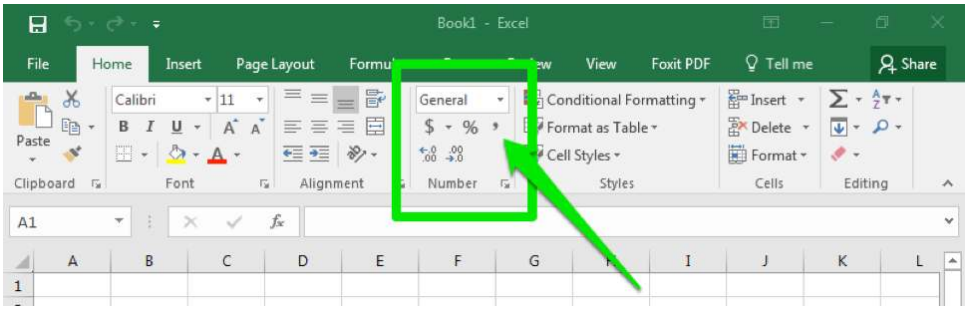


Figure 1.5.1: Number formatting expanded

Comma Styles

At times, you may also wish to use a specific comma style with numbers entered into an Excel worksheet. For example, you may wish “1234” to display as typed or with a comma like “1,234.”

Comma styles are easy to change in Excel using a quick select option in the Number group in the ribbon. Simply to click on the Comma Style button in the Number group.



When clicking the comma style button, the comma style default is to display numbers with a comma in the thousands place and include two decimal places (Ex: “1200” becomes “1,200.00). This will also change the visible cell styles in the Style” area of the ribbon so you can easily select different options for comma and display format.

Listed below are the three most common options for comma and display format.

1. **Comma**: Comma with two decimal points (e.g., 1,234.00)
2. **Comma [0]**: Comma with no decimal points (e.g., 1,234)
3. **Currency**: Comma with two decimal points and a dollar sign (e.g., $1,234.00)

Font and Alignment Group

The Font and Alignment groups allow you to highlight categories and improve readability:

- Use bold, italics, and colors to emphasize headers or totals.

- Increase font size or apply fill color to distinguish sections.
- Align text left, center, or right for professional layout consistency.

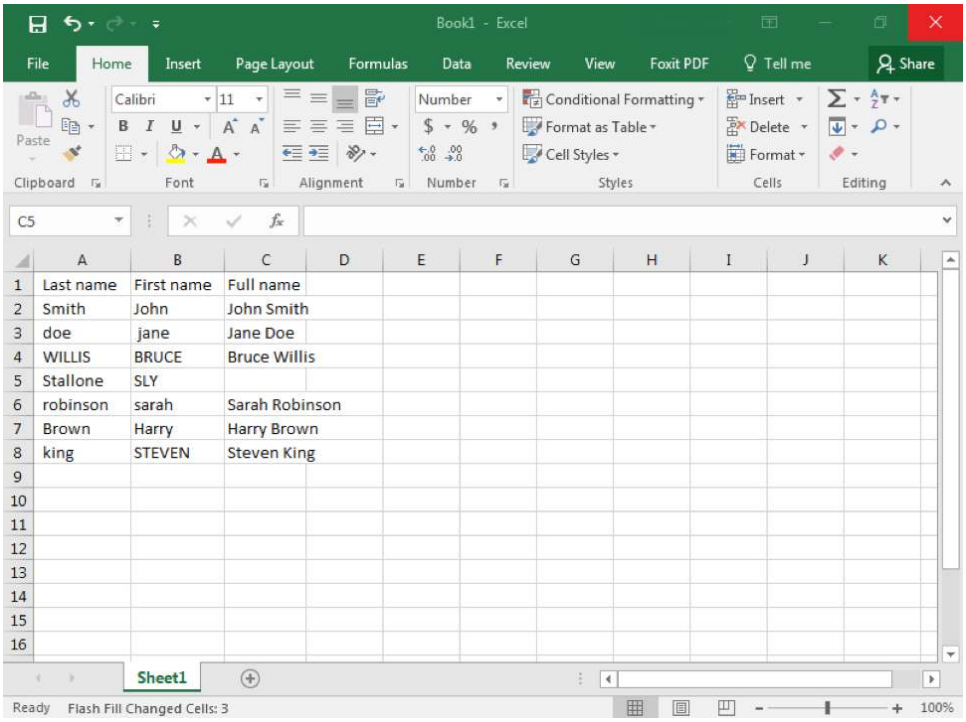
For repetitive data tasks, Excel offers tools that save time:

- AutoFill: Select a cell with “January,” drag the fill handle, and Excel continues the series (February, March…). The same applies for number sequences.
- Copy/Paste: Use Ctrl+C / Ctrl+V to duplicate content. With Paste Special, you can paste just values, formats, formulas, or column widths—extremely useful when working with templates.

Flash Fill

Like many modern software programs, Excel is designed to recognize certain patterns. For example, perhaps you are creating a table that lists the last and first names of attendees at a company training session. After all the names have been entered into two separate columns, you realize you would like a single column to correctly display the full name. An easy way to achieve this without having to manually retype the entire list is to use Flash Fill.

1. Create a new column for the combined information you wish to display.
2. In the first cell, type the name as you wish it to display. In our screenshots, this would be “John Smith.”
3. Begin typing the next piece of data in the next cell. Excel should automatically suggest a Flash Fill option.
4. If the Flash Fill suggestion matches how you would like the information displayed, simply hit the Enter key and the rest of your column should fill in automatically.



Flash Fill is especially helpful if your data is initially in different forms but you want the final information to display in the same fashion. For example, in our attendee list, some of the names were capitalized, in all caps, or had no capitalization. Sometimes you may need to manually update more than one option but Excel will detect your pattern.

Flash Fill should automatically be turned on in Excel but if it is not, you can turn it on using the File > Options > Advanced menus. You can also turn Flash Fill on or off using the shortcut Ctrl+E. **Be aware that the Mac version of Excel does not have Flash Fill.

> By combining clean entry practices with clear formatting, you ensure your worksheets are both accurate and visually professional.

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1.1.9: Microsoft Excel Calculations and Formulas

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Create basic formulas
- Add numbers in Excel using a formula or function
- Subtract numbers in Excel using a formula or function
- Multiply numbers in Excel using a formula or function
- Divide numbers in Excel using a formula or function

At WorldCorp, you manage several account teams, each of which has a sales team. Part of your job is to compare the sales agents' revenues using some basic data analysis, which you can extend to other applications in your job. To assess the performance of the agents and the sales team, you will need to create some basic formulas. These formulas could include the total sales during a specific time period by agent or the average sales per time period for the whole team. These values can then be used to put together a report of the performance of your entire team. Upper management compiles the reports from all the teams to summarize the company's performance. Using basic formulas in Microsoft Excel expedites the process and helps management to uniformly analyze the information.

Setting Up Basic Formulas

Now that you have learned how to set up a table or spreadsheet, you can perform calculations on the data. First, select the cell where you want the calculation to appear. Use the Formula Bar located below the ribbon to type in the formula or function, starting with the "=" sign (Figure 9.17).

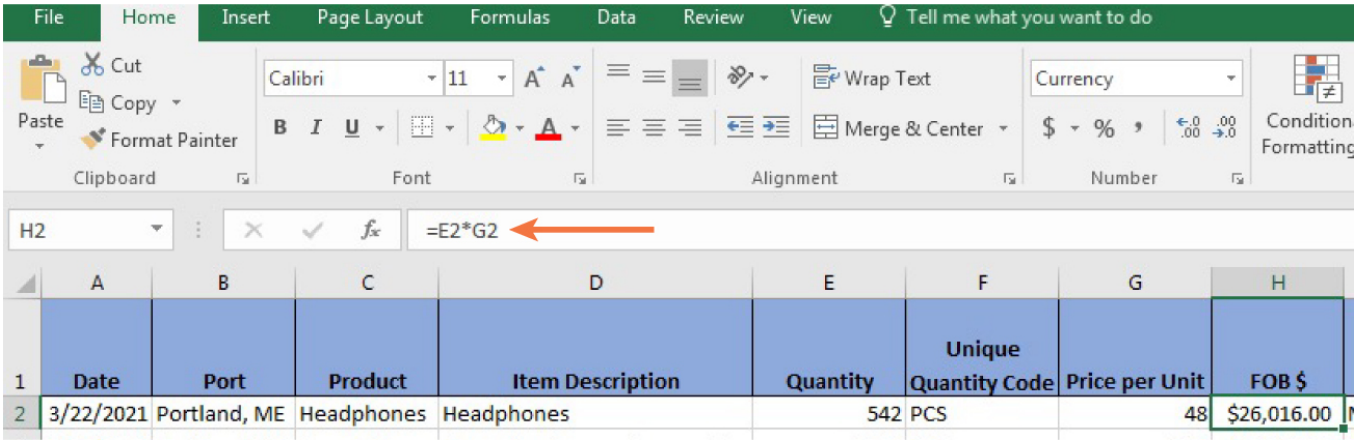
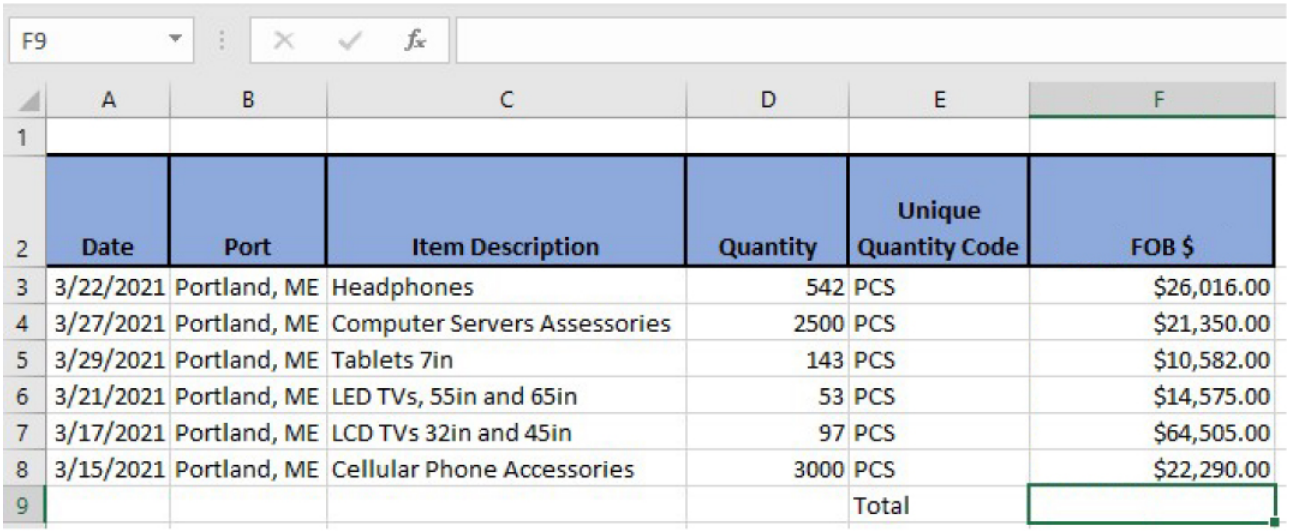


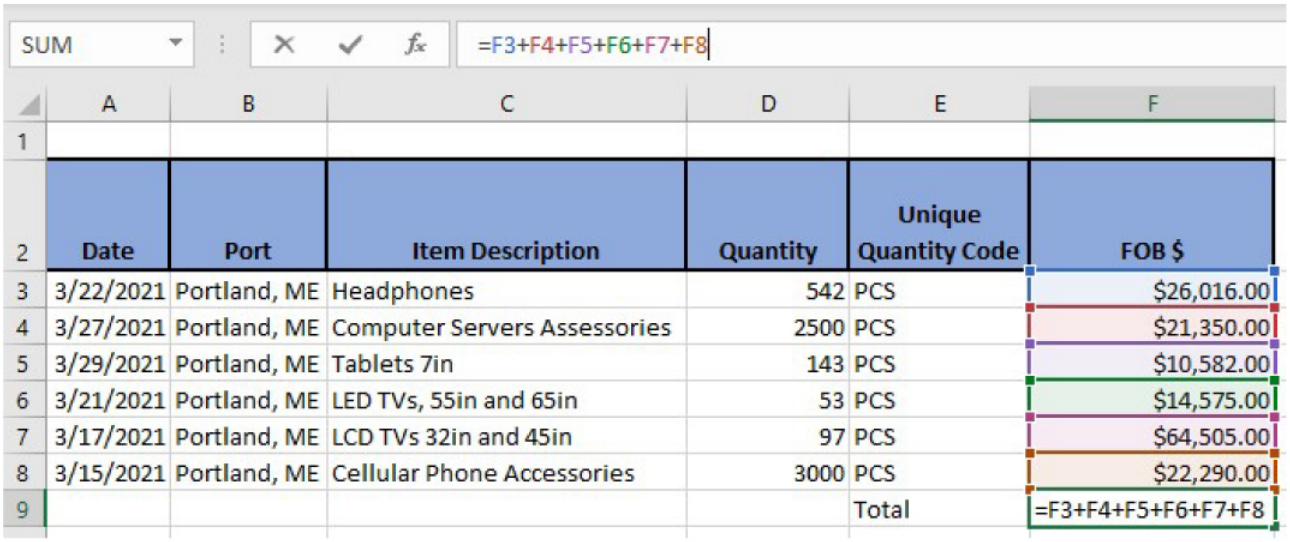
Figure 9.17: Formulas must begin with the "=" sign and contain mathematical operators (i.e., +, -, *, /). (Used with permission from Microsoft)

Adding Numbers

You have learned the two ways to add quantities in Excel: formulas and functions. We can use WorldCorp's sales data to illustrate how to add numbers. Figure 9.18a contains a set of sales data, with a row at the bottom for the total of all the sales but with the total amount missing. To fill in this empty cell, first, type "=" to open the calculation procedure. Then, click on the first cell you want to add, type a "+" sign, then click on the next cell in the column. Continue this process until all the cells you want to add are included. Figure 9.18b shows the finished formula that includes all the cells in the columns. Notice that Excel adds colors to the cells to help you follow the formulas.



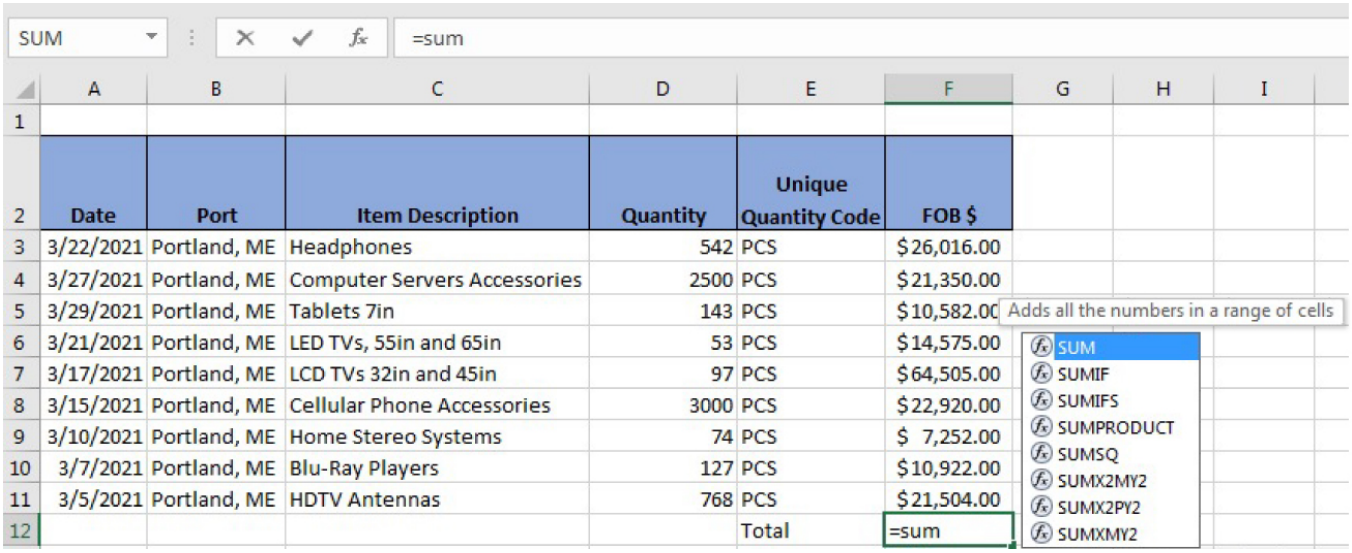
(a)



(b)

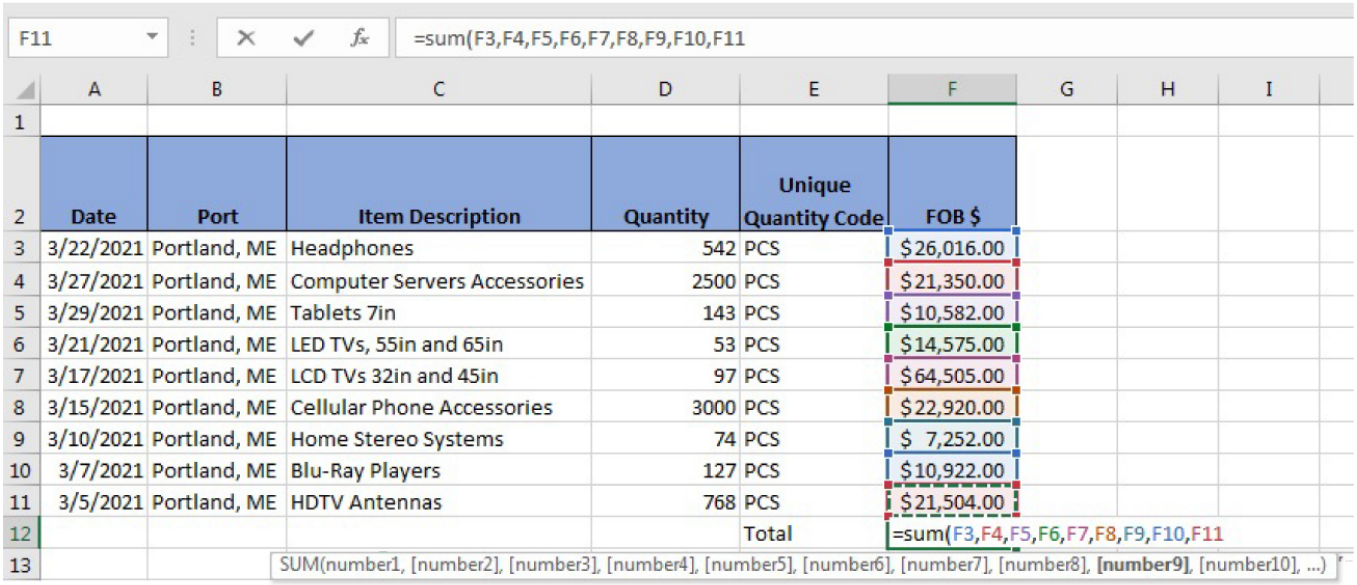
Figure 9.18: You can use a formula to find the sum of a set of cells. (a) The table has a cell for the total sales. First, type an "=" sign, then use the cell references or click on the cells and a plus sign to construct the formula. (b) The finished formula shows all of the cells referenced. (Used with permission from Microsoft)

When you have a small set of data, or when the numbers you are adding using the "+" operator are not all in one row or column, using an addition formula may be the best way to find your sum. However, Excel has built-in shortcuts, such as the SUM function. Functions can often save you time over performing the same calculations using formulas. Like formulas, functions must begin with an equals sign, but rather than using cell references to build an equation, you type the function name, in this case, SUM (Figure 9.19). Then, type an open parenthesis, insert the cell references, separated by commas, and then close the parentheses. You can click on each cell individually or type its cell reference, as in Figure 9.20, but you'll notice that this method does not save time because you are still entering or clicking each cell reference. Functions allow users to reference individual cells, but they also allow us to choose multiple cells at the same time, which does save time. To select a range of cells, which is a group of cells that are contiguous, you can type in the function and opening parenthesis, and then highlight the cells you want to add. You can also type in the range, separating the first cell and the last cell with a colon. Figure 9.21 shows the range as F3:F11. Functions are often faster to type than formulas, but sometimes you will need to use both formulas and functions to perform complex calculations.



	A	B	C	D	E	F	G	H	I
1									
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $			
3	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00			
4	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00			
5	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00			
6	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00			
7	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00			
8	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00			
9	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00			
10	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00			
11	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00			
12					Total	=sum			

Figure 9.19: Functions are time-saving methods for performing calculations on data. To find the sum of a range of cells, type the equals sign and "SUM." (Used with permission from Microsoft)



	A	B	C	D	E	F	G	H	I
1									
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $			
3	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00			
4	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00			
5	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00			
6	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00			
7	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00			
8	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00			
9	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00			
10	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00			
11	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00			
12					Total	=sum(F3,F4,F5,F6,F7,F8,F9,F10,F11			
13									

Figure 9.20: Then, choose the cells you want to include. (Used with permission from Microsoft)

https://workforce.libretexts.org/@go/page/56259

SUM =sum(f3:f11

	A	B	C	D	E	F	G	H
1								
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $		
3	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00		
4	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00		
5	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00		
6	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00		
7	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00		
8	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00		
9	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00		
10	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00		
11	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00		
12					Total	=sum(f3:f11		
13						SUM(**number1**, [number2], ...)		

Figure 9.21: Using a range, rather than listing individual cells, can save you time. (Used with permission from Microsoft)

Link to Learning

The Formula Builder is a tool in Excel that can help you create a function based on your data and your needs. Read the tutorial on the SUM function to learn how to use the Formula Builder.

Subtracting Numbers

Understanding how to add numbers in Excel makes subtracting them rather intuitive. If you wanted to subtract many cells in a column, you could type out a long subtraction equation, starting with the equals sign and using cell references and the hyphen key, for example, "=F3-F4-F5-F6-F7-F8-F9-F10-F11." Using a new set of data, you can see in Figure 9.22 that the margin is the price minus the cost. You can carry this formula down the rows in the same column.

D4 =B4-C4

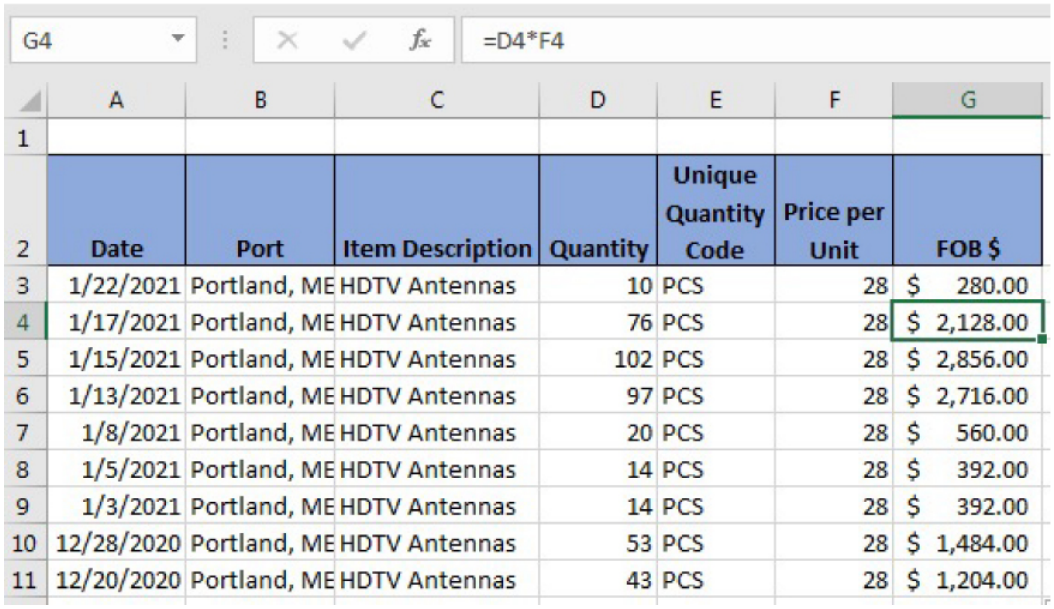
	A	B	C	D	E	F
1						
2						
3	Model	Price	Cost	Margin	Volume Sold	Marginal Profit
4	32" LCD #E-900s	$ 170.00	85.00	85.00	8752	$ 743,920.00
5	45" LCD #E-900m	$ 380.00	183.20	196.80	10563	$ 2,078,798.40
6	55" LED #E-900l	$ 550.00	253.70	296.30	9543	$ 2,827,590.90
7	65" LED #E-900xl	$ 780.00	343.20	436.80	4326	$ 1,889,596.80
8				Total		$ 7,539,906.10

Figure 9.22: Subtraction in Excel uses formulas that are similar to addition formulas, but there is no subtraction function. (Used with permission from Microsoft)

Multiplying Numbers

With multiplication, formulas and functions start getting more complicated. Sometimes, you may need to multiply the values of two or more cells, and other times, you may need to multiply a cell value by a constant value such as a percentage. One may be more efficient than the other, depending on the data. In Figure 9.23, the price per unit is the same for every row, so you can use cell

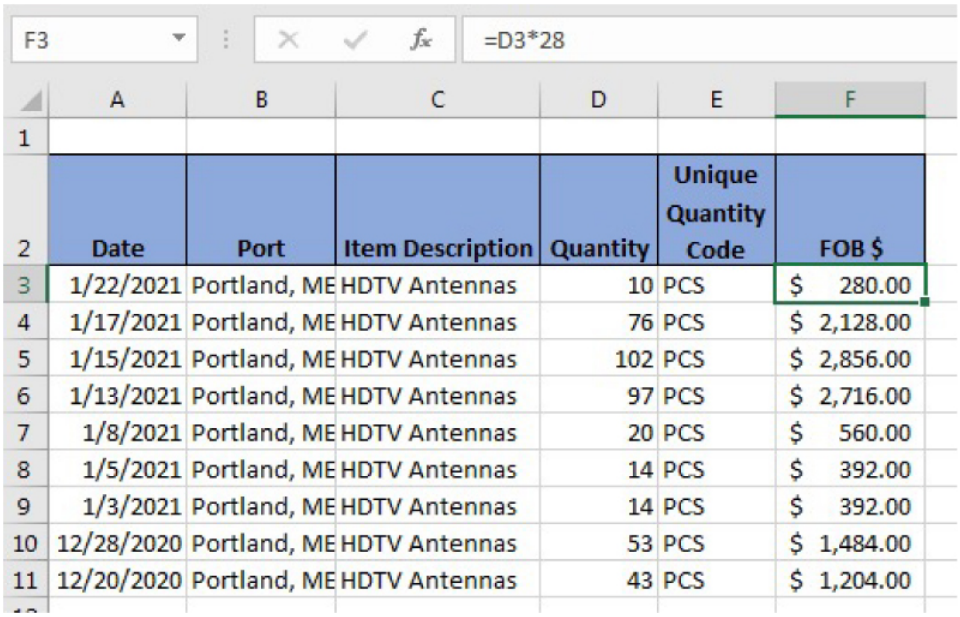
references to multiply the quantity cell by the price-per-unit cell. Because this table contains only one product, the unit price does not change, and it can be tedious to enter the same price for each sale. You can enter the price per unit in the first row and then click and drag the value to the bottom of your table. Another method would be to simplify your table by eliminating the price-per-unit column and including the value in the formula Figure 9.24. Condensing a table in this manner is helpful, especially if you have a large table of data. To construct a multiplication formula, start with an equals sign and use an asterisk (*) as the mathematical operator.



G4 =D4*F4

	A	B	C	D	E	F	G
1							
2	Date	Port	Item Description	Quantity	Unique Quantity Code	Price per Unit	FOB $
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	28	$ 280.00
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	28	$ 2,128.00
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	28	$ 2,856.00
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	28	$ 2,716.00
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	28	$ 560.00
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	28	$ 392.00
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	28	$ 392.00
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	28	$ 1,484.00
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	28	$ 1,204.00

Figure 9.23: For multiplication, use cell references to construct formulas. (Used with permission from Microsoft)



F3 =D3*28

	A	B	C	D	E	F
1						
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	$ 280.00
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	$ 2,128.00
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	$ 2,856.00
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	$ 2,716.00
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	$ 560.00
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	$ 1,484.00
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	$ 1,204.00

Figure 9.24: You can also use constants to construct formulas. (Used with permission from Microsoft)

For multiplication, you can also use the PRODUCT function. Figure 9.25 shows an example of the function syntax. When you have entered all of the cell references, close the parentheses, and the product will be the same as it would if you had used a formula.

G3 =PRODUCT(D3,F3)

	A	B	C	D	E	F	G
1							
2	Date	Port	Item Description	Quantity	Unique Quantity Code	Price per Unit	FOB $
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	28	$ 280.00
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	28	$ 2,128.00
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	28	$ 2,856.00
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	28	$ 2,716.00
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	28	$ 560.00
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	28	$ 392.00
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	28	$ 392.00
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	28	$ 1,484.00
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	28	$ 1,204.00

Figure 9.25: You can use the PRODUCT function for multiplication. (Used with permission from Microsoft)

Dividing Numbers

Division calculations use the operator "/" and follow a similar syntax as other basic mathematical formulas. Figure 9.26a shows an example of division for determining increases or decreases in prices of aluminum. As you can see, the gain on 1/10/2021 was 2.36 percent. Excel does have a QUOTIENT function, but it returns only whole numbers, leaving off the decimal portion of the quotient (Figure 9.26b). It may be useful for some situations, but formulas provide more exact answers.

E4 =D4/C4

	A	B	C	D	E
1					
2	Aluminum Price Volatility				
3	Start Date	Price Open	Price Close	Difference	Percentage
4	1/10/2021	2243.97	2298.15	54.18	0.0236
5	1/11/2021	2231.22	2276.54	45.32	0.0199
6	1/12/2021	2219.77	2261.25	41.48	0.0183
7	1/13/2021	2225.65	2213.44	-12.21	-0.0055
8					

(a)

I7

	A	B	C	D	E
1					
2	Aluminum Price Volatility				
3	Start Date	Price Open	Price Close	Difference	Percentage
4	1/10/2021	2243.97	2298.15	54.18	2.36%
5	1/11/2021	2231.22	2276.54	45.32	1.99%
6	1/12/2021	2219.77	2261.25	41.48	1.83%
7	1/13/2021	2225.65	2213.44	-12.21	-0.55%
8					

(b)

Figure 9.26: The division formula uses a slash and returns (a) a quotient with decimal places, but you can format it to be (b) a percentage. (Used with permission from Microsoft)

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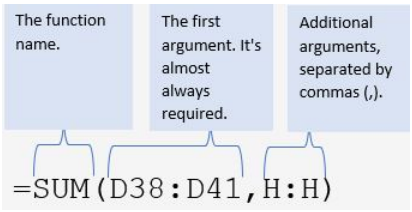
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1.1.10: Basics- Functions and Formulas

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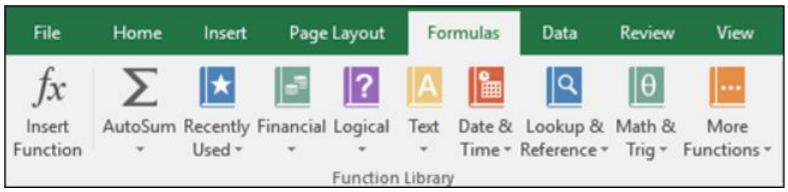
Functions

Excel contains over 400 built-in functions that can be included in a formula to perform common calculations. A **function** performs a calculation on data called arguments to compute a result. **Arguments** are variables or values the function requires and are contained within parenthesis, and usually consist of cell references, but can also contain constants, text, cell ranges, and even other functions! The syntax of a formula using a function is: *function name*(argument1, argument2, etc.)



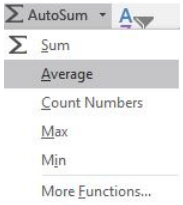
Sample function syntax

Functions can be typed with the help of a ScreenTip, or added from the Insert Function window, which can be opened by clicking the fx symbol found at the left of the formula bar, or at the left side of the Function Library found in the Formulas tab of the ribbon.



Function library

The most popular functions are also the easiest to comprehend, which might be correlated! Some of these most popular functions are easily accessible from the AutoSum button in the Editing group on the Home tab of the ribbon. Look for the Greek sigma symbol. This feature is invaluable when it comes to entering functions, especially for common calculations computed via the SUM, COUNT, AVERAGE, MAX or MIN functions.



AutoSum

There are multiple ways to utilize AutoSum, but the following procedure is probably the simplest. In the screenshot below, assume the desire is to total the number of boxes of Thin Mints cookies were sold the first 15 days of February. Make B19 the active cell (the destination cell), then click the AutoSum button. The defaulting SUM option will be inserted into the formula bar with a defaulting cell range (the source cells) inside parenthesis. The cell range that defaults appears on screen with a scrolling marquee surrounding the cell range. This range is usually correct, but not always. If Excel chooses the wrong range, simply type in the cell range, or use the mouse to re-select the correct range (pointing method), and then click the Enter check mark.

	A	B	C	D	E	F
1	Little Lizzie's Girl Scout Cookie Sales					
2						
3	Date	Thin Mints	Chocolate/Peanut Butter	Carmel D'Lites	Peanut Butter Sandwich	Sales $$
4	1-Feb	13	10	8	3	$136
5	2-Feb	11	18	13	7	$196
6	3-Feb	12	19	8	4	$172
7	4-Feb	13	18	4	4	$156
8	5-Feb	15	11	7	3	$144
9	6-Feb	8	9	2	5	$96
10	7-Feb	2	3	0	2	$28
11	8-Feb	0	0	0	0	$0
12	9-Feb	5	8	3	6	$88
13	10-Feb	1	0	0	1	$8
14	11-Feb	2	4	7	3	$64
15	12-Feb	9	6	1	2	$72
16	13-Feb	0	0	0	0	$0
17	14-Feb	0	0	0	0	$0
18	15-Feb	6	11	2	2	$84
19						
20						
21						
22						

AutoSum Example 1

The formula that defaults should be =SUM(B4:B18). Once this formula is submitted, the result, 97 will display. The intent of the **SUM** function is pretty self-explanatory. The **AVERAGE** function takes the SUM function one step further by dividing the sum of the values by the number of cells in the range. The **MIN** and **MAX** functions are used to find the smallest and largest values in a range of cells. These can be useful to identify outlier data that might skew the results. Each of these functions ignore cells that contain text or are empty. Alternatively, the **COUNT** function totals the number of cells that contain values. If a cell contains the value 0 (zero), it will be counted. However, if the cell is blank or contains the text zero, the cell will not be counted. This function is useful for determining the number of people who mark a checkbox in an Employee roster. For example, how many employees identify as a Veteran? Those who don't, wouldn't have a value, and therefore, would not be counted. If the desire if to count all cells that contain any data – use the **COUNTA** function.

Date and Time Functions

Excel can produce the current date and/or time, based on the computer's regional settings. Excel can also add and subtract dates and times. For example, it may be necessary to keep track of how many hours an employee worked each week, and calculate their pay and overtime. There are numerous Date and Time functions in Excel to help calculate the addition or difference between dates or times. Excel stores all date and time values as sequential serial numbers. For example, January 1, 1900 is represented by the serial number 1, and January 1, 2020 is represented by serial number 43831 because it is 43,831 days after January 1, 1900. To view the serial number of an existing date, format the date using the General Number format. The conversion of dates and times to serial numbers simplifies the process of using dates and times in calculations. The key to displaying the results of these calculations it using the appropriate Number format, which may require diving into the world of creating custom number formats to display only days, hour and/or minutes. For example, if only the number of years is desired to be displayed when calculating the difference between two dates, the Custom Number format should be yy.

Popular Excel Date and Time Functions	
Function & Syntax	**Usage**
=TODAY()	Returns the current computer system date. No arguments are necessary inside the parenthesis.
=NOW()	Returns the current computer system date and time. No arguments are necessary inside the parenthesis.
=DATE(year,month,day)	Returns a date, from a user-supplied year, month and day. Popular for birthdates, invoice dates or other static dates.
=DAYS(end_date,start_date)	Calculates the number of days between two dates. The arguments can be cell references or static values entered within quotation marks.

Date and Time functions

The TODAY and NOW functions are very similar since both return the current system date. However, the NOW function also returns the current system time. Many users format the results of the NOW function to only display the current system time. One

characteristic of these functions versus the DATE function is that TODAY and NOW are volatile functions, so if the workbook is opened tomorrow, these functions will update automatically, whereas the DATE function will not change. These functions are for use within the grid of the worksheet, typically to calculate durations. There are separate Date and Time fields for use in worksheet headers and footers.

Creating Formulas

Perhaps the biggest benefit of using Excel is its ability to create formulas that, when written correctly, can dynamically update when predecessor data is updated. Formulas are mathematical calculations using data in the existing workbook to calculate new values. All formulas in Excel must begin with an equal sign (=), and can contain cell references, ranges of cell references, arithmetic operators, and constants as part of the formula's **syntax**. Calculations in Excel follow normal math rules as it pertains to the order of operations rule. There are mnemonics available in various dialects to help decipher the order. The following graphics illustrate the order of operations rules and different formula syntax examples:

Order of Operations Rules		
American	**British**	**Canadian**
(P) Parenthesis	(B) Brackets	(B) Brackets
(E) Exponentiation	(O) Orders	(E) Exponentiation
(M) Multiplication	(D) Division	(D) Division
(D) Division	(M) Multiplication	(M) Multiplication
(A) Addition	(A) Addition	(A) Addition
(S) Subtraction	(S) Subtraction	(S) Subtraction

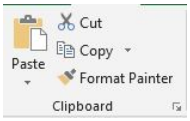
Formula Example	Description
=A4 + B4	Uses cell references and the plus sign mathematical operator.
= (A4 + B4) * 4	Uses cell references, parenthesis, a plus sign and multiplication symbol, as well as a constant value.
=SUM(A4:A11)	Uses a function and a cell range.

Formula Rules

Formulas typically reference values stored in other cells. For example, in the Accounting equation: Assets = Liabilities + Owner's Equity, one could calculate the Owner's Equity using a formula. Assume that the value for Total Assets resides in cell D30, and the value for Total Liabilities resides in D60. The formula for Owner's Equity in D65 using cell references would be =D30-D60. Using cell references is advantageous because if any of the cells that generate either the Total Assets or Total Liabilities is changed, the formulas in D30, D60 and D65 will also get updated. Another advantage is when a cell containing a formula is copied to another location, the formula will dynamically update to the new location's reference information. This is called **Relative Cell Referencing**. If the formulas in column D are copied to column E, the new formula for Owner's Equity in column E will be =E30-E60. Additionally, if rows are added or deleted in the range that the Total formulas reference, the formula will automatically update to the new formula range.

Entering the syntax for a formula can be accomplished through typing the formula components, using a **pointing** technique or a combination of both. The pointing method can help avoid typing errors. In the Owner's Equity example, the user would start by typing the equal sign, and then instead of typing D30, just click on D30. Continue by pressing the minus sign, and then click on cell D60, and the click the Enter check mark on the formula bar. Using the point method is even more practical when defining large cell ranges in formulas. Just make sure not to reference the active cell in the formula. This will likely create a **circular reference** error, which is a formula in a cell that directly or indirectly refers to its own cell.

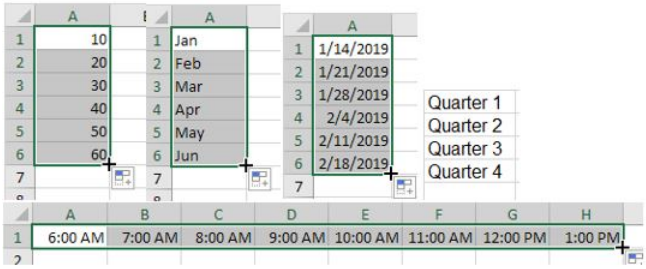
Copying and Pasting Formulas



Cut copy paste icons

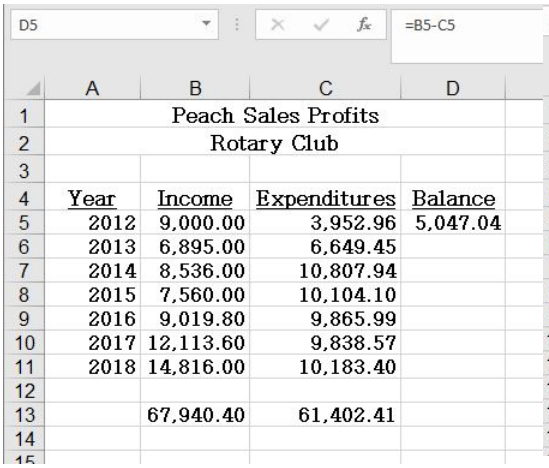
Data in Excel can be cut, copied and pasted using similar shortcut menu options, keyboard equivalents, and ribbon icon commands as seen in Microsoft Word. Following operating system file management principles, moving data is synonymous with using the "Cut" and "Paste" commands, while duplicating data is the same as using the "Copy" and "Paste" commands. Other terminology that should be recognized is "source", which is the cell or range to be moved or duplicated, and "destination", which is the upper-left cell in a worksheet where the data is to be pasted.

Copying and pasting formulas contain cell references is a very powerful feature, and to expedite this process, Excel has a nifty feature called **AutoFill.** The AutoFill procedure utilizes the **fill handle**, which is the solid, green square in the lower-right corner of the active cell or cell range. Clicking and dragging the fill handle to adjacent cells (horizontally or vertically) will copy and paste the contents and update the destination cells with relative cell references or sequential data aligned with built-in Custom Lists. This should save significant time, and likely improve accuracy, and AutoFill has many uses.

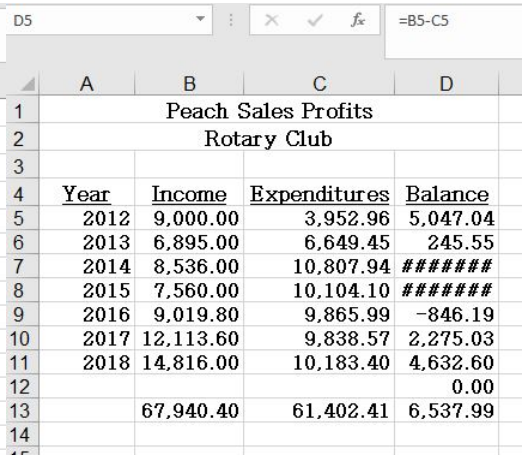


AutoFill Examples

Not only can AutoFill copy formulas, but it also be used to complete lists that have a recognizable pattern. It is helpful to select the source cells that demonstrate a pattern, then hover the mouse pointer over fill handle. The mouse pointer will change from the default pointer icon to a thin, black plus sign. The patterns can be numbers, dates, months, days of the week, etc. If AutoFill incorrectly guesses the series pattern, the AutoFill Options icon is available to change the paste actions. In the screenshots below, the fill handle in cell D5 will by copied to cells D6:D13. The results shown in the second screenshot will update the formula from D5 with relative cell references to rows 6:13. What is happening in cells D7:D8?

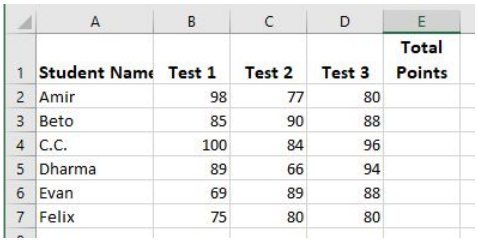


AutoFill before filling



AutoFill after

Practice 5: Test Scores

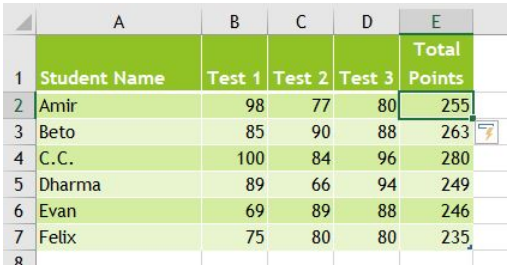


	A	B	C	D	E
1	Student Name	Test 1	Test 2	Test 3	Total Points
2	Amir	98	77	80	
3	Beto	85	90	88	
4	C.C.	100	84	96	
5	Dharma	89	66	94	
6	Evan	69	89	88	
7	Felix	75	80	80	

Excel Test Scores Start

1. In a new Excel workbook, enter the above data.
2. Make sure to apply bold formatting to row 1, and text wrapping to cell E1.
3. Format the data as a table with a header row and banded rows, but no Filter buttons.
4. Apply the Facet theme.

5. Ensure that cell E1 has the text wrapping format applied and then resize the column width of column E to be 7 points wide and the height of row 1 to 36 points.
6. AutoFit columns B, C & D.
7. In cell E2, enter the following formula: =B2+C2+D2 and click Enter. Your worksheet should look like the screenshot at right. Notice that Excel automatically filled in formulas for the rest of column E cells using relative cell references! If this action is unwanted, click the lightning icon, and choose to Undo the Calculated Column.



	A	B	C	D	E
1	Student Name	Test 1	Test 2	Test 3	Total Points
2	Amir	98	77	80	255
3	Beto	85	90	88	263
4	C.C.	100	84	96	280
5	Dharma	89	66	94	249
6	Evan	69	89	88	246
7	Felix	75	80	80	235
8					

Excel Test Scores Step 7

8. Press F12 to invoke the Save As command and save the file as Test Scores.xlsx.

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1.1.11: Data Tables and Ranges

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Learning Objectives

By the end of this section, you will be able to:

- Differentiate between a spreadsheet and a Data Table
- Explain the advantages of a Data Table
- Create/insert a Data Table from data in a spreadsheet
- Define a cell range
- Select and name a cell range
- Differentiate between a cell range and an array

WorldCorp has sufficient savings for capital investment for the Fairfax project, yet the chief financial officer (CFO) wants to borrow from a bank about 50 percent of the amount of the estimate for the new addition. There are many banks in Fairfax, each offering different interest rates and years to pay back the loan. The CFO is not sure which offer is best, as the longer the loan period is, the more interest WorldCorp will end up paying, yet the shorter the loan period, the higher the payment will be. The CFO is also analyzing the different interest rates and how they affect the installments and subsequently the total interest charge over the life of the loan.

This case shows why it's important to learn the intricacies of using Microsoft Excel's Data Tables. Data Tables can be helpful to assist management in determining the best course of action by evaluating interest charges and monthly payments. In this section, you will create a data table from existing data and will discover the advantages of using the Data Table tool in the What-If Analysis, plus related concepts and definitions, such as data ranges and arrays. The Data Table's powerful analysis options will be further explored in Organizing and Presenting Data.

Differentiating Between a Spreadsheet and a Data Table

Spreadsheets have a wide variety of applications and can be used for accounting, budgeting, data collection and analysis, and operations efficiency. Spreadsheets are used in all departments of corporations, such as marketing or operations. These departments can use spreadsheets in a variety of ways, such as compiling information from market studies, or performing statistical analysis on operations from the manufacturing plant.

A Data Table is a scenario-building tool. It lets users choose a set of cells on the spreadsheet, and then outputs different solutions or forecasts depending on different scenarios. The difference between a Data Table and a spreadsheet is that a spreadsheet is a file with blank cells that can be formatted using the various tools and commands contained in the application. A Data Table can be part of (embedded in) a spreadsheet, but a spreadsheet can also include a graph, some text for information, or the listing of the inputs for the Data Table. The Data Table feature of Excel automatically builds a table of data based on certain inputs that is part of the spreadsheet. Figure 10.2 shows an example of an Excel-generated Data Table, as well as the data used in the scenarios. You will build a Data Table after learning more about its uses.

C13 =C10

	A	B	C	D	E	F	G	H
1								
2		Price per unit	$ 13.00					
3		Cost Per Unit	$ 8.50					
4		# units	1500					
5								
6		Total Sales	$19,500.00					
7		COGS	$12,750.00					
8		Gross Profit	$ 6,750.00					
9		Marketing & Admin	$ 5,000.00					
10		Net Income	$ 1,750.00					
11								
12								
13			$ 1,750.00	1250	1750	2000	2250	
14			$ 12.75	$ 312.50	$ 2,437.50	$ 3,500.00	$ 4,562.50	
15			$ 13.25	$ 937.50	$ 3,312.50	$ 4,500.00	$ 5,687.50	
16			$ 13.50	$ 1,250.00	$ 3,750.00	$ 5,000.00	$ 6,250.00	
17			$ 13.75	$ 1,562.50	$ 4,187.50	$ 5,500.00	$ 6,812.50	
18			$ 14.00	$ 1,875.00	$ 4,625.00	$ 6,000.00	$ 7,375.00	
19								

Figure 10.2: Data Tables are added to a spreadsheet and are autogenerated in Excel based on the input you select. (Used with permission from Microsoft)

The Advantages of a Data Table

The advantages of Data Tables are many. One of their most important advantages is their ability to automate scenario-building. Another advantage is increased accuracy due to less manual entry of data. If you were to create a scenario from a blank workbook, you would need to build out the formulas initially and then copy them through the desired levels of the inputs. This increases the possibility of user error caused by inputting values or formulas incorrectly. By using the Data Table feature, all that work is done automatically—and quickly. Data Tables allow users to view all the levels of inputs in a single table without inputting multiple formulas.

Consider the example of expanding Fairfax's WorldCorp location. You have gathered the needed information to determine the amount of the loan you will need to finance the added capacity. You have the loan terms from banks in the area and you know that the loan payment period will be ten years. WorldCorp is working on its annual budget, so the CFO wants you to investigate the annual payments, not the monthly payments. The CFO also wants to examine the variability of the annual installment if the interest rate is increased by 0.5 percent increments per year over the life of the loan. The Data Table in the What-If Analysis will automatically perform the annual payment calculations for each increment. The CFO will then be able to look at the results and determine which loan from which bank will best meet the company's needs.

The first step in this analysis is to set up your data. Since you're looking at how the interest rate affects the annual payment, you can use Excel's Payment (PMT) function, which uses the present value (the value of the loan), the number of payments, and the rate. The PMT function is in the Financial library of functions found on the Formulas tab. The present value (PV) is principal to be borrowed; in this case, we will use $750,000, which is half of the total cost of the expansion. This was determined by the initial research by the CFO as the amount needed to finance the company growth. The time period of the loan has been set at ten years. Most loans are paid monthly, but since you are analyzing the annual payments, you will use 10 (not 120) for N (shown as Nper in the function builder) to define the number of payments. After gathering all the interest rates offered by the banks, it was determined that the average interest rate (I) of all is 6.5 percent. Using these input values, the yearly payment can be determined using the financial PMT function. Figure 10.3 shows the building of the PMT function in Excel.

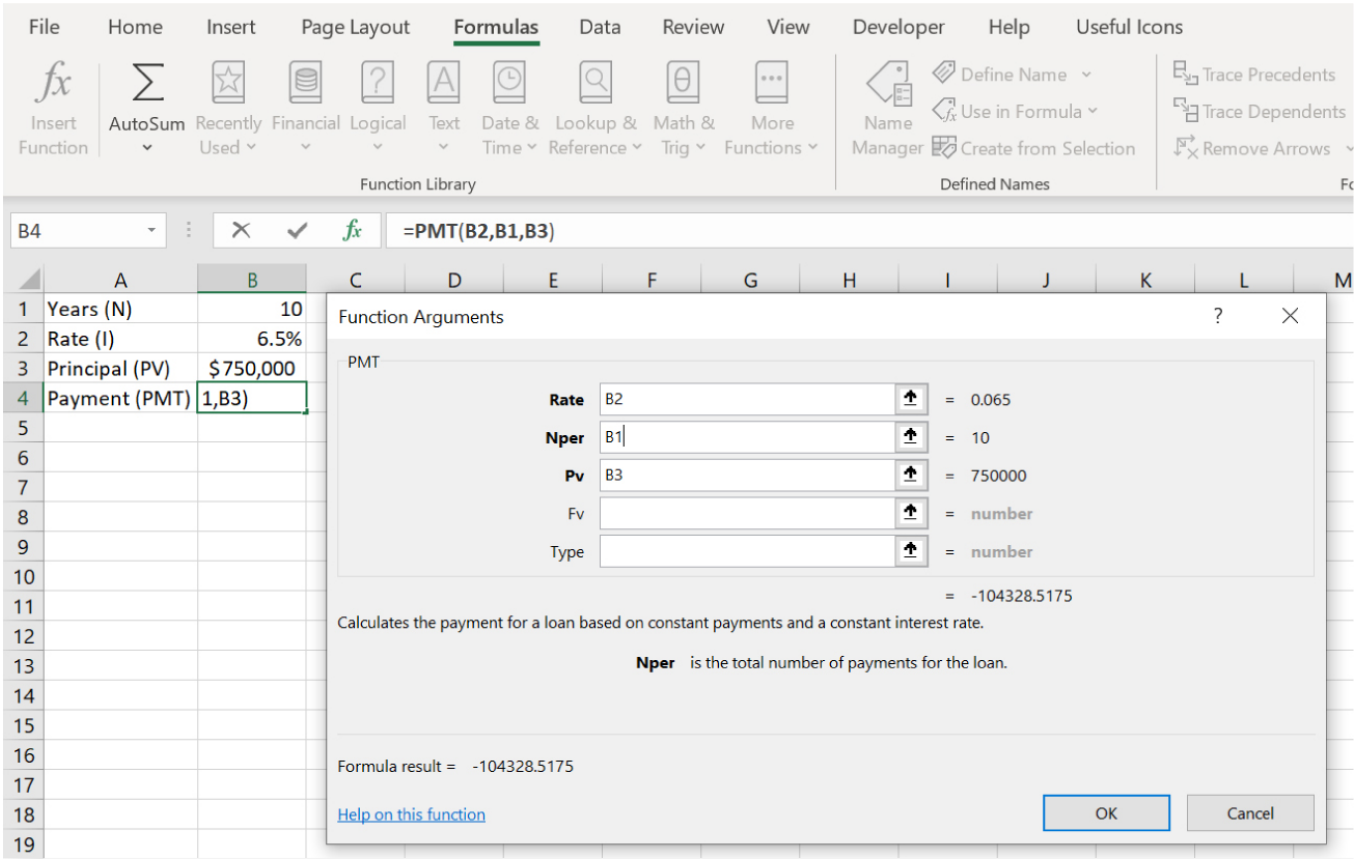


Figure 10.3: Using the inputs of the interest rate, the number of years, and the principal amount, you can quickly determine the annual payment for the loan. (Used with permission from Microsoft)

The result is an annual payment on the loan of $104,328.52 (Figure 10.4). The output for Excel with the PMT function is negative by default, which is displayed in parentheses and in red. This is to indicate that the loan total will decrease by that amount each year after the payment is made. Keep this in mind as you examine the output.

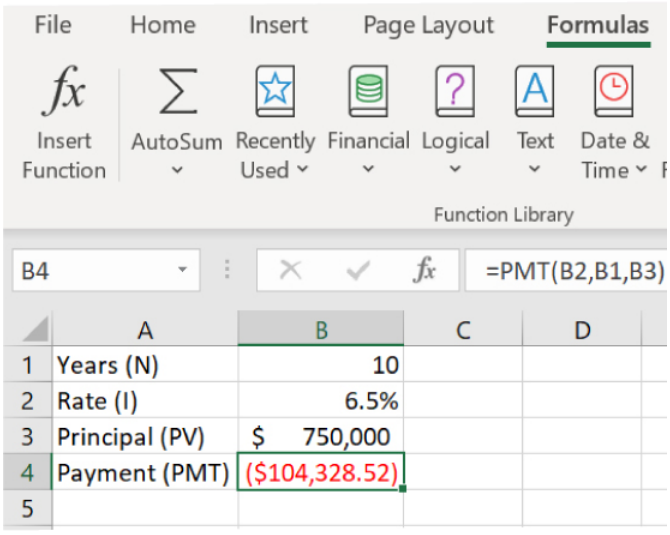


Figure 10.4: The PMT function in Excel calculates the payment required for a loan. The output is negative by default to show that the loan will decrease by that amount each time a payment is made. (Used with permission from Microsoft)

The next step in the analysis is to compare the payments with different loan terms. You can calculate the payment manually using the PMT function many times—that is, every time you change the interest rate. You can play around with it by changing the interest rate and seeing how it affects the payment. If the rate is lower, the payment will be lower, and if the rate is higher, the

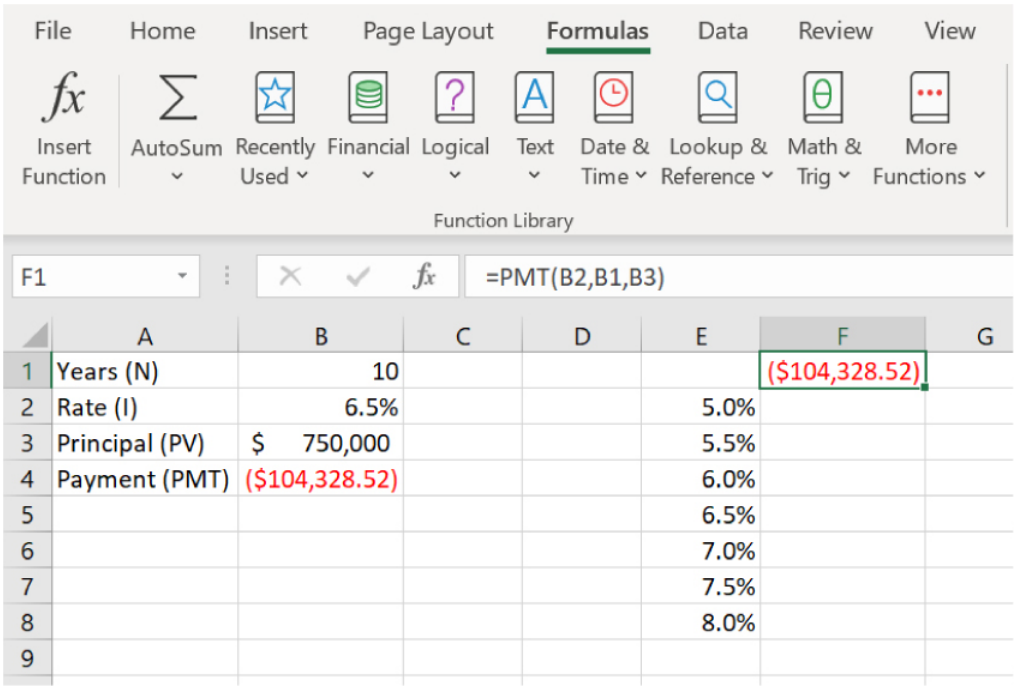
payment will be higher. For example, in Figure 10.3, if you change the rate to 5 percent, the payment automatically updates to $97,128.43. However, this approach does not retain all of the options easily. Unless you make a separate table to capture the impact of changes in the interest rate on the payment, that information is lost each time you make a change to the inputs. If you do create a table, you would need to format it in a manner suitable for additional analysis and decision making. It would be a time-consuming exercise to record all of the data for each interest rate, and then you would need to take an extra step to summarize it in an easy-to-follow table. By creating a Data Table, you can use various levels of the interest rate to calculate the payment and summarize it in one concise table.

Real-World Application - Calculating Mortgage Payoff Schedule

PMT is a useful tool for comparing different interest rates and their impact on monthly payment. It can also be used to determine a mortgage payoff schedule. Paying down a mortgage at a faster pace than agreed upon can lead to significant savings in interest payments. Even one additional payment a year can have a large impact on the amount of interest paid. You can find any number of amortization templates available online, either where you input the information and the site calculates it for you, or through an Excel template. Do some online research to find an Excel template to help you calculate your mortgage payoff schedule. Open the template and review the formulas. Notice the use of IF and PMT functions throughout. Using the template, locate a home to purchase and determine the payoff schedule for the home using today's interest rates. If you own a home already, determine what one additional payment per year will do to your final home cost upon payoff.

Creating a Data Table from Data in a Spreadsheet

To facilitate the process of comparing various interest rates on the annual payment, you can create a Data Table. To do so, the information must be arranged on the spreadsheet in a specific way. First, make a list in a column of the interest rates being examined. The order doesn't matter to Excel, but it makes the data easier to analyze if you put them in numerical order, either lowest rate to highest or vice versa. In the next column to the right and one row above, use the PMT function to calculate the payment at the current rate (recall, you used 6.5 percent), as shown in Figure 10.5.



	A	B	C	D	E	F	G
1	Years (N)	10				($104,328.52)	
2	Rate (I)	6.5%			5.0%		
3	Principal (PV)	$ 750,000			5.5%		
4	Payment (PMT)	($104,328.52)			6.0%		
5					6.5%		
6					7.0%		
7					7.5%		
8					8.0%		
9							

Figure 10.5: To create a Data Table, you must first determine the list of input values, in this case the changing interest rate. (Used with permission from Microsoft)

Next, select the area of the spreadsheet where the changing input values are contained. In this example, that is cells E1:F8. On the Data tab, you will see the What-If Analysis menu group on the right side. Select the drop-down arrow and choose Data Table (Figure 10.6).

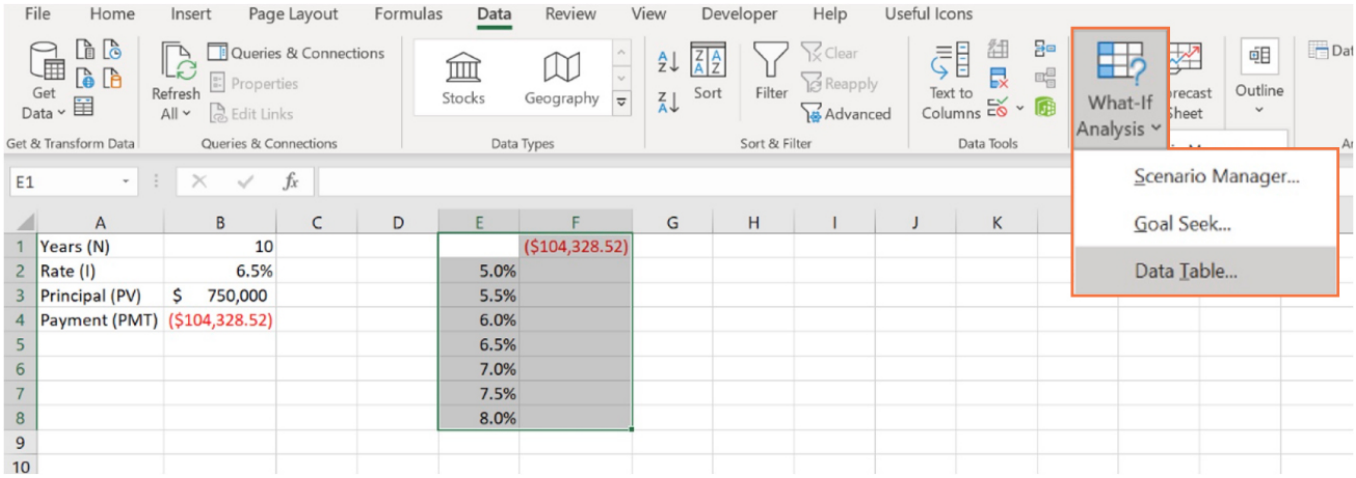


Figure 10.6: To create a Data Table, use the What-If Analysis menu. (Used with permission from Microsoft)

When the Data Table tool is selected, a dialog box appears for inputting data. Because the interest rates are listed in columns, use the "Column input cell" box. In this cell, place the cell reference for the original interest rate used in the PMT function. Notice the dollar sign ($) in front of the letter and number in the cell reference. This will set the column input cell to always refer to the value in cell B2. This is referred to as an absolute reference. You will learn more about absolute references in Absolute Cell References. For this example, the cell is B2 (Figure 10.7).

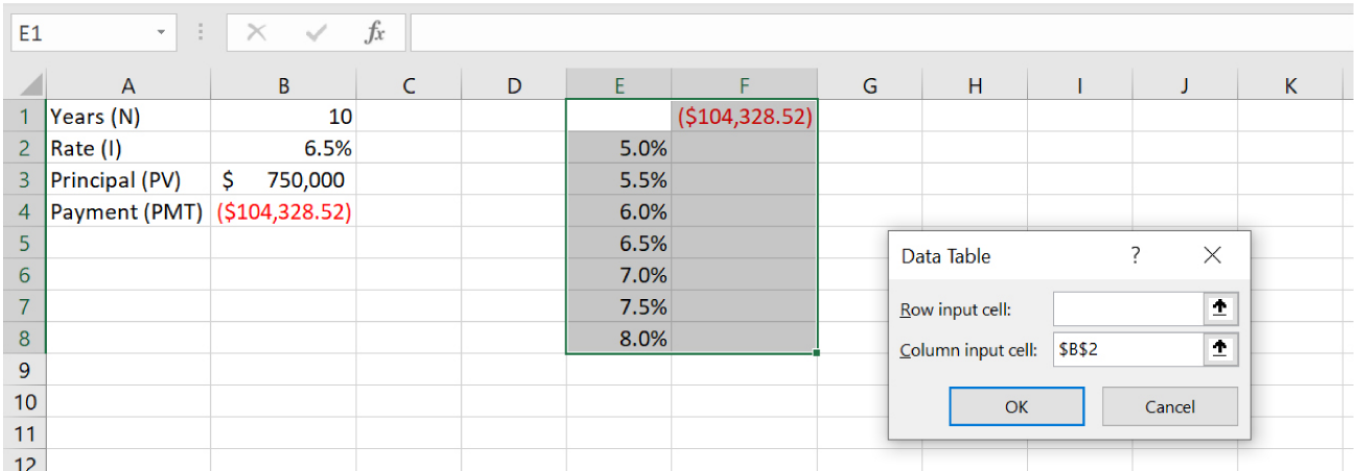
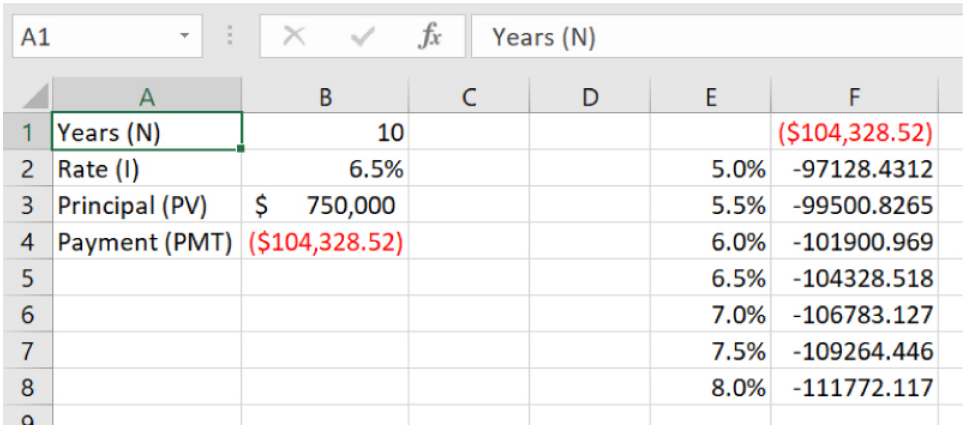


Figure 10.7: If you had placed the interest rates in a row rather than a column, you would use the "Row input cell" box instead of the "Column input cell" box. (Used with permission from Microsoft)

The Data Table will automatically calculate the payment at each of the interest rates listed in the column below the PMT, as shown in Figure 10.8. You will need to format the data to be Accounting or Currency.



	A	B	C	D	E	F
1	Years (N)	10				($104,328.52)
2	Rate (I)	6.5%			5.0%	-97128.4312
3	Principal (PV)	$ 750,000			5.5%	-99500.8265
4	Payment (PMT)	($104,328.52)			6.0%	-101900.969
5					6.5%	-104328.518
6					7.0%	-106783.127
7					7.5%	-109264.446
8					8.0%	-111772.117

Figure 10.8: When the Data Table is created, the output is not formatted. Use the Accounting or Currency format to display the data correctly. (Used with permission from Microsoft)

This process will save a lot of time, as it eliminates manually creating a formula for each cell. Furthermore, with the same Data Table, any of the values in the list can be changed and the information will automatically update to the correct value. For example, to see the payments for a 6.4 percent interest rate instead of 6.5 percent, simply change that one value, and the row's value will be autofilled to calculate the new installment payment. The rest of the data table stays the same, as you can see in Figure 10.9.

	$104,328.52
5.00%	$ 97,128.43
5.50%	$ 99,500.83
6.00%	$ 101,900.97
6.40%	$ 103,840.83
7.00%	$ 106,783.13
7.50%	$ 109,264.45
8.00%	$ 111,772.12

Figure 10.9: Notice that by changing the cell to 6.4 percent, the payment changes only for that value. (Used with permission from Microsoft)

Suppose you have taken this Data Table to the WorldCorp CFO, who tells you that the company will not pay high interest rates and will only negotiate and meet with the executives of banks that offer rates at or below 7 percent. There is no need to create a new Data Table that only includes the data for that range of rates because you may need the information at a later point. Instead, you can temporarily hide the values that exceed the 7 percent maximum using Excel's filtering tools. A filter is a tool that lets you select certain criteria so that only data with your chosen criteria is shown.

To use a filter within the Data Table, select the rate column, and then go to the Data tab. In the Sort & Filter command group, select Filter (the funnel icon). When Filter is selected, a small arrow will appear at the top of the column, as shown in Figure 10.10a. Select that arrow and go to Number Filters, then select Less Than Or Equal To.... On the dialog box that appears next, select 7.00% from the choices, and then click OK. The result is that the Data Table will only show values that are less than or equal to 7 percent, as shown in Figure 10.10b.

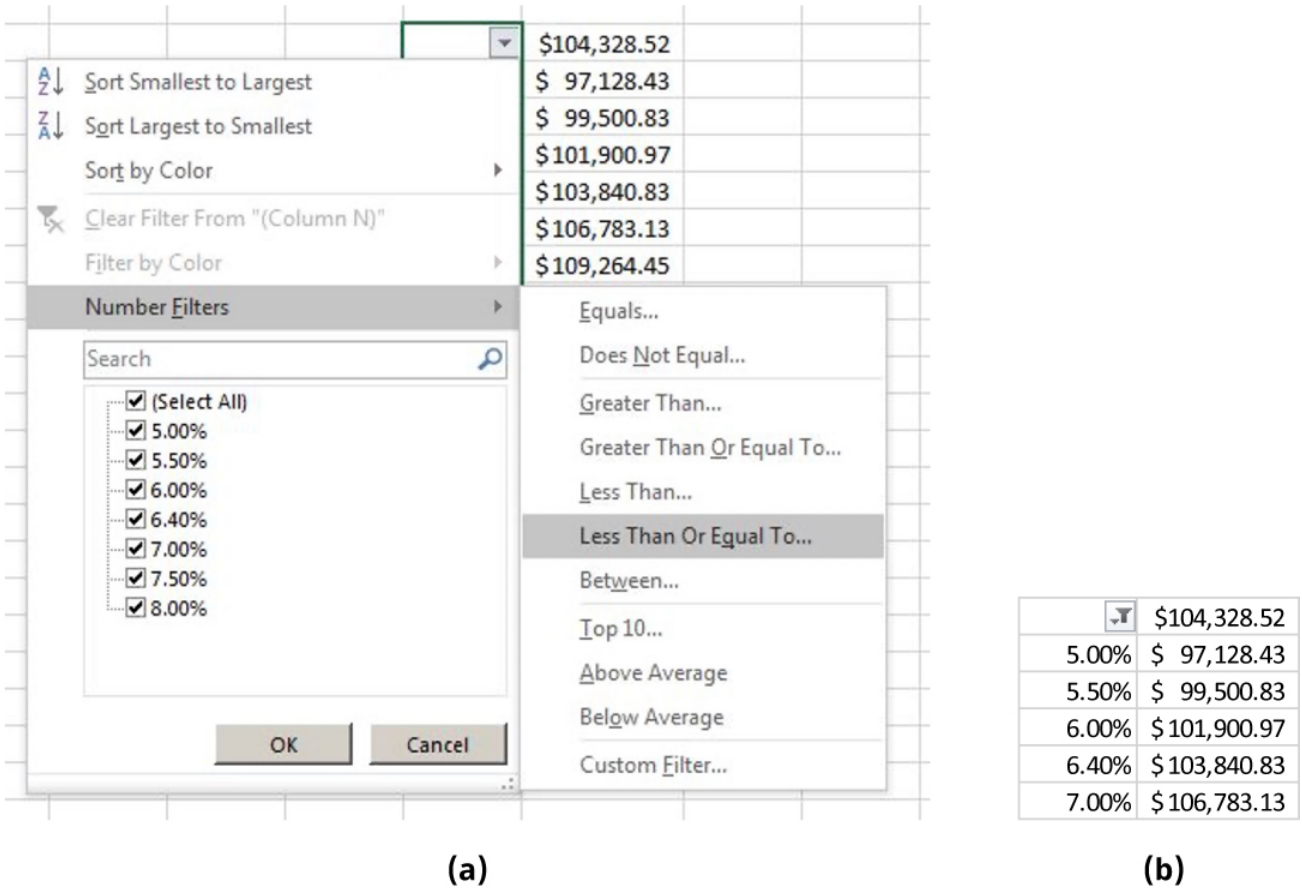


Figure 10.10: (a) In the drop-down menu, there are many different filter options. (b) The funnel icon in a cell indicates that a filter has been applied to that column. (Used with permission from Microsoft)

Now that you have created a Data Table with one variable, you will follow a similar process to analyze two variables. With the added capacity in Fairfax, WorldCorp can sell more products to help the company reach its strategic goals. Increasing unit sales could also allow the company to reduce its price per unit. You would like to better understand the impact of the increased sales and price changes on the annual revenue for WorldCorp. Let's assume that in 2020, WorldCorp sold 5,000 RX-500 digital scales in the state of Virginia, at the retail price of $17.99 per unit. That would mean an annual revenue of $89,950 for this item. What would happen if the price was decreased to $16.99, in hopes that the unit sales would increase? Or, conversely, what would happen if the price increased to $18.99? WorldCorp is not sure how the public will react to either option, but you can estimate the revenue it will produce. Let's assume that either sales will stay the same (i.e., 5,000 per year), decrease to 3,000, or increase to 7,000. With the Data Table tool located in the What-If Analysis, all the revenues will be autofilled for the different unit sales and the different prices (Figure 10.11). To create this table, follow the steps for the loan interest rate example. However, instead of only including the column input, also include the row input.

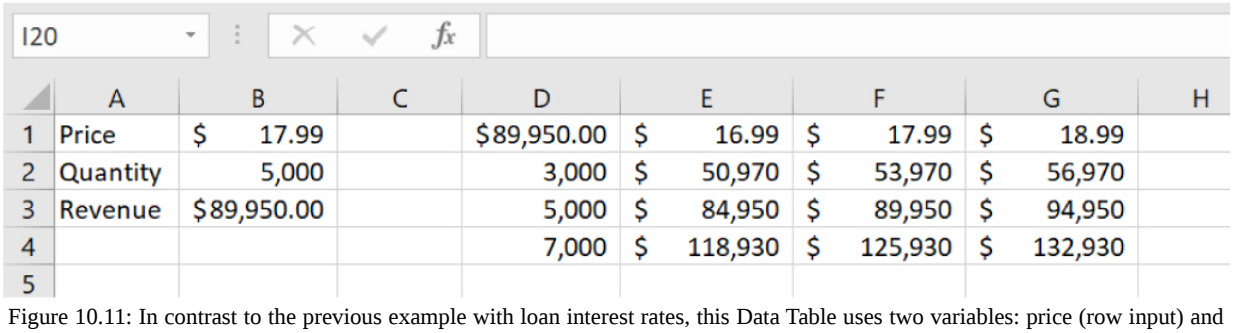


Figure 10.11: In contrast to the previous example with loan interest rates, this Data Table uses two variables: price (row input) and quantity sold (column input). (Used with permission from Microsoft)

Defining, Selecting, and Naming a Cell Range

A cell range is a selection of rows or columns of cells that is given a name to make it easier for the worksheet designer to find that specific group of cells later. It can include a group of cells that are next to each other or separated across the worksheet or workbook. Defining a cell range is especially useful when designing a large Excel worksheet with a substantial amount of data, or when interconnecting datasets or different spreadsheets. Naming a range of cells is referred to in Excel as defining a range. You can define a range in three different ways.

Method 1: Define a Range

First, select the range of cells you want to name. Then, click on the leftmost box below the ribbon (Excel calls this the Name Box). After the cursor on the Name Box begins blinking, type the name you want to use for the data range, and press Enter. Subsequently, you may refer to this range of cells as the name you typed in the Name Box. Type “digital scale” in the Name Box, as shown in Figure 10.12.

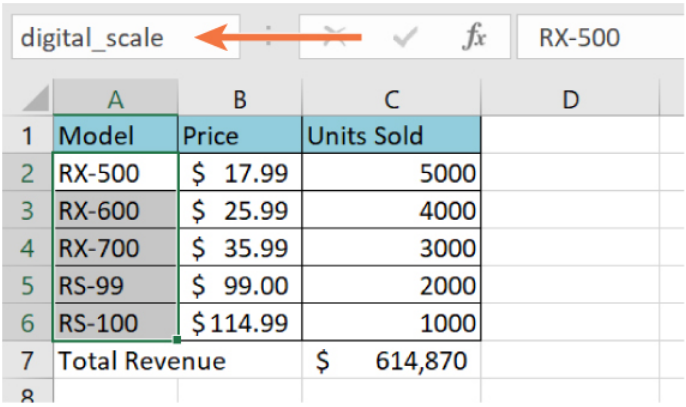


Figure 10.12: The Name Box sits just below the ribbon and above the column letters. (Used with permission from Microsoft)

Method 2: Define a Range

Begin by selecting the desired range of cells, then go to the Formulas tab, and select Define Name. A new dialog box will appear; it has three fields: Name, Scope, and Comment. Next to Name, simply type the name you want to use for the data range; under Scope, select Workbook; the Comment field is optional. Click OK to complete the process (Figure 10.13).

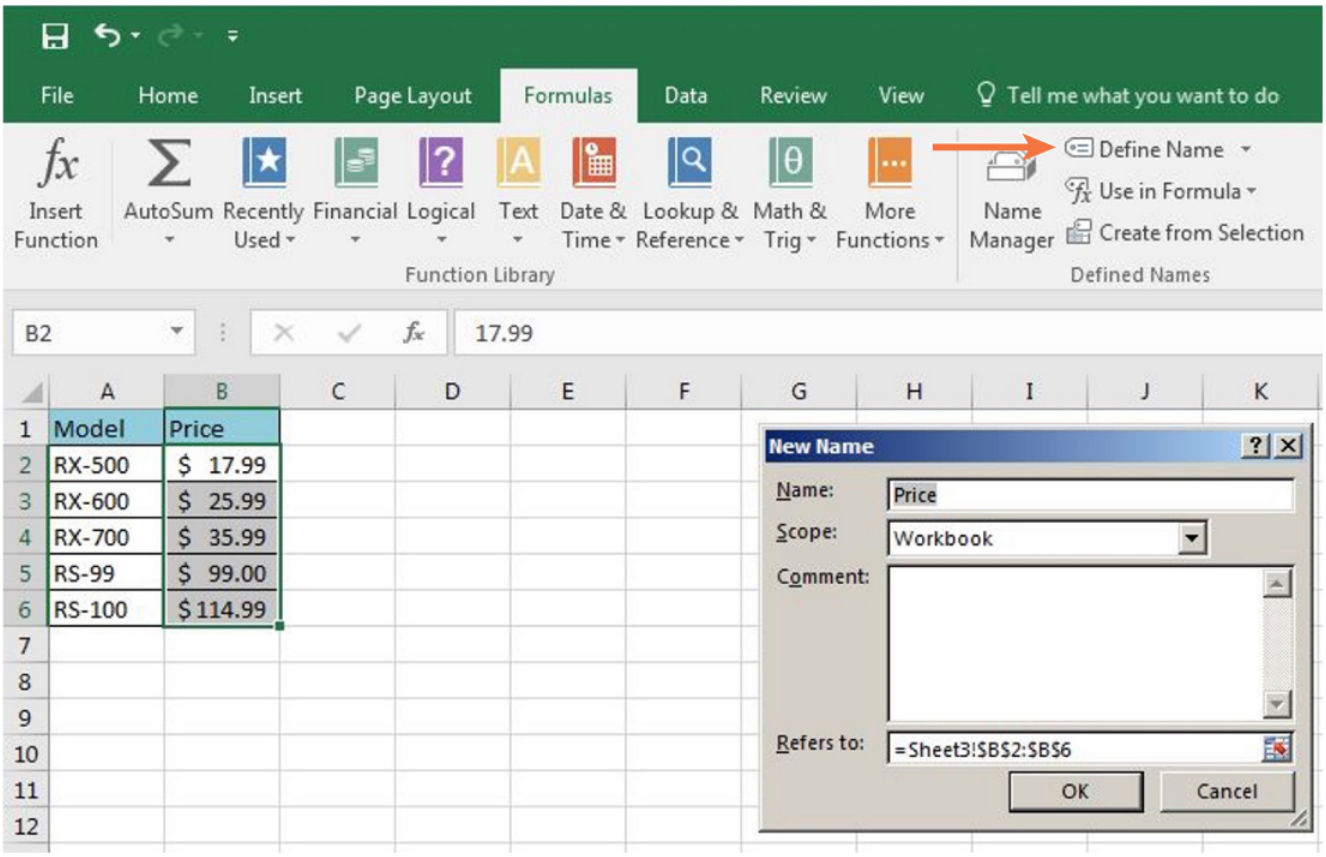
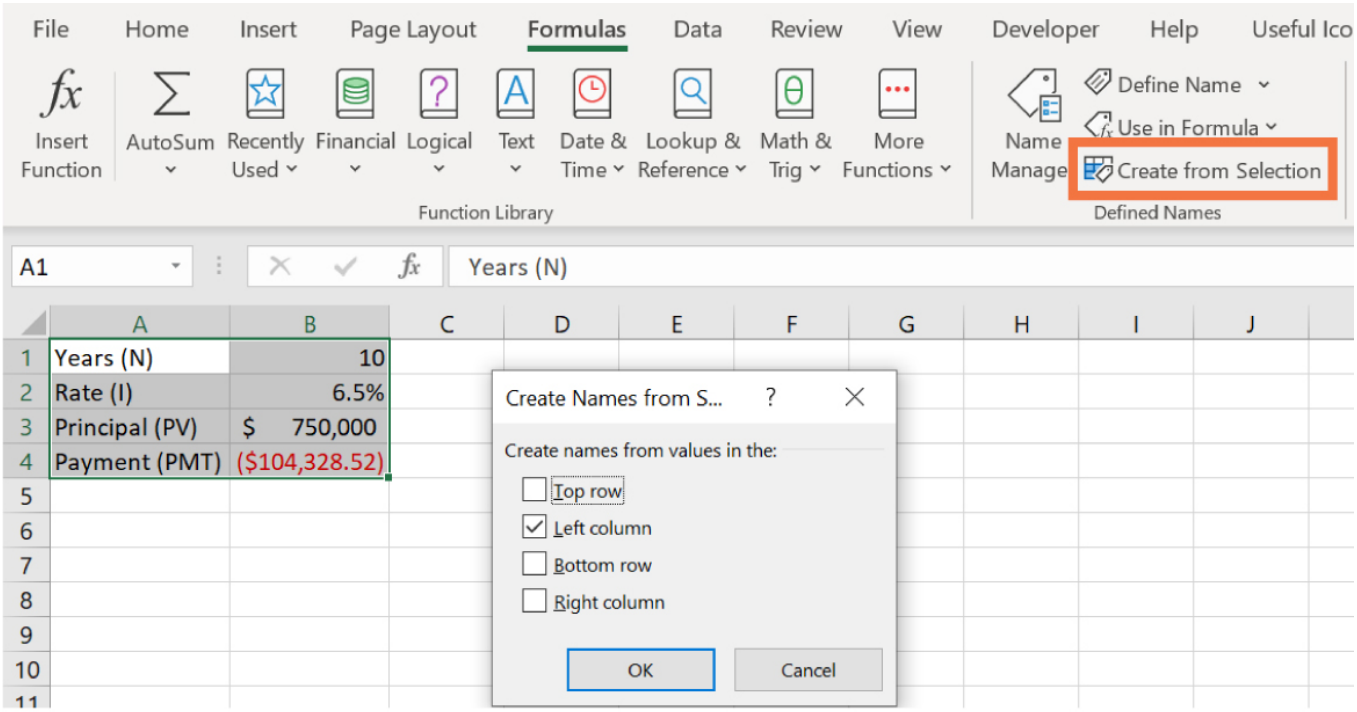


Figure 10.13: The Define Name option is in the center of the Formulas tab ribbon area. (Used with permission from Microsoft)

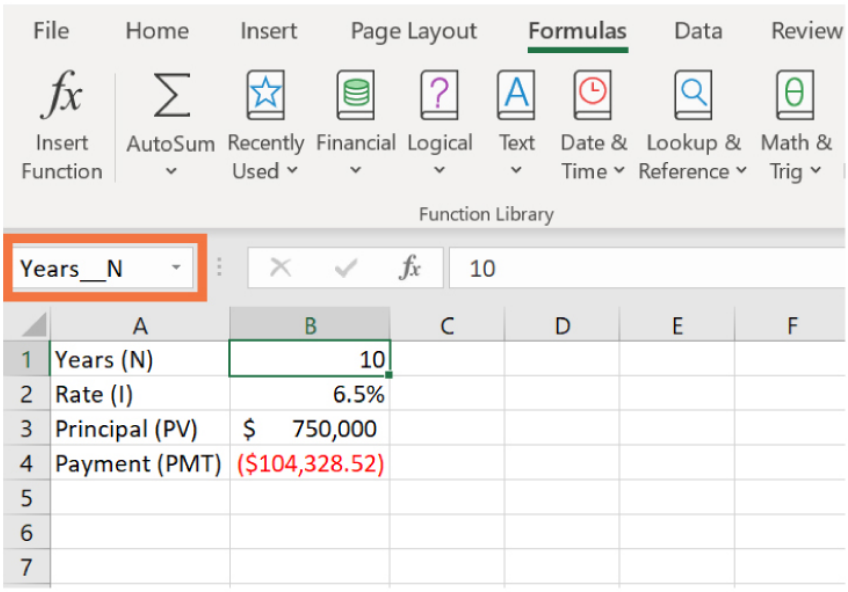
Method 3: Define a Range

The third way to define a range is more comprehensive, as it allows you to select various columns or a whole Data Table. You need to select the entire table, or the set of columns (or rows), that you want to define. After making your selection, go to the Formulas tab in the ribbon and choose Create from Selection. A dialog box will appear and where you select the headers. (Many tables have column headings only, and other tables have row headings.) In the dialog box, you will select if the table has the column headings on the bottom or on the top, or if the row headings are on the right or on the left.

Using the WorldCorp example of the loan interest rates, choose Left column, and click OK, as shown in Figure 10.14. Because you didn't type anything, as this method is more geared for tables, Excel automatically gave defined names to the data ranges (rows). Excel uses the text in the left column of the table to name (define) the data ranges. Spaces are automatically converted to "_" by Excel. Consequently, the data ranges are Years_N, Rate_I, Principal_PV, and Payment_PMT.



(a)



(b)

Figure 10.14: (a) To activate the Create from Selection command, click on the area shown after first selecting the data table. (b) Notice that cell B1 has been renamed Years_N based on the title for that row listed in the left column (column A). (Used with permission from Microsoft)

Differentiating Between a Cell Range and an Array

An array is similar to a cell range in that it is a collection of data in ranges of cells, but arrays do not have to be contiguous (right next to each other). Arrays can contain text or numbers and can span multiple rows and columns if needed. The array can be a collection of cells that consists of unrelated elements, whereas cell ranges have a start and finish and are made of elements related to each other. Arrays also are different from data ranges in that they can work creatively to simultaneously calculate different

computations at the same time. An array can replace many standard formulas and make simple computations more efficient. The array formula performs multiple calculations on several values, so using arrays and array formulas can save users time.

Let's use the WorldCorp digital scale example and recalculate it using arrays. The unit sales of each model are added to the previous data in column C. Then, using arrays, you can determine the total revenue without calculating the revenue for each model separately. Figure 10.15a shows how you can add a column for the revenue of each model and then add them up to get the total revenue of the digital scales. Figure 10.15b shows the total revenue for sales of all models in cell C7, without any of the individual calculations, using an array.

To use an array to calculate the total revenue in Figure 10.15b, click on a blank cell (here, cell C7), and type the function =sum(b2:b6*c2:c6) and hold down Ctrl+Shift as you press Enter. This function calculates the sum of the revenue for each item, as shown in the ranges in the parentheses. As visible in the Formula Bar, Excel recognizes b2:b6 from the defined data ranges, and renames it "Price" in the formula. Excel also adds a curly brace ("{ }") before and after the whole function (Figure 10.15b) because it recognizes it as an array. Excel then does all of the calculations we did manually in Figure 10.15a in one step and provides the total revenue. You'll notice that the total revenue values match, regardless of whether you do the calculations manually or use an array. When a selection is defined as an array, then any formula is calculated as an array formula, which allows for multiple calculations to happen simultaneously.

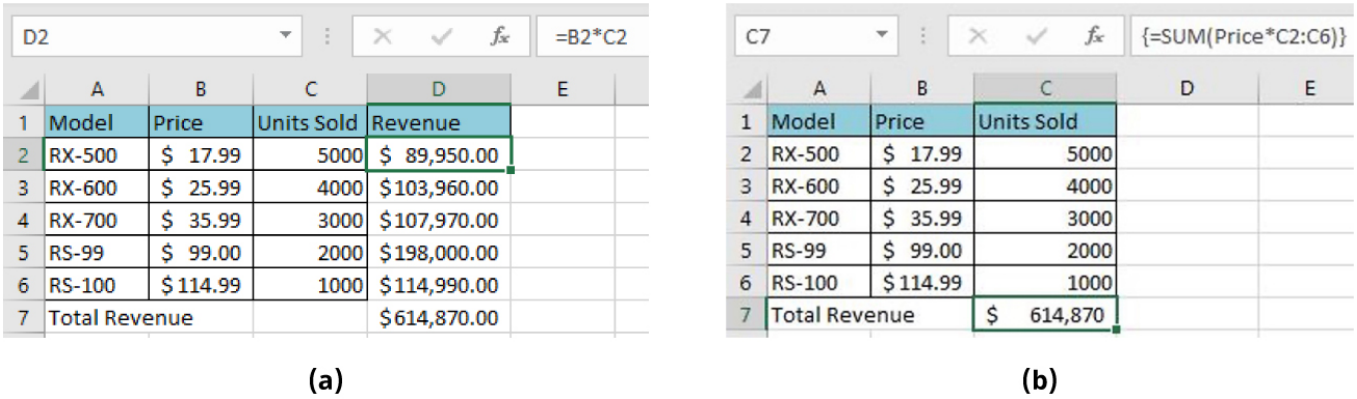


Figure 10.15: The array formula enables Excel to derive the same results using less space in the sheet. (a) You can calculate each model's revenue and then add those values to get the total revenue. (b) You can also use an array, which determines each model's revenue and adds them up in one step. (Used with permission from Microsoft)

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1.1.12: More About Formulas

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Create complex formulas
- Use cell references in formulas
- Use comparison operators
- Use arrays in formulas

Portland is a small city in Cumberland County, Maine, and is Maine's most populous city. Its main commercial attraction is that it is a port city, and among the main economic activity in the region is marine transport services. WorldCorp has an office there, as the company uses the port facilities to export some of their products to different destinations. The WorldCorp regional manager has to use intricate spreadsheets to keep track of the large volume of cargo coming from different cities in the United States. The manager wants to start using data automation intelligence tools in Excel, allowing the manager to make operational decisions more quickly.

The shipping information may contain data such as the origin city, the destination, types of inventory included in the cargo, the weight of each shipment, and specific international shipping terms for the shipment. The manager receives this information separately in each bill of lading (a summary of the shipment) and has constructed many complex Excel workbooks with different tabs, each containing the raw data from the cargo. With shipments increasing year by year, this raw data has grown and become unwieldy. Using Excel's built-in analytical tools, such as cell references, comparison operators, and array formulas, the manager can make sense of this raw data to use and process it in a more helpful way.

As a WorldCorp employee, you are asked to deliver recurring reports based on this data. These reports can be tedious to create if you are not able to immediately find the information you need in your spreadsheets. In this case, you are asked to find the heaviest shipment, the average tonnage, the most-used destination, and other report highlights.

Excel's analytical tools like cell references, comparison operators such as greater than (>), and array formulas allow all the information in your spreadsheet to be summarized automatically. Using comparison operators enables powerful functions that are used for different purposes when constructing array formulas. Cell reference notations—relative, absolute, and mixed—are used to construct automated tables. A relative cell reference means that the cell used in the formula will change if it is copied to another part of the spreadsheet. More specifically, both the column and row location are not fixed. An absolute cell reference occurs when both the row and the column are fixed to that exact cell, so if you copy the formula to another location in the spreadsheet, it will always reference the same cell. A mixed cell reference is when either the column or the row is fixed. If the column is fixed, the row will be relative when copied to another location in the spreadsheet, and if the row is fixed, the column will be relative. Understanding cell reference notations will help you learn to build and use complex formulas using the correct order of operations. More advanced use of cell references will allow you to use comparison operators and arrays in different situations.

Complex Formulas

As calculations grow in complexity, they require the use of several operators, such as +, –, /, *, and ^, in the same formula. This is the basic definition of a complex formula, a formula that uses several operators to calculate an output. One important aspect of complex formulas is that Excel will automatically calculate them in a specific order. When first working with complex formulas, it can be helpful to write out the formula on paper first. To input formulas into Excel, use parentheses to separate the different mathematical functions. Multiple parentheses might be needed when working with complex and long formulas. For example, to add cells A1 and B1 and then divide by cell C1, it would look like

Math input error

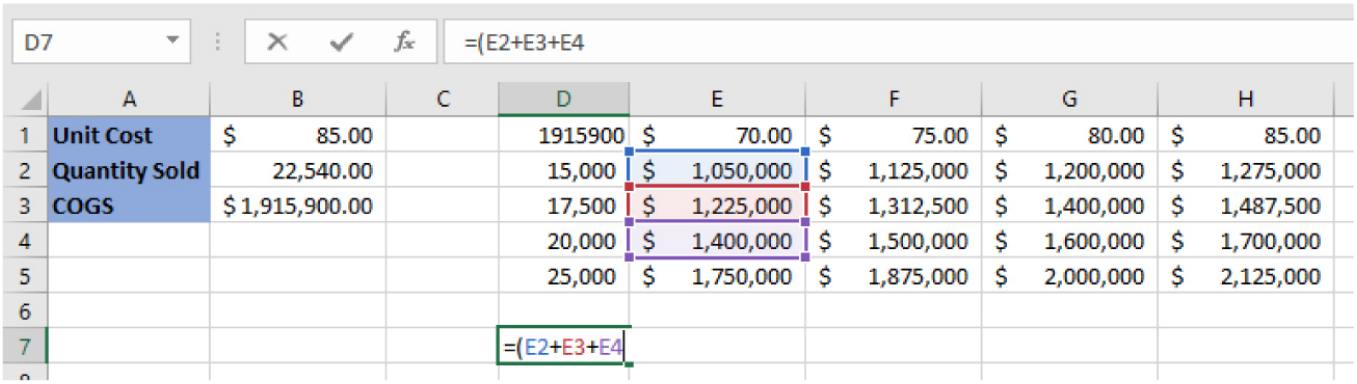


Figure 10.16: The color-coding system for complex formulas is also applied when using multiple sets of parentheses in a formula. (Used with permission from Microsoft)

Insert Function Tool

Recall, the Formula Bar is located right above the lettered columns, right beneath the ribbon. The Formula Bar can be used for double-checking that what you typed in the cell was what you intended, or for editing the relative cell references of a copied cell. However, there is another feature in the Formula Bar using the Insert Function tool, which is essentially an assistant to help users build formulas. It contains the whole roster of Excel functions, categorized by discipline (e.g., engineering, financial, math and trigonometry, statistical), so users can explore and search for functions. Insert Function is activated by clicking on the "fx" icon that you see in the Formula Bar, or by going to the Formulas tab, and selecting Insert Function. The Function Library command group on the Formulas tab also shows formulas grouped by category.

Mac Tip

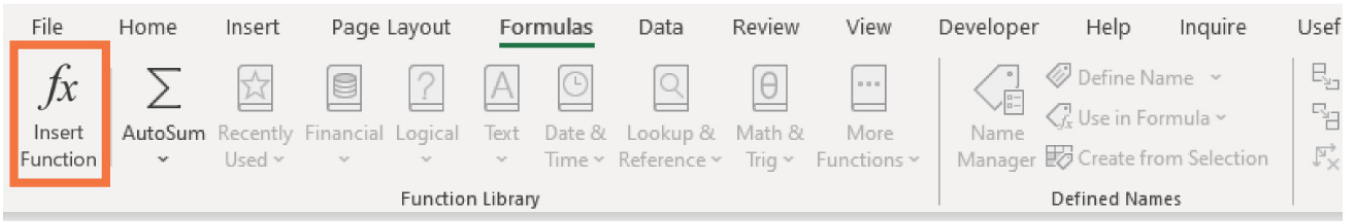
In the Mac version, the Formula Bar only shows the most commonly used formulas, but you can expand the Formulas tab.

Let's examine how to use the Insert Function tool for a simple function, the SUM function. (Note that the Insert Function tool is typically used for more complex and specialized functions because it is quick and easy to just type in the simple formulas; however, here, the SUM function provides a simple example.) First, select the cell where you want the summed total to appear. Then, click on the Insert Function icon. The dialog box will open, asking for the function you want to use; select the Math & Trig category, and look for SUM (they are listed alphabetically). When selected, a second screen will appear and ask for the range on which to perform the addition. Select the range and then click OK.

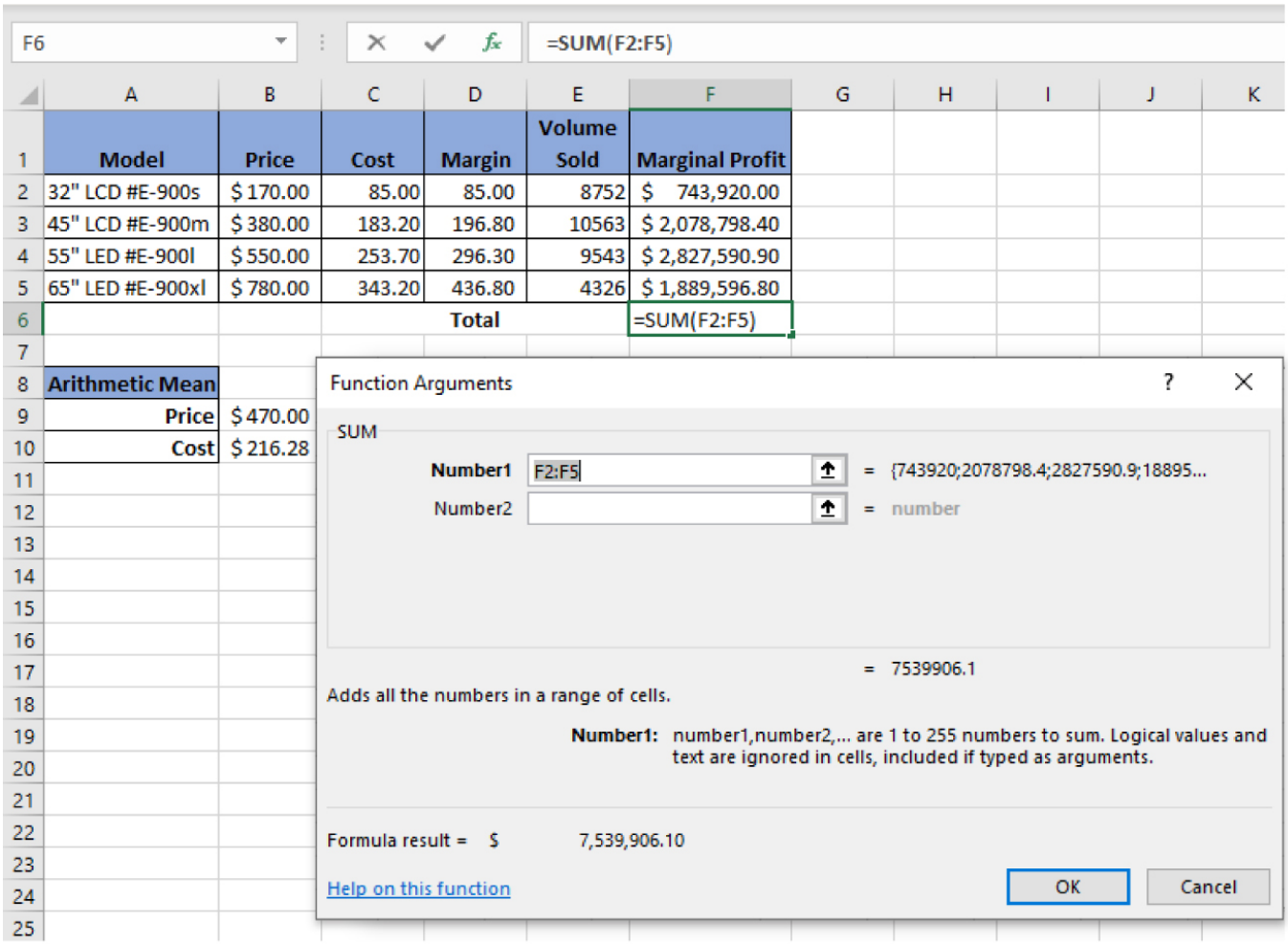
Mac Tip

In the Mac version, the Formula Builder defaults to the last formula you used.

One useful feature of the Insert Function tool is that it can automatically detect what your range might be (Figure 10.17a). In Figure 10.17b, Excel automatically guessed that the user would want to sum the range F2:F5. This Insert Function tool is useful when you do not want to manually type the formula in the Formula Bar.



(a)



(b)

Figure 10.17: The Insert Function tool includes tips on how to apply each function. (Used with permission from Microsoft)

Order of Operations

In all math equations, there are rules regarding the order in which calculations must be completed. Otherwise, the equation result will be incorrect. The order of operations is the universal law of math used to prescribe the order of doing each calculation in an equation: parentheses, exponents, multiplication, division, addition, and subtraction, going from left to right (the acronym PEMDAS can help you remember the order). For example, if you calculate 5+3*3–5 from left to right, you would add 5 and 3 to get 8, then multiply 8 by 3 to get 24, and then subtract 5 to get 19, which is incorrect. Following the mathematical order of operations, the equation should be done in this order: multiply 3 by 3 to get 9, then add 5 to get 14, then subtract 5 to get 9. You can also use parentheses to help show the correct order of operations, such as 5+(3*3)–5. The parentheses show that the multiplication should be done first. Excel requires equations to follow the correct order of operations, using parentheses when combining operations in a single cell.

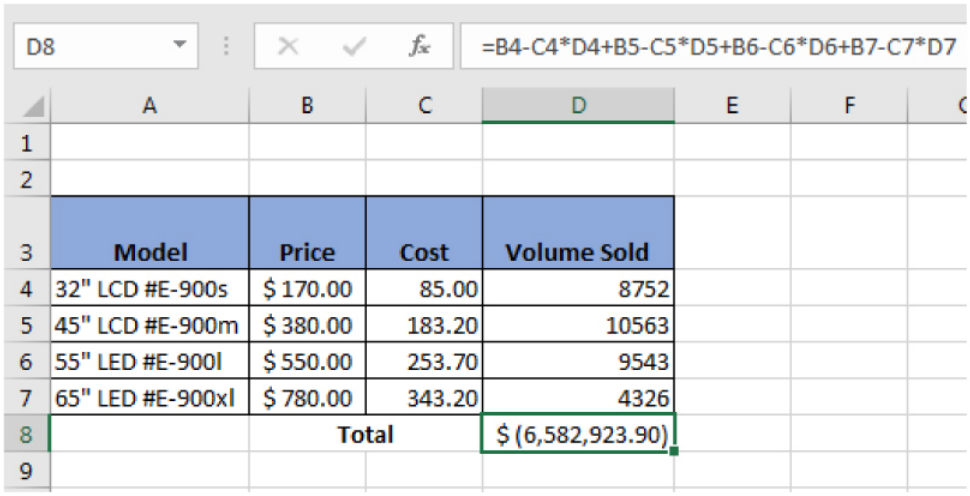
Let's look at some WorldCorp revenue streams to see this on a larger scale. WorldCorp produces thousands of different consumer electronic products, including TVs. Figure 10.18 shows the number of TVs sold for each of these models in the Volume Sold column. To calculate the margin for each model, subtract the cost from the price. Then, to calculate the profit per each model (Marginal Profit), multiply the margin by the volume sold.

Model	Price	Cost	Margin	Volume Sold	Marginal Profit
32" LCD #E-900s	$ 170.00	85.00	85.00	8752	$ 743,920.00
45" LCD #E-900m	$ 380.00	183.20	196.80	10563	$ 2,078,798.40
55" LED #E-900l	$ 550.00	253.70	296.30	9543	$ 2,827,590.90
65" LED #E-900xl	$ 780.00	343.20	436.80	4326	$ 1,889,596.80
			Total		$ 7,539,906.10

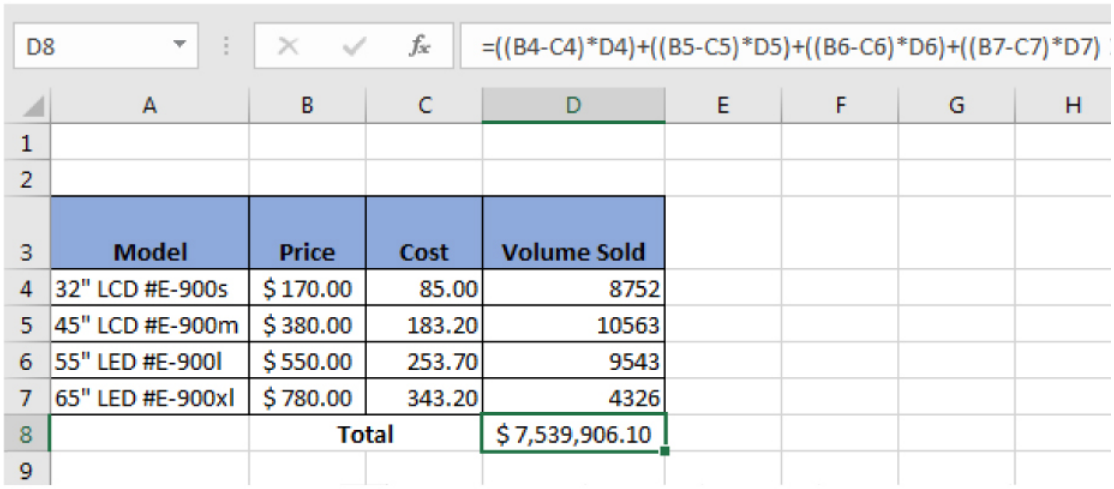
Figure 10.18: Several simple formulas were used to calculate the profit margin for each model. (Used with permission from Microsoft)

To calculate the total profit margin, you can use the SUM function on the Marginal Profit column. This simply adds up all of the profit margin amounts for each model. Alternatively, you can get this same total by creating a complex formula. Subtract the cost from the price, then multiply the difference by the volume sold, then add the product of each model and the quantity. Remember to use parentheses to make sure that each section of the formula is completed in the right order. The formula would look something like this: =((Price1-Cost1)*Volume Sold1)+((Price2-Cost2)*Volume Sold2)+((Price3-Cost3)*Volume Sold3) [etc.].

The calculation in Figure 10.19a shows the wrong answer that would result from not using parentheses in the formula. It uses the formula =Price1-Cost1*Volume Sold1+Price2-Cost2*Volume Sold2+Price3-Cost3*Volume Sold3 [etc.], which means the cost is multiplied by the volume sold *first*, before being subtracted from the price, which is not correct. Figure 10.19b shows the formula written the correct way (with the parentheses). It uses =((B4-C4)*D4)+((B5-C5)*D5)+((B6-C6)*D6)+((B7-C7)*D7), which gives the correct result.



(a)



(b)

Figure 10.19: In (a) the volume sold is incorrect because the parentheses that determine the order of operations in the formula are missing; (b) is correct. These formulas show how easy it is to make a mistake in the order of operations. (Used with permission from Microsoft)

Cell References in Formulas

In Defining, Selecting, and Naming a Cell Range, you learned about cell references and how to define a range of cells. Now, we will expand this into Excel's cell reference notation and learn how to use relative, absolute, and mixed cell references.

Relative Cell References

Formulas use relative cell references by default in Excel. A relative cell reference is one in which the cell reference in a formula or function updates automatically to reference an adjacent cell when you copy that formula or function to another cell; in other words, if your formula refers to cells A2 and B2, Excel knows that this means the columns are next to one another and in the same row. If you copy a formula with these values to the next row, Excel will automatically change the cell references to A3 and B3.

Let's consider an example. You want to replicate the TV profit calculation =((B4-C4)*D4)+((B5-C5)*D5)+((B6-C6)*D6)+((B7-C7)*D7) in another table with different models of TVs. You simply need to copy (Ctrl+C) the cell with the formula in it (D8), and paste (Ctrl+V) it into a new cell (D15). As shown in Figure 10.20a, all of the Price, Cost, and Volume Sold values in the new table are different, and cell D15 is blank. Once you copy the formula into cell D15 (as in Figure 10.20b), the result is that the formula will be exactly the same, but the cell references will automatically be changed to reflect the new table: =((B11-C11)*D11)+((B12-

C12)*D12)+((B13-C13)*D13)+((B14-C14)*D14). As a word of caution, this only works if the tables are uniform and the formulas needed are the same.

D8 =((B4-C4)*D4)+((B5-C5)*D5)+((B6-C6)*D6)+((B7-C7)*D7)

	A	B	C	D	E	F	G	H
1								
2								
3	**Model**	**Price**	**Cost**	**Volume Sold**				
4	32" LCD #E-900s	$ 170.00	85.00	8752				
5	45" LCD #E-900m	$ 380.00	183.20	10563				
6	55" LED #E-900l	$ 550.00	253.70	9543				
7	65" LED #E-900xl	$ 780.00	343.20	4326				
8		**Total**		$ 7,539,906.10				
9								
10	**Model**	**Price**	**Cost**	**Volume Sold**				
11	27" LCD #E-900s	$ 130.00	65.00	7535				
12	42" LCD #E-900m	$ 300.00	144.00	9536				
13	50" LED #E-900l	$ 480.00	220.80	10674				
14	60" LED #E-900xl	$ 690.00	303.60	4563				
15		**Total**						
16								

(a)

D15 =((B11-C11)*D11)+((B12-C12)*D12)+((B13-C13)*D13)+((B14-C14)*D14)

	A	B	C	D	E	F	G	H	I	J
1										
2										
3	**Model**	**Price**	**Cost**	**Volume Sold**						
4	32" LCD #E-900s	$ 170.00	85.00	8752						
5	45" LCD #E-900m	$ 380.00	183.20	10563						
6	55" LED #E-900l	$ 550.00	253.70	9543						
7	65" LED #E-900xl	$ 780.00	343.20	4326						
8		**Total**		$ 7,539,906.10						
9										
10	**Model**	**Price**	**Cost**	**Volume Sold**						
11	27" LCD #E-900s	$ 130.00	65.00	7535						
12	42" LCD #E-900m	$ 300.00	144.00	9536						
13	50" LED #E-900l	$ 480.00	220.80	10674						
14	60" LED #E-900xl	$ 690.00	303.60	4563						
15		**Total**		$ 6,507,235.00						
16										

(b)

Figure 10.20: Because the tables are identical in size and column values, the formula from (a) the first table will work perfectly when copied to (b) the second table. (Used with permission from Microsoft)

Mac Tip

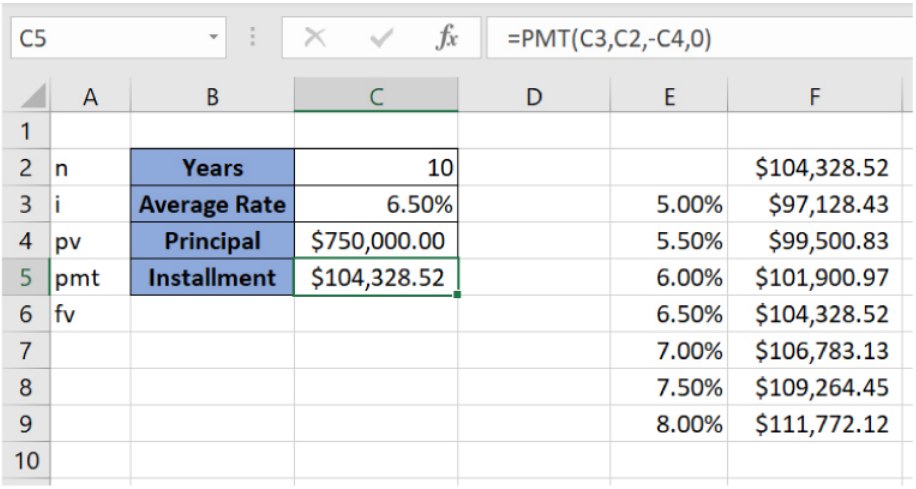
As a reminder, all shortcuts that use Ctrl on a PC use Command on a Mac.

Yet, as easy as relative cell references can be, they might not be appropriate for all circumstances. For example, you may have a set of informational data that will be used recurrently, but you don't want Excel to move the reference of one or more cells, so the relative cell reference function will not work. This is when a different type of cell reference can be used.

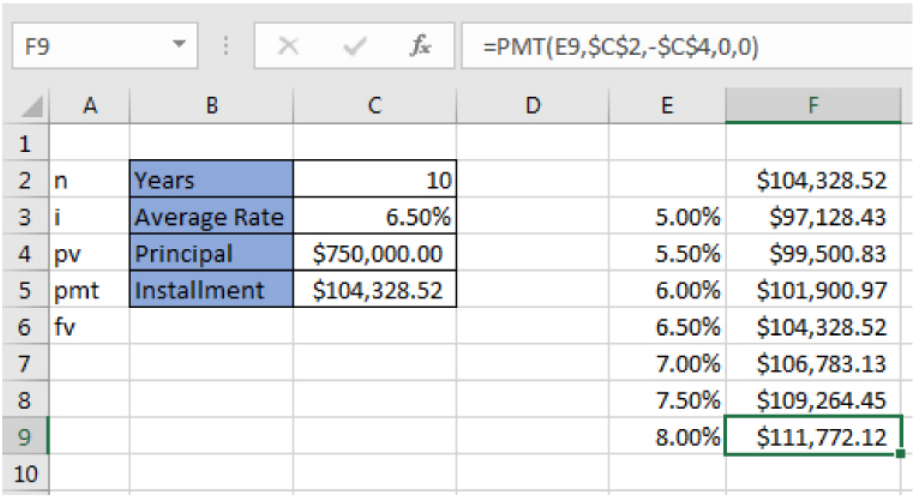
Absolute Cell References

An absolute cell reference is one in which the cell reference is fixed, regardless of where you copy the formula. To use the absolute cell reference feature, put a "$"before the column and row reference. For example, $A$3 means that the reference to column A, row 3 is fixed. If you don't add both "$" symbols, the absolute cell reference won't work, and you will simply have a relative cell reference. Another way to use the absolute cell reference is with a shortcut. Click on the cell you would like to fix, and then click F4, and Excel will automatically add the "$" to the cell.

Recall the loan you were analyzing for WorldCorp, but instead of using a Data Table What-If Analysis, you will use the PMT function and absolute cell references. As shown in Figure 10.21a, the same loan interest rate data remains, but now you will calculate the payments using absolute references. The formula in cell F3: =PMT(E3,$C$2,-$C$4,0,0). You can click on the fill handle (the lower-right corner of the cell) of cell F3 and drag it to F9. This copies the formula so that all the PMTs will automatically be calculated for you, using the fixed references to cells C2 and C4. Figure 10.21b shows the completed table, and the formula in cell F9 shows the updated formula with absolute cell references.



(a)



(b)

Figure 10.21: Using absolute cell references allows you to copy the formula to other cells without having to update your formula. (a) The PMT formula in cell C5 calculates it using relative cell references. (b) Using the absolute cell references for cells C2 and C4, you can create a table that shows the payment for various interest rates. (Used with permission from Microsoft)

Let's examine this formula without absolute cell references; in other words, using relative cell references. If cell F3 is =PMT(E3,C2,-C4,0,0), and you drag the fill handle to cell F9, then all the values from F4 to F9 will be incorrect (Figure 10.22). Essentially, you have copied the same formula, but the relative cell references have moved location along with the location of the formula. Instead of referring to cells C2 and C4 for each iteration of the formula, the reference moved down one row for each row you copied the formula down the table.

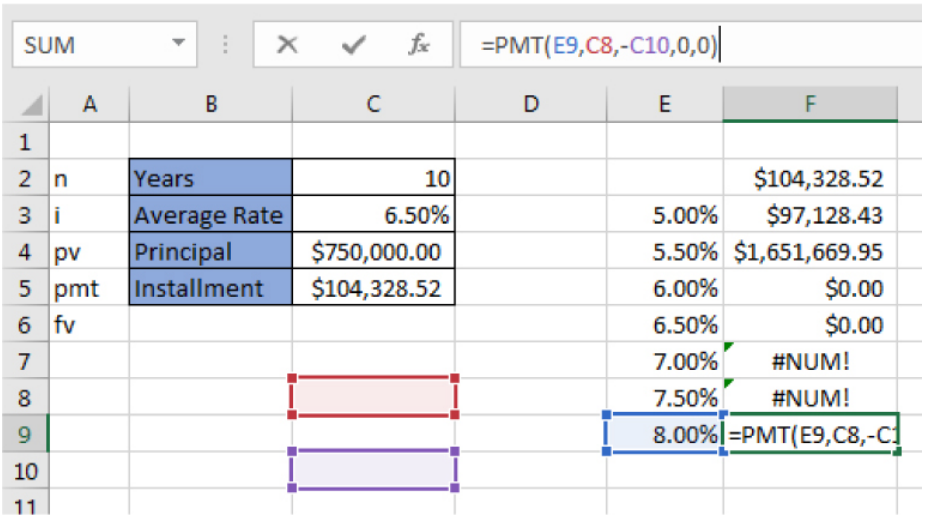


Figure 10.22: Using absolute cell references will avoid errors in your formulas when you are using the same cell in each of your formulas. (Used with permission from Microsoft)

Real-World Application - Excel Horror Stories

Even the employee with the most certifications and skills in Excel can make mistakes. Excel facilitates most computations, but if the user makes an error in the formula or with entering the data, there can be significant consequences. For instance, you might think copying and pasting information would reduce errors. However, that was not the case for an employee working at JP Morgan Chase. In 2012, an employee copied and pasted content and formulas from one spreadsheet to another while working on a Value Risk model. The data and formulas were untested and unverified, and errors were carried over into the model.

You should also consider the veracity and completeness of files you might receive. Barclays ended up purchasing 179 contracts they did not want from the Lehman Brothers in 2008. Why? They received a spreadsheet of Lehman's assets, in PDF form. When they reviewed the Excel spreadsheet, they identified 179 contracts they did not want to purchase and hid those rows, but those notes were omitted from the PDF when it was converted, and the hidden rows were visible. Excel is a very powerful tool; with that power comes the potential for grave mistakes that can be incredibly costly. The utmost care and integrity must be taken to ensure fidelity of any spreadsheet generated and/or shared.

Mixed Cell References

A mixed cell reference uses a combination of both relative and absolute cell references. A mixed cell reference might have a fixed row but a relative column or a fixed column but a relative row. When the "$" is directly to the left of the row number only (e.g., B$1), the row is absolute and the column is relative. When the "$" is directly to the left of the column only (e.g., $B1), the column is absolute and the row is relative.

Let's look at another example. The WorldCorp Portland, Maine, location offers different promotional discounts as a percentage of the TV retail price depending on the month. The manager asks you to create an autofilled table of the unit prices per TV model for the year 2020. That is easy to achieve manually, multiplying the monthly discount times the retail price, but each cell reference has to be fixed as they move. To automate the calculation, you can use mixed cell references. Figure 10.23 shows the retail prices per unit and the monthly discount rates.

R12 =$C9*(1-D$4)

	Discount Rates											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shipping Cost as a % of Profit	1%	3%	4%	3%	4%	5%	5%	3%	2%	6%	10%	13%

TV Models	Price
32" LCD #E-900s	$ 170.00
45" LCD #E-900m	$ 380.00
55" LED #E-900l	$ 550.00
65" LED #E-900xl	$ 780.00

Figure 10.23: Calculating outputs from tables with two sets of variables can be a good use of mixed cell references. (Used with permission from Microsoft)

In Figure 10.24, the discounted retail price for model 32" LCD #E-900s is $168.30 to be calculated in cell D9. This is obtained by multiplying the Price in column C9 by (1-discount rate found in cell D5). For this example, this would be 170*(1-0.01) or C9*(1-D5). Without absolute cell references for either the column or row, the table will not calculate correctly when the formula is copied (see Figure 10.23). Placing the $ before the column (column C) for the price will fix the formula to always calculate the output based on column C, and the table will fill properly with the discounted prices when you copy the formula from D9 into the remaining cells.

	Montly Retail Price Discount TV Model							
TV Models	Jan	Feb	Mar	Apr	May	Jun	Jul	A
32" LCD #E-900s	$ 168.30	$ 164.90	$ 163.20	$ 164.90	$ 163.20	$ 161.50	$ 161.50	$
45" LCD #E-900m	$ 376.20	$ 368.60	$ 364.80	$ 368.60	$ 364.80	$ 361.00	$ 361.00	$
55" LED #E-900l	$ 544.50	$ 533.50	$ 528.00	$ 533.50	$ 528.00	$ 522.50	$ 522.50	$
65" LED #E-900xl	$ 772.20	$ 756.60	$ 748.80	$ 756.60	$ 748.80	$ 741.00	$ 741.00	$

	Montly Retail Price Discount TV Model							
TV Models	Jan	Feb	Mar	Apr	May	Jun	Jul	A
32" LCD #E-900s	$ 168.30	$ -	$ -	$ -	$ -	$ -	$ -	$
45" LCD #E-900m	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
55" LED #E-900l	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
65" LED #E-900xl	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$

Figure 10.24: By having the columns fixed, the formula always references the Price column. (Used with permission from Microsoft)

Comparison Operators

The Excel comparison operators are the same as the inequality symbols used in math. These are: < (less than), > (greater than),

Math input error

Arrays in Formulas

Array formulas can save time when used for basic or intermediate calculations (recall saving the time of adding an extra column in Figure 10.15). But more importantly, array formulas are used for higher-level calculations that may involve statistical and financial analysis, such as figuring out maximums and minimums of a certain product (similar to MINIF and MAXIF functions) or summing certain X or Y rows/columns (similar to SUMIF). In short, most array applications can be done in other ways in Excel, but using arrays allows you to do multiple calculations at the same time.

Let's use a manufacturing example to see how to use arrays in formulas. WorldCorp's Fairfax, Virginia, manufacturing plant transports their items by truck to the Portland, Maine, location. The Fairfax plant has plenty of stock for some of the items in the orders, but not for all of them. Figure 10.25 shows the available stock in the Fairfax plant (Quantity In Stock) and the amounts needed to complete the orders (Quantity Planned). Let's calculate the difference between these two numbers to determine if more is needed. Specifically, if the Quantity in Stock (Column E) is larger than the Quantity Planned (Column D), we will not need to manufacture more. To make this simple, we will use a simple subtraction calculation: Quantity in Stock – Quantity Planned. If this value is a positive number, there is plenty in stock. This would be the case with Row 6 – Tablets 7in. The Quantity in Stock is 425 and the Quantity planned is 143. So, 425 – 143 = 282. So, there will be 282 units remaining after filling the Quantity Planned order. If the value of the subtraction formula is negative, then more product is needed. We see this in Row 4 where the Quantity in Stock is 464, but 542 are Planned. Using the equation, 464 – 542, we are left with a shortfall of 78 units or -78. First, determine the difference between the values in Column E and Column D using an array. This will allow us to do the calculations for all rows in one step. Highlight cells G4 to G12. Then, in the Formula Bar, type the formula: E4:E12 – D4:12 (Figure 10.25a), and then press Ctrl+Shift+Enter simultaneously for the curly braces to appear, as shown in Figure 10.25b. The formula then is automatically entered for all highlighted rows.

TEXTJOIN | =E4:E12 - D4:D12

	A	B	C	D	E	F	G
1					Date: January 13, 2021		
2	Fairfax, VA Location						
3	Date of Future Shipping	To be sent to Port	Item Description	Quantity Planned	Quantity In Stock	Estimated FOB $, if Completed Units	Difference
4	3/22/2021	Portland, ME	Headphones	542	464	$ 26,016.00	D4:D12
5	3/27/2021	Portland, ME	Computer Servers Accessories	2500	1964	$ 21,350.00	
6	3/29/2021	Portland, ME	Tablets 7in	143	425	$ 10,582.00	
7	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	74	$ 14,575.00	
8	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	128	$ 64,505.00	
9	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	5436	$ 22,920.00	
10	3/10/2021	Portland, ME	Home Stereo Systems	74	119	$ 7,252.00	
11	3/7/2021	Portland, ME	Blu-Ray Players	127	117	$ 10,922.00	
12	3/5/2021	Portland, ME	HDTV Antennas	768	532	$ 21,504.00	

(a)

G4 | {=E4:E12 - D4:D12}

	A	B	C	D	E	F	G
1					Date: January 13, 2021		
2	Fairfax, VA Location						
3	Date of Future Shipping	To be sent to Port	Item Description	Quantity Planned	Quantity In Stock	Estimated FOB $, if Completed Units	Difference
4	3/22/2021	Portland, ME	Headphones	542	464	$ 26,016.00	-78
5	3/27/2021	Portland, ME	Computer Servers Accessories	2500	1964	$ 21,350.00	-536
6	3/29/2021	Portland, ME	Tablets 7in	143	425	$ 10,582.00	282
7	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	74	$ 14,575.00	21
8	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	128	$ 64,505.00	31
9	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	5436	$ 22,920.00	2436
10	3/10/2021	Portland, ME	Home Stereo Systems	74	119	$ 7,252.00	45
11	3/7/2021	Portland, ME	Blu-Ray Players	127	117	$ 10,922.00	-10
12	3/5/2021	Portland, ME	HDTV Antennas	768	532	$ 21,504.00	-236

(b)

Figure 10.25: Make sure to highlight all the cells you want the formula to be entered into. (a) Notice the color coding of the formula that corresponds to the colors in the columns below. (b) If you don't press the Ctrl+Shift+Enter combination, the array will not work. You will see the curly braces when you have a formula as an array. (Used with permission from Microsoft)

Link to Learning

For those who are new to using the Excel math syntax and notation, the first section of this video tutorial on using math in Excel has a series of handwritten math exercises set alongside the same calculations using Excel. Seeing math equations

written out in the “traditional” way may help you better understand how to devise Excel formulas. You can access the companion handout to use as a reference.

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1.1.13: Using Arithmetic, Statistical, and Logical Functions

📌 Click here to view Microsoft Excel Setting a Foundation Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Use basic financial functions
- Identify and use arithmetic and statistical functions
- Insert logical functions

The world has changed rapidly in the decades since the 1980s, as personal computers became commonplace in offices and homes. Business calculations that used to be done by people in highly specialized accounting departments using manual methods became automated. Production plans and managerial oversight are informed with data from ever-expanding datasets that include data from sales to manufacturing. To manage this data, WorldCorp uses complex worksheets that may link to other worksheets (or other workbooks), with the aim of producing actionable business intelligence. To generate policies and strategic decisions, managers must use every tool at their disposal, including functions like MIN, MAX, STDEV; financial calculations like PV, FV, PMT; and logical functions like IF, AND, and OR.

Arithmetic and Statistical Functions

Functions used in basic math, or arithmetic functions, help users to add, multiply, find averages, and perform other types of mathematical operations. You have already learned how to use basic math functions, but there are others that will be very useful in basic data analysis, such as financial functions and statistical functions.

AVERAGE

The average, or mean, is a number found by adding up a group of values, and then dividing it by the number of values you added up. Simply select the cell where you want to calculate the mean and type =AVERAGE(range), and identify the range of the values you want to average.

Spotlight on Ethics - The Problem of Using Averages of Averages

When reporting on data, it may be tempting to average a series of averages to summarize information or determine if there is a mass effect. It is especially tempting to do this in Excel, as it makes this process quick and easy. However, averaging averages is very problematic and can indicate a greater impact than actually realized. It is much better to use the original numbers to determine the actual average versus attempting to average averages. That said, what happens if you do not have the original numbers? This may happen if you are handed processed analysis separated from the original data source. In this case, using weighted averages is a better approach. Weighted averages take into consideration the varying levels of importance of different numbers that can be found within a given dataset; to ensure you capture the percent or proportion of importance of these numbers, each number within the dataset is multiplied by a predetermined value before the average is found.

To underscore, it is best to avoid averaging averages and instead use original values to calculate the average of the totality of these values. If these are not available, you must use weighted averages that will factor in the number of values included in the averages to determine the correct average. You can do your own research regarding how to perform this calculation. There are plenty of simple but effective tutorials available online.

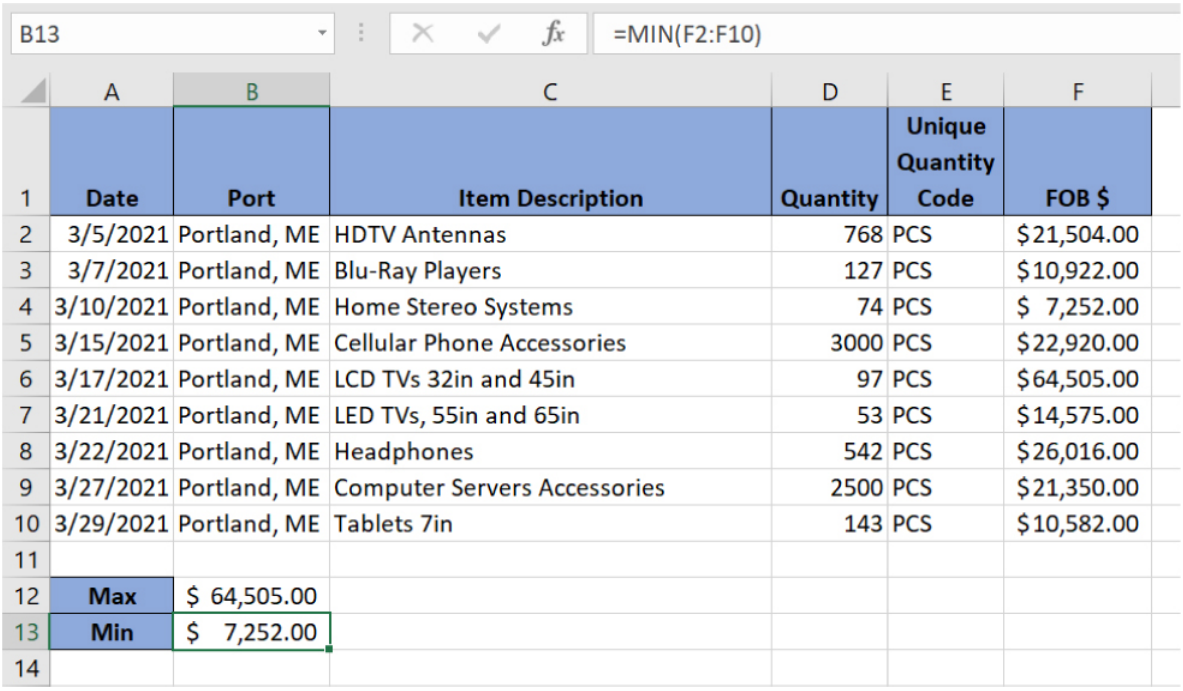
COUNT, ROWS, and COLUMNS

The function COUNT is useful when you have a large dataset of rows (or columns) and want to know how many there are. When you type =COUNT(range), Excel will count the rows or columns with numerical values in the range you identify. The major drawback of the COUNT function is that it will only count the number of rows/columns that have numerical values, and it will ignore any text values. In this scenario, you need to use the ROWS or COLUMNS function to count all of the rows/columns. Write

them in the same way: =ROWS(range) or =COLUMNS(range). Knowing the number of rows of invoices, for instance, can be useful if you need to have the exact number of *n* for an equation.

MAX and MIN

Excel has functions that can determine the highest or lowest numbers in a dataset: MAX (=MAX(range)) finds the highest value, and MIN (=MIN(range)) finds the lowest value (Figure 10.26). The range is the set of all of the cells you are analyzing to find the maximum or minimum value.

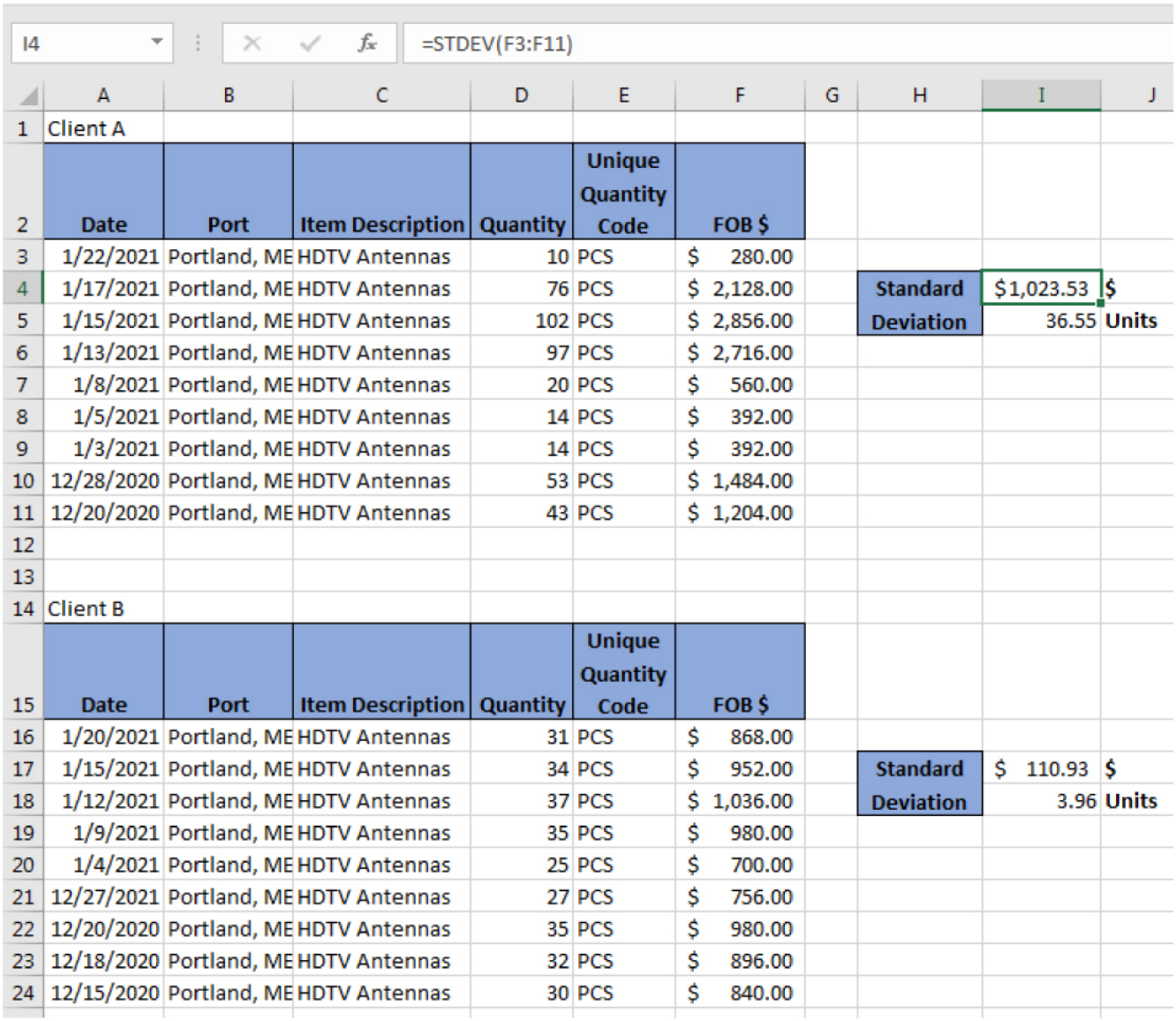


	A	B	C	D	E	F
1	**Date**	**Port**	**Item Description**	**Quantity**	**Unique Quantity Code**	**FOB $**
2	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00
3	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00
4	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00
5	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00
6	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00
7	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00
8	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00
9	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00
10	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00
11						
12	**Max**	$ 64,505.00				
13	**Min**	$ 7,252.00				
14						

Figure 10.26: The MAX and MIN functions are useful if the dataset is very large, and you cannot see the minimum or maximum value with a quick glance. (Used with permission from Microsoft)

Standard Deviation

A common statistical tool used by many data analysts to calculate the variability of the figures in a dataset from the arithmetic mean is called standard deviation. In other words, it tells how much the figures vary from the average. For example, if you have a dataset of invoices from client A, and the bills vary in their total by a considerable amount, then you would have a high standard deviation. If the invoices of client B vary less, meaning their totals are similar every time, then the standard deviation will be low. Excel has a quick way to calculate this: the STDEV function. Type =STDEV(range) and Excel will give the standard deviation for that range. For example, Figure 10.27 shows the standard deviation for the range F3:F11.



	A	B	C	D	E	F	G	H	I	J
1	Client A									
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $				
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	$ 280.00				
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	$ 2,128.00		Standard Deviation	$1,023.53	$
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	$ 2,856.00			36.55	Units
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	$ 2,716.00				
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	$ 560.00				
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00				
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00				
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	$ 1,484.00				
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	$ 1,204.00				
12										
13										
14	Client B									
15	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $				
16	1/20/2021	Portland, ME	HDTV Antennas	31	PCS	$ 868.00				
17	1/15/2021	Portland, ME	HDTV Antennas	34	PCS	$ 952.00		Standard Deviation	$ 110.93	$
18	1/12/2021	Portland, ME	HDTV Antennas	37	PCS	$ 1,036.00			3.96	Units
19	1/9/2021	Portland, ME	HDTV Antennas	35	PCS	$ 980.00				
20	1/4/2021	Portland, ME	HDTV Antennas	25	PCS	$ 700.00				
21	12/27/2021	Portland, ME	HDTV Antennas	27	PCS	$ 756.00				
22	12/20/2020	Portland, ME	HDTV Antennas	35	PCS	$ 980.00				
23	12/18/2020	Portland, ME	HDTV Antennas	32	PCS	$ 896.00				
24	12/15/2020	Portland, ME	HDTV Antennas	30	PCS	$ 840.00				

Figure 10.27: The standard deviation is probably the most used statistical tool in the data analysis set of formulas. (Used with permission from Microsoft)

Financial Functions

The main functions used for calculating loan installments, investment returns, net present value of capital investments, mortgage payment comparisons, and many more real-world applications are called basic financial functions. These functions are NPER, RATE, PV, PMT, and FV, which correspond to the N, I, PV, PMT, and FV in financial calculators. You learned about the PMT function in The Advantages of a Data Table.

Date and Time Functions

On their own, the DATE and TIME functions do not seem very useful, as you can easily just enter a date or a time in a cell by typing them. But these functions are often used in conjunction with other Excel features, such as in array formulas or complex IF functions. To enter a date, write =DATE(year,month,day), using the date's numerical values, and Excel will return with a formatted date, such as 3/31/2021. For the TIME function, write =TIME(hour,minute,second) in 24-hour format, and Excel returns a time in am/pm format. If you typed =TIME(14,44,24) Excel would return 2:44 PM.

Logical Functions

Typically, logical functions are long formulas with embedded logical tests and often use comparison operators to search for delimited data. They compare two values in your worksheet and return one result if the comparison is true and a different result if the comparison is false. These logical functions are powerful tools for allocating and sourcing large amounts of data.

The IF function is one of the most used functions in Excel. It is regularly used in conjunction with other functions. Moreover, IF functions are regularly combined with array formulas. Figure 10.28 shows an example from the WorldCorp Portland, Maine, shipments. The IF formula, written as =IF(logical test,value if true,value if false), analyzes the FOB values, and inserts “Over 20K” if they are greater than or equal to $20,000.

G2 =IF(F2>=20000,"Over 20K","")

	A	B	C	D	E	F	G
1	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $	
2	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00	Over 20K
3	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00	
4	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00	
5	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00	Over 20K
6	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00	Over 20K
7	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00	
8	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00	Over 20K
9	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00	Over 20K
10	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00	
11							

Figure 10.28: Excel gives users the freedom to invent their own true and false tags. (Used with permission from Microsoft)

SUMIF and COUNTIF are other logical functions that are very useful. The SUMIF formula, written as =SUMIF(range,criteria,sum_range) will give a total of a given range (sum_range) if certain criteria are met. For example, you can create a SUMIF function to search for and add up the amounts of all purchase orders of more than 30 servers (=SUMIF(C3:C235,“>30”,D3:D235)).

The COUNTIF (=COUNTIF(range, criteria)) function is similar except that it gives you the number of cells that meet the criteria rather than a total. You can use a COUNTIF formula to find the number of invoices that are equal to a certain sale amount (=COUNTIF(A2:A500, “=5000”)). Using these formulas with comparison operators makes gathering intelligence from large datasets easy.

Let’s revisit our WorldCorp example. WorldCorp exports that go through Portland, Maine, use container ships to transport goods to their destination. Figure 10.29 shows the shipment data from March 2021. Apply COUNTIF and SUMIF formulas to gather information on how many shipments meet certain criteria. The Excel notation used for the COUNTIF formula in cell I7 is =COUNTIF(D2:D10,“>=1000”), which calculates how many shipments (column D, “Quantity”) contained more than 1,000 pieces. The SUMIF formula in cell I2 is =SUMIF(F2:F10,“>=20000”), which adds up all of the FOB amounts that were more than $20,000. (Notice how the comparison operators and their numbers are in quotation marks—this is necessary to calculate the formula correctly.)

	A	B	C	D	E	F	G	H	I
1	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $			
2	3/22/2021	Portland, ME	Headphones	542	PCS	$26,016.00		All FOBs Over 20k, Summation	$156,295.00
3	3/27/2021	Portland, ME	Computer Servers Accessories	2500	PCS	$21,350.00			
4	3/29/2021	Portland, ME	Tablets 7in	143	PCS	$10,582.00			
5	3/21/2021	Portland, ME	LED TVs, 55in and 65in	53	PCS	$14,575.00			
6	3/17/2021	Portland, ME	LCD TVs 32in and 45in	97	PCS	$64,505.00		Shipments With More Than 1000 PCS	
7	3/15/2021	Portland, ME	Cellular Phone Accessories	3000	PCS	$22,920.00			2
8	3/10/2021	Portland, ME	Home Stereo Systems	74	PCS	$ 7,252.00			
9	3/7/2021	Portland, ME	Blu-Ray Players	127	PCS	$10,922.00			
10	3/5/2021	Portland, ME	HDTV Antennas	768	PCS	$21,504.00			

Figure 10.29: Different types of IF formulas are often used to look up values that meet a certain criterion. (Used with permission from Microsoft)

The AND, written as =AND(logical1, logical2), is regularly used in combination with the IF function. It can be used in limits, establishing a low and a high limit, and labeling them if they meet these criteria. In our WorldCorp example, this could help sales managers at the Fairfax, Virginia, location identify any invoices that are below a certain value, thus flagging those customers who might be retail consumers instead of wholesale. The formula in cell G2, in Figure 10.30, sets up an IF test: if both of the AND criteria are true (if the FOB is greater than $0 and less than $1,000), then the tag “Low Value” appears in column G.

G3 =IF(AND(F3>=0,F3<1000),"Low Value","")

	A	B	C	D	E	F	G
1	Client A						
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $	
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	$ 280.00	Low Value
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	$ 2,128.00	
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	$ 2,856.00	
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	$ 2,716.00	
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	$ 560.00	Low Value
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	Low Value
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	Low Value
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	$ 1,484.00	
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	$ 1,204.00	

Figure 10.30: The AND function can be used as an interval, as shown here. (Used with permission from Microsoft)

The OR is similar to the AND function in that it compares two values, but with the OR function, only one argument needs to be satisfied. It, too, is often used in conjunction with the IF function. In Figure 10.31, the sales manager is automating the Excel worksheet to show when quantities fall outside of certain values. This could flag a product if sales fall below 200 units, for example, because it could indicate that it requires more marketing or additional investigation into the drop in sales. Likewise, the sales manager wants to know when quantities are above 1,000 units, which might trigger a discount for customers or additional incentives for the sales agent. Use the OR function to “flag” these orders for additional review.

F2 =IF(OR(D2<200,D2>1000),"Yes","")

	A	B	C	D	E	F
1	Date	Agent	Item Description	Quantity	FOB$	Review?
2	3/29/2021	Antonio	Tablets, 7in	143	$10,582.00	Yes
3	3/27/2021	Izabelle	Computer Server Accessories	2500	$21,350.00	Yes
4	3/22/2021	Antonio	Headphones	542	$26,016.00	
5	3/21/2021	Izabelle	LED TVs, 55in and 65in	53	$14,575.00	Yes
6	3/17/2021	James	LCD TVs, 32in and 45in	97	$64,505.00	Yes
7	3/15/2021	James	Cellular Phone Accessories	3000	$22,920.00	Yes
8	3/10/2021	Antonio	Home Stereo Systems	74	$ 7,252.00	Yes
9	3/7/2021	Izabelle	Blu-Ray Players	127	$10,922.00	Yes
10	3/5/2021	James	HDTV Antennas	768	$21,504.00	

Figure 10.31: The OR function is more flexible than the AND function, as the interval can be either. (Used with permission from Microsoft)

The NOT can also be used to look for values that meet a certain criterion. It is regularly used in combination with the AND, OR, and IF functions. In Figure 10.32, NOT negates the criteria set forth by the AND function; namely, that if the FOB amount is *not* greater than or equal to $0 and also less than $1,000, then the tag “High Value” should appear in column G.

G3 =IF(NOT(AND(F3>=0,F3<1000)),"High Value","")

	A	B	C	D	E	F	G
1	Client A						
2	Date	Port	Item Description	Quantity	Unique Quantity Code	FOB $	
3	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	$ 280.00	
4	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	$ 2,128.00	High Value
5	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	$ 2,856.00	High Value
6	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	$ 2,716.00	High Value
7	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	$ 560.00	
8	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	
9	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	
10	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	$ 1,484.00	High Value
11	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	$ 1,204.00	High Value

Figure 10.32: The NOT function is regularly used in complicated IF functions. (Used with permission from Microsoft)

Link to Learning

Nesting occurs when we have a formula that uses a function and includes a function as one of the arguments; these functions are typically known as nested functions. Nested functions are used in the workplace to evaluate several conditions at a time. This can be helpful when you have multiple criteria that influence a single outcome. This can be a powerful approach to performing calculations in Excel; however, they can be very complicated as they require a specific structure in order to ensure accuracy. This tutorial from Microsoft(opens in new window) walks us through this structure. The uses for this approach are limitless, as you can nest up to 64 levels.

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CHAPTER OVERVIEW

2: Microsoft Excel- Building Proficiency



Microsoft Excel - Building Proficiency

This page delves into advanced Microsoft Excel features for enhancing data presentation and analysis to support better decision-making. It covers formatting techniques, visual elements like images and SmartArt, and advanced formulas. Key tools discussed include What-If Analysis, logical and lookup functions, and complex math functions.

Topic hierarchy

2.1: Microsoft Excel - Building Proficiency Sections
- 2.1.1: Advanced Formatting Techniques
- 2.1.2: Inserting Images, Shapes, and SmartArt
- 2.1.3: Data Tables and Ranges
- 2.1.4: Advanced Formulas and Functions
- 2.1.5: What-If Analysis
- 2.1.6: Logical and LookUp Functions
- 2.1.7: More Math Functions
- 2.1.8: Introduction to Charts and Visualizations
- 2.1.9: Creating and Customizing Charts
- 2.1.10: Chart Elements and Design
- 2.1.11: Pie Charts
- 2.1.12: Bar and Column Charts
- 2.1.13: Line Charts
- 2.1.14: Combining Charts with Formulas
- 2.1.15: Sparklines
- 2.1.16: PivotCharts for Dynamic Visualization

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SECTION OVERVIEW

2.1: Microsoft Excel - Building Proficiency Sections



Microsoft Excel - Building Proficiency

This page discusses advanced Microsoft Excel features that improve data presentation and analysis. It covers formatting techniques, visual elements like images and SmartArt, data tables, and advanced formulas. Additionally, it highlights What-If Analysis, various functions for problem-solving, and chart creation (pie, bar, line). Dynamic tools such as sparklines and PivotCharts are introduced to help transform data into clear insights for better decision-making.

Topic hierarchy

2.1.1: Advanced Formatting Techniques

2.1.2: Inserting Images, Shapes, and SmartArt

2.1.3: Data Tables and Ranges

2.1.4: Advanced Formulas and Functions

2.1.5: What-If Analysis

2.1.6: Logical and LookUp Functions

2.1.7: More Math Functions

2.1.8: Introduction to Charts and Visualizations

2.1.9: Creating and Customizing Charts

2.1.10: Chart Elements and Design

2.1.11: Pie Charts

2.1.12: Bar and Column Charts

2.1.13: Line Charts

2.1.14: Combining Charts with Formulas

2.1.15: Sparklines

2.1.16: PivotCharts for Dynamic Visualization

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2.1.1: Advanced Formatting Techniques

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Create custom formats for worksheet or table for appearance
- Create custom formats for a worksheet or table for content
- Copy formatting from one range of data to a new range of data

It is important for organizations to use uniform branding and style, which can appear anywhere, from emails to invoice templates to Excel files. Having a uniform style within an organization adds a level of professionalism and consistency to the business, and these may be tied to the company's intellectual property and similar protections. Many organizations provide guidelines or manuals for all files produced, to ensure that all employees can easily follow the same style or use the same templates.

Microsoft Excel offers many prepackaged themes and styles that can be easily applied to tables and spreadsheets. But it is also possible to create your own custom format. This can be ideal for businesses that want their products to look a certain way and contain specific branding.

Custom Formats for Appearance

The tables and datasets you've been working with were finished versions, with color, font, table size, and background set. Here, you'll create these tables step-by-step with themes and other style elements.

Using Existing Themes

To make formatting easy to use and high quality, Excel offers Themes. Applying a Theme can quickly change the color scheme, fonts, and size of a table or graph. For example, you could easily change the formatting of a table without manually readjusting everything. If your objective is to save time when changing the overall formatting, choose a default theme and all the formatting will be handled automatically.

To access Themes, go to the Page Layout tab and select the Themes icon (Figure 10.59a). Then, choose any of the available themes. ("Wisp" is shown in Figure 10.61.) All of the formatted tables and graphs in that particular workbook will be changed. If you have a simple worksheet with no specific formatting such as colors, font style, and the like, when you choose a theme, nothing will change. However, if you have a worksheet with formatted headings and charts, you will notice changes when you select a theme. The Color combo box lets users further modify the theme by selecting a different color palette (Figure 10.59b).

For additional changes, the Home tab has a combo box called Cell Styles that lets users select other font sizes or background colors, as shown in Figure 10.60. Depending on your selection in the Colors menu in the Themes command group (Page Layout tab), the options in the Styles menu will change. For instance, use Blue from the palette, and in the Styles combo box, select Heading 3 and Accent 5, 40%. If an orange color palette from the Color menu was chosen, the Styles options would be orange tones.

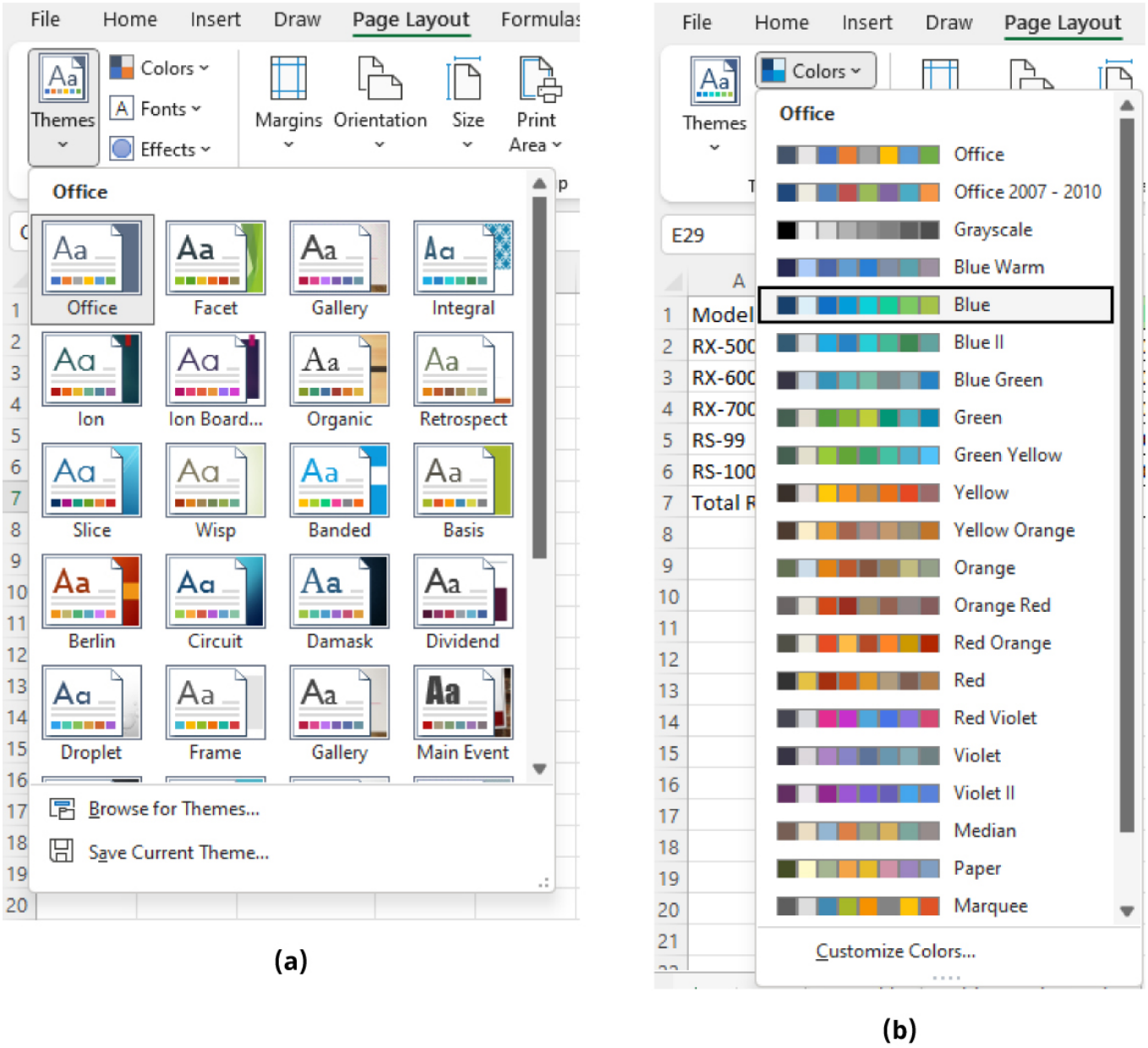


Figure 10.59: (a) Themes are useful if your company has a custom theme to apply for all charts. (b) Color schemes can be customized to meet your needs. (Used with permission from Microsoft)

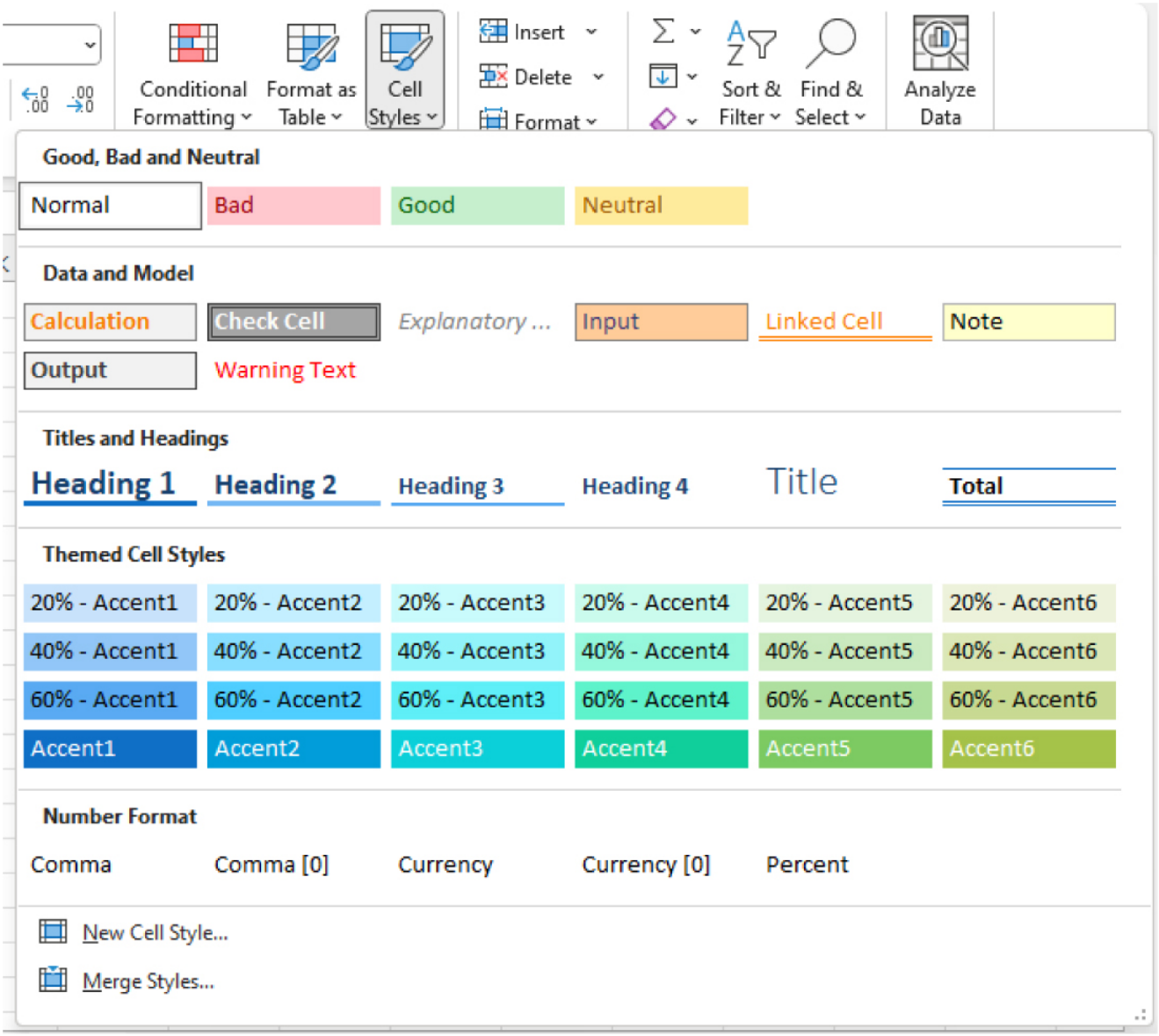


Figure 10.60: You can use the built-in themes to automatically format heading and numbers. (Used with permission from Microsoft)

	A	B	C
1	**Model**	**Price**	**Units Sold**
2	RX-500	$17.99	5000
3	RX-600	$25.99	4000
4	RX-700	$35.99	3000
5	RS-99	$99.00	2000
6	RS-100	$114.99	1000
7	Total Revenue		$ 614,870.00

Figure 10.61: Applying a theme is easier than formatting each section of the table individually. (Used with permission from Microsoft)

Creating Custom Themes

Often companies will have a color scheme for all communications and materials within and outside of the company. The palette is usually linked to the company logo and is an essential part of creating a unified and professional appearance for marketing

purposes and legal usage. If a company has a specific theme, it can be saved and used by all employees. The saved theme file can be shared company-wide to ensure consistency. Moreover, the saved theme can be used across all Microsoft products.

There are two ways to create a custom theme. First, users can create the theme from scratch. This means you define the font, color, and other elements of the theme. Second, and perhaps easier, is to start with an existing theme that is close to the desired theme. You can then make the needed adjustments such as changing the font or modifying heading colors slightly. First, format your table using the desired settings, and then choose Save Current Theme at the bottom of the Themes menu to save the theme as a file that can be used in other Microsoft products and/or shared with others.

Link to Learning

Go to Microsoft's theme repository and look for Excel themes. Think about how they might be used in a business. Look for themes that might be appropriate for an accounting department or a human resources department.

Other Formatting Tools

Another time-saving strategy is using the Format as Table tool. On the Home tab, select the Format as Table combo box to see many options for formatting tables (Figure 10.62). The background color, heading font, and borders can be changed; additionally, column widths will change automatically to fit the text. This feature also automatically adds filters to the columns, which can help with organizing the data in a table Figure 10.63. However, using the Format as Table feature does not format cells according to their content, such as currency.

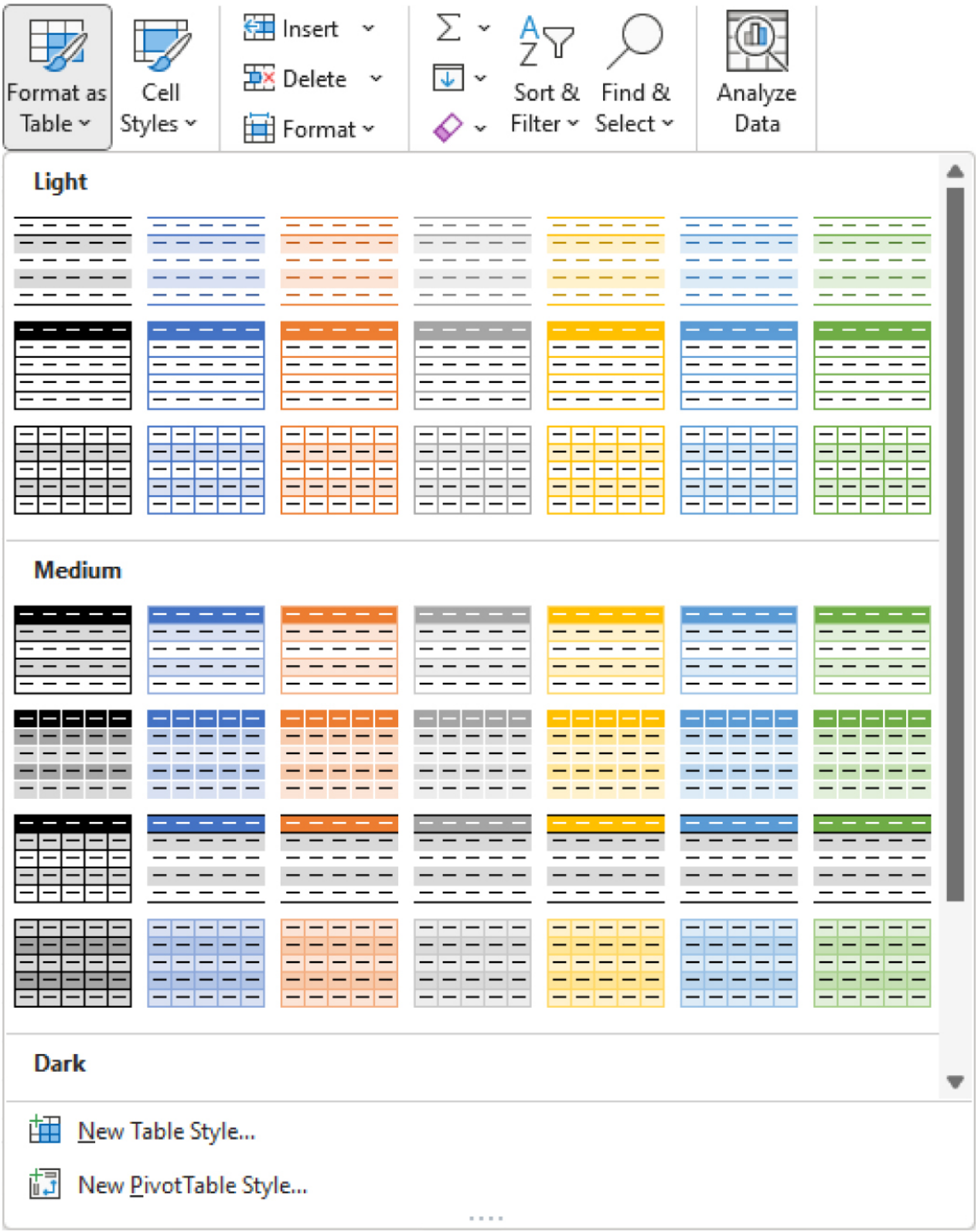


Figure 10.62: The Format as Table tool is a simple way to add full formatting to basic tables. When you format the selection as a table, there are several color options and themes to choose from. (Used with permission from Microsoft)

	A	B	C
1	Model	Price	Units Sold
2	RX-500	17.99	5000
3	RX-600	25.99	4000
4	RX-700	35.99	3000
5	RS-99	99	2000
6	RS-100	114.99	1000
7	Total Revenue		614870

Figure 10.63: You get a filter option after the selection is formatted as a table. (Used with permission from Microsoft)

Adding Images to the Background

Beyond formatting cell content, you can also add an image to a table's background. The background is a canvas that is displayed behind the cell contents of a worksheet. It could be useful to add a logo, or a topic-related image to the background of a table, especially for an internal or client-facing presentation. Often, this feature is used to indicate that documents are not finalized but in a "draft" stage.

To add an image in the background, first select the table, then go to the Page Layout tab and select Background. You will then be prompted to select an existing file, or you can search online for an image. An image of the word "Confidential" has been added in Figure 10.64 to show that this report should be kept confidential and not shared. You may insert an existing file or search the internet for a picture.

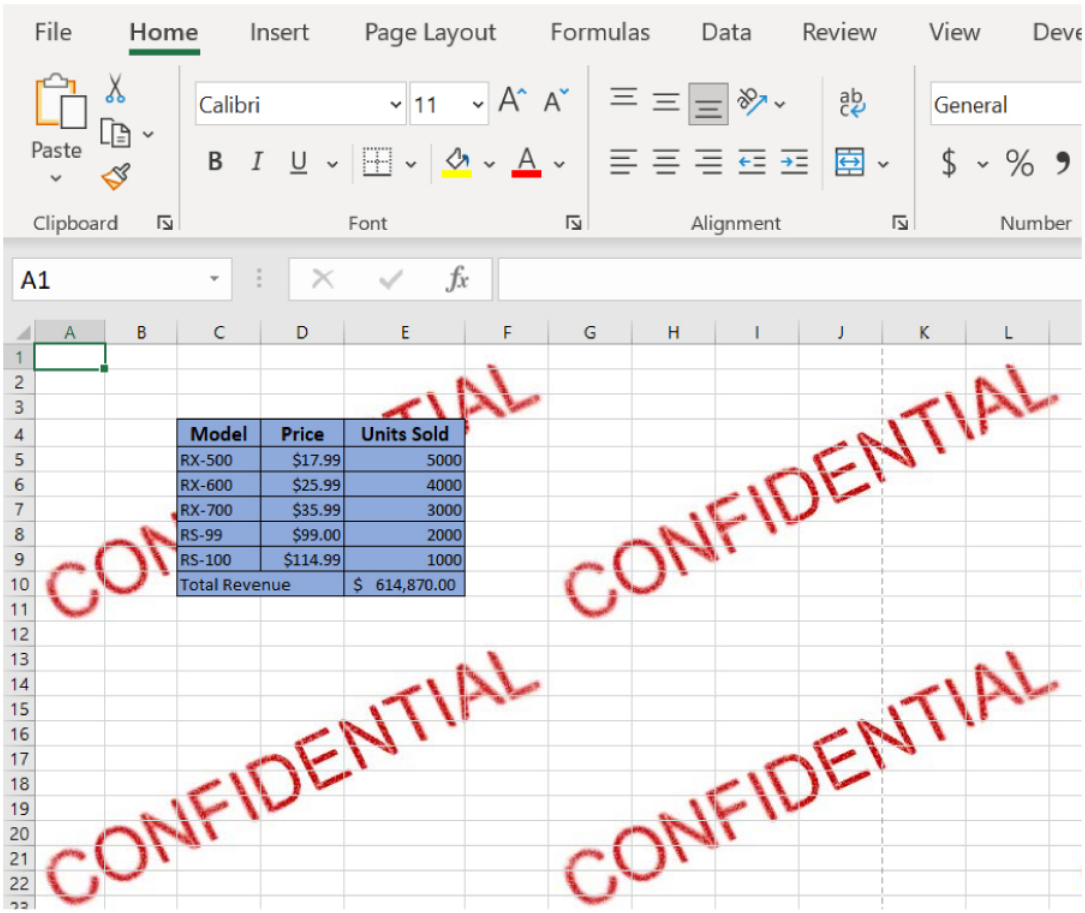


Figure 10.64: The background change tool is useful for design purposes or for company branding. (Used with permission from Microsoft)

Custom Formats for Content

Custom formats for content allow users to design a format for data contained in cells. For example, you can use custom formatting to set a format type for how your purchase order numbers are input into your company's system, or to change how dates are displayed. This feature is different from merely changing a cell's format such as the decimal points displayed or how months are abbreviated. Instead, the custom format can be saved as a format that is then widely applied to worksheets. You can create a format from scratch, but it is easier to use one of the built-in formats and adjust if necessary. You can customize most aspects of the formatting—from spacing, to displayed decimals, to font color.

Shortening Large Numbers

Sometimes, the appearance of many repeated large numbers in a spreadsheet can be overwhelming. Other times, you may simply want to reduce numbers to estimates. Excel can shorten large numbers so that they are summarized by a letter, such as K (for "thousands") or M (for "millions"). Figure 10.65 shows that the estimated COGS varies depending on the quantity sold and the unit cost.

Unit Cost	$ 85		$ 19,170,900	$ 70	$ 75	$ 80	$ 85
Quantity Sold	225,540		155,000	$ 10,850,000	$ 11,625,000	$ 12,400,000	$ 13,175,000
COGS	$ 19,170,900		180,000	$ 12,600,000	$ 13,500,000	$ 14,400,000	$ 15,300,000
			205,000	$ 14,350,000	$ 15,375,000	$ 16,400,000	$ 17,425,000
			255,000	$ 17,850,000	$ 19,125,000	$ 20,400,000	$ 21,675,000

Figure 10.65: Shortening estimated figures can be useful for presentations and reports, as they will be easier to read than these long numbers. (Used with permission from Microsoft)

Since these figures are estimations for the coming period, they can be abbreviated to the million by marking with an "m." To do this, select the cells on which to perform this process, and then right-click and select Format Cells. In the Format Cells dialog box, go to Custom, as shown in Figure 10.66. In the Type field, delete the existing text, type [0,,"m"], and then click OK. Using the 0 indicates no decimal points and to use only whole numbers. The "m" is used to round to the million units. Excel will change the figures in the selected cells to be rounded up to the nearest million, as shown in Figure 10.66.

D	E	F	G	H	I	J
$19,170,900	$ 70	$ 75	$ 80	$ 85		
155,000	$10,850,000	$11,625,000	$12,400,000	$13,175,000		
180,000	$12,600,000	$13,500,000	$14,400,000	$15,300,000		
205,000	$14,350,000	$15,375,000	$16,400,000	$17,425,000		
255,000	$17,850,000	$19,125,000	$20,400,000	$21,675,000		

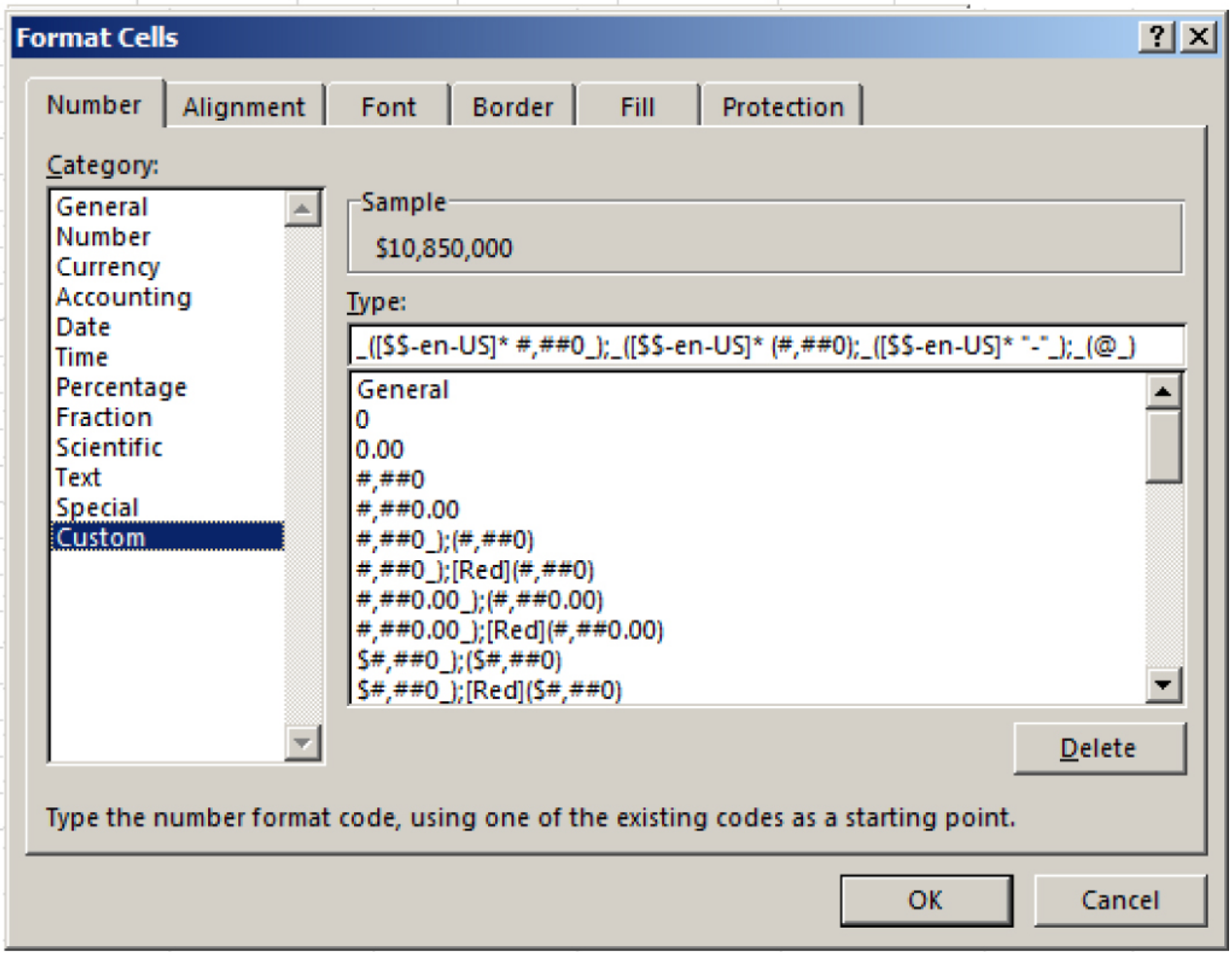


Figure 10.66: There are multiple “Custom” formatting codes, as you can see in the list. (Used with permission from Microsoft)

D	E	F	G	H
$19,170,900	$ 70	$ 75	$ 80	$ 85
155,000	11m	12m	12m	13m
180,000	13m	14m	14m	15m
205,000	14m	15m	16m	17m
255,000	18m	19m	20m	22m

Figure 10.67: Choosing to format large numbers to display as millions can make a table more readable. The finished product could now be further formatted for appearance. (Used with permission from Microsoft)

Common Number Formats

Some number formats come up frequently, such as addresses, phone numbers, or Social Security Numbers (SSNs). Their formats may be consistent in a specific region (like SSNs in the United States), or they may be similar with variations (like phone numbers with all hyphens, hyphens and parentheses, or spaces).

In Figure 10.68, you can see a table of names and contact information. However, there are some issues with the data: the numbers all look the same. Phone numbers should be separated by parentheses for the area code and a hyphen after the exchange, and SSNs use hyphens around the middle two digits. Zip codes should be five digits long, but some are showing up as only four digits; this is because Excel does not recognize the leading zero. As is, the data in the current table is confusing. Microsoft offers a standard command to format cells in these situations.

	A	B	C	D	E	F	G
1	Name	Address	City	State	Zip Code	Phone	SSN
2	Floyd Altenwerth	9543 Lakewood Dr	Newark	NJ	7101	8195930263	272921446
3	Brian Collins	1686 Dovetail Dr	Chicago	IL	60089	7402464512	625861065
4	Jill Fowler	6474 Franklin Av	Hatfield	MA	1038	9733067727	313042959
5	Sheri Foley	2002 Cornier St	Trezevant	TN	38258	8049761222	290113577

Figure 10.68: There are ways to fix the formatting issues in this table without having to manually fix each one. (Used with permission from Microsoft)

First, select each column separately, right-click each column, select Format Cells, and then select Special. For formatting zip codes (Figure 10.69), select the Zip Code column values (but not the header), and in the Special format cell dialog box, select Zip Code, and choose OK. Follow the same steps for formatting phone numbers (Figure 10.70). As you can see in the result shown in Figure 10.71, Excel already has special formats for these number types.

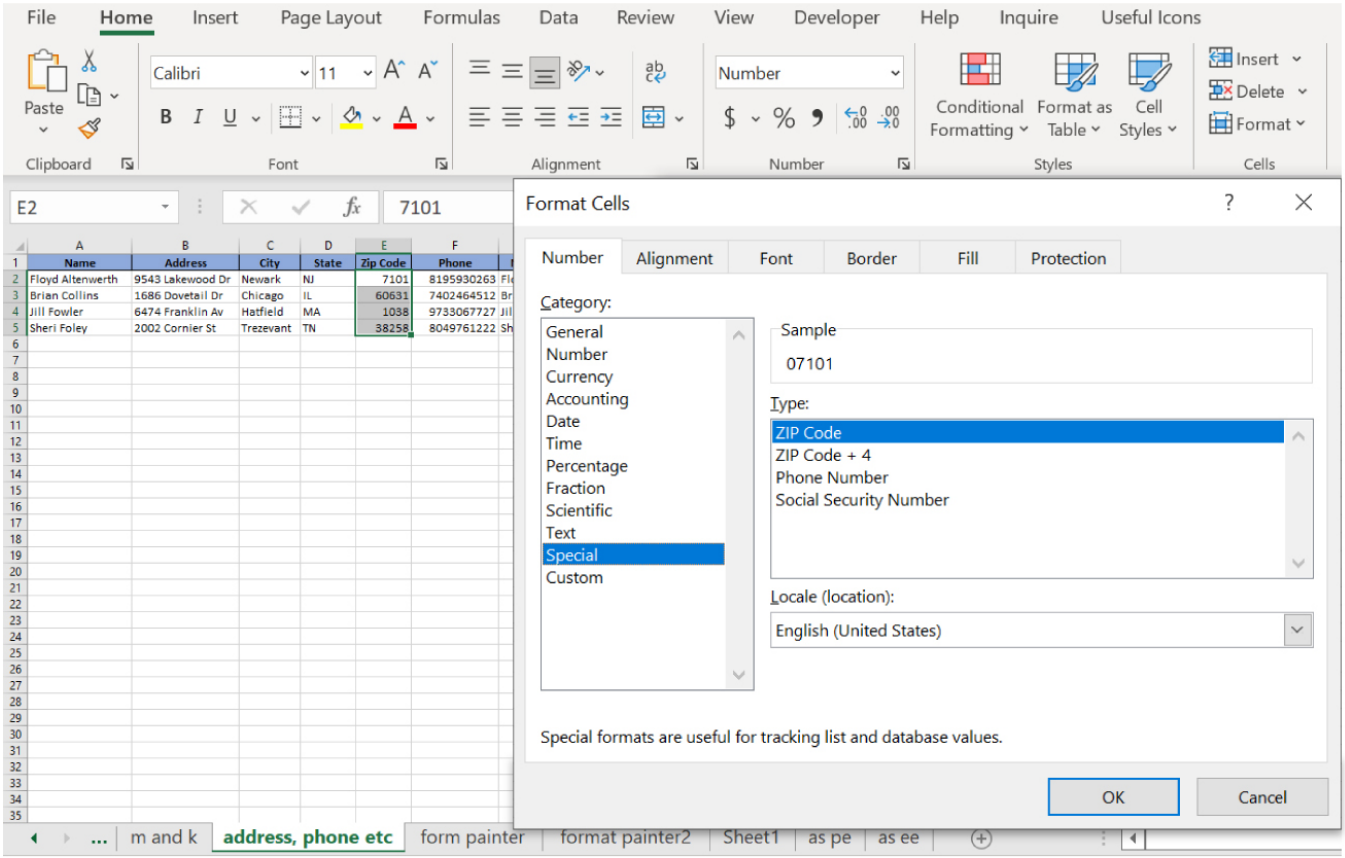


Figure 10.69: Microsoft already has preset formatting for many number types, including zip codes. (Used with permission from Microsoft)

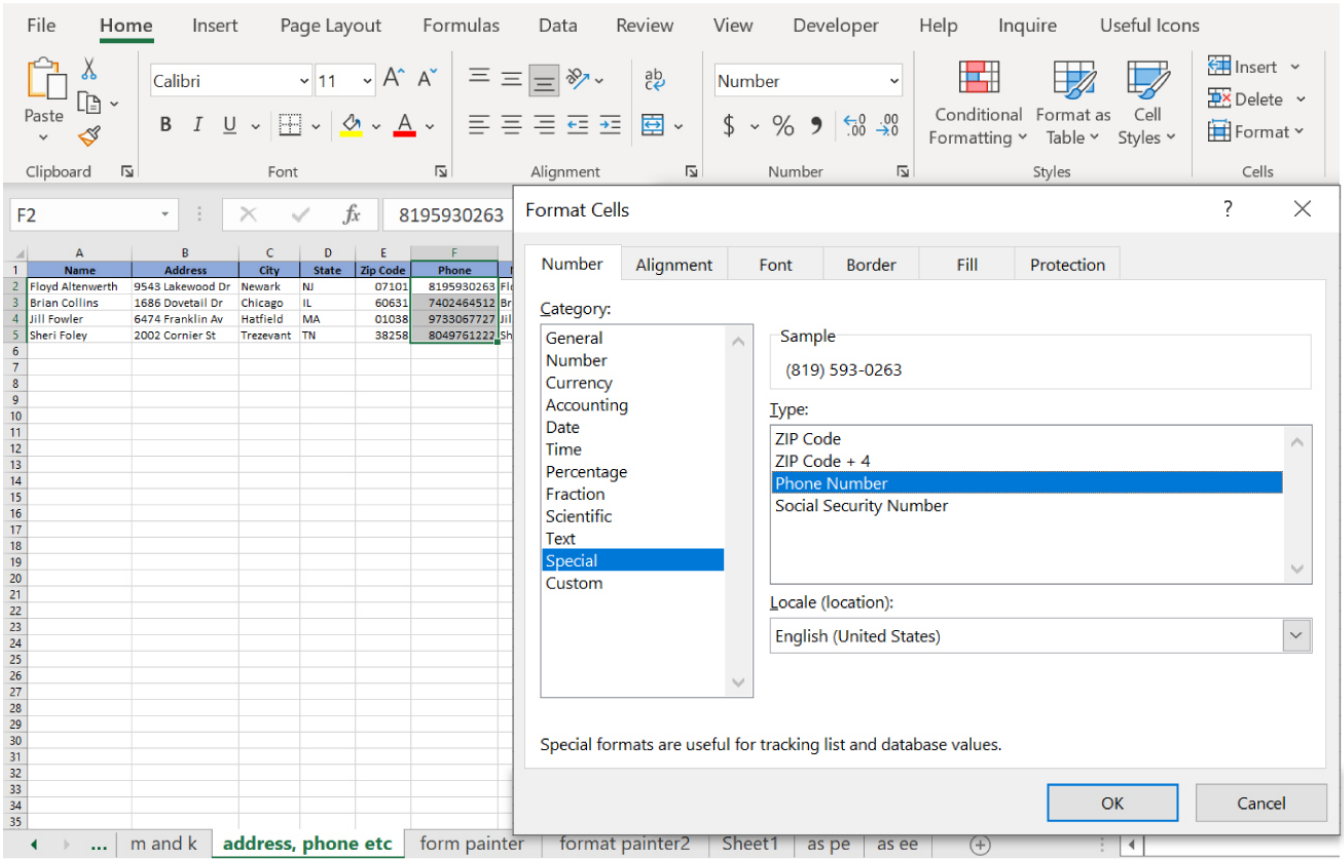


Figure 10.70: Another preset formatting is for phone numbers. (Used with permission from Microsoft)

	A	B	C	D	E	F
1	Name	Address	City	State	Zip Code	Phone
2	Floyd Altenwerth	9543 Lakewood Dr	Newark	NJ	07101	(819) 593-0263
3	Brian Collins	1686 Dovetail Dr	Chicago	IL	60631	(740) 246-4512
4	Jill Fowler	6474 Franklin Av	Hatfield	MA	01038	(973) 306-7727
5	Sheri Foley	2002 Cornier St	Trezevant	TN	38258	(804) 976-1222
6						

Figure 10.71: The finished product can save the consuming process of writing the parentheses or hyphens manually and decreases data entry errors. (Used with permission from Microsoft)

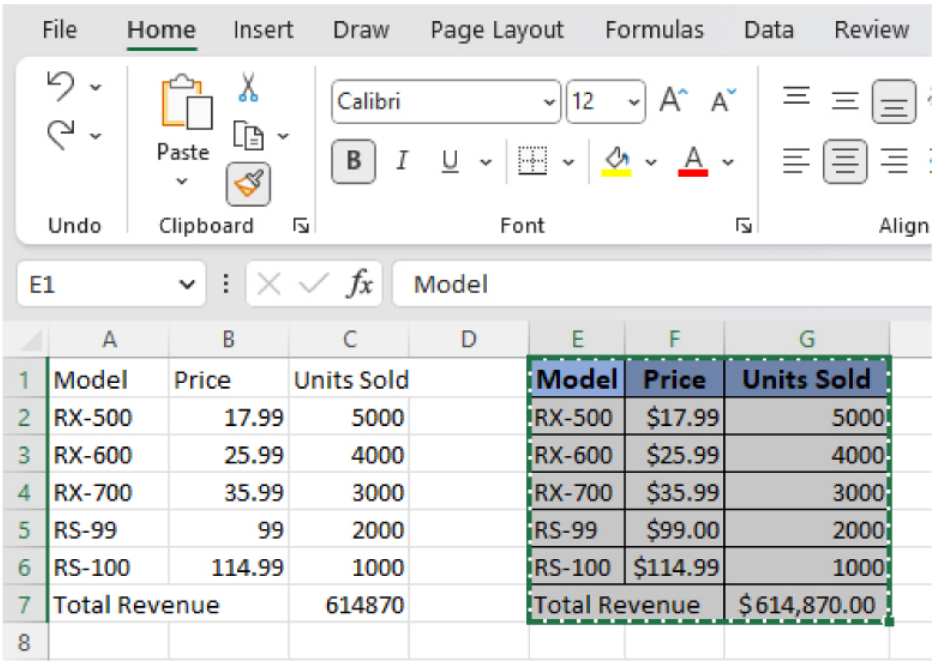
Link to Learning

The mail merge feature of Microsoft Word allows the user to create letters, mailing labels, or envelopes from a list of names and addresses such as a customer list. This can make the process much quicker than formatting each letter or envelope individually. Often lists of customers with contact information such as addresses and emails will be organized in a spreadsheet. Mail merge connects a Word document to an Excel data table to seamlessly create the documents needed for mailing. Watch this tutorial from *Business Insider* on Mail Merge to learn the steps.

Copy Formatting

Copying the format of a given cell is one of the most used commands in Microsoft Office because it is available not only in Excel, but in all other Office applications. The Format Painter command lets a user copy a certain range's formatting and apply it to a new range by selecting the cell with the desired format to be copied, and then selecting the Format Painter icon on the Home tab. Format Painter can be used to transfer the formatting from one cell or a whole table to another cell or table. The Format Painter tool is the paintbrush icon on the Home tab in the Clipboard command group. To use the tool, first select the cell or cells that have the

formatting you want to apply to other cells. Figure 10.72 shows the selected cells E1 to G7. Then, click on the paintbrush icon on the Home tab. As you do, your cursor will change to a paintbrush. With that paintbrush, select the range of cells to which you want to apply the formatting. In this example, those cells are A1 to C7. The unformatted table will then be formatted in the same manner as the formatted table. The result is apparent in Figure 10.73. The only step left is adjusting the columns by clicking on the border of each column on top.



	A	B	C	D	E	F	G
1	Model	Price	Units Sold		Model	Price	Units Sold
2	RX-500	17.99	5000		RX-500	$17.99	5000
3	RX-600	25.99	4000		RX-600	$25.99	4000
4	RX-700	35.99	3000		RX-700	$35.99	3000
5	RS-99	99	2000		RS-99	$99.00	2000
6	RS-100	114.99	1000		RS-100	$114.99	1000
7	Total Revenue		614870		Total Revenue		$614,870.00
8							

Figure 10.72: The Format Painter tool allows you to copy the formatting from one table and apply it to another. Notice the cursor paintbrush next to it. (Used with permission from Microsoft)

	A	B	C	D	E	F	G
1	Model	Price	Units Sold		Model	Price	Units Sold
2	RX-500	$17.99	5000		RX-500	$17.99	5000
3	RX-600	$25.99	4000		RX-600	$25.99	4000
4	RX-700	$35.99	3000		RX-700	$35.99	3000
5	RS-99	$99.00	2000		RS-99	$99.00	2000
6	RS-100	$114.99	1000		RS-100	$114.99	1000
7	Total Revenue		########		Total Revenue		$614,870.00

Figure 10.73: Both tables are formatted using the same font, fill color, and number format. (Used with permission from Microsoft)

Mac Tip

The Mac version uses Cell Styles to format cells.

There are also other ways to copy formatting. Another way is to use the Paste Special tool. You first select the whole formatted table and press Ctrl+C (to copy it), then select your entire unformatted table (Figure 10.74a). Then, on the Home tab, choose Paste Special from the Paste menu and click on Formatting (R) from the last row, as shown in Figure 10.74b. This tool will paste just the formatting from your original selection; it will not paste any of the values or formulas (Figure 10.74c).

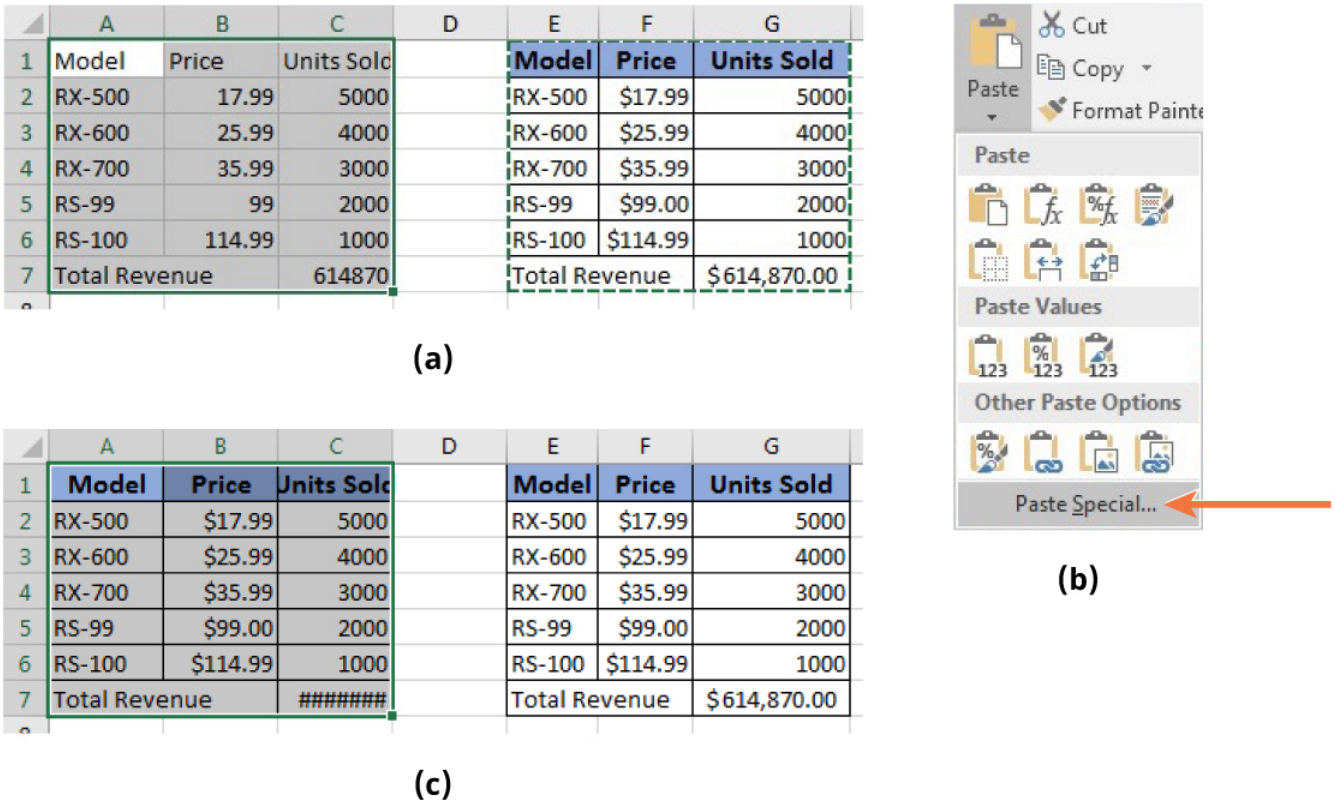


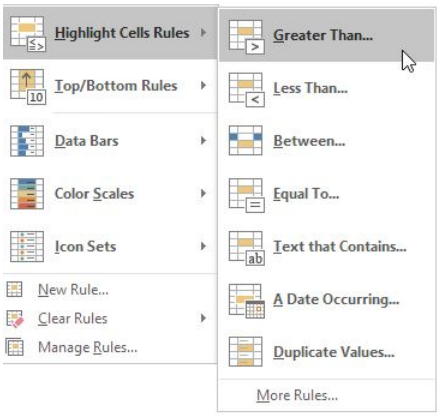
Figure 10.74: Paste Special can be used instead of the Format Painter tool. (a) First, copy the table with the formatting you want to apply. Then, highlight the table where you want to apply the formatting. (b) Choose Paste Special. (c) The tool applies the formatting only; it does not copy any of the cell contents. You would then adjust your column widths to avoid the error. (Used with permission from Microsoft)

Conditional Formatting

Using spreadsheet functionality to enhance critical thinking is a primary reason that Excel is so popular among business professionals. Decision-making is made easier when users can quickly spot trends, identify variances, and be alerted when certain criteria is met. Excel's conditional formatting feature is a really powerful tool when it comes to applying different formats to data that meets certain conditions. **Conditional formatting** is one of the most simple yet powerful features in Excel by applying user-specific formats to a cell/cells when user-specific conditions (rules) are met. Not only does it make a spreadsheet look awesome, but it also helps make sense of the data.

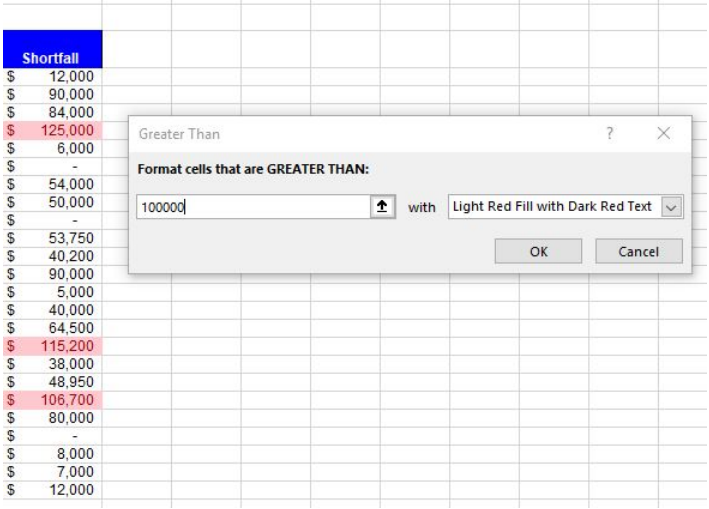


Clicking the Conditional Formatting button on the Home tab of the ribbon offers several options to define the condition criteria (rules), and several formatting options to display the data in meaningful ways. To choose formats that are applied to a cell(s) when a condition is met, select a range of cells, then click the Conditional Formatting button to display a menu of rules. Clicking a rule will expand an additional menu.



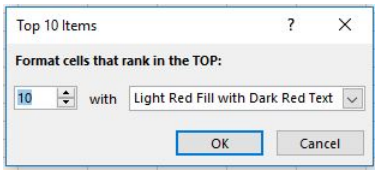
Conditional Formatting menus

For example to identify which cruise accommodation categories provide the most significant revenue shortfall, utilizing a highlighting rule that formats cells that are greater than $100,000 would be a very practical conditional formatting rule that could provide some strategic information. Selecting the range of G5:G28 and applying the Greater Than rule, will create eye-catching formatting. The data in the first field can either be a cell reference or a static value, as shown below.



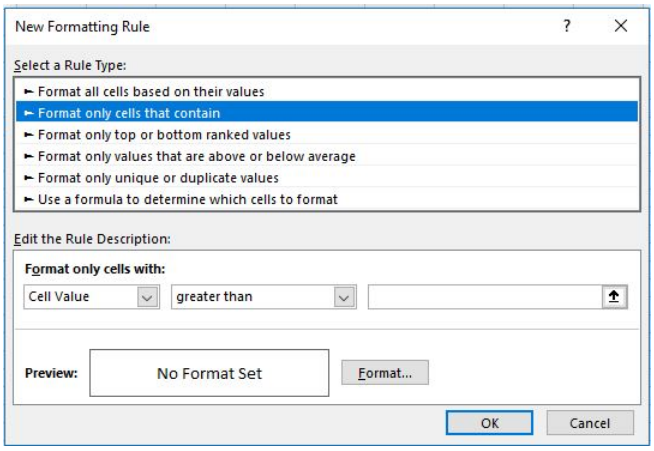
Greater Than CF rule

Numerous rule types exist beyond the preset comparison operator menu choices. Rules can identify cells that contain certain text or before/after a certain date, or even highlight duplicate data. Top/Bottom Rules can reveal the top or bottom 10 records in a certain column. The quantity can be modified from the top/bottom 10 to a user-specific number.



Top 10 criteria

Custom rules can be defined by choosing More Rules… from the Highlight Cells Rules menu, which opens the New Formatting Rule window. Choosing alternative Rule Types will modify the functionality available in this window.



New Formatting Rule

After defining the rule criterion, custom formats can be selected by clicking the Format button. The Format Cells window opens to allow custom Number, Font, Border or Fill formatting.



Icon sets menu

To enforce more complex rules, multiple conditional formatting rules can be applied to the same data. However too many colors can sometimes be distracting, and should be used sparingly. Therefore, Excel offers more formatting choices than just color fills. Data bars, color scales and icon sets can also be used to emphasize data that meets certain conditions.

The icon sets work great when color is not effective, such as when printing to black & white laser printers. Icons are even more noticeable than colors because of their unique look and sparing use. Icon sets will help visually represent the data with directional arrows, shapes, indicators, ratings, and other objects. For icons in sets of three, Excel will assign icons by dividing values into thirds – the first icon is assigned to the top one third of values, the second icon is assigned to the second third of values, and the third icon is assigned to the lowest one third of values. The values are adjusted for four and five-icon sets. Conditional formatting's flexibility is extensive, but perhaps even more impressive is that, like formulas, conditional formatting rules are volatile. As the data changes, the conditional formatting dynamically adjusts to evaluate the new data against the existing conditional rules.

Conditional formatting automatically applies visual changes to cells that meet specific criteria. Found in the Styles group, it supports:

- Highlighting cells greater/less than a value
- Identifying duplicates
- Color scales (gradient fill)
- Data bars (in-cell charts)
- Icon sets (arrows, checkmarks, flags)

Example:
A sales manager might use conditional formatting to highlight monthly sales below quota in red and above target in green.

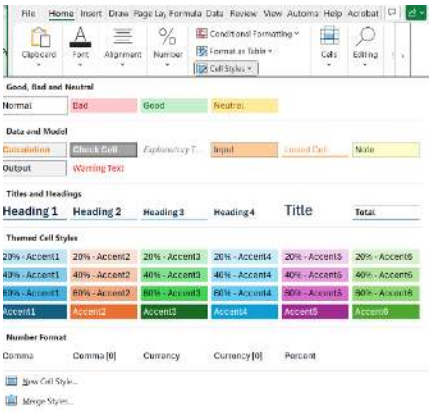


Figure 3.5.1: Showing the dropdown for cell styles that are available to use.

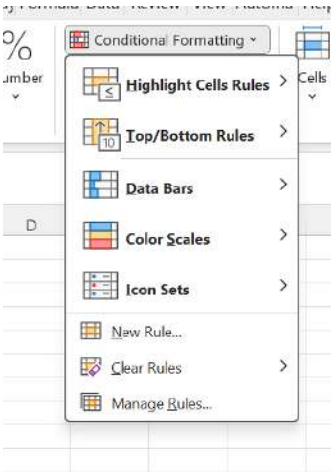


Figure 3.5.2 Showing the conditional formatting drop down.

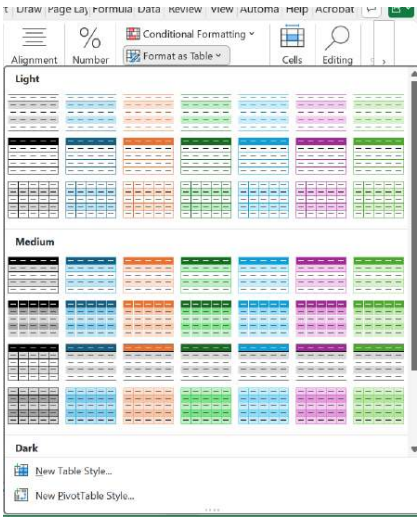


Figure 3.5.3 Showing the dropdown formatting as a table.

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2.1.2: Inserting Images, Shapes, and SmartArt

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

While Excel is primarily used for managing and analyzing data, visual elements play a key role in enhancing communication, reinforcing branding, and clarifying complex information. By incorporating images, shapes, and SmartArt, users can make spreadsheets more interactive, professional, and easier to understand—particularly in workbooks shared with clients, team members, or stakeholders.

Images

Images add visual context and branding to an Excel workbook. Common uses include inserting company logos, product images, or screenshots to support data explanations or instructions.

- To insert an image:
  - Go to Insert > Pictures and choose from This Device, Stock Images, or Online Pictures.
- Once inserted, images can be resized using corner handles and moved anywhere on the worksheet.
- Right-click an image to access formatting options, such as cropping, adding borders, or applying artistic effects.

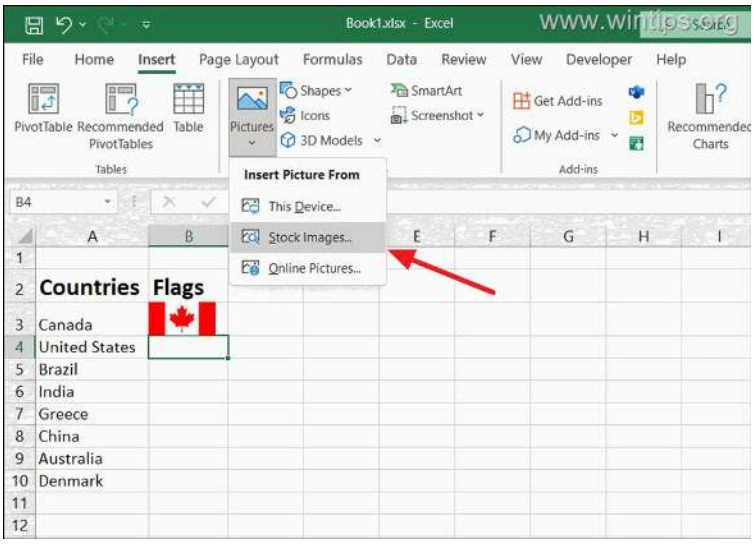


Figure 6.8.1 Picture tab, and stock images located.

Practical Tip: Place logos in the header or a fixed corner of the worksheet to establish branding without cluttering the main content area.

Shapes

Shapes provide structure and emphasis. They are useful for creating callouts, grouping related data, and drawing attention to key figures or trends.

- Access shapes through Insert > Shapes, which includes:
  - Basic forms (rectangles, ovals)
  - Arrows (to indicate flow or direction)
  - Callouts (for notes or instructions)
  - Stars and banners (to highlight key data)
- Shapes can be combined with text boxes to create labeled sections or visual annotations.

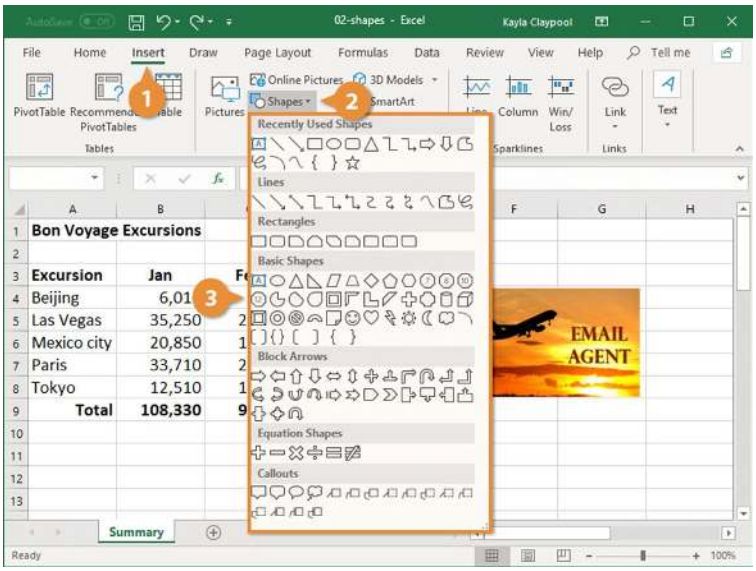


Figure 6.8.2 Shaptes tab located

Once inserted, shapes can be customized using the Format tab, allowing changes to fill color, outline, shadow, and text alignment.

Use Case: A sales report may include arrows pointing to charts or metrics to explain performance shifts, while a product sheet might use callouts to highlight product features.

SmartArt

SmartArt is a powerful feature that converts text into professional diagrams, making abstract concepts easier to understand.

- Found under Insert > SmartArt, it includes categories such as:
  - Process (to show steps or workflows)
  - Cycle (to represent repeating stages)
  - Hierarchy (to show organizational structure)
  - Relationship (to illustrate connections between elements)
- After inserting a SmartArt graphic, use the SmartArt Design and Format tabs to:
  - Modify layout and add additional steps
  - Adjust colors and styles to match workbook themes
  - Align elements within the spreadsheet

Pro Tip: Use SmartArt alongside supporting data to create visual summaries that are easy to present or share with non-technical audiences.

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2.1.3: Data Tables and Ranges

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Differentiate between a spreadsheet and a Data Table
- Explain the advantages of a Data Table
- Create/insert a Data Table from data in a spreadsheet
- Define a cell range
- Select and name a cell range
- Differentiate between a cell range and an array

WorldCorp has sufficient savings for capital investment for the Fairfax project, yet the chief financial officer (CFO) wants to borrow from a bank about 50 percent of the amount of the estimate for the new addition. There are many banks in Fairfax, each offering different interest rates and years to pay back the loan. The CFO is not sure which offer is best, as the longer the loan period is, the more interest WorldCorp will end up paying, yet the shorter the loan period, the higher the payment will be. The CFO is also analyzing the different interest rates and how they affect the installments and subsequently the total interest charge over the life of the loan.

This case shows why it's important to learn the intricacies of using Microsoft Excel's Data Tables. Data Tables can be helpful to assist management in determining the best course of action by evaluating interest charges and monthly payments. In this section, you will create a data table from existing data and will discover the advantages of using the Data Table tool in the What-If Analysis, plus related concepts and definitions, such as data ranges and arrays. The Data Table's powerful analysis options will be further explored in Organizing and Presenting Data.

Differentiating Between a Spreadsheet and a Data Table

Spreadsheets have a wide variety of applications and can be used for accounting, budgeting, data collection and analysis, and operations efficiency. Spreadsheets are used in all departments of corporations, such as marketing or operations. These departments can use spreadsheets in a variety of ways, such as compiling information from market studies, or performing statistical analysis on operations from the manufacturing plant.

A Data Table is a scenario-building tool. It lets users choose a set of cells on the spreadsheet, and then outputs different solutions or forecasts depending on different scenarios. The difference between a Data Table and a spreadsheet is that a spreadsheet is a file with blank cells that can be formatted using the various tools and commands contained in the application. A Data Table can be part of (embedded in) a spreadsheet, but a spreadsheet can also include a graph, some text for information, or the listing of the inputs for the Data Table. The Data Table feature of Excel automatically builds a table of data based on certain inputs that is part of the spreadsheet. Figure 10.2 shows an example of an Excel-generated Data Table, as well as the data used in the scenarios. You will build a Data Table after learning more about its uses.

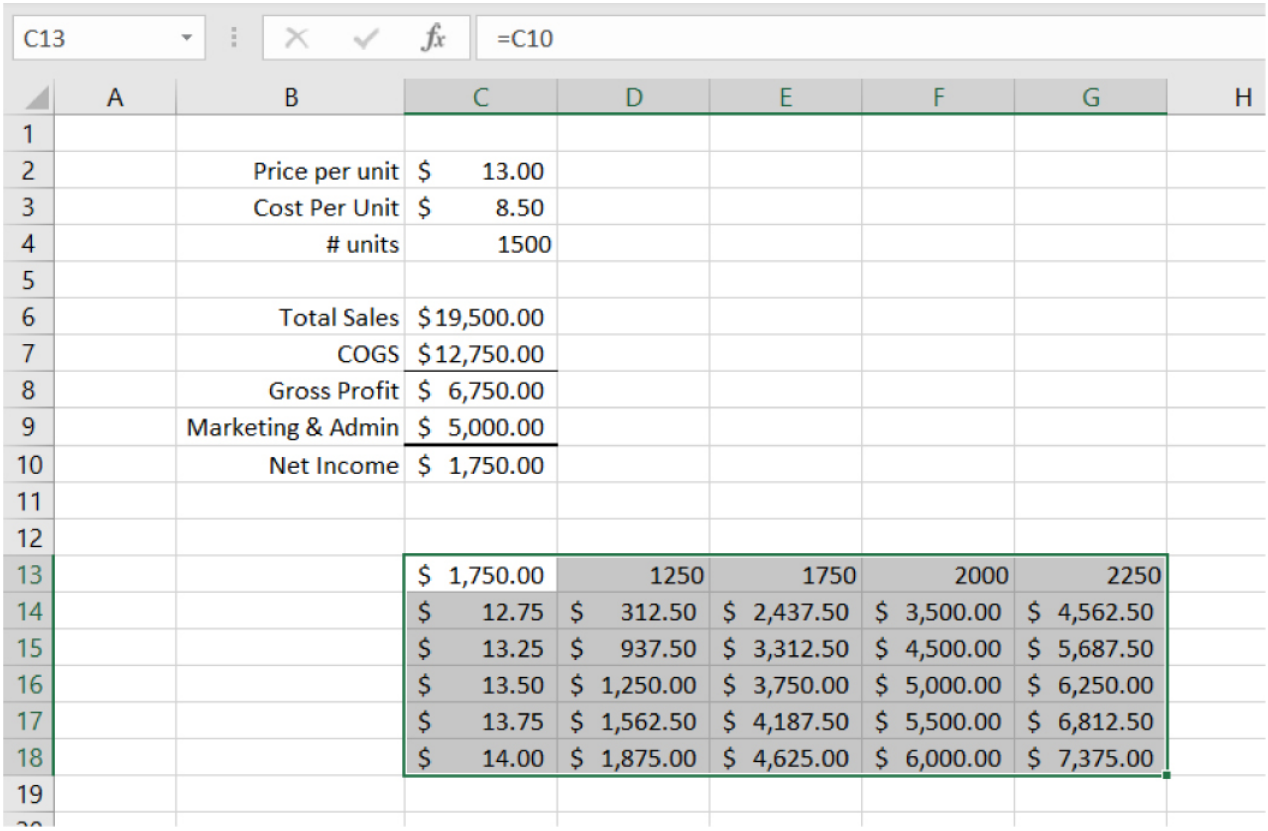


Figure 10.2: Data Tables are added to a spreadsheet and are autogenerated in Excel based on the input you select. (Used with permission from Microsoft)

The Advantages of a Data Table

The advantages of Data Tables are many. One of their most important advantages is their ability to automate scenario-building. Another advantage is increased accuracy due to less manual entry of data. If you were to create a scenario from a blank workbook, you would need to build out the formulas initially and then copy them through the desired levels of the inputs. This increases the possibility of user error caused by inputting values or formulas incorrectly. By using the Data Table feature, all that work is done automatically—and quickly. Data Tables allow users to view all the levels of inputs in a single table without inputting multiple formulas.

Consider the example of expanding Fairfax's WorldCorp location. You have gathered the needed information to determine the amount of the loan you will need to finance the added capacity. You have the loan terms from banks in the area and you know that the loan payment period will be ten years. WorldCorp is working on its annual budget, so the CFO wants you to investigate the annual payments, not the monthly payments. The CFO also wants to examine the variability of the annual installment if the interest rate is increased by 0.5 percent increments per year over the life of the loan. The Data Table in the What-If Analysis will automatically perform the annual payment calculations for each increment. The CFO will then be able to look at the results and determine which loan from which bank will best meet the company's needs.

The first step in this analysis is to set up your data. Since you're looking at how the interest rate affects the annual payment, you can use Excel's Payment (PMT) function, which uses the present value (the value of the loan), the number of payments, and the rate. The PMT function is in the Financial library of functions found on the Formulas tab. The present value (PV) is principal to be borrowed; in this case, we will use $750,000, which is half of the total cost of the expansion. This was determined by the initial research by the CFO as the amount needed to finance the company growth. The time period of the loan has been set at ten years. Most loans are paid monthly, but since you are analyzing the annual payments, you will use 10 (not 120) for N (shown as Nper in the function builder) to define the number of payments. After gathering all the interest rates offered by the banks, it was determined that the average interest rate (I) of all is 6.5 percent. Using these input values, the yearly payment can be determined using the financial PMT function. Figure 10.3 shows the building of the PMT function in Excel.

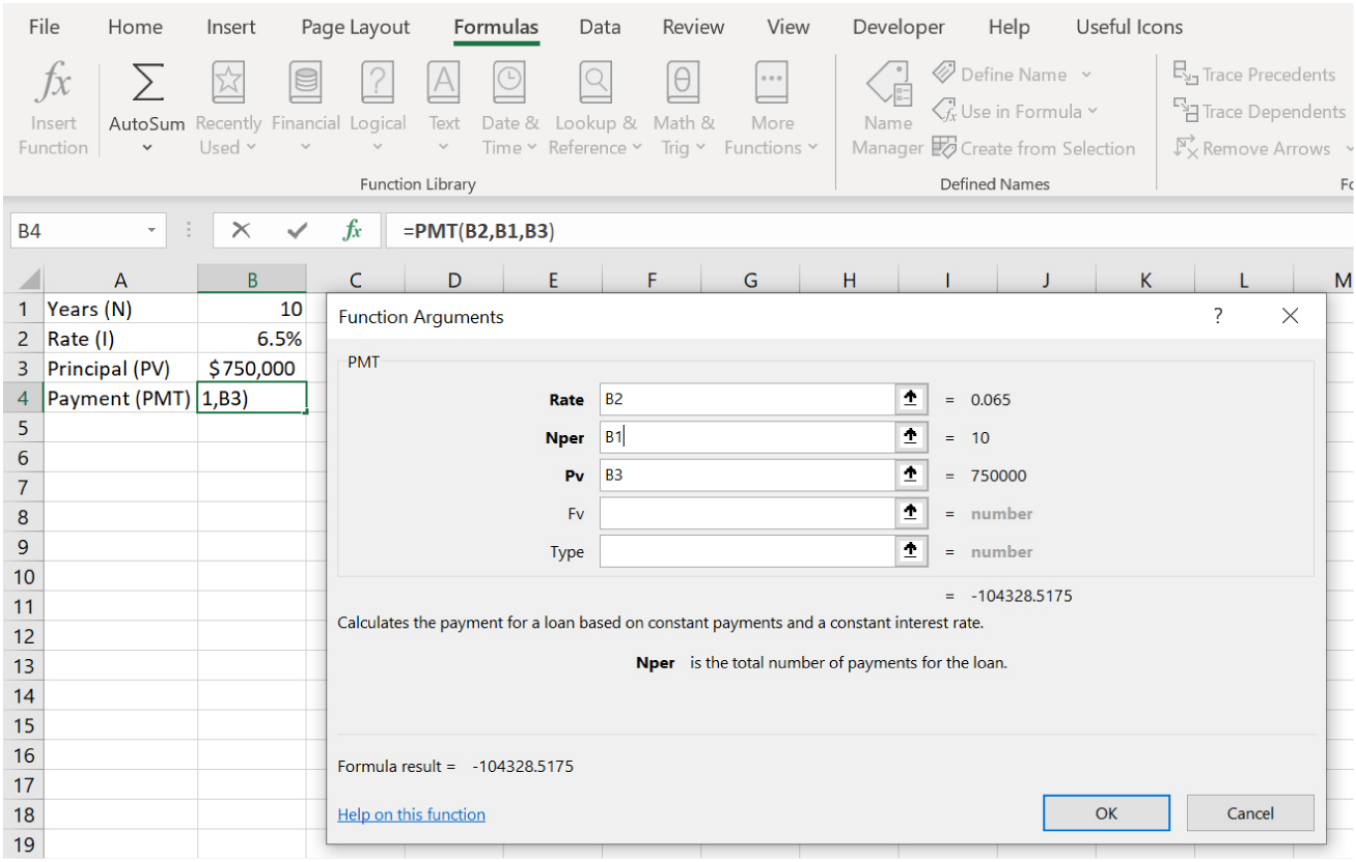


Figure 10.3: Using the inputs of the interest rate, the number of years, and the principal amount, you can quickly determine the annual payment for the loan. (Used with permission from Microsoft)

The result is an annual payment on the loan of $104,328.52 (Figure 10.4). The output for Excel with the PMT function is negative by default, which is displayed in parentheses and in red. This is to indicate that the loan total will decrease by that amount each year after the payment is made. Keep this in mind as you examine the output.

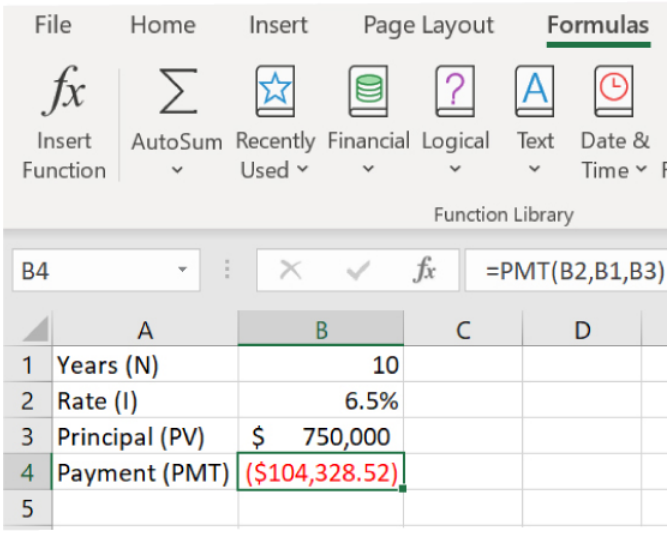


Figure 10.4: The PMT function in Excel calculates the payment required for a loan. The output is negative by default to show that the loan will decrease by that amount each time a payment is made. (Used with permission from Microsoft)

The next step in the analysis is to compare the payments with different loan terms. You can calculate the payment manually using the PMT function many times—that is, every time you change the interest rate. You can play around with it by changing the interest rate and seeing how it affects the payment. If the rate is lower, the payment will be lower, and if the rate is higher, the

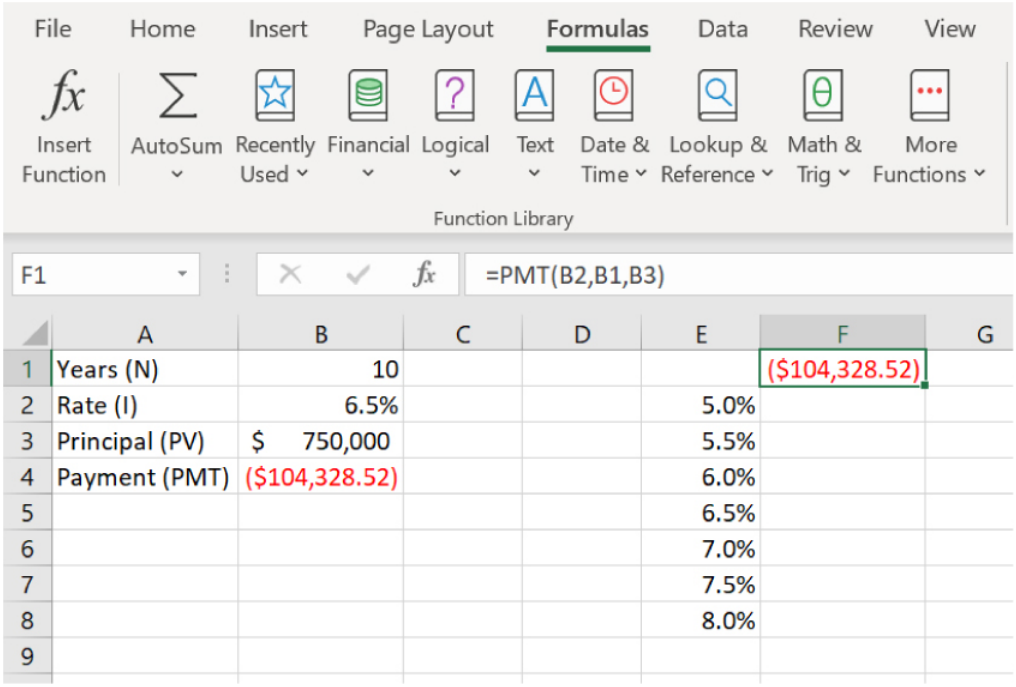
payment will be higher. For example, in Figure 10.3, if you change the rate to 5 percent, the payment automatically updates to $97,128.43. However, this approach does not retain all of the options easily. Unless you make a separate table to capture the impact of changes in the interest rate on the payment, that information is lost each time you make a change to the inputs. If you do create a table, you would need to format it in a manner suitable for additional analysis and decision making. It would be a time-consuming exercise to record all of the data for each interest rate, and then you would need to take an extra step to summarize it in an easy-to-follow table. By creating a Data Table, you can use various levels of the interest rate to calculate the payment and summarize it in one concise table.

Real-World Application - Calculating Mortgage Payoff Schedule

PMT is a useful tool for comparing different interest rates and their impact on monthly payment. It can also be used to determine a mortgage payoff schedule. Paying down a mortgage at a faster pace than agreed upon can lead to significant savings in interest payments. Even one additional payment a year can have a large impact on the amount of interest paid. You can find any number of amortization templates available online, either where you input the information and the site calculates it for you, or through an Excel template. Do some online research to find an Excel template to help you calculate your mortgage payoff schedule. Open the template and review the formulas. Notice the use of IF and PMT functions throughout. Using the template, locate a home to purchase and determine the payoff schedule for the home using today's interest rates. If you own a home already, determine what one additional payment per year will do to your final home cost upon payoff.

Creating a Data Table from Data in a Spreadsheet

To facilitate the process of comparing various interest rates on the annual payment, you can create a Data Table. To do so, the information must be arranged on the spreadsheet in a specific way. First, make a list in a column of the interest rates being examined. The order doesn't matter to Excel, but it makes the data easier to analyze if you put them in numerical order, either lowest rate to highest or vice versa. In the next column to the right and one row above, use the PMT function to calculate the payment at the current rate (recall, you used 6.5 percent), as shown in Figure 10.5.



	A	B	C	D	E	F	G
1	Years (N)	10				($104,328.52)	
2	Rate (I)	6.5%			5.0%		
3	Principal (PV)	$ 750,000			5.5%		
4	Payment (PMT)	($104,328.52)			6.0%		
5					6.5%		
6					7.0%		
7					7.5%		
8					8.0%		
9							

Figure 10.5: To create a Data Table, you must first determine the list of input values, in this case the changing interest rate. (Used with permission from Microsoft)

Next, select the area of the spreadsheet where the changing input values are contained. In this example, that is cells E1:F8. On the Data tab, you will see the What-If Analysis menu group on the right side. Select the drop-down arrow and choose Data Table (Figure 10.6).

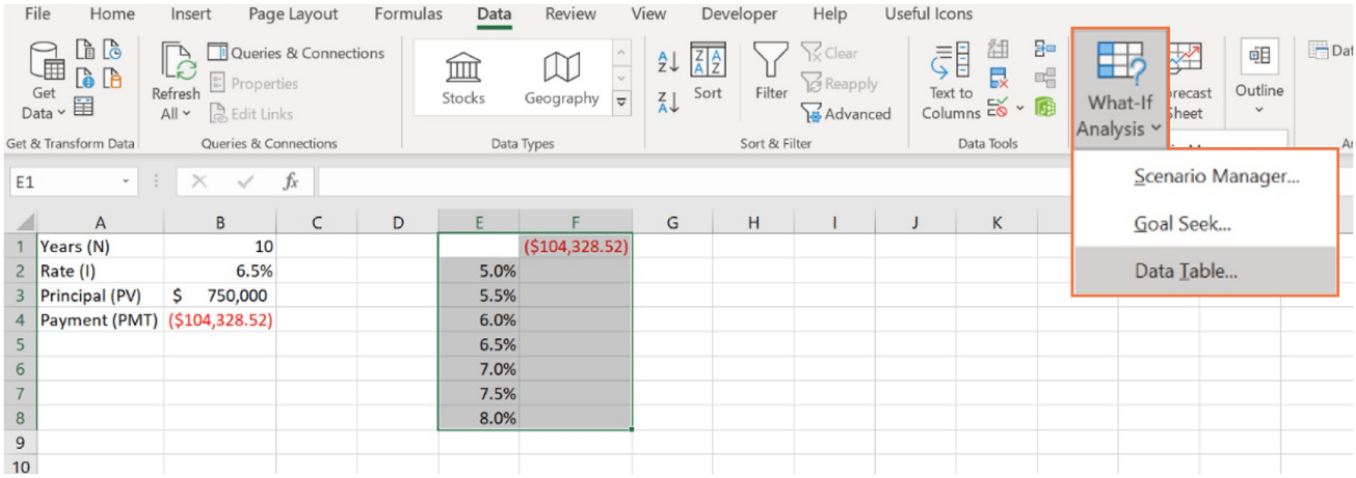


Figure 10.6: To create a Data Table, use the What-If Analysis menu. (Used with permission from Microsoft)

When the Data Table tool is selected, a dialog box appears for inputting data. Because the interest rates are listed in columns, use the "Column input cell" box. In this cell, place the cell reference for the original interest rate used in the PMT function. Notice the dollar sign ($) in front of the letter and number in the cell reference. This will set the column input cell to always refer to the value in cell B2. This is referred to as an absolute reference. You will learn more about absolute references in Absolute Cell References. For this example, the cell is B2 (Figure 10.7).

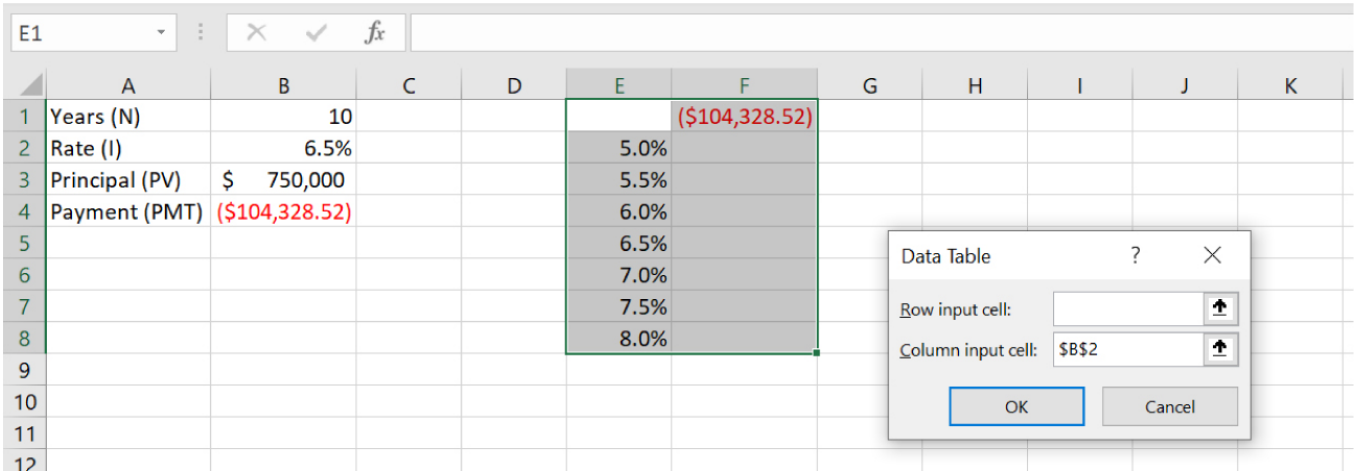


Figure 10.7: If you had placed the interest rates in a row rather than a column, you would use the "Row input cell" box instead of the "Column input cell" box. (Used with permission from Microsoft)

The Data Table will automatically calculate the payment at each of the interest rates listed in the column below the PMT, as shown in Figure 10.8. You will need to format the data to be Accounting or Currency.

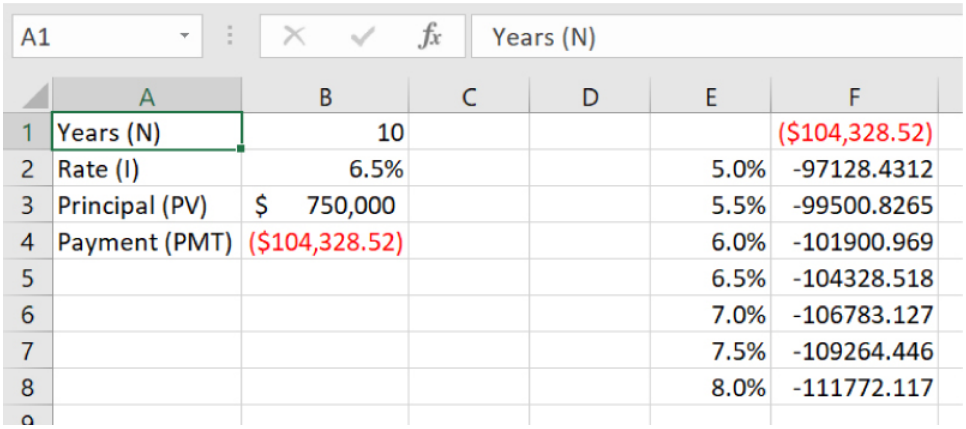


Figure 10.8: When the Data Table is created, the output is not formatted. Use the Accounting or Currency format to display the data correctly. (Used with permission from Microsoft)

This process will save a lot of time, as it eliminates manually creating a formula for each cell. Furthermore, with the same Data Table, any of the values in the list can be changed and the information will automatically update to the correct value. For example, to see the payments for a 6.4 percent interest rate instead of 6.5 percent, simply change that one value, and the row's value will be autofilled to calculate the new installment payment. The rest of the data table stays the same, as you can see in Figure 10.9.

	$104,328.52
5.00%	$ 97,128.43
5.50%	$ 99,500.83
6.00%	$ 101,900.97
6.40%	$ 103,840.83
7.00%	$ 106,783.13
7.50%	$ 109,264.45
8.00%	$ 111,772.12

Figure 10.9: Notice that by changing the cell to 6.4 percent, the payment changes only for that value. (Used with permission from Microsoft)

Suppose you have taken this Data Table to the WorldCorp CFO, who tells you that the company will not pay high interest rates and will only negotiate and meet with the executives of banks that offer rates at or below 7 percent. There is no need to create a new Data Table that only includes the data for that range of rates because you may need the information at a later point. Instead, you can temporarily hide the values that exceed the 7 percent maximum using Excel's filtering tools. A filter is a tool that lets you select certain criteria so that only data with your chosen criteria is shown.

To use a filter within the Data Table, select the rate column, and then go to the Data tab. In the Sort & Filter command group, select Filter (the funnel icon). When Filter is selected, a small arrow will appear at the top of the column, as shown in Figure 10.10a. Select that arrow and go to Number Filters, then select Less Than Or Equal To.... On the dialog box that appears next, select 7.00% from the choices, and then click OK. The result is that the Data Table will only show values that are less than or equal to 7 percent, as shown in Figure 10.10b.

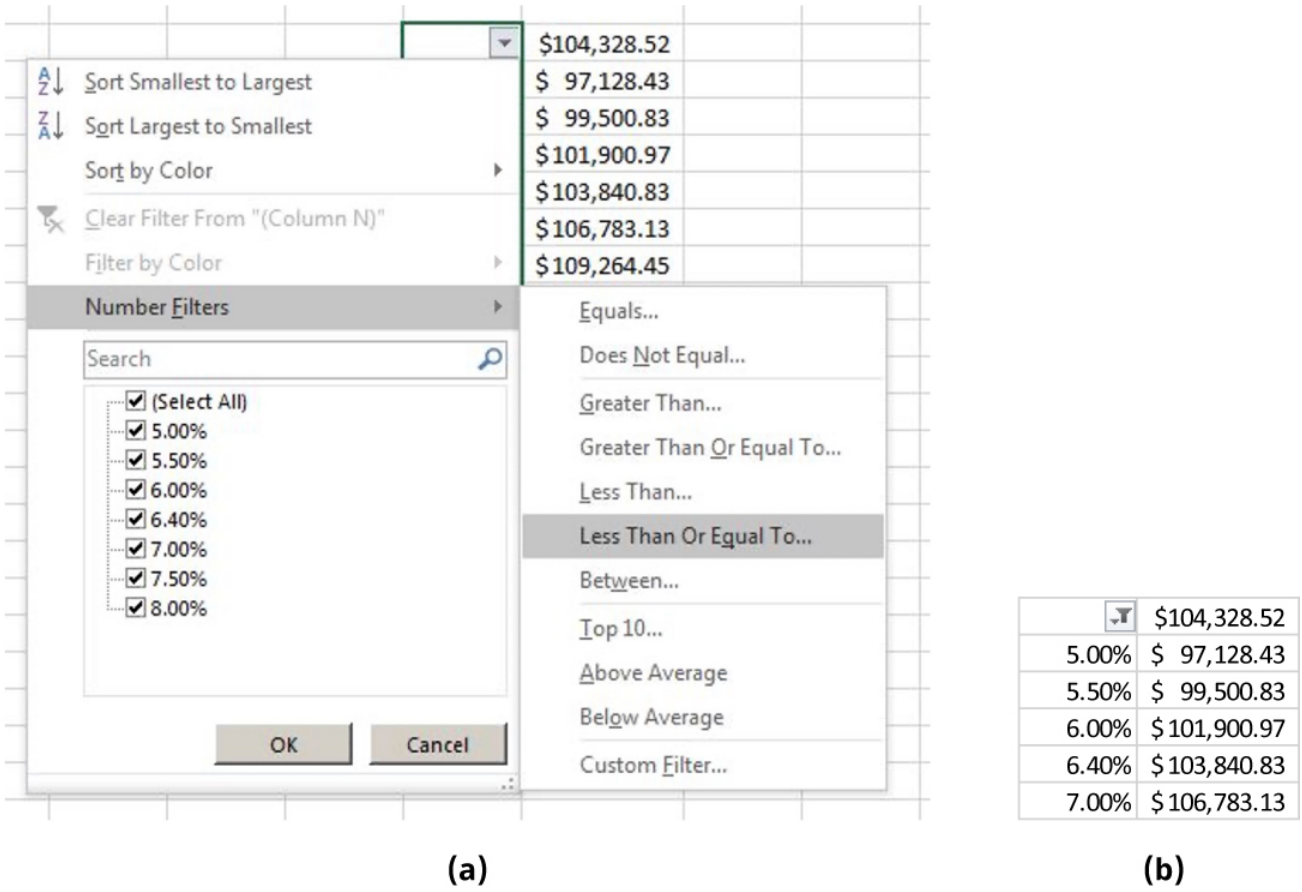


Figure 10.10: (a) In the drop-down menu, there are many different filter options. (b) The funnel icon in a cell indicates that a filter has been applied to that column. (Used with permission from Microsoft)

Now that you have created a Data Table with one variable, you will follow a similar process to analyze two variables. With the added capacity in Fairfax, WorldCorp can sell more products to help the company reach its strategic goals. Increasing unit sales could also allow the company to reduce its price per unit. You would like to better understand the impact of the increased sales and price changes on the annual revenue for WorldCorp. Let's assume that in 2020, WorldCorp sold 5,000 RX-500 digital scales in the state of Virginia, at the retail price of $17.99 per unit. That would mean an annual revenue of $89,950 for this item. What would happen if the price was decreased to $16.99, in hopes that the unit sales would increase? Or, conversely, what would happen if the price increased to $18.99? WorldCorp is not sure how the public will react to either option, but you can estimate the revenue it will produce. Let's assume that either sales will stay the same (i.e., 5,000 per year), decrease to 3,000, or increase to 7,000. With the Data Table tool located in the What-If Analysis, all the revenues will be autofilled for the different unit sales and the different prices (Figure 10.11). To create this table, follow the steps for the loan interest rate example. However, instead of only including the column input, also include the row input.

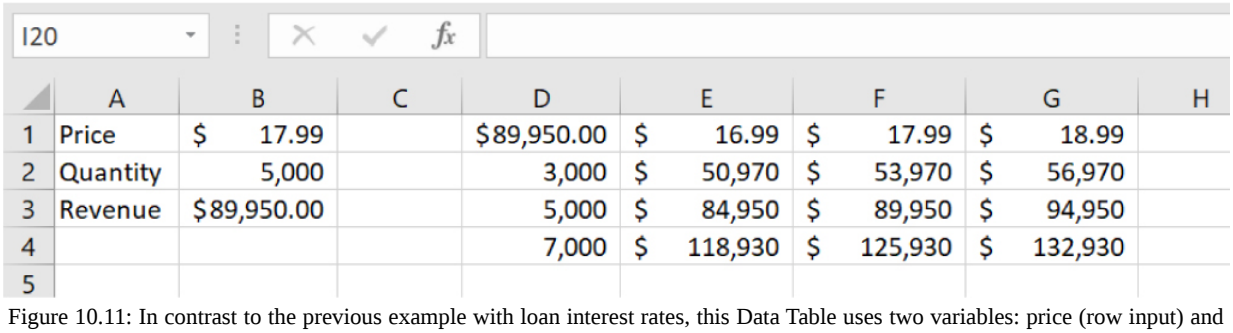


Figure 10.11: In contrast to the previous example with loan interest rates, this Data Table uses two variables: price (row input) and quantity sold (column input). (Used with permission from Microsoft)

Defining, Selecting, and Naming a Cell Range

A cell range is a selection of rows or columns of cells that is given a name to make it easier for the worksheet designer to find that specific group of cells later. It can include a group of cells that are next to each other or separated across the worksheet or workbook. Defining a cell range is especially useful when designing a large Excel worksheet with a substantial amount of data, or when interconnecting datasets or different spreadsheets. Naming a range of cells is referred to in Excel as defining a range. You can define a range in three different ways.

Method 1: Define a Range

First, select the range of cells you want to name. Then, click on the leftmost box below the ribbon (Excel calls this the Name Box). After the cursor on the Name Box begins blinking, type the name you want to use for the data range, and press Enter. Subsequently, you may refer to this range of cells as the name you typed in the Name Box. Type “digital scale” in the Name Box, as shown in Figure 10.12.

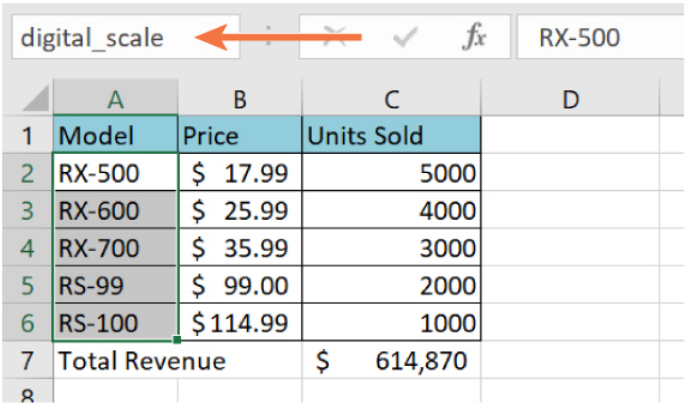


Figure 10.12: The Name Box sits just below the ribbon and above the column letters. (Used with permission from Microsoft)

Method 2: Define a Range

Begin by selecting the desired range of cells, then go to the Formulas tab, and select Define Name. A new dialog box will appear; it has three fields: Name, Scope, and Comment. Next to Name, simply type the name you want to use for the data range; under Scope, select Workbook; the Comment field is optional. Click OK to complete the process (Figure 10.13).

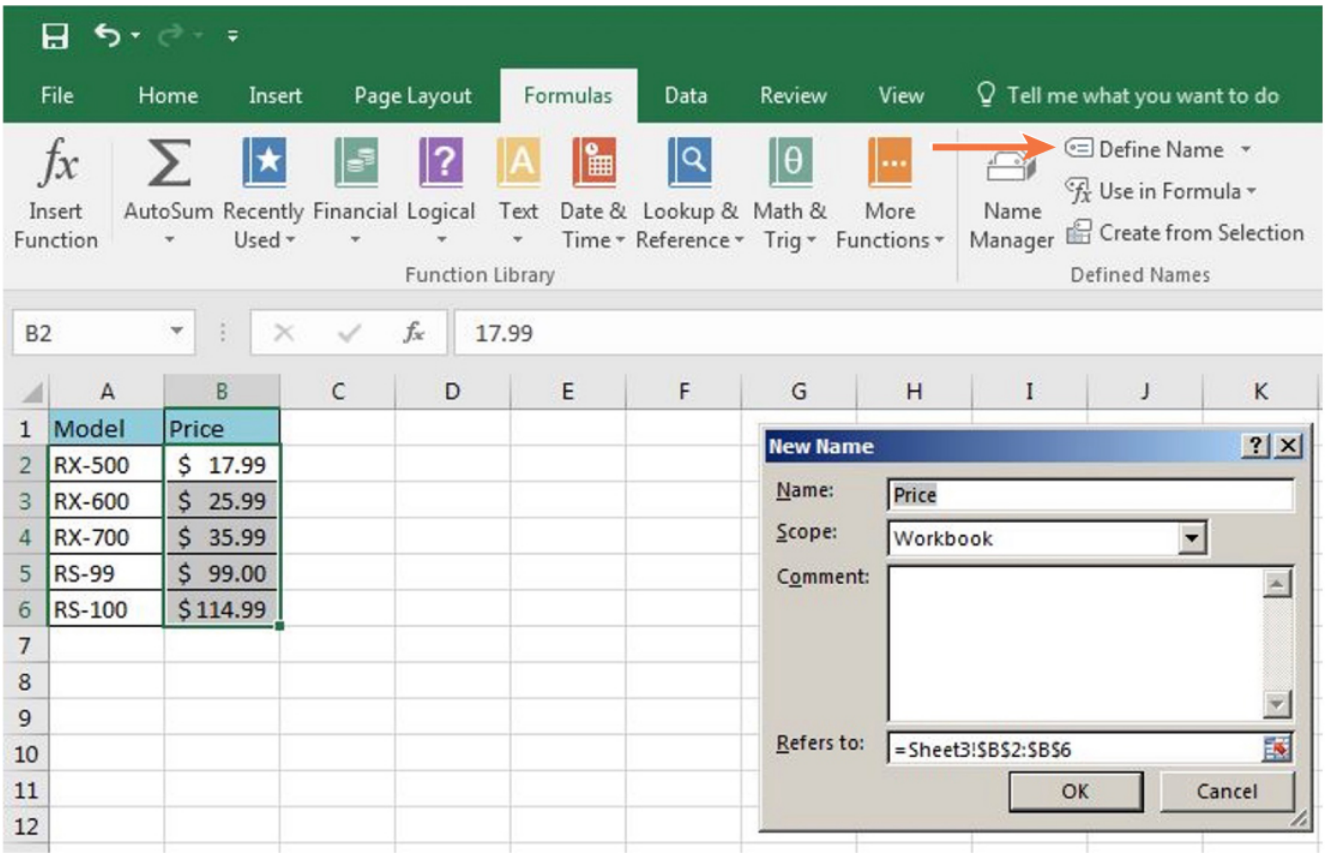
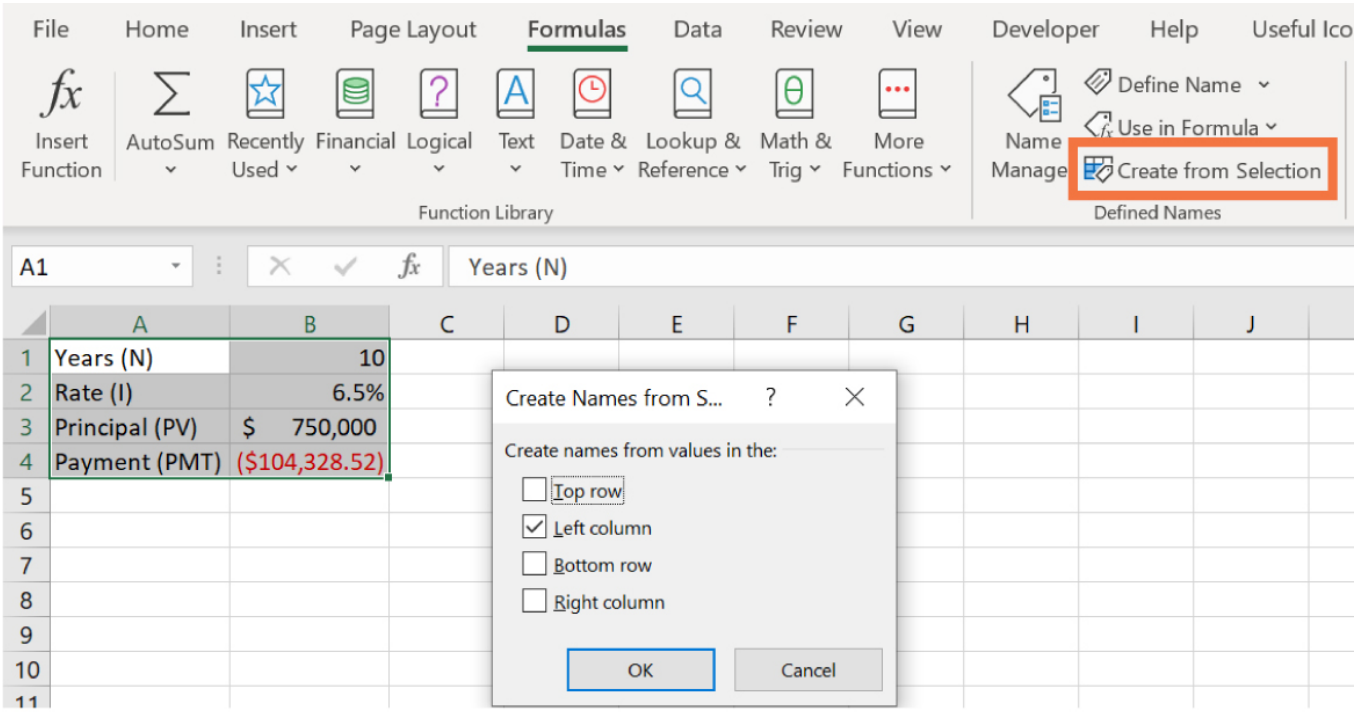


Figure 10.13: The Define Name option is in the center of the Formulas tab ribbon area. (Used with permission from Microsoft)

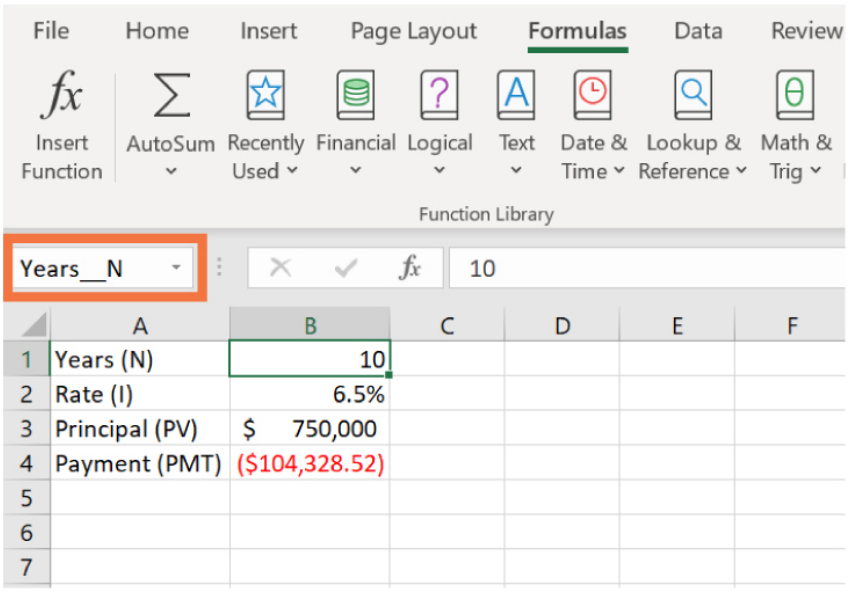
Method 3: Define a Range

The third way to define a range is more comprehensive, as it allows you to select various columns or a whole Data Table. You need to select the entire table, or the set of columns (or rows), that you want to define. After making your selection, go to the Formulas tab in the ribbon and choose Create from Selection. A dialog box will appear and where you select the headers. (Many tables have column headings only, and other tables have row headings.) In the dialog box, you will select if the table has the column headings on the bottom or on the top, or if the row headings are on the right or on the left.

Using the WorldCorp example of the loan interest rates, choose Left column, and click OK, as shown in Figure 10.14. Because you didn't type anything, as this method is more geared for tables, Excel automatically gave defined names to the data ranges (rows). Excel uses the text in the left column of the table to name (define) the data ranges. Spaces are automatically converted to "_" by Excel. Consequently, the data ranges are Years_N, Rate_I, Principal_PV, and Payment_PMT.



(a)



(b)

Figure 10.14: (a) To activate the Create from Selection command, click on the area shown after first selecting the data table. (b) Notice that cell B1 has been renamed Years_N based on the title for that row listed in the left column (column A). (Used with permission from Microsoft)

Differentiating Between a Cell Range and an Array

An array is similar to a cell range in that it is a collection of data in ranges of cells, but arrays do not have to be contiguous (right next to each other). Arrays can contain text or numbers and can span multiple rows and columns if needed. The array can be a collection of cells that consists of unrelated elements, whereas cell ranges have a start and finish and are made of elements related to each other. Arrays also are different from data ranges in that they can work creatively to simultaneously calculate different

computations at the same time. An array can replace many standard formulas and make simple computations more efficient. The array formula performs multiple calculations on several values, so using arrays and array formulas can save users time.

Let's use the WorldCorp digital scale example and recalculate it using arrays. The unit sales of each model are added to the previous data in column C. Then, using arrays, you can determine the total revenue without calculating the revenue for each model separately. Figure 10.15a shows how you can add a column for the revenue of each model and then add them up to get the total revenue of the digital scales. Figure 10.15b shows the total revenue for sales of all models in cell C7, without any of the individual calculations, using an array.

To use an array to calculate the total revenue in Figure 10.15b, click on a blank cell (here, cell C7), and type the function =sum(b2:b6*c2:c6) and hold down Ctrl+Shift as you press Enter. This function calculates the sum of the revenue for each item, as shown in the ranges in the parentheses. As visible in the Formula Bar, Excel recognizes b2:b6 from the defined data ranges, and renames it "Price" in the formula. Excel also adds a curly brace ("{ }") before and after the whole function (Figure 10.15b) because it recognizes it as an array. Excel then does all of the calculations we did manually in Figure 10.15a in one step and provides the total revenue. You'll notice that the total revenue values match, regardless of whether you do the calculations manually or use an array. When a selection is defined as an array, then any formula is calculated as an array formula, which allows for multiple calculations to happen simultaneously.

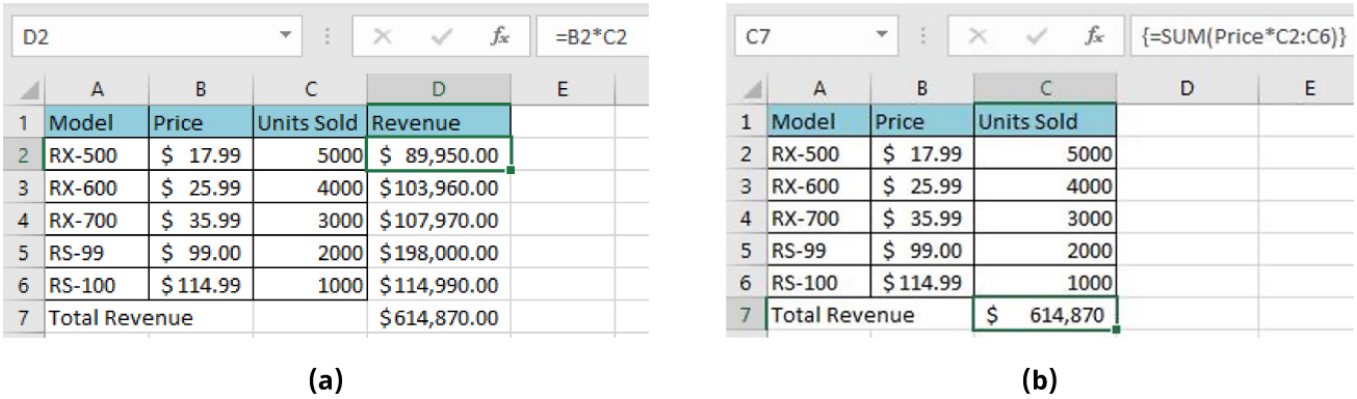


Figure 10.15: The array formula enables Excel to derive the same results using less space in the sheet. (a) You can calculate each model's revenue and then add those values to get the total revenue. (b) You can also use an array, which determines each model's revenue and adds them up in one step. (Used with permission from Microsoft)

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2.1.4: Advanced Formulas and Functions

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

Understanding Complex Formulas

Formulas can be simple mathematical formulas or complicated formulas involving multiple mathematical operations, multiple cell ranges and nested functions. While it is a good idea to remember the order of operations rules, complex formulas can use parentheses to identify the arguments of functions and to override the order of operations. In mathematical operation formulas, operations within parentheses are performed before those outside of it. For example, in =A3+B3*C3, B3 is multiplied by C3 before A3 is added to the result, but in =(A3+B3)*C3, A3 and B3 are added together first, then the result is multiplied by C3.

Parentheses in operations may be nested inside each other. The operation in the innermost set of parentheses will be performed first. Whether nesting parentheses in mathematical operations or in nested functions, always be sure to have as many closed parentheses in the formula as there are open parentheses, or Excel will return an error message. In the illustrated worksheet below, cell D30 contains a complex formula that calculates the differences between rooms available and rooms rented to determine the total number of unrented rooms in the Balcony and Penthouse categories. The formula in D30 is: =(SUM(C5:C8)-SUM(D5:D8))+(SUM(C25:C28)-SUM(D25:D28)). Notice the number of open and closed parenthesis!

D30 =(SUM(C5:C8)-SUM(D5:D8))+(SUM(C25:C28)-SUM(D25:D28))

Alaskan Insider Cruises

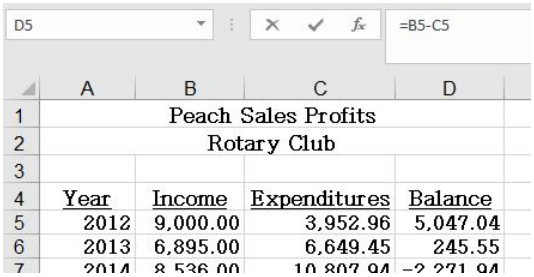
July Revenue by Accommodation Category

Cruise Date	Accommodation Category	Rooms Available	Rooms Rented	Rate	Revenue	Shortfall
July 5, 2019	Balconies	60	35	$ 5,000	$ 175,000	$ 125,000
July 12, 2019	Balconies	60	45	$ 5,600	$ 252,000	$ 84,000
July 19, 2019	Balconies	60	45	$ 6,000	$ 270,000	$ 90,000
July 26, 2019	Balconies	60	58	$ 6,000	$ 348,000	$ 12,000
July 5, 2019	Inside	50	30	$ 2,500	$ 75,000	$ 50,000
July 12, 2019	Inside	50	50	$ 2,500	$ 125,000	$ -
July 19, 2019	Inside	50	32	$ 3,000	$ 96,000	$ 54,000
July 26, 2019	Inside	50	48	$ 3,000	$ 144,000	$ 6,000
July 5, 2019	Outside Level 1	80	60	$ 4,500	$ 270,000	$ 90,000
July 12, 2019	Outside Level 1	80	72	$ 5,025	$ 361,800	$ 40,200
July 19, 2019	Outside Level 1	80	70	$ 5,375	$ 376,250	$ 53,750
July 26, 2019	Outside Level 1	80	80	$ 5,225	$ 418,000	$ -
July 5, 2019	Outside Level 2	90	75	$ 4,300	$ 322,500	$ 64,500
July 12, 2019	Outside Level 2	90	66	$ 4,800	$ 316,800	$ 115,200
July 19, 2019	Outside Level 2	90	82	$ 5,000	$ 410,000	$ 40,000
July 26, 2019	Outside Level 2	90	89	$ 5,000	$ 445,000	$ 5,000
July 5, 2019	Outside Level 3	100	80	$ 4,000	$ 320,000	$ 80,000
July 12, 2019	Outside Level 3	100	89	$ 4,450	$ 396,050	$ 48,950
July 19, 2019	Outside Level 3	100	78	$ 4,850	$ 378,300	$ 106,700
July 26, 2019	Outside Level 3	100	92	$ 4,750	$ 437,000	$ 38,000
July 5, 2019	Penthouse	3	1	$ 6,000	$ 6,000	$ 12,000
July 12, 2019	Penthouse	3	2	$ 7,000	$ 14,000	$ 7,000
July 19, 2019	Penthouse	3	2	$ 8,000	$ 16,000	$ 8,000
July 26, 2019	Penthouse	3	3	$ 7,500	$ 22,500	$ -
Unrented Balcony & Penthouse rooms:			61			

Complex Formula

Absolute versus Static References

One of the first things that new Excel users need to realize is that Excel is so much more powerful than a calculator. Some users insist in setting up a worksheet as if it is merely a calculator. These people fail to realize the power of cell references. Instead they use static references to constant values. A **static reference** is a reference to a value that does not change.



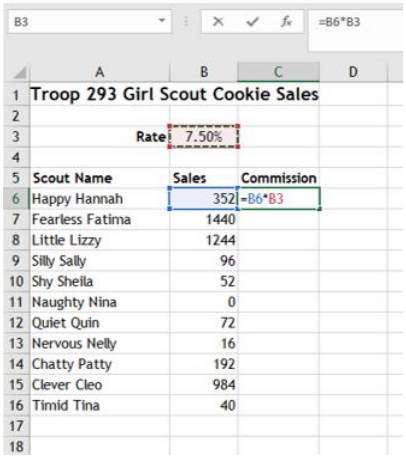
Cell References example

In the example above, instead of using static references (= 9000-3952.96) for the formula in D5, the user should employ cell references. (= B5-C5). The main benefit of use cell references is that the user can manipulate the input values in columns B and C, and the formulas in column D will remain accurate. If the user changes either input values in columns B or C with static references, the formulas in column D will need to be manually updated.

Cell referencing is an extremely useful feature when formulas need to be copied across ranges in a worksheet. When creating formulas that contain references to cells or cell ranges, the default cell reference is considered to be a relative cell reference. When formulas with these type of cell references are copied to other cells the formulas will automatically change relative to the cells that they are copied to. However, there may be instances where it is necessary for Excel to keep the exact cell referenced in a formula when copying to other cells. A cell reference that does not change when copied is called an **absolute cell reference** (sometimes called a fixed cell reference). The indicator that a cell reference is absolute is the presence of a dollar sign symbol in front of both the column letter and row number, such as $A$3. To create an absolute cell reference, either type the dollar sign manually, or press the F4 after entering the cell reference. Repeatedly pressing the F4 key cycles the reference through the four different combinations of relative, absolute, and mixed cell references.

Mixed cell references are a combination of relative and absolute: either the column is relative and the row fixed (absolute), for example D$2, or the column is fixed and the row relative: $D2. Mixed cell references are rarely used, but they play a significant role when it is necessary to keep a single row or column unchanged while copying the formula. Mixed cell references are commonly used when creating a table of values, like a multiplication table or a mortgage rate table.

Whenever possible, utilize relative and/or absolute references instead of static cell references.



Relative Cell Reference

In the worksheet above, the formula in C6 is using relative cell references to both the Sales amount (B6), and the Commission Rate (B3). Unfortunately, if this formula is copied (perhaps by using the fill handle) to rows 7:16, the resulting formulas will be wrong. Some cells will display zeros or a #VALUE! error, while others will display inflated amounts because the Rate percentage is being replaced by higher sales values. Therefore, the reference to B3 in the formula should be an absolute cell reference, i.e. =B6*$B$3. It may be tempting to construct the formula using a static reference to the constant value of .075 (i.e. =B6*.075). However, if the rate needs to be changed to 7.25%, the formulas with the static references would each need to be changed manually. Conversely, if the formulas in column C are using absolute cell references to $B$3, a single edit to B3 is all that is needed to update all of the cells

in column C. Knowing the differences between the various type of cell reference will make the worksheet more scalable and flexible for future expansion.

Scenario

WorldCorp receives many client orders every day, and the corporation needs to have an accurate count of inventory to ensure that they have the capacity to deliver orders on time. This real-time inventory handling and customer relationship management can only happen by implementing computer systems that track these business activities. Microsoft Excel can be programmed to help in fulfilling these tasks with the right data. Yet, as you can imagine, this enormous data load can be daunting, and occasionally, small errors may be made in some formulas. Excel has various tools for the user to identify such errors and thus correct them.

Reasons to Audit Formulas

As a business grows, its activities grow in complexity, requiring higher-level and concurrent data analyses. As a result, managers build large Excel workbooks to handle these business operations, designing spreadsheets with a wide selection of formulas, functions, PivotTables, arrays, data ranges, What-If Data Tables, and other Excel data exploration tools. Each of these tools requires user input, which makes them inevitably subject to user error. The process of using Excel tools to monitor and fix errors in worksheets is called auditing formulas.

Remember that almost all formulas or functions have relationships to other areas of the workbook. Cell references or named ranges may even refer to other cell references, creating a complex web of references. If the key data points do not have the right formula or function, the resulting value will not be correct. You may also see an error message in Excel if the user settings are set to alert the user when a formula or function has a broken link or incorrect syntax.

Identifying Errors in Worksheets and Tables

There are many ways to check for errors in your workbook. These include tracing precedent functions, tracing dependent functions, showing the formula, and automated checking of errors. When tracing precedent or dependent functions, you are finding the relationships between cells.

When you are tracing precedent functions, you are finding the source of an error in a formula by locating the cells that provide the data to perform the calculation in the active cell. The arrows will point to the cells that are used to construct the formula used in the active cell so you may review them before making a correction. When you are tracing dependent functions, you are finding any cells affected by the active cell. You would want to do this before deleting a cell from a worksheet. These specifically relate to checking cell references and the information found within them. Figure 10.42 shows the output when tracing precedents for a cell.

J4 =MAXIFS($E$2:E$10,B$2:B$10,"Antonio")

	A	B	C	D	E	F	G	H	I	J	K
1	Date	Agent	Item Description	Quantity	FOB$	5% Commission for sales					
2	3/29/2021	Antonio	Tablets, 7in	143	$10,582.00	NO					
3	3/27/2021	Izabelle	Computer Server Accessories	2500	$21,350.00	YES		Agent	Average Qty	Highest	Lowest
4	3/22/2021	Antonio	Headphones	542	$26,016.00	YES		Antonio	253	$ 26,016.00	$ 7,252.00
5	3/21/2021	Izabelle	LED TVs, 55in and 65in	53	$14,575.00	NO		Izabelle	893	$21,350.00	$10,922.00
6	3/17/2021	James	LCD TVs, 32in and 45in	97	$64,505.00	YES		James	1288	$64,505.00	$21,504.00
7	3/15/2021	James	Cellular Phone Accessories	3000	$22,920.00	YES					
8	3/10/2021	Antonio	Home Stereo Systems	74	$ 7,252.00	NO					
9	3/7/2021	Izabelle	Blu-Ray Players	127	$10,922.00	NO					
10	3/5/2021	James	HDTV Antennas	768	$21,504.00	YES					
11											

Figure 10.42: The arrows point to cells B2 and E2 that are used to determine the highest value in the formula. (Used with permission from Microsoft)

Showing the formula is simply looking at a certain formula or function and manually checking its syntax. There is a command on the Formulas tab called Show Formulas that will automatically show which cells contain formulas. The actual formula in the cell is displayed, replacing the value that was calculated from that formula. It changes the content of the worksheet to show exactly what formulas are in the cells. This is a good first step to finding errors in formulas. To hide the formulas and return to the original spreadsheet with the computed values, simply select the Show Formulas command again. There is also an Error Checking command, which can help to identify specific errors in formulas.

Before any error checking can occur, first make sure that your version of Excel is tracking the errors when they happen. Click on the File tab and select Options. In the dialog box, choose the Formulas tab, and check the "Enable background error checking" option. You should also check all of the "Error checking rules" boxes, and then click OK, as shown in Figure 10.43.

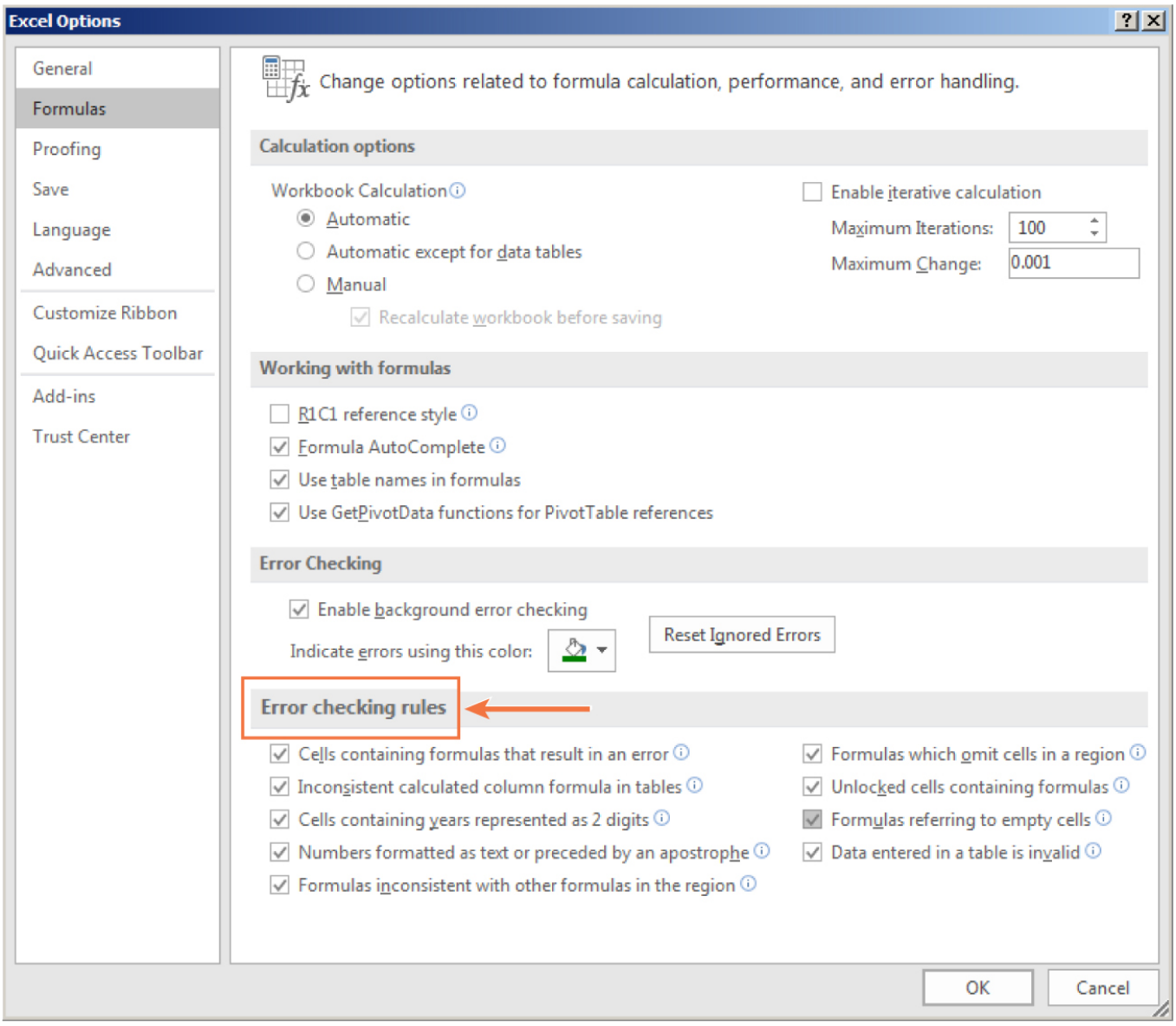


Figure 10.43: Error checking starts with having Excel notify you if any error happens. (Used with permission from Microsoft)

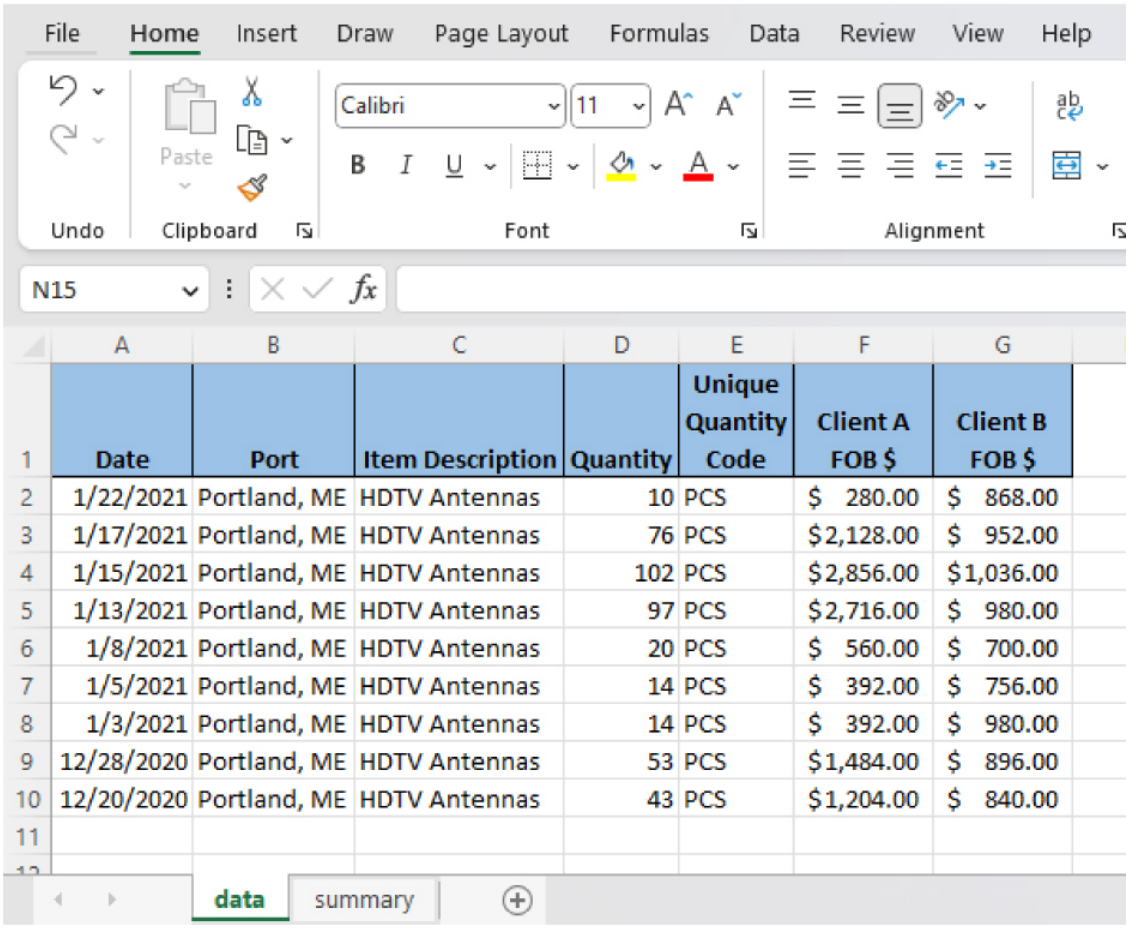
Remember that there are two main characteristics that all formulas have:

1. All formulas must start with the equals sign (=).
2. Formulas have constants, cell references, or both, and operators, functions, or both.

Constants are numbers that are typed inside a formula; they can be integers or rational numbers. Operators are math notation signs for performing different calculations, such as +, –, *, /, and ^. These operators must respect the order of operations (PEMDAS). If

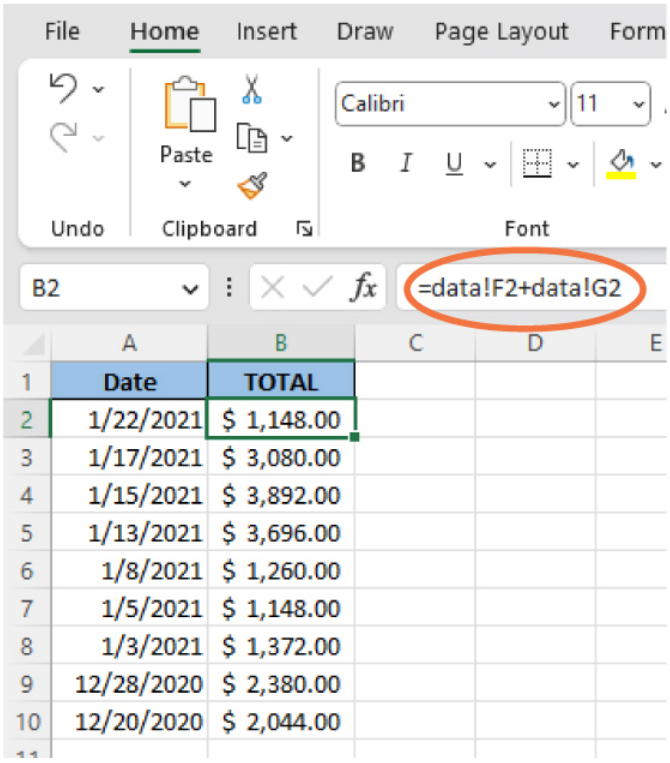
the formula is complex—if it has multiple functions, for example—you must ensure that the function's syntax rules are obeyed. For example, the PV function must include values for RATE, NPER, PMT, and FV, in that order, or the function will not work.

There are several types of potential errors. You may have syntax errors (not having the right argument in the function or having too few or too many arguments); capacity errors (in Excel, you cannot have more than 64 functions in a cell); or sheet or cell reference errors. It is worth noting that, when linking a formula in one worksheet to a cell in another worksheet, Excel automatically adds the sheet's name and "!" after the sheet's name; you must double-check that you didn't delete this mark. For example, WorldCorp's data for two clients is seen in Figure 10.44a. You summarize the overall total on a separate sheet, which references the first sheet. Notice in the formula the "!" after the worksheet named "data" and before the cell reference you include in the calculation (Figure 10.44b).



	A	B	C	D	E	F	G
1	Date	Port	Item Description	Quantity	Unique Quantity Code	Client A FOB $	Client B FOB $
2	1/22/2021	Portland, ME	HDTV Antennas	10	PCS	$ 280.00	$ 868.00
3	1/17/2021	Portland, ME	HDTV Antennas	76	PCS	$2,128.00	$ 952.00
4	1/15/2021	Portland, ME	HDTV Antennas	102	PCS	$2,856.00	$1,036.00
5	1/13/2021	Portland, ME	HDTV Antennas	97	PCS	$2,716.00	$ 980.00
6	1/8/2021	Portland, ME	HDTV Antennas	20	PCS	$ 560.00	$ 700.00
7	1/5/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	$ 756.00
8	1/3/2021	Portland, ME	HDTV Antennas	14	PCS	$ 392.00	$ 980.00
9	12/28/2020	Portland, ME	HDTV Antennas	53	PCS	$1,484.00	$ 896.00
10	12/20/2020	Portland, ME	HDTV Antennas	43	PCS	$1,204.00	$ 840.00
11							

(a)



	A	B	C	D	E
1	Date	TOTAL			
2	1/22/2021	$ 1,148.00			
3	1/17/2021	$ 3,080.00			
4	1/15/2021	$ 3,892.00			
5	1/13/2021	$ 3,696.00			
6	1/8/2021	$ 1,260.00			
7	1/5/2021	$ 1,148.00			
8	1/3/2021	$ 1,372.00			
9	12/28/2020	$ 2,380.00			
10	12/20/2020	$ 2,044.00			

Figure 10.44: (a) You can use the data on one worksheet in a formula on another worksheet. (b) Excel will include the name of the worksheet followed by "!" in the formula. (Used with permission from Microsoft)

Common Error Codes

Additionally, several errors have specific code assignations that should automatically appear in your cell if you have an error. These code errors are preceded by "#" to indicate that they are errors. Some of the common code errors are described in Table 10.5.

Table 10.5: Common Code Errors These are many of the most common code errors, and how to fix them.

# Code	Explanation	How to Fix It
####	This common error is a formatting error rather than a formula error. It occurs when the column is not wide enough for the numbers to be displayed.	Make the column wider.
#NAME?	This error is displayed if the function is not well-written, such as if there is a typo in the name of the function, or the designated function name is not complete or is written incorrectly.	Find the correct wording of the function by clicking on the Insert Function tool.
#DIV/0!	This error happens when you divide by zero. This can also be caused if a linked cell reference has no value.	Enter a value in the cell, or add the correct constant in the denominator.
#NULL!	This happens when the Excel notation syntax rules are not obeyed, such as if an operator is incorrect or missing.	Follow the pop-up menu that appears when writing a function. It tells where commas should be, what value should be referenced, and so on. If the error was made in the past, you can consult the roster of functions on the Formulas tab in the ribbon and selecting the Insert Function icon.
#NUM!	This happens when a cell reference contains contradictory or unsound numbers that stop the function from calculating the result.	Check the referenced cells, and retype the numbers that are unsound.
#REF!	This means that the cell references in a formula are not there anymore, or the cell reference was entered incorrectly in the formula.	Find the correct cell reference and fix the formula.
#VALUE!	This happens when a cell reference has a different data type, for example, when you use a function that requires two numerical values but you insert text for one of them.	Use the same data types.
#N/A	This happens when a function searches for a certain value and the function cannot find it.	Change the criterion on the search operators (e.g., LOOKUP function).
#GETTING_DATA	This is a temporary error. While waiting for Excel to calculate a complicated query, Excel will process the answer in a few seconds and display this error.	Wait for Excel to calculate the answer.

Statistical Functions

Data surrounds us. In business, there is always a need to better understand the company, the competitors, and the customers. You gain this understanding through data collection and data analysis. The field of statistics is centered on analyzing and making sense out of data. You may have taken a statistics class at some point, but even if you have not taken a statistics class, you have probably used some statistical concepts—maybe more often than you think. Concepts such as averages and probabilities are often applicable to everyday life. For example, you may have been exposed to some statistical concepts when learning about political candidates prior to an election. This could include the percentage of registered voters of a particular demographic or the correlation between geographic location and political party. Statistics can be applied across nearly all fields and situations, and there is almost always a need to know more and dig deeper into what the data are showing.

There are two branches of statistics: descriptive and inferential. Descriptive statistics, as the name implies, describe situations. For example, the average transaction amount for purchases in a store at a specific location is descriptive information about that location. Another example of descriptive information is the turnover rate of employees in a manufacturing facility.

Inferential statistics relate to predicting and forecasting. With inferential statistics, you are using historical data and trends to forecast future performance. The regional sales manager might use the last five years of sales data to make a forecast for this year's total sales. A nonprofit organization might use historical fundraising efforts to make predictions about fundraising for the next two years. Both branches are useful in understanding data. Information garnered from statistics can be used in a variety of ways in businesses to improve performance and track progress. Microsoft Excel has a variety of tools to make statistical analysis easier.

Basic Statistical Functions

There are several commonly used statistical functions that can give you a basic summary and understanding of the information in your spreadsheet. You can access the functions through the Formulas tab. From this tab, you can either choose Insert Function on the far left of the tab or use the grouped functions in the Function Library (Figure 11.28). The Function Library is helpful if you are not quite sure of the appropriate function for your needs. The functions are organized by application (e.g., financial) and include the ones that are most commonly used.

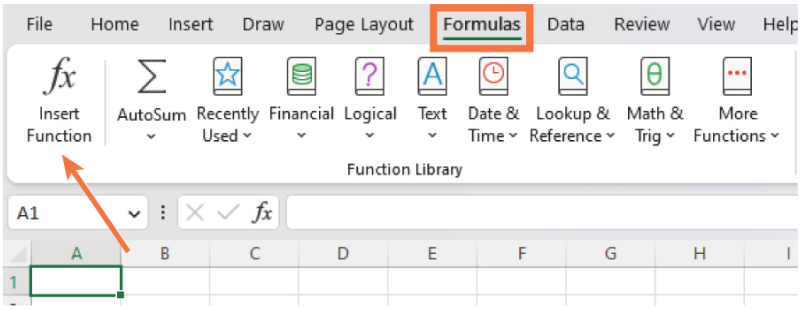


Figure 11.28: Functions can be found in the Insert Function tool or in the Function Library. (Used with permission from Microsoft)

Using the Insert Function command has some advantages. When you click on Insert Function, a window appears with the functions grouped by category like in the Function Library, and then listed alphabetically within each category. When you click on a function, a brief description of the function appears in the window. There is also an option to search for functions by typing a description or keyword. This is useful if you are unsure of the function's purpose (Figure 11.29).

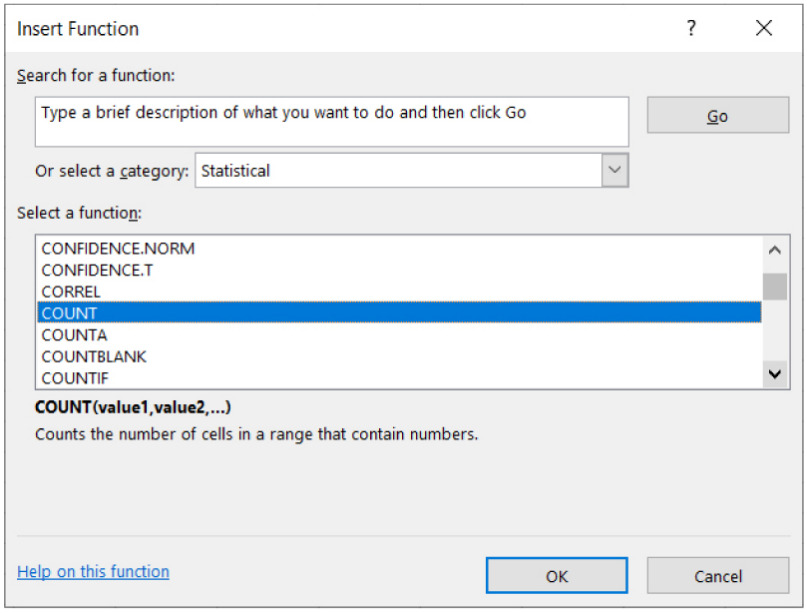


Figure 11.29: The Insert Function window lists all the built-in functions in Excel. (Used with permission from Microsoft)

To use functions, first, click in the empty cell where you want to put the function. Then, use either the Insert Function option or the Function Library to select the function. For this example, you will choose the AVERAGE function to calculate the average of a list of data. When you select a function from the Insert Function window, an input window will appear where you will select the range of data for analysis (Figure 11.30). After you select the range, click OK. Notice that the result of the function is displayed in the lower left of the input window. Also notice that a dotted line will surround the data identified for analysis. The function will also be visible in the Formula Bar.

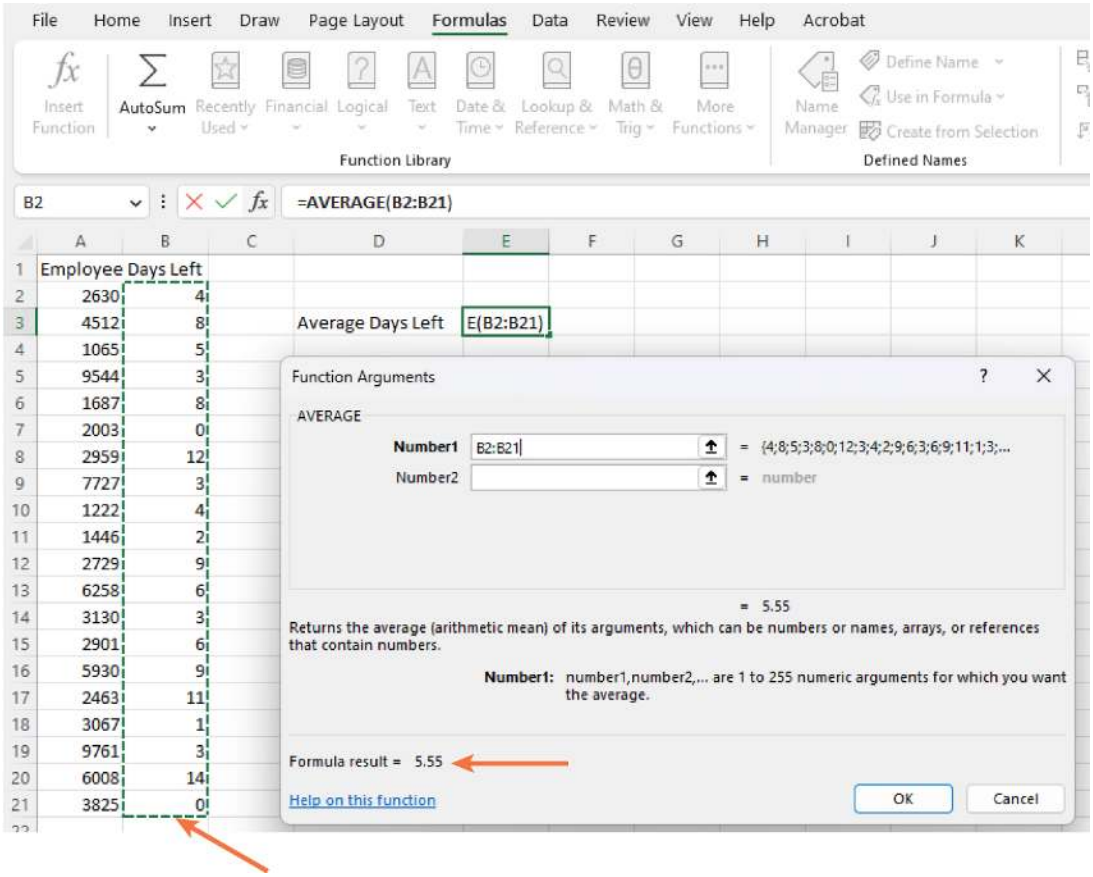


Figure 11.30: The input window to insert a function will display the answer for the given function at the bottom of the window. (Used with permission from Microsoft)

When you select a function from one of the groups in the Function Library, the function will appear in the spreadsheet (Figure 11.31). You can select the data for analysis and press Enter. A dotted line will still appear around the selected range of cells, and the function still displays in the Formula Bar.

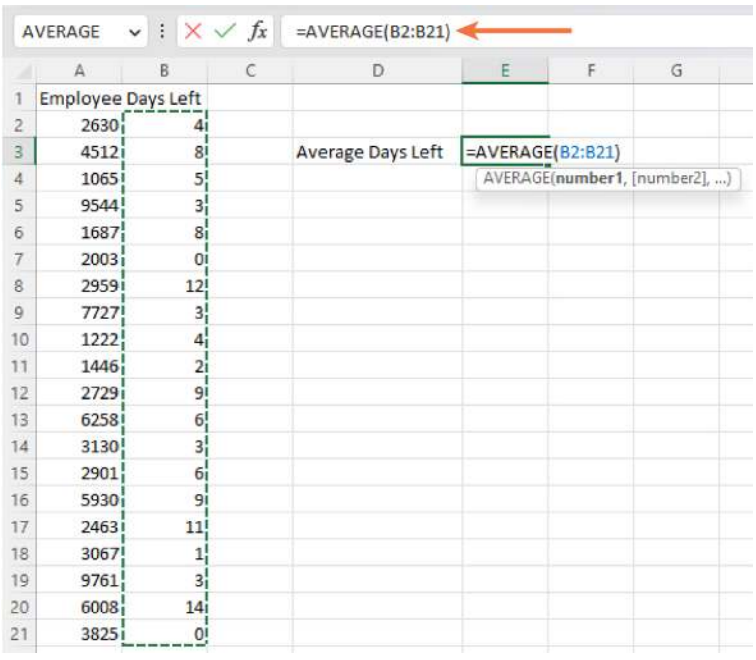


Figure 11.31: The selected cells for the function are displayed on the spreadsheet. (Used with permission from Microsoft)

One of the most commonly used functions is SUM. It even has its own button on the Home tab as the AutoSum feature (Figure 11.32). The function gives the total for a selected range of cells. Other commonly used functions in data analysis are MODE, RANGE, MEDIAN, and AVERAGE, which returns the mean of a selected range of data.



Figure 11.32: The AutoSum shortcut is a very useful tool. (Used with permission from Microsoft)

Other Useful Functions

There are several other functions available that are not specifically statistical functions, but they can be quite useful when dealing with large datasets or with text. Some of these were covered in Advanced Excel Formulas, Functions, and Techniques. These functions can help you manage and sort datasets of any size. Table 11.1 summarizes some useful functions for data analysis.

Table 11.1: Numerical Functions

Function	Definition
AVERAGEIF	Returns the average of a range that meets specific criteria
COUNT	Counts the number of entries in a range
COUNTIF	Returns the count of a range that meets specific criteria
CORR	Returns the correlation between two ranges of data
IF	Tests a condition and returns a predetermined value
MAX	Returns the maximum value in a range
MIN	Returns the minimum value in a range
SUMIF	Returns the sum of a range that meets a specific criterion
SUMIFS	Returns the sum of a range that meets multiple specific criteria

Let us look closer at the AVERAGEIF function. It returns the average of a selected range according to a set of criteria. As with other functions, it is accessed through the Insert Function button on the Data tab or from the Function Library. When selected from the Insert Function tool, an input window will appear with three arguments to fill in (Figure 11.33). In the first box, input the range to examine against the criteria. In the second box, set the criteria, and in the third box, input the range of numbers to be averaged. Both formulas and text can be entered into the criteria. Be sure to put text elements in quotation marks when establishing criteria.

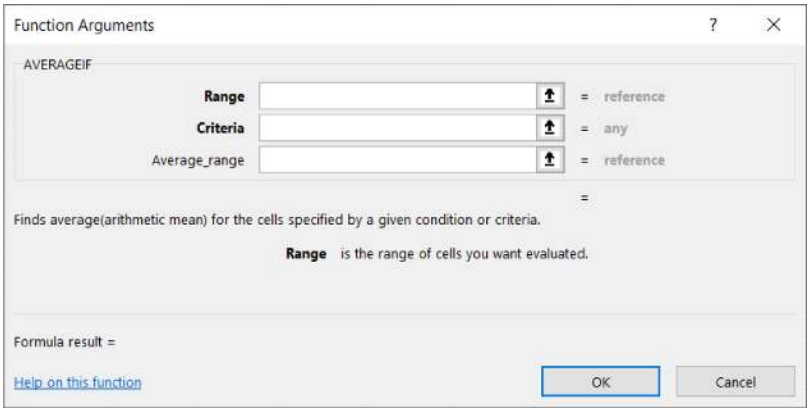


Figure 11.33: The AVERAGEIF function returns the average of a selected range according to a set of criteria. (Used with permission from Microsoft)

Let's revisit the employee vacation data and use it to find the average number of vacation days employees have remaining for the North location. The criteria range is the Location column (D2:D21), the criteria is "North," and the average range is the Days Left column (C2:C21) (Figure 11.34). The function then returns the average number of vacation days remaining for all the employees in the list at the North location.

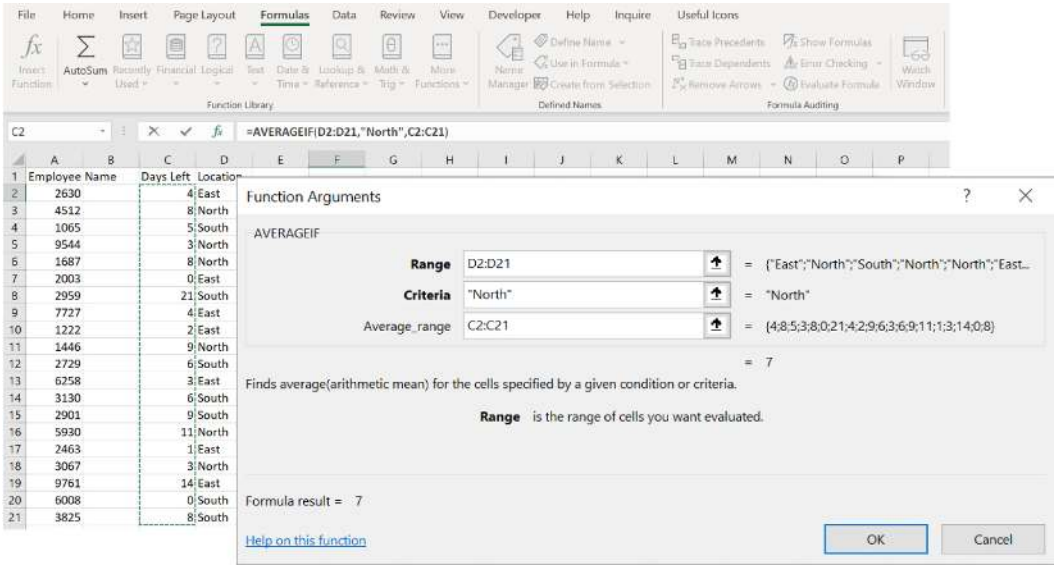


Figure 11.34: The function can use categorical data as criteria instead of just numerical information. (Used with permission from Microsoft)

In some cases, you might need to evaluate data using more than a single criterion. The AVERAGEIFS, COUNTIFS, and SUMIFS functions give the flexibility to add additional criteria. Just remember that each criterion must be matched with a range where the function will search (Figure 11.35). To add an additional criterion with its corresponding range to the analysis, simply press the Tab key on your keyboard and additional criteria will be added to the function arguments.

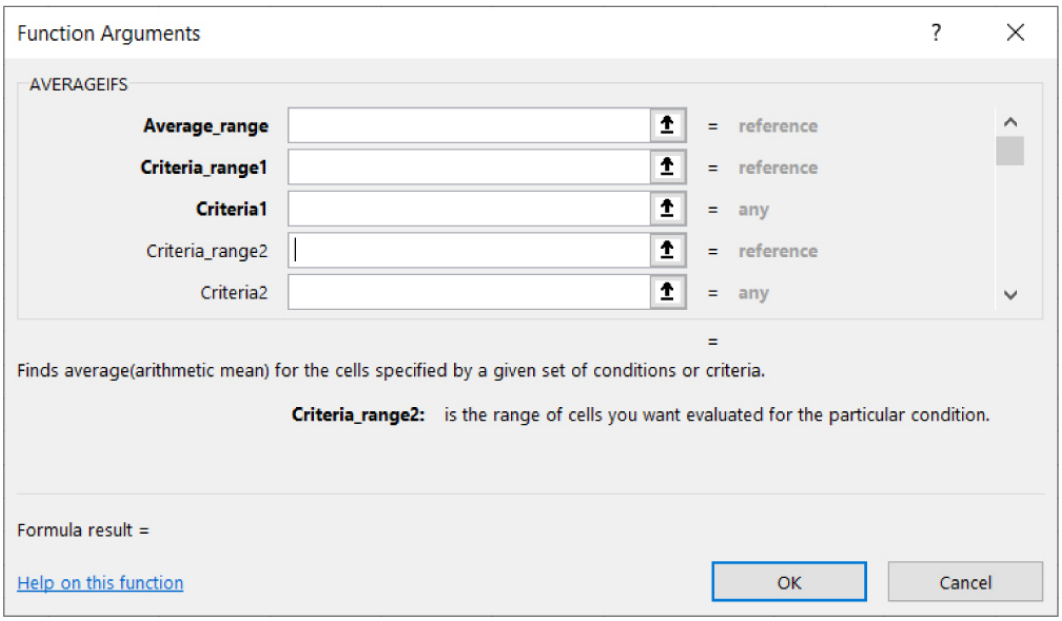


Figure 11.35: If multiple criteria are needed, use the AVERAGEIFS function. (Used with permission from Microsoft)

The functions we have discussed so far deal with numbers, but there are some functions that are useful for dealing with text. These can be particularly helpful when you are importing data into a spreadsheet. These functions can separate out parts of text or take the first several characters and put them in a separate column. Table 11.2 summarizes some useful functions for managing text in a spreadsheet.

Table 11.2: Text Functions

Function	Description
CONCATENATE	Combines information in multiple cells into one cell
LEFT	Will extract characters from the left of text
RIGHT	Will extract characters from the right of text
TRIM	Removes spaces from cells except the single space between words

The CONCATENATE function is useful when data comes from a database or other files. It combines information from multiple columns into a single column. For example, data imported into an Excel spreadsheet often contains first and last names in separate columns. With the CONCATENATE function, you can easily combine those two columns into a single column. To use the function, select the text elements that you want to combine into one cell (Figure 11.36). To include a space, in the Text2 argument insert " " (quotation marks with a space between). This will then output the first name last name correctly spaced (Figure 11.37). Use AutoFill to copy the CONCATENATE function through the entire list. In newer versions of Excel, the function has been replaced with CONCAT, which includes additional features.

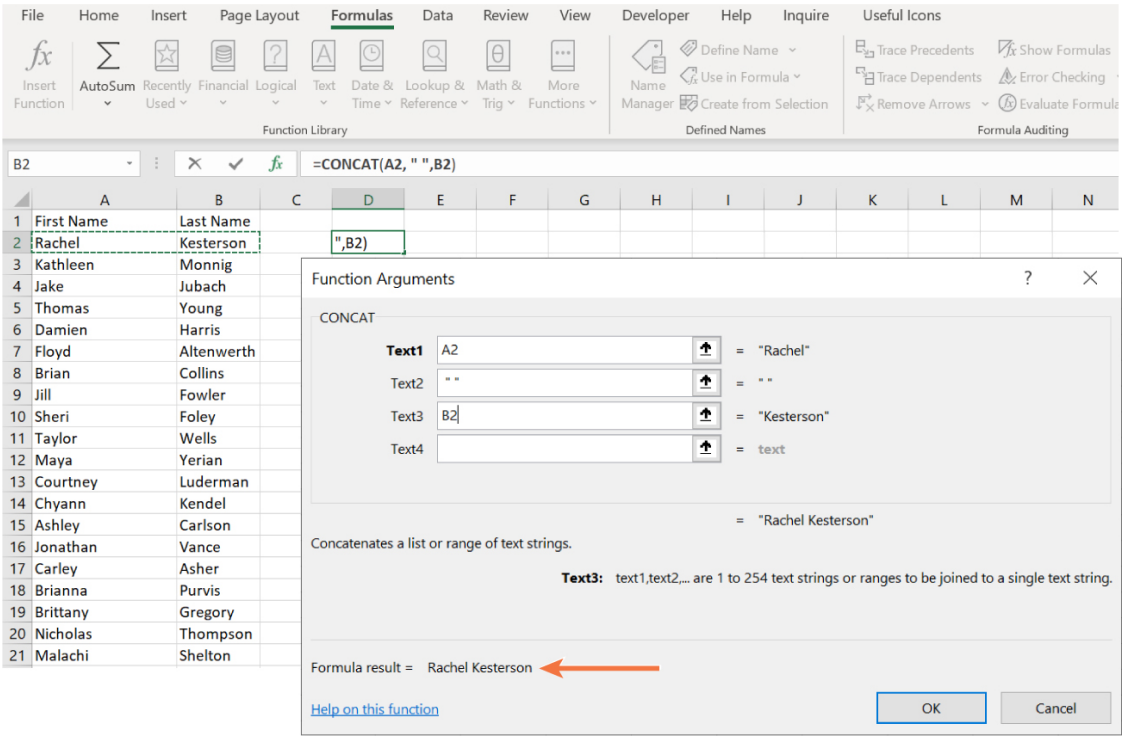
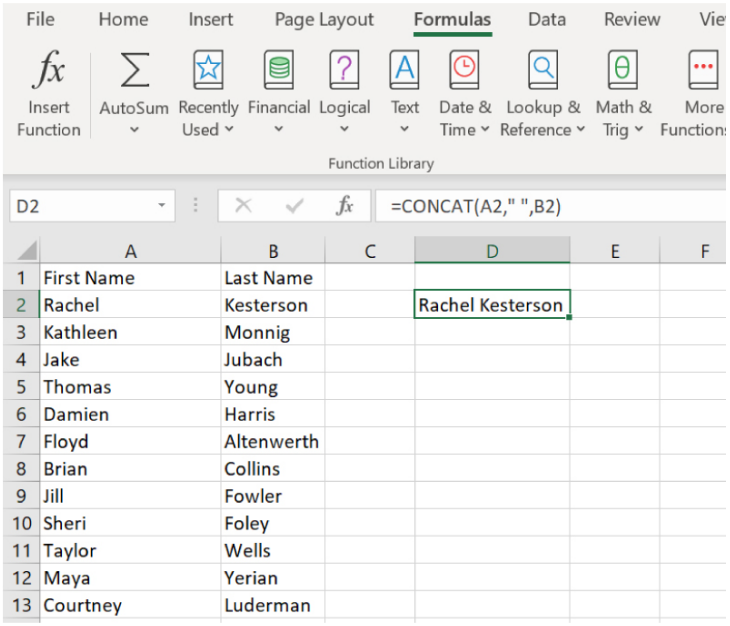


Figure 11.36: The CONCATENATE function can be useful when importing data from a database. The CONCAT function takes data from two columns. (Used with permission from Microsoft)



	A	B	C	D	E	F
1	First Name	Last Name				
2	Rachel	Kesterson		Rachel Kesterson		
3	Kathleen	Monnig				
4	Jake	Jubach				
5	Thomas	Young				
6	Damien	Harris				
7	Floyd	Altenwerth				
8	Brian	Collins				
9	Jill	Fowler				
10	Sheri	Foley				
11	Taylor	Wells				
12	Maya	Yerian				
13	Courtney	Luderman				

Figure 11.37: Then the CONCAT function combines it into one column. (Used with permission from Microsoft)

The Text to Columns tool on the Data tab is the opposite of the CONCATENATE function. It takes a single column of text and separates it into two or more columns. This tool is also a helpful tool if you are importing information. Sometimes data imported from another program might not be in the format you desire or need for further analysis. For example, you can use this tool to place First Name and Last Name in a separate column if they are imported into a single column. Text to Columns can also be used to separate out City, State, and Zip into columns.

Spotlight on Ethics - Data Integrity

> There are many ways that information and data can be manipulated to tell a different story from what is factual or to influence your interpretation of the information to slant a certain way. Simple changes such as adjusting the scaling on a chart or adding formatting changes to numbers can alter the way people interpret the information. For instance, you may want to show a larger than actual impact. You might decide to use a baseline number other than zero along the *x*-axis to show a much larger trend in the data than what is real. Or, perhaps you can choose to emphasize information and impacts by using very small units of measure. With today's endless access to data, the influence of the media, and the ever-present "fake news" online, it is important to be diligent about making sure that data is accurately reported, analyzed, and presented to the intended audience.

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2.1.5: What-If Analysis

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

Learning Objectives

By the end of this section, you will be able to:

- Use Scenario Manager to evaluate different variables
- Determine a desired result using Goal Seek

Having a backup plan is helpful when things do not go as expected. The plan offers an alternative course of action to pursue in case the first path does not work out. In business, this practice is called contingency planning, and it is essential for the business to be successful. This planning process can involve investigating alternatives if sales are lower than expected. It can involve planning for the eventual retirement of key personnel in the business. It could also address items such as the long-term strategic direction of the company. The contingency plan is a proactive attempt to anticipate some situations that might be different from your expected course of action and that might negatively impact the success of your business. Having this plan in place certainly does not guarantee that nothing outside of the plan will happen, but it helps a business to deal with specific situations they have identified as well as some degree of uncertainty. You cannot always plan for the unexpected, such as natural disasters or shifts in consumer preferences, but there are some things that you can plan around. For example, the business can have a plan in place in the event sales are lower than expected. This plan could involve budget cuts or enhanced marketing efforts to boost sales.

There is a process to developing a contingency plan for a business. These steps might also be helpful in your personal life as you plan for your future career. The first step is to list the risks or the events that have some uncertainty associated with them. For example, if you are unsure of what the utility costs might be for a new building, that could be a risk for your business. Some areas where a business may experience risks are unplanned issues with time or schedule, cost adjustments, availability of resources, or technical problems. Next, you will need to rank the risks according to the impact to the business. For example, if your business is an e-commerce site, a technical issue that crashes your website would be a significant priority over increased office supply expenses. Next, you need to set a plan for each event that you have identified. Each plan should be detailed enough to provide an alternative course of action for the business. Your business should revisit the contingency plan often and make any adjustments necessary, based on any changes in the business. There are many templates online that can help you with contingency planning in business. Some Excel templates use formatting to make the plan easy to understand and professional so that you can easily share it with others in the company.

Using Scenario Manager

The Scenario Manager tool in Excel provides a way to look quantitatively at contingency planning. It allows the user to change attributes without altering live data to examine the resulting impact on key variables. You can change up to 32 cells and view the results of those changes all at the same time. This feature can be quite helpful for contingency planning. For example, you might already have metrics that identify the best- and worst-case scenarios for sales. Using this range and the Scenario Manager tool, you can look at the impact to the overall profit picture for the business. You could also use the tool for planning your personal finances. You could investigate the impact of increasing your monthly mortgage payment on the time it will take you to pay off the loan. The tool can be instrumental in helping a business navigate multiple courses of action to determine the best approach moving forward. You can also merge the scenarios from a single or multiple worksheets together for more in-depth analysis.

What Is a Scenario?

The Scenario Manager is part of the What-If Analysis tools suite in the Forecast command group. The tool is accessed from the Data tab and is in the Forecast command group (Figure 11.63).

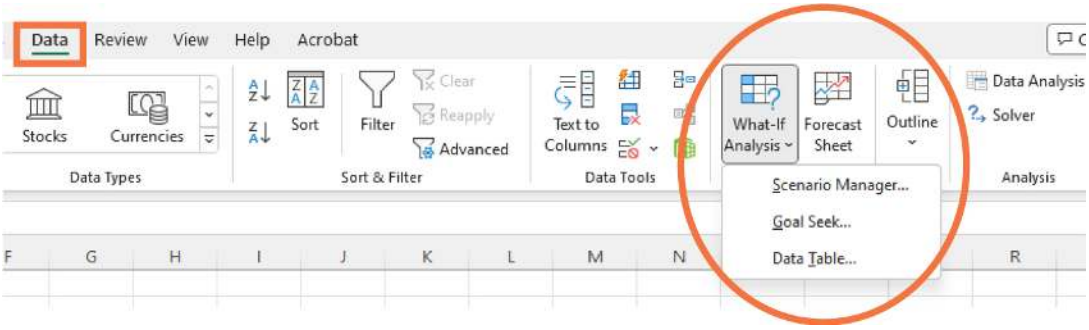


Figure 11.63: The Scenario Manager tool provides a way to look quantitatively at contingency planning. (Used with permission from Microsoft)

A scenario determines the values that Excel will use to change the input cells. You can save different scenarios with different values to view the impact on your target cell(s) at the same time. When you choose Scenario Manager, an input window will appear (Figure 11.64). From here, you will set the changing cells that define the scenario and the target cell for the results.

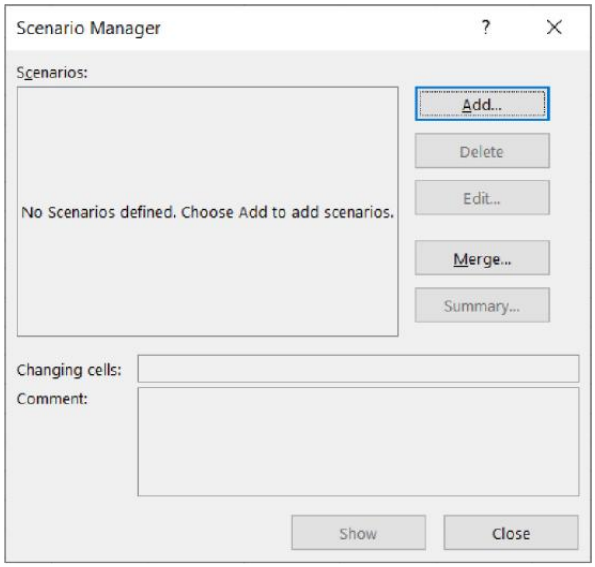


Figure 11.64: To use the Scenario Manager, first set the changing cells and target cell. (Used with permission from Microsoft)

Let's begin with a simple example of obtaining a home mortgage. The initial mortgage is for $150,000 for 30 years with an interest rate of 5 percent. You want to find a better interest rate and see the impact that rate will have on your payment and the total amount you will pay. Using the PMT (payment) and FV (future value) functions from the Function Library, you can quickly determine the status of the loan (Figure 11.65). With these values at the current rate of 5 percent, you will pay just over $800 per month and at the end of the life of the loan, you will have paid nearly $260,000. The functions by default return a negative number for the results, as indicated by the parentheses and the red font color. You will need to adjust the equation to convert the number to a positive number. You can either put a "-" in front of the function or use the ABS function at the beginning of the formula to use the absolute value of the number. You can use the Scenario Manager to investigate different interest rates and different payment terms if you decide you want to pay the loan over 15 years or a time frame other than the standard 30-year mortgage term. You will use the same mortgage example to investigate different levels for the interest rate and repayment terms.

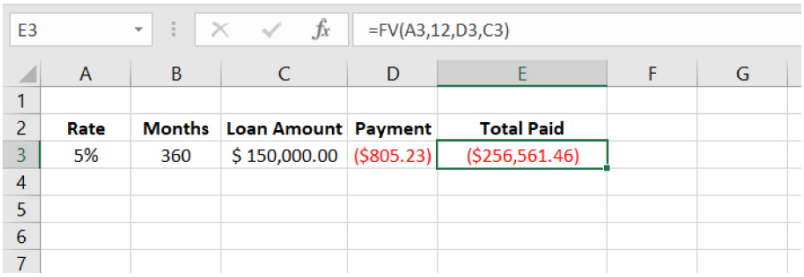


Figure 11.65: The functions by default return a negative number for the results as indicated by the parentheses and the red font color. (Used with permission from Microsoft)

Adding and Deleting a Scenario

Using the mortgage example, you can create a scenario to look at the impact of lowering the interest rate on both the payment and the total amount paid for the loan. First, to add a scenario, go to the Data tab, choose What-If Analysis, and select Scenario Manager. Click Add and the Add Scenario dialog box will appear (Figure 11.66). Here, you will define the changing cells and name the scenario. You can name this scenario "rate changes."

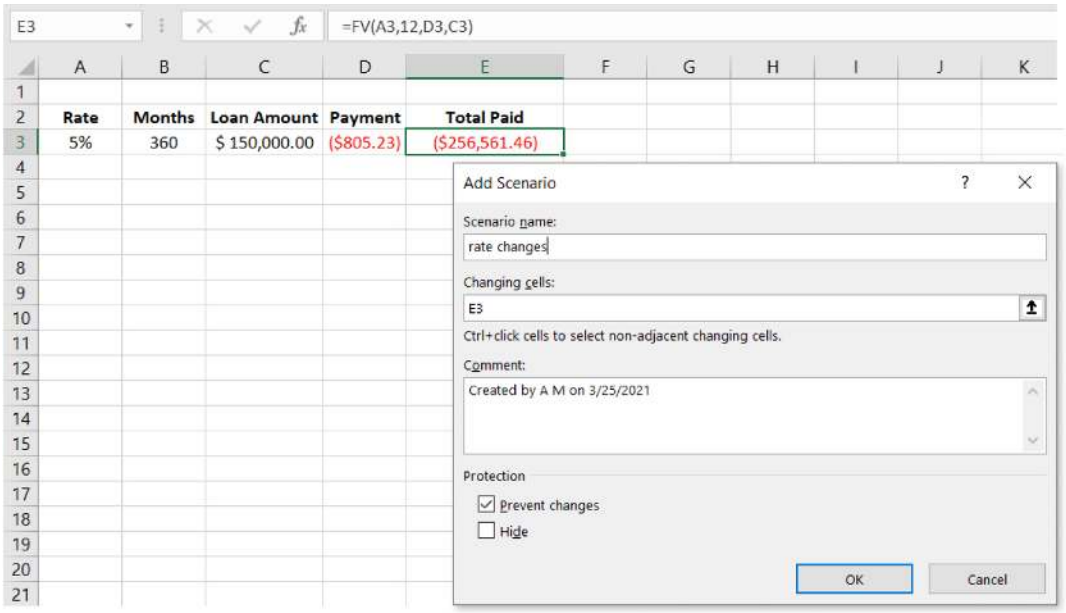


Figure 11.66: To add a scenario, click Add in the Scenario Manager window and define your scenario in the dialog box. (Used with permission from Microsoft)

Next, select the cell you want to change. To change the rate, you would select cell A3. The Scenario Manager does allow you to add more than one cell in the scenario. In this example, you will also change the length of time for the loan. Select A3:B3 for Changing cells. You can add comments if desired to explain the scenario, such as details about the reason for the selected ranges and other relevant information. Then, click OK. Next, you will define the levels or range of values that Excel will use to change the value in cells A3 and B3. Assume you want to compare the impact of a rate higher than the original 5 percent and a loan term shorter than the original 360 months to the impact of a lower rate and longer loan term (Figure 11.67). Add two separate scenarios at the various levels for each cell, A3 and B3. Click OK. This will take you back to the Scenario Manager window. Add the other scenario in the same way.

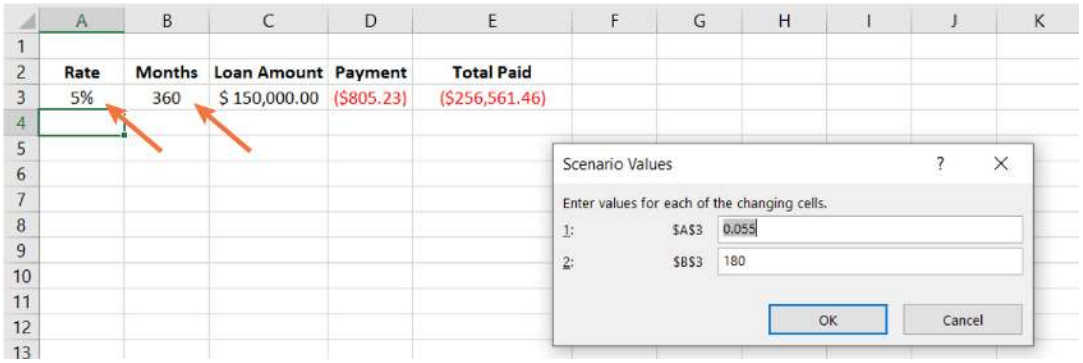


Figure 11.67: Define the ranges of values for Excel to manipulate in the scenario. (Used with permission from Microsoft)

Notice that you have two scenarios listed in the Scenario Manager (Figure 11.68).

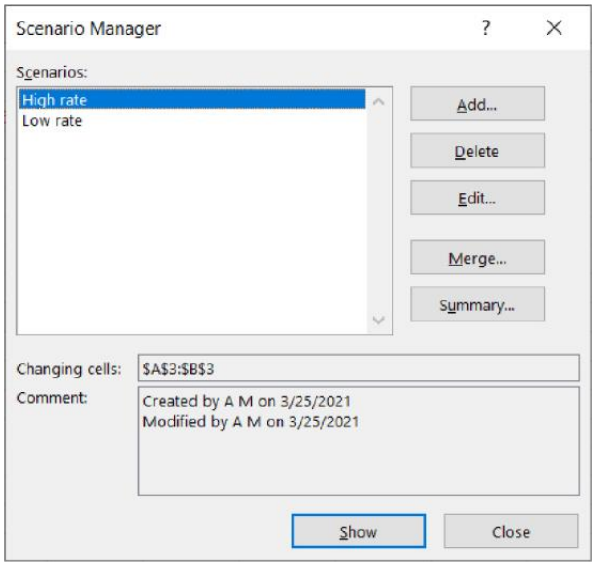
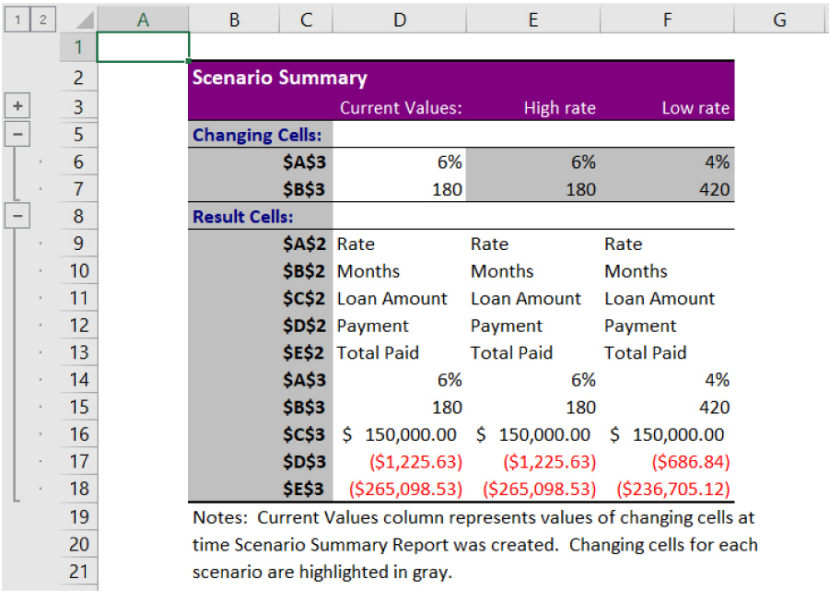


Figure 11.68: The Scenario Manager lists all the active scenarios on a spreadsheet. (Used with permission from Microsoft)

There are a couple of options at this point. If you want to see the results from either scenario on the spreadsheet, click the appropriate scenario in the list and click Show. This will change the value in the spreadsheet, but only for one scenario at a time. If you choose Summary, the Scenario Manager will compile the information for all the scenarios in the list in a clear table on a separate worksheet so that you can compare the results (Figure 11.69). You can then format and adjust the table to fit your needs. One other functionality of the Scenario Manager is that it can merge scenarios from other worksheets into a single worksheet using the Merge button.



Scenario Summary			
	Current Values:	High rate	Low rate
Changing Cells:			
$A$3	6%	6%	4%
$B$3	180	180	420
Result Cells:			
$A$2	Rate	Rate	Rate
$B$2	Months	Months	Months
$C$2	Loan Amount	Loan Amount	Loan Amount
$D$2	Payment	Payment	Payment
$E$2	Total Paid	Total Paid	Total Paid
$A$3	6%	6%	4%
$B$3	180	180	420
$C$3	$ 150,000.00	$ 150,000.00	$ 150,000.00
$D$3	($1,225.63)	($1,225.63)	($686.84)
$E$3	($265,098.53)	($265,098.53)	($236,705.12)

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

Figure 11.69: The Scenario Manager tool provides a summary of the results on a separate worksheet. (Used with permission from Microsoft)

To delete a scenario, go to the Scenario Manager and select the scenario you want to delete from the list and choose Delete. If you have created a scenario summary table, the table will remain even if you delete the scenario. If you instead selected Show and the scenario is displayed on the spreadsheet, the numbers will not revert to the original values even if you delete the scenario. Rather, you will lose your original data. For this reason, it is generally better to use the Scenario Summary rather than the Show option.

Real-World Application - Personal Budgeting

You've learned that Excel can be a helpful tool for managing your personal finances. It can also be a handy tool to help you plan for future purchases and accumulate savings for retirement. Take a look at this article to see how the Scenario Manager can help with budgeting your personal finances. Let's use the Scenario Manager to save for a vacation. You will need to investigate the cost of the vacation—for instance, factor in all costs associated with the travel (flight, hotel, food, etc.). Ideally, you will want to compare more than one cost associated with the vacation—perhaps you are comparing hotels, or flights, or even another destination altogether. Then, determine what your sources of income might be. You will use the Scenario Manager to determine the costs of the vacation by comparing the different vacation options using your budget information.

Think about the following:

- How can the Scenario Manager tool be used to help you reach your goals?
- What assumptions did you need to make in order to establish your budget?

Editing a Scenario

To edit a scenario, open the Scenario Manager, select the scenario you want to edit, and choose Edit on the right of the window. This will open the initial scenario window. You can make changes to the target cells, comments, or name of the scenario. Then, click OK. You will be prompted to adjust the values if desired. Then, click OK. You will need to run the Summary again to see the updated results based on the changes you made.

Using Goal Seek

Goal Seek is another tool in the What-If Analysis group. It is like Solver but restricted to a single input variable. The Goal Seek tool allows you to select a target cell and value for that cell by changing another cell that contains a formula. For example, Goal Seek could determine how much money you need to set aside to reach your retirement fund goal. It could also determine the mortgage interest rate needed to keep a monthly payment within your budget. In a small business, this tool can help when considering a purchase of equipment or property for the business. In this case, the duration and the total amount of the loan are typically known. Goal Seek can investigate financing options to get the monthly installment payment within budget. Conversely,

Goal Seek can determine how much in total a person or business can afford for a loan based on a set interest rate and length of the loan.

To begin, open the spreadsheet with the information needed for your analysis or create a new one. Using the mortgage example, suppose you would like to determine what value of home you can afford. Most mortgages have a term of 30 years (360 months), and you are planning on a 5 percent interest rate. You would like a monthly payment not to exceed $850. The Goal Seek tool can determine the loan amount that will keep the mortgage payment within your budget. Go to the Data tab, click on the drop-down arrow next to What-If Analysis, and choose Goal Seek (Figure 11.70). Notice the input window has three arguments: Set cell, To value, and By changing cell.

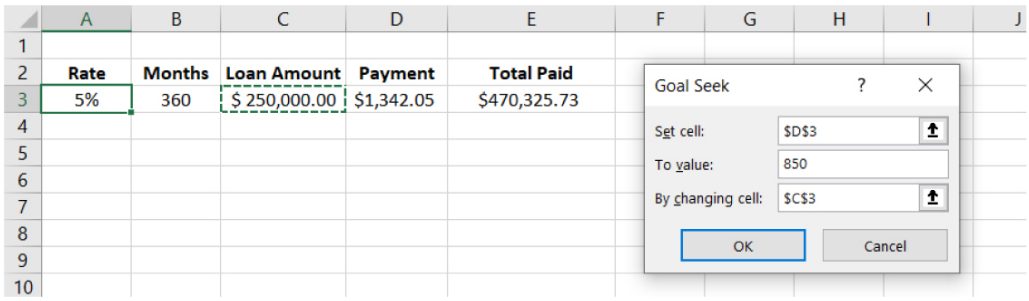


Figure 11.70: Goal Seek is similar to Solver, but you are restricted to a single input variable. (Used with permission from Microsoft)

In this example, type $D$3 in the Set cell field, 850 in the To value field, and $C$3 in the By changing cell field (loan amount). Click OK (Figure 11.71). The result will display in the window if Excel found a solution.

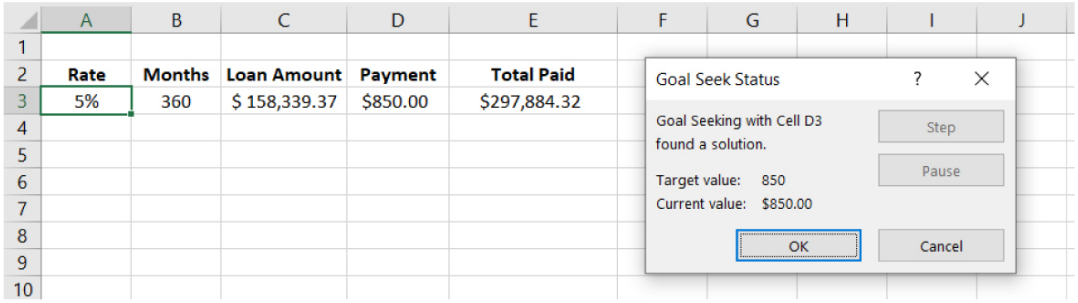


Figure 11.71: Goal Seek displays the result if a solution is found in the Goal Seek Status window. (Used with permission from Microsoft)

Your budgeted monthly payment of $850 will allow you to afford a home that is approximately $158,000. The result window also provides the target value (850) and current value ($850.00) for the solution. When you click OK, Excel retains the solution in the spreadsheet. If you want the values to return to their original numbers, click Cancel instead. You can use the tool to examine various options, such as the price you could afford if you increased your monthly payment to $900. This tool provides information for data analysis and contingency planning when you are focused on one input variable, but it is limited in its use for in-depth planning and analysis.

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2.1.6: Logical and LookUp Functions

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

Many employers and educators are placing increasing emphasis on the value of critical thinking. Critical thinking skills are often associated with problem solving skills, empathy, and thinking and acting in purposeful ways by making fact-based decisions. Excel is a practical tool for collecting and analyzing data critically. Excel's logical functions are especially useful for enabling critical thinking. However, before exploring the utilization of Excel's logical functions, it is necessary to review the logical operators that are used to compare data between cells. The operators are often referred to as comparison operators. The six main logical operators are explained in the following graphic:

Condition	Operator	Formula Example	Description
Equal to	=	=A1=B1	The formula returns TRUE if a value in cell A1 is equal to the values in cell B1; FALSE otherwise.
Not equal to	<>	=A1<>B1	The formula returns TRUE if a value in cell A1 is not equal to the value in cell B1; FALSE otherwise.
Greater than	>	=A1>B1	The formula returns TRUE if a value in cell A1 is greater than a value in cell B1; otherwise it returns FALSE.
Less than	<	=A1<B1	The formula returns TRUE if a value in cell A1 is less than in cell B1; FALSE otherwise.
Greater than or equal to	>=	=A1>=B1	The formula returns TRUE if a value in cell A1 is greater than or equal to the values in cell B1; FALSE otherwise.
Less than or equal to	<=	=A1<=B1	The formula returns TRUE if a value in cell A1 is less than or equal to the values in cell B1; FALSE otherwise.

Comparison operators

These comparison operators can be used in Excel functions to compare all types of data, including dates, numbers, Boolean values (True or False, Yes or No), or text. All arguments must evaluate to the Boolean values of either True or False, or contain another, nested logical function.

The **IF** function is one of the most popular and useful functions in Excel. It can be used to make a decision based on a comparison. If the comparison is true, one value is displayed in the cell; if the comparison is false, a second value is displayed. The syntax of the IF function is: IF(logical_test, [value_if_true], [value_if_false]).

- **logical_test** – a value or logical expression that can be either TRUE or FALSE. Required.In this argument, you can specify a text value, date, number, or any comparison operator.
- **value_if_true** – the value to return when the logical test evaluates to TRUE, i.e. if the condition is met. Optional.
- **value_if_false** – the value to be returned if the logical test evaluates to FALSE. Optional.

Simple IF functions test to see if a cell contains a certain text string, and returns different values depending on if the logical test returns a True or False logic. A sample formula is illustrated in the screenshot below. That's some logical critical thinking!

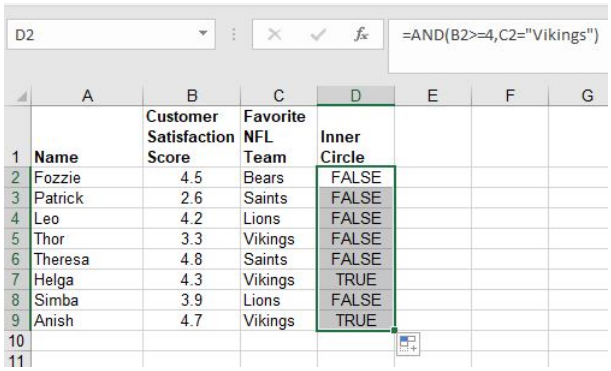


Simple IF

Instead of returning text strings, the IF formula can test the specified condition, perform a corresponding math operation and return a value based on the result. This is done by using arithmetic operators or other Excel functions in the value_if_true and /or value_if_false arguments. For example, =IF(C4>=D4, E4*.25, E4*10%). This formula is determining if the value in column C is

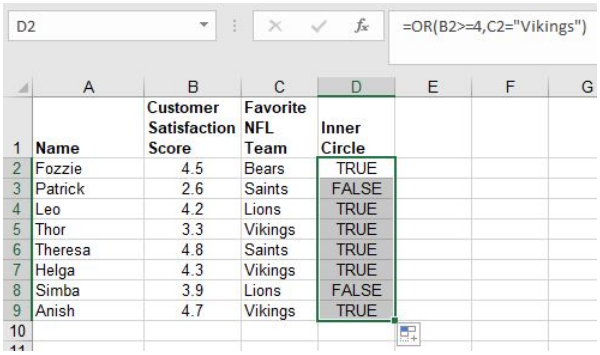
greater than or equal to the value in column D. If the result of the comparison is true, then the value to be displayed should be the value in column E multiplied by .25 (25%). If the result of the comparison is false, then the value to be displayed should be the value in column E multiplied by 10% (.10).

Other popular Excel Logical functions include the **AND**, as well as the **OR** functions. These functions allow users to create multiple logical tests within a single IF function. These functions return either TRUE or FALSE results when their arguments are evaluated. The AND function only returns TRUE if every condition is met. However, the OR function returns TRUE if any condition is met. The syntax of both functions are the same: =AND(logical1, logical2, etc.) Examples of each function are illustrated in the screenshots below. The first illustration uses the AND function to determine if any of the people are eligible for the Inner Circle. They need to have a Customer Satisfaction Score of at least 4.0, and be a Vikings fan. The second example uses the OR function. The more lenient comparison operator yields more eligible people for the Inner Circle.



	A	B	C	D	E	F	G
1	Name	Customer Satisfaction Score	Favorite NFL Team	Inner Circle			
2	Fozzie	4.5	Bears	FALSE			
3	Patrick	2.6	Saints	FALSE			
4	Leo	4.2	Lions	FALSE			
5	Thor	3.3	Vikings	FALSE			
6	Theresa	4.8	Saints	FALSE			
7	Helga	4.3	Vikings	TRUE			
8	Simba	3.9	Lions	FALSE			
9	Anish	4.7	Vikings	TRUE			
10							
11							

AND function example



	A	B	C	D	E	F	G
1	Name	Customer Satisfaction Score	Favorite NFL Team	Inner Circle			
2	Fozzie	4.5	Bears	TRUE			
3	Patrick	2.6	Saints	FALSE			
4	Leo	4.2	Lions	TRUE			
5	Thor	3.3	Vikings	TRUE			
6	Theresa	4.8	Saints	TRUE			
7	Helga	4.3	Vikings	TRUE			
8	Simba	3.9	Lions	FALSE			
9	Anish	4.7	Vikings	TRUE			
10							

OR function example

Real World Application

Excel can do other kinds of functions based on the data in your spreadsheet. In this section, we will use an **=IF** function to determine whether a student is passing or failing the class. Then, we will use a **=VLOOKUP** function to determine what grade each student has earned.

IF Function

The IF function is one of the most popular functions in Excel. It allows you to make logical comparisons between a value and what you expect. In its simplest form, the IF function says something like:
If the value in a cell is what you expect (true) – do this. If not – do that.

The IF function has three arguments:

- **Logical test –** Here, we can test to see if the value in a selected cell is what we expect. You could use something like “B7=14” or “B7>12” or “B7<6”
- **Value_if_true –** If the requirements in the logical test are met – if B7 is equal to 14 – then it is said to be true. For this argument, you can type text – “True”, or “On budget!” Or you could insert a calculation, like B7*2 (If B7 does equal 14, multiply it by 2). Or, if you want Excel to put nothing at all in the cell, type “” (two quotes).

- **Value_if_false** – If the requirements in the logical test are not met – if B7 does not equal 14 – then it is said to be false. You can enter the same instructions here as you did above. Let's say that you type the double quotes here. Then, if B7 does not equal 14, nothing will be displayed in this cell.

In column Q we would like Excel to tell us whether a student is passing – or failing the class. If the student scores **70%** or better, he/she will pass the class. But, if he/she scores less than 70%, he/she is failing.

1. Make sure that Q5 is your active cell.
2. On the Formulas tab, in the Function Library group, find the IF function on the Logical pulldown menu (see **Figure 3.9**).

   Mac Users: There is no "Function Library" group for Excel for Mac. Mac Users should click on the Formulas tab, then click the "Logical" tool list arrow, and choose IF (see **Figure 3.9).**

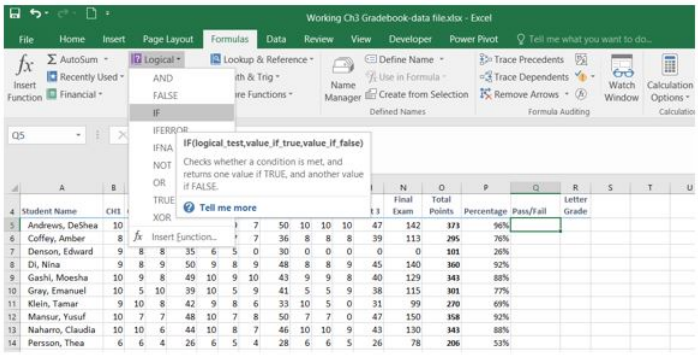


Figure 3.9 IF Function

Now you will see the IF Function dialog box, with a place to enter each of the three arguments.

Mac Users: There is no "dialog box". The "Formula Builder" pane will display at the right side of the Excel window. It has the same layout as Figure 3.10 below.

1. Click in the box for **Logical Test**. We need to test whether a student's score is less than **.7**. So, in this box, type **P5<.7**
2. Click in the box for **Value_if_true**. If the student's score is less than .7, then they are failing the class. In this box, type **Fail**.
3. Click in the box for **Value_if_false**. If the student's score is NOT less than .7, then they are passing the class. In this box, type **Pass**.
4. Make sure that your dialog box matches **Figure 3.10**.

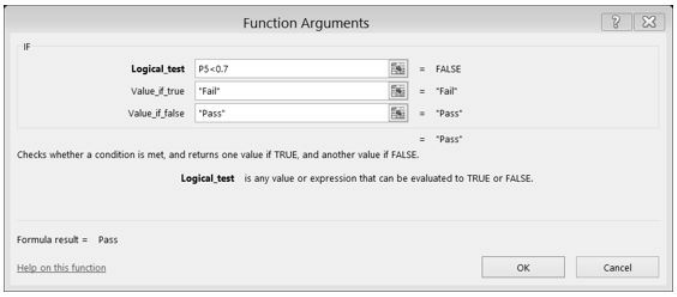


Figure 3.10 IF Function Dialog Box

While we are here, let's take a look at the dialog box. Notice that as you click in each box, Excel gives you a brief explanation of the contents (in the middle below the boxes.) In the lower left-hand corner, you can see the results of the calculation. In this case, DeShae is passing the class. Below that is a link to **Help on this function**. Selecting this link will take you to the Excel help for this function – with detailed information on how it works.

5. Once you have typed in the required arguments and reviewed to make sure they are correct, press OK.

   Mac Users should click the "Done" button, then close the Formula Builder pane.

   (The text Pass should be displayed in Q5 because DeShae is passing the class.)
6. Use the Fill handle to copy the IF function down through row 24.

7. Click on Q5. When you look in the formula bar, you will see the IF calculation: **=IF(P5<0.7,"Fail","Pass")** (see **Figure 3.11**).

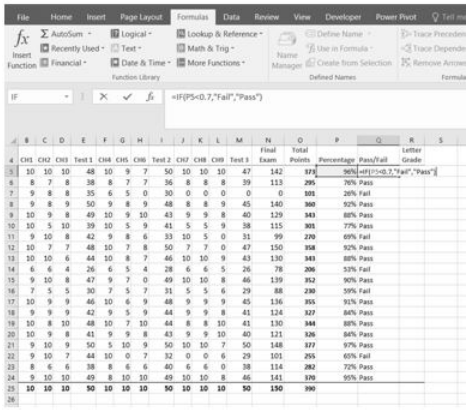


Figure 3.11 IF Function Results

VLOOKUP Function

You need to use a VLOOKUP function to look up information in a table. Sometimes that table is on a different sheet in your workbook. Sometimes it is in another file entirely. In this case, we need to know what grade each student is getting based on their percentage score. You will find the table that defines the scores and the grades in **A28:B32**.

There are four pieces of information that you will need in order to build the VLOOKUP syntax. These are the four arguments of a VLOOKUP function:

- The value you want to lookup, also called the **Lookup_value**. In our example, the lookup value will be the student's percentage score in column P.
- The **Table_array** is the range (table) where the lookup values and the values you want returned by the function are located. In our example, this is the table of percentages and corresponding letter grades in the range A28:B32. The lookup value should always be in the first column in the table array for VLOOKUP to work correctly. For example, in our table_array the lookup value is in cell A28, so the range should start with A.
- The **Col_index_num** is the column number in the range that contains the value to return. In our example, when you specify A28:B32 as the Table_array range, you should count A as the first column (1), B as the second column (2), and so on. You will enter the appropriate column number in this box as 1, 2, or 3 and so on.
- In the **Range_lookup**, you can optionally specify TRUE if you want an approximate match or FALSE if you want an exact match of the return value. If you leave this blank, the default value will always be TRUE, or approximate match.

Let's create the VLOOKUP to display the correct Letter Grade in column R.

1. Make sure that R5 is your active cell.
2. On the Formulas tab, in the Function Library, find the **VLOOKUP** function on the Lookup & Reference pull-down menu (see **Figure 3.12**).

Mac Users should click the Lookup and Reference tool list arrow  to find the **VLOOKUP** function.

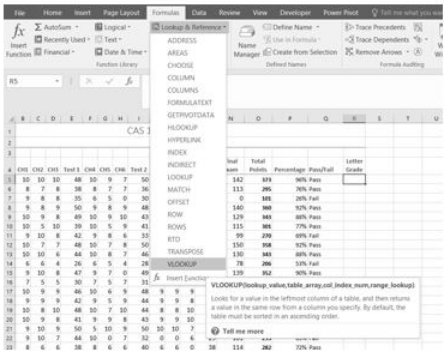


Figure 3.12 VLOOKUP Function

3. Fill in the dialog box so that it looks like the image in **Figure 3.13**.

Mac Users will use the "Formula Builder" pane at the right side of the Excel Window.

- **Lookup_value –** In this case, we will use the Percentage score. So, **P5** for the first lookup value.
- **Table_array** – This is the range that contains the value you want returned by the function. In this case, that range is A28:B32. Note that this range does NOT include the label in row 27; just the actual data. The cell references for the Table_array need to be absolute – $A$28:$B$32. When we copy this function to the other cells, we do not want these cell references to change. It should always be $A$28:$B$32. **This is very important! They must have the absolute reference symbols or the calculations will not work.**
- **Col_index_number** – This is the column in the table array range that includes the information that we are looking up. In our case, the actual grades are in the 2nd column of the range. So, the column index will be 2.
- **Range_lookup** – In some cases, you will need something in the Range_lookup box. Since we are looking for an approximate match for the percentages, we want the default value of TRUE, so we do not need to enter anything for this argument.

5. While you are in the dialog box, be sure to look at all the helpful definitions that Excel offers.
6. When you have filled in the dialog box, press OK.

Mac Users should click the "Done" button, then close the Formula Builder pane.

7. The calculation you will see in the formula bar is: =VLOOKUP(P5,$A$28:$B$32,2)
8. Use the fill handle to copy the function down through row 24. The results displayed should match **Figure 3.14**.

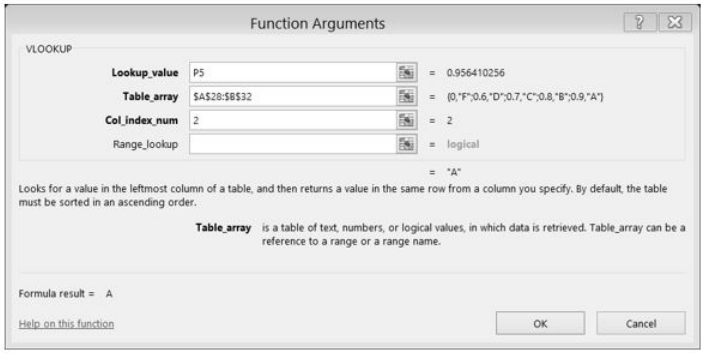


Figure 3.13 VLOOKUP completed dialog box

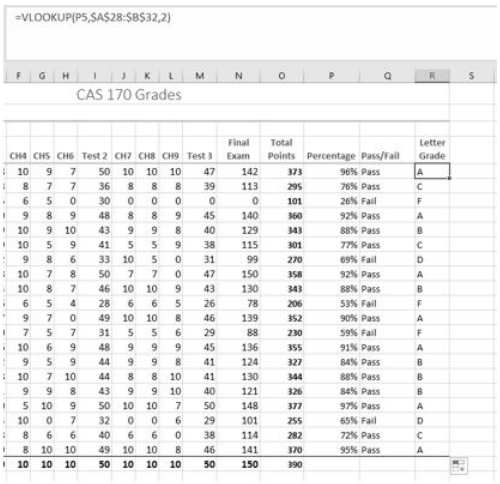


Figure 3.14 VLOOKUP Complete

Note

What if it didn't work? What if you get a result different from the one predicted? In this case, either you have made a previous error, resulting in different % scores than this exercise anticipated, or you made a mistake entering your VLOOKUP function.

To make repairs in the function, make sure that R5 is your active cell. On the Formula bar, press the Insert Function button (see **Figure 3.15**). That will reopen the dialog box so you can make your repairs. Did you forget to make the cell references for the Table_array absolute? Did you use the wrong cell for the Lookup_value? Press OK when you are done and recopy the corrected function.

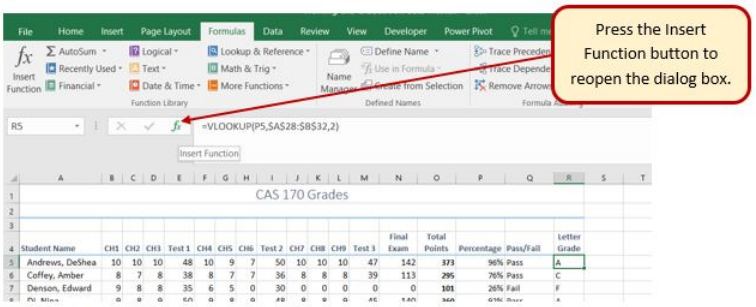


Figure 3.15 Insert Function

Error Messages

Sometimes Excel notices that you have made errors in your calculations before you do. In those cases Excel alerts you with some slightly mysterious error messages. A list of common error messages can be found in **Table 3.1** below.

Table 3.1 – Common Error Messages

Message	What Went Wrong
#DIV/0!	You tried to divide a number by a zero (0) or an empty cell.
#NAME	You used a cell range name in the formula, but the name isn't defined. Sometimes this error occurs because you type the name incorrectly.
#N/A	The formula refers to an empty cell, so no data is available for computing the formula. Sometimes people enter N/A in a cell as a placeholder to signal the fact that data isn't entered yet. Revise the formula or enter a number or formula in the empty cells.
#NULL	The formula refers to a cell range that Excel can't understand. Make sure that the range is entered correctly.
#NUM	An argument you use in your formula is invalid.
#REF	The cell or range of cells that the formula refers to aren't there.
#VALUE	The formula includes a function that was used incorrectly, takes an invalid argument, or is misspelled. Make sure that the function uses the right argument and is spelled correctly.

This table was copied from the internet. Look here for additional information.
Office for Dummies [www.dummies.com]

Date Functions

Very often dates and times are an important part of Excel data. Numbers that are correct today may not be accurate tomorrow. So, it is frequently useful to include dates and times on your spreadsheets.

These dates and times fall into two categories – ones that:

- **Remain the same**. For instance, if a spreadsheet includes data for May 15th, you don't want the date to change each time you re-open the spreadsheet.
- **Change to reflect the current date/time**. When it is important to have the current date or time on a spreadsheet, you want Excel to update the information regularly.

Take a look at the list of Date and Time functions offered in the Function Library on the Formulas tab (see **Figure 3.16**).



Figure 3.16 Date & Time Functions

For our gradebook, we want the date and time to be displayed in A2, and it needs to update whenever the workbook file is opened.

1. Make A2 your active cell. Notice that A2 extends all the way from column A to Column R. Previously, someone has used the Merge & Center tool on this cell to make it match the title above.

2. On the Formulas tab, in the Function Library, select **NOW** from the Date & Time drop-down list and then click OK.
   Mac Users click the "Done" button in the "Formula Builder" pane at the right side of the Excel window; then close the pane.
3. The result you will see in the formula bar is: =NOW(). The result you will see in A2 depends on the current date and time. The NOW function is a very handy function. It takes no arguments and is Volatile! That is not as alarming as it may seem. This just means that you don't need to give it any more information to do its job and that your results will change frequently. You can update the date and time whenever you want – you don't have to wait until you open the workbook again.
4. Make sure that A1 is your active cell and press the **F9** function key (along the top of your keyboard.) The time will update.

Excel will update this field independently whenever you save and re-open the file, or print it. It may happen more frequently than that – depending on how you have set this up in your installation of Excel.

Another variation of the current date is the **TODAY** function. Let's try that one next.

1. Make sure A2 is your active cell. Press Delete to remove the NOW function.
2. From the Date & Time drop-down list in the Function Library on the Formulas tab (see **Figure 3.16**), select TODAY and then click OK.
   Mac Users click the "Done" button in the "Formula Builder" pane; then close the pane.
3. The result you will see in the formula bar is: =TODAY(). The result you will see in A2 depends on the current date. Since we haven't asked for the time, the time you are seeing is likely 12:00. That is not very helpful so we need to change the format of the date.
4. On the Home tab, in the Number group, press the Number Format Launcher button (see **Figure3.17**).
5. In the **Format Cells**dialog box, click the Number tab. Choose the **Date**category and select **Wednesday, March 14, 2012**(this format is called **Long Date**).
   Mac Users: there is no Number Format Launcher button or "Format Cells" dialog box.
   Click the list arrow next to "Date" and choose **"Long Date"**
6. The current day and date will display in A2.

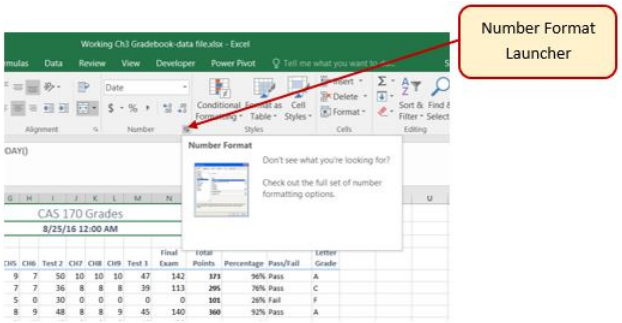


Figure 3.17 Number Format Launcher

Keyboard Shortcuts

Sometimes you want the date or the time to show up in your spreadsheet, but you don't want it to change. You can simply type in the date or time. Or, you can use shortcut keys.

- CTRL ; (semi colon) will bring you the current date
  Mac Users: same as above
- CTRL : (colon or CTRL SHIFT ;) will bring you the current time.
  Mac Users: SHIFT COMMAND

Key Takeaways

- Functions don’t always have to be about arithmetic. Excel provides functions that will help you perform logical evaluations, look things up, and work with dates and times.
- Excel displays error messages when your formulas and functions are not constructed properly.

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2.1.7: More Math Functions

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The most popular Excel function in the Math category is undoubtedly the SUM function. The Excel Math Functions perform many of the common mathematical calculations, including basic arithmetic, conditional sums & products, quotients, and rounding calculations. There are many more examples, but some of the more popular Math functions are identified in the table below. There are many variations of some of these functions to be found in the Insert Function window.

Popular Excel Math Functions	
Function & Syntax	**Usage**
PRODUCT *=PRODUCT(number1, number2,....)*	Multiplies all of the numbers given as arguments.
QUOTIENT *=QUOTIENT(numerator,denominator)*	Returns the integer portion of a division.
RAND *=RAND()*100*	Returns an evenly distributed random real number greater than or equal to 0 and less than 100.
ROUND *=ROUND(number,num_digits)*	Rounds a number to a specified number of digits.
SUMIF *=SUMIF(range,criteria,sum_range)*	Adds the cells specified by a given condition or criteria.

Math functions

The first two functions from the table above are considered basic mathematical operations. Instead of multiplying two cells using the * operator, Excel users can opt to use the **PRODUCT** function. i.e. =PRODUCT(B2,B3) versus =B2*B3. The PRODUCT function is most useful when multiplying a series of cells. Ensure that the cells referenced contain numbers or dates. If the data referenced includes text, the PRODUCT function will return the *#VALUE!* error result.

	A	B
1	13	5
2		
3	**Formula**	**Result**
4	=A1/B1	2.6
5	=QUOTIENT(13,5)	2
6	=QUOTIENT(A1,B1)	2

Quotient function example

The **QUOTIENT** function is similar to the PRODUCT function, except instead of multiplying cells, it divides cell(s) by other cell(s) and returns a result in Integer format. An integer is a whole number, therefore it will not display the remainder typically generated in division calculations. The graphic at right illustrates the differences between using the divide operator and the QUOTIENT function. The numerator is the **dividend** and is the value before the forward slash (/). The denominator is the **divisor**, and is the value after the forward slash (/). In this example, A1 (or 13) is the dividend, and B1 (or 5) is the divisor.

An alternative to using the QUOTIENT function is to utilize the ROUND function or any of its related functions (ROUNDDOWN, ROUNDUP,MROUND).

	A	B	C
1	13	6	
2			
3	**Formula**	**Result**	**Result * 5**
4	=A1/B1	2.166667	10.83333333
5	=QUOTIENT(13,6)	2	10
6	=QUOTIENT(A1,B1)	2	10
7	=ROUND(A1/B1,0)	2	10
8	=ROUND(A1/B1,1)	2.2	11
9	=ROUND(A1/B1,2)	2.17	10.85
10			

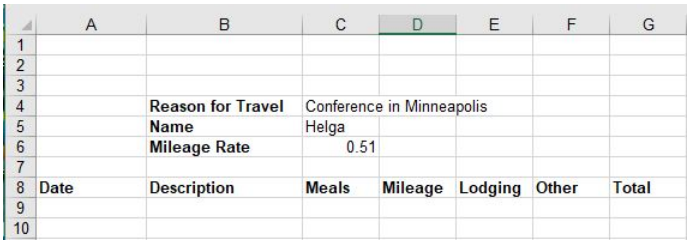
ROUND vs QUOTIENT function

In the graphic above, a user could rewrite the formula in A4 as =ROUND(A1/B1,0) by using the ROUND function to get the similar results as the QUOTIENT functions. The difference is that the QUOTIENT result does not store any remainder amounts. As shown in the graphic at the right, using the ROUND function can yield significantly different results than using the QUOTIENT

function, however, the user can control the level of detail desired in the calculation. Some users simply opt for the first scenario without using either functions. Instead, they utilize Excel's formatting functionality to remove the displaying of decimals. Using the Decrease Decimal button  from the ribbon on cell B4 can change the display to various results. However, the un-truncated/un-rounded result is still stored in the cell.

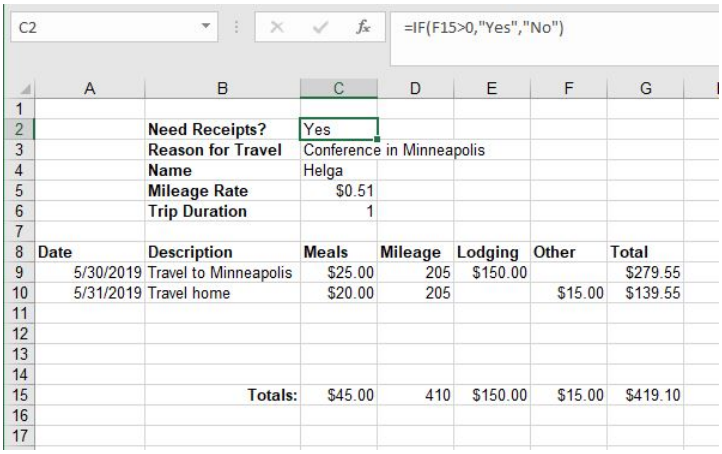
Practice 7: Expense Report

1. Create the a new worksheet with the following data from the image below:



	A	B	C	D	E	F	G
1							
2							
3							
4		**Reason for Travel**	Conference in Minneapolis				
5		**Name**	Helga				
6		**Mileage Rate**	0.51				
7							
8	**Date**	**Description**	**Meals**	**Mileage**	**Lodging**	**Other**	**Total**
9							
10							

2. In row 9 enter the following data:
   - **Date**: 5/30/2019
   - **Description**: Travel to Minneapolis
   - **Meals**: 25
   - **Mileage**: 205
   - **Lodging**: 150
   - **Other**:
3. In cell G9 enter the following complex formula using relative and absolute cell references: =C9+(D9*$C$6)+E9+F9 *(are the parenthesis necessary?)*
4. Format columns C, E, F and G as Currency format with two decimals.
5. Enter the following in row 10:
   - **Date**: 5/31/2019
   - **Description**: Travel home
   - **Meals**: 20
   - **Mileage**: 205
   - **Lodging**:
   - **Other**: 15
6. Use the fill handle to copy the formula in G9 to G10.
7. Insert a new row below the Mileage Rate row, and in B6 enter the label: Trip Duration. (bold the label)
8. In cell C6 enter a formula that subtracts A9 from A10. Change the format of cell C6 to General.
9. In cell B15 enter the label: Totals: (right-align & bold this cell).
10. Select cells C15:G15 and click the AutoSum button. Change the format of D15 to General.
11. Enter the label: Need Receipts? in cell B2. (bold the label)
12. In cell C2, enter the following logical function: =IF(F15>0,"Yes","No")
13. Save the file as Helga Expenses May2019. Your worksheet should resemble the following:



	A	B	C	D	E	F	G
1							
2		**Need Receipts?**	Yes				
3		**Reason for Travel**	Conference in Minneapolis				
4		**Name**	Helga				
5		**Mileage Rate**	$0.51				
6		**Trip Duration**	1				
7							
8	**Date**	**Description**	**Meals**	**Mileage**	**Lodging**	**Other**	**Total**
9	5/30/2019	Travel to Minneapolis	$25.00	205	$150.00		$279.55
10	5/31/2019	Travel home	$20.00	205		$15.00	$139.55
11							
12							
13							
14							
15		**Totals:**	$45.00	410	$150.00	$15.00	$419.10
16							
17							

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2.1.8: Introduction to Charts and Visualizations

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Learning Objectives

- Select the most appropriate chart type (column/bar, line, pie, combo, PivotChart) for comparison, trend, composition, and mixed-metric scenarios.
- Build and customize charts (titles, axes, legends, data labels, colors, gridlines) for clarity, accessibility, and professional presentation.
- Link formulas and tables to charts so visuals update dynamically as data changes.
- Create PivotCharts from PivotTables to explore data interactively with filters, groupings, and drill-downs.
- Incorporate images, shapes, icons, WordArt, and SmartArt to strengthen storytelling and presentation quality.

Raw numbers often fail to communicate the full story of a dataset. While spreadsheets are excellent for storing and calculating information, visual representations—such as charts, diagrams, and infographics—help reveal patterns, comparisons, and trends that may otherwise go unnoticed. Charts turn data into insight, allowing audiences to interpret complex information quickly and accurately.

In professional environments, effective data visualization is an essential skill. Business analysts use charts to present quarterly sales growth or market trends; educators rely on visuals to illustrate student performance or attendance patterns; and project managers use them to track milestones or budgets. In each case, the goal is the same: to make data *meaningful* and *actionable*. Well-designed visuals improve communication, support decision-making, and enhance the overall professionalism of a report or presentation.

Excel offers a comprehensive suite of tools to create these visualizations. From basic chart types like column, bar, and pie charts to more advanced tools such as combo charts and PivotCharts, users can select the best format for their message and audience. Beyond charts, Excel also includes SmartArt, icons, images, and WordArt, which can transform data-driven workbooks into visually polished reports or dashboards.

This chapter focuses on mastering Excel's visualization tools and developing an understanding of design principles that make visuals effective. You'll learn how to choose the right chart type for your dataset, customize colors and labels for clarity, and combine text and images to enhance storytelling. By the end of this module, you'll be able to design clear, compelling visuals that not only represent your data accurately but also communicate your message with impact—an essential skill in business, academic, and technical fields alike.

Design Best Practices- Choosing the Right Chart Type

Not all charts communicate information equally well. The effectiveness of a visualization depends on choosing the right chart type for your data and applying design principles that enhance clarity rather than distract from it. A well-chosen chart makes complex patterns easy to see; a poor choice can mislead, confuse, or overwhelm your audience.

Selecting the appropriate chart type involves understanding the story your data is meant to tell—whether it's a comparison, a trend over time, a proportion of a whole, or a relationship between variables. In professional contexts such as business reporting, academic research, or administrative presentations, clarity and accuracy are paramount.

Guidelines for Effective Chart Selection

Each chart type serves a different analytical purpose. Use the following principles to decide which one fits your data best:

1. Line Charts – Display Time-Based Trends
   Line charts show how values change over time. They are ideal for continuous data such as monthly sales, student GPA progression, or website traffic trends.
   - *Example:* Tracking total revenue from January to December or enrollment growth across semesters.
   - *Tip:* Keep line colors distinct and use markers sparingly to avoid clutter.

2. Bar and Column Charts – Compare Categories
   Bar (horizontal) and column (vertical) charts are the most common choice for comparing quantities across categories. They clearly show differences between groups, departments, or time periods.
   - *Example:* Comparing sales by product line, expenses by department, or survey responses by age group.
   - *Tip:* Use consistent colors and order categories logically (e.g., highest to lowest).
3. Pie Charts – Show Proportions of a Whole
   Pie charts illustrate how individual parts contribute to a total. However, they become difficult to read with too many slices or small percentages. Use them sparingly and only when the total equals 100%.
   - *Example:* Showing how a company's revenue divides among four business segments.
   - *Tip:* Limit to five or fewer slices and label each percentage clearly for readability.
4. Combo Charts – Compare Related Data Series
   Combo charts combine two chart types (often column + line) to show relationships between different data sets. This approach helps compare magnitude and trend simultaneously.
   - *Example:* Displaying total sales as bars and profit margin as a line on the same graph.
   - *Tip:* Use distinct color schemes or secondary axes to distinguish metrics.

Design Principles for Clear Communication

Even the best data can be misunderstood if the design distracts from the message. Follow these principles to create professional, accessible charts that communicate effectively:

- Keep It Simple: Avoid 3D effects, unnecessary shadows, or gradients that distort perception. Clean, flat visuals are easier to interpret and print.
- Minimize Clutter: Remove excessive gridlines, borders, and labels. Include only what is necessary for comprehension.
- Use Consistent Formatting: Apply the same fonts, colors, and chart styles across all visuals in a report to maintain professionalism.
- Ensure Accessibility: Use contrasting colors and patterns for people with color-vision differences. Avoid using color alone to indicate meaning—combine with text or symbols when possible.
- Label Clearly: Every chart should include an informative title, properly formatted axis titles, and a clear legend.
- Check Readability: Preview charts in print or on different screens to ensure labels and colors remain legible.

When deciding between chart types, ask yourself: *"What question am I trying to answer with this visualization?"*

If the goal is to compare quantities—use a column chart.
If you're showing change over time—use a line chart.
If you're illustrating a percentage breakdown—use a pie or donut chart.

Always design with purpose, and let the data dictate the format, not the other way around.

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2.1.9: Creating and Customizing Charts

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Excel provides a variety of chart types designed to help you communicate data effectively. Choosing the right chart depends on what story you want the data to tell—comparison, trend, composition, or relationship. Each chart type serves a specific purpose and can transform raw numbers into clear, visual meaning.

1. Bar and Column Charts – Comparing Quantities Across Categories
Bar and column charts are the most commonly used visualization tools in Excel. They display differences in values between categories, making it easy to compare performance, frequency, or totals.
Example: Comparing monthly revenue across product lines, or evaluating student attendance for multiple courses.
Tip: Use horizontal bar charts when category names are long, and vertical column charts for time-based or numerical comparisons.

2. Line Charts – Showing Change Over Time
Line charts are ideal for tracking trends, growth, or progress across a continuous timeline. Each data point is connected by a line, visually representing the direction and rate of change.
Example: Tracking a student's GPA across semesters, or visualizing quarterly sales growth over a fiscal year.
Tip: Avoid too many lines in a single chart—three or fewer series are best for readability.

3. Pie Charts – Displaying Parts of a Whole
Pie charts show how individual values contribute to a total. Each "slice" represents a category's percentage of the whole. They are best used for data with fewer categories and where exact proportions are meaningful.
Example: Showing expense categories as percentages of a total budget, or illustrating how a team's time is divided among tasks.
Tip: Limit slices to six or fewer and label percentages directly to enhance clarity.

4. Combo Charts – Comparing Different Data Types
Combo charts combine two chart types (commonly a column and a line) to display related datasets with different value ranges. This makes it easier to visualize relationships between two metrics, such as quantity and trend.
Example: Displaying monthly sales volume as bars and revenue growth percentage as a line.
Tip: Use secondary axes to balance scaling when the two datasets differ greatly in units or magnitude.

Customizing Charts

Creating a chart is only the beginning. Customizing it for clarity, accuracy, and professionalism ensures that your audience can interpret your message effectively. Excel provides powerful tools under the Chart Design and Format tabs to refine your visualization.

- Titles: Add a descriptive chart title and clear axis labels that define what each measure represents. A well-written title should explain *what* the viewer is seeing and *why it matters*.
  Example: "Monthly Sales Performance – 2025" is more effective than "Sales Chart."
- Legends: Position and format the legend to make it easy to associate colors or symbols with data categories. Place it beside or below the chart where it does not obstruct data.
- Data Labels: Display exact values on your chart to provide context. Use them selectively—highlighting totals or percentages rather than labeling every point—to maintain visual balance.
- Colors and Styles: Apply prebuilt or custom color palettes to improve readability and align with branding or accessibility standards. High-contrast colors enhance legibility, while consistent use of hues across charts helps audiences recognize categories quickly.
- Gridlines: Use gridlines sparingly. Too many can clutter the visual, while a few subtle horizontal lines can help viewers estimate values easily. Removing unnecessary visual noise improves focus on key data points.

Together, these customization options transform basic visuals into polished, presentation-ready charts that communicate insight with clarity and confidence.

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3D Maps

Formerly Power Maps, 3D maps provide a 3- dimensional visualization.

> For more information, visit Microsoft Office Getting Started with 3D Maps.

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2.1.10: Chart Elements and Design

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Once you have created a chart, the next essential step is customization—ensuring that your visual is not only accurate but also clear, readable, and visually appealing. Proper formatting transforms a simple chart into a polished communication tool that supports analysis and storytelling.

The Chart Design and Format tabs in Excel provide powerful tools to refine your charts. With just a few adjustments, you can add context through titles and axis labels, increase legibility with legends and data labels, and enhance professionalism through consistent fonts, colors, and spacing.

Chart Title

The chart title sets the stage for interpretation—it immediately tells the viewer what the chart represents. Without a clear, descriptive title, even well-designed visuals can confuse the audience or lead to misinterpretation.

How to Customize:

· Click on the chart title placeholder and type a concise, meaningful description (for example, *Monthly Sales by Product Line – 2025*).

· Use the Format Chart Title pane or Home tab to adjust the font, size, and color to match your workbook's style.

· Keep the design consistent—bold, legible text (around 12–14 pt) in a simple font helps maintain readability and professionalism.

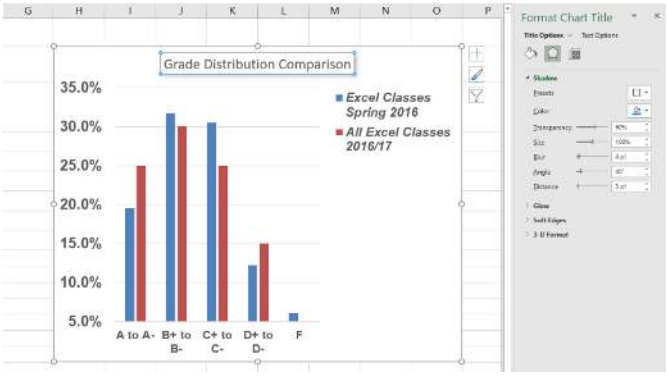


Figure 6.4.1 Format Chart Title Box

Legend

The legend serves as the key to understanding the chart's color-coded or patterned elements. It ensures that each data series can be easily identified and interpreted, especially in multi-series charts such as those comparing products, departments, or regions.

How to Customize:

· Select the legend area, then use Chart Design ▸ Add Chart Element ▸ Legend to position it (Top, Bottom, Left, or Right).

· Resize or reposition the legend to avoid overlapping the chart data.

· Match legend text styling (font, color, and size) with the rest of your workbook for consistency.

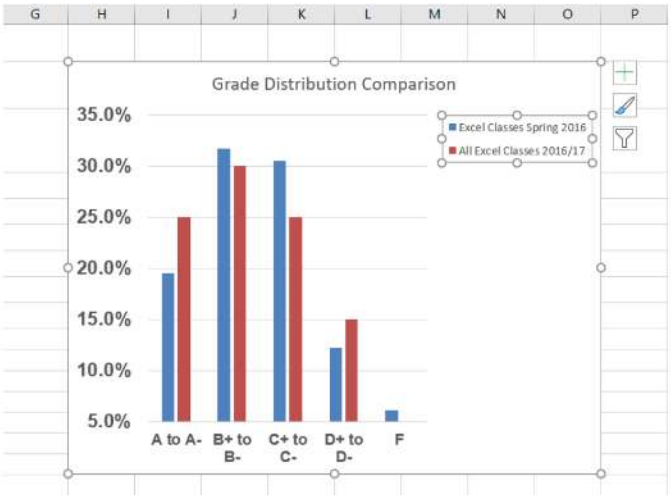


Figure 6.4.2 Moving the Legend

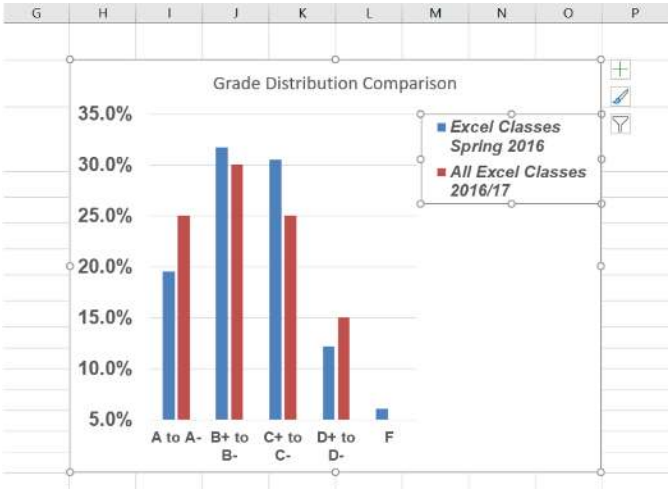


Figure 6.4.3 Legend Formatted and Resized

Formatting the Chart Legend and Title Steps

Legend:

1. Click the Legend to activate it.
2. Click either the Home tab or right click to activate the appropriate formatting pane.
3. Select any of the available formatting commands.
4. Click and drag the legend to move it.
5. Click and drag any of the sizing handles to adjust the size of the legend.

Title:

1. Click anywhere on the chart title.
2. Click either the Home tab or right click to activate the appropriate formatting pane.
3. Select any of the available formatting commands.

Axis Titles

Axis titles provide context for what the horizontal (X) and vertical (Y) axes measure—such as time, units sold, percentages, or currency. Without them, numbers may lose meaning or be misinterpreted.

How to Customize:

· Navigate to Chart Design ▸ Add Chart Element ▸ Axis Titles ▸ Primary Horizontal / Primary Vertical.

· Replace generic text with descriptive labels, such as *Month* for the X-axis or *Revenue (in $ 000s)* for the Y-axis.

· Apply formatting—like bold or color accents—to make the labels easy to read without overwhelming the chart.

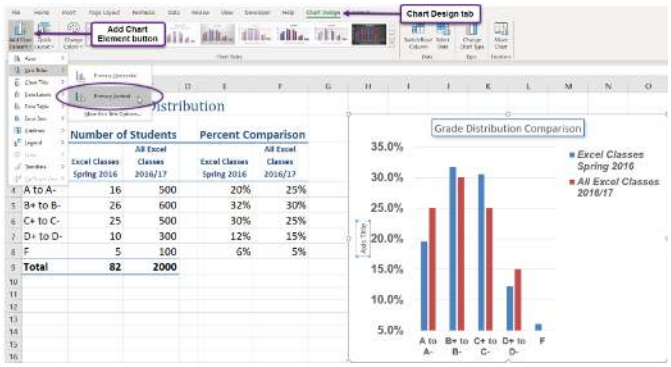


Figure 6.4.4 Selecting a Title for the Y Axis

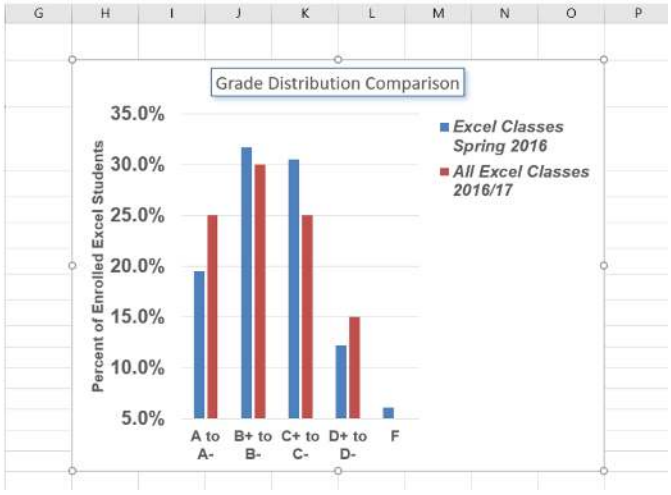


Figure 6.4.5 Adding and Formatting the Y Axis Title

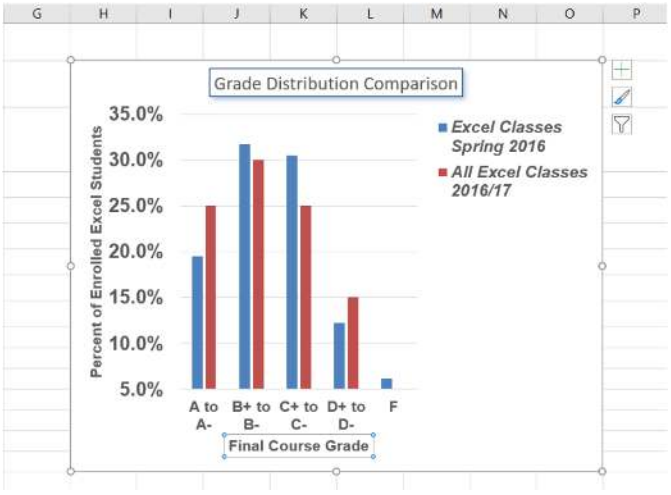


Figure 6.4.6 X and Y Axis Titles Added

Data Labels

Data labels display the actual values associated with each point or bar, allowing viewers to understand precise figures at a glance without referencing axes. This is especially useful in presentations or reports where you want the reader to focus on key numbers quickly.

How to Customize:

· Select the chart and choose Chart Design ▸ Add Chart Element ▸ Data Labels, then pick a position (Inside End, Outside End, Center, etc.).

· Format label text for readability—use clear fonts, subtle colors, and consistent alignment.

· If labels overlap, adjust individual ones by double-clicking to select and dragging them into place.

· Avoid clutter—include only the most relevant data labels for clarity.

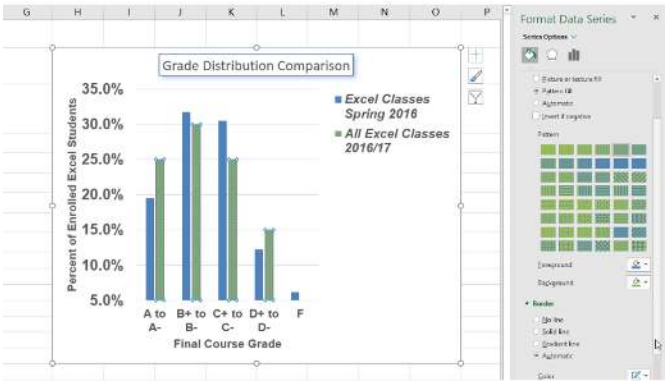


Figure 6.4.7 Changing the Fill of a Data Series

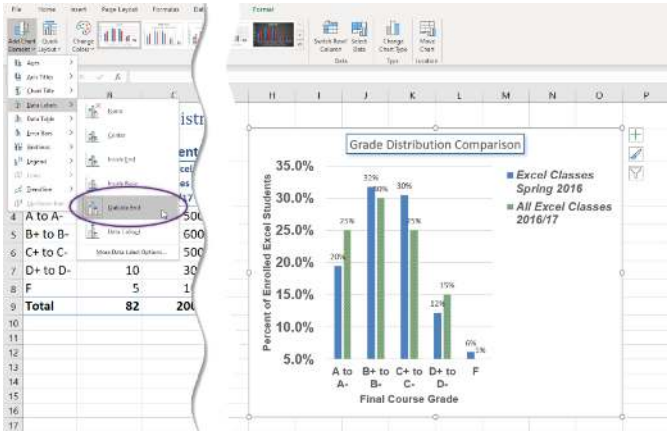


Figure 6.4.8 Adding Labels to a Data Series

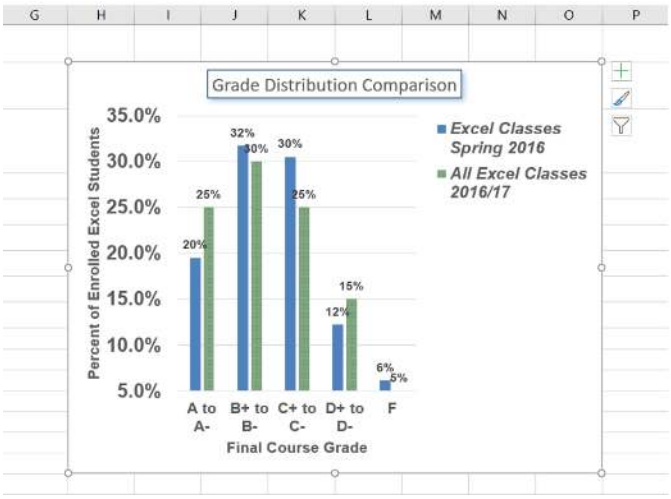


Figure 6.4.9 Completed Formatting Adjustments for the Data Series

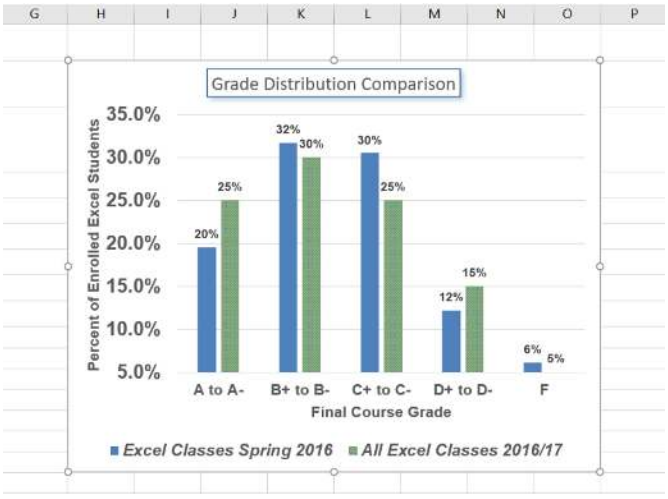


Figure 6.4.10 Completed Formatting Adjustments for the Legend

Gridlines and Plot Area

Gridlines help guide the viewer's eye across the chart and improve data alignment. However, too many or overly bold gridlines can distract from the main message. Similarly, the plot area (the section where the chart's data appears) can be adjusted to enhance visual focus.

How to Customize:

· Go to Chart Design ▸ Add Chart Element ▸ Gridlines, and toggle between *Major*, *Minor*, or *None* depending on the level of detail you want.

· Use light gray or neutral tones for gridlines instead of heavy black lines.

· Format the Plot Area under the Format tab to adjust background color, add borders, or remove unnecessary shading.

· Keep the focus on the data—avoid decorative backgrounds that make values harder to see.

Practical Tips

- Apply your workbook's theme first (Page Layout ▸ Themes) to maintain consistent colors and fonts across all visuals.
- Use the Format Painter to copy a preferred chart style onto others for a cohesive look.
- Preview charts in Page Layout View or Print Preview to ensure the layout and colors appear correctly when printed or exported.

- Use contrasting colors and patterns for different data series to improve accessibility—especially for readers with color-vision deficiencies.
- Keep your design minimal: fewer gridlines, limited color palettes, and clear text help your charts communicate more powerfully.

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2.1.11: Pie Charts

📌 Click here to view Microsoft Excel Building Proficiency Chapter Overview

With Excel, users can organize data so that it has context and meaning. The output of Excel manipulation can take the shape of either a table or chart. When deciding to use a chart or a table to communicate the data-driven message, it is wise to always ask how the information will be used, and who is the audience? People interact very differently with these two types of visuals. **Tables**, which display data in a columnar layout, are meant to be read. Therefore tables are ideal when the data requires more specific analysis. Tables offer preciseness, letting users dive deeper to crunch the numbers and examine exact values, instead of focusing on approximations or visualizations.

A **chart** is a visual representation of a range of related worksheet data. A chart can illustrate a large amount of numerical data quickly and in an easy-to-understand fashion. Charts are particularly useful for simplifying complex sets of data to expose the shape of the data – numerical patterns, trends, and other significant activity. What charts lack in terms of precision they overcome with broader insight and quicker comprehension.

According to some psychologists, people can be classified as either “left-brained” or “right-brained” thinkers. A person who is “left-brained” is often said to be more logical, analytical, and objective.

Note

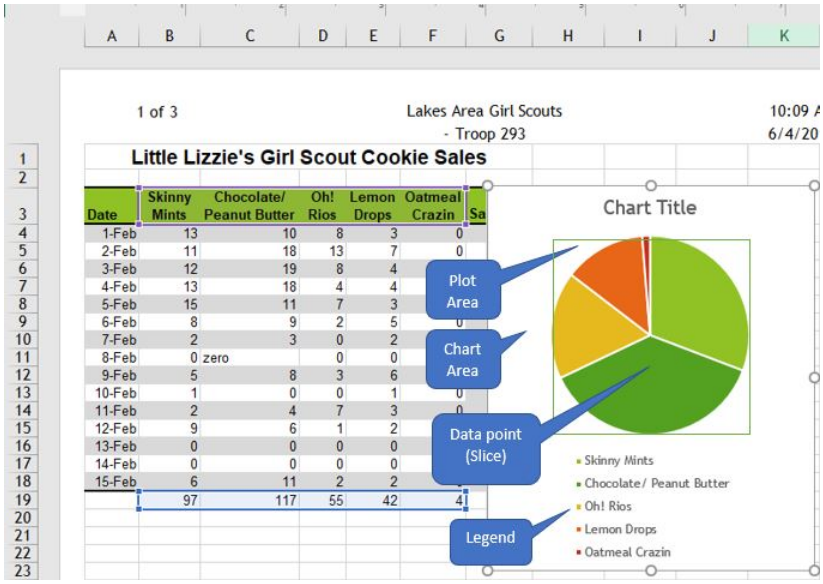
The right brain-left brain theory originated in the work of Roger W. Sperry, who was awarded the Nobel Prize in 1981 .

Utilizing tables to display spreadsheet data may be more effective with “left-brained” people. A person who is “right-brained” is said to be more creative, thoughtful, and subjective. Conversely, displaying spreadsheets data using certain Excel charts may be more suitable for “right-brained” people. Both tables and charts offer unique advantages, but one is not always better than the other. The choice ultimately depends on the data at hand, the message that is intended to convey, and the audience that will be consuming the information.

Learning how to work with charts means not only knowing how to create them but also realizing that different types of chart and layouts can reveal and emphasize different knowledge. Like a picture, a chart can be worth a thousand words. It all depends on how well the chart is designed and developed. A well constructed chart will provide context and clarity for data analysis and story telling. The first step to creating useful charts it to organize and precisely select the data that should be charted. This includes the cells that contain both the data and the label headings.

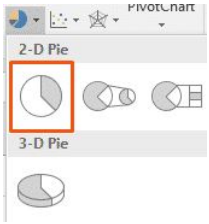
Each chart type conveys information in different ways. **Pie charts**, for example, are best for charting data that is a percentage of a whole. For example, what percentage of your monthly income is spent on transportation? Charts contain different objects for each chart type. Objects in a pie chart include:

- **Chart title** – describes what is charted. The label heading of the data series is used by default, but this can be edited.
- **Legend** – an index of information that corresponds to the category labels.
- **Data labels** – identify each value in the data series.
- **Plot area** – the part of the chart that displays data graphically.
- **Chart area** – the entire chart and all of its elements.



Pie chart annotated

A pie chart can only include a single series of data, whether it is a single column or a single row of data. A **data series** is the sequence of values that Excel uses to plot in a chart. Each value from the data series is represented by a slice (or wedge) of the pie. The size of each slice varies with its percentage of the total of the entire data series. To create a pie chart, first carefully select the appropriate data range before selecting the chart type from the Insert tab. In the above chart, the selected data range is $B$3:$F$3, $B$19:$F$19, since the only data series being charted is the total sales (quantity) of each cookie flavor. Every date (row) represents an additional data series, but since pie charts only plot a single data series, these series' should not be selected. Pie charts should be avoided when there are many categories, or when categories do not total 100%. Typically, 2-D charts are easier to read than 3-D charts.



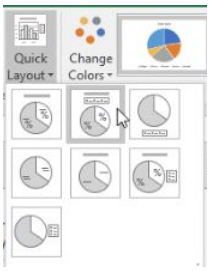
Insert pie chart

When a chart is created as an object on a worksheet, sizing handles will appear on the outer borders. The chart, or any object within the chart, can be moved and/or resized similarly to a picture or other objects in Microsoft Office. When a pie chart is first created, Excel will use the default colors and design. Users can customize the chart look easily by utilizing chart styles. In the Design contextual tab of the Ribbon, a number of different styles will be displayed in a row. Mouse over them to see a preview:



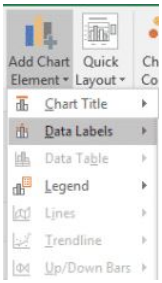
Chart styles

An additional option for quickly changing the look of a chart is to utilize the **Quick Layout menu** to select one of several preset to add elements like percentage labels, value labels, and differently located legends to the chart.



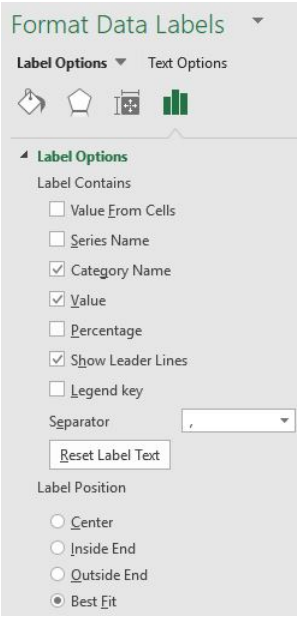
Quick layout menu

Users can also add and remove individual elements, such as chart titles, data labels, data tables, and more by using the **Add Chart Element** menu.



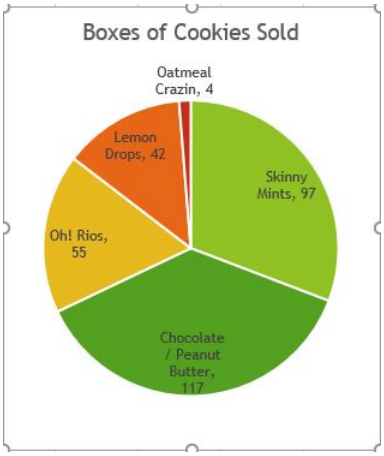
Add chart element

Some elements are not available for certain chart types. One of the most useful chart elements that get added manually to a chart are **data labels.**



Format Data Labels task pane

Data labels are linked to values on the worksheet, and they update automatically when changes are made to these values. Data labels make a chart easier to understand because they show details about a data series or its individual data points. Users can add data labels to all data points or a specific data slice by ensuring that only the specific slice is selected. In addition to the Add Chart Element menu and quick layout options, users can add data labels by right-clicking the chart and choosing Add Data Labels from the shortcut menu. Once added, the data labels can be further modified by right-clicking the chart and choosing Format Data Labels to open the Format Data Labels task pane. One or more types of labels can be added and positioned. Adding Category Name labels make the legend redundant. Be careful not to add so many labels that the chart becomes too crowded to read!



Pie chart with labels

After adding labels, it may become necessary to resize or move the chart. After adding a title, data labels, and removing the legend, the chart looks different, but is still the same size, even though certain elements have resized.

Which pie chart looks better? Generally, removing the legend through use of data labels is considered a preferable design strategy. Alas, there are even more ways to customize a pie chart that is beyond the scope of this text! Additional functionality includes creating 3-D pie charts, exploding slices, rotating, sorting, adding different fill designs, and much more!

Pie Chart

The following steps are an introduction to creating the pie chart:

1. Highlight the range A2:B8.
2. Click the Insert tab of the Ribbon.
3. Click the Pie Chart button: This will open the Pie and Doughnut chart drop-down menu of options (see Figure 6.3.3).
4. Select the 2D Pie option from the list of column chart options (see Figure 6.3.3).

Tip:

Use a pie chart only when your data represents parts of a whole that total 100%. Too many slices can make the chart confusing—limit categories to five or six. Combine small categories into an “Other” slice for clarity. Always label percentages or values directly on the chart to make interpretation quick and accurate.

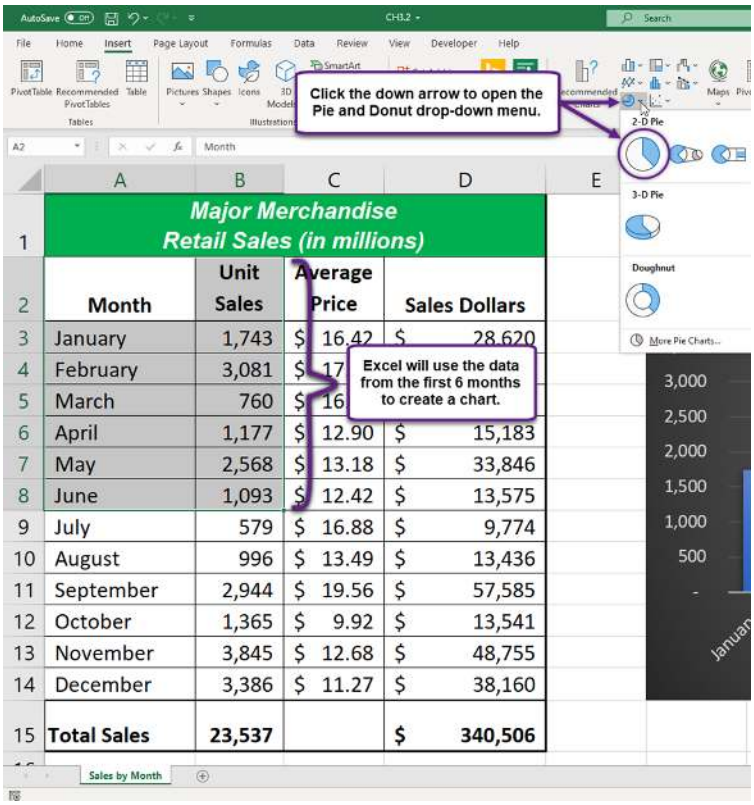


Figure 6.3.3 Pie and Doughnut Chart Drop-Down Menu

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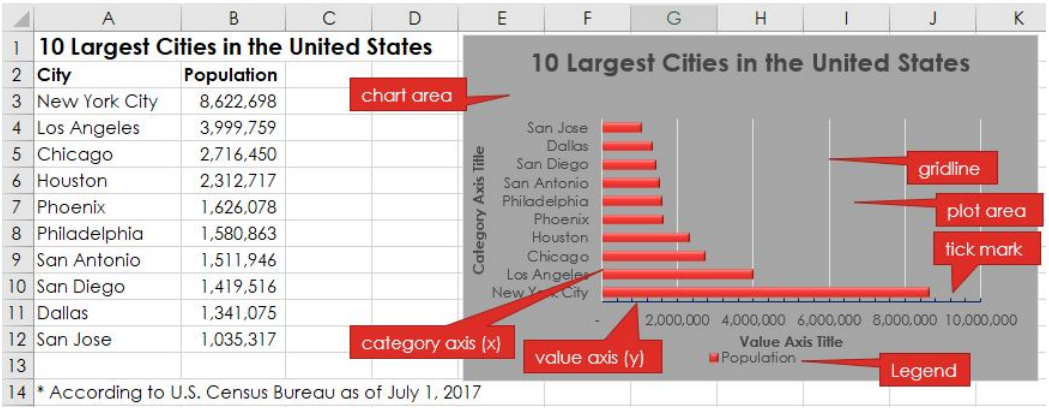
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2.1.12: Bar and Column Charts

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Bar charts are practical for comparing the differences between values with horizontal bars. The lengths of the bars are proportional to the size of the data category they represent. A vertical bar chart is referred to as a column chart, and they are basically the same – just 90° apart. Unlike a pie chart, a bar chart can include several series of data. Bar charts are simple, easy and flexible, and thanks to the horizontal layout, bar charts can accommodate longer category names. Bar (and column) charts contain the following objects:

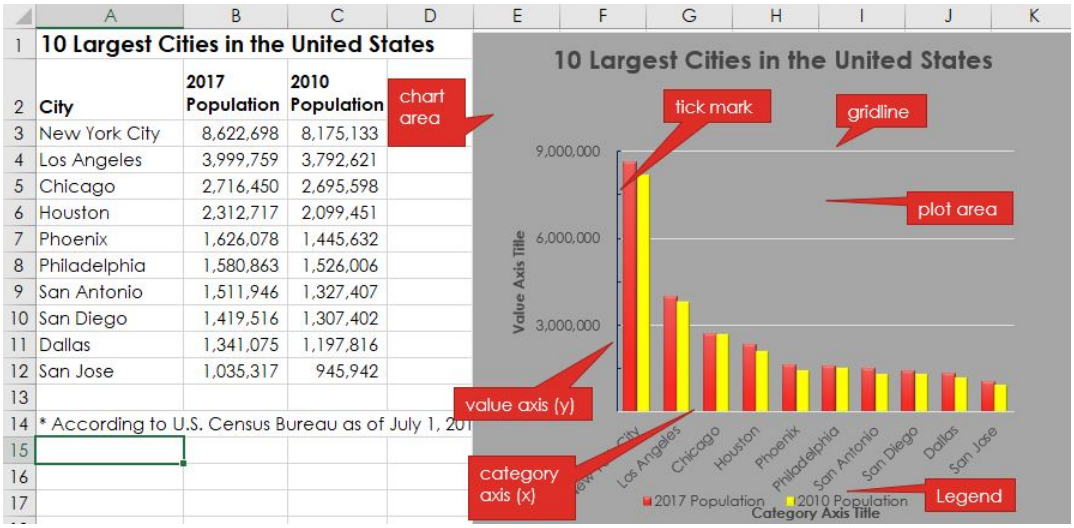
- **Chart title** – describes what is charted.
- **Chart area** – the entire chart and all of its elements.
- **Plot area** – the region within the horizontal and vertical axes.
- **Axes titles** (horizontal, vertical)- describe the data.
- **Legend** – an index of information that corresponds to the series names.
- **Data labels** – identify each value in a data series.
- **Value axis (y-axis)** – contains values. Horizontal axis on bar charts and vertical axis on column charts.
- **Category axis (x-axis)** – contains the category labels. Horizontal axis on column charts and vertical axis on bar charts.
- **Gridlines** – mark the intervals on an axis.



	A	B
1	**10 Largest Cities in the United States**	
2	**City**	**Population**
3	New York City	8,622,698
4	Los Angeles	3,999,759
5	Chicago	2,716,450
6	Houston	2,312,717
7	Phoenix	1,626,078
8	Philadelphia	1,580,863
9	San Antonio	1,511,946
10	San Diego	1,419,516
11	Dallas	1,341,075
12	San Jose	1,035,317
13		
14	* According to U.S. Census Bureau as of July 1, 2017	

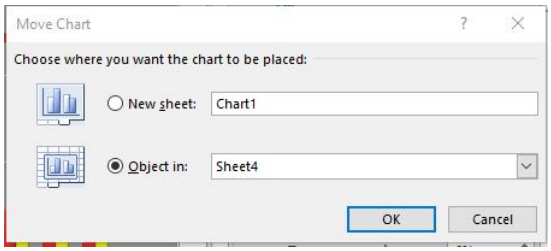
Bar chart annotated

While the data and chart above only displays one data series, most bar and column charts tend to display multiple data series to compare and contrast one set of data against another. The chart below adds a second data series in column C, and changes the chart type to a column chart. The two different data series are illustrated with different color data points. Also, note how the axes change directions! The value axis maximum, major and minor units were also modified to different numerical values.



Multiseries column chart

Charts can easily get crowded with details. Therefore, keeping the chart on the same worksheet as the data is not always feasible. Users can move a chart to any location on a worksheet or to a new or existing worksheet. By default, a chart is created as an object within a sheet. The chart can be resized, but sometimes the chart needs to be as large as possible. To move the chart to a new worksheet, click the Move Chart button on the Chart Tools Design tab.



Move Chart

Next, click the New sheet radio button, and then in the New sheet box, type a name for the new worksheet. After clicking OK, the new sheet will be to the left of the existing sheet. A new, standalone chart will occupy the entire page to maximize the visibility of the data. The Move Chart window also provides the option of moving the chart as an embedded object into an existing sheet.

Column Chart

The following steps are an introduction to creating the column chart:

1. Highlight the range you wish to use. Example in Figure: A2:B14.
2. Click the Insert tab of the Ribbon.
3. Click the Column button: This will open the column chart drop-down menu of options (see Figure 6.3.1).
4. Select the 2D Clustered Column option from the list of column chart options (see Figure 6.3.1).

Tip:

Use Column Charts when comparing quantities across different categories, such as sales by product or grades by assignment. Keep the gap width between bars moderate and use consistent, high-contrast colors for readability. Sort categories logically (e.g., highest to lowest or chronologically) to help viewers quickly identify patterns or differences.

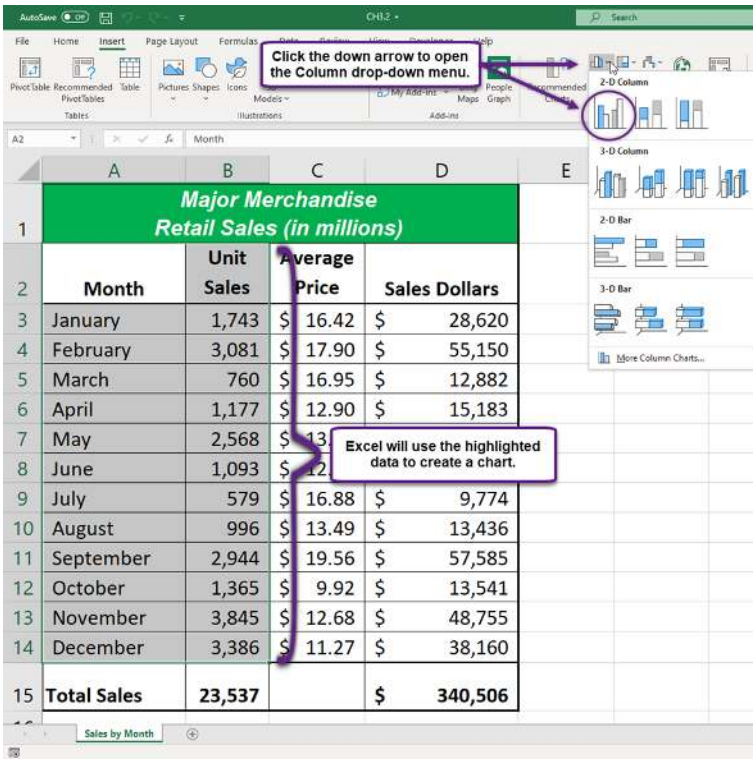


Figure 6.3.1 Column Chart Drop-Down Menu

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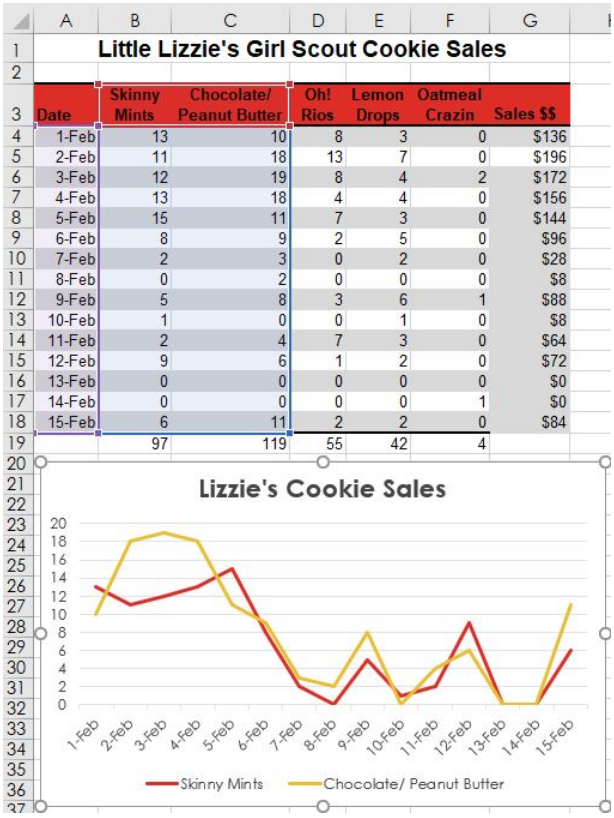
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2.1.13: Line Charts

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A line chart displays a series of data points connected by a straight line. Line charts are a good way to show change or trends over time. Line charts are simple to create and easy to read. In contrast to column or bar charts, line charts can handle more categories and more data points without becoming too cluttered. Each line displays as a different color. Line charts help people examine why data is changing and make decisions about how to proceed. The Line Chart is especially effective in displaying data trends. Stock market investors utilize line charts to track historical stock performances, and help determine if a trend can be forecasted in the future.



Date	Skinny Mints	Chocolate/ Peanut Butter	Oh! Rios	Lemon Drops	Oatmeal Crazin	Sales $$
1-Feb	13	10	8	3	0	$136
2-Feb	11	18	13	7	0	$196
3-Feb	12	19	8	4	2	$172
4-Feb	13	18	4	4	0	$156
5-Feb	15	11	7	3	0	$144
6-Feb	8	9	2	5	0	$96
7-Feb	2	3	0	2	0	$28
8-Feb	0	2	0	0	0	$8
9-Feb	5	8	3	6	1	$88
10-Feb	1	0	0	1	0	$8
11-Feb	2	4	7	3	0	$64
12-Feb	9	6	1	2	0	$72
13-Feb	0	0	0	0	0	$0
14-Feb	0	0	0	0	1	$0
15-Feb	6	11	2	2	0	$84
	97	119	55	42	4	

Line chart

In a Line Chart, the vertical axis (Y-axis) always displays numeric values and the horizontal axis (X-axis) displays time or other categories. Time intervals can be measured in years, months, days, or hours.

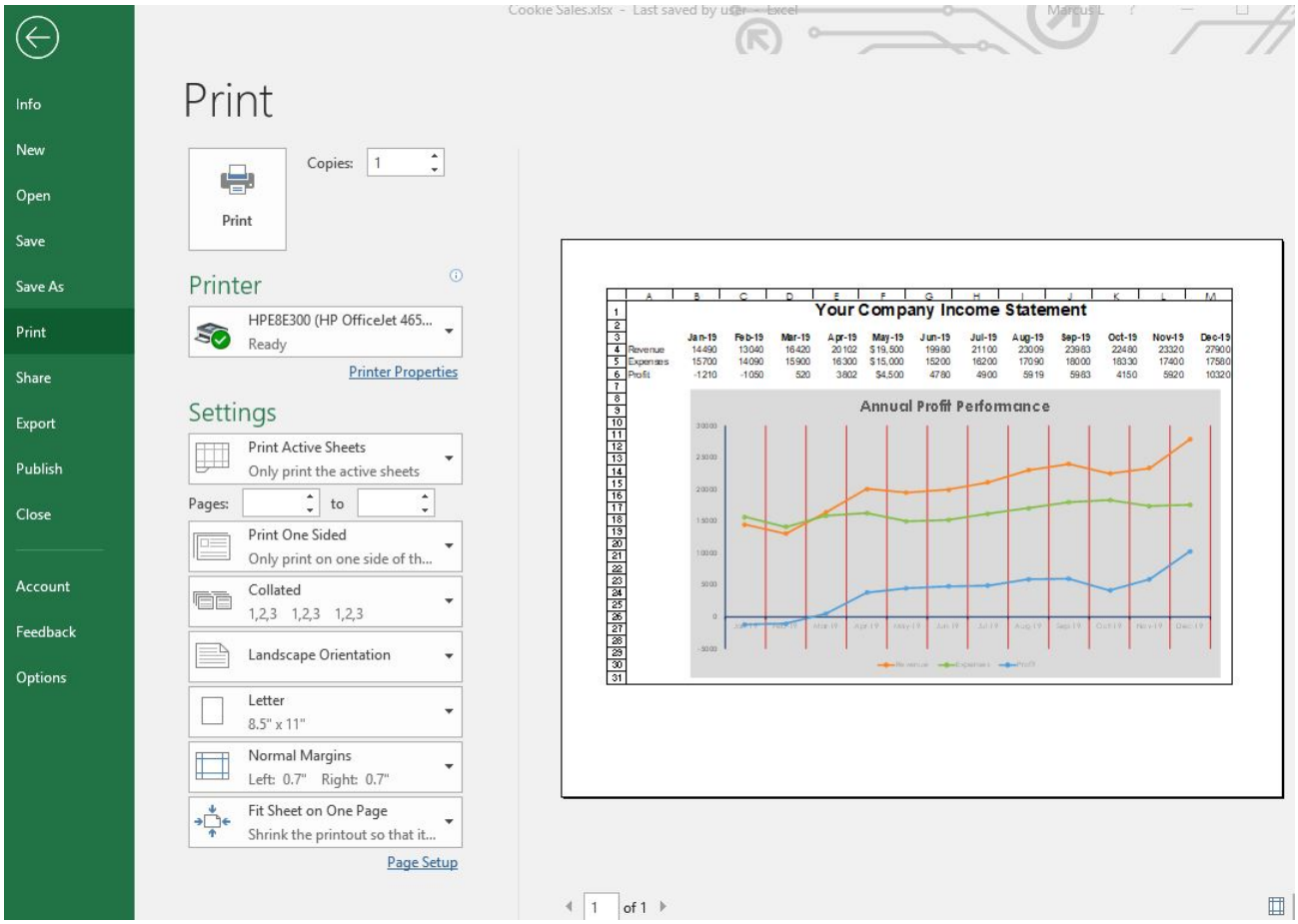
To create a line chart, start by selecting the data range, then choosing the Line Chart button  in the Charts group from the Insert tab.

In the 2-D line chart illustrated above, two sets of data series are plotted for fifteen days. The Skinny Mints cookies are identified by the red line, and the orange line plots the Chocolate/Peanut Butter cookies. Each date is a data point. Additional data series can be added by expanding the data source range. Line charts provide an easy way to track historical data. In many cases, the way the data is trending makes it easy to predict the results of data in future periods.

Excel offers numerous other charts that might better help illustrate the story behind the data, however all charts must address the challenge of sharing or outputting the graphic(s) to their target audience(s). Here are a few printing issues to consider:

- Printing only the chart. If the active cell is not selecting the chart, both the chart and worksheet data will print. However, if the chart is currently selected, only the chart will print by default (as a chart sheet). If the intent is to print both the chart and the

data, make sure to move and/or resize the chart to ensure everything fits appropriately within the sheet margins. This will embed the chart within the sheet. Utilizing the Print Preview window to verify what will print by default will allow the user to make numerous changes, such as the orientation, margins and scaling. A different installed printer can also be selected. The graphic below illustrates from the Print Preview window, an embedded line chart in landscape orientation with headings enabled for print. The sheet has also been scaled to fit to one page.



Excel Print Preview Line Chart

- Chart colors that are not compatible with black and white printers. A lot of office printers are black and white laser printers due to their low-cost to operate at high volumes. A color laser printer may be a worthy investment for common chart printing. If a black and white printer is all that is available, it may be necessary to change the colors to patterns or contrasting shades of grey.
- Not enough or too much information. Reads of the chart must be able to comprehend the message the chart is attempting to convey. This might require adding context, such as titles, data labels, and text-box callouts. Conversely, a chart can have too much information that the chart is cluttered and unreadable. In this case, summarizing the data my be prudent, or even re-selecting a different source data range. A chart can also be unreadable due to poor design considerations like wrong fonts and font sizes, as well as distracting colors and object sizes.
- Excel charts are volatile and will change as often as the source data is changed. If a static copy of a chart is needed, consider saving the chart as a picture. This can be accomplished through using the copy and paste special commands. Using Paste Special will allow a chart to pasted in either PNG, JPEG, GIF or other formats. Alternatively, Excel files can be saved as PDF files for inserting in other electronic documents/files.

Practice 8: Weather Report

	A	B	C	D
1	**The Weather Report**			
2	Average Monthly High Temperatures (in Fahrenheit) of Potential New Plant			
3				
4				
5		Anchorage, AK	Mesa, AZ	Detroit Lakes, MN
6	Jan	23	67	19
7	Feb	27	71	26
8	Mar	34	76	37
9	Apr	44	85	56
10	May	56	94	69
11	Jun	63	104	78
12	Jul	65	106	82
13	Aug	64	104	81
14	Sep	55	99	71
15	Oct	40	89	56
16	Nov	28	75	38
17	Dec	25	67	22
18				
19				
20	** U.S. climate data; www.usclimatedata.com			

The Weather Report

1. Open the data file *The Weather Report.xlsx* or create a new sheet from the illustration at right.
2. Add conditional formatting to all cells in B6:E17 so that any cell is at least 90° with red fill cell formatting, or below 32° in light blue fill.
3. Use the Internet to research average monthly high temps for Fort Myers, FL. Enter a label and the temps in column E. The conditional formatting should dynamically format the cells.
4. Create a 2-D bar chart of Anchorage and Mesa temps for all twelve months.
5. Move the bar chart to its own chart sheet.
6. Return to the original source data sheet and create an embedded 2-D line chart with markers for all four cities for all twelve months. Change the chart title to Average Month High Temps. Move the chart slightly so the top-left edge is in cell F6.
7. Use Print Preview to view the entire sheet (not just the chart). Change the orientation to landscape. Compare your results with the screenshot below:

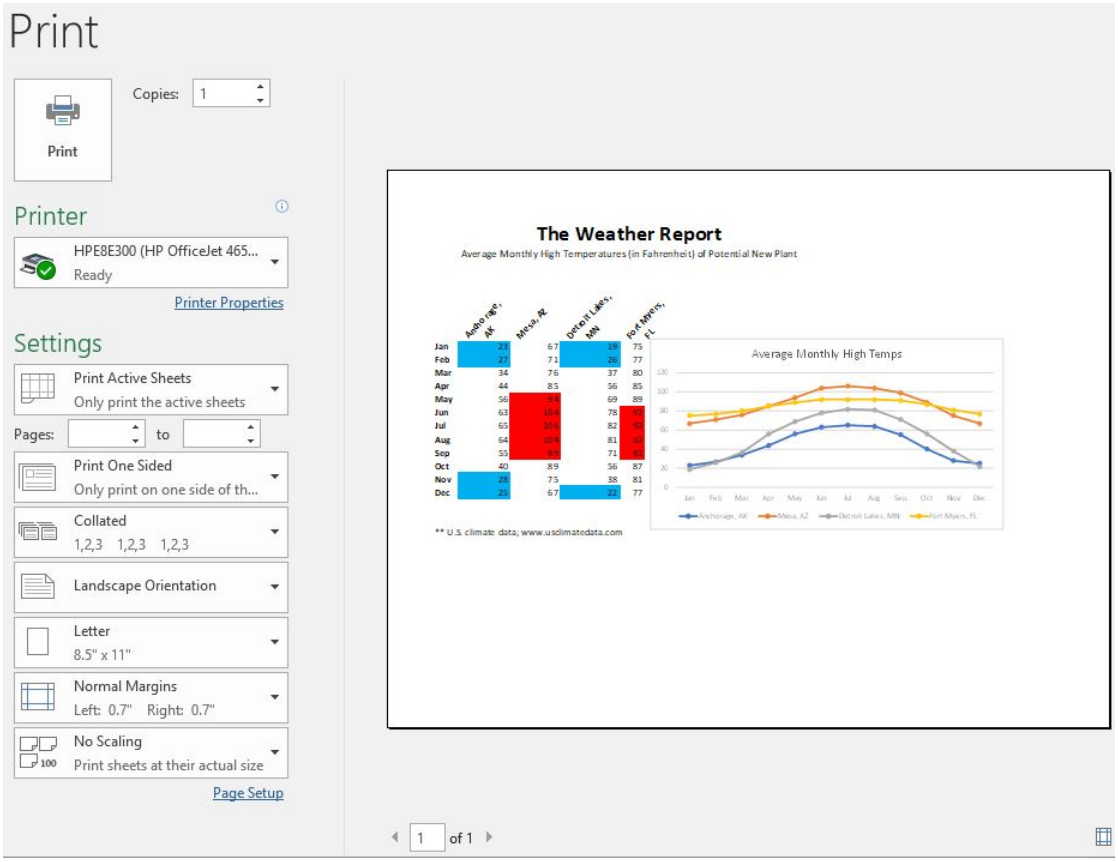


Figure 2.1.13.1: Copy and Paste Caption here. (Copyright; author via source)

8. Save the file as The Weather Report2.xlsx to your hard drive.

Line Chart

The following steps are an introduction to creating the line chart:

1. Highlight the range of data that includes your labels (for example, months) and corresponding values. Example range: A2:B14.
2. Click the Insert tab on the Ribbon.
3. Click the Insert Line or Area Chart button: this will open the drop-down menu of available line chart options (see Figure 6.3.2).
4. Select the 2D Line option from the list to insert a basic line chart (see Figure 6.3.2).

Tip:
Use a line chart to show trends or changes over time. If you have multiple data series, limit the number of lines to three or fewer to maintain clarity. You can also add data markers or adjust line styles for better visibility.

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2.1.14: Combining Charts with Formulas

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Linking Formulas and Charts for Dynamic Insights

Behind every effective chart lies a foundation of well-structured formulas. Charts are only as reliable as the data that feeds them—meaning the accuracy of your visualizations depends directly on the quality and structure of your underlying calculations. In Excel, formulas serve as the analytical engine that transforms raw data into meaningful visuals, allowing charts to automatically update as data changes.

When formulas and charts work together, they create a dynamic system: instead of manually recreating charts each time values change, Excel automatically refreshes visuals in real time. This integration not only saves time but also ensures that decisions are based on current, accurate data.

Formulas as the Foundation of Visualization

Formulas perform the behind-the-scenes work of organizing, summarizing, and computing data for visualization. Functions such as SUM, AVERAGE, COUNTIF, and IF generate the metrics that appear in your charts—turning raw inputs into insights.

Example:

- A line chart displaying monthly revenue may depend on SUM formulas that total sales from individual departments or stores.
- A pie chart showing the proportion of project tasks may use COUNTIF or COUNTIFS to count how many tasks are labeled "Completed," "In Progress," or "Pending."
- A column chart comparing performance across regions might reference calculated averages or percentages based on AVERAGE or PERCENTILE functions.

Each of these examples highlights how formulas and visuals are intertwined—charts don't calculate values on their own; they visualize what formulas compute.

Dynamic Updates and Real-Time Accuracy

One of Excel's greatest advantages is its ability to automatically recalculate formulas and update charts when data changes. If new entries are added to a dataset—such as additional monthly sales figures or new survey responses—any linked chart instantly refreshes to reflect the updated totals or percentages.

This dynamic link ensures that charts remain accurate without requiring manual editing. For example:

- A chart tracking student GPA averages updates automatically when new grades are entered.
- A budget visualization adjusts when expenses are modified.
- A KPI dashboard recalculates percentages each time new data is imported.

By combining formulas and charts, users can build interactive dashboards and automated reports that deliver real-time insights with minimal maintenance.

Best Practices for Linking Formulas and Charts

To ensure consistent and reliable visualizations:

- Keep source data organized in clearly labeled tables with consistent formatting.
- Use structured references when possible (e.g., =SUM(Table1[Revenue])) to make charts easier to manage and extend.
- Avoid hardcoding values into formulas; instead, reference dynamic cells that update as data grows.
- Test formulas before creating charts to ensure the calculations driving visuals are correct.
- Use named ranges for key data sections (e.g., "Total_Sales" or "Completed_Tasks")—this makes chart creation easier and improves readability.

Aligning formulas with charts not only improves accuracy—it enhances transparency, efficiency, and storytelling. When the underlying formulas are well-structured and automated, your charts become trustworthy tools for analysis rather than static decorations. This approach also reinforces data integrity across reports, allowing business leaders, educators, or analysts to make confident, data-driven decisions.

In short, formulas give charts their meaning, turning numbers into stories that are accurate, adaptive, and insightful.

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2.1.15: Sparklines

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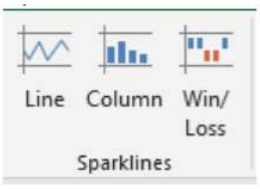
Now that you have seen the value of data visualization in charts, we can address a much simpler and compact visualization: a sparkline. Sparklines are small graphs that are created to offer simple visual clues about the data graphed. Basically, they are tiny charts inside a single cell.

There are three types of sparklines:

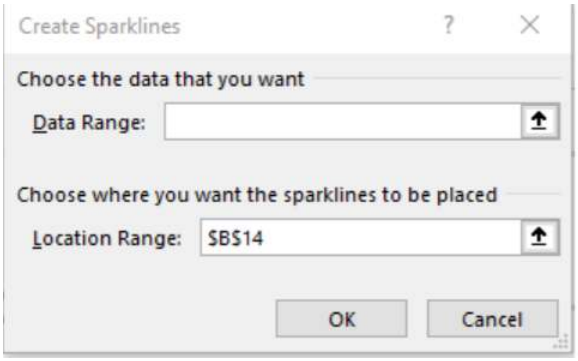
1. **Line:** visualizes the data in a line graph form
2. **Column:** visualizes the data in column form, similar to the clustered column chart
3. **Win/Loss:** visualizes the data as positive or negative based on color

The best use of a sparkline is to place it close to the data you are visualizing. You may be wonder what use a sparkline is since you know how to create a chart. Well, the great thing about sparklines is they automatically print when you print a worksheet. Charts do not print when you print a worksheet; they must be separately printed or moved to another program like Word or PowerPoint.

> Sparklines are also great in that they automatically update if you change the data they display.



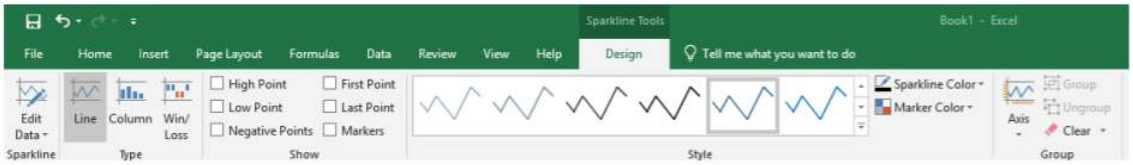
Sparklines are very small graphs or charts that exist within a cell. They are usually entered as a quick visual reference or representation of numerical data. There are three types of Sparklines available: Line, Column/Loss. Line & Column Sparklines provide the same type of visual reference of information as charts. Win/Loss Sparklines show an upward-facing chart for positive values and a downward-facing chart for negative values. To add a sparkline to a cell, highlight the cells in which you want to use their data to create a sparkline. Then click on the icon corresponding to the type of Sparkline you would like to create. Once selecting the Sparkline, a Sparkline dialogue box will appear, allowing you to select or change the cells to be used to generate the Sparkline and a cell to select to insert the Sparkline. When all data is entered, click OK and the Sparkline will be inserted in the appropriate cell.



	A	B
1	Month	Profits
2	January	$1,000.00
3	February	$1,010.00
4	March	$1,020.00
5	April	$1,030.00
6	May	$1,040.00
7	June	$1,050.00
8	July	$1,060.00
9	August	$1,070.00
10	September	$1,080.00
11	October	$1,090.00
12	November	$1,100.00
13	December	$1,110.00
14		

Sparkline Design Tools

After a Sparkline is created, the user can adjust some of the design elements of the Sparkline by selecting the cell and then navigating to the Design Tab in the Excel Ribbon.

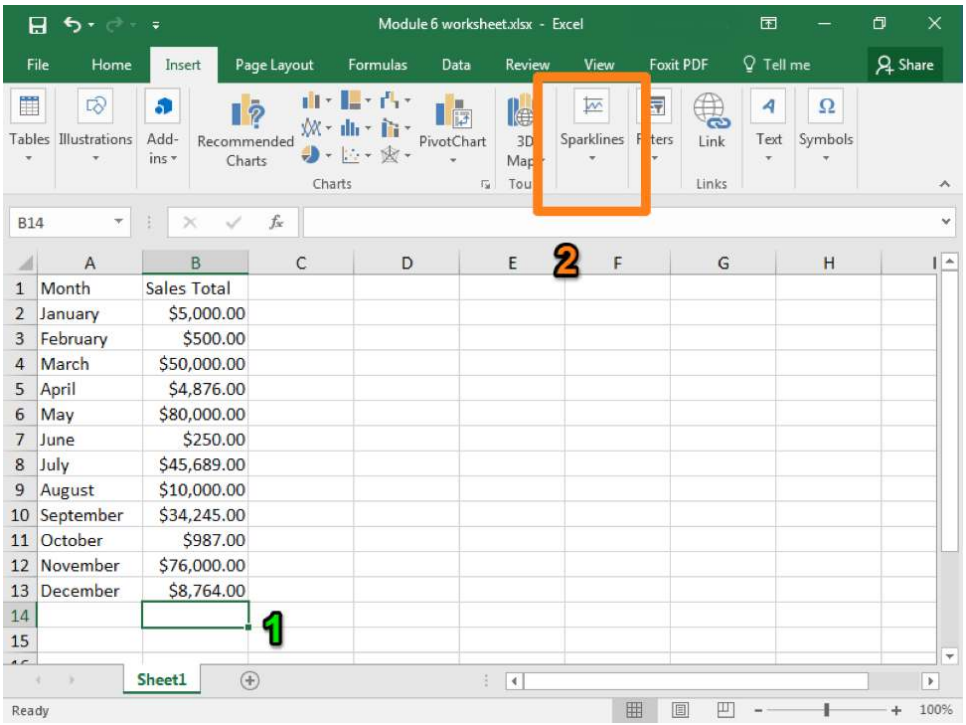


Using the Design tools, users may edit the Sparkline Data, change the type of Sparkline, and select whether to display different points/stages of data in the sparkline. Users may also adjust the Sparkline color.

Create Sparklines

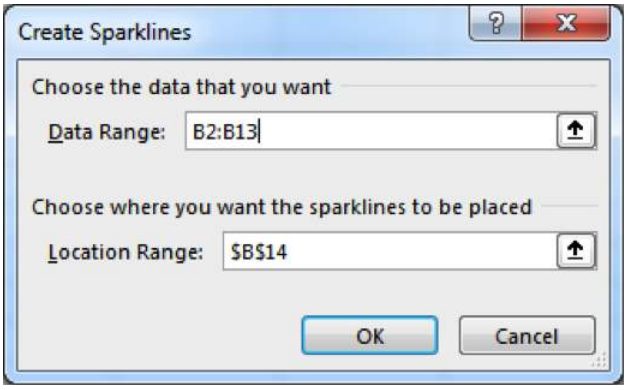
To create your own sparklines, follow the steps below.

1. Click on the cell where you want your sparkline to appear.
2. Click on the Insert tab and find the Sparklines group. Select the type of sparkline you want to create.

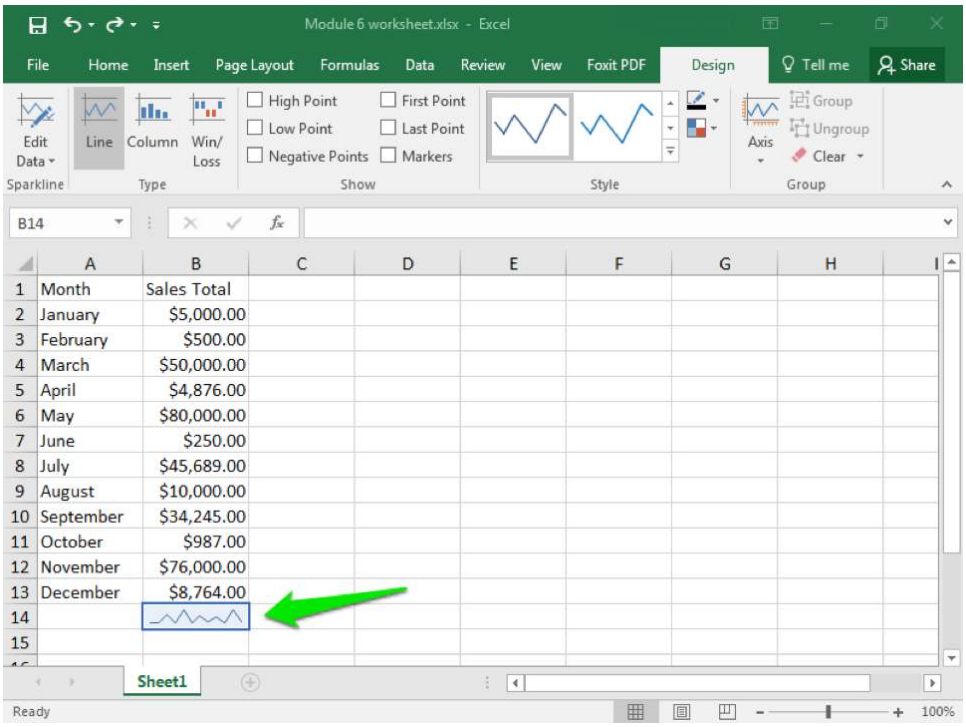


	A	B
1	Month	Sales Total
2	January	$5,000.00
3	February	$500.00
4	March	$50,000.00
5	April	$4,876.00
6	May	$80,000.00
7	June	$250.00
8	July	$45,689.00
9	August	$10,000.00
10	September	$34,245.00
11	October	$987.00
12	November	$76,000.00
13	December	$8,764.00
14		
15		

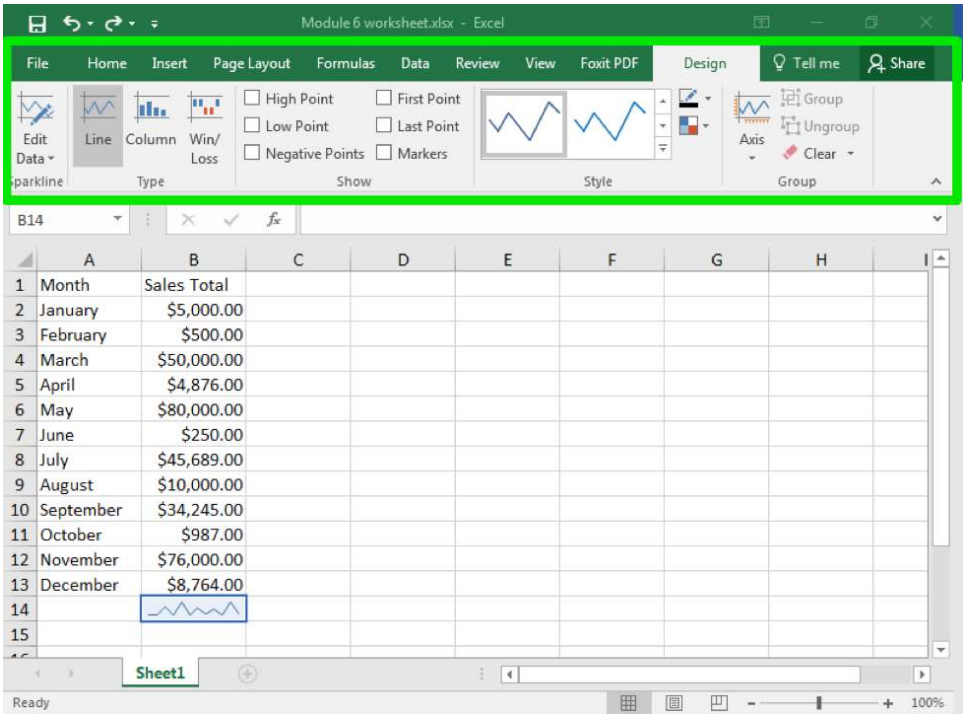
3. A new data box will appear. This is where you will enter the range of cells to be graphed by your sparkline.



4. Hit Enter.



Note that like any other chart, you can change the display options of a sparkline, including colors and style, after you have created it. To change a sparkline, you will need to access the Design tab that appears under Sparkline Tools once you have created a sparkline. This tab will only appear if you have selected the cell with your sparkline in it.



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2.1.16: PivotCharts for Dynamic Visualization

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While traditional charts display static data ranges, PivotCharts build directly on PivotTables to create interactive visualizations that respond instantly to filters, groupings, and summaries. They transform summarized data into clear, dynamic visuals—allowing users to spot patterns, trends, and outliers without manually updating formulas or recreating charts.

PivotCharts are especially valuable for professional reports and dashboards where datasets evolve frequently. Because they are tied to PivotTables, any change—such as adjusting filters, rearranging fields, or grouping dates—immediately updates both the table and the chart. This makes them ideal for interactive data exploration, where decision-makers can analyze multiple perspectives of the same dataset with just a few clicks.

How to Create a PivotChart

Follow these steps to build a PivotChart from your summarized data:

1. Insert a PivotTable
   Select your dataset and choose Insert ▸ PivotTable. Place the table in a new or existing worksheet.
2. Add a PivotChart
   Go to the PivotTable Analyze tab and click PivotChart.
3. Choose a Chart Type
   Select the chart style that best fits your analysis—Column, Bar, Line, Pie, or Combo.
4. Arrange and Filter Data
   Use the PivotTable's field list to drag fields into the Rows, Columns, Values, or Filters areas.
   - Apply filters using the interactive field buttons on the chart to show or hide specific categories.
   - Collapse or expand grouped data (such as quarters within years) to change the level of detail.

As you modify fields or filters, the PivotChart automatically recalculates and redraws itself, giving you an instant visual reflection of your selected criteria.

Example: Dynamic Campaign Analysis

A marketing analyst tracking regional campaign performance builds a PivotTable that summarizes metrics like impressions, clicks, and conversions by quarter. By inserting a PivotChart, the analyst can instantly visualize:

- Click-through rates by region,
- Conversion trends by time period, and
- Overall campaign ROI across multiple filters.

Instead of creating multiple charts for each scenario, the analyst uses the PivotChart's field buttons to toggle between regions, products, or months—updating visuals dynamically and saving hours of manual work.

Advantages of Using PivotCharts

- Dynamic Interaction: Users can drill down or filter data directly on the chart, revealing patterns at different levels of detail.
- Automatic Updates: When PivotTable data changes or is refreshed, the PivotChart updates automatically—no need to rebuild visuals.
- Efficient Storytelling: PivotCharts allow complex analyses to be summarized in intuitive, visually engaging ways.
- Unified Data Exploration: Both the PivotTable and PivotChart are linked, providing a consistent view of the same data from numerical and graphical perspectives.

Tips for Professional Use

- Choose chart types that suit your data—Column and Bar for comparisons, Line for trends, and Pie for proportions.
- Remove unnecessary field buttons before printing or sharing reports to maintain a clean appearance.

- Use clear titles and color schemes that align with your workbook theme for consistent presentation.
- When presenting to stakeholders, demonstrate filters or collapsible categories live to show the power of interactive data analysis.

PivotCharts bring data to life. By combining the analytical strength of PivotTables with the visual impact of charts, they allow users to explore summarized data interactively, uncover insights quickly, and present results with clarity and confidence.

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CHAPTER OVERVIEW

3: Microsoft Excel Overview and Emerging Features



Microsoft Excel Overview and Emerging Features

This page provides an overview of Excel for the Web, highlighting its features, such as collaboration, accessibility, and ease of use, which enhance productivity. It discusses management options like deleting tabs and character limits, emphasizing how these tools streamline workflows and improve document management in a web-based environment.

Topic hierarchy

3.1: Microsoft Excel Overview and Emerging Features Sections
- 3.1.1: Artificial Intelligence and Excel
- 3.1.2: New Tool - Solver
- 3.1.3: Power, Power, Power - Oh, so much power!!!
- 3.1.4: 3-D References
- 3.1.5: Excel Summary and Helpful Tips
- 3.1.6: Real World Applications
- 3.1.7: Excel Terminology
- 3.1.8: Excel Terminology Flashcards
- 3.1.9: Excel Hands-on Exercises

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SECTION OVERVIEW

3.1: Microsoft Excel Overview and Emerging Features Sections



Microsoft Excel Overview and Emerging Features

This page provides an overview of advanced Microsoft Excel tools aimed at enhancing data analysis and decision-making. It highlights AI features like Analyze Data and Flash Fill, optimization tools such as Solver, and business intelligence tools like Power BI and Power Query. Techniques for improved data management, such as 3-D references, are also discussed. The central theme focuses on leveraging these advanced technologies to work effectively and extract valuable insights from data.

Topic hierarchy

3.1.1: Artificial Intelligence and Excel

3.1.2: New Tool - Solver

3.1.3: Power, Power, Power - Oh, so much power!!!

3.1.4: 3-D References

3.1.5: Excel Summary and Helpful Tips

3.1.6: Real World Applications

3.1.7: Excel Terminology

3.1.8: Excel Terminology Flashcards

3.1.9: Excel Hands-on Exercises

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3.1.1: Artificial Intelligence and Excel

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AI in Microsoft Excel

Excel has evolved from a spreadsheet program into an intelligent data analysis platform. AI capabilities in Excel are compelling because they make advanced data analysis accessible to users who may not have extensive technical training in statistics or programming.

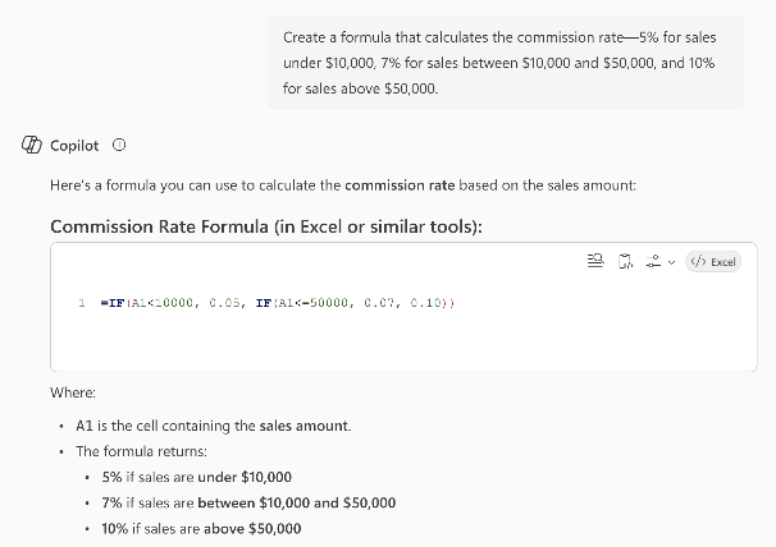
Natural language data analysis is transforming how professionals interact with spreadsheets—previously, analyzing data required knowing specific functions and formulas. Now, you can ask questions in plain English. For example, with a sales dataset open, you might type "What were the top 5 selling products last quarter?" or "Show me a breakdown of revenue by region." Copilot interprets these questions, performs the necessary calculations, and presents results—often with visualizations.

This capability democratizes data analysis. You no longer need to memorize dozens of Excel functions to extract insights from your data. Instead, you can focus on asking the right questions and interpreting the answers.

Automated formula generation addresses one of Excel's steepest learning curves. Complex formulas, particularly those using functions like VLOOKUP, INDEX-MATCH, or nested IF statements, can be intimidating. With AI assistance, you can describe what you want to calculate in everyday language: "Create a formula that calculates the commission rate—5% for sales under $10,000, 7% for sales between $10,000 and $50,000, and 10% for sales above $50,000."

Copilot generates the appropriate formula, often explaining how it works. This serves a dual purpose: you get immediate results, and over time, you learn more about Excel's capabilities by seeing how the AI solves problems.

When formulas contain errors, AI can help identify and correct them. Instead of searching through documentation or online forums, you can simply describe the error you're encountering, and the AI can identify the issue and suggest corrections.



Real-world example: Financial analysis and forecasting. Consider a scenario where you're working in a company's finance department, analyzing monthly expenses to create a budget forecast.

1. You import six months of expense data into Excel—thousands of rows covering various departments and expense categories.
2. You ask Copilot to "identify the top three expense categories and show month-over-month growth rates." Within seconds, you have a summary table and chart.
3. You notice an unusual spike in marketing expenses. You ask, "Which specific marketing expenses increased most dramatically in April?" The AI breaks down the category and identifies the outliers.

4. For forecasting, you request: "Create a three-month projection for each department's expenses based on current trends, accounting for the 5% budget reduction mandate." Copilot generates formulas using appropriate statistical functions and creates forecast tables.
5. You review the projections, apply your business knowledge (perhaps you are aware of an upcoming project that will impact specific departments), and adjust the AI's baseline forecasts accordingly.

Again, the pattern is clear: AI handles data manipulation and calculation, while you provide business context, verify accuracy, and make informed decisions based on the results.

One of the hottest topics in technology in modern times is the proliferation of artificial intelligence (AI) functionality in our daily lives. Excel has utilized elements of AI for several years, and the latest releases continue to integrate AI throughout Excel and other Microsoft applications.

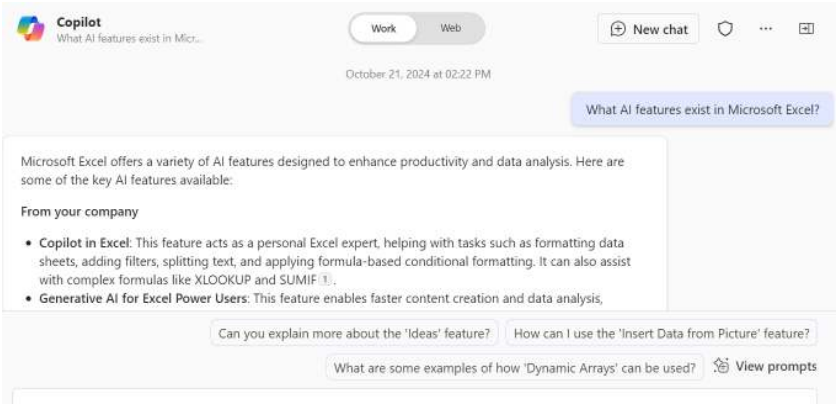


Figure 3.1.1.1: Copilot Prompt (Copyright © 2025 by Marcus Lacher, CC BY NC)

In the realm of Excel, artificial intelligence is about utilizing advanced algorithms and machine learning techniques to automate data analysis, reduce errors, and improve efficiency. AI in Excel enables the software to understand complex patterns in data, make predictions, and suggest optimized solutions. While one could simply ask Copilot or another generative-AI tool to deduce which AI features exist in Excel, it may be easier to read this short summary.

Artificial Intelligence in Excel

Recommended Charts and PivotTables

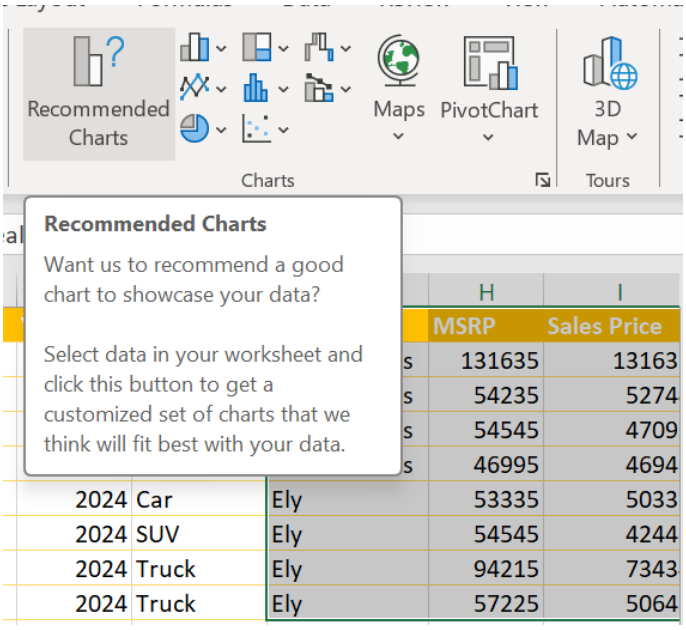


Figure 3.1.1.1: Recommended Charts (Copyright © 2025 by Marcus Lacher, CC BY NC)

Some introductory artificial intelligence functionality has been in Excel for years. For example, when inserting a chart, Excel will provide a suggestion of appropriate charts based on your data. **Recommended Charts and Recommended PivotTables** are examples of AI because they use algorithms to analyze the data you select and suggests the most suitable chart type for effectively visualizing that data. By understanding the data's nature and relationships, the AI identifies patterns and trends, recommending the chart that best communicates the insights in a meaningful way.

Flash Fill

Excel data entry AI is a game changer regarding data input as it saves time and reduces the chance of errors. This is facilitated through functionality that replaces human data entry with machine learning features like AutoComplete, AutoCorrect, AutoFill or **Flash Fill**, which works by recognizing patterns of filled data and filling out the rest. Try using AutoFill by typing Sunday in one cell, then type Monday in the next cell. Select the two cells and drag the fill handle to see Excel's artificial intelligence fill the neighboring cell with "Tuesday". Usually Flash Fill starts automatically, and you only need to provide a pattern.

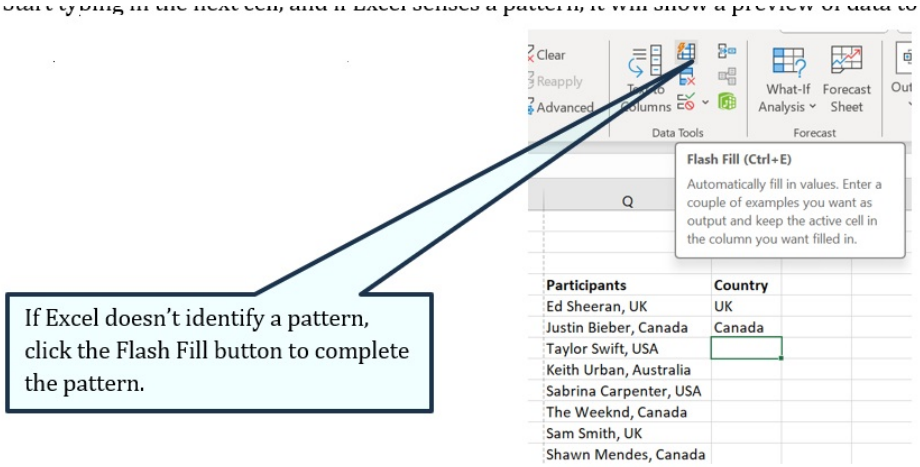


Figure 3.1.1.1: Flash Fill (Copyright © 2025 by Marcus Lacher, CC BY NC)

1. Insert a new column adjacent to the column with your source data.
2. In the first cell of a newly added column, type the desired value.
3. Start typing in the next cell, and if Excel senses a pattern, it will show a preview of data to be auto filled in the cells below.
4. Press the Enter key to accept the preview.

Insert Data from Picture

Another AI data entry feature is the **Insert Data from Picture** feature which allows users to insert data from a screen capture on their clipboard, or an image file from their computer. One can even screen capture a table from a web site and convert the picture into Excel data. Copying data from websites into Excel will never be the same! Try it below!

Import data from a sample image file or clipboard Right-click the following image and "Save image as…" a local copy, then click **Data > From Picture > Picture From File …. (or Clipboard)** and follow the on-screen instructions to convert the picture to data.

Provider	Deductible	Coverage	Reimburse %	Cost/month	Type	Notes
Embrace	$500.00	$5,000.00	80%	$57.10	Accident/Illness	
Fetch	$500.00	$10,000.00	80%	$48.72	Accident/Illness	add Wellness for $11.29/mo
Pumpkin	$500.00	$10,000.00	90%	$53.82	Accident/Illness	
Healthy Paws	$500.00	Unlimited	80%	$59.07	Accident/Illness	
PetsBest	$500.00	Unlimited	80%	$39.92	Accident/Illness	add Wellness for $21.75/mo
Spot	$500.00	$5,000.00	80%	$34.02	Accident/Illness	
Figo	$500.00	$10,000.00	80%	$23.82	Accident/Illness	add Vet exams for $4.86/mo
Prudent Pet	$500.00	$10,000.00	80%	$26.23	Accident/Illness	add Vet exams for $5.26/mo

Figure 3.1.1.1: Data (Copyright © 2025 by Marcus Lacher, CC BY NC)



Analyze Data

Analyze Data in Excel (formerly known as Ideas) empowers users to understand their data through natural language queries that allow users to ask questions about their data without having to write complicated formulas. In addition, Analyze Data provides high-level visual summaries, trends, and patterns. Simply select a cell in a data range > select the **Analyze Data** button on the **Home** tab. Analyze Data in Excel will analyze your data and return interesting visuals about it in a task pane.

Linked Data Types

Linked data types connect to reputable sources of data, such as Bing, Power BI and more, so users can access information about a variety of subjects without ever leaving Excel. Real-time stock quote integration, geography and currencies are three new data types that use AI to connect to online data in return real-time data into Excel for further analysis. To get current data for the data types, right-click a cell with the linked data type and select **Data Type** > **Refresh**. That will refresh the selected cell, plus any other cells that have that same data type.

Without artificial intelligence, users must write a formula for every value they want. However, the **AI dynamic arrays** feature allows users to write a formula, hit the enter key, and immediately see an array of values. Using dynamic arrays, any formula that returns an array of values will seamlessly "spill" into neighboring unoccupied cells, making it as easy to get an array of values returned as it is to work on a single cell. Users can immediately harness the power of dynamic arrays by using one of the new FILTER, UNIQUE, SORT, SORTBY, SEQUENCE, SINGLE, and RANDARRAY functions to build spreadsheets that would previously have been nearly impossible.

ChatGPT for Excel add-in

Several AI functions began appearing in some versions of Excel 365 for Windows in 2024. If you have the right version of Excel, try typing **=ai** in the formula bar, and if the AI functions are available you'll see something like this.

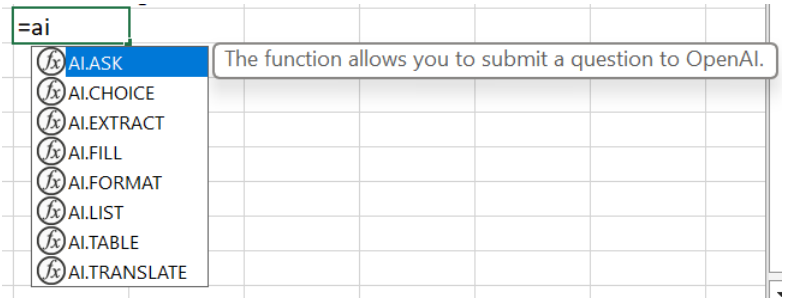


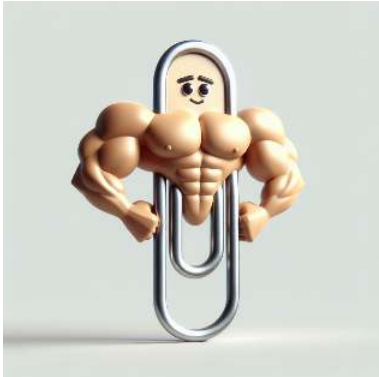
Figure 3.1.1.1: AI function (Copyright © 2025 by Marcus Lacher, CC BY NC)

One might be surprised to see the reference to OpenIA in the screentip! The current version of Excel utilizes the OpenAI server/API to connect the AI functionality to their data. This might be a short-term solution until a complete Microsoft Copilot solution is released.

Current AI functionality in Excel requires add-on functionality to be installed, such as the ChatGPT for Excel add-in which introduces five key AI functions — AI.ASK, AI.FILL, AI.TABLE, AI.EXTRACT, and AI.TRANSLATE.

How to Add ChatGPT in Excel

1. Start Microsoft Excel on your computer.
2. Click on the **Home** tab.
3. Select **Get Add-ins** from the **Add-ins group.**
4. In the Office Add-ins window, use the search bar to type **"ChatGPT For Excel"** and click **Add** to install it.



The AI.ASK function allows users to query their data in natural language. This simplifies complex data analysis by interpreting questions and providing answers directly within Excel. It can be used to write text, summarize, analyze data, and more—like having a virtual assistant inside Excel! It's Clippy on Steroids!

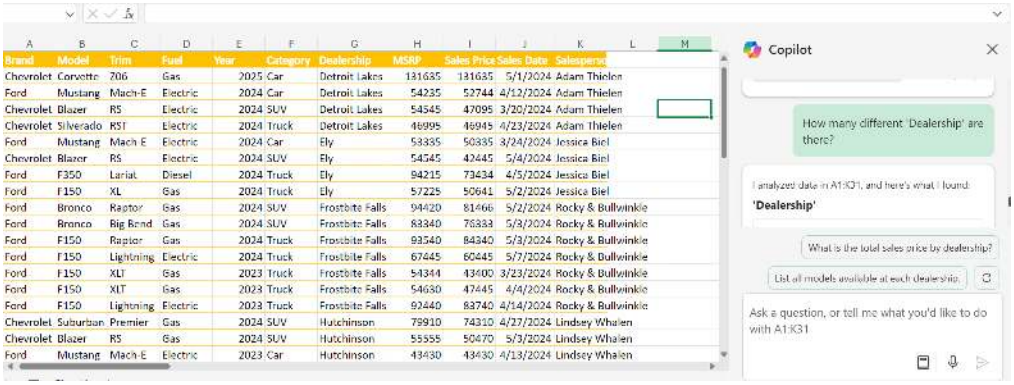
For example, the formula:
=AI.ASK("Identify the highest selling model of Ford vehicles in 2024")
will return the result:

As of 2024, the highest selling model of Ford vehicles is the Ford F-Series, particularly the Ford F-150. The F-Series has consistently been one of the best-selling vehicle lines in the United States for many years, and it continues to dominate the market in 2024.

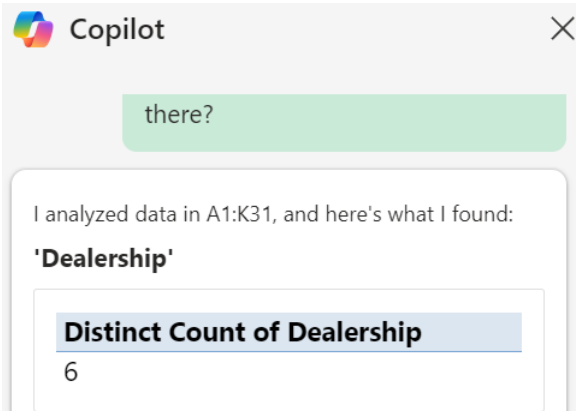
Copilot in Excel

The future of artificial intelligence integration in Excel rests with Microsoft's Copilot functionality, which was released in late 2024, but might not be live for all Excel users right away. Web versions of Excel are more likely to reveal AI functionality before the desktop version licenses are updated.

Copilot in Excel is built into your workbook, enabling users to iterate with it quickly and easily. This integration allows users to continually prompt as they work, making it feel like users have an Excel expert right by their side. Copilot in Excel can help you go from a blank page to a finished document in a fraction of the time it would take to compose text on your own. Copilot can now reason over structured data, not just tables, and it can complete tasks such as adding filters or splitting text. It can respond to prompts to help users analyze data trends. For example, in the following illustration, a prompt was asked to determine "How many different "Dealership" are there (in the worksheet)?



The result returned was:



Another prompt asked, “Which Salesperson has the most sales?” The result returned was:



While a user could write formulas with functions to extrapolate similar answers, the Copilot prompting functionality generated answers in a fraction of the time!

In addition to answering prompts, Copilot can identify insights, generate formulas, highlight, sort & filter, as well as advanced functionality such as helping to write Python code, and provide text insights to streamline and enhance data interpretation. With AI-powered features, Excel users can now analyze large datasets, identify trends, and make informed decisions more efficiently.

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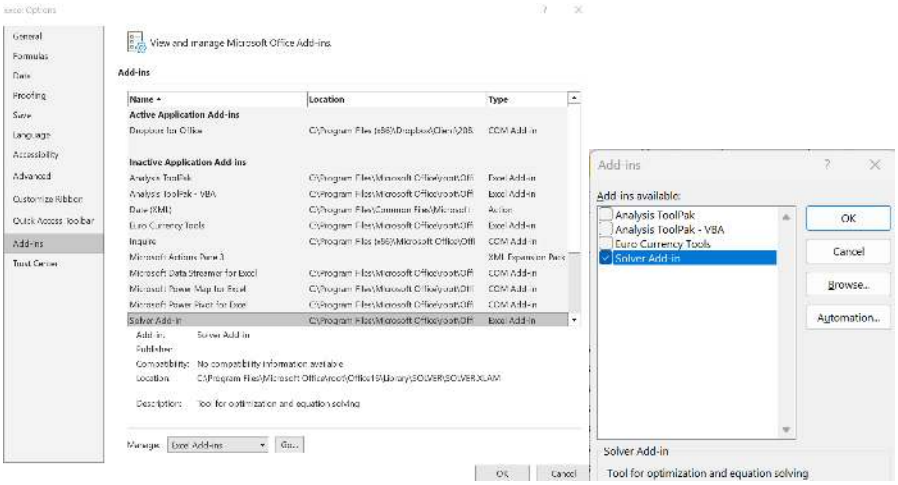
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3.1.2: New Tool - Solver

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Solver

The Solver tool is an add-in program available in Excel that allows users to perform additional what-if analysis, by altering different variables in a spreadsheet in order find an optimal (maximum or minimum) value for a formula in one cell — called the objective cell — subject to constraints, or limits, on the values of other formula cells on a worksheet. For example, what is the minimum number of sales you'd need to make to cover the cost of an expensive piece of business equipment?



Solver has three parts to it—a target value, variables that it can change to reach that value, and constraints that Solver has to work in. Solver adjusts the values in the variable cells to satisfy the limits on constraint cells and produce the result you want for the objective cell.

To install Solver, go to File > Options and in the Excel Options window choose the Solver Add-in. If necessary, select **Excel add-ins** from the **Manage** drop-down menu at the bottom of the window, then press the **Go** button. In the Add-ins window, mark the checkbox next to Solver Add-in and click OK. The Solver option should appear in an Analysis group under the Data tab.

Let's use Solver to determine a common staffing scheduling dilemma. You manage a small business and need to determine the optimal hours per week to schedule each employee given a set of constraints. Open the following worksheet (try using the Insert Data From Picture feature) and study the formulas in column D & F.

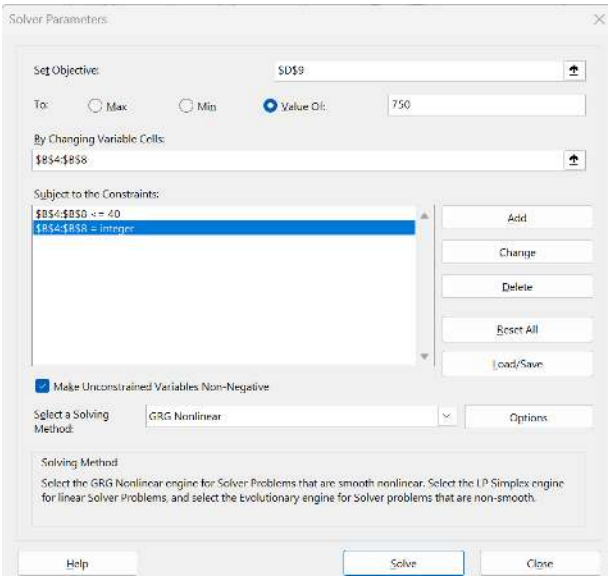
	A	B	C	D	E	F
1	**Let Them Eat Cake, Inc.**					
2	**Decorating Staff Work Schedule Hand-Decorated Valentines Cakes**					
3	**Employee**	**Hours per Week**	**Cakes per Hr**	**Number of Cakes**	**Hourly Wage**	**Labor Cost**
4	Esslinger, Annmarie	32	4.00	128	$ 14.00	$ 448.00
5	Holland, Christine	20	5.00	100	12.50	$ 250.00
6	Gunderson, Mike	40	4.00	160	12.00	$ 480.00
7	Petermeier, Jane	35	3.50	122.5	15.55	$ 544.25
8	Swanson, Brian	20	4.50	90	12.65	$ 253.00
9	Total					

Hours per Week	Cakes per Hr	Number of Cakes	Hourly Wage	Labor Cost
32	4	=B4*C4	14	=B4*E4
20	5	=B5*C5	12.5	=B5*E5
40	4	=B6*C6	12	=B6*E6
35	3.5	=B7*C7	15.55	=B7*E7
20	4.5	=B8*C8	12.65	=B8*E8

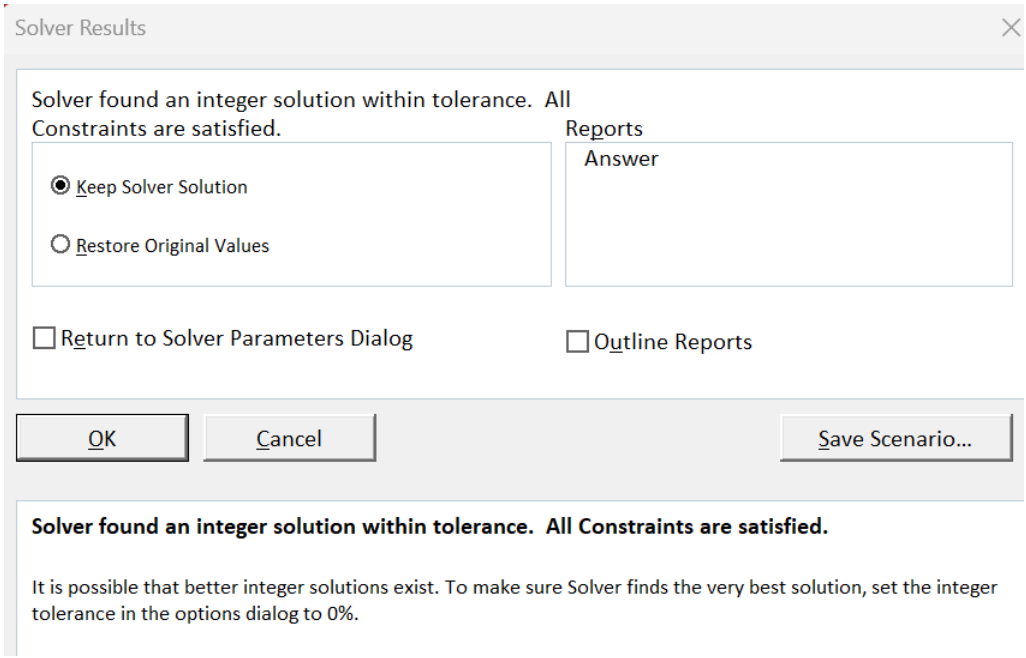
Consider the following constraints:

- Ensure that no employee works more than 40 hours per week.
- Fractional cakes are not acceptable.

- Select the range B9:F9 and click the AutoSum button.
- Select cell D9 and use the Solver feature to determine how many hours each employee needs to work to produce at least 750 cakes in a week. (Current output is barely 600 cakes)
- In the Solver window that opens, add the objective, variables and constraints as shown below.



- Choose Solve. The Solver Results window should eventually display…



- Choose the Keep Solver Solution option and click OK. Your updated spreadsheet should now display the solution to your scheduling dilemma.

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3.1.3: Power, Power, Power - Oh, so much power!!!

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Power, Power, Power – Oh, so much power!!!



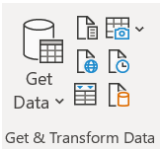
Power^3 – Oh, so much power!!!

Power BI, Power Query, and Power Pivot are powerful business intelligence tools developed by Microsoft that allow users to connect, transform, and analyze data from various sources to create compelling visualizations, reports, and dashboards. While they all help manage data, there are key differences between these solutions.

Power BI

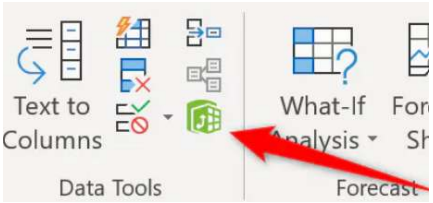
Power BI, Microsoft's business intelligence tool, enables users to transform raw data into operable insights. Power BI focuses on data visualization and reporting, while Excel is better for detailed analysis and financial modeling. Power BI and Excel both have Power Query for gathering/combining and transformation of data, however power BI lets users connect to more data sources (such as Google sheets). Both Power Query and Power Pivot are part of the Power BI cloud-based business analytics service. Power BI strengths over regular Excel are in its visualizations. Visualizations is the name assigned to the charts, slicers, tables and matrixes that users can insert into their reports in Power BI. Power BI has a greater choice of visualizations than Excel, and lots of options for how they interact with the other visualizations on a page, or even across the entire report.

Power Query



Power Query is a data extraction, loading and transformation tool used for business intelligence. With Power Query (known as Get & Transform in Excel), users can import or connect to external data, and then *shape* that data. For example, a user can remove a column, change a data type, or merge tables, in ways that meet their needs. Then, the user can load their query into Excel to create charts and reports. Periodically, the user can refresh the data to make it up to date. In Excel, select the Datatab on the ribbon to see the Get & Transform Data and Queries & Connections groups.

After importing and refreshing data from a wide variety of data sources, users can then shape the data in a step-by-step transformation that gradually creates a unique, tabular shape to fit the user's data analysis needs. For users who perform repetitive data transformation tasks or struggle to organize and analyze their data, Power Query might be a great solution.



Power Pivot

Power Pivot is used to model data and perform more complex calculations than Excel can handle. Power Pivot is great when working with huge data sets. Once Power Query has imported and cleaned the various data sources, Power Pivot is used to establish relationships between the tables/queries. Using DAX (Data Analysis Expressions), the formula language of Power Pivot, users can create more powerful calculations and more sophisticated data models than they can in Excel alone.

Power Query can prepare simple but large datasets for analysis. Power Pivot, on the other hand, is for more complex models and more powerful calculations than Excel worksheet functions or PivotTables alone. Conversely, while Power Pivot contains features for importing and shaping data, it is recommended to leave this job to Power Query. Use both to shape your data in Excel so you can explore and visualize it in PivotTables, PivotCharts, and Power BI.

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3.1.4: 3-D References

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3-D References

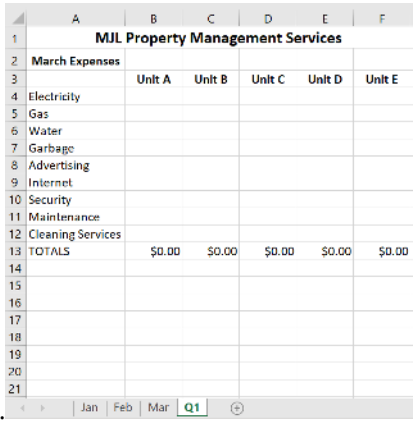
An Excel cell reference that refers to the same cell or range on multiple sheets is called a 3-D reference. A 3-D reference, sometimes referred to as 3-D formula, is a useful and convenient way to reference several worksheets that follow the same pattern and contain the same type of data—such as when a user consolidates budget data from different departments in their organization.

3-D references work brilliantly when a user desires to consolidate data into a summary sheet. For example, monthly sales data can be entered on separate sheets, then consolidated via 3-D formulas on a summary sheet that reference each monthly sheet.

Creating a 3D reference is straightforward once you understand the structure of your workbook. Here's a simple guide to setting up a 3D reference:

1. **Identify the Range**: Determine which cell or range of cells you want to reference. Make sure this cell or range is consistently used across all worksheets for accurate results.
2. **Initiate the Formula**: Click on the cell where you want to display the result of your calculation. Begin typing the formula that will incorporate the 3D reference, such as =SUM(or =AVERAGE(.
3. **Select the Worksheet Range**: While still in the formula bar, click on the first worksheet tab that you want to include in the reference. Then hold down the Shift key and click on the last worksheet tab to include. This action selects all worksheets between and including the first and last tabs clicked.
4. **Complete the Reference**: After selecting the worksheets, select the cell or range of cells in the formula bar that you wish to calculate across the selected sheets. For example, if calculating the sum of values in cell B3 across sheets "Jan" to "Dec", the completed formula would look like =SUM(Jan:Dec!B3).
5. **Enter and Apply**: Press Enter to complete the formula. Excel will now calculate the sum, average, or other aggregate measures of the cell or range across the selected worksheets.

In the workbooks below, a small business has monthly expenses in separate worksheets (Jan, Feb, Mar) that the manager would like to aggregate into a summary sheet, named Q1. Each sheet has the identical structure, but many of the cells that represent variable expenses, differ from month-to-month, while other fixed expenses stay consistent from month-to-month. The Q1 sheet



	A	B	C	D	E	F
1	MJL Property Management Services					
2	March Expenses					
3		Unit A	Unit B	Unit C	Unit D	Unit E
4	Electricity					
5	Gas					
6	Water					
7	Garbage					
8	Advertising					
9	Internet					
10	Security					
11	Maintenance					
12	Cleaning Services					
13	TOTALS	$0.00	$0.00	$0.00	$0.00	$0.00
14						
15						
16						
17						
18						
19						
20						
21						

Jan | Feb | Mar | Q1

below is ready for some 3-D references to consolidate data from sheets Jan, Feb, and Mar.



	A	B	C	D	E	F
1	MJL Property Management Services					
2	January Expenses					
3		Unit A	Unit B	Unit C	Unit D	Unit E
4	Electricity	$646.00	$180.88	$206.72	$109.82	$148.58
5	Gas	$510.00	$142.80	$163.20	$86.70	$117.30
6	Water	$211.00	$59.08	$67.52	$35.87	$48.53
7	Garbage	$56.00	$15.68	$17.92	$9.52	$12.88
8	Advertising	$50.00	$50.00	$50.00	$50.00	$50.00
9	Internet	$98.00	$27.44	$31.36	$16.66	$22.54
10	Security	$55.00	$15.40	$17.60	$9.35	$12.65
11	Maintenance	$300.00	$100.00	$100.00	$60.00	$100.00
12	Cleaning Services	$400.00	$112.00	$128.00	$68.00	$92.00
13	TOTALS	$2,326.00	$703.28	$782.32	$445.92	$604.48
14						
15						
16						
17						
18						
19						
20						
21						

Jan | Feb | Mar | Q1

In cell B4 of the Q1 sheet the following formula will be inserted: =SUM(Jan:Mar!B4)



F12 =SUM(Jan:Mar!F12)

	A	B	C	D	E	F
1	MJL Property Management Services					
2	March Expenses					
3		Unit A	Unit B	Unit C	Unit D	Unit E
4	Electricity	$2,029.20	$556.67	$636.52	$333.46	$482.28
5	Gas	$1,575.40	$435.28	$495.55	$267.12	$391.39
6	Water	$665.30	$178.07	$202.85	$109.47	$173.42
7	Garbage	$168.00	$47.04	$53.76	$28.56	$38.64
8	Advertising	$150.00	$150.00	$150.00	$150.00	$150.00
9	Internet	$294.00	$82.32	$94.08	$49.98	$67.62
10	Security	$165.00	$46.20	$52.80	$28.05	$37.95
11	Maintenance	$900.00	$300.00	$300.00	$180.00	$300.00
12	Cleaning Services	$1,200.00	$336.00	$384.00	$204.00	$276.00
13	TOTALS	$7,146.90	$2,131.58	$2,369.56	$1,350.64	$1,917.30
14						
15						
16						
17						
18						
19						
20						
21						

Jan | Feb | Mar | Q1

After using AutoFill to copy the formulas to the rest of columns B:F and rows 4:12, the Q1 worksheet now appears on the right. Any changes to the data in the Jan, Feb or Mar sheets will be reflected in the Q1 sheet.

3-D references are a powerful feature in Excel that allow for dynamic data management and analysis across multiple worksheets. By learning how to create and manage these references, users can significantly streamline their workflow, ensuring that their calculations are both efficient and accurate.

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3.1.5: Excel Summary and Helpful Tips

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In information covered on Microsoft Excel, you developed essential skills for working effectively with Microsoft Excel. You learned how to create, open, save, and manage Excel workbooks—the foundational unit for organizing and storing spreadsheet data. You explored the layout of the Excel interface, including the Ribbon, tabs, and Quick Access Toolbar. You practiced entering text, numbers, and dates; applying formatting to improve clarity; and using AutoFill and Copy-Paste. Finally, you organized worksheets by renaming, adding, and reordering them, applying consistent naming conventions and visual indicators such as tab colors.

These foundational skills serve as the building blocks for more complex Excel functions introduced in future modules. Whether you are preparing a personal budget, compiling class data, supporting a small business, or contributing to a workplace team, the ability to confidently navigate and manage Excel workbooks will support your success in academic, professional, and everyday applications.

You explored how to create and customize a variety of chart types—bar, column, line, pie, and combo charts—to present comparisons, trends, and proportions effectively. You also learned how to enhance clarity through chart design tools such as titles, legends, axis labels, and gridlines, as well as how to maintain a professional look with formatting, themes, and consistent color choices. These features help ensure that your charts not only convey accurate information but also meet the standards of business and academic communication.

Beyond charts, this chapter introduced ways to make your workbooks more engaging and visually coherent through images, SmartArt, icons, and WordArt. When used strategically, these visual elements can strengthen the message of your data, highlight key points, and align your work with professional branding or presentation standards.

Finally, you learned the importance of selecting the right chart type for your data and applying design best practices to ensure accessibility, readability, and integrity. Every chart should tell a clear story—one that supports informed decision-making and reflects attention to detail.

Taken together, these skills allow you to transform raw data into clear, compelling visuals that communicate effectively with any audience. By combining analytical accuracy with visual design, you are not just presenting data—you're shaping understanding, influencing decisions, and elevating the professionalism of your work.

Excel Summary

- Excel as a Core Productivity Tool: Excel is one of the most versatile applications in the Microsoft Office suite, used to organize, calculate, and visualize data across nearly every career field.
- The Workbook Structure: A workbook is the main Excel file, containing one or more worksheets that store data in rows and columns. Each worksheet can be renamed, reordered, and formatted to suit specific tasks.
- Navigating the Interface: The Ribbon organizes Excel's tools by category (Home, Insert, Data, etc.), while the Quick Access Toolbar offers shortcuts to frequently used commands. The Formula Bar allows data entry and editing, and the Status Bar displays useful indicators like average, count, or zoom level.
- Entering and Editing Data: Data can include text, numbers, or dates. You can enter data directly in a cell or use the Formula Bar for longer entries. Double-click to edit a cell, or press F2 to edit in place.
- Formatting for Clarity: Use number formats (Currency, Percentage, Date), alignment, and font tools to enhance readability. Consistent formatting helps convey meaning and reduces misinterpretation.
- Worksheet Organization: Rename, add, or reorder sheets to keep related data together. Apply color-coding and descriptive tab names for quick navigation in multi-sheet workbooks.
- Saving and Managing Files: Save your work regularly using Ctrl+S. Choose meaningful file names and organize folders logically (e.g., "Budget_2025" or "ProjectData_Q1").
  Use the correct file types for your needs:
  - .xlsx for standard workbooks

  - .csv for data exchange
  - .xlsm for macro-enabled files (used in later chapters)
- Foundational Skills for Success: These skills lay the groundwork for advanced features—formulas, charts, data analysis, and automation—that will be explored in future modules.
- Purpose of Visuals: Charts and visuals turn raw numbers into stories that are easy to interpret. They help audiences identify patterns, relationships, and key takeaways at a glance.
- Chart Types and Uses:
  - Column & Bar Charts: Compare quantities across categories.
  - Line Charts: Show trends or changes over time.
  - Pie Charts: Illustrate proportions of a whole—best used sparingly.
  - Combo Charts: Combine chart types (e.g., bars + lines) to compare related data.
  - PivotCharts: Add interactivity to summarized data, allowing users to filter and drill down dynamically.
- Chart Customization: Use the Chart Design and Format tabs to enhance clarity and professionalism by adding titles, legends, axis labels, data labels, and gridlines.
- Consistent color schemes, fonts, and layout styles help maintain a cohesive and accessible presentation.
- Integrating Data and Formulas: Many charts rely on underlying formulas (such as SUM, COUNTIF, or AVERAGE) to keep visuals dynamic and accurate as data changes. Aligning calculations with charts ensures results remain up to date.
- Visual Enhancements: Incorporating SmartArt, icons, WordArt, and images adds professional polish and visual engagement. These elements help explain processes, highlight key sections, and support branding consistency.
- Design and Accessibility Best Practices:
  - Choose the right chart for the data's purpose (comparison, trend, or distribution)
  - Keep visuals simple—avoid 3D effects, clutter, or excessive color.
  - Use contrasting colors, readable fonts, and clear labeling to ensure accessibility.
  - Maintain uniform styling across all visuals within a workbook.
- Communication and Professionalism: Effective data visualization bridges the gap between numbers and narrative. By mastering chart creation, formatting, and design best practices, you can present information that is accurate, insightful, and visually compelling.

Quick Tips & Common Errors

Quick Tips:

- Save Often: Press Ctrl + S regularly to prevent data loss.
- AutoFill Smartly: Drag the fill handle to continue sequences like months or numbers.
- Right-Click Menus: Most formatting commands can be accessed by right-clicking—great for quick changes.
- Use Descriptive Names: Label worksheets and files clearly for easy retrieval.
- Leverage Templates: Explore built-in Excel templates (e.g., budget, planner, invoice) to save setup time.
- Apply a theme first (Page Layout → Themes) for consistent fonts/colors across all charts.
- Use Tables (Ctrl+T) so charts auto-expand as data grows.
- Add data labels selectively (totals/percentages) to emphasize key points without clutter.
- Sort categories logically (e.g., descending value or chronological order) for faster comprehension.
- For presentations, increase font sizes (titles ~14–18 pt, labels ~10–12 pt).
- Use secondary axis carefully; always label it clearly to avoid confusion.
- Hide field buttons on PivotCharts before printing/sharing for a cleaner look.
- Always preview in Print/Page Layout—on-screen clarity may not match print/PDF.

Common Errors:

- Entering text instead of numbers (Fix it: Remove spaces or apostrophes before numbers and set the cell format to *General* or *Number*).
- Incorrect totals or missing cells in SUM formulas (Fix it: Use AutoSum (Σ) and confirm the full cell range before pressing Enter).

- Misaligned columns or uneven spacing (Fix it: Avoid merging cells; use alignment tools like *Center Across Selection* for consistent layout).
- Lost or unsaved work (Fix it: Save frequently with Ctrl + S and enable *AutoRecover* under File → Options → Save).
- Confusing worksheet tabs (Fix it: Rename sheets with descriptive titles (e.g., *Budget_2025*), reorder logically, and apply tab colors).
- Accidentally overwriting a template (Fix it: Use *Save As* to create a new version (e.g., *ExpenseTracker_v2.xlsx*) instead of saving over the original).
- Overly cluttered formatting (Fix it: Simplify your design—use consistent fonts, light shading, and avoid too many colors or bold styles).
- Choosing the wrong chart type (Fix: Map the goal first: comparison = column/bar; trend = line; composition (100%) = pie/doughnut (≤5–6 slices); mixed metrics = combo.)
- Overloaded pie chart (too many slices) (Fix: Limit to a few categories; group small ones into "Other"; label percentages directly.)
- Unreadable multi-series line chart (Fix: Keep ≤3 series; add markers sparingly; increase line contrast; consider small multiples instead.)
- Cluttered chart (too many labels/gridlines) (Fix: Show only key labels; use light gridlines or remove them; increase white space.)
- Mismatched scales in combo charts (Fix: Add a secondary axis and clearly label it; avoid deceptive scaling.)
- Charts don't update with new data (Fix: Base charts on Excel Tables or named ranges; use structured references.)
- Ambiguous axes/units (Fix: Add clear axis titles with units (e.g., "Revenue ($000s)").)
- Color-only meaning (accessibility issue) (Fix: Use contrasting colors + patterns/labels; avoid red/green only distinctions.)
- Legends overlapping data (Fix: Reposition the legend (Right/Bottom) or reduce chart area margins.)
- Copy/paste charts lose formatting (Fix: Apply a workbook theme; use Format Painter; lock styles before duplication.)

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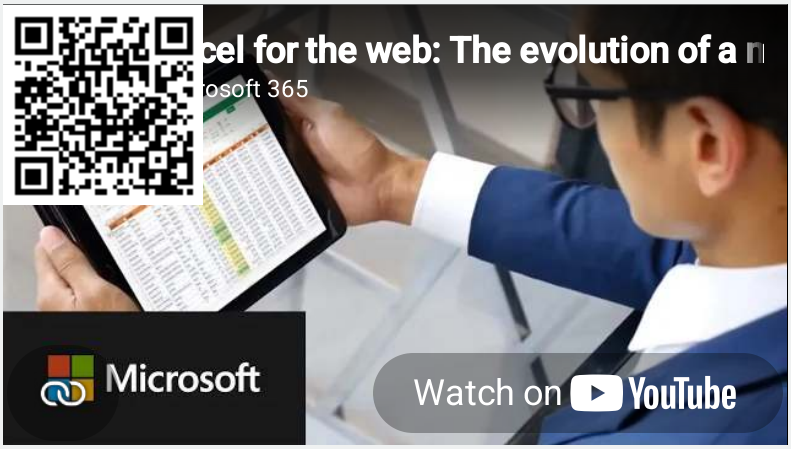
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3.1.6: Real World Applications

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Excel for the Web

The Evolution of a Modern Web App



This video provides an overview of the features and value of Excel for the web.

Microsoft Excel: Transforming Data into Insight

While Word captures the narrative of a business, **Excel captures its numbers, patterns, and logic**. Excel is the universal platform for data organization, analysis, and visualization. Its ability to handle complex and straightforward datasets has made it a cornerstone of modern business operations — used by analysts, managers, executives, and entrepreneurs alike.

Industry Applications

- **Finance and Accounting:** Financial analysts use Excel to build budgeting models, calculate cash flows, and forecast revenue. Accountants track expenses, reconcile statements, and generate profit-and-loss summaries. PivotTables and formulas such as SUMIFS, VLOOKUP, and INDEX/MATCH allow efficient financial analysis and performance reporting.
- **Marketing and Sales:** Marketing professionals use Excel to analyze campaign metrics, calculate cost-per-click (CPC) and return on ad spend (ROAS), and visualize results through charts and dashboards. To inform strategy and resource allocation, sales teams track lead conversions, quotas, and customer engagement trends.
- **Operations and Supply Chain:** Operations managers depend on Excel to monitor production schedules, optimize logistics routes, and forecast demand. Conditional formatting can alert teams to low inventory levels or delayed shipments, enabling proactive problem-solving.
- **Human Resources:** HR professionals use Excel to manage employee data, calculate compensation, and analyze turnover trends. Excel provides transparency and accuracy for HR metrics used in strategic planning and compliance.
- **Education and Research:** Educators and researchers use Excel to track student performance, manage grades, and analyze survey or experiment data. Its functions for statistical analysis make it a reliable companion for early data exploration before transitioning to specialized software.

What makes Excel invaluable is its versatility. It can be used for everything from simple calculations to complex financial modeling, from one-person data management to enterprise-wide reporting. Excel's **visualization features**—charts, graphs, and conditional formatting—transform raw numbers into clear, actionable insights.

More advanced users leverage **automation tools** like **Macros**, **Power Query**, and **Power Pivot** to process large datasets and standardize reporting. In corporate settings, these capabilities save teams hours of manual work and enable data-driven decision-

making consistently.

Ultimately, Excel bridges the gap between information and interpretation. It allows professionals to collect data and **understand what it means**, supporting decisions with measurable evidence rather than intuition.

Attribution

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When will you use workbooks?

Area	Scenario	Example Use Case
Business / Office	Inventory Tracking	Retail manager uses worksheets by category (Electronics, Apparel, etc.) with SKU, stock, and reorder levels; conditional formatting flags low stock.
Business / Office	Shift Schedules	HR assistant builds weekly schedules; rows = employees, columns = days, color-coded for shifts.
Business / Office	Customer Logs	Sales team tracks clients with contact info, last purchase date, and notes; filters sort by region or frequency.
Personal Use	Monthly Budget	Individual records income/expenses by category; pie chart shows spending breakdown.
Personal Use	Spending Analysis	User imports bank CSV, categorizes transactions, and charts spending trends over time.
Education	Research Data	Student logs trials with variables/results; formulas calculate averages and standard deviation.
Education	Assignment Logs	Tracker lists students vs. assignments; conditional formatting highlights late/missing work.
Education	Grades	Instructor's gradebook uses formulas for totals and IF statements for letter grades.
Small Business / Freelance	Client/Event Worksheets	Photographer tracks clients, event dates, hours, and rates; sheet calculates total per event.
Small Business / Freelance	Invoices	Business builds invoice templates with client info, services, subtotal, tax, and total.
Small Business / Freelance	Payments	Freelancer monitors invoices with due dates and payment status; overdue items flagged red.

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3.1.7: Excel Terminology

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Term	Definition
3D map	a type of map that is three dimensional and appears to have all three spatial dimensions including length, width, and depth
Absolute	a cell reference that refers to cells by their fixed position in a worksheet; an absolute cell reference remains the same when the formula is copied and is indicated by
absolute cell reference	one in which the cell reference is fixed regardless of where you copy the formula
Active Cell	The currently selected cell where data entry or editing will occur outlined by a bold border.
array	selection of rows or columns that do not have to be contiguous
auditing formulas	process of using Excel tools to monitor and fix errors in worksheets
AutoFill	A tool that automatically continues patterns or series in data (e.g. filling months numbers or days of the week).
average	number found by adding up a group of values and then dividing it by the number of values; also called the mean
background	canvas that is displayed behind the cell contents of a worksheet
Backstage View (File Tab)	The area accessed by clicking File where users can create open save print and manage Excel files and options.
basic financial functions	main functions for calculating loan installments investment returns net present value mortgage comparisons and other real-world applications
Cell	The intersection of a row and column identified by a unique address such as A1. Each cell can contain text numbers or formulas.
Cell Formatting	Visual modifications applied to a cell or range including text color borders alignment and background shading.
cell range	selection of rows or columns that is given a name to make it easier to find that group later
Cell Range	A group of adjacent cells selected together identified by the top-left and bottom-right cell references (e.g. A1:D5).
cell reference	address of a cell relative to the other cells in a worksheet
Cell Reference	The column letter and row number that identify a cell's location on a worksheet (e.g. B3).
Cell Style	tool that lets you select other font sizes and background colors
Chart Elements	Title legend axes axis titles data labels gridlines plot area—components used to clarify a chart.
Column/Bar Chart	Visual compares values across categories (vertical vs. horizontal bars).
Combo Chart	Combines two chart types (often column + line) to compare magnitude and trend; can use a secondary axis.
comparison operators	inequality symbols used in math including < > ≥ ≤ = and <>
complex formula	one that uses several operators to calculate an output
conditional formatting	feature in Excel that analyzes the cell contents and applies preset designs or layouts based on the content
Ctrl+Select	command that allows you to select two or more areas that are not contiguous
data analysis	scientific discipline that uses mathematical and statistical tools to measure trends
Data Labels	Numeric/text values shown on chart marks to provide exact readings.
Data Table	scenario-building tool that outputs different solutions or forecasts based on selected scenarios
Excel Table	Structured data range that auto-expands and supports structured references.
File Extension	The suffix at the end of a filename that identifies its type (e.g. .xlsx .csv .xlsm).
filter	tool that lets the user select criteria so only matching data is shown
Format Painter	tool that copies a range's formatting and applies it to another range
formatting	applying colors font types and borders to cells for styling purposes
Formatting	Adjusting the visual appearance of data in cells to improve readability and presentation.
formula	mathematical operation that may use constants or cell references or a combination of both
Formula Bar	The area above the worksheet grid that displays the contents of the active cell and allows users to enter or edit data and formulas.

Term	Definition
freeze panes	fixing the headers on the screen while allowing users to scroll through the rest of the data
function	mathematical or analytical operation that uses words instead of mathematical operators
Gridlines (Major/Minor)	Horizontal/vertical guides that aid value estimation.
header	label added to tables at the top of columns or to the left of rows to make the data understandable
hide	temporarily remove designated rows or columns from view
Line Chart	Shows trends over continuous time or sequence.
logical functions	long formulas with embedded logical tests often using comparison operators to search for delimited data
MAX	function that finds the highest value in a dataset
merge	combine content from two or more cells
MIN	function that finds the lowest value in a dataset
mixed cell reference	one that uses a combination of both relative and absolute cell references
Number Format	A style that determines how numerical data is displayed such as Currency Percentage Date or Accounting.
numeric data	information made of numerals that Excel reads like a calculator to perform mathematical equations
order of operations	universal math law prescribing the order of calculations in an equation
Pie/Donut Chart	Displays parts of a whole best with few categories.
PivotChart	A chart linked to a PivotTable supporting interactive filtering grouping and drill-down.
PivotTable	tool that lets users create interactive charts and tables from raw datasets
PivotTable	Tool to summarize or aggregate data by categories.
Quick Access Toolbar (QAT)	A customizable toolbar above the Ribbon that provides one-click access to frequently used commands like Save Undo or Redo.
relative cell reference	one in which the reference updates automatically when copied to another cell
Ribbon	The command area at the top of Excel that organizes tools into tabs (Home Insert Page Layout Formulas Data Review View).
Secondary Axis	Additional axis to scale a second data series with different units or magnitudes.
Sheet Tab	The labeled tab at the bottom of the workbook used to navigate between worksheets.
Shortcut Key	A key or combination of keys (e.g. Ctrl+S Ctrl+C) that performs a command quickly.
Small Multiples	Several similar charts with the same axes for easy comparison.
SmartArt	Built-in diagrams to visualize processes hierarchies cycles and relationships.
spreadsheet	software application with rows and columns in a grid pattern where you can enter data to design tables graphs and perform data analysis
Status Bar	The bar at the bottom of the Excel window displaying information about the current worksheet view zoom level and summary calculations.
Structured References	Table-based formula references using column names (e.g. =SUM(Table1[Revenue])).
Tab (on the Ribbon)	A labeled section of the Ribbon grouping related commands (e.g. Home tab for formatting and editing Insert tab for charts or tables).
Template	A predesigned workbook with predefined structure formatting and formulas used to save time when creating common spreadsheets.
text data	information made up of words letters numerals or a combination
workbook	file that contains one or more worksheets
Workbook	The main Excel file that contains one or more worksheets used to store and organize data. File extension: .xlsx (or .xlsm for macro-enabled workbooks).
Workbook Navigation	The process of moving between cells ranges or worksheets using the mouse keyboard shortcuts or navigation tools.
worksheet	tab within a workbook where you can input data and design tables and graphs

Term	Definition
Worksheet	A single spreadsheet within a workbook consisting of rows and columns that form cells where data is entered.
Wrap Text	feature that arranges the text in a cell so that it extends onto another line and increases the row height

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3.1.8: Excel Terminology Flashcards

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Coming Soon

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3.1.9: Excel Hands-on Exercises

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Hands-On Exercise: Sales Dashboard with Dynamic Charts

Build a small dashboard that compares categories, shows a trend over time, and highlights composition—then make it dynamic.

Instructions

1. Create a table named SalesData with columns: Month (Jan–Dec), Category (e.g., A/B/C/D), Units, Revenue.
2. Enter at least 12 months × 4 categories (48 rows). Convert to Table (Ctrl+T).

Step 1: Column Chart (Comparison)

- Insert a Clustered Column chart showing Revenue by Category (sum).
- Sort categories by Revenue (descending).
- Add a Chart Title and Data Labels (for totals only).
- Use a consistent palette and move the legend to the bottom.

Step 2: Line Chart (Trend)

- Insert a Line chart for Monthly Revenue (sum across all categories).
- Add markers and a horizontal Major gridline for readability.
- Title: “Monthly Revenue Trend – 2025”.

Step 3: Pie/Donut Chart (Composition)

- Insert a Donut chart for Category Share of Revenue (latest month only).
- Limit to 4–5 slices; label percentages directly.
- Title: “Revenue Composition – Latest Month”.

Step 4: PivotTable + PivotChart (Dynamic)

- Create a PivotTable from SalesData: Rows = Month; Columns = Category; Values = Sum of Revenue; Filters = (optional) Region or Sales Rep (if added).
- Insert a PivotChart (Clustered Column or Line).
- Use field buttons to filter by Category/Month. Hide buttons for clean export.

Step 5: Dashboard Polish

- Place charts on a single sheet named Dashboard.
- Align/size charts (snap to grid); apply a theme; standardize title fonts (16–18 pt).
- Add a small notes box stating data source and last refresh date.

Deliverable: Save as Chapter6_Sales_Dashboard.xlsx.

Creating a Personal Expense Tracker

Build a simple, functional spreadsheet that tracks monthly expenses while practicing data entry, formatting, and worksheet organization.

Instructions

1. Create a New Workbook
   - Open Excel → Blank Workbook.
   - Save as: ExpenseTracker_YourLastName.xlsx.
2. Set Up Headers

- In Row 1, type:
  Date | Description | Category | Payment Method | Amount | Notes

3. Enter Sample Data
   - Fill in at least 10 rows of realistic transactions.
     Example categories: Rent, Utilities, Groceries, Gas, Entertainment.
4. Format for Clarity
   - Apply bold and center alignment to the header row.
   - Use Currency format for the Amount column.
   - AutoFit column widths (double-click between column letters).
5. Add Totals
   - Below your data, use AutoSum (Σ) to calculate total spending for the month.
     Example formula: =SUM(E2:E11)
6. Enhance the Worksheet
   - Apply cell shading to headers.
   - Use border lines to separate sections.
   - Rename the worksheet tab: January_Expenses.
   - Add a second sheet for February_Expenses.
7. Save and Review
   - Save your workbook and verify totals update correctly if values change.

Challenge Extension:

Add a “Monthly Budget” value and create a simple formula to display Remaining Balance = Budget - Total Spent.

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