EXCEL

For Lifelong Learning

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FOREWORD

Microsoft Excel is a spreadsheet program developed by Microsoft for Windows, MacOS, Android, and iOS and is part of the Office suite of software. It features calculation, graphing tools, pivot tables, and a macro programming language called *Visual Basic for Applications*. Excel is used widely for many financially-related activities from simple quarterly forecasts to full corporate annual reports. Excel is also used for common information organization like contact lists and inventory tracking. Finally, Excel helps researchers perform statistical analysis tasks like variance analysis, chi-square testing, and charting complex data.

I've used Excel for both business and personal use for more than 20 years. For the *Cochise College Center for Lifelong Learning* class, I started with an "open source" book since it is available free of charge and I could modify it to meet the objectives of this class.

> *Beginning Excel* by Noreen Brown, Barbara Lave, Julie Romey, Mary Schatz, Diane Shingledecker. I found it at *Open Oregon Educational Resources*, https://ecampusontario.pressbooks.pub/beginningexcel/

I deeply appreciate the original authors' work and their decision to publish their book under the Creative Commons so I could modify it for my class. The original book has six chapters, but to better fit my class I added three chapters with advanced skills and then reformatted the entire work into my own voice.

This book includes information for both Excel 2016 and Excel 365. These two products are identical for the most part; however, when there is a difference in functionality that will be identified with one of two symbols.

- **Excel 2016** This is something that is only found in Excel 2016.

- **Excel 365** This is something that is only found in Excel 365.

Throughout the book you will find references that look like this: Click **Home** ⇒ **Cells** ⇒ **Clear**. This means to look on the *Home* tab, the *Cells* group of commands, and click the *Clear* button.

The book includes both background information and activity steps to complete. Activity steps are printed with a distinctive background color, as illustrated below.

1. This is step one.

2. This is step two.

3. This is step three.

While this book is useful in its current form, I will continually update it based on my students' experiences and my own research. It is my hope that students can use this book to learn about Excel and other instructors can adapt it for their own classes.

— George Self

BRIEF CONTENTS

CONTENTS

Part I

BASIC EXCEL

This part is a basic introduction to Excel and is designed for students who have little or no Excel experience. It starts with creating new workbooks and then covers entering, editing, and managing worksheets, including selecting cells, entering data, and using the Excel Ribbon. This part also covers creating and using mathematical formulas and adding Excel functions to worksheets. Students who complete this part will have an excellent grounding in Excel that they can use in their work, but they will also be prepared for more advanced topics.

FUNDAMENTAL SKILLS

Microsoft® Excel® is a tool that can be used in virtually all careers and is valuable in both professional and personal settings. Applications as diverse as keeping track of medications in inventory for a hospital or creating a financial plan for retirement can be done efficiently and accurately with Excel. This chapter introduces the fundamental skills necessary start with Excel. Most people find that learning only a few skills makes them very productive in a short period of time.

1.1 OVERVIEW OF MICROSOFT EXCEL

> **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, but Excel is perhaps the most versatile and widely used of all the Office applications. Most career paths need to use Excel from time-to-time to accomplish professional objectives, often daily. This chapter provides an overview of the Excel application along with an orientation for accessing the commands and features of an Excel workbook.

1.1.1 *Making Decisions With Excel*

Taking a simple view, Excel is a tool for entering quantitative data into an electronic spreadsheet to apply one or several 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 adminis-

ter to a patient, or how to balance income with outgo. With respect to personal decisions, Excel can help determine how much money is available to spend on a house, car payment, or savings for retirement. This text demonstrates using Excel to make these decisions, and many more.

Figure 1 shows a completed Excel worksheet that will be constructed in this chapter. The information shown in this worksheet is the top-line sales data for a hypothetical merchandise retail company. The worksheet data can help this retailer determine how many salespeople are needed for each month, how much inventory is needed to satisfy sales, and what types of products should be purchased.

	A	B	C	D
		General Merchandise World Retail Sales (in millions)		
	Month	Unit Sales	Average Price	Sales Dollars
	January	2,670	$ 9.99	$ 26,685
	February	2,160	$ 12.49	$ 26,937
	March	515	$ 14.99	$ 7,701
	April	590	$ 17.49	$ 10,269
	May	1,030	$ 14.99	$ 15,405
	June	2,875	$ 12.49	$ 35,916
	July	2,700	$ 9.99	$ 26,937
	August	900	$ 19.99	$ 17,958
	September	775	$ 19.99	$ 15,708
	October	1,180	$ 19.99	$ 23,562
	November	1,800	$ 17.49	$ 31,416
	December	3,560	$ 14.99	$ 53,370
	Total Sales	20,755		$ 291,864

Figure 1: Example of an Excel Worksheet

1.1.2 Starting Excel

1. Locate Excel on the Windows menu.

2. Click **Microsoft Excel** to launch the Excel application.

3. Click the first option, **Blank Workbook**.

1.1.3 *The Excel Workbook*

Once Excel is started, a blank workbook will open. A workbook is an Excel file that contains one or more worksheets (sometimes 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 2 shows a blank workbook after starting Excel. Take some time to become familiar with this screen. (*Note: the worksheet screen may be slightly different depending on the version of Excel being used.*)
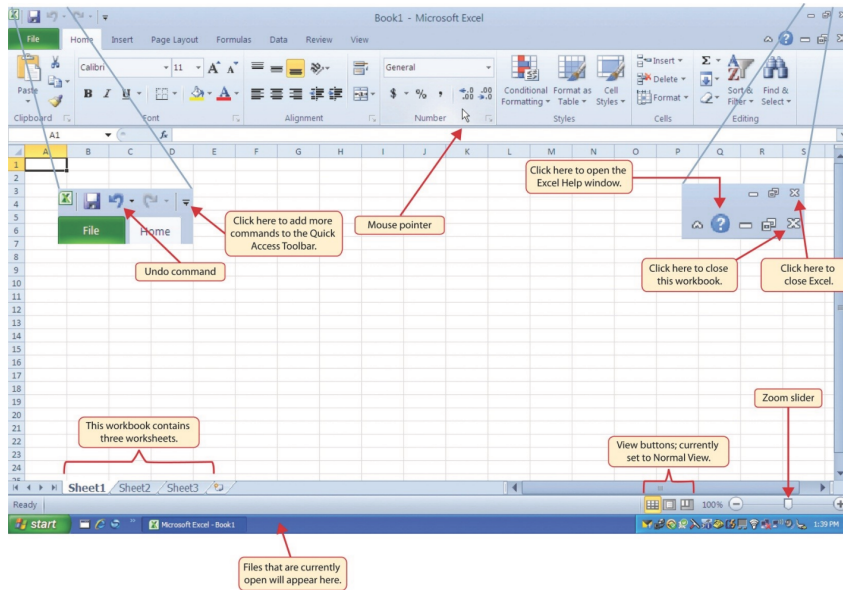
Figure 2: Blank Workbook

The workbook should already be maximized (or shown at full size) once Excel is started, as shown in Figure 2. However, if the screen looks like Figure 3 after starting Excel, click the *Maximize* button, as shown in the figure.
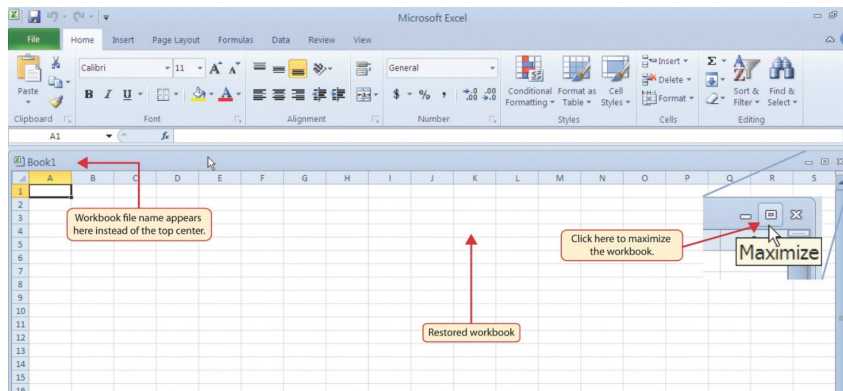
Figure 3: Restored Worksheet

1.1.4 *Navigating Worksheets*

Data is 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 is located at an address, which is defined by a column letter followed by a row number. For example, the cell that is currently activated in Figure 3 is A1. This would be referred to as cell location A1 or cell reference A1. The following steps explain how to navigate in an Excel worksheet.

- Place the mouse pointer over cell **D5** and left click.

- Check to make sure **Column D** and **Row 5** are highlighted, as shown in Figure 4.
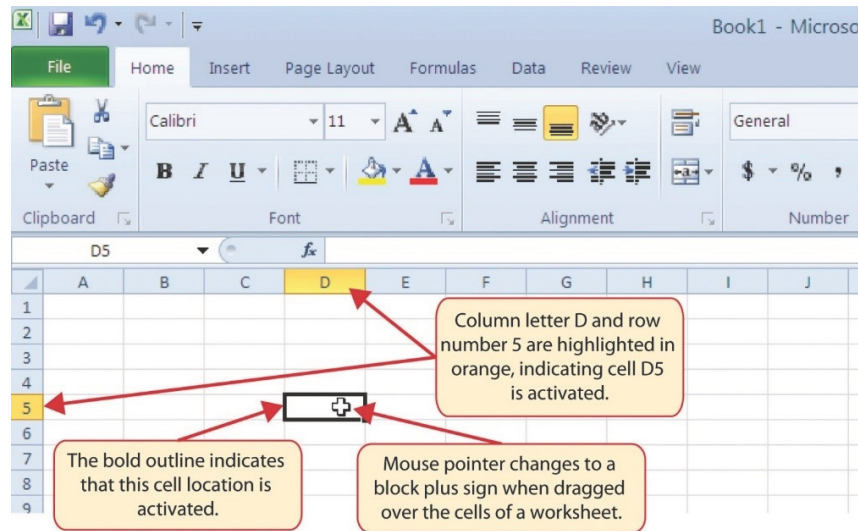
Figure 4: Activating a Cell Location

1. Click the mouse pointer in 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. Several cells are now highlighted, as shown in Figure 5.
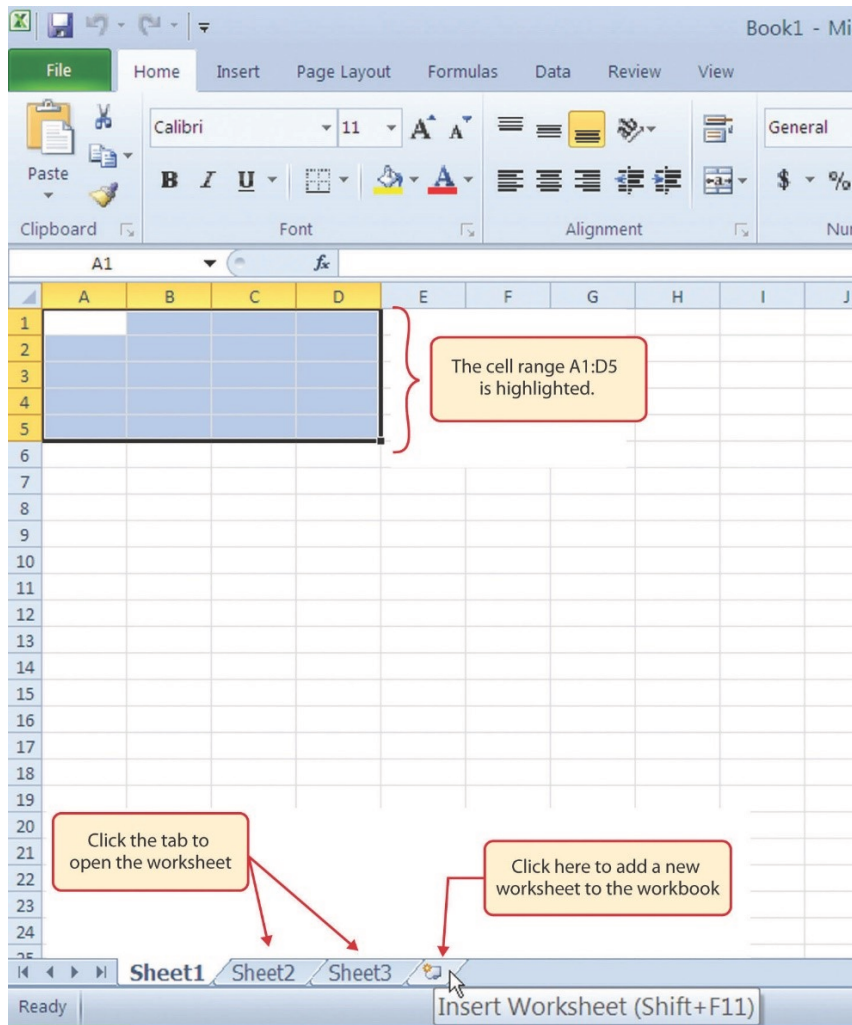
Figure 5: Highlighting a Range of Cells

This is referred to as a cell range and is usually written as A1:D5. Any two cell locations separated by a colon are known as a cell range. The first cell in the range is the top left corner and the second cell is the lower right corner.

1. At the bottom of the screen are tabs that identify different worksheets. Depending on the version of Excel being used there may be three as displayed in Figure 5 or just one. If there is only one sheet, clicking **Insert Worksheet** adds a new worksheet. Different versions of Excel use **+** or **Insert Worksheet** buttons. For this exercise, add worksheets as necessary so three are available.

2. Click the **Sheet1** tab at the bottom of the screen to activate it, as shown in Figure 5.

> **Keyboard Shortcuts**
>
> **Basic Worksheet Navigation**
>
> - Use the arrow keys on the keyboard to move the cell pointer to different cells on the worksheet.
> - Hold the [Shift] key and press the arrow keys on the 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.

1.1.5 *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 6 shows the commands available in the *Home* tab of the Ribbon. Table 1, *Command Overview for Each Tab of the Ribbon*, provides an overview of the commands that are found in each tab of the Ribbon.
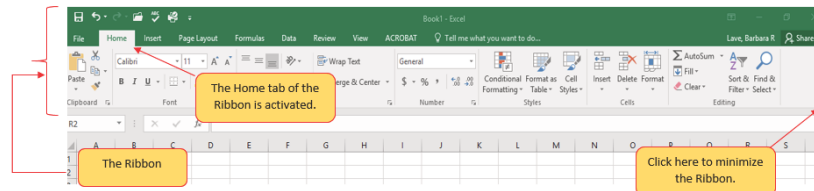
Figure 6: Home Tab of the Ribbon

Tab	Description
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. Excel's user 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 grid lines 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.

Table 1: Command Overview for Ribbon Tabs

The Ribbon shown in Figure 6 is full, or maximized. The benefit of having a full Ribbon is that the commands are always visible while developing a worksheet. However, depending on the screen dimensions of the computer, the Ribbon may take up too much vertical space on the worksheet. If this is the case, it can be minimized by clicking the button shown in Figure 6. When minimized, the Ribbon will show only the tabs and not the command buttons. Clicking a tab makes the command buttons appear until a command is selected or the mouse is clicked anywhere on the worksheet. Once the ribbon is expanded it can be pinned open by clicking the **pin** button at the lower left corner of the ribbon.

> **Keyboard Shortcuts**
>
> **Minimizing or Maximizing the Ribbon**
>
> - Hold down the `Ctrl` key and press the `F1` key to toggle between the maximized and minimized view of the ribbon.

1.1.6 *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 7. This area provides access to the most frequently used commands, such as Save and Undo. The *Quick Access Toolbar* can be customized by adding commands that are extensively used. By placing these commands in the *Quick Access Toolbar*, it is not necessary to navigate through the Ribbon to find them. To customize the *Quick Access Toolbar*, click the down arrow as shown in Figure 7. This will open a menu of commonly used commands that can be added to the *Quick Access Toolbar*. If the desired command is not on the list, select the *More Commands* option, which opens a screen containing every command on the ribbon.
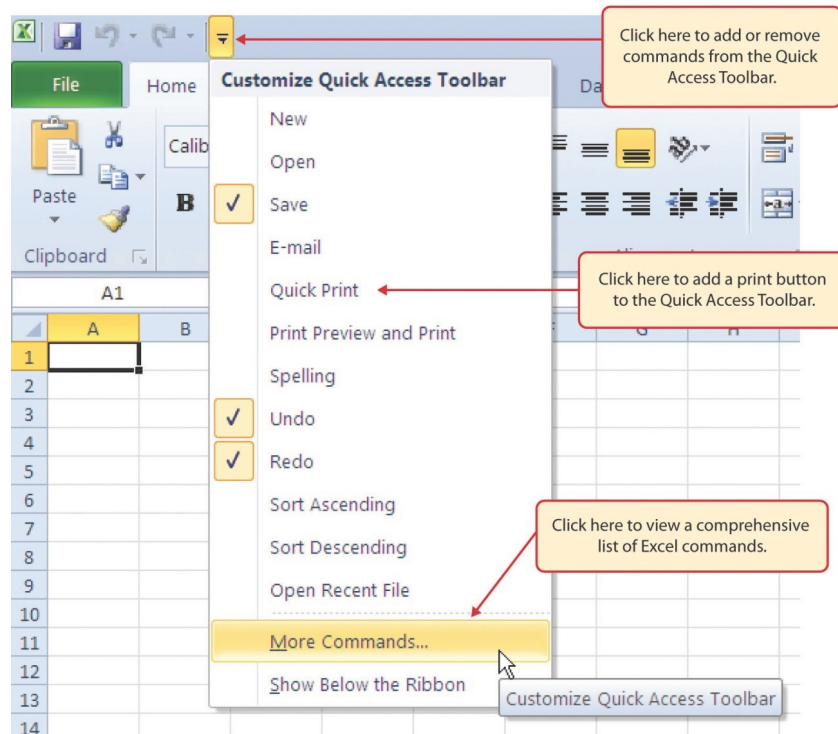
Figure 7: Customizing the Quick Access Toolbar

In addition to the Ribbon and Quick Access Toolbar, commands can also be accessed by right-clicking anywhere on the worksheet

and opening a context menu. 8 shows an example of the commands available in the context menu.
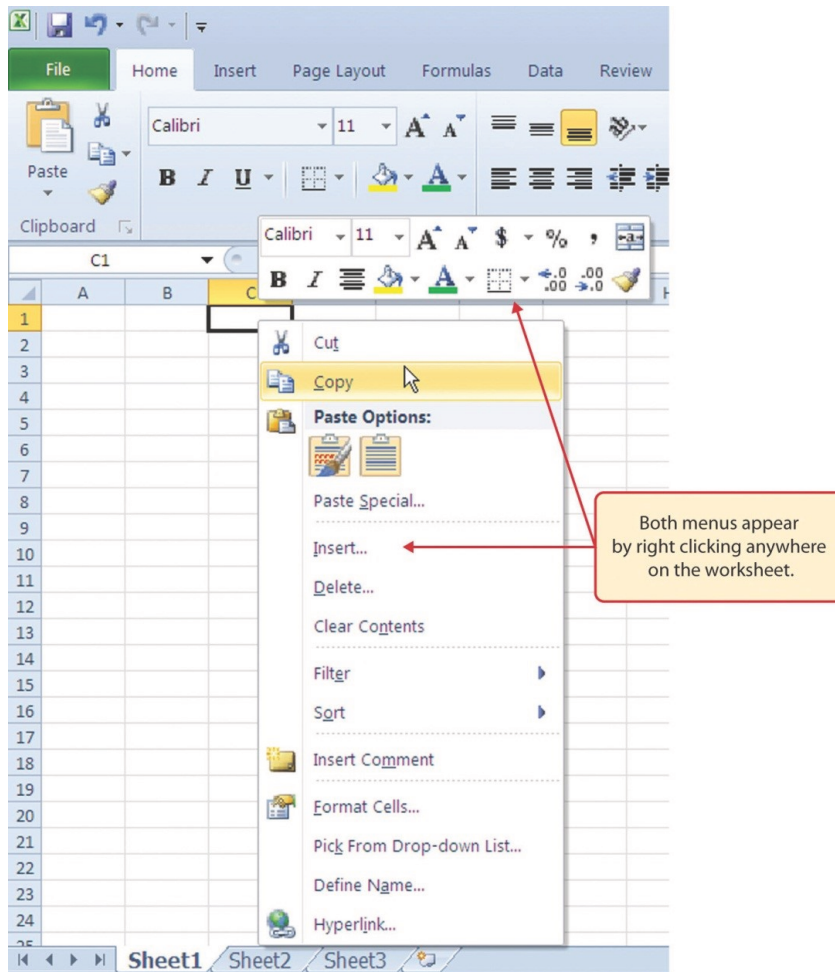
Figure 8: Right-Click Menu

1.1.7 *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 the computer or network. Figure 9 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 in Figure 9.
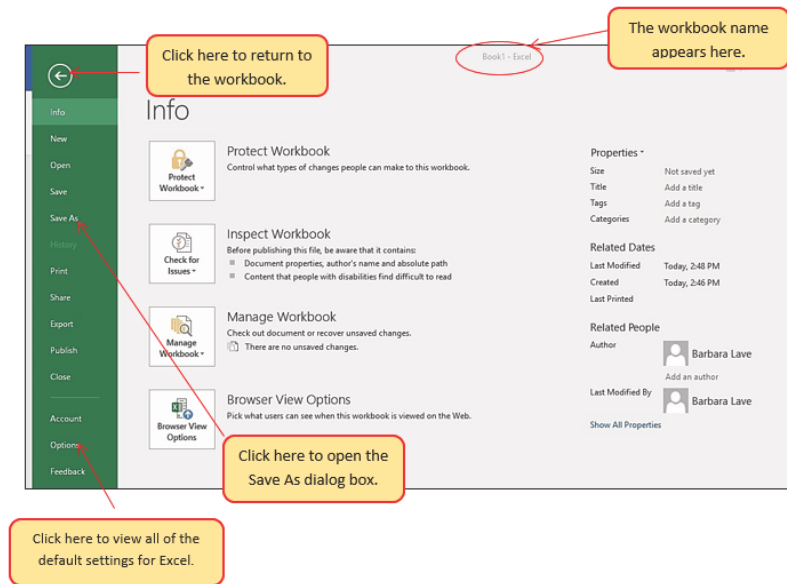
Figure 9: File Tab or Backstage View of a Workbook

Included in the *File* tab are the numerous Excel settings that can be accessed and modified by clicking the *Options* button. Figure 10 shows the Excel *Options* window, which opens access to settings such as the default font style, font size, and the number of worksheets that appear in new workbooks[1].
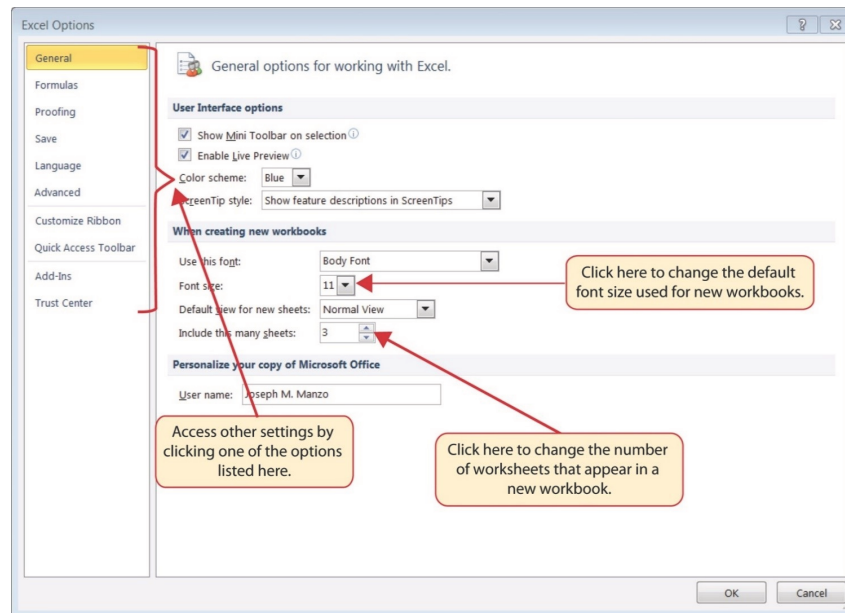
Figure 10: Excel Options Window

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1 Chapter 9, ADVANCED TOPICS, page 439, has more information about setting common options.

1.1.8   *Saving Workbooks (Save As)*

Once a new workbook is created, the file name needs to be specified and a location chosen on the computer or network to save that file. A blank workbook was opened earlier in this lesson and it should now be saved. It is important to remember where the workbook is saved since it will be used later in this chapter to construct the workbook shown in Figure 1. As a tip, it is probably easiest to store all workbooks used in this course in the same folder.

1. Click **File** ⇒ **Save As**. This will open the *Save As* dialog.

2. Determine a location for saving on the computer by clicking **Browse** on the left side to open the *Save As* dialog box as illustrated in Figure 11.

3. Click in the *File Name* box near the bottom of the *Save As* dialog box. Type the new file name: *CH1-GMW Sales Data*

4. Review the settings in the screen for correctness and click the **Save** button.
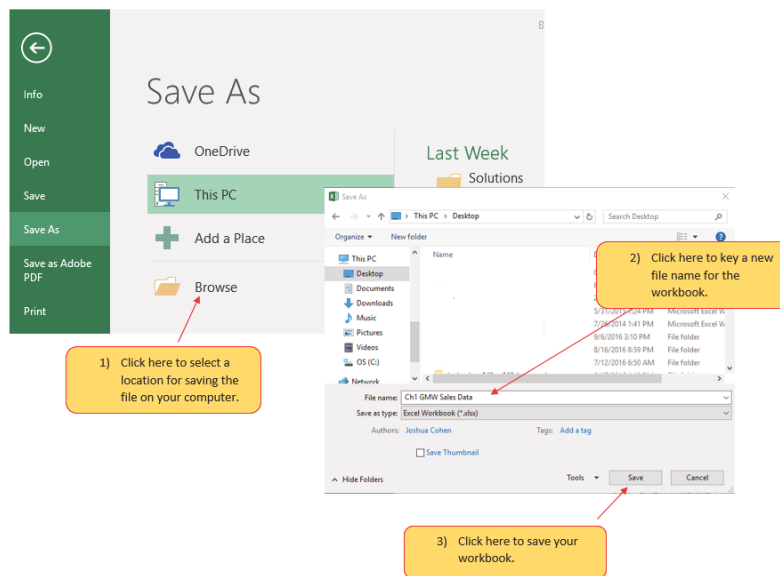
Figure 11: Save As Dialog in Excel

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 the keyboard and Key Tips, small letters and numbers, appear on the Ribbon. Press the F key on the keyboard for the **File** tab and then the A key. This will open the *Save As* dialog box.

Skill Refresher

Saving Workbooks (Save As)

- Click the *File* tab on the Ribbon.
- Click the *Save As* option.
- Select a location on the computer.
- Click in the *File* name box and type a new file name if needed.
- Click *Save as type* ⇒ *Down Arrow* and select the appropriate file type if needed.
- Click the *Save* button.

1.1.9 *The Status Bar*

The Status Bar is located below the worksheet tabs on the Excel screen (see Figure 12). It displays a variety of information, such as the status of certain keys on the 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. The Status Bar can be customized 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 12).

2. Select the **Caps Lock** option from the menu (see Figure 12).

3. Press the Caps Lock key on the keyboard and notice the Caps Lock indicator on the lower left side of the Status Bar.

4. Press the [Caps Lock] on the keyboard again. The indicator on the Status Bar goes away.
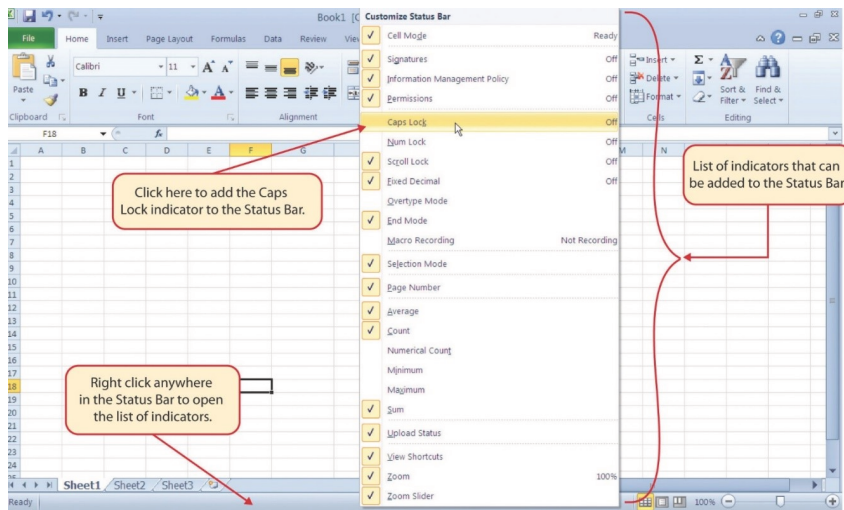
Figure 12: Customizing the Status Bar

1.1.10 *Excel Help*

The Help feature provides extensive information about the Excel application. Although some of this information may be stored on the local computer, the Help window will automatically connect to the Internet if there is a live connection to provide resources that can answer most questions.

Excel 2016 To access help, enter a question in the *Tell me what you want to do* text box above the ribbon. A drop-down list with links to several potential answers will appear. Select from the links or click the question mark to launch the Excel Help window.

Excel 365 The Excel Help window can be opened by clicking the **Help** tab. Alternatively, enter a question in the *Search* text box above the ribbon. A drop-down list with links to several potential answers will appear. Select from the links or click the question mark to launch the Excel Help window.
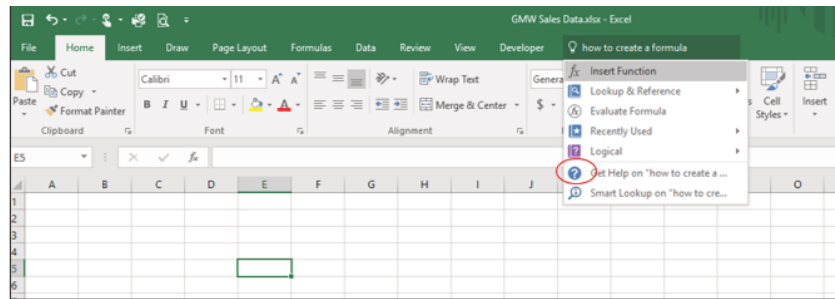
Figure 13: Excel Help Window

Keyboard Shortcuts

Excel Help

- Press the F1 key on the keyboard.

Key Take-Aways

Overview

- Excel is a powerful tool for processing data for the purposes of making decisions.
- Excel commands are found throughout the tabs in the Ribbon.
- The *Quick Access Toolbar* can be customized by adding frequently-used commands.
- Information displayed on the Status Bar can be customized.
- The Help window provides extensive information about Excel.

1.2   ENTERING, EDITING, AND MANAGING DATA

Learning Objectives

- Understand how to enter data into a worksheet.
- Examine how to edit data in a worksheet.
- Examine how the Auto Fill Handle is used when entering data.
- Understand how to delete data from a worksheet and use the Undo command.
- Examine how to adjust column widths and row heights in a worksheet.
- Understand how to hide columns and rows in a worksheet.
- Examine how to insert columns and rows into a worksheet.
- Understand how to delete columns and rows from a worksheet.
- Learn how to move data to different locations in a worksheet.

This section begins the development of the workbook shown in Figure 1. The skills covered in this section are typically used in the early stages of developing one or more worksheets in a workbook.

1.2.1   *Entering Data*

Begin building the workbook shown in Figure 1 by manually entering data into the worksheet. Begin by entering the column headings in *Row 2*.

1. Click cell location **A2** on the worksheet.

2. Type the word *Month*.

3. Press the Tab key. This will enter the word into cell **A2** and activate the next cell to the right.

4. Type *Unit Sales* and press the Tab key.

5. Repeat the above step for the words *Average Price* and then again for *Sales Dollars*.

Figure 14 shows how the worksheet should appear after the column headings have been entered into *Row 2*. Notice that the word *Price* in cell location C2 is not visible. This is because the column is too narrow to fit the entry. This will be corrected in the next section.
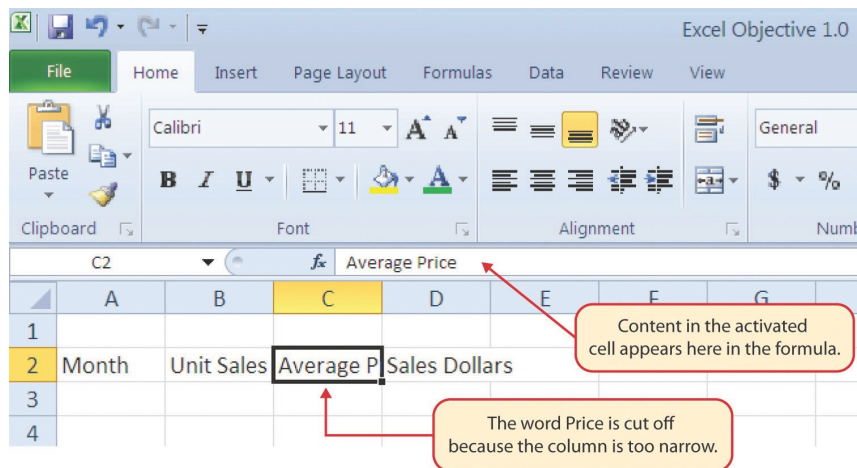
Figure 14: Entering Column Headings into a Worksheet

Integrity Check

Column Headings

It is critical to include column headings that accurately describe the data in each column of a worksheet. In professional environments, Excel workbooks are commonly shared among coworkers. Good column headings reduce the chance of someone misinterpreting the data contained in a worksheet, which could lead to costly errors.

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1. Click cell location **B3**.

2. Type the number 2670 and press the [Enter] key. After pressing the [Enter] key, cell **B4** will be activated. Using the [Enter] key is an efficient way to enter data vertically down a column.

3. Enter the following numbers in cells **B4** through **B14**: 2160, 515, 590, 1030, **2875** , 2700, 900, 775, 1180, 1800, and 3560.

4. Click cell location **C3**.

5. Type the number 9.99 and press the [Enter] key.

6. Enter the following numbers in cells **C4** through **C14**: 12.49, 14.99, 17.49, 14.99, 12.49, 9.99, 19.99, 19.99, 19.99, 17.49, and 14.99.

7. Click in cell **D3**.

8. Type the number 26685 and press the [Enter] key.

9. Enter the following numbers in cells **D4** through **D14**: 26937, 7701, 10269, 15405, 35916, 26937, 17958, 15708, 23562, 31416, and 53370.

10. When finished, check that the data entered matches Figure 15.

▲	A	B	C	D	E
1					
2	Month	Unit Sales	Average P	Sales Dollars	
3		2670	9.99	26685	
4		2160	12.49	26937	
5		515	14.99	7701	
6		590	17.49	10269	
7		1030	14.99	15405	
8		2875	12.49	35916	
9		2700	9.99	26937	
10		900	19.99	17958	
11		775	19.99	15708	
12		1180	19.99	23562	
13		1800	17.49	31416	
14		3560	14.99	53370	
15					
16					
17					
18					
19					

Numbers have been entered without symbols such as dollar signs or commas.

Figure 15: Completed Data Entry for Columns B, C, and D

Integrity Check

Data Entry

One of the most likely points of error in any spreadsheet project is inaccurate data entry. When entering row and row of numbers it is easy to transpose or skip digits. Carefully checking data entry will reduce confusing results during the analysis phase of the project.

> **Why?**
>
> **Avoid Formatting Symbols When Entering Numbers**
>
> When typing numbers into an Excel worksheet, it is best to avoid adding any formatting symbols such as dollar signs and commas. Although Excel allows these symbols to be included while typing numbers, it slows down the process of entering data. It is more efficient to use Excel's formatting features to add these symbols to numbers after they are typed into a worksheet.

1.2.2 *Editing Data*

Data that has been entered in a cell can be changed by double clicking the cell location or using the Formula Bar. The Formula Bar can be used for initial entry of data into cells as well as for editing data that already exists in a cell. The following steps provide an example of entering and then editing data that has been entered into a cell location.

1. Click cell **A15** in the **Sheet1** worksheet.

2. Type the abbreviation *Tot* and press the [Enter] key.

3. Click cell **A15**.

4. Move the mouse pointer up to the Formula Bar. Notice that the pointer turns into a cursor. Move the cursor to the end of the abbreviation *Tot* and left click.

5. Type the letters *al* to complete the word *Total*.

6. Click the checkmark to the left of the Formula Bar (see Figure 16) or press the [Enter] key to enter the change into the cell.
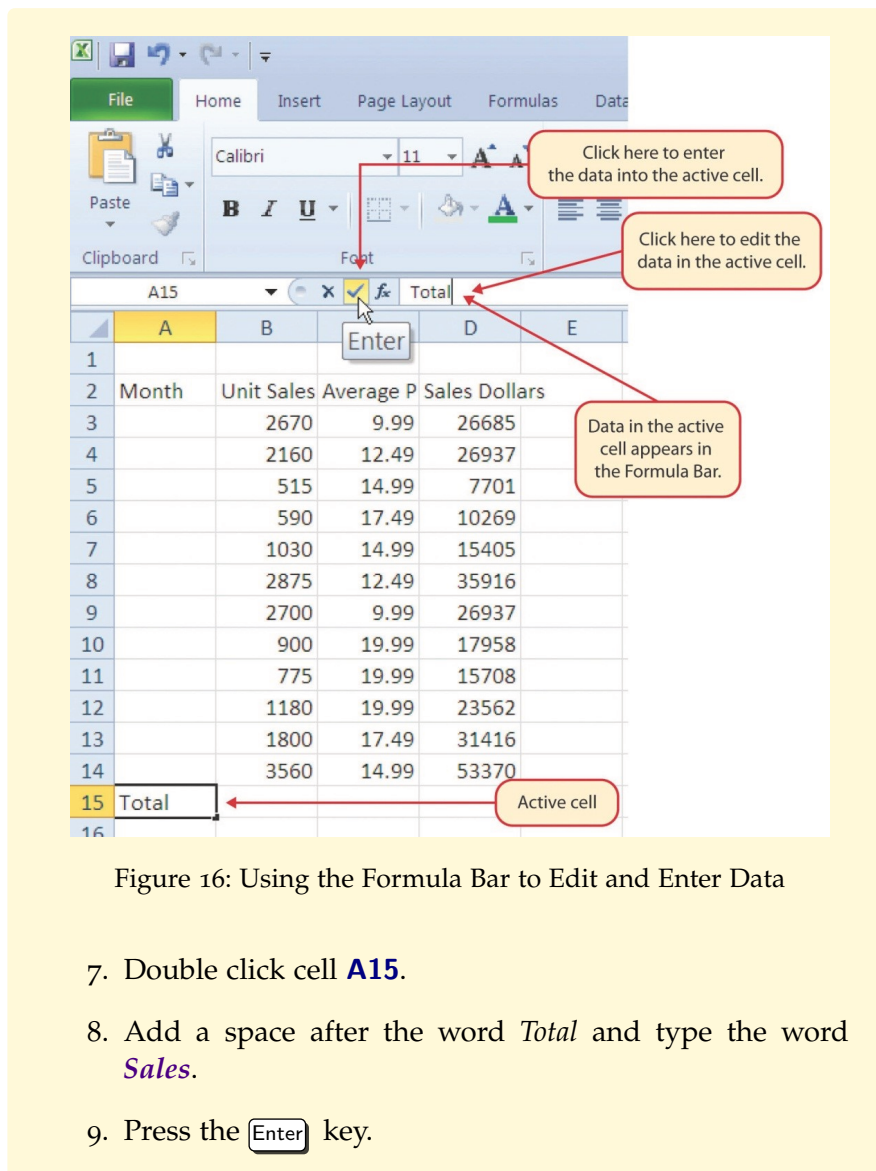
Figure 16: Using the Formula Bar to Edit and Enter Data

7. Double click cell **A15**.

8. Add a space after the word *Total* and type the word *Sales*.

9. Press the Enter key.

Keyboard Shortcuts

Editing Data in a Cell

- Click in the cell that is to be edited and press the F2 key on the keyboard. Alternatively, double-click the cell to be edited.

1.2.3   *Auto Fill*

The *Auto Fill* feature is a valuable tool when manually entering data into a worksheet. This feature has many uses, but it is most beneficial when entering data in a defined sequence, such as the numbers 2, 4, 6, 8, and so on, or non-numeric data such as the days of the week or

months of the year. The following steps demonstrate how the *Auto Fill Handle* can be used to enter the months of the year in *Column A*.

1. Click cell **A3** in the **Sheet1** worksheet.

2. Type the word *January* and press the ⸢Enter⸣ key.

3. Click in cell **A3** again.

4. Move the mouse pointer to the lower right corner of cell **A3**. Notice a small square in this corner of the cell which is called the **Auto Fill Handle** (See Figure 17) When the mouse pointer gets close to the **Auto Fill Handle**, the pointer's white block plus sign will turn into a black plus sign.
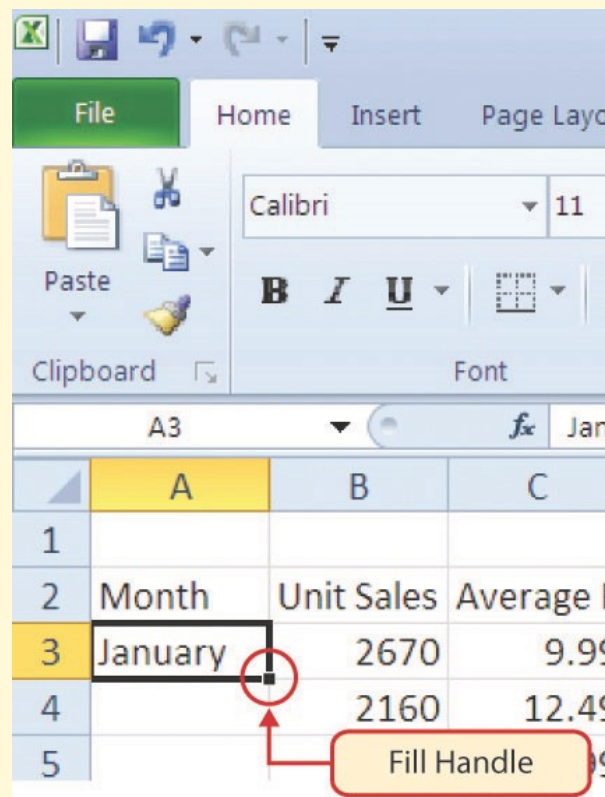
Figure 17: Auto Fill Handle

5. Left click and drag the **Auto Fill Handle** to cell **A14**. Notice that the **Auto Fill Handle** tip box indicates what month will be placed into each cell (see Figure 18). Release the left mouse button when the tip box reads *December*.
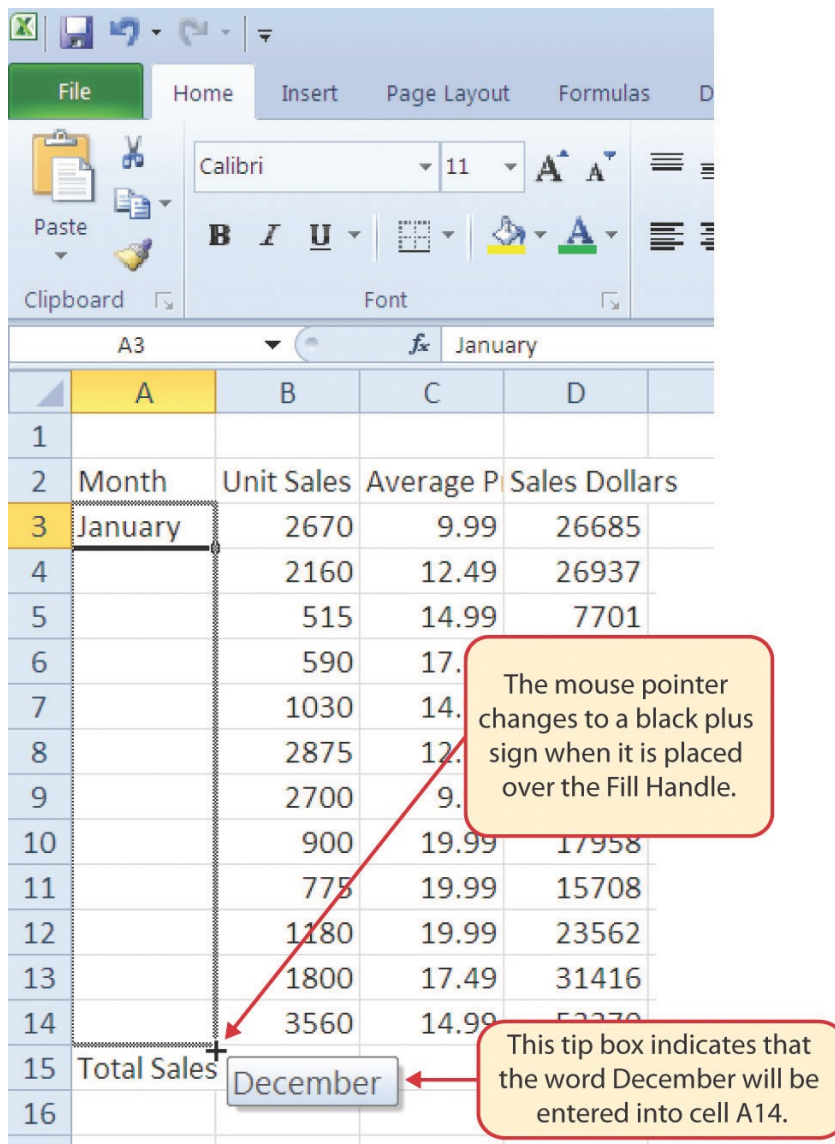
Figure 18: Using Auto Fill Handle to Enter the Months of the Year

Once the left mouse button is released, all twelve months of the year should appear in the cell range A3:A14, as shown in Figure 19. After auto-filling a range, an *Auto Fill Options* button pops up at the lower right corner of the filled range, as shown in Figure 19.

Excel 2016 The *Auto Fill Options* button presents several options for changing the way that the range is filled.
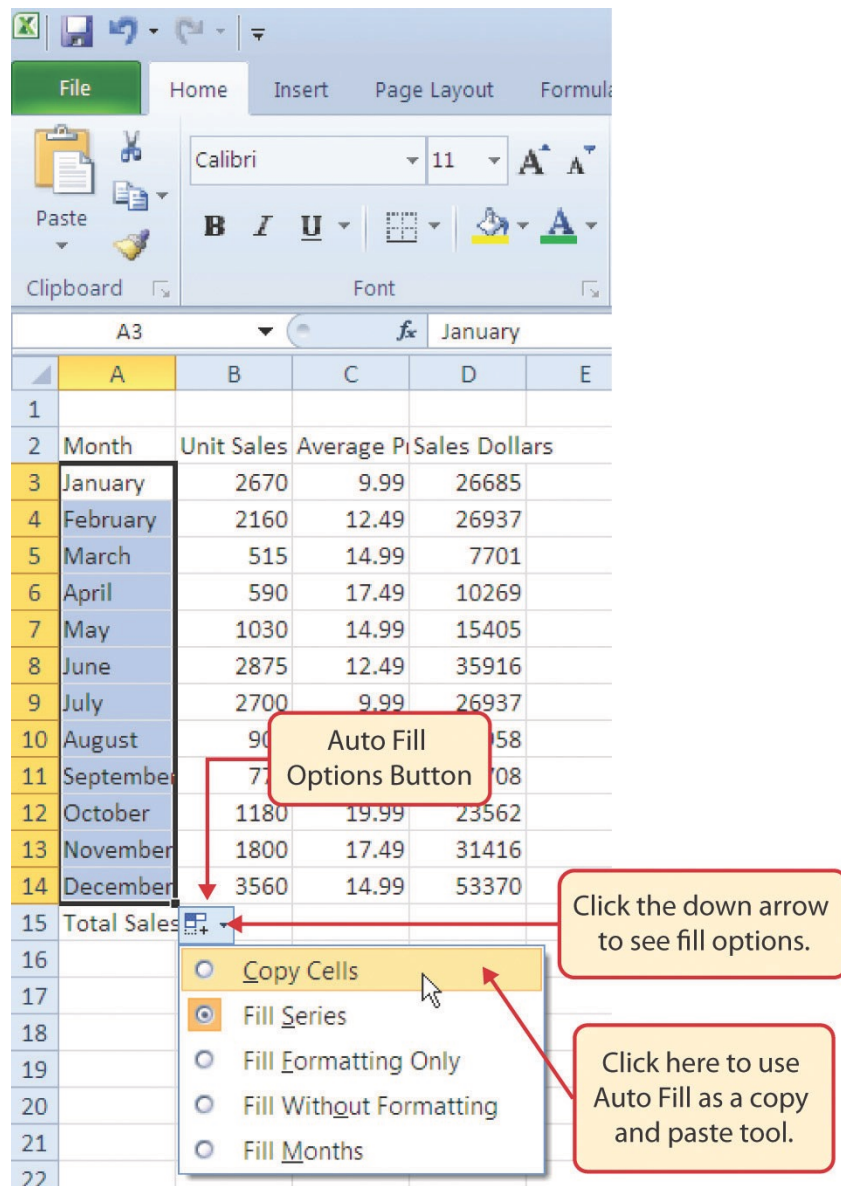
Figure 19: Auto Fill Options Button

1. Click the **Auto Fill Options** button.

2. Click the **Copy Cells** option. This will change the months in the range **A4:A14** to January.

3. Click the **Auto Fill Options** button again.

4. Click the **Fill Months** option to return the months of the year to the cell range **A4:A14**. The **Fill Series** option will provide the same result.

Excel 365 The *Auto Fill Options* button was replaced with the *Quick Analysis* button. That button will apply several possible analysis features to the filled range, like highlighting entries that are duplicates.

	A	B	C	D	E
1					
2	Month	Unit Sales	Average P	Sales Dollars	
3	January	2670	9.99	26685	
4	February	2160	12.49	27937	
5	March	515	14.99	7701	
6	April	590	17.49	10269	
7	May	1030	14.99	15405	
8	June	2875	12.49	35916	
9	July	2700	9.99	26937	
10	August	900	19.99	17958	
11	Septembe	775	19.99	15708	
12	October	1180	19.99	23562	
13	Novembe	1800	17.49	31416	
14	December	3560	14.99	53370	
15	Total Sales				
16					

Formatting   Charts   Totals   Tables   Sparklines

Text...   Duplicat...   Unique...   Equal To   Clear...

Conditional Formatting uses rules to highlight interesting data.

| 25 | | | | | |

Figure 20: Quick Analysis Button

1. Click the **Quick Analysis** button.

2. Hover the mouse over each of the Format tab options and notice how the text in the cells is highlighted.

3. Click anywhere in the worksheet to finish the auto fill process.

1.2.4 *Deleting Data and the Undo Command*

There are several methods for removing data from a worksheet, a few of which are demonstrated here. With each method, use the *Undo*

command to return the data that was deleted. Undo is available on the Quick Access Toolbar or use the keyboard shortcut of Ctrl + Z . This is a helpful command if data is mistakenly deleted from the worksheet. The following steps demonstrate how to delete data from a cell or range of cells.

1. Click cell **C2** by placing the mouse pointer over the cell and clicking the left mouse button.

2. Press the Delete key on the keyboard. This removes the contents of the cell.

3. Highlight the range **C3:C14** by placing the mouse pointer over cell **C3** then left click and drag the mouse pointer down to cell **C14**.

4. Place the mouse pointer over the **Auto Fill Handle**. Notice that the white block plus sign change to a black plus sign.

5. Click and drag the mouse pointer up to cell **C3**, as in Figure 21. Release the mouse button. The contents in the range **C3:C14** will be removed.
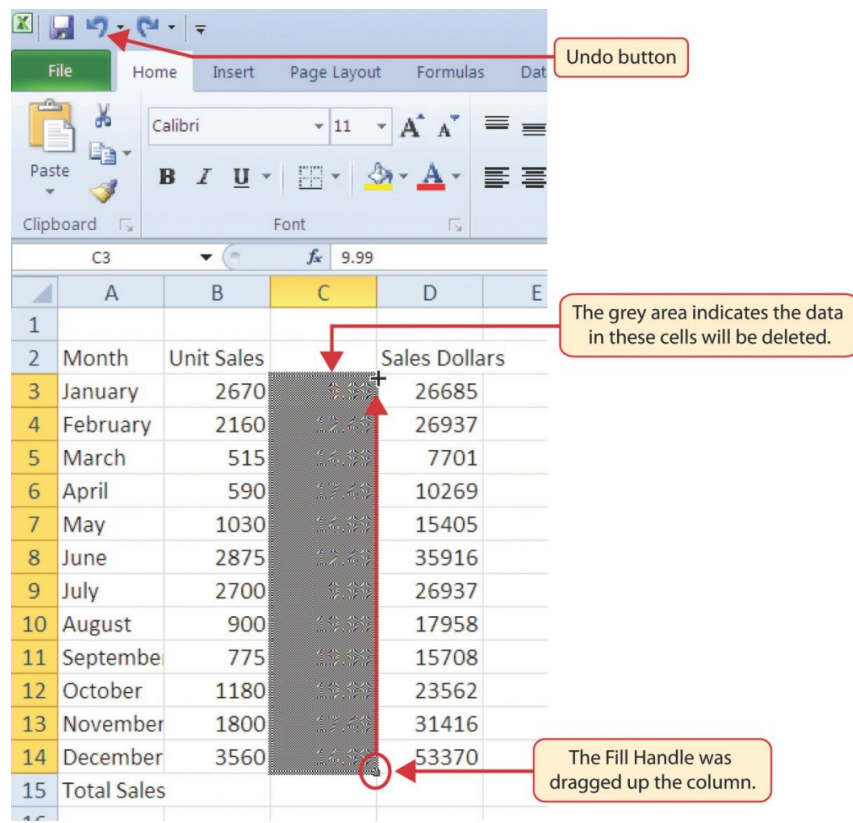
Figure 21: Using Auto Fill to Delete Contents of Cell

1. Click the **Undo** button in the **Quick Access Toolbar**, as illustrated in Figure 21. This should replace the data in the range **C3:C14**.

2. Click the **Undo** button again to replace the data in cell **C2**.

Keyboard Shortcuts

Undo Command

- Hold down the ⌨Ctrl key while pressing the letter ⌨Z on the keyboard.

1. Highlight the range **C2:C14** by placing the mouse pointer over cell **C2**. Then left click and drag the mouse pointer down to cell **C14**.

2. Click **Home** ⇒ **Editing** ⇒ **Clear** (see Figure 22). This opens a drop-down menu that contains several options for removing or clearing data from a cell. Notice that there are also options for clearing just the formats or the hyperlinks in a cell.

3. Click the **Clear All** option. This removes the data in the cell range.

4. Click the **Undo** button. This replaces the data in the range **C2:C14**.
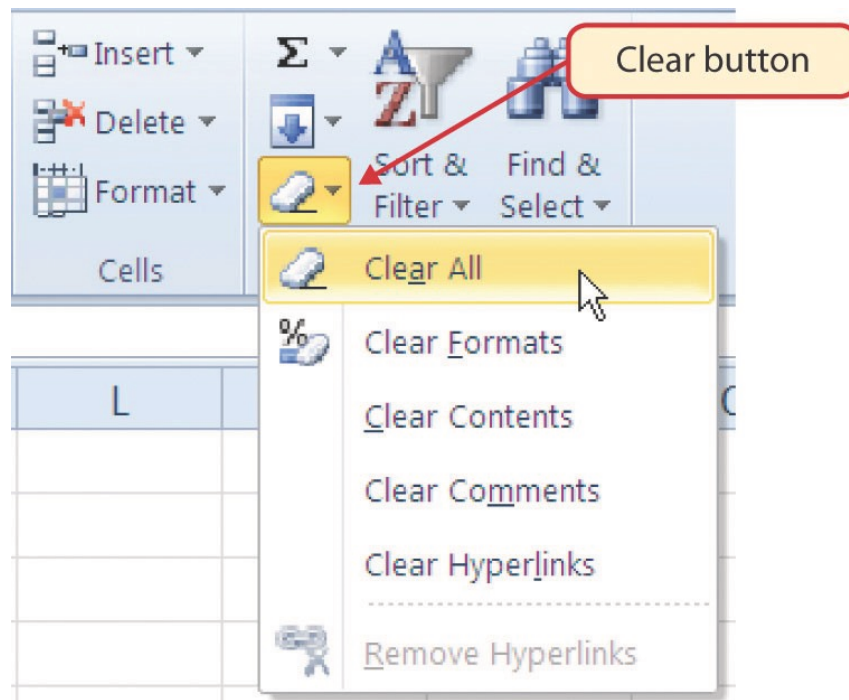
Figure 22: Clear Command Drop-Down Menu

1.2.5 *Adjusting Columns and Rows*

There are a few entries in the worksheet that appear to be cut off. For example, the last letter of the word *September* cannot be seen in cell A11. This is because the column is too narrow for this word. The columns and rows on an Excel worksheet can be adjusted to accommodate the data that is being entered into a cell. The following steps explain how to adjust the column widths and row heights in a worksheet.

1. Bring the mouse pointer between **Column A** and **Column B** in the **Sheet1** worksheet, as shown in Figure 23. Notice that the pointer's white block plus sign turns into double arrows.

2. Click and drag the column to the right so the entire word *September* in cell **A11** can be seen. As the column separator is dragged to the right the column width pops up in a tip box. This box displays the number of characters that will fit into the column using the Calibri 11-point font which is the default setting for font/size.

3. Release the left mouse button.
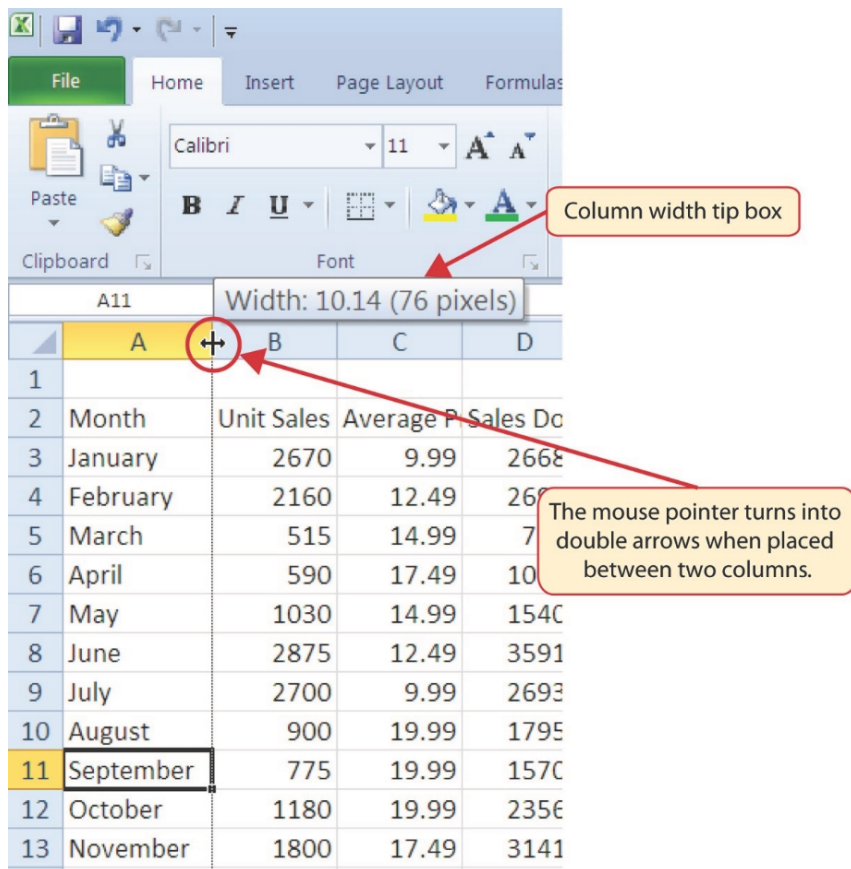
Figure 23: Adjusting Column Widths

The click-and-drag method can be inefficient to set a specific character width for more than one column. The following steps illustrate a second method for adjusting columns to a specific width.

1. Click any cell location in **Column A** by moving the mouse pointer over a cell location and clicking the left mouse button.

2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Column Width**. This will open the *Column Width* dialog box.

3. Type the number **13** and click the **OK** button on the *Column Width* dialog box. This will set **Column A** to this character width (see Figure 24).

4. As a third option, bring the mouse pointer between **Column A** and **Column B** so that the double arrow pointer displays and then double-click. This activates **AutoFit**, which adjusts the column width based on the longest entry in the column.

5. Use the *Column Width* dialog box to set the width to **13**.
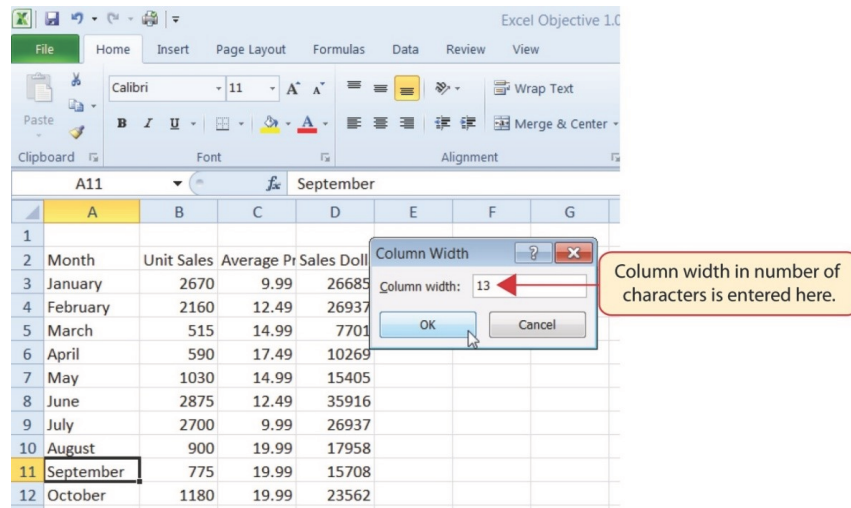
Figure 24: Column Width Dialog Box

Keyboard Shortcuts

Column Width

- Press and release the [Alt] key on the keyboard and then press the letters [H], [O], and [W] one at a time.

The following steps demonstrate how to adjust row height, which is like adjusting column width.

1. Click cell **A15**.

2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Row Height**. This will open the *Row Height* dialog box.

3. Type the number *24* and click the **OK** button on the *Row Height* dialog box. This will set **Row** 15 to a height of 24 points. A point is equivalent to approximately 1/72 of an inch. This adjustment in row height was made to create space between the totals for this worksheet and the rest of the data.

4. Row height can also be adjusted by dragging the border between **Row 15** and **Row 16** or by double-clicking the border between **Row 15** and **Row 16**.

> **Keyboard Shortcuts**
>
> **Column Width**
>
> - Press the [Alt] key on the keyboard, then press the letters [H], [O], and [H] one at a time.

Figure 25 shows the appearance of the worksheet after **Column A** and **Row** 15 are adjusted.

Figure 25: CH1-GMW Sales Data with Column A and Row 15 Adjusted

> **Skill Refresher**
>
> **Adjusting Columns and Rows**
>
> - Activate at least one cell in the row or column being adjusted.
> - Click *Home ⇒ Cells ⇒ Format*
> - Click either *Row Height* or *Column Width* from the drop-down menu.
> - Enter the Row Height in points or Column Width in characters in the dialog box.
> - Click the *OK* button.

1.2.6   *Hiding Columns and Rows*

In addition to adjusting the columns and rows on a worksheet, they can also be hidden. This is a useful technique for enhancing the visual appearance of a worksheet that contains data that is not necessary to display. These features will be demonstrated using the *CH1-GMW Sales Data* workbook later in the course; however, there is no need to have hidden columns or rows in this worksheet. The use of these skills will be presented here for demonstration purposes only.

1. Click cell **C1** in the **Sheet1** worksheet.

2. Click **Home ⇒ Cells ⇒ Format ⇒ Hide & Unhide**. This will open a submenu of options.

3. Click the **Hide Columns** option in the submenu of options (see Figure 26) to hide **Column C**.
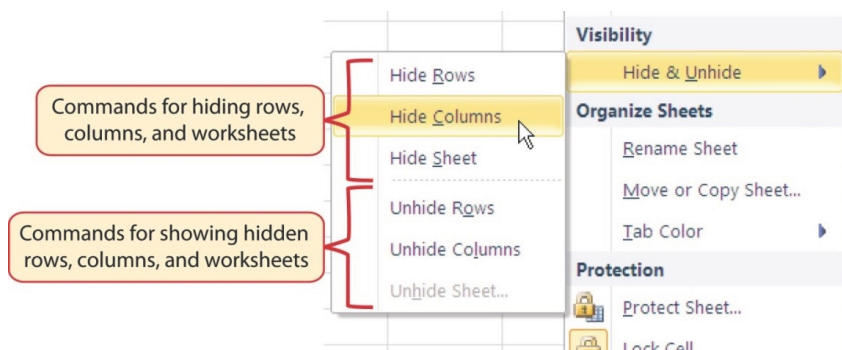
Figure 26: Hide & Unhide Submenu

> **Keyboard Shortcuts**
>
> **Hiding Columns**
>
> - Hold down the ⎡Ctrl⎤ key while pressing the number ⎡0⎤ on the keyboard. (Note, this is the number zero, not the letter O.)

Figure 27 shows the workbook with *Column C* hidden. If a column is hidden, its name is missing, like the missing letter *C* at the top of the column.
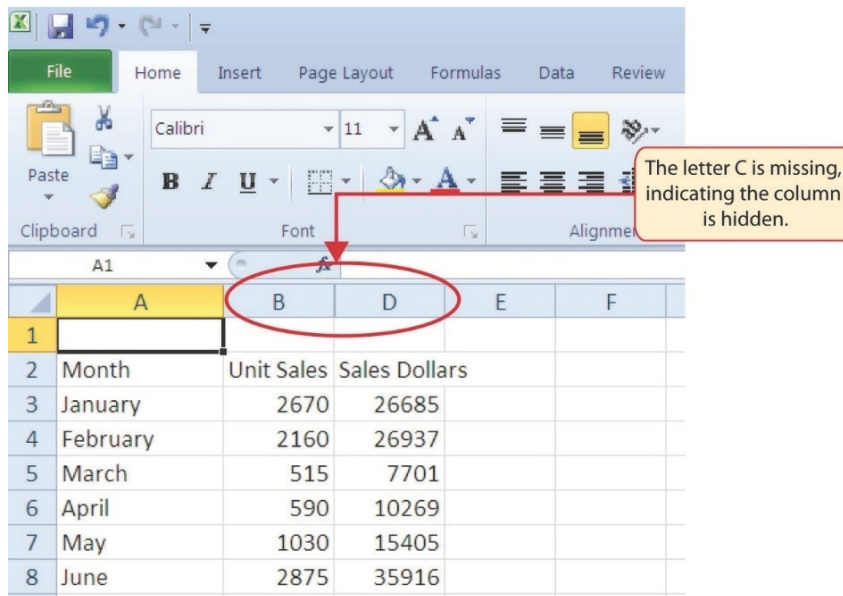
Figure 27: Hidden Column

To unhide a column, use the following steps.

> 1. Highlight the range **B1:D1** by activating cell **B1** and clicking and dragging over to cell **D1**.
>
> 2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Hide & Unhide**.
>
> 3. Click the **Unhide Columns** option in the submenu of options. **Column C** will now be visible on the worksheet.

Keyboard Shortcuts

Unhiding Columns

- Highlight cells on either side of the hidden column(s), then hold down the `Ctrl` key and the `Shift` key while pressing `)`, the close parenthesis key, on the keyboard. Note: This keyboard shortcut does not reliably work for some reason that has not been explained by Microsoft. If it does not work, then use the ribbon button.

The following steps demonstrate how to hide rows, which is like hiding columns.

1. Click cell **A3** in the **Sheet1** worksheet.

2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Hide & Unhide**. This will open a submenu of options.

3. Click the **Hide Rows** option in the submenu of options. This will hide **Row 3**.

Keyboard Shortcuts

Hiding Rows

- Hold down the `Ctrl` key while pressing the number `9` key on the keyboard.

To unhide a row, follow these steps.

1. Highlight the range **A2:A4** by activating cell **A2** and clicking and dragging down to cell **A4**.

2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Hide & Unhide**. This will open a submenu of options.

3. Click the **Unhide Rows** option in the submenu of options to unhide **Row 3**.

Keyboard Shortcuts

Unhiding Rows

- Highlight cells above and below the hidden row(s), then hold down the `Ctrl` key and the `Shift` key while pressing `(` , the open parenthesis key, on the keyboard.

Skill Refresher

Hiding Columns and Rows

- Activate at least one cell in the row(s) or column(s) being hidden.
- Click *Home ⇒ Cells ⇒ Format ⇒ Hide & Unhide*
- Click either the *Hide Rows* or *Hide Columns* option.

Skill Refresher

Unhiding Columns and Rows

- Highlight the cells above and below the hidden row(s) or to the left and right of the hidden column(s).
- Click *Home ⇒ Cells ⇒ Format ⇒ Hide & Unhide*
- Click either the *Unhide Rows* or *Unhide Columns* option.

Integrity Check

Hidden Rows and Columns

In most careers, it is common for professionals to use Excel workbooks that have been designed by a coworker. Before using a workbook developed by someone else, always check for hidden rows and columns. It is easy to determine if a row or column is hidden by looking for missing row numbers or column letters.

1.2.7   *Inserting Columns and Rows*

Using Excel workbooks that have been created by others is a very efficient way to work because it eliminates the need to create worksheets from scratch. However, to accomplish a specific goal, additional columns or rows may need to be added to a worksheet. In

this case, blank columns or rows are inserted into a worksheet as demonstrated below.

1. Click cell **C1** in the **Sheet1** worksheet.

2. Click **Home** ⇒ **Cells** ⇒ **Insert** ⇒ **Down Arrow** (see Figure 28).
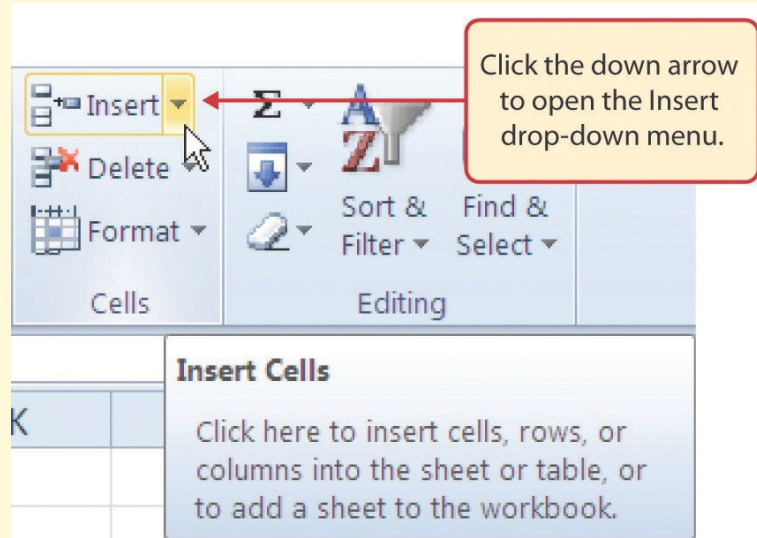
Figure 28: Insert Button (Down Arrow)

3. Click the **Insert Sheet Columns** option from the drop-down menu (see Figure 29). A blank column will be inserted to the left of **Column C**. The contents that were previously in **Column C** now appear in **Column D**. Note that columns are always inserted to the left of the activated cell.
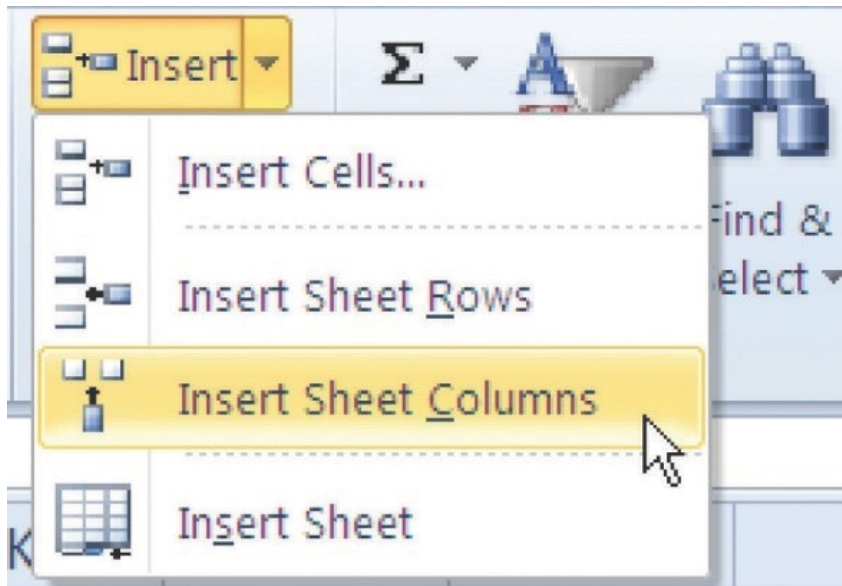
Figure 29: Insert Drop-Down Menu

Keyboard Shortcuts

Inserting Columns

- Press the [Alt] key and then the letters [H], [I], and [C] one at a time. A column will be inserted to the left of the activated cell.

1. Click cell **A3** in the **Sheet1** worksheet.

2. Click **Home** ⇒ **Cells** ⇒ **Insert** ⇒ **Down Arrow** (see Figure 28).

3. Click the **Insert Sheet Rows** option from the drop-down menu (see Figure 29). A blank row will be inserted above **Row** 3. The contents that were previously in **Row** 3 now appear in **Row** 4. Note that rows are always inserted above the activated cell.

Keyboard Shortcuts

Inserting Rpws

- Press the [Alt] key and then the letters [H], [I], and [R] one at a time. A row will be inserted above the activated cell.

> **Skill Refresher**
>
> **Inserting Columns and Rows**
>
> - Activate the cell to the right of the desired blank column or below the desired blank row.
> - Click *Home ⇒ Cells ⇒ Insert ⇒ Down Arrow*
> - Click either the *Insert Sheet Columns* or *Insert Sheet Rows* option.

1.2.8   *Moving Data*

Once data is entered into a worksheet, it can be moved to different locations, as demonstrated below.

1. Highlight the range **D2:D15** by clicking cell **D2** and dragging down to cell **D15**.

2. Bring the mouse pointer to the left edge of cell **D2**. Notice that the white block plus sign change to cross arrows (see Figure 30). This indicates that the data can be dragged to a new location by left-clicking the mouse.
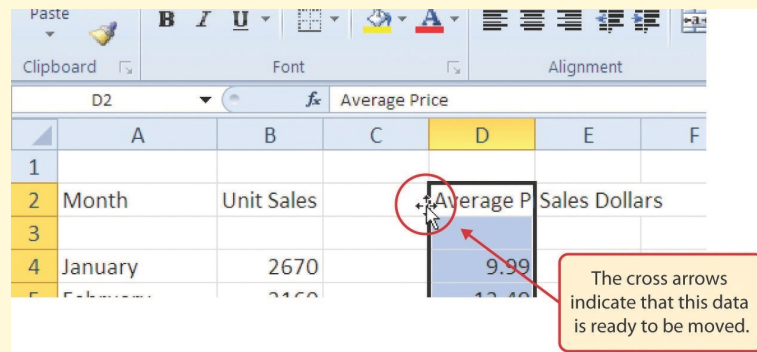
Figure 30: Moving Data

3. Left Click and drag the mouse pointer to cell **C2**.

4. Release the left mouse button. The data now appears in **Column C**.

5. Click the *Undo* button in the **Quick Access Toolbar**. This moves the data back to **Column D**.

Integrity Check

Moving Data

Before moving data on a worksheet, make sure to identify all the components that belong with the series being moved. For example, if a column of data is being moved make sure the column heading is included. Also, make sure all values are highlighted in the column before moving it.

1.2.9   *Deleting Columns and Rows*

It may occasionally be necessary to delete entire columns or rows of data from a worksheet. For example, a worksheet may contain blank columns or rows that need to be removed. The methods for removing cell contents were covered earlier and can be used to delete unwanted data. However, to delete an entire column or row in a workbook, use the following steps.

1. Click cell **A3**.

2. Click **Home** ⇒ **Cells** ⇒ **Delete** ⇒ **Down Arrow**

3. Click the **Delete Sheet Rows** option from the drop-down menu (see Figure 31). This removes **Row 3** and shifts all the data in the worksheet up one row.
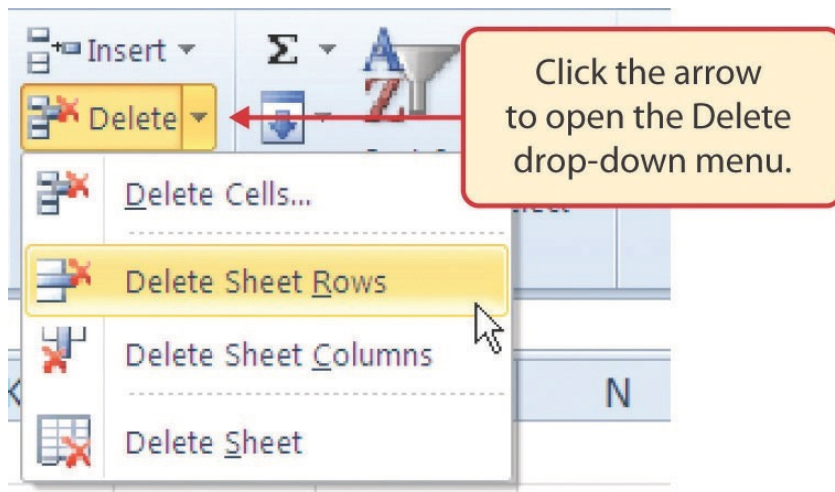
Figure 31: Delete Drop-Down Menu

Keyboard Shortcuts

Deleting Rows

- Press the [Alt] key and then the letters [H] , [D] , and [R] one at a time. The row with the activated cell will be deleted.

1. Click cell **C1**.

2. Click **Home** ⇒ **Cells** ⇒ **Delete** ⇒ **Down Arrow**.

3. Click the **Delete Sheet Columns** option from the drop-down menu (see Figure 31). This removes **Column C** and shifts all the data in the worksheet over one column to the left.

4. Save the changes to the workbook by clicking either **Quick Access Toolbar** ⇒ **Save** or **File** ⇒ **Save**.

Keyboard Shortcuts

Deleting Columns

- Press the [Alt] key and then the letters [H] , [D] , and [C] one at a time. The column with the activated cell will be deleted.

Skill Refresher

Deleting Columns and Rows

- Activate any cell in the row or column that is to be deleted.
- Click *Home* ⇒ *Cells* ⇒ *Delete* ⇒ *Down Arrow*.
- Click either *Delete Sheet Columns* or *Delete Sheet Rows*.

Key Take-Aways

Entering, Editing, and Managing Data

- Column headings should be used in a worksheet and should accurately describe the data contained in each column.
- Using symbols such as dollar signs when entering numbers into a worksheet can slow down the data entry process.
- Worksheets must be carefully proofread when data has been manually entered.
- The Undo command is a valuable tool for recovering data that was deleted from a worksheet.
- When using a worksheet that was developed by someone else, look carefully for hidden columns or rows.

1.3 FORMATTING AND DATA ANALYSIS

Learning Objectives

- Use formatting techniques as introduced in the *Excel Spreadsheet Guidelines*, below, to enhance the appearance of a worksheet.
- Understand how to align data in cell locations.
- Examine how to enter multiple lines of text in a cell location.
- Understand how to add borders to a worksheet.
- Examine how to use the AutoSum feature to calculate totals.
- Use the Cut, Copy, and Paste commands to manipulate the data on a worksheet.
- Understand how to move, rename, insert, and delete worksheet tabs.

This section addresses formatting commands that can be used to enhance the visual appearance of a worksheet. It also introduces mathematical calculations. The skills introduced in this section provides powerful tools for analyzing the data used in this workbook and will highlight how Excel is used to make key decisions in virtually any career. Additionally, *Excel Spreadsheet Guidelines* for format and appearance will be introduced as a format to be used for the spreadsheets submitted as part of this course.

1.3.1 *Formatting Data and Cells*

Enhancing the visual appearance of a worksheet is a critical step in creating a valuable tool for coworkers when making key decisions. For example, there are accepted professional formatting standards used when spreadsheets contain only currency data. For this course, the following *Excel Guidelines for Formatting* will be used. Figure 32 displays how to use Accounting number format when ALL figures are currency. Only the first row of data and the totals should be formatted with the *accounting* format while the other data should be formatted with *comma* style. There also needs to be a top border above the numbers in the total row. If any of the numbers have cents, format all the data with two decimal places.
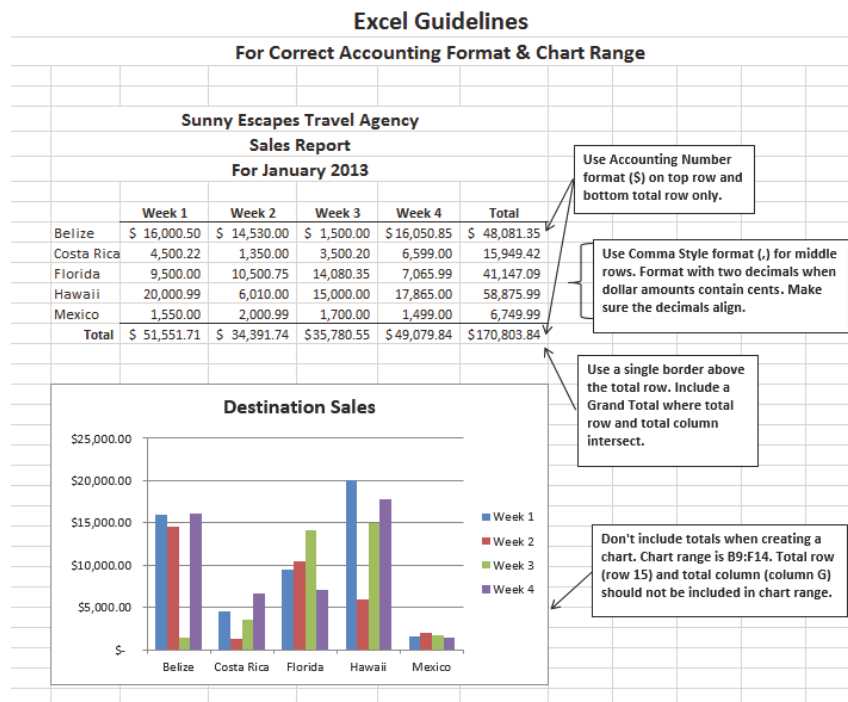
Figure 32: Excel Guidelines for Formatting Currency

Often, Excel spreadsheet contain values that are both currency and non-currency in nature. When that is the case, use the guidelines in Figure 33.

Excel Guidelines
For Units and Dollar Amounts in the Same Worksheet

Sunny Escapes Travel Agency
Sales Report
For January 2013

	Week 1		Week 2		Week 3		Week 4	
	Number of Trips	Sales ($)	Number of Trips	Sales ($)	Number of Trips	Sales ($)	Number of Trips	Sales ($)
Belize	15	$ 16,001	12	$ 14,530	1	$ 1,500	15	$ 16,051
Costa Rica	3	$ 4,500	1	$ 1,350	2	$ 3,500	4	$ 6,599
Florida	4	$ 9,500	9	$ 10,501	12	$ 14,080	5	$ 7,066
Hawaii	19	$ 20,001	5	$ 6,010	15	$ 15,000	16	$ 17,865
Mexico	1	$ 1,550	2	$ 2,001	1	$ 1,700	1	$ 1,499
Total	42	$ 51,552	29	$ 34,392	31	$ 35,781	41	$ 49,080

Use a three line title if the workbook doesn't include a Documentation sheet. The three lines should include:
- Company Name
- Type of Report
- Date

When mixing columns of units with columns of dollars, format entire dollar column with Accounting Number format ($)

Format with no decimals when dollar amounts are whole dollars without cents

Remember to:
✓ Spellcheck your worksheet
✓ Print Preview before printing or submitting
✓ Use common sense when proofreading - do the results make sense?
✓ Make sure the worksheet looks professional

Figure 33: Excel Guidelines for Formatting Numbers

The following steps demonstrate several fundamental formatting skills that will be applied to the workbook developed for this chapter. Several of these formatting skills are identical to ones that may have been used in other Microsoft applications such as Microsoft® Word® or Microsoft® PowerPoint®.

1. Highlight the range **A2:D2** in the **Sheet1** worksheet by placing the mouse pointer over cell **A2** and left clicking and dragging to cell **D2**.

2. Click **Home** ⇒ **Font** ⇒ **Bold** (see Figure 34).

3. Click **Home** ⇒ **Font** ⇒ **Border** ⇒ **Down Arrow**. Select the **Bottom Border** option from the list to place a border on the bottom of **Row** 2.
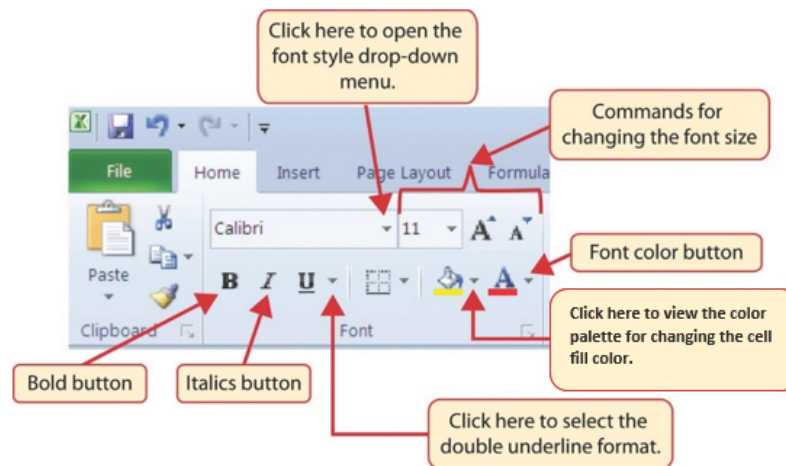
Figure 34: Font Group of Commands

Keyboard Shortcuts

Text Formats

- Bold: hold the ⟨Ctrl⟩ key while pressing the letter ⟨B⟩ on the keyboard.
- Italics: hold the ⟨Ctrl⟩ key while pressing the letter ⟨I⟩ on the keyboard.
- Underline: hold the ⟨Ctrl⟩ key while pressing the letter ⟨U⟩ on the keyboard.

---

1. Highlight the range **A15:D15** by placing the mouse pointer over cell **A15** and left clicking and dragging to cell **D15**.

2. Click **Home** ⇒ **Font** ⇒ **Bold**.

3. Click **Home** ⇒ **Font** ⇒ **Border** ⇒ **Down Arrow**. Select the **Top Border** option from the list to place a border on the top of **Row** 15 where totals will eventually be displayed.

4. Highlight the range **B3:B14** by placing the mouse pointer over cell **B3** and left clicking and dragging down to cell **B14**.

5. Click **Home** ⇒ **Number** ⇒ **Comma Style**. This feature adds a comma and two decimal places to numbers in the cell (see Figure 35).
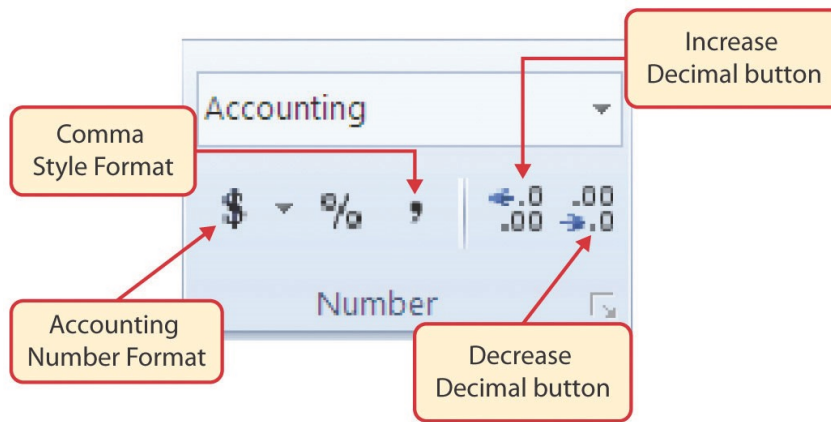
Figure 35: Number Group of Commands

> **Why?**
>
> **Format Column Headings and Totals**
>
> Applying formatting enhancements to the column headings and column totals in a worksheet is a very important technique, especially if the workbook will be shared with other people. These formatting techniques allow users of the worksheet to clearly see the column headings that define the data. In addition, the column totals usually contain the most important data on a worksheet with respect to making decisions, and formatting techniques allow users to quickly find this information.

1. Since the figures in this range do not include cents, click **Home ⇒ Number ⇒ Decrease Decimal** two times (see Figure 35).

2. The numbers will be reduced to zero decimal places.

3. Highlight the range **C3:C14** by placing the mouse pointer over cell **C3** and left clicking and dragging down to cell **C14**.

4. Click **Home ⇒ Number ⇒ Accounting Number** (see Figure 35). This will add a currency symbol and two decimal places to the values, which is common when working with pricing data. As discussed in the Formatting Data and Cells section above, use Accounting format on all values in this range since the worksheet contains non-currency as well as currency data.

5. Highlight the range **D3:D14** by placing the mouse pointer over cell **D3** and left clicking and dragging down to cell **D14**.

6. Apply the Accounting Number Format to add the US currency symbol to the values and set them for two decimal places.

7. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** two times to reduce the decimal places to zero since there are no cents in these figures.

8. Highlight the range **A1:D1** by placing the mouse pointer over cell **A1** and left clicking and dragging over to cell **D1**.

9. Click **Home** ⇒ **Font** ⇒ **Fill Color** ⇒ **Down Arrow** (see Figure 36). This will prepare the range for a worksheet title.
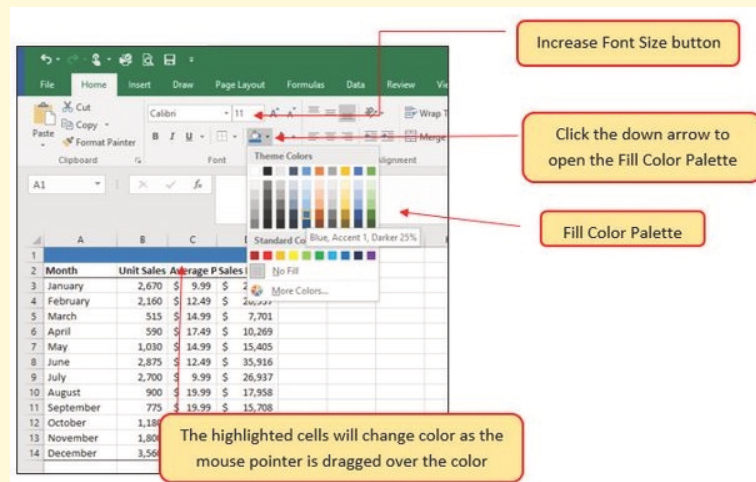
Figure 36: Fill Color Palette

10. Click the *Blue, Accent 1, Darker 25%* color from the palette (see Figure 36). Notice that as the mouse pointer moves over the color palette, a preview of the color appears in the highlighted cells. That makes it easy to experiment with various colors.

11. Click on **A1** and enter the worksheet title, *General Merchandise World*.

12. Click on **A2** and then click on **A1**.This is necessary to select the cell that contains the text rather than the text itself.

13. Since the black font is difficult to read on the blue back-ground, change the font color to be more visible. Click **Home** ⇒ **Font** ⇒ **Font Color** ⇒ **Down Arrow** and select *White* as the font color for this range (see Figure 34).

14. Highlight the range **A1:D15** by placing the mouse pointer over cell **A1** and left clicking and dragging down to cell **D15**.

15. Click **Home** ⇒ **Font** ⇒ **Down Arrow** and select *Arial* as the font for this range (see Figure 34). Notice that as the mouse pointer moves over the font style options, it changes the highlighted cells. This makes it easy to preview various font options before they are applied.

16. Expand the column width of **Column D** to 14 characters.

Figure 37 shows how the **Sheet1** worksheet should appear after the formatting techniques are applied.

Figure 37: Formatting Techniques Applied

Why

Hashtags (####) Appear in Columns

When a column is too narrow for a long number, Excel will automatically convert the number to a series of hashtags (####). In the case of words or text data, Excel will only show the characters that fit in the column. However, this is not the case with numeric data because it can give the appearance of a number that is much smaller than what is actually in the cell. To remove the hashtags, increase the width of the column.

1.3.2 *Data Alignment (Wrap Text, Merge Cells, and Center)*

The skills presented in this section show how data is aligned within cell locations. For example, text and numbers can be centered, left aligned, right aligned, and so on within a cell. In some cases, multi-word text entries may need to be stacked vertically instead of expanding the width of a column, which is referred to as wrapping text. These skills are demonstrated in the following steps.

1. Highlight the range **B2:D2** by placing the mouse pointer over cell **B2** and left clicking and dragging over to cell **D2**.

2. Click **Home** ⇒ **Alignment** ⇒ **Center** (see Figure 38). This will center the column headings in each cell location. Notice the difference between text that is centered horizontally and text that is middle aligned vertically.
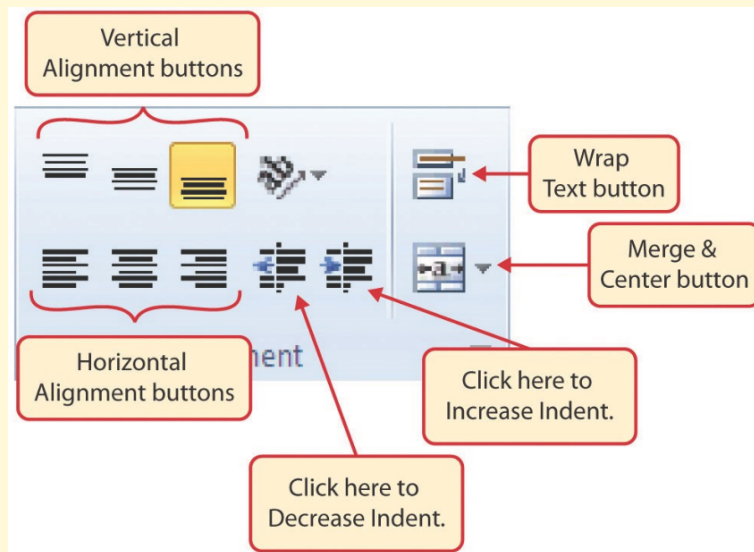
Figure 38: Alignment Group in Home Tab

3. Click **Home** ⇒ **Alignment** ⇒ **Wrap Text** (see Figure 38). The height of **Row** 2 automatically expands, and the words that were cut off because the columns were too narrow are now stacked vertically.

4. Highlight the range **A1:D1** by placing the mouse pointer over cell **A1** and left clicking and dragging over to cell **D1**.

5. Click **Home** ⇒ **Alignment** ⇒ **Merge & Center** ⇒ **Down Arrow**.

6. Click the **Merge & Center** option (see Figure 39). This will create one large cell location running across the top of the data set.
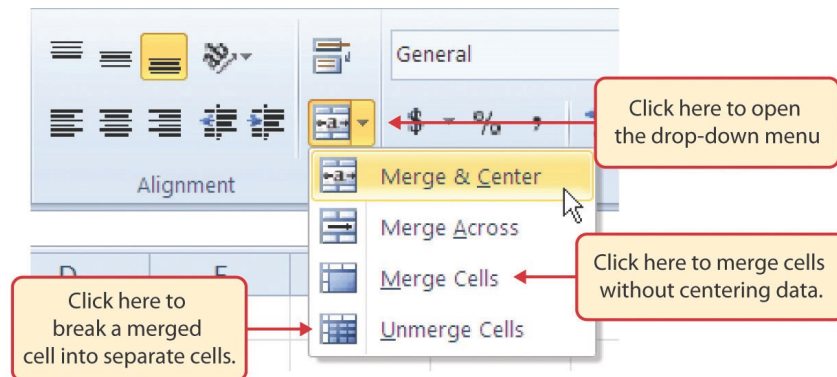
Figure 39: Merge Cell Drop-Down Menu

Keyboard Shortcuts

Merge Commands

- **Wrap Text**: Press the `Alt` key and then the letters `H` and `W` one at a time.
- **Merge & Center**: Press the `Alt` key and then the letters `H`, `M`, and `C` one at a time.
- **Merge Cells**: Press the `Alt` key and then the letters `H`, `M`, and `M` one at a time.
- **Unmerge Cells**: Press the `Alt` key and then the letters `H`, `M`, and `U` one at a time.

Why?

Wrap Text

The benefit of using the Wrap Text command is that it significantly reduces the need to expand the column width to accommodate multi-word column headings. The problem with increasing the column width is that it may reduce the amount of data that can fit on a piece of paper or one screen. This makes it cumbersome to analyze the data in the worksheet and could increase the time it takes to make a decision.

Figure 40 shows the *Sheet1* worksheet with the data alignment commands applied. The reason for merging the cells in the range A1:D1 will become apparent in the next section.

Figure 40: Sheet1 with Data Alignment Features Added

Why?

Merge & Center

One of the most common reasons the **Merge & Center** command is used is to center the title of a worksheet directly above the columns of data. Once the cells above the column headings are merged, a title can be centered above the columns of data. It is very difficult to center the title over the columns of data if the cells are not merged.

> **Skill Refresher**
>
> **Wrap Text**
>
> - Activate the cell or range of cells that contain text data.
> - Click *Home ⇒ Alignment ⇒ Wrap Text*.

> **Skill Refresher**
>
> **Merge Cells**
>
> - Highlight a range of cells that will be merged.
> - Click *Home ⇒ Alignment ⇒ Merge & Center Down Arrow*.
> - Select an option from the *Merge & Center* list.

1.3.3 *Entering Multiple Lines of Text*

In the *Sheet1* worksheet, the cells in the range A1:D1 were merged for the purposes of adding a title to the worksheet. This worksheet will contain both a title and a subtitle. The following steps explain how to enter text into a cell and determine where the second line of text should begin.

1. Click cell **A1** in the **Sheet1** worksheet. Since the cells were merged, clicking cell **A1** will automatically activate the range **A1:D1**. Position the mouse to the end of the title, directly after the "d" in the word "World" and double-click to get a cursor (flashing I-beam).

2. Hold down the Alt key and press the Enter key. This will start a new line of text in this cell location.

3. Type the text *Retail Sales (in millions)* and press the Enter key.

4. Click cell **A1**.

5. Increase the height of Row 1 to 30 points. Once the row height is increased, all the text typed into the cell will be visible (see Figure 41).

6. Click **Home ⇒ Font ⇒ Bold**.

7. Click **Home ⇒ Font ⇒ Italics**.

Figure 41: Title & Subtitle Added to the Worksheet

Skill Refresher

Entering Multiple Lines of Text

- Activate a cell location.
- Type the first line of text.
- Hold down the Alt key and press the Enter key.
- Type the second line of text and press the Enter key.

1.3.4 Borders (Adding Lines to a Worksheet)

In Excel, adding custom lines to a worksheet is known as adding borders. Borders are different from the grid lines that appear on a worksheet and that define the perimeter of the cell locations. Borders add a variety of line styles to a worksheet that can make reading the

worksheet much easier. The following steps illustrate methods for adding both preset and custom borders to a worksheet.

1. Click **Home** ⇒ **Font** ⇒ **Borders** ⇒ **Down Arrow** to view border options (see Figure 42).
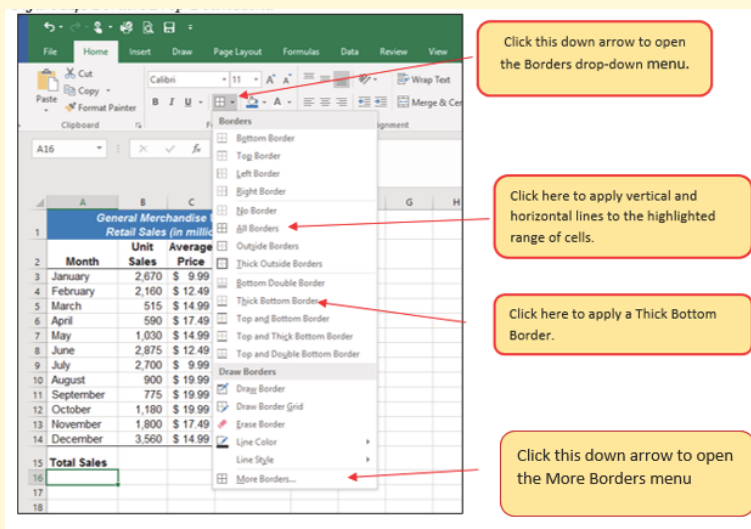
Figure 42: Borders Drop-Down Menu

2. Highlight the range **A1:D15**.

3. Click **Home** ⇒ **Font** ⇒ **Borders** ⇒ **Down Arrow** ⇒ **All Borders** (see Figure 42). This will add vertical and horizontal lines to the range **A1:D15**.

4. Highlight the range **A2:D2** by clicking **A2** and dragging to cell **D2**.

5. Click **Home** ⇒ **Font** ⇒ **Borders** ⇒ **Down Arrow** ⇒ **Thick Bottom Border**

6. Highlight the range **A14:D14** and click **Home** ⇒ **Font** ⇒ **Borders** ⇒ **Down Arrow** ⇒ **Thick Bottom Border**. The thick border will help maintain the *Excel Formatting Guidelines*.

7. Highlight the range **A1:D15**.

8. Click **Home** ⇒ **Font** ⇒ **Borders** ⇒ **Down Arrow** ⇒ **More Borders...**

9. This will open the *Format Cells* dialog box (see Figure 43). All Excel formatting commands can be accessed through this dialog box.

10. In the *Style* section of the *Borders* tab, click the thickest line style (see Figure 43).

11. Click the **Outline** button in the *Presets* section (see Figure 43).

12. Click the **OK** button at the bottom of the dialog box (see Figure 43).

Figure 43: Borders Tab of the Format Cells Dialog Box

The *Sheet1* worksheet should now look like Figure 44.

Figure 44: Borders Added to the Sheet1 Worksheet

Skill Refresher

Preset Borders

- Highlight a range of cells that require borders.
- Click the *Home* tab of the Ribbon.
- Click the down arrow next to the *Borders* button.
- Select an option from the preset borders list.

Custom Borders

- Highlight a range of cells that require borders.
- Click *Home ⇒ Font ⇒ Borders ⇒ Down Arrow ⇒ More Borders...*
- Select a line style and line color.
- Select a placement option.
- Click the *OK* button on the dialog box.

1.3.5 *Autosum*

Notice at the bottom of Figure 44 that *Row 15* is intended to show the totals for the data in this worksheet. Applying mathematical compu-

tations to a range of cells is accomplished through functions in Excel[2]. The following steps will demonstrate how to quickly sum the values in a column of data using the AutoSum command.

1. Click in cell **B15** in the **Sheet1** worksheet.

2. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum** ⇒ **Down Arrow** (see Figure 45). Note that autosum can also be found at **Home** ⇒ **Editing** ⇒ **AutoSum**.
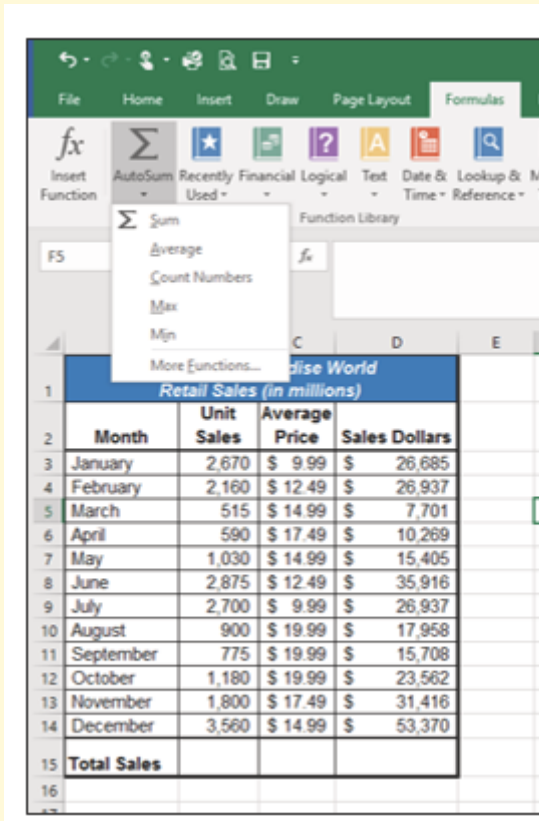
Figure 45: AutoSum Drop-Down List

3. Click the **Sum** option from the *AutoSum* drop-down menu. The first click will display a flashing marquee around the range. Press the Enter key or click the **Check Mark** next to the Formula bar to complete the function.

4. Excel will provide a total for the values in the *Unit Sales* column.

5. It would not make sense to total the averages in **Column C** so **C15** will be left blank.

---

2 Chapter 3, FORMULAS, page 141, in this book reviews mathematical formulas and functions in detail.

6. Click in cell **D15**.

7. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum** ⇒ **Down Arrow**.

8. Click the **Sum** option from the *AutoSum* drop-down menu. The first click will display a flashing marquee around the range. Press the ⌈Enter⌋ key or click the **Check Mark** next to the Formula bar to complete the function (see Figure 46).

	A	B	C	D
1		*General Merchandise World*		
		Retail Sales (in millions)		
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	3,560	$ 14.99	$ 53,370
15	**Total Sales**	**20,755**		**$ 291,864**
16				
17				

Figure 46: Totals Added to the Sheet1 Worksheet

Skill Refresher

AutoSum

- Highlight a cell location below or to the right of a range of cells that contain numeric values.
- Click the *Formulas* tab of the Ribbon.
- Click the down arrow below the *AutoSum* button.
- Select a mathematical function from the list.

1.3.6 *Moving, Renaming, Inserting, and Deleting Worksheets*

The default names for the worksheet tabs at the bottom of workbook are *Sheet1*, *Sheet2*, and so on. However, the worksheet names can be changed to identify the data each worksheet contains. Additionally, the order that the worksheet tabs appear can be changed. The following steps explain how to rename and move the worksheets in a workbook.

1. Double-click the **Sheet1** worksheet tab at the bottom of the workbook (see Figure 47).

2. Type the name *Sales by Month* and press Enter .

3. Double click the **Sheet2** worksheet tab at the bottom of the workbook.

4. Type the name *Unit Sales Rank* and press Enter .
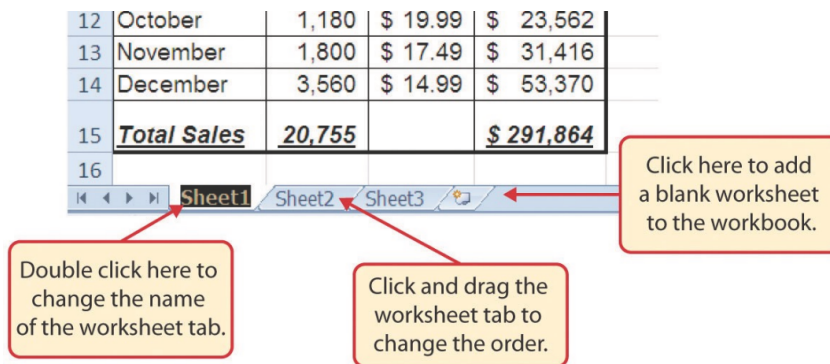
Figure 47: Renaming a Worksheet Tab

1. Click-and-drag the **Unit Sales Rank** worksheet tab to the left of the **Sales by Month** sheet. It will become the first worksheet in the workbook.

2. Click the **Sheet3** worksheet tab.

3. Click **Home ⇒ Cells ⇒ Delete ⇒ Down Arrow ⇒ Delete Sheet**. This removes the unneeded worksheet.

4. If a warning box pops up, click the **Delete** button.

5. Also delete the **Unit Sales Rank** worksheet since it was decided that worksheet is also unnecessary. This means that the workbook is left with just one worksheet, **Sales by Month**.

6. Save the changes to the workbook by clicking either **Quick Access Toolbar** ⇒ **Save** or **File** ⇒ **Save**.

Integrity Check

Deleting Worksheets

Be very cautious when deleting worksheets that contain data. Once a worksheet is deleted it is gone forever; the Undo command cannot bring the sheet back. *Deleting a worksheet is permanent!*

Keyboard Shortcuts

Inserting New Worksheets

- Press the Shift key and then the F11 key on the keyboard.

Figure 48 shows the final appearance of the *CH1-GMW Sales* workbook.

	A	B	C	D
	General Merchandise World			
1	**Retail Sales (in millions)**			
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	3,560	$ 14.99	$ 53,370
15	**Total Sales**	**20,755**		**$ 291,864**
16				

Figure 48: Final Appearance of the CH1-GMW Sales Workbook

Skill Refresher

Renaming Worksheets

- Double click the worksheet tab.
- Type the new name.
- Press the Enter key.

Moving Worksheets

- Left click the worksheet tab.
- Drag it to the desired position.

Deleting Worksheets

- Open the worksheet to be deleted.
- Click *Home ⇒ Cells ⇒ Delete ⇒ Down Arrow ⇒ Delete Sheet*.
- Click *Delete* on the warning box.

Best Practice

Summary Worksheet

It is considered a best practice to make the first worksheet in a workbook a summary. That sheet should include the purpose of the workbook and a brief explanation for each of the sheets in the book. It should also include contact information for the originator so questions that may come up later can be clarified. The simple workbooks in this course will not include a summary sheet, but it would be included in more complex projects.

Key Take-Aways

Save

- Formatting skills are critical for creating worksheets that are easy to read and have a professional appearance.
- A series of hashtags (####) in a cell location indicates that the column is too narrow to display the number entered.
- Using the Wrap Text command allows multi-word column headings to be stacked vertically in a cell location, reducing the need to expand column widths.
- Use the *Merge & Center* command to center the title of a worksheet directly over the columns that contain data.
- Adding borders or lines will make the worksheet easier to read and helps to separate the data in each column and row.
- The Undo command will not bring back a worksheet that has been deleted.

1.4 PRINTING

Learning Objectives

- Use the *Page Layout* tab to prepare a worksheet for printing.
- Add headers and footers to a printed worksheet.
- Explore how to print worksheets and workbooks.

Once a workbook is completed, it is good practice to select the appropriate settings for printing. These settings are in the *Page Layout* tab of the Ribbon and discussed in this section of the chapter.

1.4.1 *Page Setup*

Before the worksheets in a workbook can be printed, the setting must be adjusted. The following steps explain several of the commands in the *Page Layout* tab of the Ribbon used to prepare a worksheet for printing.

1. Open the **CH1-GMW Sales** workbook if it is not already open.

2. Click **Page Layout** ⇒ **Page Setup** ⇒ **Margins**. This will open a drop-down list of options for setting the margins of the printed document. The **Normal**, **Wide**, and **Narrow** will quickly apply one of those common margin settings and for this worksheet, click **Narrow**.

3. To further adjust the margin settings, **Page Layout** ⇒ **Page Setup** ⇒ **Margins** ⇒ **Custom Margins**.

4. On the *Page Setup* dialog box, click the **Page** tab, then select **Landscape**.

5. Click the *Margins* tab and locate the **Center on Page** section. Click the boxes to center the data horizontally and vertically on the worksheet (see Figure 49).

6. Click **OK**.
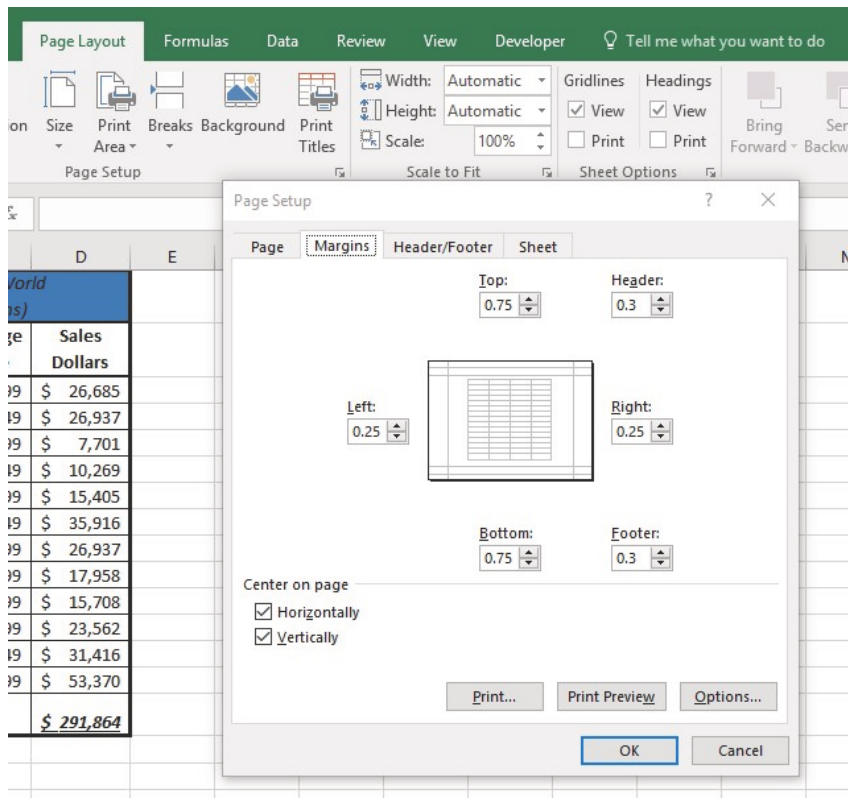
Figure 49: Page Layout Commands for Printing

Why?

Use Print Settings

Because professionals often share Excel workbooks, it is a good practice to select the appropriate print settings in the *Page Layout* tab even if there is no intent to print the worksheets. It can be extremely frustrating for recipients of a workbook who wish to print the worksheets to find that the necessary print settings have not been selected.

Table 2 lists the various page layout settings and how they would be used.

Command	Purpose	Use
Margins	Sets the top, bottom, right, and left margin space for the printed document	1. Click the Page Layout tab of the Ribbon. 2. Click the Margin button. 3. Click one of the preset margin options or click Custom Margins.
Orientation	Sets the orientation of the printed document to either portrait or landscape	1. Click the Page Layout tab of the Ribbon. 2. Click the Orientation button. 3. Click one of the preset orientation options.
Size	Sets the paper size for the printed document	1. Click the Page Layout tab of the Ribbon. 2. Click the Size button. 3. Click one of the preset paper size options or click More Paper Sizes.
Print Area	Used for printing only a specific area or range of cells on a worksheet	1. Highlight the range of cells on a worksheet to be printed. 2. Click the Page Layout tab of the Ribbon. 3. Click the Print Area button. 4. Click the Set Print Area option from the drop-down list.
Breaks	Manually set the page breaks on a worksheet	1. Activate a cell on the worksheet where the page break should be placed. Breaks are created above and to the left of the activated cell. 2. Click the Page Layout tab of the Ribbon. 3. Click the Breaks button. 4. Click the Insert Page Break option from the drop-down list.
Background	Adds a picture behind the cell locations in a worksheet	1. Click the Page Layout tab of the Ribbon. 2. Click the Background button. 3. Select a picture stored on the local computer or network.
Print Titles	Used when printing large data sets that are several pages long. This command will repeat the column headings at the top of each printed page.	1. Click the Page Layout tab of the Ribbon. 2. Click the Print Titles button. 3. Click in the Rows to Repeat at Top input box in the Page Setup dialog box. 4. Click any cell in the row that contains the column headings for the worksheet. 5. Click the OK button at the bottom of the Page Setup dialog box.

Table 2: Purpose and Use for Page Setup Commands

1.4.2 *Headers and Footers*

When printing worksheets from Excel, it is common to add headers and footers to the printed document. Information in the header or footer could include the date, page number, file name, company

name, and so on. The following steps explain how to add headers and footers to the *CH1-GMW Sales Data* workbook.

> 1. Click **Insert** ⇒ **Text** ⇒ **Header & Footer**.

Note: A new tab containing header and footer controls is added to the ribbon. `Excel 2016` names the tab *Design* and `Excel 365` names it *Header & Footer*. Other than the name of the tab, the next few instructions are the same for both versions of Excel. Inserting a header or footer will also open the *Page Layout* view of the worksheet, which makes it easy to add elements like the date or page number. Figure 50 shows the tab that is used to work with headers and footers.
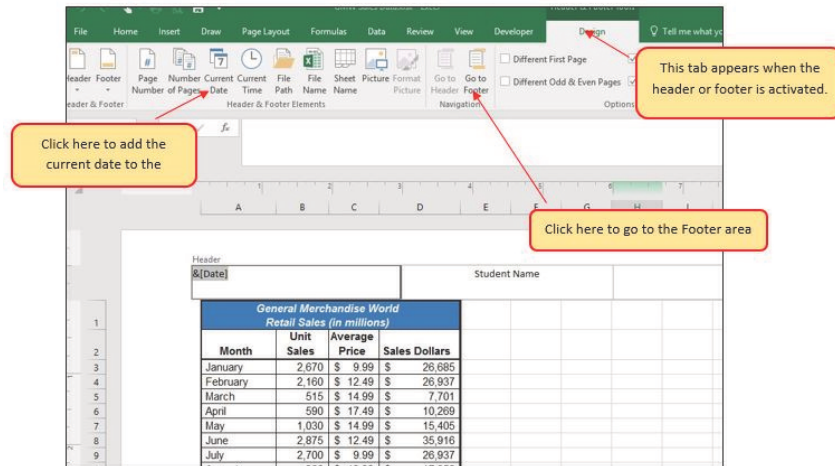
Figure 50: Tab for Creating Headers and Footers

> 1. Type the author's name in the center section of the Header.
>
> 2. Click in the left section of the Header (see Figure 50).
>
> 3. Click **Design** ⇒ **Header & Footer Elements** ⇒ **Current Date**. Note: the date will display as *&[Date]* until the workbook is printed, or the normal view is restored.
>
> 4. Click **Design** ⇒ **Navigation** ⇒ **Go To Footer**.
>
> 5. Click in the right section of the footer.
>
> 6. Click **Design** ⇒ **Header & Footer** ⇒ **Page Number**. Note: the page number will display as *&[Page]* until the workbook is printed, or the normal view is restored.
>
> 7. Click any cell location outside the header or footer area.

8. Click the **Normal** view button in the lower right side of the Status Bar (see Figure 51).
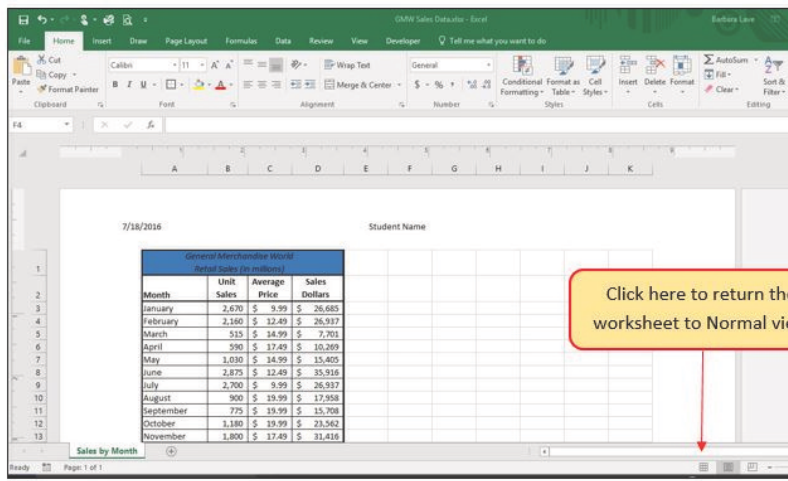
Figure 51: Worksheet in Page Layout View

1.4.3 *Printing Worksheets and Workbooks*

Once the print settings have been adjusted and the headers and footers added, it is time to print the worksheet. The following steps explain how to print the worksheet in the *CH1-GMW Sales* workbook.

1. Click the **File** tab on the Ribbon.

2. Click the **Print** option on the left side of the *Backstage* view (see Figure 52). Notice that there is a preview of the printed worksheet on the right side of the *Backstage* view.
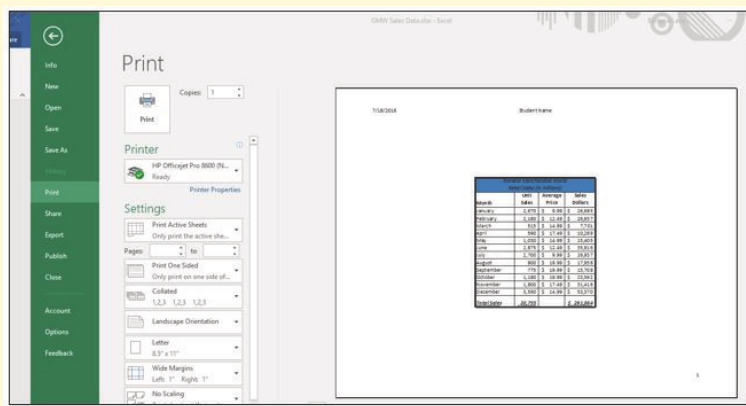
Figure 52: Backstage View Print option

3. Click the **Print Active Sheets** button in the **Print** section of the *Backstage* view (see Figure 52).

4. Click the **Print** button to print the active sheet.

5. Click the **Home** tab of the Ribbon.

6. Save the **CH1-GMW Sales Data** workbook.

7. Compare the worksheet with the self-check answer key (**CH1-GMW Sales Data Solution**) and then close and submit the **CH1-GMW Sales Data** workbook as directed by the instructor.

Key Take-Aways

Print

- The commands in the Page Layout tab of the Ribbon are used to prepare a worksheet for printing.
- Headers and footers can be added to a worksheet to show key information such as page numbers, the date, the file name, author's name, and so on.
- The **Print** commands are in the **File** tab of the Ribbon.

1.5   CHAPTER PRACTICE

1.5.1   *Basic Monthly Budget for a Medical Office*

Creating and maintaining budgets are common practices in many careers. Budgets play a critical role in helping a business or household control expenditures. In this exercise a budget for a hypothetical medical office will be created while reviewing the skills covered in this chapter.

1. Open the file named **PR1-Data**, then save as **PR1-Medical Office Budget**.

2. Activate all the cell locations in the **Sheet1** worksheet by clicking the **Select All** button in the upper left corner of the worksheet (See Figure 53).
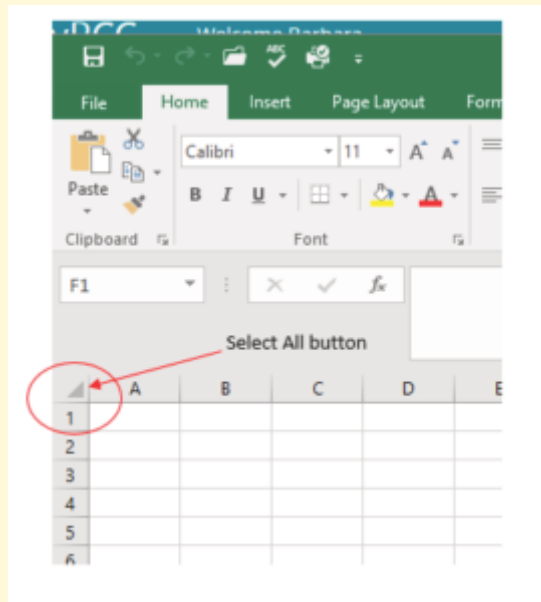
Figure 53: The Select All Button

3. In the **Home** tab of the Ribbon, set the font style to Arial and the font size to 12 points. Then click any cell to deselect the worksheet.

4. Double-click the divider between the tops of **Column A** and **Column B** to automatically change the width of **Column A** so all the entries in the range **A3:A8** are visible.

5. Click in **B2** and enter *Quarter 1*.

6. Use the **Auto Fill Handle** to complete the headings in the range **C2:E2**. Click in cell **B2** and place the mouse pointer over the **Auto Fill Handle**. When the mouse pointer changes to a black plus sign, left click and drag it to cell **E2**.

7. Click **B2:E2** to select those cells.

8. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Column Width**. Set the column width to 11.57.

9. Click **A1** and enter *Medical Office Budget*.

10. Click on **B1** and then click **Home** ⇒ **Cells** ⇒ **Insert** ⇒ **Insert Sheet Columns**.

11. Click **B2** and enter *Budget Cost*.

12. Adjust the width of **Column B** to approximately 13.25 characters.

13. Click-and-drag from **A1** to **F1** to select that range.

14. Click **Home** ⇒ **Alignment** ⇒ **Merge & Center**.

15. Make the following format adjustments to the merged range **A1:F1**: bold; italics; change the font size to 14 points; change the cell fill color to Aqua-Accent 5-Darker 50% and change the font color to *white*.

16. Click **A1** then click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Row Height**. Set the height to 24.75.

17. Make the following format adjustment to the range **A2:F2**: bold; fill color to Tan-Background 2-Darker 10%. Center the column titles so that they are horizontally centered in each cell.

18. Select **B2** and then click **Home** ⇒ **Alignment** ⇒ **Wrap Text**.

19. Copy cell **C3** and paste the contents into the range **D3:F3**.

20. Click **C6** and drag to **C8** to select that range. Click **Home** ⇒ **Clipboard** ⇒ **Copy**.

21. Click **D6** and drag to **F8** to select that range. Click **Home** ⇒ **Clipboard** ⇒ **Paste**.

22. Click cell **B3**. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum**. To complete the formula, click **C3** and drag to **F3** to select that range, then press the [Enter] key.

23. Copy the formula in cell **B3** and paste it into the range **B4:B8**.

24. Format the range **B3:F8** with Accounting format and zero decimal places.

25. Select the range **A1:F8**.

26. Click **Home** ⇒ **Font** ⇒ **Borders**. Select **All Borders**.

27. Double click the **Sheet1** tab at the bottom of the worksheet and change its name to *Budget*, then press the [Enter] key.

28. Delete all unused worksheets.

29. Click **Page Layout** ⇒ **Page Setup** ⇒ **Orientation** ⇒ **Landscape**.

30. Add a header to the **Budget** worksheet that shows the current date in the upper left corner and the author's name in the center.

31. Add a footer to the **Budget** worksheet that shows the page number in the lower right corner.

32. Save the **PR1-Medical Office Budget** workbook.

33. Compare the worksheet with the self-check answer key (**PR1-Medical Office Budget Solution**) and then close and submit the **PR1-Medical Office Budget** workbook as directed by the instructor.

1.6 SCORED ASSESSMENT

1.6.1 *Sales and Inventory Items*

A key activity for marketing professionals is to analyze projected sales and inventory information. This is especially important for retail environments. This exercise utilizes the skills covered in this chapter to analyze sales and inventory data.

1. Open the file named **SC1-Data** and then save as **SC1-Sales and Inventory**

2. In the **Sheet1** worksheet, enter the word *Totals* in cell **C14**.

3. Format all the cells in **Sheet1** to Century font style and a 12-point font size.

4. Set the column width for **Column A** through **Column G** to 13.5.

5. Edit the entry in cell **B2** to read *Item Number*.

6. Use the **Auto Fill Handle** to fill the Item Numbers from **B3** into the range **B4:B13**. The item numbers should increase by one as they are filled through the range so **B13** is *A1510*.

7. Copy the content of cell **A3** and paste it into the range **A4:A8**.

8. Delete **Column F**.

9. Format the range **A1:F2** so the text is Bold.

10. Set the alignment in the range **A2:F2** to Wrap Text.

11. Prepare **A1:F1** for the title text by changing the fill color of the cells in the range **A1:F1** to *Red, Accent 2, Darker 25%*.

12. Make the following font changes to the range **A1:F1**: set the font color to *white*, add italics, and set the font size to 14.

13. Merge and center the cells in the range **A1:F1**.

14. Enter the title for this worksheet in the range **A1:F1**. The title should appear on two lines. The first line should read *Status Report* and the second line should read *Sales and Inventory by Item*.

15. Increase the height of **Row** 1 so the entire title is visible.

16. Format the values in the range **C3:C13** with dollar signs and two decimal places.

17. Format the values in the range **E3:F13** with comma style, zero decimal places.

18. In cell **E14**, use **AutoSum** to calculate the sum of the values in the range **E3:E13**.

19. In cell **F14**, use **AutoSum** to calculate the sum of the values in the range **F3:F13**.

20. Apply **All Borders** to the range **A1:F14**.

21. Add a thick bottom border to **A2:F2**; add a thick bottom border to **A13:F13**.

22. Add a thick outside border around the perimeter of the range **A1:F14**.

23. Insert a new blank worksheet in the workbook (this will be **Sheet4**).

24. Delete **Sheet3**.

25. Move **Sheet4** ahead of **Sheet2** so the order of the worksheets is **Sheet1**, **Sheet4**, and **Sheet2**.

26. Rename the **Sheet1** worksheet tab to *Status Report*.

27. Change the orientation of the **Status Report** worksheet so it prints landscape instead of portrait.

28. Add a header to the **Status Report** worksheet that shows the date in the upper left corner and the author's name in the center.

29. Add a footer to the **Status Report** worksheet that shows the page number in the lower right corner with the word *Page* before the number.

30. Center the worksheet both horizontally and vertically on the page.

31. Save and close the **SC1-Sales and Inventory** workbook.

32. Submit the **SC1-Sales and Inventory** workbook as directed by the instructor.

MATHEMATICAL COMPUTATIONS

2

Perhaps the most valuable feature of Excel is its ability to produce mathematical outputs using the data in a workbook. This chapter reviews several mathematical outputs that can be produced in Excel through the construction of formulas and functions. The chapter begins with the construction of formulas for basic and complex mathematical computations. The second section reviews statistical functions, such as *SUM*, *AVERAGE*, *MIN*, and *MAX*, which can be applied to a range of cells. The last section of the chapter addresses functions used to calculate mortgage and lease payments as well as the valuation of investments. This chapter also shows how data from multiple worksheets can be used to construct formulas and functions. These skills will be demonstrated in the context of a personal cash budget. The personal budget objective will also provide several opportunities to demonstrate Excel's what-if scenario capabilities, which highlight how formulas and functions automatically produce new outputs when one or more inputs are changed.

2.1 FORMULAS

> **Learning Objectives**
>
> - Learn how to create basic formulas.
> - Understand relative referencing when copying and pasting formulas.
> - Manage the order of operations in complex formulas.
> - Understand formula auditing tools.

This section reviews the fundamental skills for entering formulas into an Excel worksheet by constructing a personal budget. Most financial advisors recommend that households construct and maintain a personal budget to achieve and maintain strong financial health. A budget is also a vital tool when making financial decisions for a small business.

Figure 54 shows the completed workbook that will be demonstrated in this chapter. Notice that this workbook contains four worksheets. The first worksheet, *Budget Summary*, contains formulas that utilize or reference the data in the other three worksheets. As a result, the *Budget Summary* worksheet serves as an overview of the data that was entered and calculated in the other three worksheets.

Figure 54: Completed Personal Budget Workbook

2.1.1 *Creating a Basic Formula*

Formulas are used to calculate a variety of mathematical outputs in Excel and can be used to create virtually any custom calculation required. Furthermore, when constructing a formula in Excel, cell locations added to a formula become cell references. This means that Excel uses, or references, the number entered in that cell location when calculating a mathematical output. As a result, when the numbers in the cell references are changed, Excel automatically produces a new output. This is what gives Excel the ability to create a variety of what-if scenarios, which will be explained later in the chapter.

   To demonstrate the construction of a basic formula, begin with the *Budget Detail* worksheet in the *Personal Budget* workbook, which is shown in Figure 55. Several formulas and functions will be added to this worksheet. Table 3 provides definitions for each of the spend categories listed in the range A3:A11. When developing a personal budget, these categories are defined based on how money is spent. It is likely that every person would have somewhat different categories or define the categories differently; therefore, it is important to review the definitions in Table 3 to understand how these categories are defined for this exercise.

Figure 55: Budget Detail Worksheet

Category	Definition
Household Utilities	Money spent on electricity, heat, and water, cable, phone, and Internet access
Food	Money spent on groceries, toiletries, and related items
Gasoline	Money spent on fuel for automobiles
Clothes	Money spent on clothes, shoes, and accessories
Insurance	Money spent on homeowners or automobile insurance
Taxes	Money spent on school and property taxes (this example of the personal budget assumes property ownership)
Entertainment	Money spent on entertainment, including dining out, movie and theater tickets, parties, and so on
Vacation	Money spent on vacations
Miscellaneous	Includes any other spending categories, such as textbooks, software, journals, school or work supplies, and so on

Table 3: Spend Category Definitions

The first formula added to the *Budget Detail* worksheet will calculate the *Monthly Spend* values. The formula will be constructed so that it takes the values in the *Annual Spend* column and divides them by 12. This will show how much money will be spent per month for each of the categories listed in *Column A*. The following steps creates the formula.

1. Click **File** ⇒ **Open** ⇒ **Browse**.

2. Navigate to **CH2-Data** and click **Open**.

3. Click **File** ⇒ **Save As** ⇒ **Browse**.

4. Navigate to the desired file location and save it with the name **CH2-Personal Budget**.

5. Click the **Budget Detail** worksheet tab to open the worksheet.

6. Click cell **C3**.

7. Type an equal sign **=**. When the first character entered in a cell location is an equal sign, it signals Excel to perform a calculation or produce a logical output.

8. Type *D3*. This adds location **D3** to the formula, which is now a cell reference. Excel will use whatever value is entered in cell **D3** to produce an output.

9. Type the slash symbol **/**. This is the symbol for division in Excel. As shown in Table 4 the mathematical operators in Excel are slightly different from those found on a typical calculator.

10. Type the number *12*. This divides the value in cell **D3** by 12. In this formula, a number, or constant, is used instead of a cell reference because it will not change. In other words, there will always be 12 months in a year.

11. Press the [Enter] key.

Symbol	Operation
+	Addition
−	Subtraction
/	Division
∗	Multiplication
∧	Power/Exponent

Table 4: Excel Mathematical Operators

Figure 56 shows how the formula appears in cell C3 before pressing the [Enter] key and Figure 57 shows the output of the formula after pressing the [Enter] key. The *Monthly Spend* for *Household Utilities* is $250 because the formula is taking the *Annual Spend* in cell D3 and dividing it by 12. If the value in cell D3 is changed, the formula automatically produces a new output. This calculates the spend per

month for each category because people often get paid and are billed for these items monthly. This formula helps compare monthly income to bills paid to determine whether there is enough income to pay the expenses.
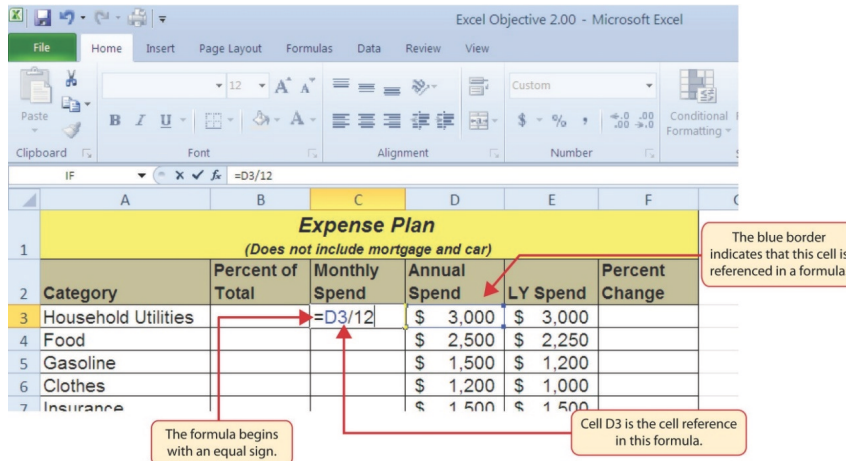
Figure 56: Adding a Formula to a Worksheet
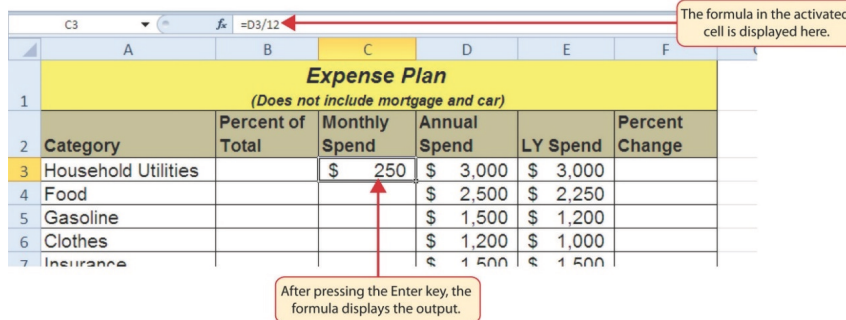
Figure 57: Formula Output for Monthly Spend

> **Why?**
>
> **Use Cell References**
>
> Cell references enable Excel to dynamically produce new outputs when one or more inputs in the referenced cells are changed. Cell references also trace how outputs are being calculated in a formula. As a result, never use a calculator to determine a mathematical output and type it directly into a cell location of a worksheet. Doing so eliminates Excel's cell-referencing benefits as well as the ability to trace a formula to determine how outputs are being produced.

2.1.2 *Relative References (Copying and Pasting Formulas)*

Once a formula is typed into a worksheet, it can be copied and pasted to other cell locations. For example, Figure 57 shows the output of the formula that was entered in cell C3. However, this calculation needs to be performed for the rest of the cell locations in *Column C*. Since the D3 cell reference is used in the formula, Excel automatically adjusts that cell reference when the formula is copied and pasted into the rest of the cell locations in the column. This is called relative referencing and is demonstrated as follows.

1. Click cell **C3**.

2. Place the mouse pointer over the **Auto Fill Handle**.

3. When the mouse pointer turns from a white block plus sign to a black plus sign, click and drag down to cell **C11**. This pastes the formula into the range **C4:C11**.

4. Double click cell **C6**. Notice that the cell reference in the formula was automatically changed to **D6**.

5. Press the Enter key.

Figure 58 shows the outputs added to the rest of the cell locations in the Monthly Spend column. For each row, the formula takes the value in the Annual Spend column and divides it by 12. In the figure, cell D6 has been double clicked to show the formula. Notice that Excel automatically changed the original cell reference from D3 to D6. This is the result of relative referencing, which means Excel automatically adjusts a cell reference relative to its original location when it is pasted into new cell locations. In this example, the formula was pasted into eight cell locations below the original cell location. As a

result, Excel increased the row number of the original cell reference by a value of one for each row it was pasted into.

Figure 58: Relative Reference Example

Why?

Use Universal Constants

Numerical values used in an Excel formula should be constants that do not change, such as the number of days in a week, weeks in a year, and so on. Do not enter values that exist in other cell locations into an Excel formula. This will eliminate Excel's cell-referencing benefits, which means if the value in a cell location being used in a formula is changed, Excel will not be able to calculate a new output.

2.1.3   Creating Complex Formulas (Controlling the Order of Operations)

The next formula to be added to the *Personal Budget* workbook is the percent change over last year. This formula determines the difference between the values in the LY (Last Year) Spend column and shows the difference in terms of a percentage. This requires that the order of mathematical operations be controlled to get an accurate result. Table 5 shows the standard order of operations for a typical formula. To change the order of operations that is shown in the table, use parentheses to process certain mathematical calculations first. The percent change formula is added to the worksheet as follows.

1. Click cell **F3** in the **Budget Detail** worksheet.

2. Type an equal sign **=**.

3. Type an open parenthesis **(**.

4. Click cell **D3**. This will add a cell reference to cell **D3** to the formula. When building formulas, clicking cells to enter their locations is usually less error-prone than typing them.

5. Type a minus sign **-**.

6. Click cell **E3** to add this cell reference to the formula.

7. Type a closing parenthesis **)**.

8. Type the slash **/** symbol for division.

9. Click cell **E3**. This completes the formula that will calculate the percent change of last year's actual spent dollars vs. this year's budgeted spend dollars (see Figure 59).

10. Press the Enter key. The result of this formula is 0.0% since the values in *Annual Spend* and *LY Spend* are the same.

11. Click cell **F3**.

12. Place the mouse pointer over the **Auto Fill Handle**.

13. When the mouse pointer turns from a white block plus sign to a black plus sign, click and drag down to cell **F11**. This pastes the formula into the range **F4:F11**.

	A	B	C	D	E	F	
	IF	▾ ⌐ ✕ ✔ ƒ×	=(D3-E3)/E3				
1			**Expense Plan** *(Does not include mortgage and car)*				
2	**Category**	**Percent of Total**	**Monthly Spend**	**Annual Spend**	**LY Spend**	**Percent Change**	
3	Household Utilities		$ 250	$ 3,000	$ 3,000	=(D3-E3)/E3	
4	Food		$ 208	$ 2,500	$ 2,250	11.1%	
5	Gasoline		$ 125	$ 1,500	$ 1,200	25.0%	
6	Clothes		$ 100	$ 1,200	$ 1,000	20.0%	
7	Insurance		$ 125	$ 1,500	$ 1,500	0.0%	
8	Taxes		$ 292	$ 3,500	$ 3,500	0.0%	
9	Entertainment		$ 167	$ 2,000	$ 2,250	-11.1%	
10	Vacation		$ 125	$ 1,500	$ 2,000	-25.0%	
11	Miscellaneous		$ 104	$ 1,250	$ 1,558	-19.8%	
12	*Totals*						
13			**Number of Categories**				
14			Average Spend				

Mathematical computations in parentheses are performed first.

Figure 59: Adding the Percent Change Formula

Symbol	Operation
()	Override Standard Order: Any mathematical computations placed in parentheses are performed first and override the standard order of operations. If there are layers of parentheses used in a formula, Excel computes the innermost parentheses first and the outermost parentheses last.
$\wedge$	First: Excel executes any exponential computations first.
* or /	Second: Excel performs any multiplication or division computations second. When there are multiple instances of these computations in a formula, they are executed in order from left to right.
+ or −	Third: Excel performs any addition or subtraction computations third. When there are multiple instances of these computations in a formula, they are executed in order from left to right.

Table 5: Standard Order of Mathematical Operations

Why?

Use Relative Referencing

Relative referencing is a convenient feature in Excel. When cell references are used in a formula, Excel automatically adjusts the cell references when the formula is pasted into new cell locations. If this feature were not available, formulas would have to be manually retyped when the same calculation is applied to other cell locations in a column or row.

Figure 59 shows the formula that was added to the *Budget Detail* worksheet to calculate the percent change in spending. The parentheses were added to this formula to control the order of operations. Any mathematical computations placed in parentheses are executed first before the standard order of mathematical operations (see Table 5). In this case, if parentheses were not used, Excel would produce an erroneous result for this worksheet.

Figure 60 shows the result of the percent change formula if the parentheses are removed. The formula produces a result of a 299900% increase. Since there is no change between the *LY Spend* and the budget *Annual Spend*, the result should be 0%. However, without the parentheses, Excel is following the standard order of operations. This means the value in cell E3 is divided by E3 first $(3,000/3,000)$, which is 1. Then, the value of 1 is subtracted from the value in cell D3 $(3,000 − 1)$, which is $2,999$. Since cell F3 is formatted as a percentage, Excel expresses the output as an increase of 299900%.

Figure 60: Removing the Parentheses from the Percent Change Formula

> ### Skill Refresher
>
> **Formulas**
>
> - Type an equal sign =.
> - Click or type a cell location. If using constants, type a number.
> - Type a mathematical operator.
> - Click or type a cell location. If using constants, type a number.
> - Use parentheses where necessary to control the order of operations.
> - Press the *Enter* key.

2.1.4 *Auditing Formulas*

Excel provides a few tools that can be used to review the formulas entered in a worksheet. For example, instead of showing the outputs for the formulas used in a worksheet, Excel can be set to show the formula as it was entered in the cell locations. This is demonstrated below.

1. Click **Formulas ⇒ Formula Auditing ⇒ Show Formulas**. This displays the formulas in the worksheet instead of showing the mathematical outputs.

2. Click **Formulas ⇒ Formula Auditing ⇒ Show Formulas** again. The worksheet returns to showing the output of the formulas.

Figure 61 shows the *Budget Detail* worksheet after activating *Show Formulas*. As shown in the figure, this command allows all the formulas in a worksheet to be viewed and checked without having to click each cell individually. After activating this command, the column widths in the worksheet increase significantly. The column widths were adjusted for the worksheet shown in Figure 61 so all columns

can be seen. The column widths return to their previous width when *Show Formulas* is deactivated.
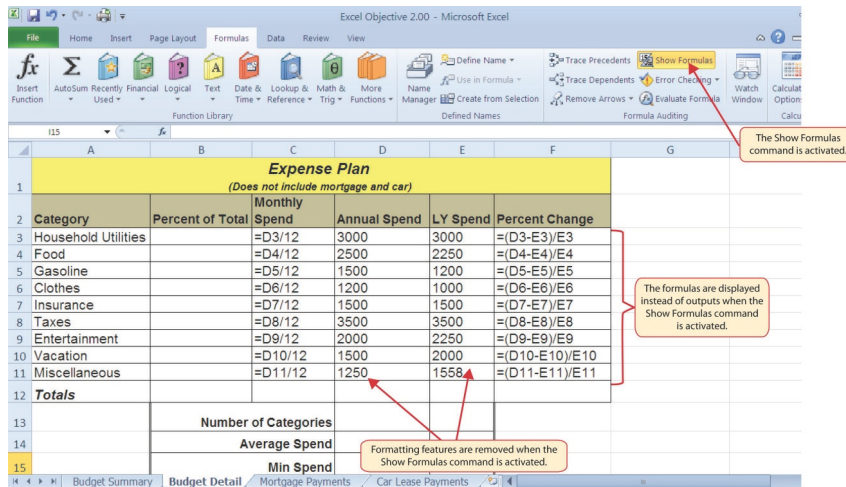
Figure 61: Show Formulas Command

Integrity Check

Does the Output of The Formula Make Sense?

It is important to note that the accuracy of the output produced by a formula depends on how it is constructed. Therefore, always check the result of a formula to see whether it makes sense with data in the worksheet. As shown in Figure 60, a poorly constructed formula can give a wildly inaccurate result. In other words, it is easy to see that there is no change between the *Annual Spend* and *LY Spend* for *Household Utilities*. Therefore, the result of the formula should be 0%. However, since the parentheses were removed in this case, the formula is clearly producing an erroneous result.

Skill Refresher

Show Formulas

- Click *Formulas* ⇒ *Formula Auditing* ⇒ *Show Formulas* to toggle the formula display on and off.

Keyboard Shortcuts

Show/Hide Formulas

- Hold down the ⌃Ctrl key while pressing the accent symbol ⎣ (this is the key to the left of the number one key on the keyboard). This will toggle the formula display on and off.

Two other valuable formula tools are *Trace Precedents* and *Trace Dependents*. These commands are used to trace the cell references used in a formula. A precedent cell is a cell whose value is used in other cells. The *Trace Precedents* command uses an arrow to indicate the cells or ranges ("precedents") which affect the active cell's value. A dependent cell is a cell whose value depends on the values of other cells in the workbook. The *Trace Dependents* command shows where any given cell is referenced in a formula. The following demonstrates these commands.

1. Click cell **D3** in the **Budget Detail** worksheet.

2. Click **Formulas** ⇒ **Formula Auditing** ⇒ **Trace Dependents**. A double blue arrow appears, pointing to cell locations **C3** and **F3** (see Figure 62). This indicates that cell **D3** is referenced in formulas that are entered in cells **C3** and **F3**.

3. Click **Formulas** ⇒ **Formula Auditing** ⇒ **Remove Arrows** to remove the *Trace Dependents* arrow.

4. Click cell **F3** in the **Budget Detail** worksheet.

5. Click **Formulas** ⇒ **Formula Auditing** ⇒ **Trace Precedents**. A blue arrow running through cells **D3** and **E3** and pointing to cell **F3** appears (see Figure 63). This indicates that cells **D3** and **E3** are references in a formula entered in cell **F3**.

6. Click **Formulas** ⇒ **Formula Auditing** ⇒ **Remove Arrows** to remove the *Trace Precedents* arrow.

7. Save the **CH2-Personal Budget** file. Remember, it is always a good idea to regularly save a file.

Figure 62 shows the *Trace Dependents* arrow on the *Budget Detail* worksheet. The blue dot represents the activated cell. The arrows indicate where the cell is referenced in formulas.
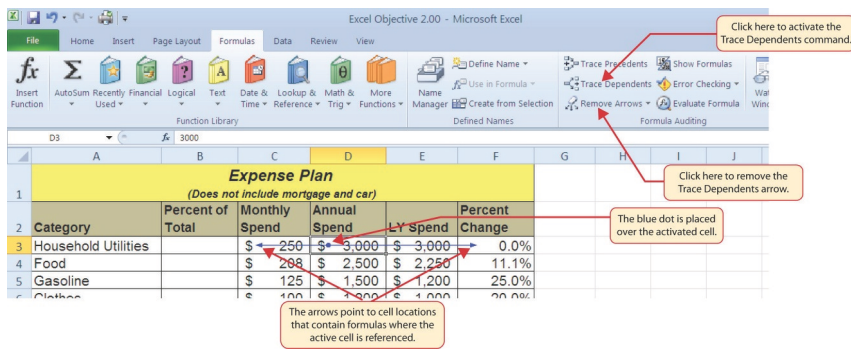
Figure 62: Trace Dependents Example

Figure 63 shows the *Trace Precedents* arrow on the *Budget Detail* worksheet. The blue dots on this arrow indicate the cells that are referenced in the formula contained in the activated cell. The arrow is pointing to the activated cell location that contains the formula.
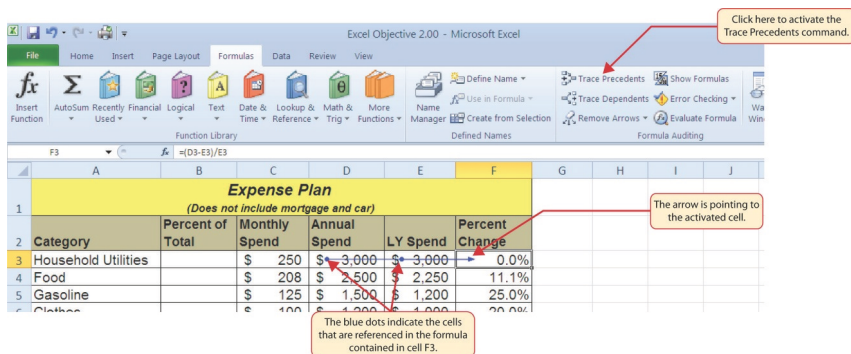
Figure 63: Trace Precedents Example

Skill Refresher

Trace Dependents

- Click a cell location that contains a number or formula.
- Click *Formulas* ⇒ *Formula Auditing* ⇒ *Trace Dependents*.
- Use the arrow(s) to determine where the cell is referenced in formulas and functions.
- Click *Formulas* ⇒ *Formula Auditing* ⇒ *Remove Arrows* to remove the arrows from the worksheet.

Skill Refresher

Trace Precedents

- Click a cell location that contains a formula or function.
- Click *Formulas ⇒ Formula Auditing ⇒ Trace Precedents*.
- Use the dot(s) along the line to determine what cells are referenced in the formula or function.
- Click *Formulas ⇒ Formula Auditing ⇒ Remove Arrows* to remove the arrows from the worksheet.

Key Take-Aways

Formulas

- Mathematical computations are conducted through formulas and functions.
- An equal sign = precedes all formulas and functions.
- Formulas and functions must be created with cell references to conduct what-if scenarios where mathematical outputs are recalculated when one or more inputs are changed.
- Mathematical operators on a typical calculator are different from those used in Excel. Table 4, *Excel Mathematical Operators*, lists Excel mathematical operators.
- When using numerical values in formulas and functions, only use universal constants that do not change, such as days in a week, months in a year, and so on.
- Relative referencing automatically adjusts the cell references in formulas and functions when they are pasted into new locations on a worksheet. This eliminates the need to retype formulas and functions when they are needed in multiple rows or columns on a worksheet.
- Parentheses must be used to control the order of operations when necessary for complex formulas.
- Formula auditing tools such as Trace Dependents, Trace Precedents, and Show Formulas should be used to check the integrity of formulas that have been entered in a worksheet.

2.2 STATISTICAL FUNCTIONS

> **Learning Objectives**
>
> - Use the *SUM* function to calculate totals.
> - Use absolute references to calculate percent of totals.
> - Use the *COUNT* function to count cell locations with numerical values.
> - Use the *AVERAGE* function to calculate the arithmetic mean.
> - Use the *MAX* and *MIN* functions to find the highest and lowest values in a range of cells.
> - Learn how to copy and paste formulas without formats applied to a cell location.
> - Learn how to set a multiple level sort sequence for data sets that have duplicate values or outputs.

In addition to formulas, another way to conduct mathematical computations in Excel is through built-in functions. Statistical functions apply an established mathematical process to a group of cells in a worksheet. For example, the *SUM* function is used to add the values contained in a range of cells. A list of commonly used statistical functions is shown in Table 6. Functions are more efficient than formulas when applying a mathematical process to a group of cells. If formulas are used to add the values in a range of cells, each cell location would have to be added to the formula one at a time. This can be very time-consuming, especially if the worksheet includes hundreds of cell locations. However, when using a function, all the cells that contain values to sum can be highlighted in just one step. This section demonstrates a variety of statistical functions that will be added to the *Personal Budget* workbook. In addition to demonstrating functions, this section also reviews "percent of total" calculations and the use of absolute references.

Function	Output
ABS	The absolute value of a number
AVERAGE	The average or arithmetic mean for a group of numbers
COUNT	The number of cell locations in a range that contain a numeric character
COUNTA	The number of cell locations in a range that contain a text or numeric character
MAX	The highest numeric value in a group of numbers
MEDIAN	The middle number in a group of numbers (half the numbers in the group are higher than the median and half the numbers in the group are lower than the median)
MIN	The lowest numeric value in a group of numbers
MODE	The number that appears most frequently in a group of numbers
PRODUCT	The result of multiplying all the values in a range of cell locations
SQRT	The positive square root of a number
STDEV.S	The standard deviation for a group of numbers based on a sample
SUM	The total of all numeric values in a group

Table 6: Commonly Used Statistical Functions

The following discusses a few of the more commonly used statistical functions.

2.2.1 *The Sum Function*

The SUM function is used to calculate totals for a range of cells or a group of selected cells on a worksheet. Regarding the *Budget Detail* worksheet, the *SUM* function is used to calculate the totals in *Row* 12. It is important to note that there are several methods for adding a function to a worksheet and all will be demonstrated throughout the remainder of this chapter. The following illustrates how a function can be added to a worksheet by typing it into a cell location.

1. Click the **Budget Detail** worksheet tab to open the worksheet if it is not already open.

2. Click cell **C12**.

3. Type an equal sign **=**.

4. Type the function name *SUM*.

5. Type an open parenthesis (.

6. Click cell **C3** and drag down to cell **C11**. This places the range **C3:C11** into the function.

7. Type a closing parenthesis).

8. Press the [Enter] key. The function calculates the total for the *Monthly Spend* column, which is $1,496.

Figure 64 shows the appearance of the *SUM* function added to the *Budget Detail* worksheet before pressing the [Enter] key.

Figure 64: Adding the **SUM** Function to the Budget Detail Worksheet

As shown in Figure 64, the *SUM* function was added to cell C12. However, this function is also needed to calculate the totals in the *Annual Spend* and *LY Spend* columns. The function can be copied and pasted into these cell locations because of relative referencing, which serves the same purpose for functions as it does for formulas. The following demonstrates how the total row is completed.

1. Click cell **C12** in the **Budget Detail** worksheet.

2. Click **Home** ⇒ **Clipboard** ⇒ **Copy**.

3. Click in **D12** and drag the mouse to **E12** to select both cells.

4. Click **Home** ⇒ **Clipboard** ⇒ **Paste**. This pastes the **SUM** function into cells **D12** and **E12** and calculates the totals for these columns.

5. Press ⌃Esc to stop the "marching ants" highlighting of **C12**.

6. Click cell **F11**.

7. Click **Home** ⇒ **Clipboard** ⇒ **Copy**.

8. Click cell **F12**.

9. Click **Home** ⇒ **Clipboard** ⇒ **Paste**. Since the totals in are available in **Row** 12, the percent change formula can be pasted into this row.

Figure 65 shows the output of the *SUM* function that was added to cells C12, D12, and E12. In addition, the percent change formula was copied and pasted into cell F12. Notice that this version of the budget is planning a 1.7% decrease in spending compared to last year.

Figure 65: Results of the SUM Function in the Budget Detail Worksheet

Integrity Check

Cell Ranges in Statistical Functions

When using a statistical function on a range of cells in a worksheet, make sure the two cell locations are separated by a colon and not a comma. If two cell locations are separated by a comma, the function will produce an output but it will be applied to only two cell locations instead of the entire range of cells. For example, the SUM function shown in Figure 66 is written with a comma and will add only the values in cells C3 and C11, not the range C3:C11.

	C	D
2	**Monthly Spend**	**Annual Spend**
3	$ 292	$ 3,!
4	$ 250	$ 3,(
5	$ 208	$ 2,!
6	$ 167	$ 2,(
7	$ 125	$ 1,!
8	$ 125	$ 1,!
9	$ 125	$ 1,!
10	$ 104	$ 1,:
11	$ 100	$ 1,:
12	=SUM(C3, C11)	

The comma indicates the function will only be applied to cells C3 and C11.

Figure 66: SUM Function Adding Two Cell Locations

2.2.2 *Absolute References (Calculating Percent of Totals)*

Since totals were added to *Row* 12 of the *Budget Detail* worksheet, a percent of total calculation can be added to *Column B* beginning in cell B3. The percent of total calculation shows the percentage for each value in the *Annual Spend* column with respect to the total in cell D12. However, after the formula is created, it will be necessary to turn off Excel's relative referencing feature before copying and pasting the formula to the rest of the cell locations in the column. Turning off Excel's relative referencing feature is accomplished through using an absolute reference. The following steps explain how this is done.

1. Click cell **B3** in the **Budget Detail** worksheet.

2. Type an equal sign **=**.

3. Click cell **D3**.

4. Type a forward slash **/**.

5. Click cell **D12**.

6. Press the [Enter] key. Notice that Household Utilities represents 16.7% of the Annual Spend budget (see Figure 67).

Figure 67: Adding a Formula to Calculate the Percent of Total

Figure 67 shows the completed formula that is calculating the percentage that the *Annual Spend* for *Household Utilities* represents to the total *Annual Spend* for the budget (see cell B3). Normally, this formula would be copied and pasted into the range B4:B11. However, because of relative referencing, both cell references will increase by one row as the formula is pasted into the cells below B3. This is fine for the first cell reference in the formula (D3) but not for the second cell reference (D12). Figure 68 illustrates what happens if the formula is pasted into the range B4:B12 in its current state. Notice that Excel produces the *#DIV/0* error code. This means that Excel is trying to divide a number by zero, which is impossible. Look at the formula in cell B4 and notice that the first cell reference was changed from D3 to D4. This is fine because now the *Annual Spend* for *Insurance* should be divided by the total *Annual Spend* in cell D12. However, Excel has also changed the D12 cell reference to D13. Because cell location D13 is blank, the formula produces the *#DIV/0* error code.

Figure 68: #DIV/0 Error from Relative Referencing

To eliminate the divide-by-zero error shown in Figure 68 absolute cell references to D12 must be used in the function. An absolute reference prevents relative referencing from changing a cell reference in a formula, which is also referred to as locking a cell. The following explains how this is accomplished.

1. Double click cell **B3**.

2. Place the mouse pointer in front of **D12** and click. The blinking cursor should be in front of the **D** in the cell reference **D12**.

3. Press the F4 key. Notice a dollar sign ($) is added in front of the column letter **D** and the row number 12. Alternatively, dollar signs can be manually typed in front of the column letter and row number.

4. Press the Enter key.

5. Click cell **B3**.

6. Click **Home ⇒ Clipboard ⇒ Copy**.

7. Select the range **B4:B11**.

8. Click **Home ⇒ Clipboard ⇒ Paste**.

Figure 69 shows the percent of total formula with an absolute reference added to D12. Notice that in cell B4, the cell reference remains D12 instead of changing to D13 as shown in Figure 68. Also, notice

that the percentages are being calculated in the rest of the cells in the column and the divide-by-zero error is eliminated.

Figure 69: Adding an Absolute Reference to a Cell Reference in a Formula

> **Skill Refresher**
>
> **Absolute References**
>
> - Click in front of the column letter of a cell reference in a formula or function that should not be altered when the formula or function is pasted into a new cell location.
> - Press the F4 key or type a dollar sign ($) in front of the column letter and row number of the cell reference.

2.2.3 *The Count Function*

The next function that will be added to the *Budget Detail* worksheet is the *COUNT* function. The *COUNT* function is used to determine how many cells in a range contain a numeric entry. The *COUNT* function will not work for counting text or other non-numeric entries. For the *Budget Detail* worksheet, the *COUNT* function will be used to count the number of items that are planned in *Annual Spend* (*Column D*). The following explains how the *COUNT* function is added to the worksheet by using the function list.

1. Click cell **D13** in the **Budget Detail** worksheet.

2. Type an equal sign **=**.

3. Type the letter C.

4. Click the down arrow on the scroll bar of the function list (see Figure 70) and find the word **COUNT**.

5. Double click the word **COUNT** from the function list.

6. Click **D3** and drag the mouse to **D11** to select that range.

7. Type a closing parenthesis **)** and then press the Enter key, or simply press the Enter key and Excel will close the function automatically.

Figure 70 shows the function list box that appears after typing the first letter of a function. The function list provides an alternative method for adding a function to a worksheet. Many users find it easier to select a function from a list rather than try to remember the function's name.
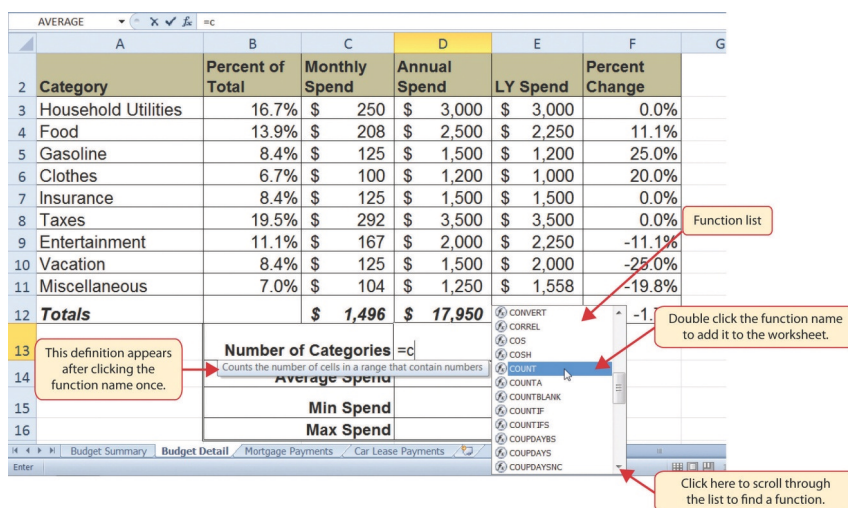
Figure 70: Using the Function List to Add the **COUNT** Function

Figure 71 shows the output of the *COUNT* function after pressing the Enter key. The function counts the number of cells in the range D3:D11 that contain a numeric value. The result of 9 indicates that there are 9 categories planned for this budget.

Figure 71: Completed **COUNT** Function in the Budget Detail Worksheet

2.2.4 *The Average Function*

The next function to be added to the *Budget Detail* worksheet is the *AVERAGE* function. This function is used to calculate the arithmetic mean (often called the "average") for a group of numbers. The *Budget Detail* worksheet will use the function to calculate the average of the values in the *Annual Spend* column. This function will be added to the worksheet by using *Function Library*. The following steps explain how this is accomplished.

1. Click cell **D14** in the **Budget Detail** worksheet.

2. Click **Formulas** $\Rightarrow$ **Function Library** $\Rightarrow$ **More Functions**.

3. Place the mouse pointer over the **Statistical** option from the drop-down list of options (see Figure 72).

4. Click the **AVERAGE** function name from the list of functions that appear in the menu. This opens the *Function Arguments* dialog box (see Figure 73).

5. Click the **Collapse Dialog** button for *Number1* in the *Function Arguments* dialog box.

6. Select the range **D3:D11**.

7. Click the **Expand Dialog** button in the *Function Arguments* dialog box (see Figure 74). Simply pressing the Enter key will get the same result.

8. Click the **OK** button on the *Function Arguments* dialog box. This adds the **AVERAGE** function to the worksheet.

Figure 72 illustrates how a function is selected from the *Function Library*.
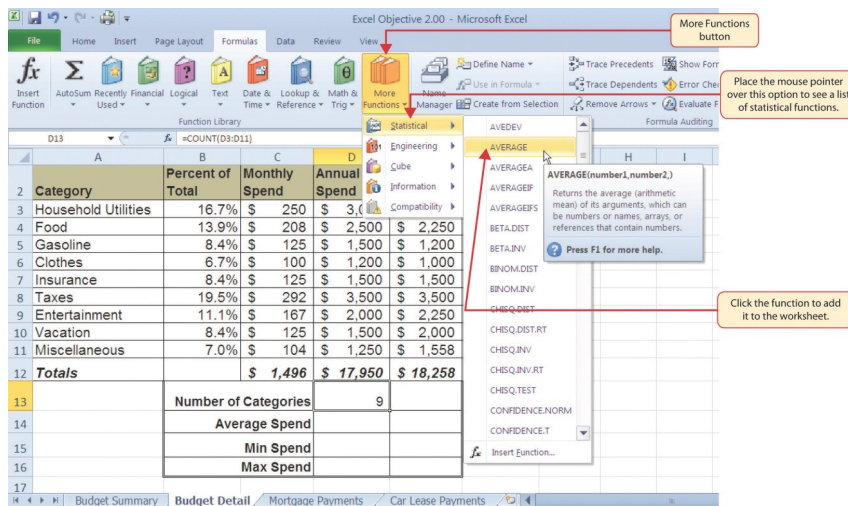
Figure 72: Selecting the AVERAGE Function from the Function Library

Figure 73 shows the *Function Arguments* dialog box. This appears after a function is selected from the *Function Library*. The *Collapse Dialog* button is used to hide the dialog box so a range of cells can be highlighted on the worksheet and then added to the function.
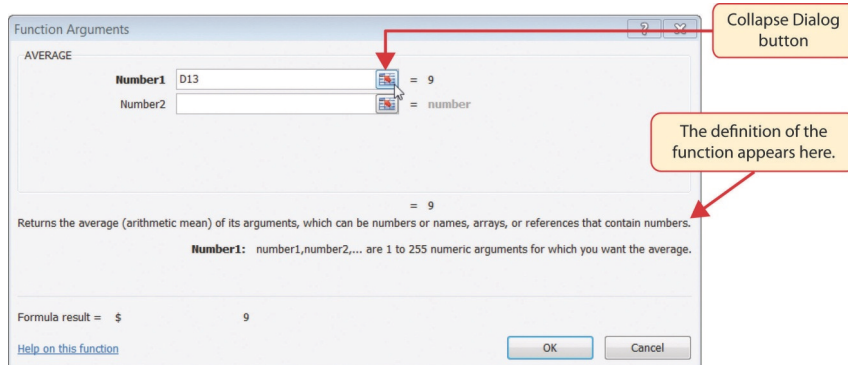
Figure 73: Function Arguments Dialog Box

Figure 74 shows how a range of cells can be selected from the *Function Arguments* dialog box once it has been collapsed.
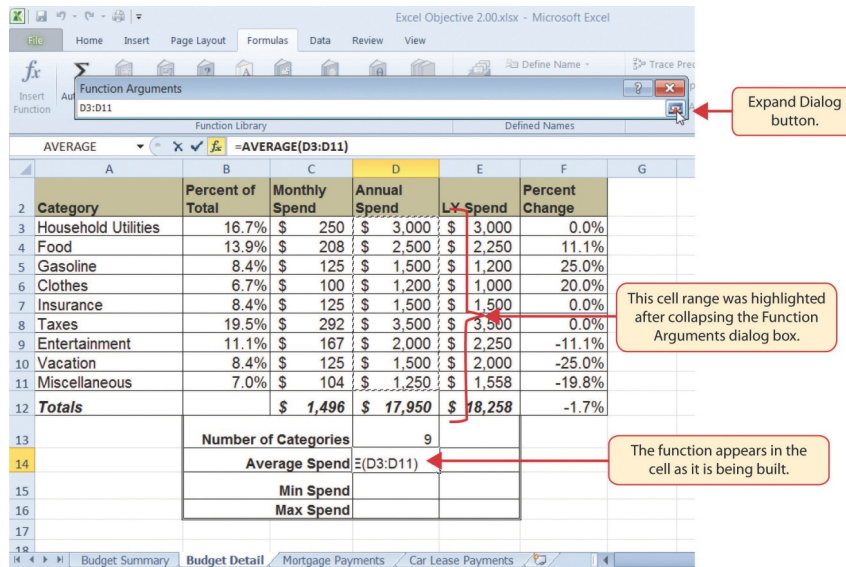
Figure 74: Selecting a Range from the Function Arguments Dialog Box

Figure 75 shows the *Function Arguments* dialog box after the cell range is defined for the *AVERAGE* function. The dialog box shows the result of the function before it is added to the cell location. This means that the function output is available before it is added to the worksheet to determine whether it makes sense.
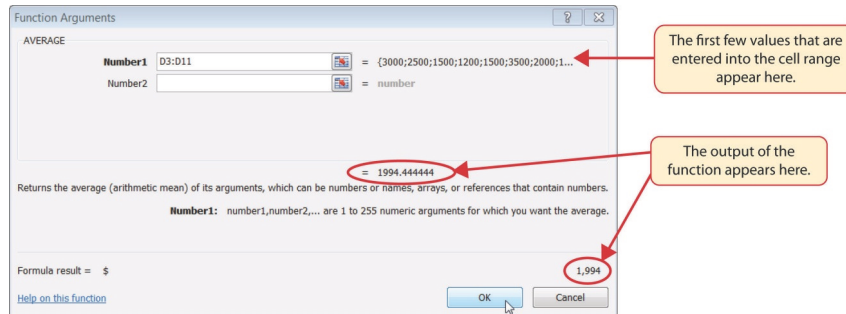
Figure 75: Function Arguments Dialog Box after a Cell Range Is Defined for a Function

Figure 76 shows the completed *AVERAGE* function in the *Budget Detail* worksheet. The output of the function shows that on average $1,994$ will be spent for each of the categories listed in *Column A* of the budget. This average spend calculation per category can be used as an indicator to determine which categories are costing more or less than the average budgeted spend dollars.

Figure 76: Completed AVERAGE Function

2.2.5 *The Max and Min Functions*

The final two statistical functions that will be added to the *Budget Detail* worksheet are the *MAX* and *MIN* functions. These functions identify the highest and lowest values in a range of cells. The following steps explain how to add these functions to the *Budget Detail* worksheet.

1. Click cell **D15** in the **Budget Detail** worksheet.

2. Type an equal sign **=**.

3. Type the word *MIN*.

4. Type an open parenthesis **(**.

5. Select the range **D3:D11**.

6. Type a closing parenthesis **)** and press the Enter key, or simply press the Enter key and Excel will close the function automatically. The **MIN** function produces an output of $1,200, which is the lowest value in the *Annual Spend* column (see Figure 77).

7. Click cell **D16**.

8. Type an equal sign **=**.

9. Type the word *MAX*.

10. Type an open parenthesis **(**.

11. Select the range **D3:D11**.

12. Type a closing parenthesis **)** and press the [Enter] key, or simply press the [Enter] key and Excel will close the function automatically. The **MAX** function produces an output of $3,500. This is the highest value in the *Annual Spend* column (see Figure 78).

Figure 77: **MIN** Function Added to the Budget Detail Worksheet

Figure 78: **MAX** Function Added to the Budget Detail Worksheet

Skill Refresher

Statistical Functions

- Type an equal sign =.
- Type the function name followed by an open parenthesis (or double click the function name from the function list.
- Select a range on a worksheet or click individual cell locations followed by commas.
- Type a closing parenthesis) and press the [Enter] key or simply press the [Enter] key to close the function.

2.2.6 *Copy and Paste Formulas (Pasting Without Formats)*

As shown in Figure 78, the *COUNT*, *AVERAGE*, *MIN*, and *MAX* functions are summarizing the data in the *Annual Spend* column. There is also space to copy and paste these functions under the *LY Spend* column. This allows a comparison between what was spent last year and what is expected to be spent this year. Normally, functions would be simply copied/pasted into the range E13:E16. However, notice the double-line style border that was used around the perimeter of the range B13:E16. If a regular Paste command is used the double line on the right side of the range E13:E16 would be replaced with a single line since the format for the copied cells will be used. Therefore, one of the *Paste Special* commands will be used to paste only the functions without any of the cell formatting. This is accomplished through the following steps.

1. Select **D13:D16** in the **Budget Detail** worksheet.

2. Click **Home** ⇒ **Clipboard** ⇒ **Copy**.

3. Click cell **E13**.

4. Click **Home** ⇒ **Clipboard** ⇒ **Paste Down Arrow**.

5. Click the **Formulas** option from the drop-down list of buttons (see Figure 79).

Figure 79 shows the list of buttons that appear when the down arrow is clicked below the *Paste* button in the *Home* tab of the Ribbon. One thing to note about these options is that they can be previewed before they are applied by hovering the mouse pointer over the options, one at a time. As shown in the figure, when the mouse pointer is placed over the *Formulas* button, the function appearance is visible before selecting. Notice that the double-line border does not change

when this option is previewed, which is why this selection is made instead of the regular *Paste* option.
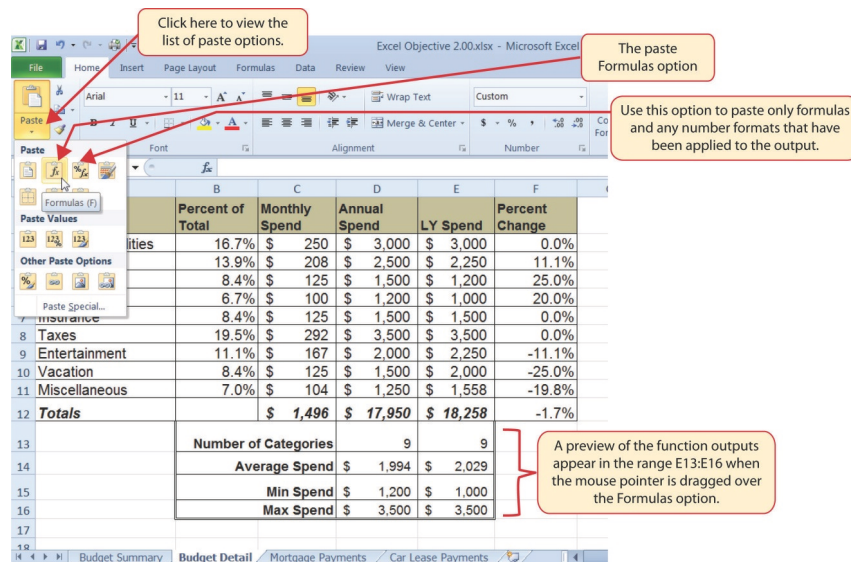
Figure 79: Paste Formulas Option

Skill Refresher

Paste Formulas

- Click a cell location containing a formula or function.
- Click *Home ⇒ Clipboard ⇒ Copy*.
- Click the cell location or cell range where the formula or function will be pasted.
- Click *Home ⇒ Clipboard ⇒ Paste Down Arrow ⇒ Formulas*.

2.2.7 *Sorting Data (Multiple Levels)*

The *Budget Detail* worksheet shown in Figure 79 is now producing several mathematical outputs through formulas and functions. The outputs allow analysis of the details and identify trends as to how money is being budgeted and spent. Before drawing conclusions from this worksheet, it will be sorted based on the *Percent of Total* column. Sorting is a powerful tool that enables analysis of key trends in any data set. Sorting will be covered thoroughly in another chapter but will be briefly introduced here. For the purposes of the *Budget Detail* worksheet, multiple levels for the sort order must be used. This is accomplished through the following steps.

1. Select **A2:F11** in the **Budget Detail** worksheet.

2. Click **Data** ⇒ **Sort & Filter** ⇒ **Sort**. This opens the *Sort* dialog box, as shown in Figure 80.

3. Click the down arrow next to the **Sort by** box.

4. Click the **Percent of Total** option from the drop-down list.

5. Click the down arrow next to the sort *Order* box.

6. Click the **Largest to Smallest** option.

7. Click the **Add Level** button. This allows a second level to be set in case there are any duplicate values in the *Percent of Total* column.

8. Click the down arrow next to the **Then by** box.

9. Select the **LY Spend** option. Leave the Sort Order as **Smallest to Largest**

10. Click **OK** at the bottom of the *Sort* dialog box.

11. Save the **CH2-Personal Budget** file.
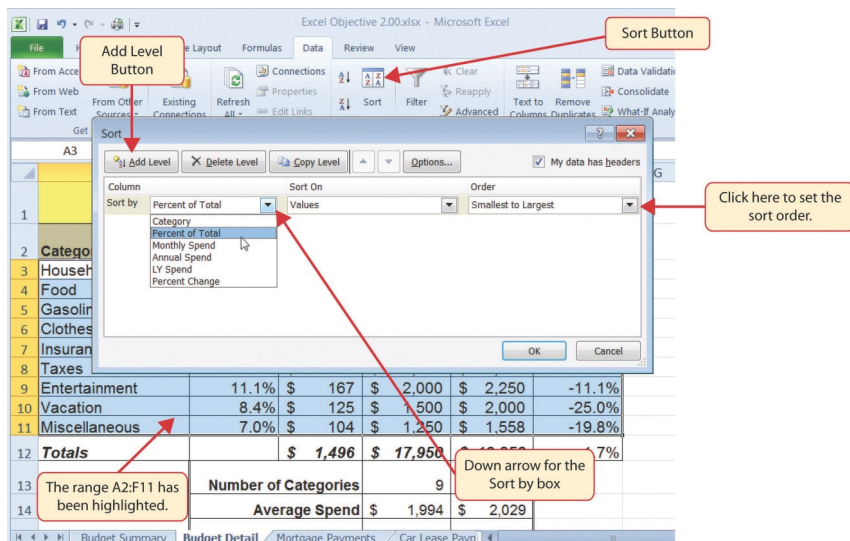
Figure 80: Sort Dialog Box

Figure 81 shows the **Budget Detail** worksheet after it has been sorted. Notice that there are three identical values in the *Percent of Total* column, which is why a second sort level had to be created for this worksheet. The second sort level arranges the values of 8.4% based on the values in the *LY Spend* column in ascending order. As

many sort levels as necessary may be selected for the data contained in a worksheet.

Figure 81: Budget Detail Worksheet after Sorting

Skill Refresher

Sorting Data (Multiple Levels)

- Select a range of cells to be sorted.
- Click *Data ⇒ Sort & Filter ⇒ Sort*.
- Select a column from the *Sort by* drop-down list in the *Sort* dialog box.
- Select a sort order from the *Order* drop-down list in the *Sort* dialog box.
- Click the *Add Level* button in the *Sort* dialog box.
- Add as many levels as necessary.
- Click the *OK* button on the *Sort* dialog box.

Now that the *Budget Detail* worksheet is sorted, a few key trends can be easily identified. The worksheet clearly shows that the top three categories as a percentage of total budgeted spending for the year are *Taxes*, *Household Utilities*, and *Food*. All three categories are necessities (or realities) of life and typically require a significant amount of income for most households. The *Percent Change* column indicates how the planned spending is expected to change from last year. This is perhaps the most important column on the worksheet because it shows whether the budget plan is realistic. Notice that there are no

changes planned for *Taxes* and *Household Utilities*. While *Taxes* can change from year to year, it is not too difficult to predict what they will be. In this case, the assumption is that there are no changes to the tax costs for the budget. The plan also includes no change in *Household Utilities*. While these costs can fluctuate from year to year, measures can be taken to reduce costs, such as using less electricity, turning off heat when no one is in the house, keeping track of the wireless minutes to avoid overage charges, and so on. As a result, there is no change in planned spending for *Household Utilities* because any rate increases will be offset with a decrease in usage. The third item that is planned to not change is *Insurance*. Insurance policies for cars and homes can change, but as is true for taxes, the changes are predictable. Therefore, it is reasonable to assume no changes in the insurance policy.

The first big change that is noticeable in the worksheet is the *Food* and *Entertainment* categories in Rows 5 and 6 (see the category definitions in Table 3). The *Percent Change* column indicates that there is an 11.1% decrease in *Entertainment* spending and an 11.1% increase in *Food* spending. This is logical because if the plan is to eat in restaurants less frequently then eating at home will be more frequent. Although this makes sense in theory, it may be hard to do in practice. Dinners and parties with friends may be tough to turn down. However, the entire process of maintaining a budget is based on discipline, and it certainly takes a significant amount of discipline to plan targets and stick to them.

A few other points to note are the changes in the *Gasoline* and *Vacation* categories. Commuting to school or work means that the price of gas can have a significant impact on the budget. It is important to be realistic in the budget if gas prices are increasing. To compensate for the increased spending for gas, the spending plan for vacations has been reduced by 25%. Budgeting often requires a certain degree of creativity. Although the *Vacation* budget has been reduced, there is still money that can be set aside to make plans for long weekends or other breaks.

Finally, the budget shows a decrease in *Miscellaneous* spending of 19.8%. This was defined as a group containing several expenses, such as textbooks, school supplies, software updates, and so on (see Table 3). This spending may be able to be reduced if items like online textbooks can be used. This reduction in spending can free up funds for *Clothes*, a spend category that has increased by 20%. This *Personal Budget* workbook will be further developed in Section 2.3: Functions for Personal Finance.

Key Take-Aways

Statistical Functions

- Statistical functions are used when a mathematical process is required for a range of cells, such as summing the values in several cell locations. For these computations, functions are preferable to formulas because adding many cell locations one at a time to a formula can be very time-consuming.
- Statistical functions can be created using cell ranges or selected cell locations separated by commas. Make sure to use a cell range (two cell locations separated by a colon) when applying a statistical function to a contiguous range of cells.
- To prevent Excel from changing the cell references in a formula or function when they are pasted to a new cell location, use an absolute reference. Do this by placing a dollar sign ($) in front of the column letter and row number of a cell reference.
- The *#DIV/0* error appears if a formula attempts to divide a constant or the value in a cell reference by zero.
- The Paste Formulas option is used to paste formulas without any formatting treatments into cell locations that have already been formatted.
- Set multiple levels, or columns, in the Sort dialog box when sorting data that contains several duplicate values.

2.3   FUNCTIONS FOR PERSONAL FINANCE

Learning Objectives

- Understand the fundamentals of loans and leases.
- Use the *PMT* function to calculate monthly mortgage payments on a house.
- Use the *PMT* function to calculate monthly lease payments for an automobile.
- Learn how to summarize data in a workbook by using worksheet links to create a summary worksheet.

In this section, the *Personal Budget* workbook will continue to be developed. Notable items that are missing from the *Budget Detail* worksheet are payments for a car or a home. This section demonstrates

Excel functions used to calculate lease payments for a car and mortgage payments for a house.

2.3.1 *The Fundamentals of Loans and Leases*

One of the functions to be added to the *Personal Budget* workbook is the *PMT* function. This function calculates the payments required for a loan or a lease. However, before demonstrating this function, it is important to cover a few fundamental concepts about loans and leases.

A loan is a contractual agreement in which money is borrowed from a lender and paid back over a specific period. The amount of money that is borrowed from the lender is called the principal of the loan. The borrower is usually required to pay the principal of the loan plus interest. When the borrowed money is to buy a house, the loan is referred to as a mortgage since the house being purchased also serves as collateral to ensure payment. In other words, the bank can take possession of the house if the borrower fails to make loan payments. Table 7 defines several key terms related to loans and leases.

Term	Definition
Collateral	Any item of value that is used to secure a loan to ensure payments to the lender.
Down Payment	The amount of cash paid toward the purchase of a house. A down payment of 20% means that 20% of the house's cost is being paid in cash and the rest is being borrowed.
Interest Rate	The interest that is charged to the borrower as a cost for borrowing money.
Mortgage	A loan where property is put up for collateral.
Principle	The amount of money that has been borrowed.
Residual Value	The estimated selling price of a vehicle at a future point in time.
Term	The amount of time to repay a loan.

Table 7: Key Terms for Loans and Leases

Figure 82 shows an example of an amortization table for a loan. A lender is required by law to provide borrowers with an amortization table when a loan contract is offered. The table in the figure shows how the payments of a loan would work if $100,000$ is borrowed from a lender to be paid back in 10 years at an interest rate of 5%. Notice that each payment is part interest and part principal. Each year, the amount of interest paid to the bank decreases and the amount of money applied against the principal increases since the bank is charging interest on the amount of principal that has not been paid. As the amount of principal decreases, the interest rate is applied to a

lower number, which reduces the interest charges. Finally, the figure shows that the sum of the values in the *Interest Payment* column is $29,505. This is how much it costs to borrow this money over 10 years. It is important to note that to simplify this example, the payments were calculated on an annual basis. However, most loan payments are made monthly.

	A	B	C	D
1		Loan Details		
2	Annual Interest Rate		5.0%	
3	Terms in Years		10	
4	Loan Principal		$ 100,000	
5	Annual Payments		$12,950	
6				
7		Amortization Table for Loan		
8	Year	Interest Payment	Principal Payment	Beginning Principal Balance
9	1	$ 5,000	$ 7,950	$ 100,000
10	2	$ 4,602	$ 8,348	$ 92,050
11	3	$ 4,185	$ 8,765	$ 83,702
12	4	$ 3,747	$ 9,204	$ 74,936
13	5	$ 3,287	$ 9,664	$ 65,733
14	6	$ 2,803	$ 10,147	$ 56,069
15	7	$ 2,296	$ 10,654	$ 45,922
16	8	$ 1,763	$ 11,187	$ 35,267
17	9	$ 1,204	$ 11,746	$ 24,080
18	10	$ 617	$ 12,334	$ 12,334

For each year, the Interest Payment plus the Principle Payment is $12,950.

Total for this column is $29,505.

At the end of year 10, the loan is paid in full.

Figure 82: Example of an Amortization Table

A lease is a contract in which a lessee uses an asset such as a car or a piece of equipment and agrees to make regular payments to the lessor. When a car is leased, the manufacturer or a leasing company retains ownership of the vehicle and the customer agrees to make regular payments for a specific period. The amount of the payments depends on the price of the car, the term of the lease contract, and the car's expected residual value at the end of the lease. The calculation of lease payments is like the calculation of loan payments; however, payments for a car lease is intended to cover only the value of the car that is used. For example, suppose a car is leased for $25,000 for 4 years at an interest rate of 5%. If the residual value of the car is $10,000 then it will lose $15,000 of its value over 4 years. Another way to state this is that the car will depreciate $15,000. A lease will be structured so that the payments cover this $15,000 in depreciation. However, the interest charges will be based on the purchase price

of $25,000. Because these are common transactions, the next section uses Excel functions to calculate payments for both leasing a car and buying a home.

2.3.2 *The Pmt (Payment) Function for Loans*

Mortgage payments are a major component of a household budget. In Excel, mortgage payments are conveniently calculated through the *PMT* (*payment*) function. This function is more complex than the statistical functions covered in Section 2.2: Statistical Functions. Statistical functions only require a range of cells, known as the argument. With the *PMT* function, a series of arguments must be accurately defined for the function to produce a reliable output. Table 8 lists the arguments for the *PMT* function. It is helpful to review the key loan and lease terms in Table 7 before reviewing the *PMT* function arguments.

Argument	Definition
Rate	This is the interest rate the lender is charging the borrower. The interest rate is usually quoted in annual terms, so it must be divided by 12 to calculate monthly payments.
Nper	The argument letters stand for "Number of Periods." This is the term of the loan, which is the amount of time allowed to repay the bank. This is usually quoted in years, so it must be multiplied by 12 to calculate monthly payments.
Pv	The argument letters stand for "Present Value." This is the principal of the loan or the amount of money that is borrowed. When defining this argument, a minus sign must precede the cell location or value. For leases, this argument is used for the price of the item being leased.
[Fv]	The argument letters stand for "Future Value." The brackets around the argument indicate that it is not always necessary to define it. It is used if there is a lump-sum payment that will be made at the end of the loan terms. This is also used for the residual value of a lease. If it is not defined, Excel will assume that it is zero.
[Type]	This argument can be defined with either a 1 or a 0. The number 1 is used if payments are made at the beginning of each period. A 0 is used if payments are made at the end of each period. The argument is in brackets because it does not have to be defined if payments are made at the end of each period. Excel assumes that this argument is 0 if it is not defined.

Table 8: Arguments for the PMT Function

By default, the result of the *PMT* function in Excel is shown as a negative number. This is because it represents an outgoing payment. When making a mortgage or car payment, money is being paid out of a bank account. This number can be left negative or converted to a positive number depending on the way that it is being used. In the following assignments, the payments calculated using the *PMT* function will be made positive to make them easier to work with. To do this, when defining the *PV* argument (amount of money borrowed) in the *PMT* dialog box, a minus sign must precede the cell location or value (see the *PV* argument in Figure 85).

The *PMT* function will be used in the *Personal Budget* workbook to calculate the monthly mortgage payments for a house. These calculations will be made in the *Mortgage Payments* worksheet and then displayed in the *Budget Summary* worksheet through a cell reference link. So far, several methods have been demonstrated for adding functions to a worksheet. The following steps explain a new method using the *Insert Function* command for adding the *PMT* function.

1. Click the **Mortgage Payments** worksheet tab.

2. Click cell **B5**.

3. Click **Formulas** ⇒ **Function Library** ⇒ **Insert Function** (see Figure 83). This opens the *Insert Function* dialog box, which can be used for searching all functions in Excel.

4. In the *Search for a function:* input box at the top of the *Insert Function* dialog box, type ***payments*** (see Figure 84).

5. Click **Go** in the upper right side of the *Insert Function* dialog box. This adds all the Excel functions that match the description in the *Select a function:* box to the lower half of the *Insert Function* dialog box (see Figure 84).

6. Scroll down to find and click the **PMT** option in the *Select a function:* box in the lower half of the *Insert Function* dialog box.

7. Click **OK** at the lower right side of the *Insert Function* dialog box. This will open the *Function Arguments* dialog box.
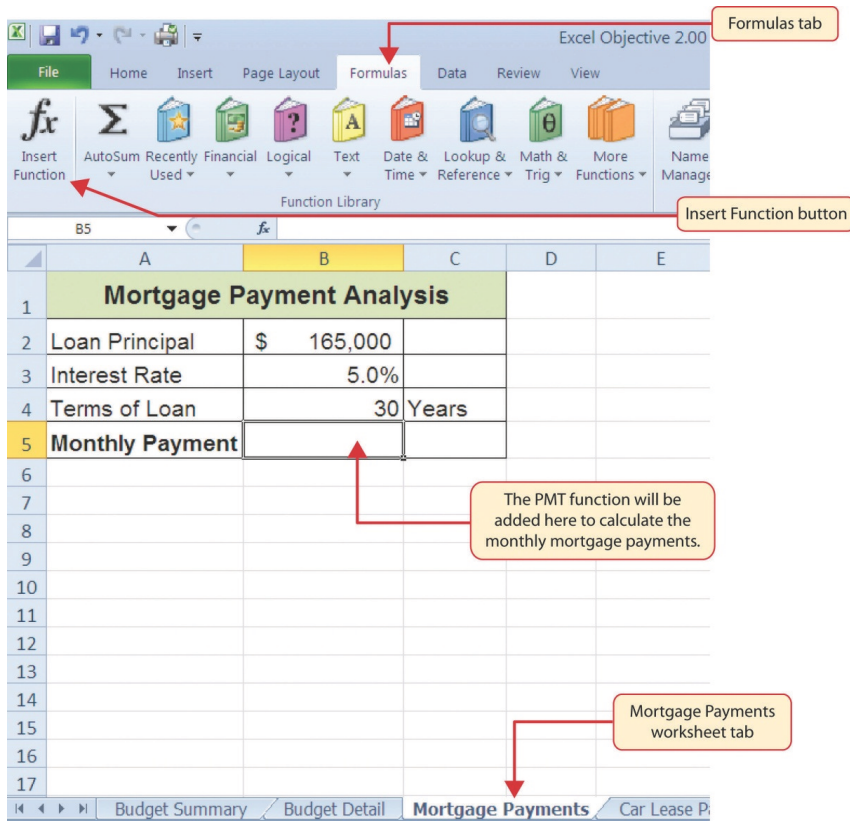
Figure 83: Mortgage Payments Worksheet
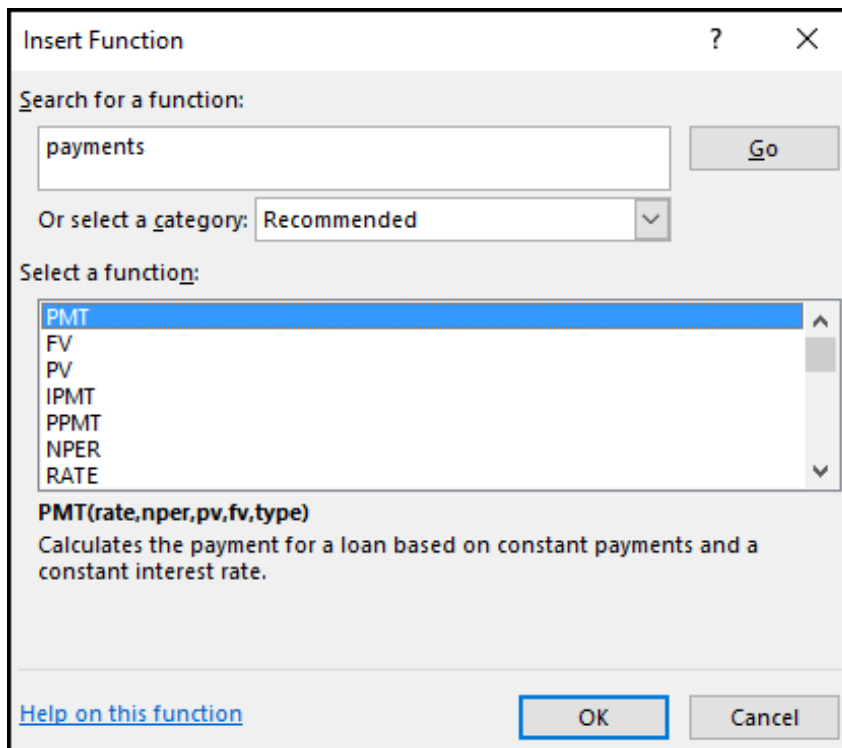
Figure 84: Insert Function Dialog Box

1. Click the **Collapse Dialog** button next to the **Rate** argument in the *Function Arguments* dialog box. This will be the first argument defined for the function (see Figure 85).

2. Click cell **B3** on the worksheet. This is the rate being charged on the loan.

3. Type a forward slash **/** for division.

4. Type the number *12*. Since the goal is to calculate the monthly payments for the loan, the rate, which is stated in annual terms, must be divided by 12 to convert the annual rate to a monthly rate.

5. Press the Enter key. This returns the *Function Arguments* dialog box to its expanded form. Notice that that the *Rate* argument is now defined.

6. Click the **Collapse Dialog** button next to the **Nper** argument in the *Function Arguments* dialog box. This is the second argument to be defined in the function.

7. Click cell **B4** on the worksheet. This is the term or the amount of time to repay the loan.

8. Type an asterisk ***** for multiplication.

9. Type the number *12*. Since the goal is to calculate the monthly payments for the loan, the terms of the loan must be multiplied by 12 to converts the terms from years to months.

10. Press the Enter key. This returns the *Function Arguments* dialog box to its expanded form. Notice that the Nper argument is now defined.

11. Click the **Collapse Dialog** button next to the **Pv** argument in the *Function Arguments* dialog box. This is the third argument to be defined in the function.

12. Type a minus sign **-**. When defining the Pv argument of the **PMT** function, the cell location or value must be preceded with a minus sign.

13. Click cell **B2** on the worksheet. This is the principal of the loan.

14. Press the Enter key. Notice that the **Rate**, **Nper**, and **Pv** arguments are all defined for the function.

15. Click **OK** at the bottom of the *Function Arguments* dialog box. The function will now be placed into the worksheet. Since there are no lump sum payments at the end of the loan, there is no need to define the **Fv** argument. Also, since the monthly mortgage payments will be made at the end of each month, there is no need to define the **Type** argument.

Keyboard Shortcuts

Functions

- **Insert Function**: Hold the `Shift` key while pressing the `F3` key.
- **Function Arguments**: After the equal sign = and function name are typed into cell a location, hold down the `Ctrl` key and press the letter `A` on the keyboard.

Figure 85 shows the completed *Function Arguments* dialog box for the *PMT* function. Notice that the dialog box shows the values for the **Rate** and **Nper** arguments. The **Rate** is divided by 12 to convert the annual interest rate to a monthly interest rate. The **Nper** argument is multiplied by 12 to convert the terms of the loan from years to months. Finally, the dialog box provides a definition for each argument, which appears when the input box for the argument is clicked.
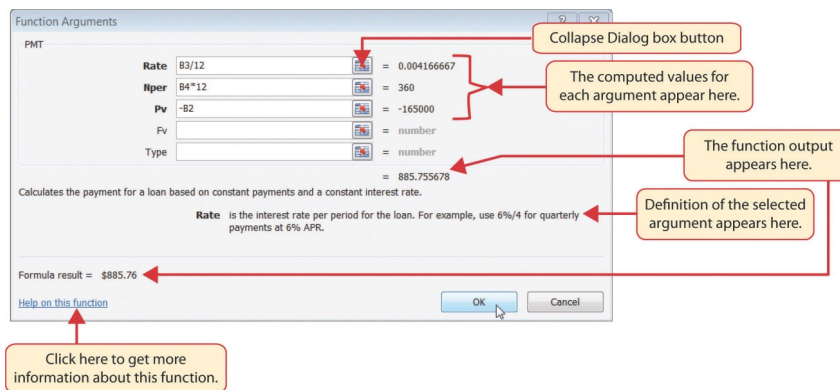
Figure 85: Function Arguments Dialog Box for the PMT Function

Figure 86 shows the final appearance of the *Mortgage Payments* worksheet after the *PMT* function is added. The result of the function in cell *B5* will be displayed in the *Budget Summary* worksheet.

Figure 86: Mortgage Payments Worksheet with the PMT Function

> **Integrity Check**
>
> **Comparable Arguments for PMT Function**
>
> When using functions such as *PMT*, make sure the arguments are defined in comparable terms. For example, if monthly payments of a loan are being calculated, make sure both the Rate and Nper argument are expressed in terms of months. The function will produce an erroneous result if one argument is expressed in years while the other is expressed in months.

2.3.3   *The Pmt (Payment) Function for Leases*

In addition to calculating the mortgage payments for a home, the *PMT* function will be used in the *Personal Budget* workbook to calculate the lease payments for a car. The details for the lease payments are found in the *Car Lease Payments* worksheet. Like the statistical functions, *PMT* function can be typed directly into a cell or the *Insert Function* button can be used. However, it is important to know the definitions for each argument of the function and understand how these arguments need to be defined based on the objective. The terms for loans and leases are in Table 7 and the definitions for the arguments of the *PMT* function are in Table 8. The following steps explain how the *PMT* function is added to the *Personal Budget* workbook to calculate the lease payments for a car.

1. Click cell **B6** in the **Car Lease Payments** worksheet.

2. Click **Formulas** ⇒ **Function Library** ⇒ **Financial** ⇒ **PMT**. This will open the *PMT Function Arguments* dialog box (see Figure 87).

3. Click the **Collapse Dialog** button next to the **Rate** argument in the *PMT Function Arguments* dialog box. This will be the first argument defined for the monthly car lease payment.

4. Click cell **B4**. This is the interest rate being charged for the lease.

5. Type the forward slash **/** for division.

6. Type the number **12**. Since the goal is to calculate monthly lease payments, divide the interest rate by 12 to convert the annual rate to a monthly rate.

7. Press the Enter key. This returns the *Function Arguments* dialog box to its expanded form. Notice that the **Rate** argument is now defined.

8. Click the **Collapse Dialog** button next to the **Nper** argument in the *Function Arguments* dialog box. This is the second argument defined in the function.

9. Click cell **B5**. This is the term or the length of time for the lease contract. Since the term is already expressed in months, just reference cell **B5** and move to the next argument. If the term was defined in years instead of months, it would need to be multiplied by 12 to convert the years to months.

10. Press the Enter key. This returns the *Function Arguments* dialog box to its expanded form. Notice that the **Nper** argument is now defined.

11. Click the **Collapse Dialog** button next to the **Pv** argument in the *Function Arguments* dialog box. This is the third argument defined in the function.

12. Type a minus sign **-**. Remember that cell locations or values used to define the **Pv** argument must be preceded with a minus sign.

13. Click cell **B2** on the worksheet, which is the price of the car.

14. Press the Enter key. Notice that the **Rate**, **Nper**, and **Pv** arguments are all defined for the function.

15. Click the *Collapse Dialog* button next to the **Fv** argument in the *Function Arguments* dialog box. This is the fourth argument defined in the function.

16. Click cell **B3** on the worksheet. This is the residual value of the car. Note that cell location and values used to define the **Fv** argument are NOT preceded by a minus sign.

17. Press the Enter key. Notice that the **Rate**, **Nper**, **Pv** and **Fv** arguments are all defined for the function.

18. Click the **Collapse Dialog** button next to the **Type** argument in the *Function Arguments* dialog box. This is the fifth and last argument defined in the function.

19. Type the number **1**, which assumes that the lease payments will be due at the beginning of each month. For payments made at the beginning of the period, a 1 is entered in the Type argument box and for payments made at the end of the period, a 0 is entered in the Type argument box.

20. Press the Enter key. Notice that the **Rate**, **Nper**, **Pv**, **Fv** and **Type** arguments are defined for the function (see Figure 87).

21. Click **OK** at the bottom of the *Function Arguments* dialog box. The function will now be placed into the worksheet.

Figure 87 shows how the the completed *Function Arguments* dialog box for the *PMT* function car lease should appear before pressing the *OK* button.
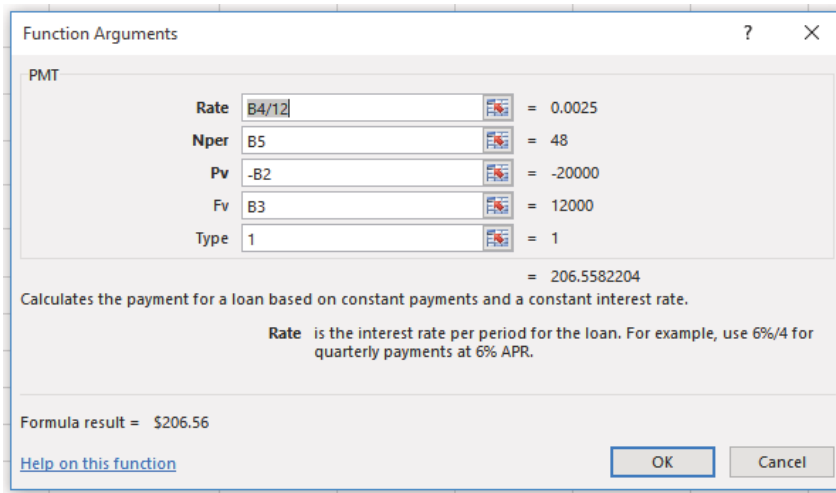
Figure 87: Function Arguments Dialog Box for the PMT Lease Function

Figure 88 shows the result of the *PMT* function for the car lease. The monthly payments for this lease are $206.56. This monthly payment will be displayed in the *Budget Summary* worksheet.

Figure 88: Results of the PMT Function in the Car Lease Payments Worksheet

Skill Refresher

PMT Function

- Type an equal sign =.
- Type the letters *PMT* followed by an open parenthesis, or double click the function name from the function list.
- Define the **Rate** argument with a cell location that contains the rate being charged by the lender for the loan or lease. If the interest rate given is an annual rate, divide it by 12 to convert it to a monthly rate.
- Define the **Nper** argument with a cell location that contains the amount of time to repay the loan or lease. If the amount of time is in years, multiply it by 12 to convert it to number of months.
- Define the **Pv** argument with a cell location that contains the principal of the loan or the price of the item being leased. Cell locations or values used for this argument must be preceded by a minus sign.
- Define the **Fv** argument with a cell location that contains the residual value of the item being leased or the lump sum payment for a loan.
- Define the **Type** argument with a 1 if payments are made at the beginning of each period or 0 if payments are made at the end of each period.
- Type a closing parenthesis).
- Press the Enter key.

2.3.4   *Linking Worksheets (Creating a Summary Worksheet)*

So far, cell references in formulas and functions allow Excel to produce new outputs when the values in the cell references are changed. Cell references can also be used to display values or the outputs of formulas and functions in cell locations on other worksheets. This is how data will be displayed on the *Budget Summary* worksheet in the *Personal Budget* workbook. Outputs from the formulas and functions that were entered in the *Budget Detail*, *Mortgage Payments*, and *Car Lease Payments* worksheets will be displayed on the *Budget Summary* worksheet using cell references. The following steps explain how this is accomplished.

1. Click cell **C3** in the **Budget Summary** worksheet.

2. Type an equal sign **=**.

3. Click the **Budget Detail** worksheet tab.

4. Click cell **D12** on the **Budget Detail** worksheet.

5. Press the Enter key. The output of the SUM function in cell **D12** on the **Budget Detail** worksheet will be displayed in cell **C3** on the **Budget Summary** worksheet.

Figure 89 shows how the cell reference appears in the *Budget Summary* worksheet. Notice that the cell reference D12 is preceded by the *Budget Detail* worksheet name enclosed in apostrophes followed by an exclamation point (*'Budget Detail'!*) This indicates that the value displayed in the cell is referencing a cell location in the *Budget Detail* worksheet.

Figure 89: Cell Reference Showing the Total Expenses in the Budget Summary Worksheet

As shown in Figure 89, the *Budget Summary* worksheet is designed to show the expense budget for the mortgage payments and the auto lease payments. However, recall that the *PMT* function was used to calculate the monthly payments. In the *Budget Summary* worksheet, the total annual payments must be shown. As a result, create a formula that references cell locations in the *Mortgage Payments* and *Car Lease Payments* worksheets and then multiply that amount by 12. The following steps explain how this is accomplished.

1. Click cell **C4** in the **Budget Summary** worksheet.

2. Type an equal sign **=**.

3. Click the **Mortgage Payments** worksheet tab.

4. Click cell **B5** in the **Mortgage Payments** worksheet.

5. Type an asterisk ***** for multiplication.

6. Type the number **12**. This multiplies the monthly payments by 12 to calculate the total payments required for the year. The formula in the formula bar should read: **='Mortgage Payments'!B5*12**

7. Press the [Enter] key. The value of multiplying the monthly mortgage payments by 12 is now displayed on the **Budget Summary** worksheet.

8. Click cell **C5** on the **Budget Summary** worksheet.

9. Type an equal sign **=**.

10. Click the **Car Lease Payments** worksheet tab.

11. Click cell **B6** in the **Car Lease Payments** worksheet.

12. Type an asterisk ***** for multiplication.

13. Type the number **12**. This multiplies the monthly lease payments by 12 to calculate the total payments required for the year.

14. Press the [Enter] key. The value of multiplying the monthly lease payments by 12 is now displayed on the **Budget Summary** worksheet.

Figure 90 shows the results of creating formulas that reference cell locations in the *Mortgage Payments* and *Car Lease Payments* worksheets.

Figure 90: Formulas Referencing Cells in Mortgage Payments and Car Lease
Payments Worksheets

Other formulas and functions can be added to the *Budget Summary* worksheet to calculate the difference between the total spend dollars vs. the total net income in cell D2. The following steps explain how this is accomplished.

1. Click cell **D6** in the **Budget Summary** worksheet.

2. Type an equal sign **=**.

3. Type the function name *SUM* followed by an open parenthesis **(**.

4. Select the range **C3:C5**.

5. Type a closing parenthesis **)** and press the ⟨Enter⟩ key or simply press the ⟨Enter⟩ key to close the function. The total for all annual expenses now appears on the worksheet.

6. Click cell **D7** on the **Budget Summary** worksheet. Enter a formula to calculate *Net Change in Cash* in this cell.

7. Type an equal sign **=**.

8. Click cell **D2**.

9. Type a minus sign **-** and then click cell **D6**.

10. Press the ⟨Enter⟩ key. This formula produces an output of $1,942, indicating the income is greater than the total expenses.

Figure 91 shows the results of the formulas that were added to the *Budget Summary* worksheet. The output for the formula in cell D7 shows that the net income exceeds total planned expenses by $1,942. Overall, having the income exceed expenses is a good thing because the surplus can be saved for future spending needs or unexpected events.

Figure 91: Formulas Added to Show Income Is Greater Than Expenses

Now, a few formulas can be added that calculate both the spending rate and the savings rate as a percentage of net income. These formulas require the use of absolute references, which were covered earlier in this chapter. The following steps explain how to add these formulas.

1. Click cell **E6** in the **Budget Summary** worksheet.

2. Type an equal sign **=**.

3. Click cell **D6**.

4. Type a forward slash **/** for division and then click **D2**.

5. Press the F4 key. This adds an absolute reference to cell **D2**.

6. Press the Enter key. The result of the formula shows that total expenses consume 94.1% of the net income.

7. Click cell **E6**.

8. Place the mouse pointer over the **Auto Fill Handle**.

9. When the mouse pointer turns to a black plus sign, left click and drag down to cell **E7** to copy and paste the formula into cell **E7**.

10. Save the **CH2-Personal Budget** file.

11. Compare the worksheet with the self-check answer key (**CH2-Personal Budget Solution**) and then close and submit the **CH2-Personal Budget** workbook as directed by the instructor.

Figure 92 shows the output of the formulas calculating the spending rate and savings rate as a percentage of net income. The absolute reference shown for cell D2 prevents the cell from changing when the formula is copied from cell E6 and pasted into cell E7. The results of the formula show that the current budget allows for a savings rate of 5.9%, which is a good savings rate.

Figure 92: Calculating the Savings Rate

> **Key Take-Aways**
>
> **Functions for Personal Finance**
>
> - The *PMT* function can be used to calculate the monthly mortgage payments for a house or the monthly lease payments for a car.
> - When using the *PMT* function, each argument must be separated by a comma.
> - To calculate the monthly payment for a loan using the *PMT* function, the **Rate** and **Nper** arguments must be defined in terms of months. The **Rate** should be divided by 12 to convert it from an annual rate to a monthly rate. The **Nper** should be multiplied by 12 to convert the term of the loan from years to months.
> - The *PMT* function produces a negative output if the **Pv** argument is not preceded by a minus sign. For the purposes of this textbook, a minus sign will be entered before the **Pv** argument in the *PMT* dialog box.

2.4   PREPARING TO PRINT

> **Learning Objectives**
>
> - Review and learn new cell formatting techniques.
> - Understand how to modify page scaling and margins.
> - Create custom headers and footers to automatically update information.

This section reviews some of the formatting techniques covered in Chapter 1, FUNDAMENTAL SKILLS, as well as introduces new techniques. A two-page worksheet will be previewed and then page setup options will be adjusted to present the data in a professional manner. A new data file will be used for this section.

Juliet's Bakery Supply
Monthly Sales Figures

Salesperson	Sales ID	January	February	March	April	May	June
Brown, John	BrownJ	$ 24,878	$ 19,227	$ 18,069	$ 13,553	$ 13,765	$ 19,042
Harris, Marc	HarrisM	18,381	19,762	16,539	5,635	10,640	18,877
Hodgson, Karen	HodgsonK	26,899	4,308	12,202	15,818	18,760	12,014
Johnson, Frank	JohnsonF	13,661	23,156	18,781	8,228	22,143	10,083
Martinez, Sarah	MartinezS	22,514	18,530	25,365	11,235	24,024	15,409
Miller, Brett	MillerB	19,889	1,919	2,656	27,110	17,294	20,678
Moore, Steve	MooreS	19,299	13,798	14,267	23,624	28,271	20,949
Smith, Mary	SmithM	7,866	20,043	29,699	15,629	23,391	8,926
Wilson, Diane	WilsonD	661	19,278	13,398	1,546	29,600	24,677
Totals		$ 154,047	$ 140,023	$ 150,975	$ 122,379	$ 187,888	$ 150,655

Printed on 12/9/2016   Filename: CH 2 Sales Data

Figure 93: Finished Prepare to Print Worksheet in Print Preview

2.4.1 *Formatting the Worksheet*

Sales data for a bakery supply company needs to be formatted in a professional manner. This worksheet will be printed and presented to investors, so it needs to be prepared for printing as well. Figure 93 shows how the finished worksheet will appear in Print Preview.

1. Click **File** ⇒ **Open** ⇒ **Browse**.

2. Navigate to **CH2-PTP Data** and click **Open**.

3. Click **File** ⇒ **Save As** ⇒ **Browse**.

4. Navigate to the desired file location and save it with the name **CH2-Sales Data**.

5. To change the font of the entire worksheet, click the **Select All** button in the top left corner of the worksheet grid (see Figure 94).

6. Change the font to Calibri, Size 12.
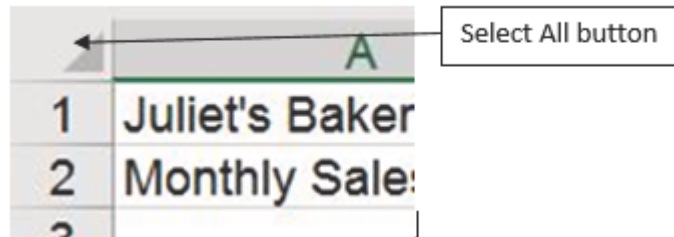
Figure 94: Select All button

Using the skills learned in Chapter 1, FUNDAMENTAL SKILLS, page 3, make the following formatting changes.

1. **A1:H1** — Merge and Center; font is 14 point bold; fill color is *Blue, Accent 1, Darker 25%*; font color is *White*

2. **A2:H2** — Merge and Center; font is 12-point bold italic; fill color is *Blue, Accent 1, Lighter 40%*; font color is *Black*

3. **A5:H5** — font is bold; fill color is *Blue, Accent 1, Lighter 40%*; font color is Black

4. **C5:H5** — Center align

5. **A15:H15** — Apply Top Border to the cells; format text as bold

6. **C6:H6** and **C15:H15** — Apply Accounting Number format with 0 decimal places

7. **C7:H14** — Apply Comma style with 0 decimal places

8. **A6:A14** (salespeople's names) — **Home ⇒ Alignment ⇒ Increase Indent**. This will indent the text from the cell border.
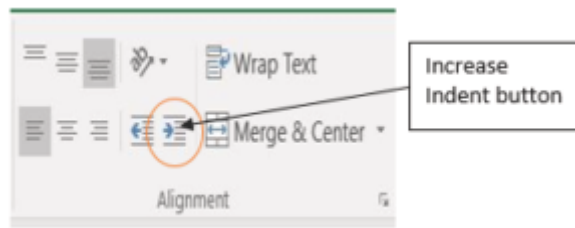
Figure 95: Increase Indent button

2.4.2 *Using Page Setup Options*

Once the worksheet is professionally formatted, look at it in *Print Preview* to see how the pages will print.

1. Click **File** to open the *Backstage* view.

2. Click **Print**.

3. Notice that the worksheet is currently printing on two pages, with the page breaking between the April and May columns. To fix this problem, first change the left and right margins while still in *Print Preview*.

4. Click **Page Setup** ⇒ **Margins Tab** (The Page Setup link is at the bottom of the settings column, see Figure 96).

5. Type in *0.5* for the Left Margin and *0.5* for the Right Margin.

6. Click **OK**. Changing the margins brought the May column onto the same page, but the June column is still on a separate page. Use Page Scaling to fix this while still in *Print Preview*.

7. Click the **Scaling** drop-down arrow in the Settings section (it is the last setting and, by default, is set for *No Scaling*, see Figure 96).

8. Select *Fit All Columns on One Page*.

9. Exit Backstage View by clicking the circled arrow at the top right corner of the screen.
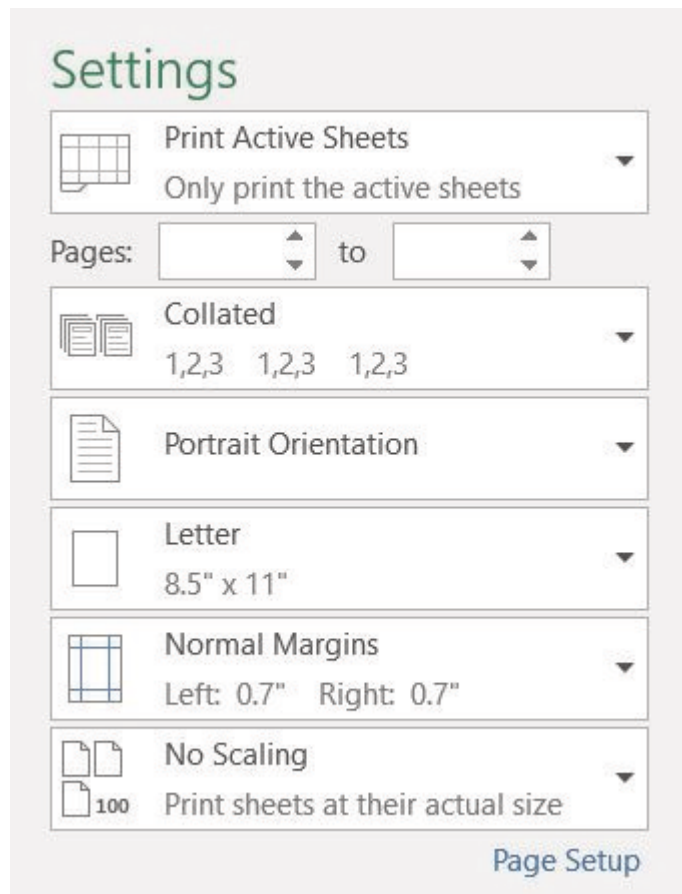
Figure 96: Settings section of Print Preview

2.4.3 *Creating a Footer Using Page Setup*

Now that the entire worksheet is printing on one page, add a footer
with information about the date the file was printed along with the
filename. Chapter 1, FUNDAMENTAL SKILLS, page 3, demonstrated
how to create headers and footers using the *Insert* ribbon tab. Headers
and footers can also be created using the *Custom Header/Footer* dialog
box.

1. Click **Page Layout** ⇒ **Page Setup** ⇒ **Dialog Box
   Launcher**. (Note, the *Dialog Box Launcher* is a small icon
   that looks like an arrow in a box found in the lower right
   corner of the *Page Setup* group.)

2. Click the **Header/Footer** tab in the *Page Setup* dialog box.
   A window similar to Figure 97 will appear.
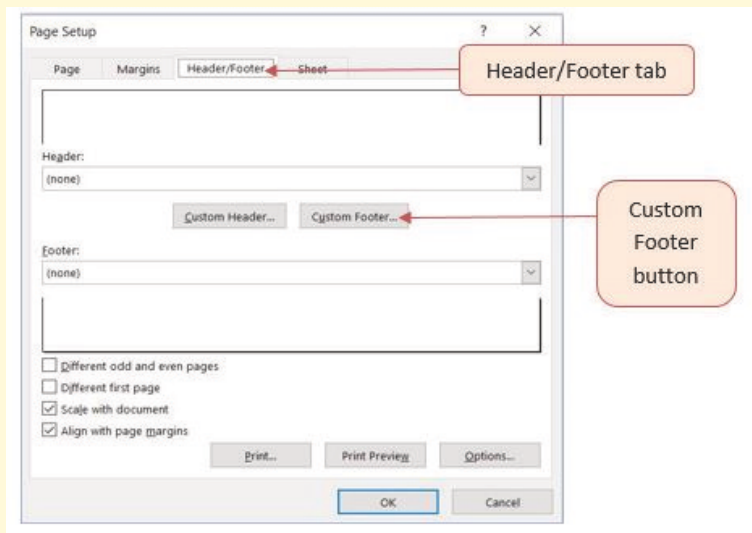
Figure 97: Page Setup Dialog Box

3. Click the **Custom Footer** button. The *Footer* dialog box will appear (see Figure 98).
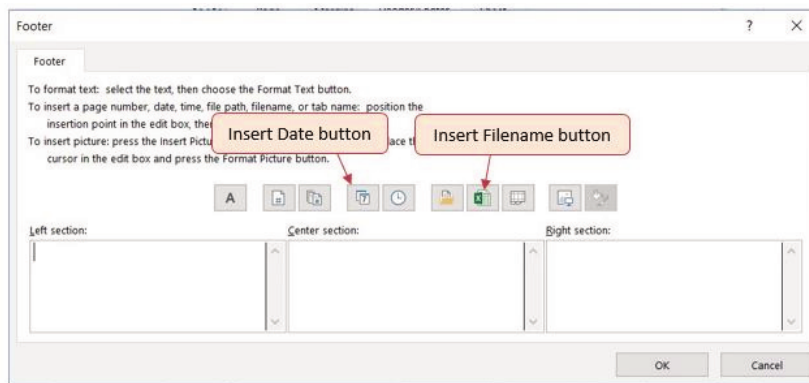
Figure 98: Footer Dialog Box

1. Click in the Left section box and type *Printed on*.

2. Making sure to leave a space after the word on, click the **Insert Date** button.

3. Click in the Right section box and type *Filename:*.

4. Making sure to leave a space after the colon, click the **Insert File Name** button.

5. The *Footer* dialog box should look like Figure 99.

6. Click the **OK** button. Click **OK** again to close the *Page Setup* dialog box.

7. Go to **File** ⇒ **Print** to see that the current date and file name are displayed in the footer.

8. Exit *Backstage* View.

9. Save the **CH2-Sales Data** file.

10. Compare the worksheet with the self-check answer key (**CH2-Sales Data Solution**) and then close and submit the **CH2-Sales Data** workbook as directed by the instructor.
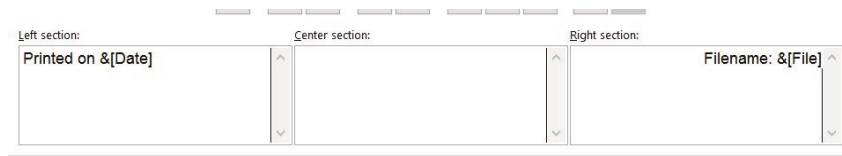
Figure 99: Completed Custom Footer Dialog Box

Key Take-Aways

Save

- It is important to always check workbooks in Print Preview to ensure that the data is printed in a professional and easy to read manner.
- Adjust margins and page scaling as needed to keep columns of data together on one page if possible.
- Use headers and footers to display information in the top and bottom margins of the printed worksheet.
- Use the Insert buttons to insert changing information, such as dates and file names, instead of typing them in directly.

2.5   CHAPTER PRACTICE

2.5.1   *Financial Plan for a Lawn Care Business*

Running a lawn care business can be an excellent way for young people to make money over the summer. It can also be a way to supplement existing income for the purpose of saving money for retirement or for a college fund. However, managing the costs of the business will be critical for it to be a profitable venture. In this exercise, a sim-

ple financial plan will be created for a lawn care business by using the skills covered in this chapter.

1. Open the file named **PR2-Data** and then Save As **PR2-Lawn Care**.

2. **Annual Plan** worksheet.

   a) Click cell **C5**.

   b) Write a formula that calculates the average price per lawn cut. Do *not* use the *AVERAGE* function. The formula should be the *Price per Acre * Average Acreage per Customer*.

   c) Click cell **C8**.

   d) Enter a formula that calculates the total number of lawns that will be cut during the year: *Number of Customers * Frequency of Lawn Cuts per Customer*.

   e) Click cell **D9**.

   f) Enter a formula that calculates the total sales for the plan: *Average Price per Cut * Total Lawn Cuts*.

3. **Leases** worksheet.

   a) Click cell **F3**. The **PMT** function will be used to calculate the monthly lease payment for the first item. For many businesses, leasing (or renting) equipment is a more favorable option than purchasing equipment because it requires far less cash. This enables someone to begin a business such as a lawn care business without having to put up a lot of money to buy equipment. The **PMT** function can be entered using the **Insert Function** button as seen in this chapter, or the **PMT** function can be typed directly into a cell. For this assignment, type the function into cell **F3** using the following instructions.

   b) Type **=PMT(**. Define the arguments of the function as follows.

      i. **Rate**: Click cell **B3**, type a forward slash **/** for division, type the number **12**, and type a comma **,**. Since monthly payments are being calculated, the annual interest rate must be converted to a monthly interest rate by dividing by 12.

      ii. **Nper**: Click cell **C3**, type ***12** and then type a comma **,**. Like the Rate argument, the terms of

the lease must be converted to months by multiplying by 12 since monthly payments are being calculated.

   iii. **Pv**: Type a minus sign **-**, click cell **D3**, and type a comma **,**. Remember that this argument must always be preceded by a minus sign.

   iv. **Fv**: Click cell **E3** (Residual Value) and type a comma **,**.

   v. **Type**: Type the number **1**, type a closing parenthesis **)**, and press the Enter key. This assumes the lease payments will be made at the beginning of each month, which requires that this argument be defined with a value of 1.

c) Copy the **PMT** function in cell **F3** and paste it into the range **F4:F6** or use the **Auto Fill Handle**.

d) Click cell **F10**.

e) Enter an Autosum function to calculate the total for the monthly lease payments. Make sure that blank rows (7 through 9) were included in the range for the **SUM** function so if other items are added later, they will be included in the output of the **SUM** function.

f) Select the range **A2:F6**.

g) The data in this range will be sorted, first by *Interest Rate* and then by *Price*. Click **Data ⇒ Sort & Filter ⇒ Sort**. In the *Sort* dialog box, select *Interest Rate* in the *Sort by* drop-down box. Select *Largest to Smallest* for the sort order. Then, click **Add Level**. Select *Price* in the *Then by* drop-down box. Select *Largest to Smallest* for the sort order. Click **OK**.

4. **Annual Plan** worksheet.

a) Click cell **B11**. The monthly lease payments that are calculated in the *Leases* worksheet will be displayed in this cell.

b) Type an equal sign **=**, click the **Leases** worksheet, click cell **F10**, and press the Enter key.

c) Click **C12**. Create a formula that calculates the annual lease payments. This should be the *Monthly Lease Payments* ∗12.

d) Click cell **C14**. Create a formula that calculates the Total Lawn & Equipment Expenses (*Lawn & Equipment Expenses per Cut * Total Lawn Cuts*).

e) Click cell **D16**. Enter a **SUM** function that adds the Expenses for the business in **Column C**. Make sure to add the *Expenses* only (not the *Sales Plan* information).

f) Click cell **D17**. Enter a formula that calculates the annual profit (*Operating Income*) for the business. This should be the *Total Sales – Total Expenses*.

g) Format all cells that contain money amounts for *Accounting Number Format* ($) with no decimals.

5. **Investments** worksheet.

a) Click cell **B10**.

b) Enter a **COUNT** function that counts the number of investments that currently have a balance in **Column B**. Make sure that the additional blank rows in **Row 6** through **Row 8** are included in the range for this function. The function output will automatically change if any new investments are added to the worksheet. It is important to note, however, that the *Total* in cell **B9** should not be included in the *Count* range.

c) Click cell **D3**.

d) Type an equal sign **=**. Click the **Annual Plan** worksheet. Click cell **D17** and type a forward slash **/** for division. Click the **Investments** worksheet. Click cell **B10** and press the ⏎Enter key. This formula divides the profit calculated on the **Annual Plan** worksheet by the number of investments in the **Investments** worksheet. This assumes that the profits from this business will be invested evenly among the funds listed in **Column A** of the **Leases** worksheet.

e) Before copying and pasting the formula created in cell **D3**, absolute references must be added to the cell locations in the formula. Edit the formula in cell **D3** on the **Investments** worksheet so that cells **D17** and **B10** are absolute. The formula in cell **D3** should be: *='Annual Plan'!$D$17/ Investments!$B$10*. When the formula is copied down

from cell **D3**, the cell references will not change, because they are absolute. The formula will continue to divide the Operating Income in cell **D17** of the Annual Plan by the Number of Investments in cell **B10** of the **Investments** sheet.

f) Copy cell **D3** and paste it into cells **D4** and **D5** or use the **Auto Fill Handle** to copy down.

g) Click cell **B9**.

h) Enter a **SUM** function that adds the current balance for all investments in **Column B**. Make sure that blank rows (**Row 6** through **Row 8**) are added to the range for the function so additional investments will automatically be included in the Autosum function output.

i) Copy the **SUM** function in cell **B9** and paste it into cell **D9**.

6. Format the **Investments** and **Leases** sheets appropriately for Accounting Format. This should include $ signs on the top row and total row for money amounts, and comma style in the middle rows.

a) On the **Investments** sheet, apply Accounting format with 0 decimals to **B3**, **D3 B9**, and **D9**. Apply Comma format with 0 decimals to the ranges **B4:B8** and **D4:D8**.

b) On the **Leases** worksheet, apply Accounting format with two decimals to the range **D3:F3** and **F10**. Apply Comma format with two decimals to the range **D4:F9**.

Double check that the formatting matches Figures 100, 101, and 102.

7. Save the **PR2-Lawn Care** workbook.

8. Compare the worksheet with the self-check answer key (**PR2-Lawn Care Solution**) and then close and submit the **PR2-Lawn Care** workbook as directed by the instructor.

	A	B	C	D
1	**Lawn Care Annual Financial Plan**			
2	**Sales Plan:**			
3	Price per Acre	$ 50		
4	Average Acreage per Customer	0.5		
5	Average Price per Cut		$ 25	
6	Number of Customers	30		
7	Frequency of Lawn Cuts per Customer	22		
8	Total Lawn Cuts		660	
9	**Total Sales**			$ 16,500
10	**Expenses:**			
11	Monthly Lease Payments	$ 122		
12	Annual Lease Payments		$ 1,461	
13	Lawn & Equipment Expenses Per Cut	$ 5		
14	Total Lawn & Equipment Expenses		$ 3,300	
15	Office and Other Expenses		$ 1,500	
16	**Total Expenses**			$ 6,261
17	**Operating Income**			$ 10,239
18				
19				
20				

Annual Plan | Investments | Leases

Figure 100: Completed Lawn Care Annual Plan Worksheet

	A	B	C	D
1	**Investment Analysis**			
2	**Investment Fund**	**Current Balance**	**Target Growth Rate**	**Annual Investments**
3	Treasury Bond	$ 10,000	4.5%	$ 3,413
4	Domestic Stock Fund	20,000	8.0%	3,413
5	Emerging Markets	10,000	10.5%	3,413
6				
7				
8				
9	**Total**	$ 40,000		$ 10,239
10	**Number of Investments**	3		
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Annual Plan | **Investments** | Leases

Figure 101: Completed Lawn Care Investments Worksheet

	A	B	C	D	E	F
1			Equipment Leasing Plan			
2	Item	Interest Rate	Terms of Lease in Years	Price	Residual Value	Monthly Payment
3	Blower	6.0%	3	$ 700.00	$ 200.00	$ 16.13
4	Commercial Lawn Mower	5.5%	4	6,000.00	3,000.00	83.14
5	Edger	4.0%	2	400.00	150.00	11.32
6	Trimmer	4.0%	2	350.00	100.00	11.15
7						
8						
9						
10	Total					$ 121.74
11						
12						
13						
14						
15						
16						
17						

Annual Plan   Investments   **Leases**   ⊕

Figure 102: Completed Lawn Care Leases Worksheet

2.6   SCORED ASSESSMENT

2.6.1   *Hotel Occupancy and Expenses*

The hotel management industry presents a wide variety of career opportunities, ranging from running a bed and breakfast to a management position at a large hotel. Regardless of the hotel management career, understanding hotel occupancy and costs are critical to running a successful operation. This exercise examines the occupancy rate and expenses of a small hotel.

1. Open the file named **SC2-Data** and then Save As **SC2-Hotel**.

2. Enter a formula in cell **C5** on the **Occupancy** worksheet to calculate the January capacity for the hotel. The capacity shows how many people the hotel can hold during the month. It is calculated by first multiplying the *Number of Rooms* by the *Occupants per Room* in the hotel. This result is then multiplied by the number of *Days in Month* (cell **B5** for January). Create this formula using absolute references so that the appropriate cells do not change when the formula is pasted throughout **Column C**. *Hint*: two of the cells in the formula need to be absolute references.

3. Copy the formula in cell **C5** and paste it into the range **C6:C16**. Use a paste method that does not remove the border at the bottom of cell **C16**.

4. Enter a formula in cell **E5** on the **Occupancy** worksheet to calculate the *Percent Occupied* of the hotel (this statistic shows what percentage of the hotel is full or occupied). The formula should divide the *Actual Occupancy* by the *Hotel Capacity*. Then copy and paste the formula into the range **E6:E16**. Use a paste method that does not remove the border at the bottom of cell **E16**. Format the results in **E5:E16** as percentages with two decimal places.

5. Enter a function in cell **C17** on the **Occupancy** worksheet that sums the values in the range **C5:C16**. Copy the function and paste it into cell **D17**.

6. Copy the formula in cell **E16** and paste it into cell **E17**. Make sure cell **E17** is formatted as a percentage with two decimals and bold.

7. On the **Statistics** worksheet, enter a function into cell **B3** that shows the highest value (Max) in the range **D5:D16** in the *Actual Occupancy* column on the **Occupancy** worksheet.

8. On the **Statistics** worksheet, enter a function into cell **B4** that shows the lowest value (Min) in the range **D5:D16** in the *Actual Occupancy* column on the **Occupancy** worksheet.

9. On the **Statistics** worksheet, enter a function into cell **B5** that shows the average value in the range **D5:D16** in the *Actual Occupancy* column on the **Occupancy** worksheet.

10. Use the **Auto Fill Handle** to copy the formulas in the range **B3:B5** to the range **C3:C5**.

11. Format the range **B3:B5** for comma format with zero decimal places. Format cells **C3:C5** as percentages with two decimal places.

12. The hotel is considering buying or leasing a car to shuttle customers to and from the airport. The hope is to keep the monthly payment under $400. On the **Lease or Buy** worksheet, type the terms in Figure 103 for the purchase vs. lease of the car. Make sure that dollar amounts and percentages are formatted to match Figure 103.

	Purchase	Lease
Price of Car	$ 25,000	$ 25,000
Residual Value		$ 15,000
Interest Rate (per year)	6.0%	7.0%
Terms of Loan (years)	6	3
Monthly Payment		

Figure 103: Terms for the Purchase vs. Lease of the Car

13. In cell **B8** create a **PMT** function to calculate the Monthly Payment if the car is purchased. Make sure the arguments in the **PMT** function are converted into months and that the Monthly Payment is a positive number.

14. In cell **C8** create a **PMT** function to calculate the Monthly Payment if the car is leased. The car will have a residual value of $15,000 when the lease is over. Assume that payments are made at the end of the month.

15. Format the Monthly Payments in **B8:C8** for Accounting Number Format with two decimals.

16. Select the range **A4:A8** and click the **Increase Indent** button once to indent the labels in **Column A**.

17. Click **Page Layout** ⇒ **Page Setup** ⇒ **Dialog Box Launcher**.

18. Center the **Lease or Buy** worksheet horizontally on the page.

19. Insert a footer on the **Lease or Buy** worksheet. Insert the date (use the **Insert Date** button) in the left section of the footer. Insert the File Name (use the **Insert File Name** button) in the right section of the footer.

20. Save and close the **SC2-Hotel** workbook.

21. Submit the **SC2-Hotel** workbook as directed by the instructor.

3

FORMULAS

Excel workbooks are designed to create useful and complex calculations. In addition to doing arithmetic, Excel can look up data and display results based on logical conditions. Finally, Excel can highlight specific results to enhance analysis. These skills will be demonstrated in the context of a typical grade book spreadsheet that contains the results for an imaginary Excel class.

> **Learning Objectives**
>
> - Use the *Quick Analysis Tool* to find the Total Points and Points Possible for all students.
> - Write a division formula to find the Percentage for each student, using an absolute reference to the *Total Points Possible*.
> - Write an *IF* Function to determine Pass/Fail where passing is 70% or higher.
> - Write a *VLOOKUP* to determine the Letter Grade using a Letter Grades scale.
> - Use the *TODAY* function to insert the current date.
> - Review common Error Messages using *Smart Lookup* to get definitions of some of the terms in the spreadsheet.
> - Apply *Data Bars* to the Total Points values.
> - Apply *Conditional Formatting* to the Percentage, Pass/-Fail, and Letter Grade columns.
> - Printing Review – Change to Landscape, Scale to Fit Columns on One Page and Set Print Area.

Figure 104 shows the completed workbook that will be demonstrated in this chapter. Notice the techniques used in *Column O* and *Column R* that highlight the results of the calculations. Notice, also that there are more numbers on this version of the file than in the original data file. These are all completed using Excel calculations.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1									CAS 170 Grades										
2									Thursday, August 25, 2016										
3														Final	Total			Letter	
4	Student Name	CH1	CH2	CH3	Test 1	CH4	CH5	CH6	Test 2	CH7	CH8	CH9	Test 3	Exam	Points	Percentage	Pass/Fail	Grade	
5	Andrews, DeShea	10	10	10	48	10	9	7	50	10	10	10	47		231	59%	Fail	F	
6	Coffey, Amber	8	7	8	38	8	7	7	36	8	8	8	39	113	295	76%	Pass	C	
7	Denson, Edward	9	8	8	35	6	5	0	30	0	0	0	0	0	101	26%	Fail	F	
8	Di, Nina	9	8	9	50	9	8	9	48	8	8	9	45	140	360	92%	Pass	A	
9	Gashi, Moesha	10	9	8	49	10	9	10	43	9	9	8	40	129	343	88%	Pass	B	
10	Gray, Emanuel	10	5	10	39	10	5	9	41	5	5	9	38	115	301	77%	Pass	C	
11	Klein, Tamar	9	10	8	42	9	8	6	33	10	5	0	31	99	270	69%	Fail	D	
12	Mansur, Yusuf	10	7	7	48	10	7	8	50	7	7	0	47	150	358	92%	Pass	A	
13	Naharro, Claudia	10	10	6	44	10	8	7	46	10	10	9	43	130	343	88%	Pass	B	
14	Persson, Thea	6	6	4	26	6	5	4	28	6	6	5	26	78	206	53%	Fail	F	
15	Popov, Olga	9	10	8	47	9	7	0	49	10	10	8	46	139	352	90%	Pass	A	
16	Prinosil, Jonas	7	5	5	30	7	5	7	31	5	5	6	29	88	230	59%	Fail	F	
17	Riley, Jordyn	10	9	9	46	10	6	9	48	9	9	9	45	136	355	91%	Pass	A	
18	Smirnov, Yuri	9	9	9	42	9	5	9	44	9	9	8	41	124	327	84%	Pass	B	
19	Sokolov, Yegor	10	8	10	48	10	7	10	44	8	8	10	41	130	344	88%	Pass	B	
20	Tan, Duong	10	9	8	41	9	9	8	43	9	9	10	40	121	326	84%	Pass	B	
21	Taylor, Jaquoya	9	10	9	50	5	10	9	50	10	10	7	50	148	377	97%	Pass	A	
22	Trong, Nguyen	9	10	7	44	10	0	7	32	0	0	6	29	101	255	65%	Fail	D	
23	Vesely, Katerina	8	6	6	38	8	6	6	40	6	6	0	38	114	282	72%	Pass	C	
24	Weller, Elijah	9	10	10	49	8	10	10	49	10	10	8	46	141	370	95%	Pass	A	
25	Points Possible	10	10	10	50	10	10	10	50	10	10	10	50	150	390				
26																			
27	Letter Grades																		
28	0%	F																	
29	60%	D																	
30	70%	C																	
31	80%	B																	
32	90%	A																	

Grades ⊕

Figure 104: Completed Grade Book Worksheet

3.1   MORE ON FORMULAS AND FUNCTIONS

> **Learning Objectives**
>
> - Review the use of the =*MAX* function.
> - Examine the *Quick Analysis Tool* to create standard calculations, formatting, and charts very quickly.
> - Create Percentage calculation.
>   - Use the *Smart Lookup* tool to acquire additional information about percentage calculations.
>   - Review the use of Absolute cell reference in a division formula.

3.1.1   *Another Use for =MAX*

Before moving on to the more interesting calculations discussed in this chapter, it is necessary to determine how many points it is possible for each student to earn for each of the assignments. This information will go into *Row* 25. The =*MAX* function is the tool of choice for this task.

> 1. Open the data file **CH3-Data** and save the file as **CH3-Grade Book**.

2. Click **B25**.

3. Start typing **=MAX** (See Figure 105). Note the explana-
   tion that pops up on the offered list of functions. Either
   keep typing **(** (an open parenthesis) or double click **MAX**
   from the popup list.

17	Riley, Jordyn	10	9	9	46	10	6	9	48	9	9	9	45	136
18	Smirnov, Yuri	9	9	9	42	9	5	9	44	9	9	8	41	124
19	Sokolov, Yegor	10	8	10	48	10	7	10	44	8	8	10	41	130
20	Tan, Duong	10	9	8	41	9	9	8	43	9	9	10	40	121
21	Taylor, Jaquoya	9	10	9	50	5	10	9	50	10	10	7	50	148
22	Trong, Nguyen	9	10	7	44	10	0	7	32	0	0	6	29	101
23	Vesely, Katerina	8	6	6	38	8	6	6	40	6	6	0	38	114
24	Weller, Elijah	9	10	10	49	8	10	10	49	10	10	8	46	141
25	**Points Possible**	=max												
26			MAX	Returns the largest value in a set of values. Ignores logical values and text										
27	Letter Grades		MAXA											
28		0% F												
29		60% D												
	Grades													

Figure 105: Entering a function

4. Select the range **B5:B24**. The calculation will update to:
   =MAX(B5:B24). Press Enter to complete the formula.

5. Now, use the **Auto Fill Handle** to copy **B25** to **C25:N25**.
   Note that as the calculation is copied from one column
   to the next, the cell references change. The calculation
   in **B25** reads: **=MAX(B5:B24)** and the one in **N25** reads
   =MAX(N5:N24). These cell references are called *relative*
   references.

By default, the calculations that Excel copies change their cell ref-
erences relative to the row or column they are copied to. That makes
sense. *Column N* should not display an answer that uses the values
from *Column K*.

To see all the calculations that were just created, press Ctrl + `` ` `` (that
is the back-tic near the one on the keyboard, see Figure 106) Ctrl + `` ` ``
displays the calculations (formulas) in each cell. Pressing Ctrl + `` ` `` a
second time will display calculations as values, which is the default
view for cells.

15	Popov, Olga	9	10	8	47	9	7	0	49	10	10	8	46	139
16	Prinosil, Jonas	7	5	5	30	7	5	7	31	5	5	6	29	88
17	Riley, Jordyn	10	9	9	46	10	6	9	48	9	9	9	45	136
18	Smirnov, Yuri	9	9	9	42	9	5	9	44	9	9	8	41	124
19	Sokolov, Yegor	10	8	10	48	10	7	10	44	8	8	10	41	130
20	Tan, Duong	10	9	8	41	9	9	8	43	9	9	10	40	121
21	Taylor, Jaquoya	9	10	9	50	5	10	9	50	10	10	7	50	148
22	Trong, Nguyen	9	10	7	44	10	0	7	32	0	0	6	29	101
23	Vesely, Katerina	8	6	6	38	8	6	6	40	6	6	0	38	114
24	Weller, Elijah	9	10	10	49	8	10	10	49	10	10	8	46	141
25	Points Possible	=MAX(B5:	=MAX(C5:	=MAX(D5	=MAX(E5:E24)	=MAX(F5:	=MAX(G5	=MAX(H5	=MAX(I5:I24)	=MAX(J5:	=MAX(K5:	=MAX(L5:	=MAX(M5:M2	=MAX(N5:N24)
26														

Figure 106: Relative References – Displayed as calculations.

3.1.2   *Quick Analysis Tool*

The *Quick Analysis Tool* creates standard calculations, formatting, and charts very quickly. In this exercise, it is used to insert the *Total Points* for each student in *Column O*.

If necessary, press Ctrl + 〔 to return the spreadsheet to the normal view (the results of the formulas in *Row* 25 should be displayed, not the formulas themselves).

1. Select **B5:N25**

2. In the lower right corner of the selection, notice the **Quick Analysis Tool** (see Figure 107).
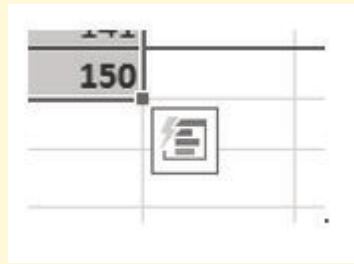
Figure 107: Quick Analysis Tool

3. In the **Quick Analysis Tool**, select **Totals ⇒ COLUMN SUM** (see Figure 108). (Note: there are two SUM buttons, the second will sum columns, as indicated by the tan-colored column indicator on the button.) Selecting the **COLUMN SUM** button places a *=SUM()* calculation all cells in **Column O**.
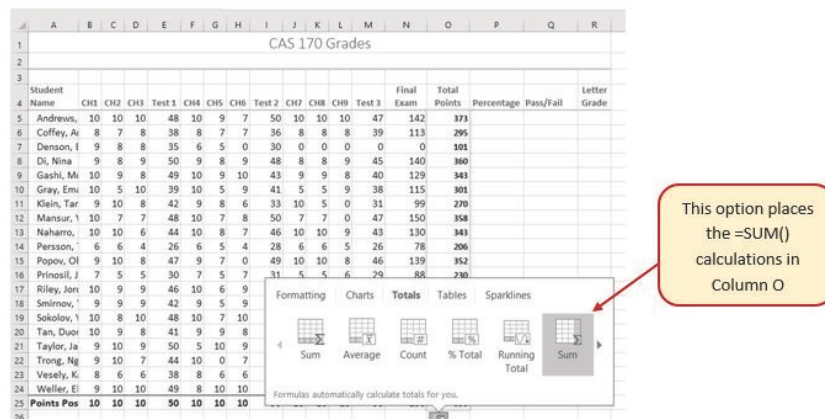
Figure 108: Quick Analysis Tool – Totals, Sum Column

3.1.3 *Percentage Calculation*

Column P requires a Percentage calculation. Before creating a calculation for this, it might be handy to know precisely what is needed. The *Smart Lookup* tool is a handy way to get more information if the computer is connected to the Internet.

> 1. Select cell **P4**.
>
> 2. Click **Review** ⇒ **Insights** ⇒ **Smart Lookup** (see Figure 109). This will find more about Percentage calculations. If this is the first time that the *Smart Lookup* tool has been used a privacy statement may pop up. Press the **Got it** button.

Excel searches the web for articles relevant to *percentage* and lists links to those articles. Figure 109 illustrates the result of the search done when this lesson was written, but that result will change depending on what information is available on the web.
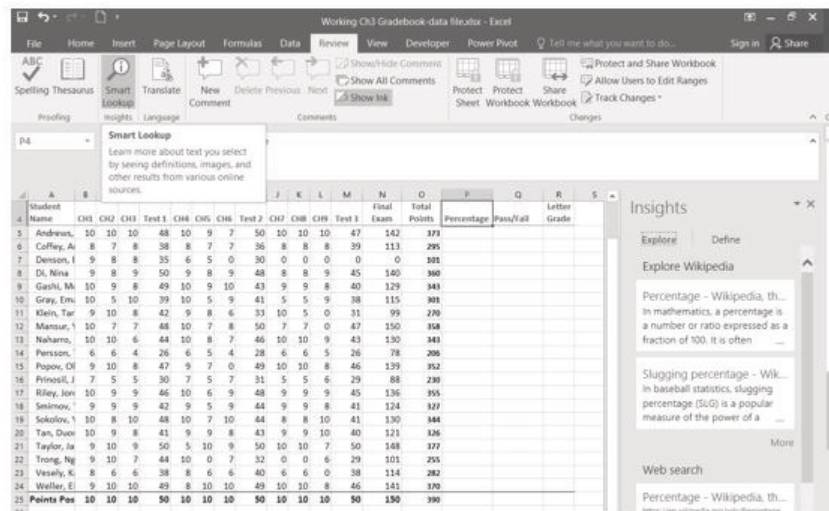
Figure 109: Smart Lookup tool

Now that the data needed for the *Percentage* calculation is known, a formula can be written so Excel will complete the calculation. The *Total Points* for each student must be divided by the *Total Points Possible*. Notice that there is a different number of points earned for each student, but there is only one *Total Points Possible* — the value in cell O25.

> 1. Click in **P5**.
>
> 2. Press **=** then click **O5**.

3. Enter **/**

4. Click **O25**. The calculation should look like **=O5/O25**.

5. Press [Enter] . The result of the formula should be 0.95641026. So far, so good. DeShea Andrews is doing well in this class, with a percentage grade of almost 96%—definitely an "A"!)

6. Next use the **Auto Fill Handle** to copy the calculation from **P5** to **P6:P24** to calculate the other students' grades. Unfortunately, this error message is displayed: #DIV/0. This message means that an attempt has been made to divide a number by 0 (zero), which is impossible. The formula in **P9** reads = O9/O29. The first cell reference is correct — it points to Moesha Gashi's total points for the class. But the second reference is wrong. It points to an empty cell, **O29**.

Figure 110: Illegal Cell Reference

Before copying the calculation, the second reference, (O25), must be changed to an absolute cell reference. That way, when it is copied down the column, the cell reference for O25 will be locked and will not change.

1. Click in **P5**.

2. In the *Formula Bar* click on **O25** (see Figure 111).

3. Press F4 to make the **O25** reference absolute. That way, it will not change when the cell is copied (see Figure 112). It is also easy enough to simply type a $ before the **O** and another one before the **25** for devices like tablets and laptops that may not have function keys.

4. Press Enter .

5. The formula in **P5** now looks like *=O5/$O$25*.

6. Click in **P5** and use the **Auto Fill Handle** to copy that cell to **P6:P24**. Now the formula has the correct values for all students.
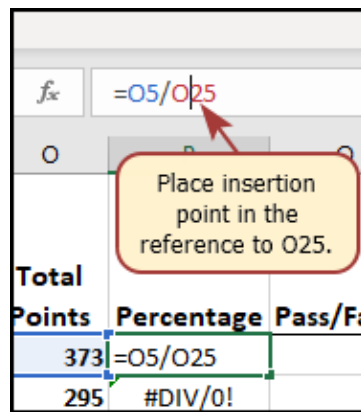
Figure 111: Editing a Formula
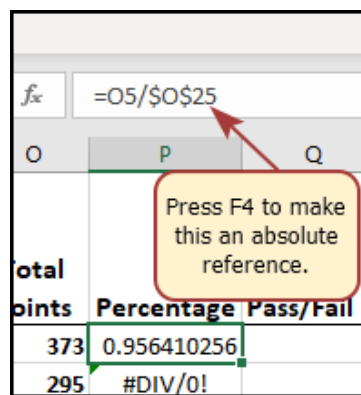
Figure 112: Absolute Cell reference – press F4

Those long decimals in the percent column are nonstandard so they should be changed to a percent by applying cell formatting.

1. Select the range **P5:P24**.

2. Click **Home** ⇒ **Number** ⇒ **% (Percent)**.

Skill Refresher

Absolute References

- Click in front of the column letter of a cell reference in a formula or function that should not be altered when the formula or function is pasted into a new cell location.
- Press the F4 key or type a dollar sign ($) in front of the column letter and row number of the cell reference.

Key Take-Aways

Functions

- Functions can be created using cell ranges or selected cell locations separated by commas. Make sure to use a cell range (two cell locations separated by a colon) when applying a statistical function to a contiguous range of cells.
- To prevent Excel from changing the cell references in a formula or function when they are pasted to a new cell location, use an absolute reference. Do this by placing a dollar sign ($) in front of the column letter and row number of a cell reference or by using the F4 function key.
- The *#DIV/0* error appears if a formula attempts to divide a constant or the value in a cell reference by zero, typically because it refers to an empty cell.

3.2 LOGICAL AND LOOKUP FUNCTIONS

Learning Objectives

- Use an *IF* Function to make logical comparisons between a value and what is expected.
- Create a *VLOOKUP* calculation to look up information in a table.
- Understand error messages.
- Understand how to enter and format Date/Time Functions.

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

3.2.1   *If Function*

The *IF* function is one of the most popular functions in Excel. It makes logical comparisons between a value and what was expected and then fills a cell based on that comparison. In its simplest form, the *IF* function says something like, *If the value in a cell is expected (true) then do this; otherwise do that*.

The *IF* function has three arguments.

- **Logical test**. This is the test to see if the value in a selected cell expected. A test can be something like "B7 = 14" or "B7 > 12" or "B7 < 6."

- **Value_if_true**. What to do if the requirements in the logical test are met, for example, if B7 is equal to 14 then fill the cell with text like "True," or "On budget!" Alternatively, this argument can contain a calculation, like B7 ∗ 2. That is, if B7 equals 14 then multiply it by 2. Finally, if Excel should put nothing at all in the cell then type "" (two empty quotes).

- **Value_if_false**. What to do if the requirements in the logical test are *NOT* met; for example, if *B7* does *NOT* equal 14. To have Excel do nothing, then type empty double quotes. Of course, Excel can also enter whatever text or calculation is desired.

For the grade book, *Column Q* should indicate whether a student is passing or failing the class. Students who score 70% or better are considered passing while scores less than 70% are failing.

1. Click in **Q5**.

2. Click **Formulas** ⇒ **Function Library** ⇒ **Logical** ⇒ **IF** (see Figure 113).
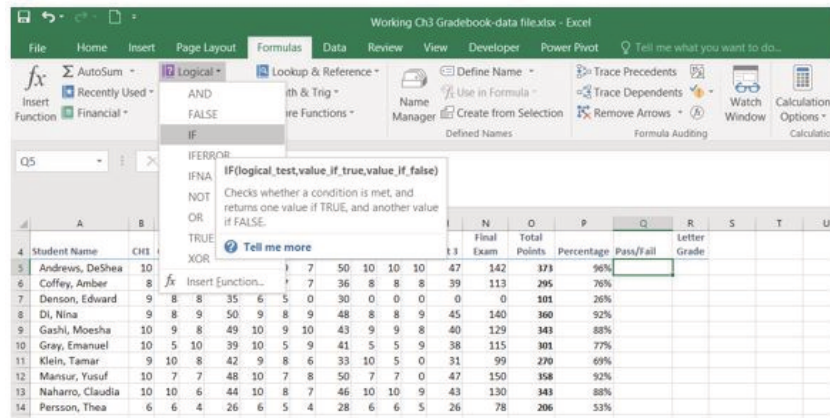
Figure 113: IF Function

The *IF Function* dialog box pops up with a place to enter each of the three arguments.

1. Click in the box for **Logical Test**. To test whether a student's score is less than 0.7 enter $P5 < 0.7$.

2. Click in the box for **Value_if_true**. If the student's score is less than 0.7, then they are failing the class. In this box, type *Fail*. Note: Excel automatically encloses the word *Fail* in quote marks.

3. Click in the box for **Value_if_false**. If the student's score is *NOT* less than 0.7, then they are passing the class. In this box, type *Pass*. Note: Excel automatically encloses the word *Pass* in quote marks.

4. Make sure that the dialog box matches Figure 114.
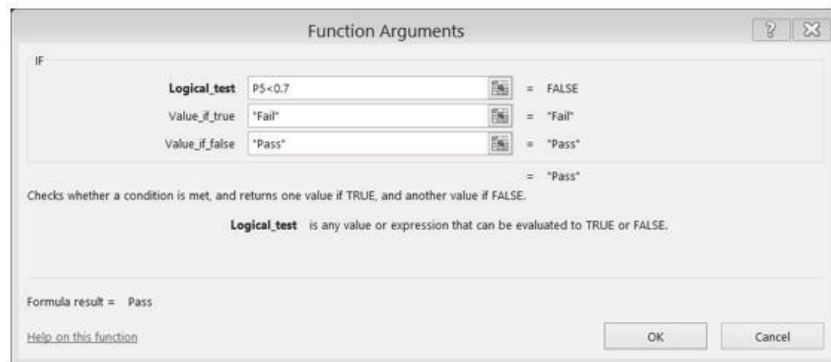
Figure 114: IF Function Dialog Box

Notice that as each box is filled, Excel offers a brief explanation of the contents (below the boxes.) In the lower left corner is the results

of the calculation so it can be checked before the function is inserted in the cell. In this case, DeShae is passing the class. Below that is a link to Help on this function. Selecting this link will open Excel help for this function, along with detailed information on how it works.

1. Once the required arguments are entered and checked, press **OK**.

2. The text *Pass* should be displayed in **Q5** because DeShae is passing the class.

3. Click on **Q5**. The formula bar should display the **IF** calculation: $= IF(P5 < 0.7,$*"Fail","Pass")* (see Figure 115).

4. Use the **Auto Fill Handle** to copy **Q5** to **Q6:Q24**.

Figure 115: IF Function Results

3.2.2 *Vlookup Function*

A *VLOOKUP* function is used to look up information in a table. Sometimes that table is on a different sheet in the workbook, though it can be in another file entirely. In this case, all students' grades are determined by their percentage score. For this grade book, the table that relates a score to a grade is in *A28:B32*.

There are four pieces of information that are needed to build the *VLOOKUP* function.

- The **Lookup_value** is the value to look up. For this exercise, the lookup value will be the student's percentage score in *Column P.*

- The **Table_array** is the range (or table) where the lookup values are located. In this example the table of percentages and corresponding letter grades is in the range *A28:B32*. The lookup value, or percentage grade in this case, should always be in the first column in the table array for *VLOOKUP* to work correctly.

- The **Col_index_num** is the column number in the range that contains the value to return. In this example, *A28:B32* is the *Table_array* range so *Column A* is the first column (1), *Column B* is the second column (2). To return the grade in *Column B*, the number 2 would be entered as the *Col_index_num*.

- The **Range_lookup** is TRUE for an *approximate* match or FALSE for an exact match. If this is left blank the default value is TRUE, or an approximate match.

Follow these steps to create the *VLOOKUP* to display the correct *Letter Grade* in *Column R*.

1. Click in **R5**.

2. Click **Formulas ⇒ Function Library ⇒ Lookup & Reference ⇒ VLOOKUP**. (See Figure 116).
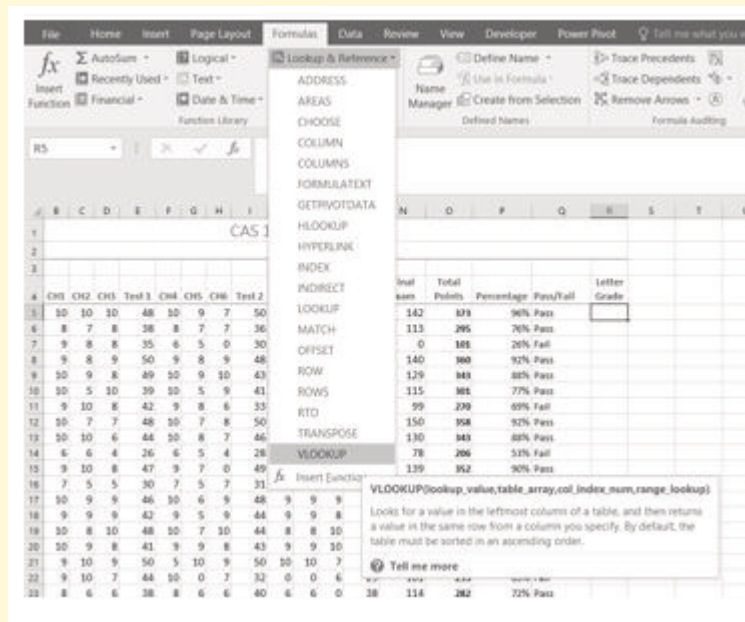
Figure 116: VLOOKUP Function

3. Fill in the dialog box so that it looks like Figure 117.

- **Lookup_value**. Specify the percentage score, which is in cell **P5** for the first student.

- **Table_array**. This is the range that contains the value to be 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. It is important that the cell references for the Table_array need to be absolute: **$A$28:$B$32**. When this function is copied to other cells the cell references should not change.

- **Col_index_number**. This is the column in the table array range that includes the information that should be returned. In this case, the grades are in the 2nd column of the range so the column index will be 2.

- **Range_lookup**. Since an approximate match is appropriate for this application the default value of TRUE is appropriate. Since that is the default, nothing needs to be entered for this value.

4. Be sure to observe the helpful definitions that Excel offers while filling in the **VLOOKUP** dialog box.

5. When the dialog box is complete, press **OK**.

6. The calculation in the formula bar is: **=VLOOKUP(P5,$A$28:$B$32,2)**

7. Use the **Auto Fill Handle** to copy **R5** to **R6:R24**.
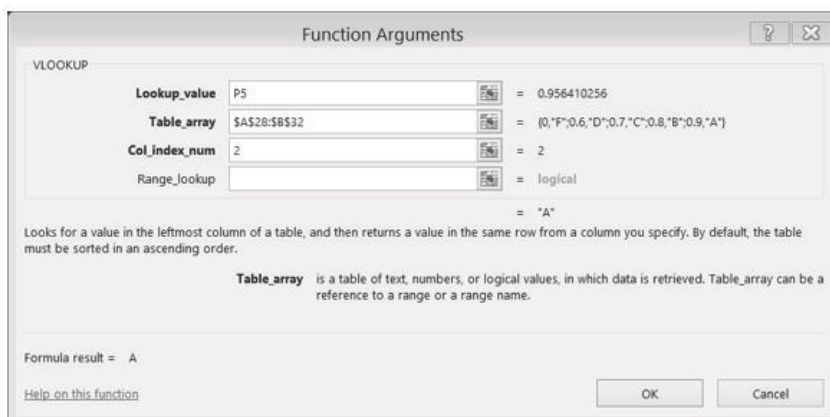
Figure 117: VLOOKUP completed dialog box

Figure 118 illustrates the grade book when the *VLOOUP* function is applied.

=VLOOKUP(P5,$A$28:$B$32,2)

CAS 170 Grades

CH4	CH5	CH6	Test 2	CH7	CH8	CH9	Test 3	Final Exam	Total Points	Percentage	Pass/Fail	Letter Grade
10	9	7	50	10	10	10	47	142	373	96%	Pass	A
8	7	7	36	8	8	8	39	113	295	76%	Pass	C
6	5	0	30	0	0	0	0	0	101	26%	Fail	F
9	8	9	48	8	8	9	45	140	360	92%	Pass	A
10	9	10	43	9	9	8	40	129	343	88%	Pass	B
10	5	9	41	5	5	9	38	115	301	77%	Pass	C
9	8	6	33	10	5	0	31	99	270	69%	Fail	D
10	7	8	50	7	7	0	47	150	358	92%	Pass	A
10	8	7	46	10	10	9	43	130	343	88%	Pass	B
6	5	4	28	6	6	5	26	78	206	53%	Fail	F
9	7	0	49	10	10	8	46	139	352	90%	Pass	A
7	5	7	31	5	5	6	29	88	230	59%	Fail	F
10	6	9	48	9	9	9	45	136	355	91%	Pass	A
9	5	9	44	9	9	8	41	124	327	84%	Pass	B
10	7	10	44	8	8	10	41	130	344	88%	Pass	B
9	9	8	43	9	9	10	40	121	326	84%	Pass	B
5	10	9	50	10	10	7	50	148	377	97%	Pass	A
10	0	7	32	0	0	6	29	101	255	65%	Fail	D
8	6	6	40	6	6	0	38	114	282	72%	Pass	C
8	10	10	49	10	10	8	46	141	370	95%	Pass	A
10	10	10	50	10	10	10	50	150	390			

Figure 118: VLOOKUP Complete

What if the *VLOOKUP* function does not work as expected? In this case, a mistake was made in either the calculation of the % scores in *Column P* or there is an error in the *VLOOKUP* function. To make repairs to the function, make sure that R5 is the active cell. On the Formula bar, press the *Insert Function* button (see Figure 119). That will reopen the dialog box to make repairs. A common error is to forget to make the cell references for the *Table array* absolute. Press *OK* when the correction is completed and then recopy the corrected function.
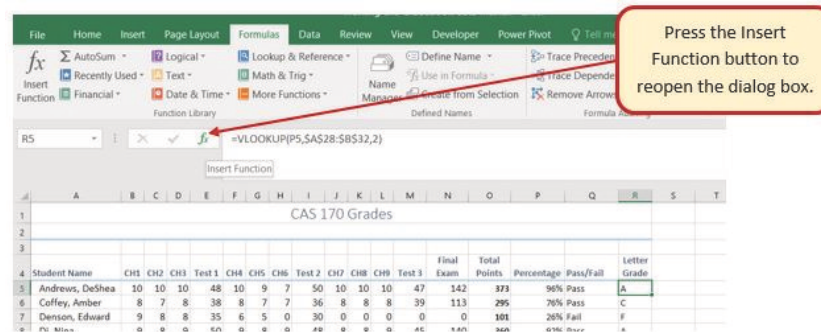
Figure 119: Insert Function

3.2.3 *Error Messages*

Sometimes Excel notices errors in the calculations and may post a slightly mysterious error message. Table 9 lists the common error messages that Excel displays along with their meanings[1].

Message	What Went Wrong
#DIV/0	The division operation refers to a cell that contains the value 0 or is blank.
#N/A	Technically, this is not an error value but a special value that can be manually entered into a cell to indicate that there is no value yet. This is a placeholder used while a spreadsheet is being developed.
#NAME?	This error value appears when a range name is incorrectly entered, or the name is deleted. Also, this commonly means that the formula is missing quotation marks around a text string.
#NULL	This error occurs if a space is used instead of a comma between ranges in function arguments. The formula needs to be carefully checked and corrected.
#NUM	This error is caused by an invalid argument in an Excel function or by a formula that produces a number too large or too small for the worksheet.
#REF	This error occurs when a cell referred to in a formula has been deleted.
#VALUE	This error is most often the result of specifying a mathematical operation that refers to one or more cells that contain text.

Table 9: Common Error Messages

3.2.4 *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 the spreadsheets. Dates and times fall into two general categories.

- **Remain the same.** For instance, if a spreadsheet includes data for May 15th then that date should not change each time the spreadsheet is accessed.

- **Change to reflect the current date/time.** When it is important to have the current date or time on a spreadsheet then Excel should update the information regularly.

---

1 Table 9 was adapted from https://www.dummies.com/software/microsoft-office/excel/understanding-excel-2010s-formula-error-values/

Look at the functions at *Formulas ⇒ Function Library ⇒ Date & Time* (see Figure 120).
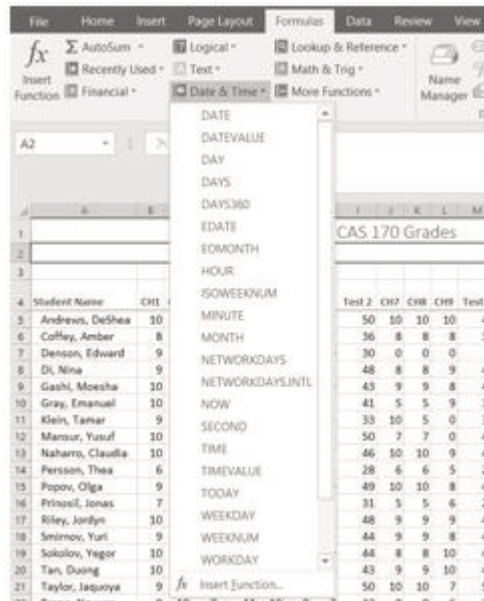
Figure 120: Date & Time Functions

For the grade book, the date and time should be displayed in *A2*, and it needs to be updated whenever the workbook file is opened.

1. Click in **A2**. Notice that **A2** extends all the way from **Column A** to **Column R**. Previously, the **Merge & Center** tool was used on this cell to make it match the width of the title in **Row 1**.

2. Click **Formulas ⇒ Function Library ⇒ Date & Time ⇒ NOW**.

3. Click **OK**.

4. The result in the formula bar is: **=NOW()** and the result 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 it does not need any information to do its job and the results will change frequently.

5. Wait at least one minute and then click in **A2** and press F9 to update the time.

Excel will update this field automatically whenever the file is saved, reopened, or printed. It may also happen more frequently than that, depending on how Excel is set up.

Another variation of the current date is the *TODAY* function.

1. Click in **A2**. Press ⌨Delete to remove the **NOW** function.

2. Click **Formulas** ⇒ **Function Library** ⇒ **Date & Time** ⇒ **TODAY**.

3. Click **OK**.

4. The result in the formula bar is **=TODAY()** and the result in **A2** is the current date. Since the time was not requested it is likely 12:00 *AM*. That is not helpful, so the date format needs to be adjusted.

5. Click **Home** ⇒ **Number** ⇒ **Number Format Launcher** (see Figure 121).

6. In the *Format Cells* dialog box, click the *Number* tab. Choose the **Date** category and select the second option, **Wednesday, March 14, 2012** (this format is called *Long Date*).

7. Click **OK**.

8. The current day and date should now be displayed in **A2**.
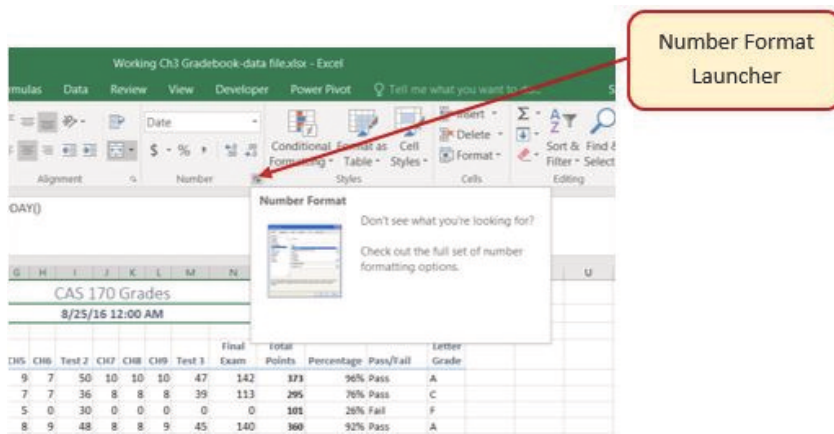
Figure 121: Number Format Launcher

Keyboard Shortcuts

Static Date and Time

- ⌨CTRL + ⌨; (semicolon) inserts the current date
- ⌨CTRL + ⌨: (colon) inserts the current time.

> **Key Take-Aways**
>
> **Date Functions**
>
> - Functions do not always have to be about arithmetic. Excel provides functions that helps perform logical evaluations, look things up, and work with dates and times.
> - Excel displays error messages when formulas and functions are not constructed properly.

3.3   CONDITIONAL FORMATTING

> **Learning Objectives**
>
> - Use Conditional Formatting techniques to provide flexible highlighting or applying specified formatting only when certain conditions are met. Techniques include:
>   - **Data bars**. Makes it easy to visualize values in a range of cells.
>   - **Cell Rules**. Highlights values that match specified requirements.

3.3.1   *Initiating Conditional Formatting*

All necessary calculations are now in the *CAS 170 Grades* spreadsheet. However, the grade book contains a lot of data. To make it easier to quickly find the most important pieces of data, Excel provides *Conditional Formatting*.

1. Select the range **O5:O24**.

2. At the bottom of the selection, click on the **Quick Analysis Tool**. This is a popup tool with an icon that looks like a spreadsheet with colored lines.

3. Click **Formatting** ⇒ **Data Bars** (see Figure 122).

Excel places blue bars on top of the values; long blue bars for larger numbers, shorter ones for smaller numbers. This makes it easier to see how well each student did in the class immediately without having to look at the specific numbers.

	A	B	C	D	E	
1	Ticket Sales Last Season	20,000.00				
2	Revenue Per Ticket	$ 8.00		**Projection**		
3	Revenue Last Season	$160,000.00		Growth	Revenue	
4	Projected Growth	0%			160000	
5	Revenue This Season	$160,000.00		0.50%		
6				1.00%		
7				1.50%		
8				2.00%		
9				2.50%		
10				3.00%		
11				3.50%		
12				4.00%		
13				4.50%		
14				5.00%		
15						

Data Table   ?   ✕

Row input cell:

Column input cell: :d_Growth

OK   Cancel

Figure 122: Data Bars on the Quick Analysis tool

Following is another way to apply Data Bars.

1. Select the range **O5:O24**.

2. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Data Bars**.

3. From there, data bars of different colors and opacities can be selected (see Figure 123).
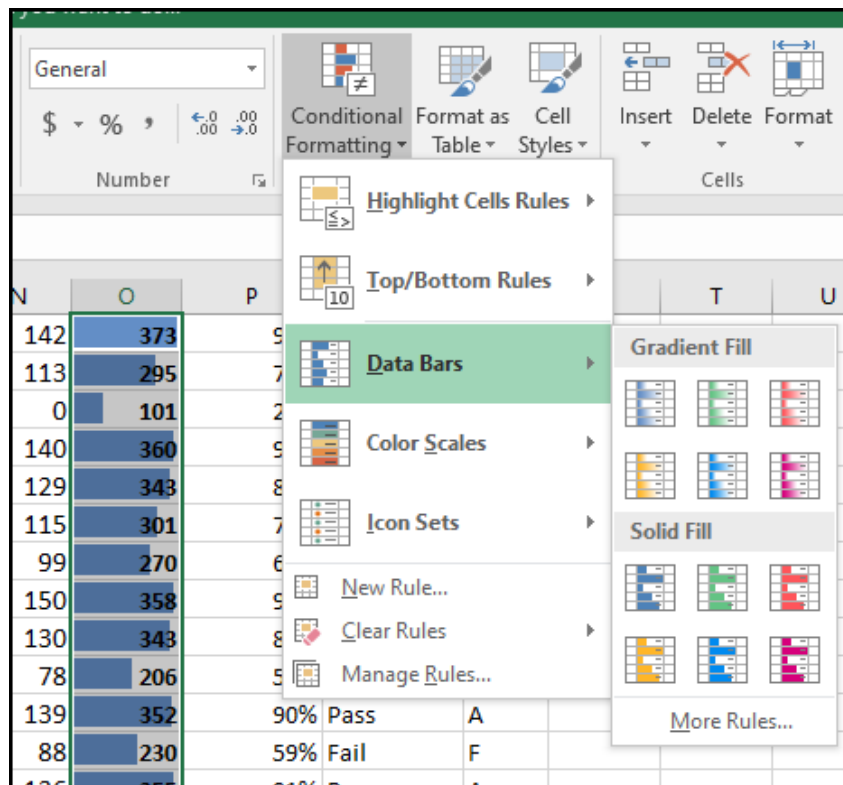
Figure 123: Data Bars on the Conditional Formatting tool

It is even more important to highlight the students who are failing in the class, so that will be done in two places, the *Percentages* and *Letter Grade* columns. To start, any *F* letter grades should be formatted with a light red fill color and dark red text.

1. Select the range **R5:R24**.

2. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Highlight Cells Rules** (see Figure 124).

3. Select **Equal To**

4. Enter **F** in the *Format cells that are EQUAL TO* text box, so those cells are highlighted with **Light Red Fill with Dark Red Text** (see Figure 125).

5. Click **OK**.
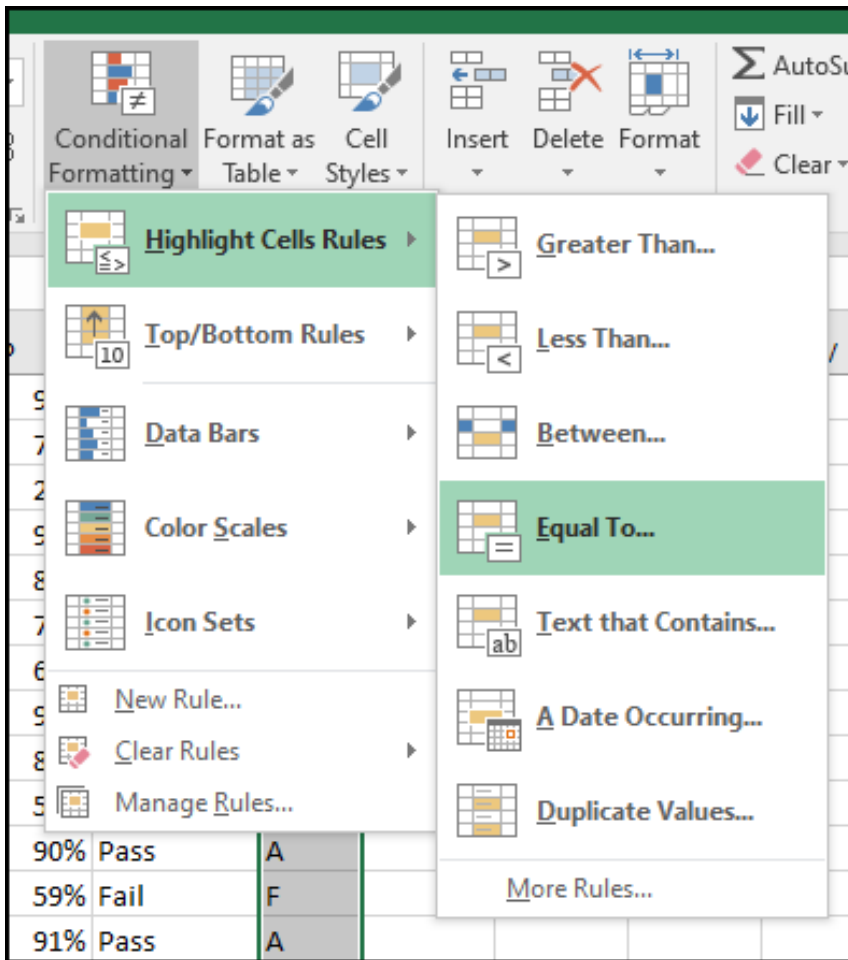
Figure 124: Conditional Formatting Equal To
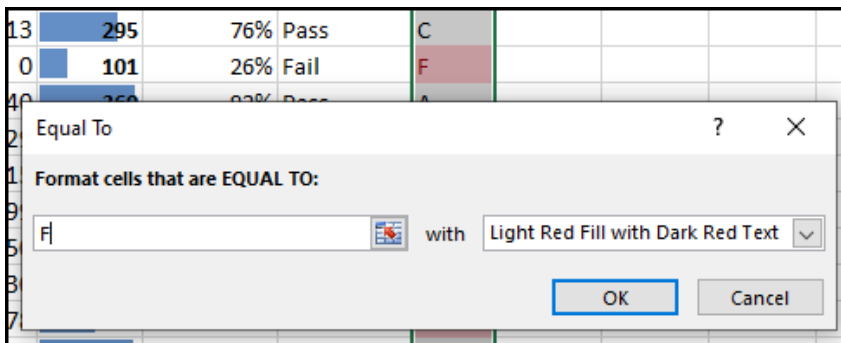
Figure 125: Conditional Formatting Equal To Dialog Box

Now, highlight students who are passing the class. This time use the Pass/Fail text in the Pass/Fail column. If the text for a student is *Pass* the cell should be formatted with a yellow fill and dark yellow text.

1. Select the range **Q5:Q24**.

2. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Highlight Cells Rules** (see Figure 124).

3. Select **Equal To**

4. Enter *Pass* in the *Format cells that are EQUAL TO* text box, so those cells are highlighted with **Yellow Fill with Dark Yellow Text**.

5. Click **OK**.

The default styles are a simple way to make specified data stand out, but any cell formatting can be set. When using custom cell formatting, it is probably a good idea to include other styling in addition to color. Remember that spreadsheets are often printed in black and white so conditional formatting that relies only on color would be lost. Next, use conditional formatting to display any *Percentages* that are less than 60% with red text formatted in bold and italic.

1. Select the range **P5:P24**.

2. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Highlight Cells Rules** (see Figure 124).

3. Select **Less Than**

4. Fill out the *Less Than* dialog box so that cells that are less than 0.6 (that is 60%) will have conditional formatting. Instead of using the default red text on a light red fill, press the down arrow at the end of the *with* box and select **Custom Format**.

5. On the *Font* tab of the *Format Cells* dialog box, in the *Font style* box, select **Bold Italic**. In the *Color* box, select **Red** (see Figure 126).

6. Press **OK**. Then press **OK** again.
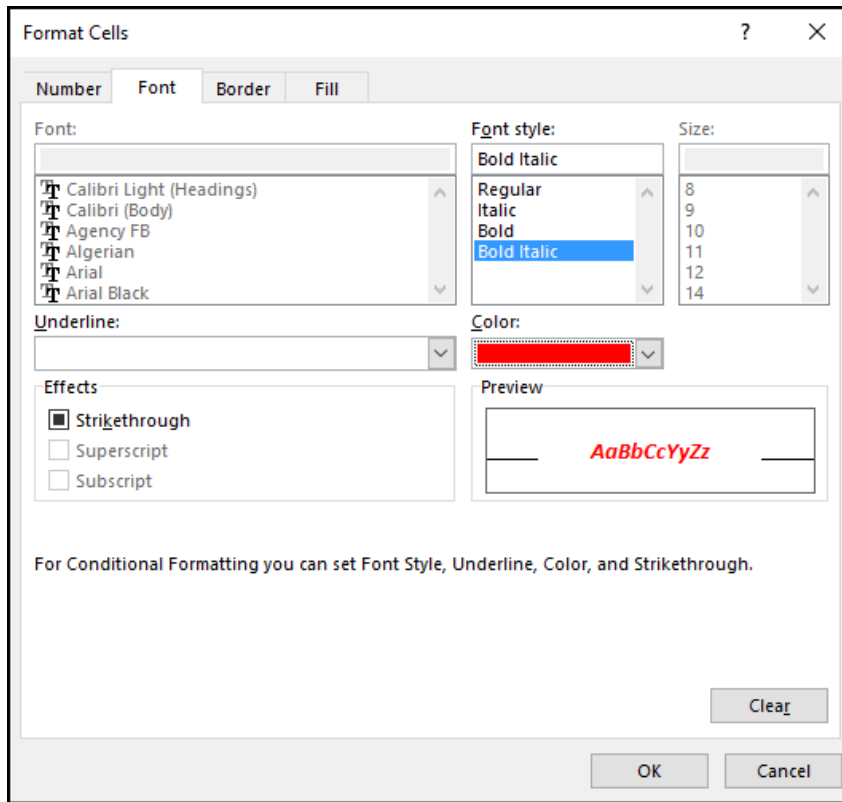
Figure 126: Conditional Formatting Custom Format Cells Dialog box

Conditional Formatting is valuable since it reflects the current data and it changes whenever the data changes. To test this, delete DeShea's final exam score. (Click N5 then press ⌈Delete⌉ on the keyboard.) Suddenly, DeShae is failing the course and the Conditional Formatting reflects that. Press ⌈CTRL⌉ + ⌈Z⌉ (Undo). The test score reappears, and the Conditional formatting reflects that as well.

3.3.2 *Modifying Conditional Formatting*

What if there is a mistake with the Conditional Formatting or it needs to be deleted altogether? Use the *Conditional Formatting Manage Rules* tool. The following steps remove the conditional formatting rule that formats the *Pass* text with yellow and modify the minimum passing percentage.

1. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Manage Rules**.

2. Select **This Worksheet** for *Show formatting rules for* (see Figure 127).

3. Since there is no need to highlight the students who are passing the class, click the second rule in the *Rules Manager* ("Cell Value = 'Pass'") and press the **Delete Rule** button.
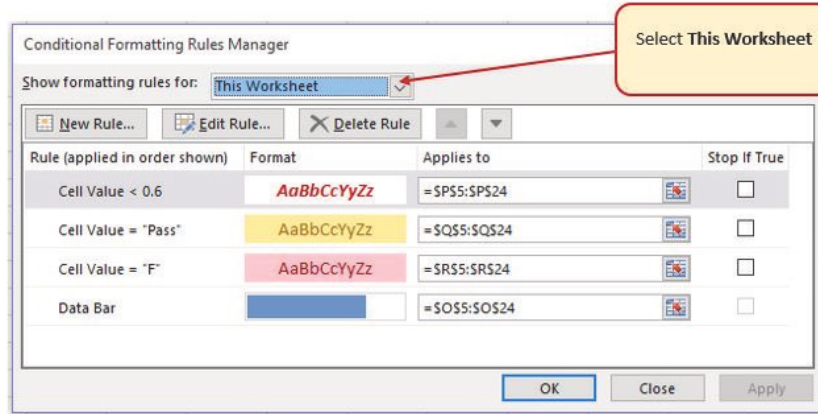
Figure 127: Conditional Formatting Manage Rules

In a previous exercise (the *IF* function), it was decided that students were failing if they got a percentage score of less than 70%, so the *Conditional Formatting* rule in the *Percentage* column needs to be changed to match that value.

1. Click the first rule, it reads *Cell Value* < 0.6.

2. Click the **Edit Rule** button and change the 0.6 to 0.7 (see Figure 128).

3. Click **OK** (or **Apply**) two times.
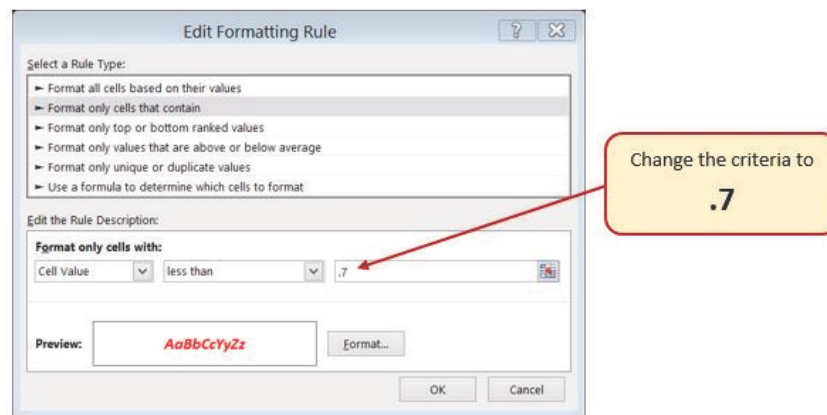
Figure 128: Conditional Formatting Edit Formatting Rule Dialog box

Double check that the completed workbook matches Figure 129.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1								CAS 170 Grades											
2								Wednesday, September 28, 2016											
3																			
4	Student Name	CH1	CH2	CH3	Test 1	CH4	CH5	CH6	Test 2	CH7	CH8	CH9	Test 3	Final Exam	Total Points	Percentage	Pass/Fail	Letter Grade	
5	Andrews, DeShea	10	10	10	48	10	9	7	50	10	10	10	47	142	373	96%	Pass	A	
6	Coffey, Amber	8	7	8	38	8	7	7	36	8	8	8	39	113	295	76%	Pass	C	
7	Denson, Edward	9	8	8	35	6	5	0	30	0	0	0	0	0	101	26%	Fail	F	
8	Di, Nina	9	8	9	50	9	8	9	48	8	8	9	45	140	360	92%	Pass	A	
9	Gashi, Moesha	10	9	8	49	10	9	10	43	9	9	8	40	129	343	88%	Pass	B	
10	Gray, Emanuel	10	5	10	39	10	5	9	41	5	5	9	38	115	301	77%	Pass	C	
11	Klein, Tamar	9	10	8	42	9	8	6	33	10	5	0	31	99	270	69%	Fail	D	
12	Mansur, Yusuf	10	7	7	48	10	7	8	50	7	7	0	47	150	358	92%	Pass	A	
13	Naharro, Claudia	10	10	6	44	10	8	7	46	10	10	9	43	130	343	88%	Pass	B	
14	Persson, Thea	6	6	4	26	6	5	4	28	6	6	5	26	78	206	53%	Fail	F	
15	Popov, Olga	9	10	8	47	9	7	0	49	10	10	8	46	139	352	90%	Pass	A	
16	Prinosil, Jonas	7	5	5	30	7	5	7	31	5	5	6	29	88	230	59%	Fail	F	
17	Riley, Jordyn	10	9	9	46	10	6	9	48	9	9	9	45	136	355	91%	Pass	A	
18	Smirnov, Yuri	9	9	9	42	9	5	9	44	9	9	8	41	124	327	84%	Pass	B	
19	Sokolov, Yegor	10	8	10	48	10	7	10	44	8	8	10	41	130	344	88%	Pass	B	
20	Tan, Duong	10	9	8	41	9	9	8	43	9	9	10	40	121	326	84%	Pass	B	
21	Taylor, Jaquoya	9	10	9	50	5	10	9	50	10	10	7	50	148	377	97%	Pass	A	
22	Trong, Nguyen	9	10	7	44	10	0	7	32	0	0	6	29	101	255	65%	Fail	D	
23	Vesely, Katerina	8	6	6	38	8	6	6	40	6	6	0	38	114	282	72%	Pass	C	
24	Weller, Elijah	9	10	10	49	8	10	10	49	10	10	8	46	141	370	95%	Pass	A	
25	Points Possible	10	10	10	50	10	10	10	50	10	10	10	50	150	390				
26																			
27	Letter Grades																		
28	0%	F																	
29	60%	D																	
30	70%	C																	
31	80%	B																	
32	90%	A																	
33																				
34																				

Figure 129: Completed Ch3-grade book

3.3.3 Setting the Print Area

Before this workbook is finished, it needs to be prepared for printing. The first thing to do is set the *Print Area* so that the table of *Letter Grades* in *A27:B32* does not print.

1. Select **A1:R25**. This is the only part of the worksheet to be printed.

2. Click **Page Layout** ⇒ **Page Setup** ⇒ **Print Area** ⇒ **Set Print Area**.

Next, preview the worksheet in *Print Preview* to check that the print area setting worked and to make sure it is printing on one page.

1. Click **File** ⇒ **Print**.

2. Set the orientation to **Landscape**.

3. Change the scaling so that the entire worksheet prints on one page.

4. Close the print preview by clicking the arrow at the top left corner of the preview screen.

5. Save the **CH3-Grade Book** workbook.

6. Compare the worksheet with the self-check answer key (**CH3-Grade Book Solution**) and then close and submit the **CH3-Grade Book** workbook as directed by the instructor.

3.4   PREPARING TO PRINT

> **Learning Objectives**
>
> - Locate and fix formatting consistency errors.
> - Apply new formatting techniques.
> - Use Print Titles to repeat rows and columns on each page of a multiple page worksheet.
> - Control where page breaks occur in a multiple page worksheet.

In this section, a worksheet will be reviewed for formatting consistency and two new formatting techniques are presented. The worksheet used in this section currently prints on four pages, so new page setup options are used to control how these pages print.

3.4.1   *Reviewing Formatting for Consistency*

The workbook used for this exercise contains data about the national parks in the western United States. The workbook has been formatted but needs to be reviewed for consistency and prepared for printing. Figure 130 shows how the second page of the finished worksheet will appear in *Print Preview*.

Figure 130: Completed National Parks worksheet

3.4.2   *Reviewing Formatting for Inconsistencies*

The first thing to do is review the worksheet for formatting inconsistencies.

1. Open the data file named **CH3-PTP Data** and use the *File/Save As* command to save it as **CH3-National Parks**.

2. Scroll through the worksheet and locate the following formatting errors.

   - The formatting of the *Utah* label does not match the other states.

   - The *Year Established* values for *Hawaii* are not center aligned like the other years.

   - The cells for the *Nevada* data should have the same green fill color as the other alternating states.

   - The number of digits after the decimal place for the *Size* values is inconsistent. Also, these values should be formatted with *Comma* style to make them easier to read.

3. Complete the following steps to fix these errors.

   - Select **A34:A38**.

   - Click **Home** ⇒ **Alignment** ⇒ **Merge & Center**.

- Change the font size to 16 and apply Bold format.
- Select **C28:C29**.
- Click **Home** ⇒ **Alignment** ⇒ **Center**.
- Select **A31:E31**.
- Apply a fill of *Green, Accent 6, Lighter 60%*.
- Select **E4:E43**.
- Click **Home** ⇒ **Number** ⇒ **Comma**.
- Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until one digit appears after the decimal place for all values.

4. While these formatting errors are being corrected all typos should also be corrected.

3.4.3 *Fine-Tuning Formatting*

Now that the formatting inconsistencies have been corrected, apply additional formatting techniques to make the worksheet look better. Start by vertically aligning the names of the states within the cells.

1. Select **A4:A43** (the cells with the state labels).

2. Click **Home** ⇒ **Alignment** ⇒ **Middle Align** (see Figure 131). Notice that the names of the states are now centered between the top and bottom borders of the cells.
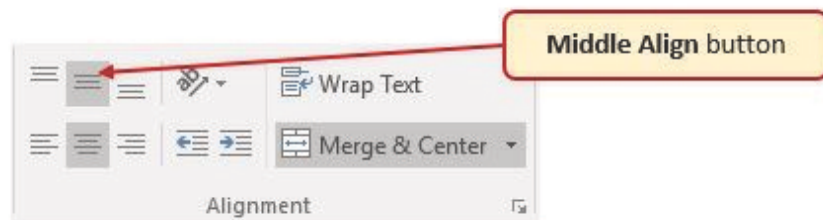
Figure 131: Alignment Group

The next formatting correction is to change the label in E3 from *Size (km2)* to *Size (km²)* with the 2 after *km* formatted as a superscript.

1. Double-click on cell **E3** to enter *Edit* mode

2. Select just the 2 (be careful not to select anything else).

3. Click **Home** ⇒ **Font** ⇒ **Dialog Box Launcher**.

4. In the Effects section of the *Format Cells* dialog box, check the box for **Superscript** (see Figure 132).

5. Click **OK**.

6. Save the **CH3-National Parks** file.
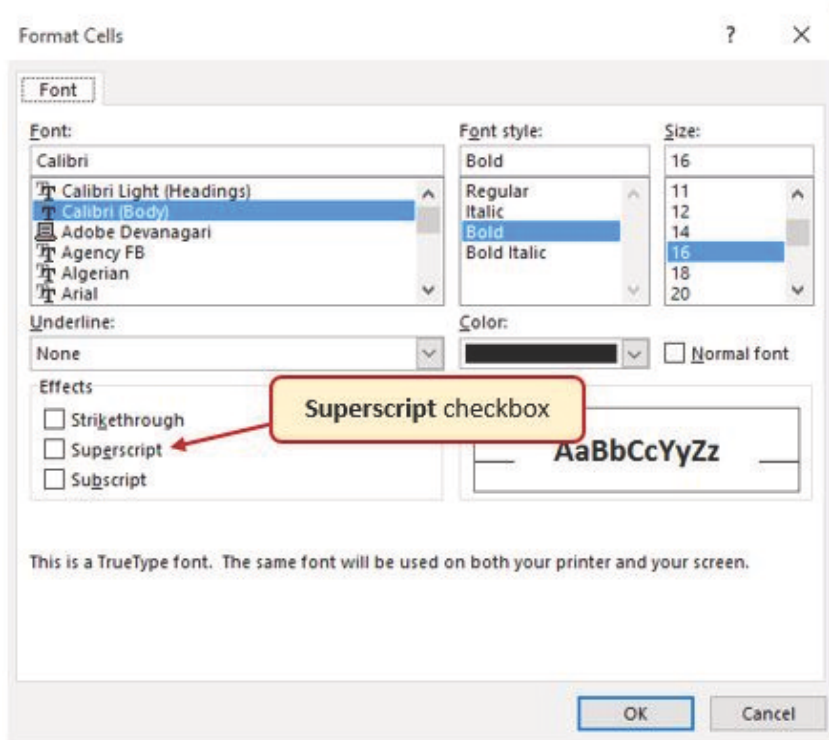
Figure 132: Font Tab in Format Cells Dialog Box

3.4.4   *Repeating Column (And Row) Labels*

Now that the cell and text formatting are corrected, review the worksheet in *Print Preview*. Notice that the worksheet is printing on multiple pages and it is not possible to know what each column of data represents on some of the pages.

1. With the **CH3-National Parks** file still open, click **File** ⇒ **Print**.

2. Click through each of the pages using the page number identifier at the bottom of the preview. The worksheet is currently printing on four pages, with the *City* and *Sizes*

columns printing on separate pages from the rest of the data.

3. Using the **Orientation** button on the left side of the preview, change the orientation to *Landscape* to fit all the columns on one page. Unfortunately, the second and third pages have no column labels to identify the information in each column.

4. Exit *Print Preview* by clicking the arrow button at the top left corner of the preview.

5. Click **Page Layout** ⇒ **Page Setup** ⇒ **Print Titles**. The dialog box shown in Figure 133 should appear.
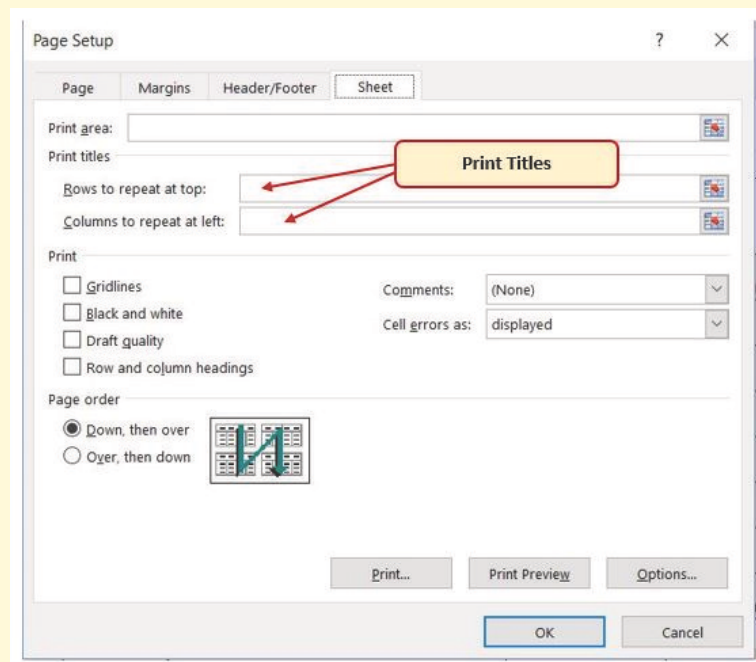
Figure 133: Print Titles

6. Click the **Collapse Dialog** button next to the **Rows to repeat at top:** text box in the *Page Setup* dialog box.

7. In the worksheet, select **Row** 1 through **Row** 3.

8. Press the [Enter] key. This returns the *Page Setup* dialog box to its expanded form. Notice that that the *Rows to repeat at top* argument is now defined as $1:$3.

9. Click **OK**.

The worksheet does not change in Normal view, so return to *Print Preview*. While in *Print Preview*, notice that the pages are breaking

in the middle of the information for a single park, but that will be corrected next.

1. Click **File** $\Rightarrow$ **Print**. Notice that the first three rows are now repeated at the top of each page.

2. Exit *Print Preview* by clicking the arrow button at the top left corner of the preview.

Skill Refresher

Creating Print Titles

- Open the *Page Setup* dialog box and click the *Sheet* tab.
- Click in the *Rows to repeat at top:* box or the *Columns to repeat at left:* box.
- Click in the worksheet and select the row(s) or column(s) to be repeated on each page.

3.4.5 *Inserting Page Breaks*

Notice that the data for California is split between the first and second pages. Since it is desirable to keep all the data for each state on the same page, the page breaks need to be adjusted. Start by inserting a page break before the California data to force it to start on the second page, then move the page break for the third page if needed. To make these changes work in *Page Break Preview*.

1. Click **View** $\Rightarrow$ **Workbook Views** $\Rightarrow$ **Page Break Preview**. The screen should be like Figure 134.

Figure 134: Page Break Preview

In *Page Break Preview*, automatic page breaks are displayed as dotted blue lines. Notice the dotted blue lines after *Row* 20 and *Row* 37, which indicate where Excel will start a new page. For this worksheet, the first page should break at the *California* data, so insert a manual page break there.

1. Select cell **A15**. When inserting a page break, select the cell *below* where the page break should appear.

2. Click **Page Layout** ⇒ **Page Setup** ⇒ **Breaks** ⇒ **Insert Page Break** (see Figure 135).

3. There is now a solid blue line after *Row* 14, which indicates a manual page break was inserted.

4. Click **File** ⇒ **Print**. Notice that the California data now starts on the second page.
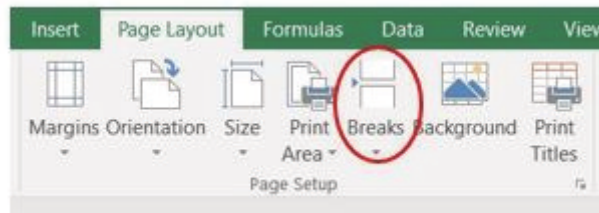
Figure 135: Breaks Button on Page Layout tab

After looking at each page in *Print Preview* it was decided that the third page should start with *Montana*. To make this change, move the automatic page break that appears after *Nevada*.

1. Exit *Print Preview* by clicking the arrow button at the top left corner of the preview.

2. Switch back to *Page Break Preview* if needed.

3. Locate the dotted blue line (automatic page break) after **Row 31**.

4. Put the pointer over the dotted blue line, and it will switch to a vertical double-headed arrow. Click on the dotted blue line and drag it above **Row 30** (Montana).

5. The line will now be a solid blue line, indicating a manual page break.

6. Click **File ⇒ Print**. The Montana row now appears at the top of the third page.

While evaluating the pages in *Print Preview* it appears that there is too much white space at the bottom of the pages. To fix this, center the contents vertically on the pages.

1. Click the **Page Setup** link at the bottom of the *Settings* section of *Backstage View* to open the *Page Setup* dialog box.

2. Click on the **Margins** tab.

3. In the *Center on page* section, check the box for **Vertically** then click **OK**.

4. Review each page in *Print Preview* to see the changes.

5. Exit *Print Preview* by clicking the arrow button at the top left corner of the preview.

3.4.6 *Creating a Header and Footer Using Page Layout View*

Now that the worksheet is printing on three pages, with page breaks in appropriate places, it is time to add a header with the current date and filename. A footer will also be added with the page number and the total number of pages that will appear as *Page 1 of 3*.

1. Click **View** ⇒ **Workbook Views** ⇒ **Page Layout**.

2. The white space at the top of the worksheet should say *Add header*.

3. Place the mouse pointer over the left section of the *Header* and click to activate that section.

4. Click **Header & Footer Tools Design** ⇒ **Header & Footer Elements** ⇒ **Current Date** (see Figure 136). Inserting the date this way will insert a field that will update every time the workbook is opened. (**Excel 365** This tab is called **Header & Footer**.)

5. Place the mouse pointer over the right section of the *Header* and click to activate that section.

6. Click **Header & Footer Tools Design** ⇒ **Header & Footer Elements** ⇒ **Filename** (see Figure 136). Inserting the filename this way will insert a field that will update if the filename is changed.

7. Click **Header & Footer Tools Design** ⇒ **Navigation** ⇒ **Go to Footer**.

8. In the center section of the footer, type the word *Page* with a space after it.

9. Click **Header & Footer Tools Design** ⇒ **Header & Footer Elements** ⇒ **Page Number** (see Figure 136), then type a space after the *&[Page]* code that appears.

10. Type the word *of* with a space after it.

11. Click **Header & Footer Tools Design** ⇒ **Header & Footer Elements** ⇒ **Number of Pages** (see Figure 136). The footer should match Figure 137.

12. Click anywhere on the worksheet to close the *Footer* editing.

13. Click **File** ⇒ **Print**. Check that the date and file name are in the header and the page numbers in the footer are correct.

14. Exit *Print Preview* by clicking the arrow button at the top left corner of the preview.

15. Save the **CH3-National Parks** workbook.

16. Compare the worksheet with the self-check answer key (**CH3-National Parks Solution**) and then close and submit the **CH3-National Parks** workbook as directed by the instructor.
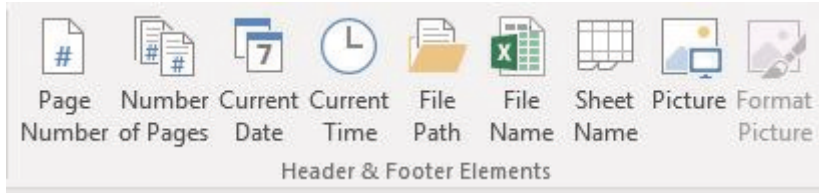
Figure 136: Header & Footer Elements buttons
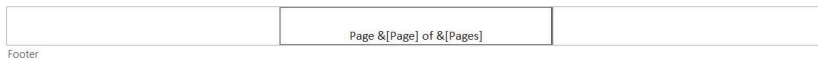
Figure 137: Completed Footer

Skill Refresher

Inserting Page Numbers

- In Page Layout View, click in the section of the header or footer where the page number should appear.
- Type the word *Page* followed by a space.
- Click *Header & Footer Tools Design* ⇒ *Header & Footer Elements* ⇒ *Page Number*. This will create *Page* 1.
- Type a space after the *&[Page]* code then type the word *of* followed by a space.
- Click *Header & Footer Tools Design* ⇒ *Header & Footer Elements* ⇒ *Number of Pages*. This will create *Page* 1 *of* 4.

> **Key Take-Aways**
>
> **Preparing to Print**
>
> - Always check the formatting of worksheets for consistency.
> - If a worksheet is printing on multiple pages, use *Print Titles* to repeat rows at the top and/or columns at the left of every page to make it easier to interpret the data.
> - Insert manual page breaks as needed in *Page Break Preview* to control where a new page begins.
> - Multiple page worksheets should include the page number in either the header or footer. Be sure to insert the Page Number element so that the correct page number will display on each page of the worksheet.

3.5   CHAPTER PRACTICE

3.5.1   *Household Budget*

Elijah and Kelly Williams are a recently married couple living in Portland, Oregon. Elijah works part time and attends the local community college. Kelly works as a marketing manager at a clothing company in North Portland. They are trying to decide if they can afford to move to a better apartment, one that is closer to work and school. They want to use Excel to examine their household budget. They have started their budget spreadsheet, but they need help with it.

1. Open the file named **PR3-Data** and then save it as **PR3-Williams**.

2. Insert two new rows at the top of the worksheet.

3. Enter the following text in the indicated cells.

   - **A2**: *Category*
   - **B2**: *Item*
   - **C2**: *January*
   - **O2**: *Yearly Total* (adjust column width as needed to fit this text)

4. Starting in **C2**, use the **Auto Fill Handle** to fill in the months *February* through *December* in cells **D2:N2**. Adjust the widths of **Column C** to **Column N** to 10.

5. Select **A2:O2**.

6. Click **Home** ⇒ **Font** ⇒ **Bold**.

7. Click **Home** ⇒ **Alignment** ⇒ **Center**.

8. Click **A1** and enter *Williams Family Budget*.

9. Select **A1:O1**.

10. Click **Home** ⇒ **Alignment** ⇒ **Merge & Center**.

11. Select **A1:O1**.

12. Click **Home** ⇒ **Font** ⇒ **Bold**.

13. Click **Home** ⇒ **Font** ⇒ **22 point**.

14. Fill the cells for fixed expenses.

    a) Copy **C3:C4** and paste to **D3:N4**.

    b) Copy **C8:C9** and paste to **D8:N9**.

    c) Copy **C25** and paste to **D25:N25**.

    d) Copy **C27** and paste to **D27:N27**.

    e) Copy **C41** and paste to **D41:N41**.

15. Select **O3:O44**.

16. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum**.

17. Delete the formulas from **O7**, **O17**, **O24**, **O32**, and **O38**.

18. Select **C6**.

19. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum**. Make certain that Excel selects **C3:C5** for the *AutoSum* function then press Enter . This will calculate the *Total Income* for January.

20. Use the **Auto Fill Handle** to copy **C6** to **D6:O6**.

21. Select **C16**.

22. Click **Formulas** ⇒ **Function Library** ⇒ **AutoSum**. Make certain that Excel selects **C8:C15** for the *AutoSum* function then press Enter . This will calculate the *Total Home Expenses* for January.

23. Use the **Auto Fill Handle** to copy **C16** to **D16:O16**.

24. Select **C23**.

25. Click **Formulas ⇒ Function Library ⇒ AutoSum**. Make certain that Excel selects **C18:C22** for the *AutoSum* function then press Enter. This will calculate the *Total Daily Living Expenses* for January.

26. Use the **Auto Fill Handle** to copy **C23** to **D23:O23**.

27. Select **C31**.

28. Click **Formulas ⇒ Function Library ⇒ AutoSum**. Make certain that Excel selects **C25:C30** for the *AutoSum* function then press Enter. This will calculate the *Total Transportation Expenses* for January.

29. Use the **Auto Fill Handle** to copy **C31** to **D31:O31**.

30. Select **C37**.

31. Click **Formulas ⇒ Function Library ⇒ AutoSum**. Make certain that Excel selects **C33:C36** for the *AutoSum* function then press Enter. This will calculate the *Total Entertainment Expenses* for January.

32. Use the **Auto Fill Handle** to copy **C37** to **D37:O37**.

33. Select **C45**.

34. Click **Formulas ⇒ Function Library ⇒ AutoSum**. Make certain that Excel selects **C39:C44** for the *AutoSum* function then press Enter. This will calculate the *Total Personal Expenses* for January.

35. Use the **Auto Fill Handle** to copy **C45** to **D45:O45**.

36. Select **C3:O3**.

37. Click **Home ⇒ Number ⇒ Accounting**.

38. Click **Home ⇒ Number ⇒ Decrease Decimal** until there are no decimal places displayed.

39. Click **Home ⇒ Font ⇒ Top Border**

40. Select **C16:O16**.

41. Click **Home ⇒ Number ⇒ Accounting**.

42. Click **Home ⇒ Number ⇒ Decrease Decimal** until there are no decimal places displayed.

43. Click **Home ⇒ Font ⇒ Top Border**

44. Select **C23:O23**.

45. Click **Home** ⇒ **Number** ⇒ **Accounting**.

46. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

47. Click **Home** ⇒ **Font** ⇒ **Top Border**

48. Select **C31:O31**.

49. Click **Home** ⇒ **Number** ⇒ **Accounting**.

50. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

51. Click **Home** ⇒ **Font** ⇒ **Top Border**

52. Select **C37:O37**.

53. Click **Home** ⇒ **Number** ⇒ **Accounting**.

54. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

55. Click **Home** ⇒ **Font** ⇒ **Top Border**

56. Select **C45:O45**.

57. Click **Home** ⇒ **Number** ⇒ **Accounting**.

58. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

59. Click **Home** ⇒ **Font** ⇒ **Top Border**

60. Select **C4:O5**.

61. Click **Home** ⇒ **Number** ⇒ **Comma**.

62. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

63. Select **C8:O15**.

64. Click **Home** ⇒ **Number** ⇒ **Comma**.

65. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

66. Select **C18:O22**.

67. Click **Home** ⇒ **Number** ⇒ **Comma**.

68. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

69. Select **C25:O30**.

70. Click **Home** ⇒ **Number** ⇒ **Comma**.

71. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

72. Select **C33:O36**.

73. Click **Home** ⇒ **Number** ⇒ **Comma**.

74. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

75. Select **C39:O44**.

76. Click **Home** ⇒ **Number** ⇒ **Comma**.

77. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

78. Click **A47** and enter *Total Expenses*.

79. Click **C47** and enter *=SUM(C16,C23,C31,C37,C45)*

80. Copy **C47** to **D47:O47**.

81. Click **A49**.

82. Enter *NET INCOME*.

83. Click **Home** ⇒ **Font** ⇒ **Bold**.

84. Click **Home** ⇒ **Alignment** ⇒ **Indent**.

85. Click **C49**.

86. Enter *=C6-C47*.

87. Copy **C49** to **D49:O49**.

88. Select **C47:O47**.

89. Click **Home** ⇒ **Number** ⇒ **Accounting**.

90. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

91. Click **Home** ⇒ **Font** ⇒ **Bold**.

92. Select **C49:O49**.

93. Click **Home** ⇒ **Number** ⇒ **Accounting**.

94. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** until there are no decimal places displayed.

95. Click **Home** ⇒ **Font** ⇒ **Bold**.

96. Click **Home** ⇒ **Font** ⇒ **Top and Bottom Border**

97. Select **C49:N49**.

98. Click **Home** ⇒ **Styles** ⇒ **Conditional Formatting** ⇒ **Data Bars** ⇒ **Gradient Fill Blue**.

99. Click **B50**.

100. Enter *New Apartment?*.

101. Click **C50**.

102. Enter an **IF** statement in that displays the word *No* if the amount in **C49** is less than or equal to zero and *Maybe* if the amount is greater than zero. Hint: remember that the words "No" and "Maybe" must be enclosed in quotes.

103. Copy **C50** to **D50:N50**.

104. Check to see if the **IF** statement worked correctly in **Row 50**. If the cells say *No* when the data bar in the cell above it is red and *Maybe* when the data bar in the cell above it is blue, then the **IF** statement is correct.

105. Review the worksheet in *Print Preview*. Make any changes needed to make the worksheet print with landscape orientation on one page.

106. Save the **PR3-Williams** workbook.

107. Compare the result with the self-check answer key (**PR3-Williams Solution**) and then close and submit the **PR3-Williams** workbook as directed by the instructor.

3.6 SCORED ASSESSMENT

3.6.1 *Astrocoffee Company*

Cynthia McHenry owns a coffee supply company named *AstroCoffee*. She needs some help writing the formulas for the order form she uses to invoice customers. Formulas are needed for all of the calculations

on the form. Some of the more complex parts are determining if the customer will get a discount (based on the customer status) as well as the shipping charge (orders over \$200 get free shipping). Use **IF** functions for both of those calculations.

1. Open the **SC3-Data** workbook and save it as **SC3-AstroCoffee**.

2. Enter the following order information.

   - Order #: 45676

   - Order Date: use a function that displays the current date

3. Enter the following Billing Information.

   Edwina Copeland

   4270 Heron Way Portland, OR 97225

   503-779-1873

   edwina.copeland@hmail.com

4. For the *Shipping Information*, create formulas using cell references to display the corresponding information from the *Billing Information* section. For example, the *Customer* cell will display the name of the customer found in **C11**.

5. In the range **B19:E22**, enter the following item orders:

Item #	Description	Qty	Unit Price
K56	Dark Mocha K-Cups (12 pack)	1	10.99
G03	Decaf Dark Roast – Ground (1 lb.)	3	12.99
B07	Dark Roast – Whole Bean (1 lb.)	2	13.99
K52	Chai Latte K-Cups (12 pack)	3	12.99

Table 10: AstroCoffee Orders

6. In cell **F19**, enter an **IF** function that tests whether the order quantity in cell **D19** is greater than 0 (zero). If it is, return the value of the Qty (in **D19**) multiplied by the Unit Price (in **E19**), otherwise, return no text by entering "".

7. Copy/fill the formula in **F19 F20:F25**. *Hint:* be sure to copy the formula to all of the *Item Total* cells, even if they are blank so the worksheet is prepared for orders with more items in the future.

8. In cell **F26**, calculate the sum of all of the Item Total cells.

9. In cell **F27**, use an **IF** function to calculate the discount amount for this order based on the customer's status (which is found in **F16**). If the customer's status is *Preferred*, the discount amount will be the *Order Subtotal* times the discount percentage found in cell **B29**; otherwise the discount amount will be 0 (zero). *Hint:* a formula is needed for the *Value if True* argument.

10. Calculate the Discounted Total for this order in cell **F28**. *Hint:* Use a simple subtraction formula.

11. In cell **F29**, use an **IF** function to display the correct Shipping Charge, based on the amount of the *Discounted Total*. If the *Discounted Total* is greater than or equal to the *Free Shipping Minimum* found in cell **B28**, the Shipping Charge is 0 (zero), otherwise, the Shipping Charge is 5% of the Discounted Total. *Hint:* a formula is needed for the Value if False to calculate what 5% of the Discounted Total will be.

12. Calculate the *Invoice Total* in cell **F31**. *Hint:* This will be the total of the *Discounted Total* and the *Shipping Charge*.

13. Review the worksheet in *Print Preview*. Make any changes needed to make the worksheet print on one page.

14. Save and close the **SC3-AstroCoffee** workbook.

15. Submit the **SC3-AstroCoffee** workbook as directed by the instructor.

Part II

INTERMEDIATE EXCEL

This part covers creating and using Excel charts to simplify data analysis, including selecting an appropriate type of chart for the audience and data. It next covers Excel tables and how they can be used to provide analysis tools like filters to simplify data. Finally, this part covers using multiple worksheets for complex data structures. Students who complete this part will be able to add graphic elements to worksheets and will be prepared for more advanced topics.

PRESENTING DATA WITH CHARTS

One of the most important things to consider when using charts in Excel is that they are intended to be used for communicating an idea to an audience, whether that audience is reading a written report or listening to a presentation. Excel charts are often imported or pasted into Word documents or PowerPoint slides, which serve the purpose of communicating ideas to an audience. Although there are no rules set in stone for using specific charts for certain data types, some chart types are designed to communicate certain messages better than others. This chapter explores numerous charts that can be used for a variety of purposes. In addition, the chapter examines formatting charts and using those charts in Word and PowerPoint documents.

4.1 CHOOSING A CHART TYPE

Learning Objectives

- Construct a line chart to show a time series trend.
- Learn how to adjust the Y Axis scale.
- Construct a line chart to present a comparison of two trends.
- Learn how to use a column chart to show a frequency distribution.
- Create a separate chart sheet for a chart embedded in a worksheet.
- Construct a column chart that compares two frequency distributions.
- Learn how to use a pie chart to show the percent of total for a data set.
- Construct a stacked column chart to show how a percent of total changes over time.

This section reviews the most used Excel chart types. To demonstrate the variety of chart types available in Excel, it is necessary to use a variety of data sets. This is necessary not only to demonstrate the construction of charts but also to explain how to choose the right type of chart given the data and idea being communicated.

Here are a few key points to consider before creating any chart in Excel.

- Identify the idea or message. It is important to keep in mind that the primary purpose of a chart is to present quantitative information to an audience. Therefore, first decide what message or idea is being presented. This is critical in selecting specific data from a worksheet that will be used in a chart. This chapter continually reinforces the idea of determining the intended message before creating each chart.

- Select the right chart type, based on the data and the message to communicate.

- Identify the values that should appear on the X Axis and Y Axis. One of the ways to identify which values belong on the axes is to sketch the chart on paper first. Visualizing the chart first makes easier to select the information and then use Excel to construct an effective chart that accurately communicates the message.

Table 11, *Key Steps Before Constructing an Excel Chart*, provides a summary of the preceding points.

Step	Description
Define the message	Identify the main idea being communicated. If there is no main point or important message that can be revealed by a chart, then do not create a chart.
Identify the data needed	Once there is a clear message, identify the data on a worksheet that is needed to construct a chart. In some cases, formulas may be needed to better define the data, or some data items may need to be consolidated into broader categories.
Select a chart type	The type of chart selected will depend on the message being communicated and the data being presented.
Identify the values for the X Axis and Y Axis	After selecting a chart type, drawing a sketch is often helpful in identifying which values should be on the X Axis and Y Axis. In Excel, the axes are: the X, or "category," axis, which is the horizontal axis, where the labels are found; and the Y, or "value," axis, which is the vertical axis, where the numbers are found.

Table 11: Key Steps before Constructing an Excel Chart

4.1.1   *Time Series Trend: Line Chart 1*

Figure 138 shows part of the data that will be used to create two different line charts. The first will show the trend of the NASDAQ stock index[1].

---

1 The NASDAQ data was found at http://www.investopedia.com/terms/n/nasdaq.asp

This chart will be used to communicate a simple message: to show how the index has performed over a two-year period. This chart can be used in a presentation to show whether stock prices have been increasing, decreasing, or remaining constant over the designated pe-period.

> **Integrity Check**
>
> **Carefully Select Data When Creating a Chart**
>
> Just because a worksheet contains data does not mean it must all be placed onto a chart. When creating a chart, it is common for only specific data points to be used. To determine what data should be used when creating a chart, start by identifying the message or idea that must be communicated to the audience.

	A	B	C	D	E	F	G	H	I	J	K
					Stock Trend Comparison						
1					24 Months from May 2014 to May 2016						
2					NASDAQ						
3			Average Closing Price			Change in Price			Individual Stock Prices		
4	Date	Month	Volume	Close		NASDAQ	% change		Nike	Adidas	Columbia
5	2-May-16	Month 1	3,572,300	46.39		0%	0%		59.59	65.00	57.86
6	1-Apr-16	Month 2	1,461,900	51.70		-59%	11%		61.59	64.55	58.57
7	1-Mar-16	Month 3	2,112,900	45.87		-41%	-1%		62.92	58.39	60.09
8	1-Feb-16	Month 4	3,711,200	45.65		4%	-2%		63.16	53.05	59.52
9	4-Jan-16	Month 5	1,447,700	80.24		-59%	73%		61.52	51.44	55.12
10	1-Dec-15	Month 6	748,600	94.22		-79%	103%		66.66	48.51	48.76
11	2-Nov-15	Month 7	1,356,400	97.03		-62%	109%		65.60	48.32	46.83
12	1-Oct-15	Month 8	1,292,000	83.96		-64%	81%		61.91	44.73	54.85
13	1-Sep-15	Month 9	1,734,700	79.78		51%	72%		54.22	40.34	58.70

Figure 138: Stock Trends

Before creating the line chart, it is important to identify why it is an appropriate chart type given the message being communicated and the data available. When presenting the trend for any data over a designated period, the most used chart types are the line chart and the column chart. The line chart constructed in this exercise will show the Month number on the X Axis and the volume of sales for the NASDAQ on the Y Axis. Column charts will be used in later projects.

1. Open data file **CH4-Data** and save it as **CH4-Charting**.

2. Open the **Stock Trend** worksheet.

3. Select the range **B4:C28**. (Notice that labels in the **B4:C4** and all the labels in **B5:B28** are selected. Observe where they show up in the completed chart.)

4. Click **Insert** ⇒ **Charts** ⇒ **Line Chart Down Arrow** ⇒ **2D Line Chart** (this is the first option from the *Line Chart* list, see Figure 139).
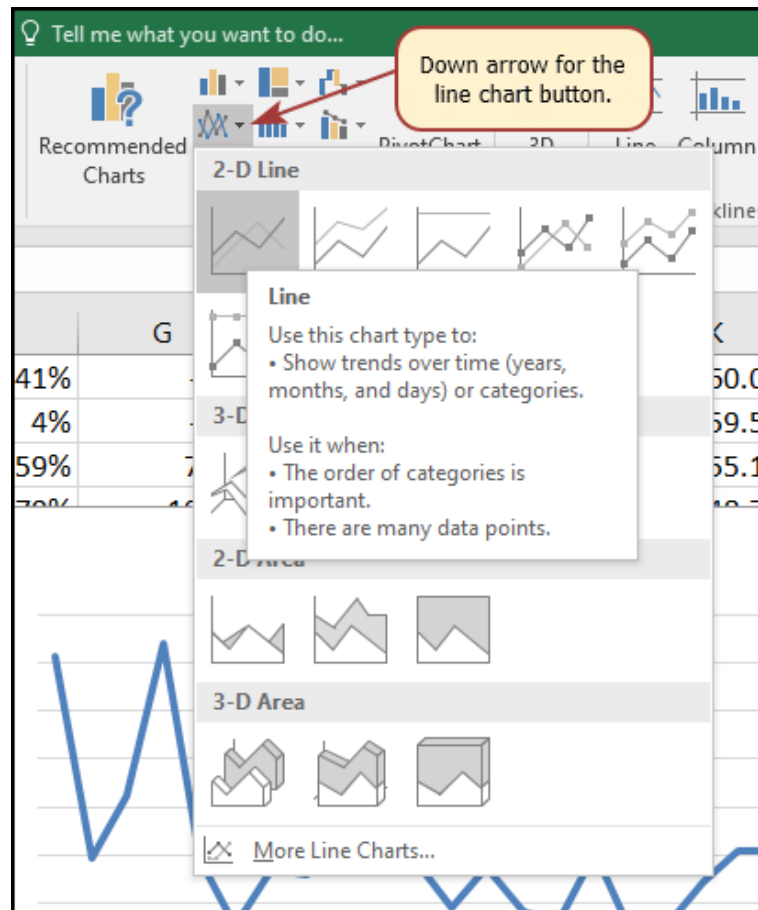
Figure 139: Selecting the Basic Line Chart

This adds, or embeds, the line chart to the worksheet, as shown in Figure 140. Notice where the labels showed up on the chart.

> **Why?**
>
> **Line Chart vs. Column Chart**
>
> Both a line chart and a column chart can be used to illustrate a trend over time. However, a line chart is far more effective when there are many periods of time being measured. For example, if fifty-two weeks are being reported a column chart would require fifty-two bars. A general rule of thumb is to use a column chart when twenty bars or fewer are required. A column chart becomes difficult to read as the number of bars exceeds twenty.

Notice that additional tabs, called "contextual" tabs, are added to the ribbon when a chart is selected and only appear when the chart is active. The commands in these tabs will be demonstrated throughout this chapter.
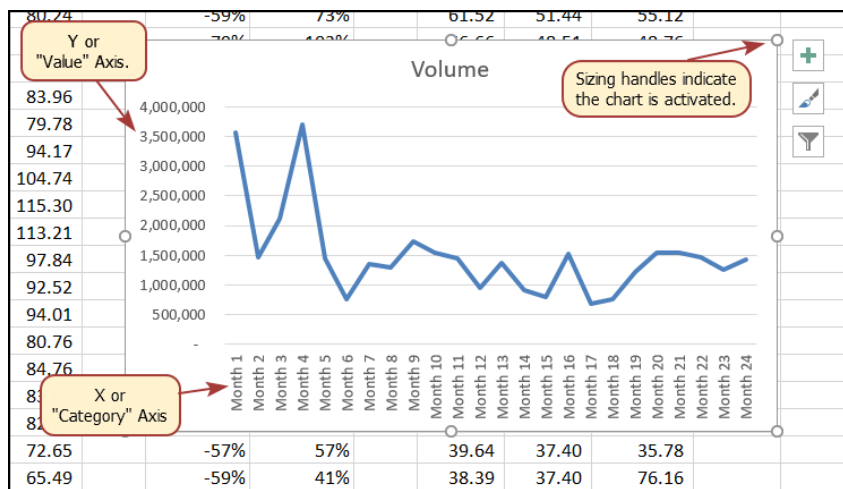
Figure 140: Embedded Line Chart in the Stock Trend Worksheet

As shown in Figure 140, the embedded chart is not placed in an ideal location on the worksheet since it is covering several cell locations that contain data. The following steps demonstrate common adjustments that are made when working with embedded charts.

Note for the next step: The pointer will change into the shape illustrated on the right when it is in the right place to **move** the chart.

Note for the next step: The pointer will change into the shape illustrated on the right when it is in the right place to **resize** the chart.

1. Click and drag the chart until its upper left corner is near the top-left corner of cell **B30**.

2. Place the mouse pointer over the sizing handle in the upper right corner of the chart, hold down the Alt key on the keyboard, and click and drag that handle until it "snaps" to the top of **Row** 30 and the right side of **Column I**.

3. Place the mouse pointer over the sizing handle in the lower left corner of the chart, hold down the Alt key on the keyboard, and click and drag that handle until it "snaps" to the bottom of **Row** 45 and the left side "snaps" to the left side of **Column B**.

4. Click the chart title once and then click in front of the first letter. This should place a blinking cursor in front of the letter which allows the title of the chart to be modified. Type the following in front of the first letter in the chart title: *May 2014-2016 Trend for NASDAQ Sales*.

5. Click anywhere outside of the chart to deactivate it.

6. Save the **CH4-Charting** workbook.

Figure 141 shows the line chart after it is moved and resized. Notice that the title of the chart has been edited to read *May 2014-2016 Trend for NASDAQ Sales Volume*. Notice that the sizing handles do not appear around the perimeter of the chart since the chart has been deactivated. To activate the chart, click anywhere inside the chart perimeter.
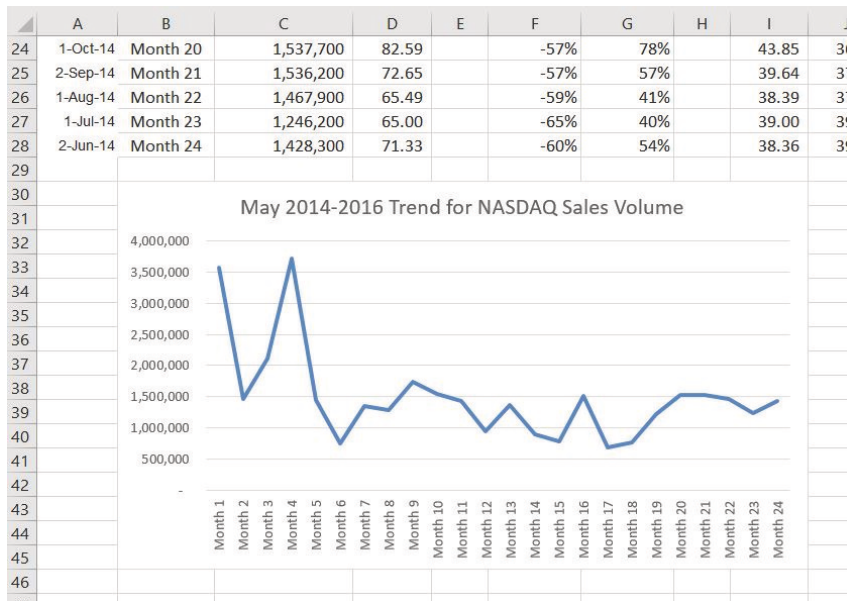
Figure 141: Line Chart Moved and Resized

Skill Refresher

Inserting a Line Chart

- Select a range of cells that contain data that will be used to create the chart. Be sure to include labels in the selection.
- Click *Insert ⇒ Charts ⇒ Line Chart*. Then, click the icon for the specific type of chart desired.

Integrity Check

Category Axis

When using line charts in Excel, keep in mind that anything placed on the *X Axis* is considered a descriptive label, not a numeric value. This is an example of a category axis. This is important because there will never be a change in the spacing of any items placed on the *X Axis* of a line chart. If numeric data must be placed on the category axis, the chart will need to be modified, which is covered later in the chapter.

4.1.1.1 *Adjusting the Y Axis Scale*

After creating an Excel chart, it may be necessary to adjust the scale of the Y Axis. Excel automatically sets the maximum value for the

Y Axis based on the data used to create the chart and the minimum value is usually set to zero. That is usually appropriate. However, depending on the data used to create the chart, setting the minimum value to zero can substantially minimize the graphical presentation of a trend. For example, the trend shown in Figure 141 appears to be increasing slightly in recent months. The presentation of this trend can be improved if the minimum value of the Y Axis started at 500,000 instead of zero. The following steps explain how to make this adjustment to the *Y Axis*.

1. Click anywhere on the *Y Axis* (*Value Axis* or *Vertical Axis*) on the *May 2014-2016 Trend for NASDAQ Sales Volume* line chart in the **Stock Trend** worksheet.

2. Right Click and select **Format Axis** in the popup context menu. The *Format Axis* pane should appear on the right side of the screen, as shown in Figure 142. *Note*: If **Format Axis** is not on the menu then the mouse was clicked in the wrong location. Press Escape to turn the menu off and try again.
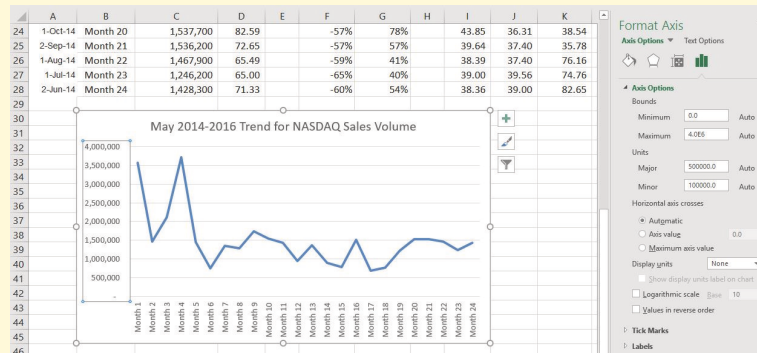
Figure 142: Format Axis Pane

3. In the *Format Axis* pane, click the input box for the *Minimum* axis option and delete the content of that box. Then type the number 500000 and press Enter . As soon as this change is made the Y Axis on the chart adjusts.

4. Click the **X** in the upper right corner of the *Format Axis* pane to close it.

5. Save the **CH4-Charting** workbook.

Figure 143 shows the change in the presentation of the trend line. Notice that with the Y Axis starting at 500,000, the trend for the NAS-DAQ is more pronounced. This adjustment makes it easier for the audience to see the magnitude of the trend. Do be careful when ad-

justing the Y Axis. Adjusting the minimum or maximum of this axis makes it easy to distort a relatively small trend to make it look bigger than it really is.
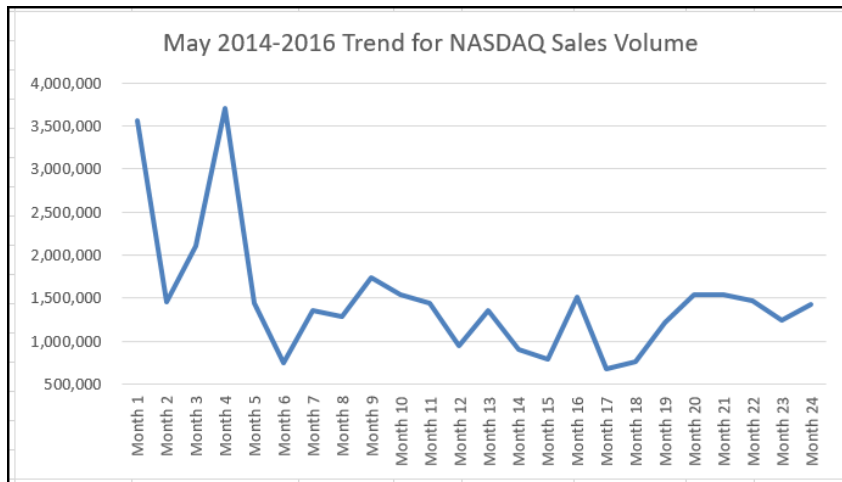
Figure 143: Adjusted Y Axis for the S&P 500 Chart

Skill Refresher

Adjusting the Y Axis Scale

- Right-click anywhere along the Y Axis to popup the context menu.
- Select *Format Axis* where changes can be made to the axis.
- Enter the desired amounts for the *Minimum* or *Maximum* values.
- Click the *Close* button at the top right of the *Format Axis* pane to close it.

4.1.2   *Trend Comparisons: Line Chart 2*

A second line chart will be created using the data in the *Stock Trend* worksheet. The purpose of this chart is to compare two trends: the change in *NASDAQ Volume* and *Closing Price*.

Before creating the chart to compare the *NASDAQ Volume* and *Closing Price*, it is important to review the data in the range B4:D28 on the *Stock Trend* worksheet. Even a brief examination reveals that the *NASDAQ Volume* and *Closing Price* cannot be used directly on the same chart because the values are not comparable. That is, the *NASDAQ Volume* is in a range of $684,000$ to $3,711,000$ but the *Closing Price* is in a range of \$45.00 to \$115.00. If these values are used without scaling, the *Closing Price* would not be visible at all when compared to the *NASDAQ Volume*.

The process to construct the second line chart will be like the first one. The X Axis will be the month numbers in B4:D28.

1. Select the range **B4:D28** on the **Stock Trend** worksheet.

2. Click **Insert** ⇒ **Charts** ⇒ **Line Chart Down Arrow** ⇒ **2D Line Chart** (this is the first option from the *Line Chart* list).

Figure 144 shows the appearance of the line chart comparing the *NASDAQ Volume* to the *Closing Price* before it is moved and resized. Notice that the red line for *Closing Price* (labeled as *Close* in the legend) appears as a straight line at the bottom of the chart. Also, the chart is so large that it is covering the data and the title needs to be changed.
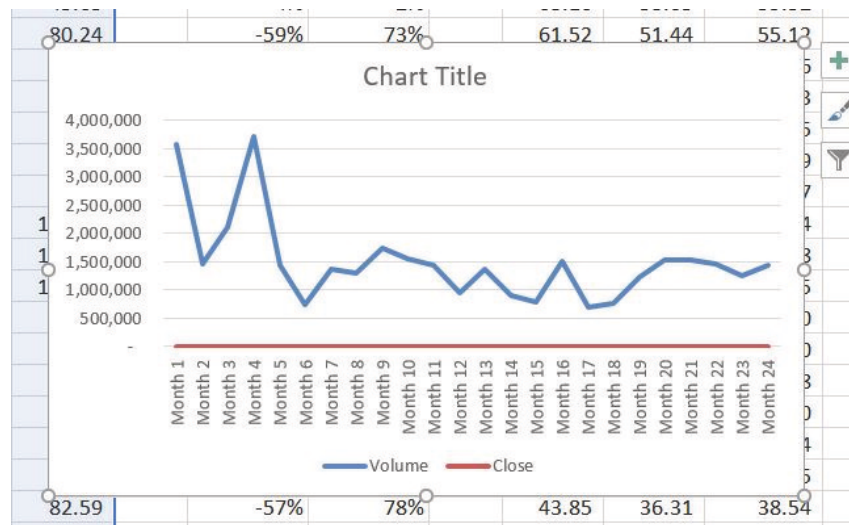
Figure 144: Trend Comparison Line Chart

1. Move the chart, so the upper left corner is in the middle of cell **M3**.

2. Resize the chart using the following values. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 3**
Left	Left of **Column M**
Bottom	Bottom of **Row 17**
Right	Right of **Column U**

3. Edit the *Chart Title* text box and replace the contents with *24 Month Trend Comparison*.

The *Closing Price* data is just a flat red line at the very bottom of the chart and cannot be seen very well. That is because the scale for this chart goes from 0 to 4,000,000 so the *Closing Price* data is compressed at the bottom of the scale. Complete the following steps to add a secondary axis to correct this problem.

1. Right click the red line at the bottom of the chart that represents the *Closing Price*.

2. On the popup context menu, select **Format Data Series** to open the *Format Data Series* pane.

3. In the *Series* Options, select **Secondary Axis**.
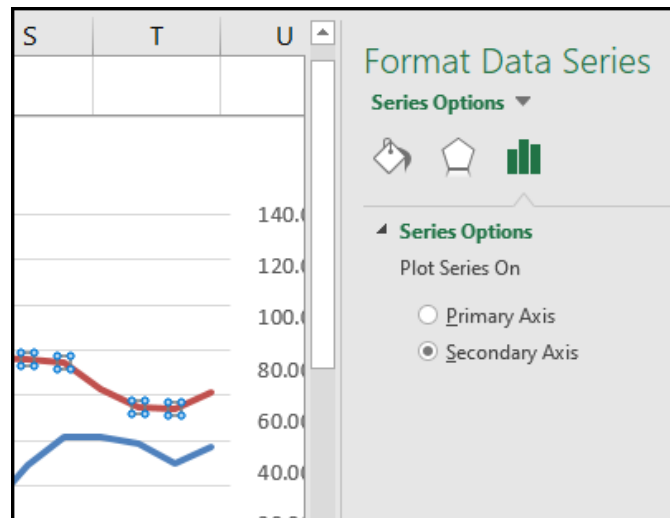
Figure 145: Adding a Secondary Axis

The chart is better; but it would be nice to be able to see that the values on the right represent prices rather than just numbers.

1. Right click the Secondary Vertical Axis. (The vertical axis on the right that goes from 0 to 140.)

2. From the context menu, select **Format Axis**.

3. In *Axis Options*, select **Number**. (The menu may need to be scrolled down.)

4. Use the *Symbol* list box to add the $ (see Figure 146).

5. Press the **X** (*close*) button to close the *Format Axis* pane.

6. Save the **CH4-Charting** worksheet.
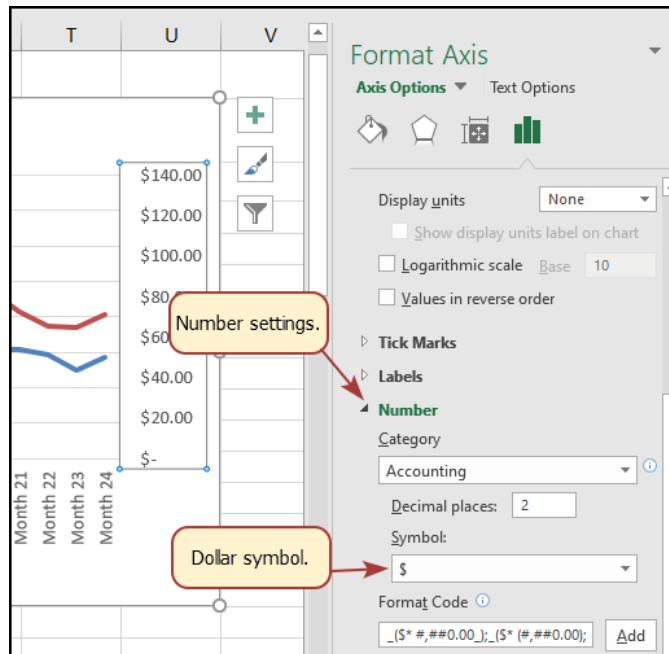
Figure 146: Modifying the Secondary Axis

Now the chart makes it easy to compare the sales volume with the closing price.
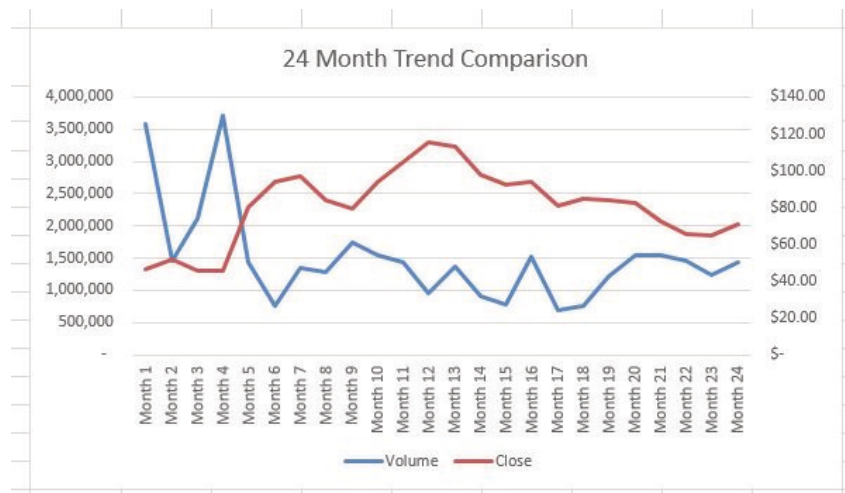
Figure 147: Final Comparison Line Chart

4.1.3   *"Instant" Chart – F11*

Excel includes an *Instant Chart* capability that makes charts easy to add with only a few mouse clicks. While these charts may need to be adjusted somewhat, they are often ready to use without any additional work. Follow these steps to add an "instant" chart.

1. Select **A4:A28** on the **Stock Trend** worksheet.

2. Hold down the Ctrl key and select **D4:D28**. Figure 148 shows the top of the two selected columns.

	A	B	C	D
3			**Average Closing Price**	
4	**Date**	**Month**	**Volume**	**Close**
5	2-May-16	Month 1	3,572,300	46.39
6	1-Apr-16	Month 2	1,461,900	51.70
7	1-Mar-16	Month 3	2,112,900	45.87
8	1-Feb-16	Month 4	3,711,200	45.65
9	4-Jan-16	Month 5	1,447,700	80.24
10	1-Dec-15	Month 6	748,600	94.22
11	2-Nov-15	Month 7	1,356,400	97.03
12	1-Oct-15	Month 8	1,292,000	83.96
13	1-Sep-15	Month 9	1,734,700	79.78
14	3-Aug-15	Month 10	1,546,700	94.17

Figure 148: Range Selection

3. Press F11 . If the factory default settings have not been changed, Excel will create a column chart and place it on a separate chart sheet, as illustrated in Figure 149.

4. Change the name of the new worksheet by double-clicking its name: **Chart1**. Type *Closing Prices* as the new name and press Enter .

5. Save the **CH4-Charting** workbook.
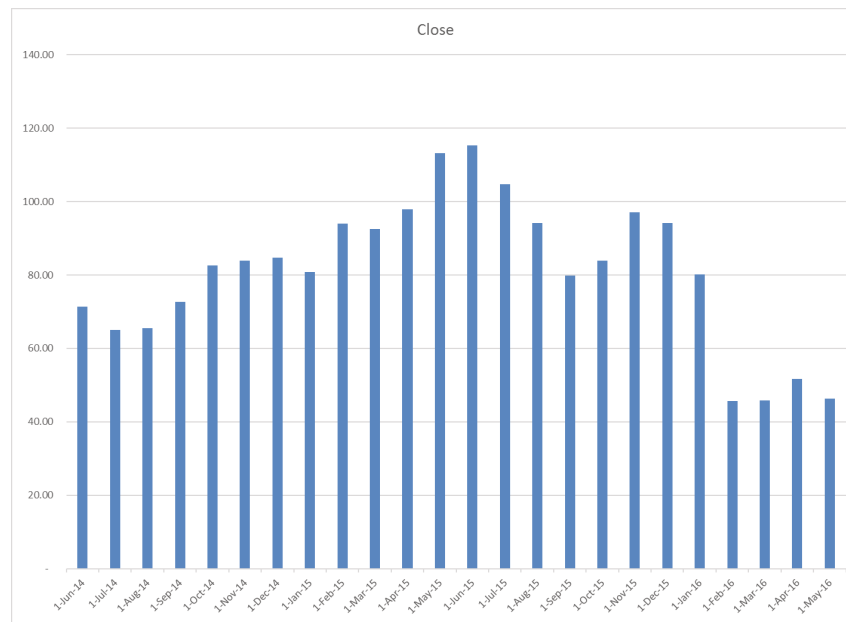
Figure 149: Instant Chart

4.1.4 *Frequency Distribution: Column Chart 1*

A column chart is used to show trends over time if the data is limited to no more than twenty points. A common use for column charts is a frequency distribution, which shows the number of occurrences by established categories. For example, a common frequency distribution used in most academic institutions is a grade distribution. A grade distribution shows the number of students that achieve each level of a typical grading scale (A, A-, B+, B, etc.). The *Grade Distribution* worksheet contains final grades for several hypothetical Excel classes. To show the grade frequency distribution for all the Excel classes in that year, the numbers of students appear on the Y Axis and the grade categories appear on the X Axis. The number of students for this chart is in *Column C*. The labels for grades are in *Column A*. The following steps explain how to create this chart.

1. Click the **Grade Distribution** worksheet to activate it.

2. Change the years in **Row** 3 to the current academic term and year.

3. Select **A3:A8**, which shows the grade categories.

4. Press Crtl and select **C3:C8**

5. Click **Insert** $\Rightarrow$ **Charts** $\Rightarrow$ **Column** $\Rightarrow$ **Clustered Column** (this is the first option in the *2-D Column* section).

Figure 150: Selecting a Column Chart

6. Click and drag the chart, so the upper left corner is in the middle of cell **H2**.

7. Resize the chart using the following values. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 2**
Left	Left of **Column H**
Bottom	Bottom of **Row 10**
Right	Right of **Column O**

8. Excel may have automatically created a legend with the chart, but since the it presents only one data series, a legend is not necessary. Delete it by clicking it one time and pressing the [Delete] key on the keyboard.

9. Add the text *Final Grades for* to the beginning of the chart title. The chart title should now be *Final Grades for All Excel Classes 2020/2021* (or whichever academic year is being used).

10. Click any cell location on the **Grade Distribution** worksheet to deactivate the chart.

11. Save the **CH4-Charting** workbook.

Figure 151 shows the completed grade frequency distribution chart. By looking at the chart, it is obvious that the greatest number of students earned a final grade in the B+ to B- range.
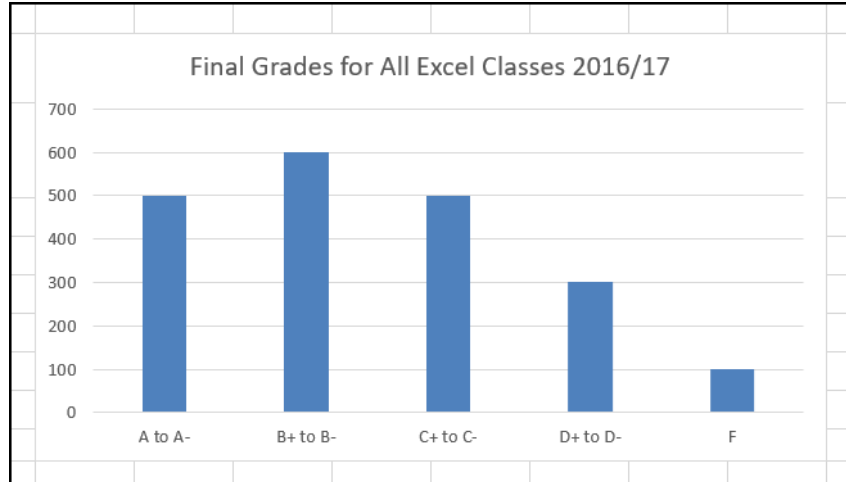
Figure 151: Grade Frequency Distribution Chart

4.1.5 *Creating a Chart Sheet*

The charts that have been created up to this point have been added to, or embedded in, an existing worksheet (except the **Instant Chart** created using F11). Charts can also be placed in a dedicated worksheet called a *chart sheet* because it contains only an Excel chart. Chart sheets are easier to navigate than having multiple charts embedded in a single worksheet. The following steps explain how to move the grade frequency distribution chart to a dedicated chart sheet.

1. Right-click anywhere near the edge of the *Final Grades for All Excel Classes* chart on the **Grade Distribution** worksheet.

2. Select **Move Chart**, which opens the *Move Chart* Dialog box.

3. Click the **New sheet** option on the *Move Chart* dialog box. (The top option.)

4. The entry in the input box for assigning a name to the chart sheet tab should automatically be highlighted once the New sheet option is clicked. Type *All Excel Classes*.

This replaces the generic name in the input box (see Figure 152).

5. Click the **OK** button at the bottom of the *Move Chart* dialog box. This adds a new chart sheet to the workbook with the name *All Excel Classes*.

6. Save the **CH4-Charting** workbook.
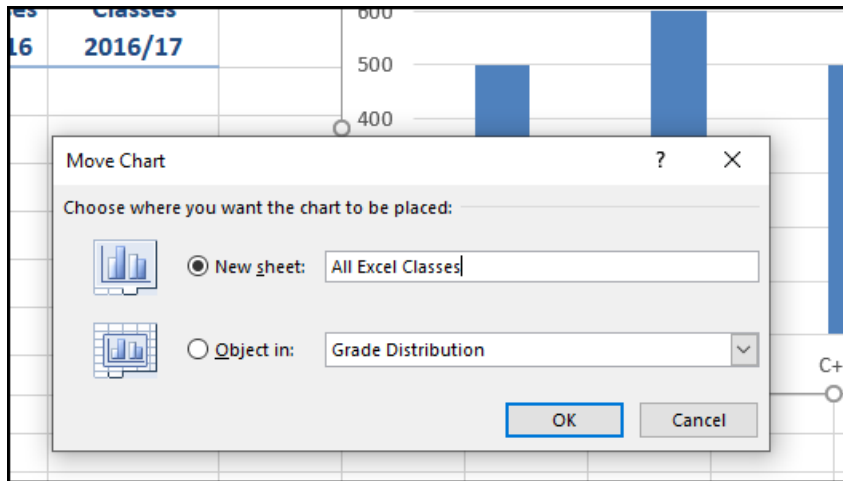
Figure 152: Moving a Chart to a Chart Sheet

Why?

Column Chart vs. Bar Chart

When using charts to show frequency distributions, the difference between a column chart (where the bars are vertical) and a bar chart (where the bars are horizontal) is really a matter of preference. Both are effective in showing frequency distributions. However, to show a trend over a period of time, a column chart is preferred because a period is typically shown on a horizontal axis, with the oldest date on the left edge and the newest date on the right edge.

Figure 153 shows the *Final Grades for all Excel Classes* column chart is in a separate chart sheet. Notice the new worksheet tab added to the workbook matches the name entered into the *Move Chart* dialog box. Since the chart is moved to a separate chart sheet, it is no longer displayed in the *Grade Distribution* worksheet.
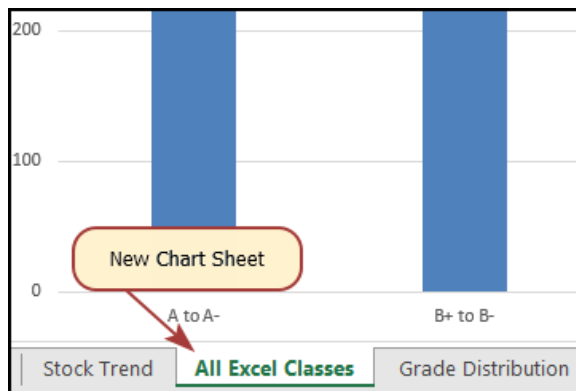
Figure 153: Chart Sheet Added to the Workbook

4.1.6   *Frequency Comparison: Column Chart 2*

A second column chart will be created to show a comparison be-
tween two frequency distributions. *Column B* on the *Grade Distribu-
tion* worksheet contains data showing the number of students who
received grades within each category for the Spring Quarter. This col-
umn chart will compare the grade distribution for Spring (*Column
B*) with the overall grade distribution for the whole year (*Column
C*). However, since the number of students in the term is significantly
different from the total number of students in the year, a percentage
must be calculated to make an effective comparison. The following
steps explain how to calculate the percentages.

1. Click the **Grade Distribution** tab to activate that work-
   sheet.

2. Select the range **B9:C9**.

3. Click **Home** ⇒ **Editing** ⇒ **Autosum**. This automatically
   adds **SUM** functions that sum the values in the range
   B4:B8 and **C4:C8**.

4. Click **E4**.

5. Enter a formula that divides the value in cell **B4** by the
   total in cell **B9**. Add an absolute reference to cell **B9** in
   the formula, like this *=B4/$B$9*.

6. Copy the formula in cell **E4** and paste it into the range
   E5:E8 using the Paste command or with the **Auto Fill
   Handle**.

7. Click **F4**.

8. Enter a formula that divides the value in cell **C4** by the total in cell **C9**. Add an absolute reference to cell **C9** in the formula, like this *=C4/$C$9*.

9. Copy the formula in cell **F4** and paste it into the range **F5:F8** using the Paste command or the **Auto Fill Handle**.

Figure 154 shows the completed percentages added to the *Grade Distribution* worksheet.

	A	B	C	D	E	F
1			Grade Distribution			
2		**Number of Students**			**Percent Comparison**	
3	**Grade**	**Excel Classes Spring 2016**	**All Excel Classes 2016/17**		**Excel Classes Spring 2016**	**All Excel Classes 2016/17**
4	A to A-	16	500		20%	25%
5	B+ to B-	26	600		32%	30%
6	C+ to C-	25	500		30%	25%
7	D+ to D-	10	300		12%	15%
8	F	5	100		6%	5%
9	**Total**	82	2000			

Figure 154: Completed Grade Distribution Percentages

Next, create a column chart that uses the grade categories in the range *A4:A8* on the X Axis and the percentages in the range *E4:F8* on the Y Axis.

1. Select **A3:A8** then hold down the Ctrl key and select **E3:F8**.

2. Click **Insert** ⇒ **Charts** ⇒ **Column**. Select the first option from the drop-down list of chart formats, which is the *2-D Clustered Column*.
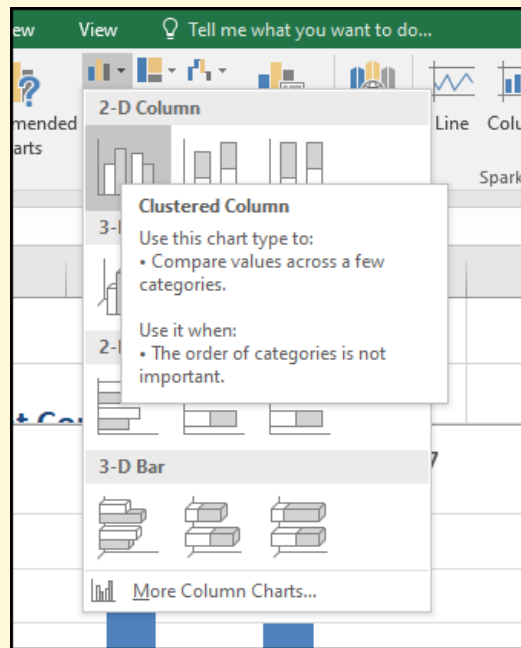
3. Click and drag the chart, so the upper left corner is in the middle of cell **H2**.

4. Resize the chart using the following values. For each side of the chart, press the Alt key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 2**
Left	Left of **Column H**
Bottom	Bottom of **Row 10**
Right	Right of **Column N**

5. Change the chart title to *Grade Distribution Comparison*. To add a chart title if one is not present, click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Chart Title** ⇒ **Above Chart**.

6. Save the **CH4-Charting** workbook.

Figure 155 shows the completed data series operation.
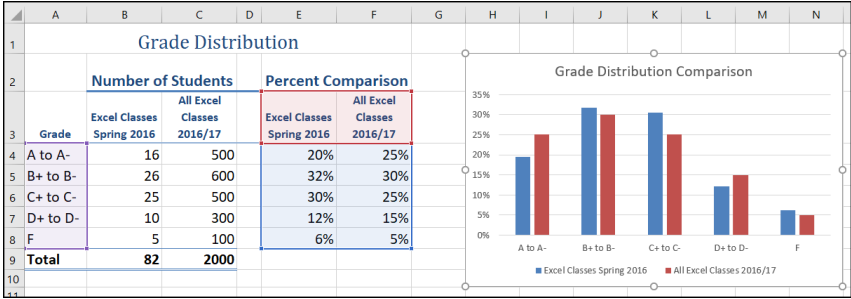
Figure 155: Completed Data Series for the Class Grade Distribution

Figure 156 shows the final appearance of the column chart. The column chart is an appropriate type for this data because there are fewer than twenty data points and it is easy to compare each category. A reader can quickly see that the spring class issued fewer *A's* compared to the rest of the academic year, but more *B's* and *C's*.
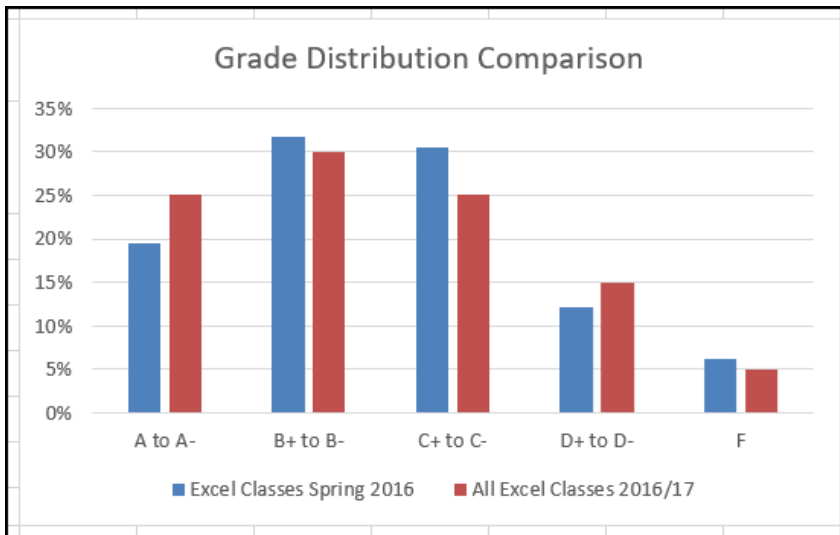
Figure 156: Completed Grade Distribution Column Chart

Integrity Check

Too Many Bars on a Column Chart?

Although there is no specific limit for the number of bars used on a column chart, a general rule of thumb is twenty bars or less. Figure 157 contains a total of thirty-two bars. This is considered a poor use of a column chart because it is difficult to identify meaningful trends or comparisons. The data used to create this chart might be better used in two or three different column charts, each with a distinct idea or message.
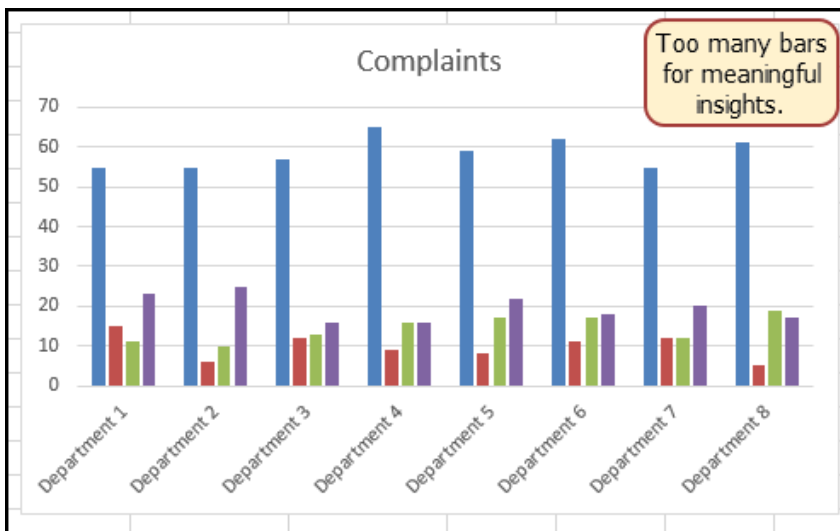
Figure 157: Poor Use of a Column Chart

4.1.7 *Percent of Total: Pie Chart*

A pie chart is used to show a percent of total for a data set at a specific point in time. The data used to demonstrate a pie chart is related to enrollment data for Portland Area Community Colleges for Fall of 2014. That data is found on the *Enrollment Statistics* sheet.

1. Click the **Enrollment Statistics** worksheet to activate it.

2. Select **A2:B6**.

3. Click **Insert** ⇒ **Charts** ⇒ **Pie** ⇒ **The First 2-D Option**.

4. To make the "slices" stand out better, choose to "explode" the pie chart using the following steps.

   - Click and hold the mouse button down in any of the slices of the pie. Note that there are selection handles on all the pie slices.

   - Without letting go of the mouse button, drag one of the slices away from the center.

   - All the slices "explode" out from the center.

   - *Note*: if the mouse button is released and clicked a second time before dragging a "slice" of the pie then only that one slice will move. This is another option for displaying the data. If this happens accidentally, use the *Undo* button, and then try again.

5. Click off the slices and then click the white canvas to deselect the pie and select the entire chart.

6. Click and drag the pie chart, so the upper left corner is in the middle of cell **E2**.

7. Resize the chart using the following values. For each side of the chart, press the ⌧Alt key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 2**
Left	Left of **Column E**
Bottom	Bottom of **Row 10**
Right	Right of **Column L**

	A	B	C	D	E	F	G	H	I	J	K	L
		Community College Students										
		In the Portland Oregon Area										
1		Fall 2014										
		Mt Hood Community College	Portland Community College	Clackamas Community College			Mt Hood Community College					
2	Race/ethnicity											
3	White	5,457	18,720	4,751								
4	Black	449	1,775	151								
5	Asian	595	2,125	238								
6	Other/Undisclosed	2,775	8,309	2,162								
7	Total	9,276	30,929	7,302								
8												
9												
		Community College Students										
		In the Portland Oregon Area										
10		Fall 2014					▪White ▪Black ▪Asian ▪Other/Undisclosed					
		Mt Hood Community College	Portland Community College	Clackamas Community College								
11	Gender											
12	Male	4,443	14,305	3,733								
13	Female	4,833	16,624	3,569								
14	Total	9,276	30,929	7,302								

Figure 158: Pie Chart Moved and Resized

8. Click the chart legend once and press the ⌑Delete⌑ key. A pie chart typically shows labels next to each slice. Therefore, the legend is not needed.

9. Right click any of the slices in the pie chart and select **Add Data Labels** from the list. This will add the values for each of the slices in the pie.

10. Now, right click one of the numbers that was just added to the pie chart and select **Format Data Labels** from the list. This will open the *Format Data Labels* pane on the right.

11. Check the boxes for **Category Name** and **Percentage** then uncheck the **Value** box in the *Label Options* section in the *Format Data Labels* pane (see Figure 159).

12. Click the **Close** button at the top of the *Format Data Labels* pane.

13. Select the data labels again (if needed) by clicking on one of the labels. Click **Home** ⇒ **Font** ⇒ **Bold** to make the labels bold font.

14. Save the **CH4-Charting** workbook.
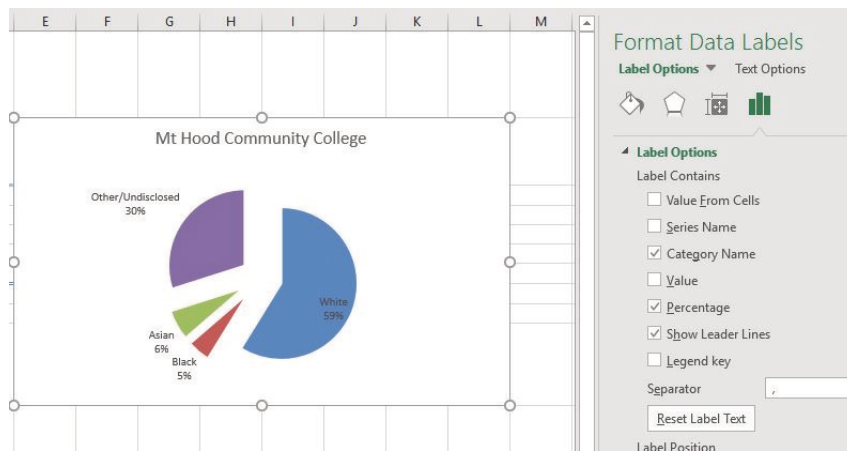
Figure 159: Final Settings in the Format Data Labels Pane

Although there are no specific limits for the number of categories that can be used on a pie chart, a good rule of thumb is ten or less. As the number of categories exceeds ten it becomes more difficult to identify key categories that make up most of the total. Figure 160 shows the completed pie chart.
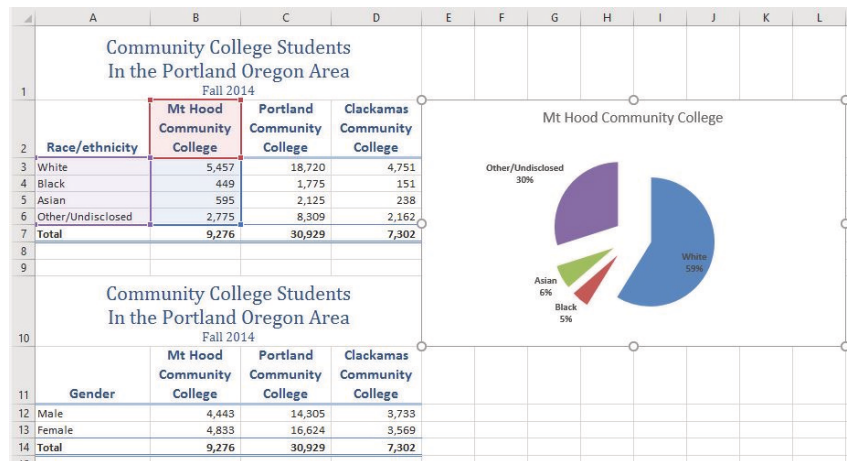
Figure 160: Final Enrollment Statistics Pie Chart

Skill Refresher

Inserting a Pie Chart

- Select a range of cells that contain the data used to create the chart.
- Click *Insert ⇒ Charts ⇒ Pie*.
- Select a format option from the Pie Chart drop-down menu.

4.1.8 *Percent of Total: Stacked Column Chart*

The last chart type demonstrated in this chapter is the stacked column chart. A stacked column chart is used to show a percent of a total. For example, the data on the *Enrollment Statistics* worksheet shows student enrollment by race for several colleges. Suppose that it was necessary to show all the data for all colleges.

1. Click the **Enrollment Statistics** worksheet to activate it if it is not already activated.

2. Select **A2:D6**.

3. Click **Insert** ⇒ **Charts** ⇒ **Column**. Select the **100% Stacked Column** format option from 2-D Column section in the drop-down list (see Figure 161).
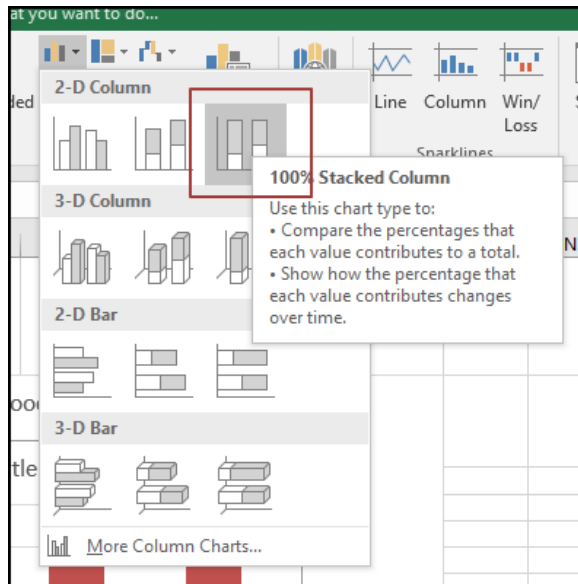
Figure 161: Selecting the 100% Stacked Column Chart

Figure 162 shows the column chart that is created after selecting the *100% Stacked Column* format option. As mentioned, the goal of this chart is to show the enrollment of students by race. However, notice that Excel places the racial categories on the X Axis. It would be more useful if the college names were on that axis instead.
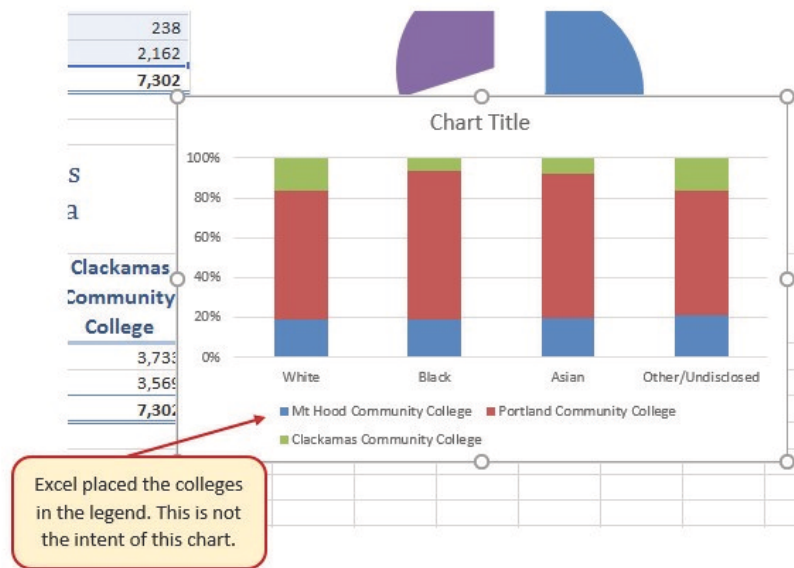
Figure 162: Initial Construction of the 100% Stacked Column Chart

The reason that Excel organized the data this way is that there are more Race/ethnicity categories (data in *Column A*) than there are colleges (data in *Row 2*). This is not a bad guess on Excel's part; but this is not what is wanted in this case. The next steps explain how to correct this problem and complete the chart.

1. Click **Chart Tools Design ⇒ Data ⇒ Switch Row/Column**. This reverses the legend and current *X-Y Axis* categories. (**Excel 365** named the tab *Chart Design*.)
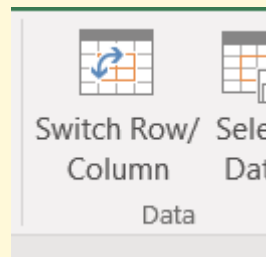
   Figure 163: Switch Row/Column

2. Click and drag the chart, so the upper left corner is in the middle of cell **E12**.

3. Resize the chart using the following values. For each side of the chart, press the Alt key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 12**
Left	Left of **Column E**
Bottom	Bottom of **Row 30**
Right	Right of **Column N**

4. Click the legend one time and press the ⎡Delete⎤ key on the keyboard.

5. Add a Data Table. This is another way of displaying a legend for a column chart along with the numerical values that make up each component.

6. Click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Data Table** ⇒ **With Legend Keys**. (⎡Excel 365⎤ named the tab *Chart Design*.)

7. Change the Chart Title to *Enrollment by Race*. If there is no chart title, click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Chart Title** ⇒ **Above Chart**. (⎡Excel 365⎤ named the tab *Chart Design*.)

8. Save the **CH4-Charting** workbook.

Figure 164 shows the final stacked column chart. Notice the similarities and differences in the enrollments at the local community colleges.
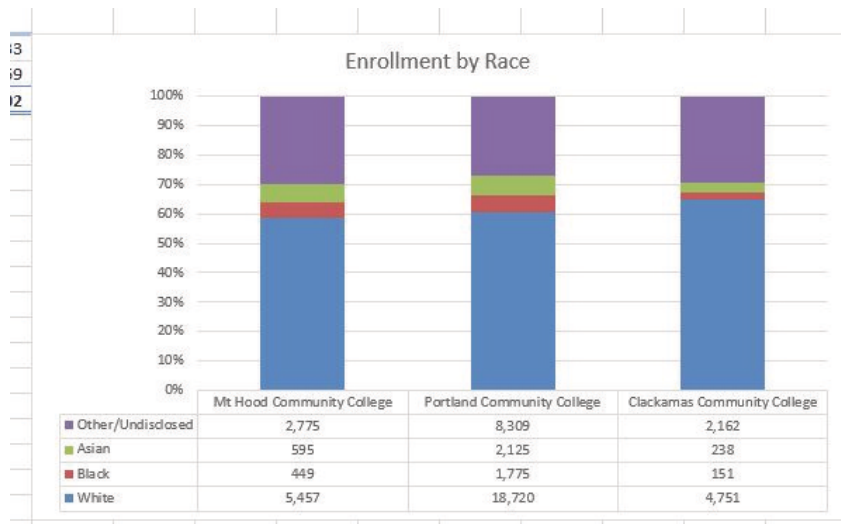
Figure 164: Final 100% Stacked Column Chart

Skill Refresher

Inserting a Stacked Column Chart

- Select a range of cells that contain data that will be used to create the chart.
- Click *Insert ⇒ Charts ⇒ Column*.
- Select the *Stacked Column* format option from the *Column Chart* drop-down menu to show the values of each category on the Y Axis. Select the *100% Stacked Column* option to show the percent of total for each category on the Y Axis.

Key Take-Aways

Save

- Identifying the message to be conveyed to an audience is a critical first step in creating an Excel chart.
- Both a column chart and a line chart can be used to present a trend over a period. However, a line chart is preferred over a column chart when presenting data over long periods of time.
- The number of bars on a column chart should be limited to twenty bars or less.
- When creating a chart to compare trends, the values for each data series must be within a reasonable range. If there is a wide variance between the values in the two data series (two times or more), the percent change should be calculated with respect to the first data point for each series.
- When working with frequency distributions, the use of a column chart or a bar chart is a matter of preference. However, a column chart is preferred when working with a trend over a period.
- A pie chart is used to present the percent of total for a data set.
- A stacked column chart is used to show how a percent total changes over time.

4.2 FORMATTING CHARTS

> **Learning Objectives**
>
> - Apply formatting commands to the X Axis and Y Axis.
> - Enhance the visual appearance of the chart title and chart legend by using various formatting techniques.
> - Assign titles to the X Axis and Y Axis that clarify labels and numeric values for the reader.
> - Apply labels and formatting techniques to the data series in the plot area of a chart.
> - Apply formatting commands to the chart area and the plot area of a chart.
> - Employ series lines and annotations to enhance trends and provide additional information on a chart.

A variety of formatting techniques can be used to enhance the appearance of a chart once it is created. Formatting commands are applied to a chart for the same reason they are applied to a worksheet, they make the chart easier to read. However, formatting techniques also help qualify and explain the data in a chart. For example, footnotes can be added that explain the data source as well as notes that clarify the type of numbers being presented (i. e., if the numbers in a chart are truncated, a note can state whether they are in thousands, millions, etc.). These notes are also helpful in answering questions when using charts in a live presentation. This section demonstrates these formatting techniques using the column chart and stacked column chart from the previous section.

4.2.1 *Axis Formats*

There are numerous formatting commands that can be applied to the X Axis and Y Axis of a chart. Although adjusting the font size, style, and color are common, many more options are available through the *Format Axis* pane. The following steps demonstrate a few of these formatting techniques on the *Grade Distribution Comparison* chart. (Note: this section continues the previous exercise. Students who only need to complete this section can open **CH4-Charting Solution 1_1** to start where the previous exercise ended.)

> 1. Switch to the **Grade Distribution** worksheet and click anywhere along the X Axis (horizontal axis) of the *Grade Distribution Comparison* chart.

2. Right click and select **Font**.

3. Change the font to Arial, the Font Style to Bold, and the Size to 11 (see Figure 165).

4. Click **OK**.
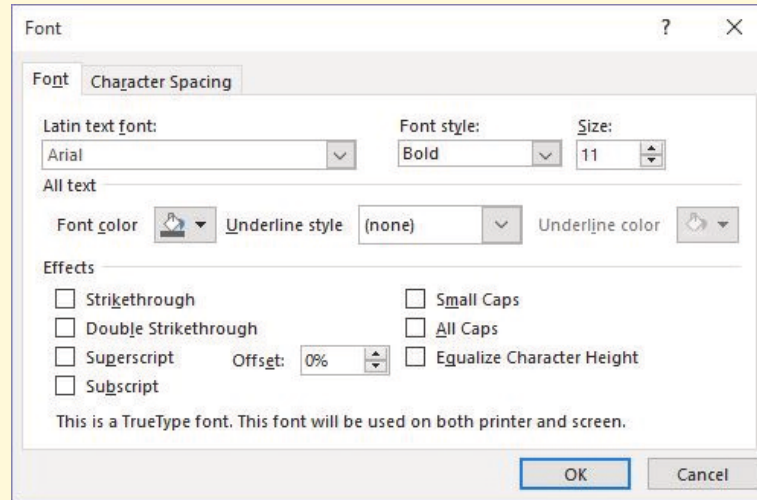
Figure 165: Font Dialog Box

5. Click anywhere along the Y Axis to activate it.

6. Right click and select **Font**.

7. Change the font to Arial, the Font Style to Bold, and the Size to 11.

8. Click on the chart title.

9. Right click and select **Font**.

10. Change the font to Arial, the Font Style to Bold, and the Size to 14.

11. The final appearance of the axes is shown in Figure 166.
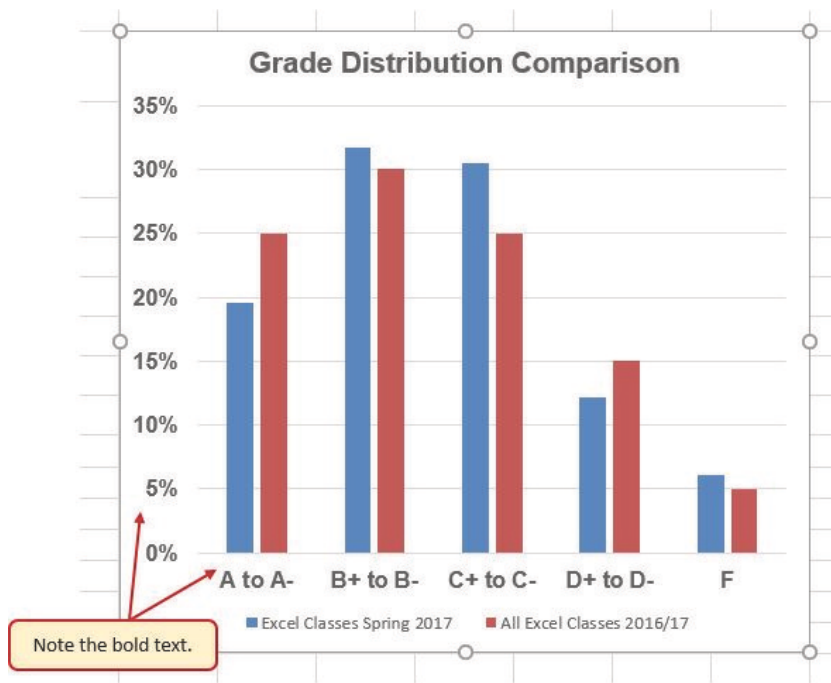
Figure 166: Formatted X and Y Axes

Next, make some changes to the percentage numbers on the Y Axis (vertical axis).

1. Right click the Y Axis.

2. Select **Format Axis**. This opens the *Format Axis* pane.

3. Click **Number** at the bottom of list of options. The options in this section of the *Format Axis* pane are used to format the numbers that appear on the axis.

4. Click in the *Decimal* places input box and change the value to 1.

5. Select **Axis Options** at the top of the list of options.

6. Change the *Minimum Bound* to .05 to make the differences in the columns more dramatic. The *Format Axis* pane should match Figure 167.

7. Click the **Close** button at the top of the *Format Axis* pane.

8. Save the **CH4-Charting** workbook.
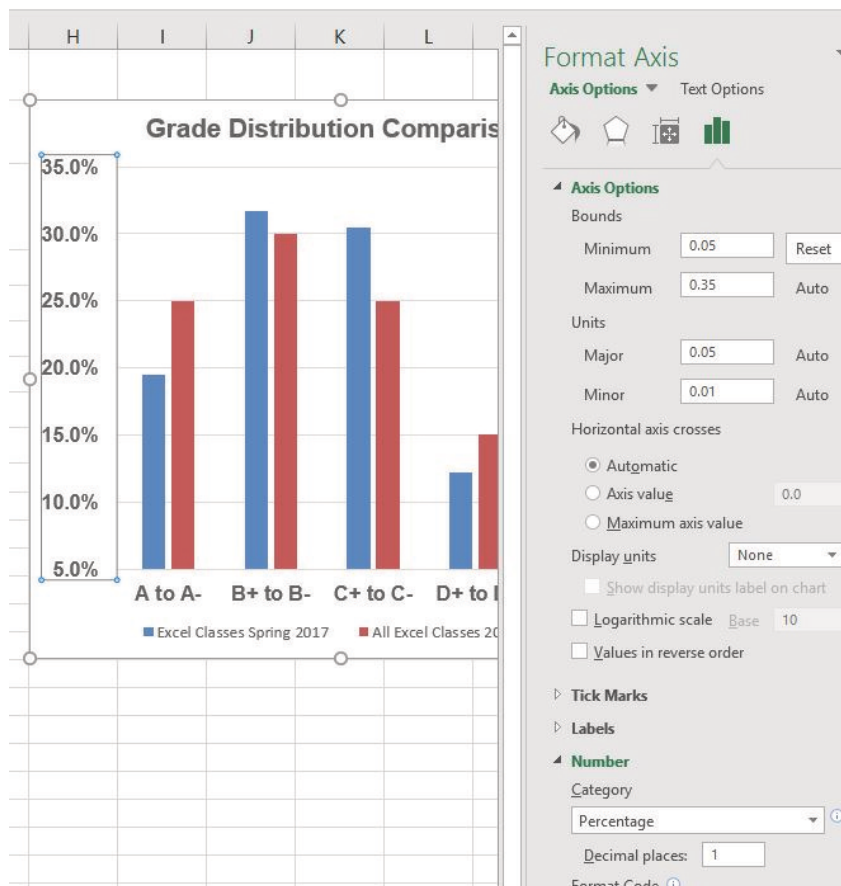
Figure 167: Format Axis Pane Changes

Note

Experiment!

The font styling can also be changed using shortcut keys and the buttons on the *Home* tab.

Skill Refresher

Formatting the X Axis and Y Axis

- Click anywhere along the X Axis or Y Axis to activate it.
- Click either the *Home* tab or *Chart Tools Design* tab of the ribbon.
- Select any of the available formatting commands in these tabs.

Skill Refresher

X Axis and Y Axis Number Formats

- Click anywhere along the X Axis or Y Axis to activate it.
- Click *Chart Tools Format* ⇒ *Format Selection*.
- Click *Number* from the list of options on the left side of the *Format Axis* dialog box.
- Select a number format and set decimal places on the right side of the *Format Axis* dialog box.
- Click the *Close* button in the *Format Axis* pane.

4.2.2 *Chart Legend and Title Formats*

The next items to be formatted on the *Grade Distribution Comparison* chart are the chart legend and title. Like the X Axis and the Y Axis, format these items by activating them and using commands in the *Home* tab or the *Format* pane. The following steps explain how to change these formats.

1. Right click the legend on the *Grade Distribution Comparison* chart and select **Format Legend**.

2. Select **Right** in the *Legend Position* options.

3. Close the *Format Legend* pane.

4. Move the legend by placing the cursor, shaped like a plus sign with four arrows, on the edge of the selection box. Click and drag the legend so the top of the legend aligns with the 35% line next to the plot area (see Figure 168).
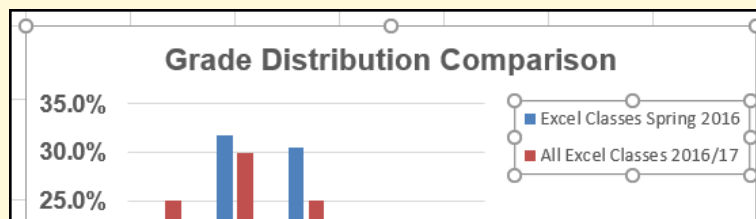
Figure 168: Moving the Legend

5. While the legend is still selected, change **Home** ⇒ **Font** to Arial, Bold, Italics, Size 12.

6. Click and drag the left sizing handle so the legend is just touching the horizontal grid lines of the plot area and the bottom sizing handle, so the entire legend is visible (see Figure 169).
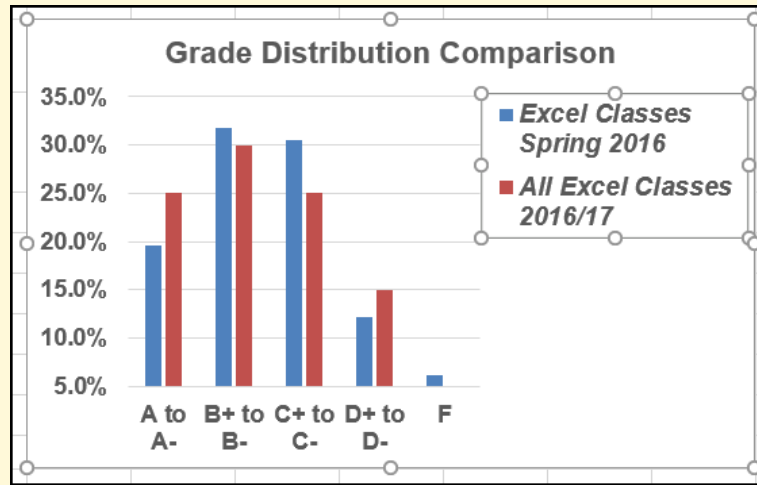
Figure 169: Legend Formatted and Resized

7. Right click on the chart title and select **Format Chart Title** to open the *Format Chart Title* pane (see Figure 170).

8. Under *Title Options* in the Effects group (the option in the middle) select the first *outer* preset shadow.

9. Select *Blue, Accent 1* as the shadow color.

10. Close the *Format Chart Title* pane.

11. Save the **CH4-Charting** workbook.
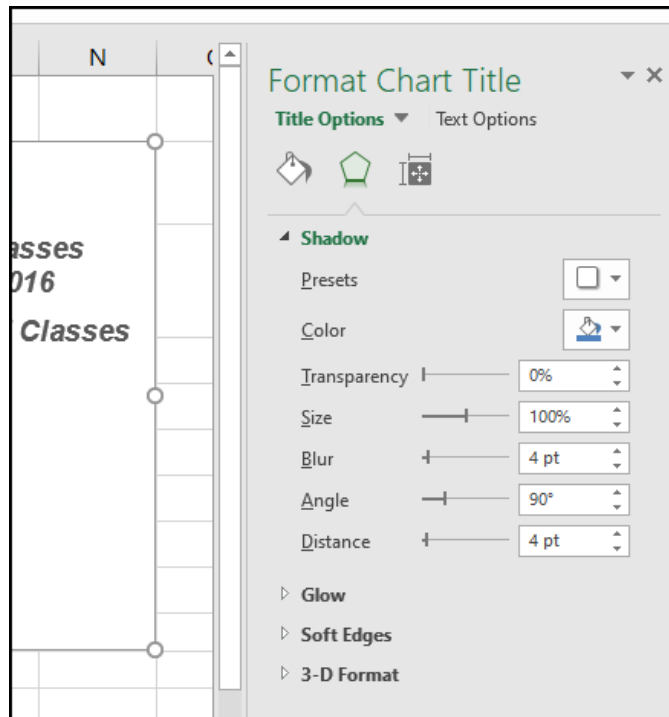
Figure 170: Format Chart Title Pane

Skill Refresher

Formatting the Chart Legend

- Click the Legend to activate it.
- Click either the *Home* tab or right click to activate the appropriate formatting pane.
- Select any of the available formatting commands.
- Click and drag the legend to move it.
- Click and drag any of the sizing handles to adjust the size of the legend.

Skill Refresher

Formatting the Chart Title

- Click anywhere on the chart title.
- Click either the *Home* tab or right click to activate the appropriate formatting pane.
- Select any of the available formatting commands.

4.2.3   X Axis and Y Axis Titles

Titles for the X Axis and Y Axis are necessary for defining the numbers and categories presented on a chart. For example, by looking at the *Grade Distribution Comparison* chart, it is not clear what the percentages along the Y Axis represent. The following steps explain how to add titles to the X Axis and Y Axis to define these numbers and categories.

1. Click anywhere on the *Grade Distribution Comparison* chart in the **Grade Distribution** worksheet to activate it.

2. Click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Axis Titles** ⇒ **Primary Vertical** (See Figure 171). (Excel 365 named the tab *Chart Design*.)
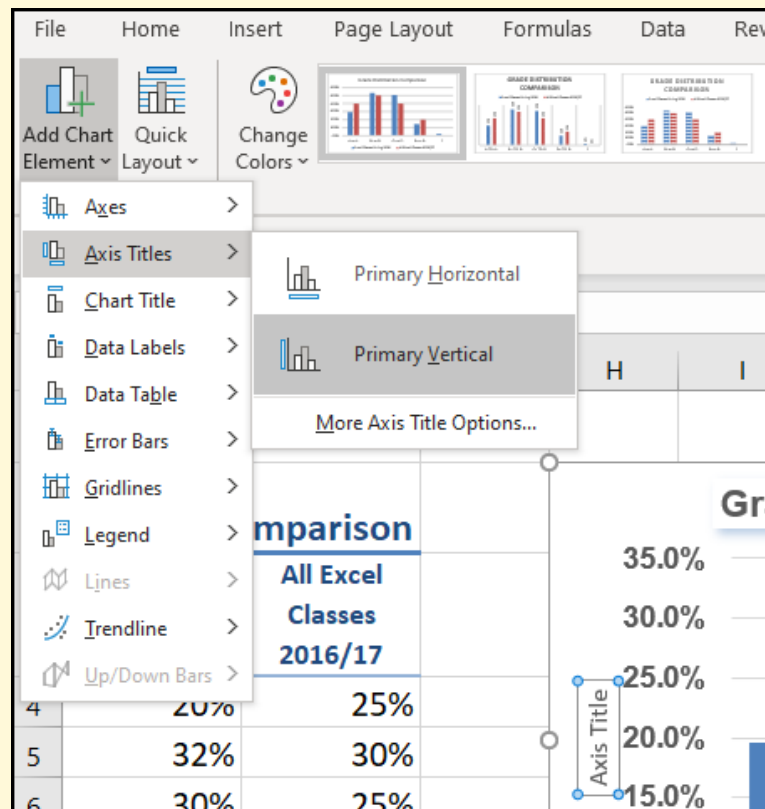
Figure 171: Adding a Title for the Y Axis

3. Using **Home** ⇒ **Font**, change the font of the axis title to Arial, Bold, Size 11.

4. Click in the beginning of the Y Axis title and delete the generic title, then type *Percent of Enrolled Students* (see Figure 172).
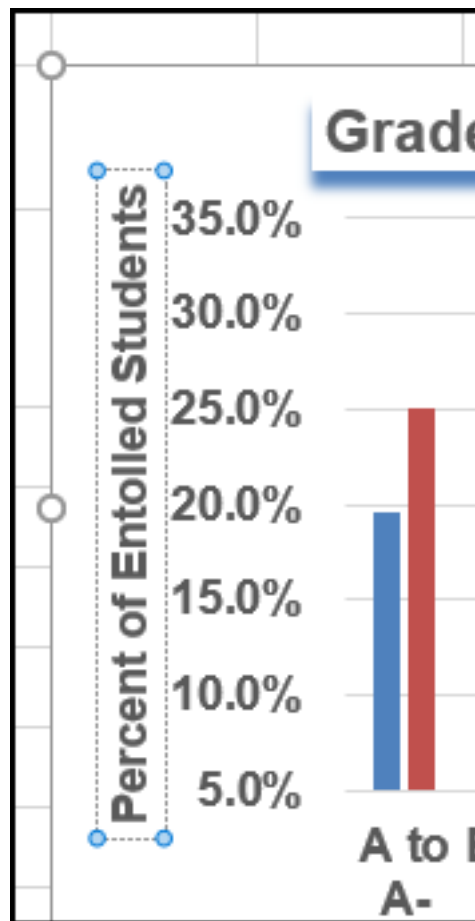
Figure 172: Adding and Formatting the Y Axis Title

Next, add the title for the X Axis.

1. Click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Axis Titles** ⇒ **Primary Horizontal**. (Excel 365 named the tab *Chart Design*.)

2. Using **Home** ⇒ **Font**, change the font of the axis title to Arial, Bold, Size 11.

3. Click in the beginning of the X Axis title and delete the generic title, then type *Final Course Grade*. Figure 173 shows the added titles for the X Axis and Y Axis. The titles provide definitions for the grade categories along the X Axis as well as the percentages on the Y Axis.

4. Save the **CH4-Charting** workbook.
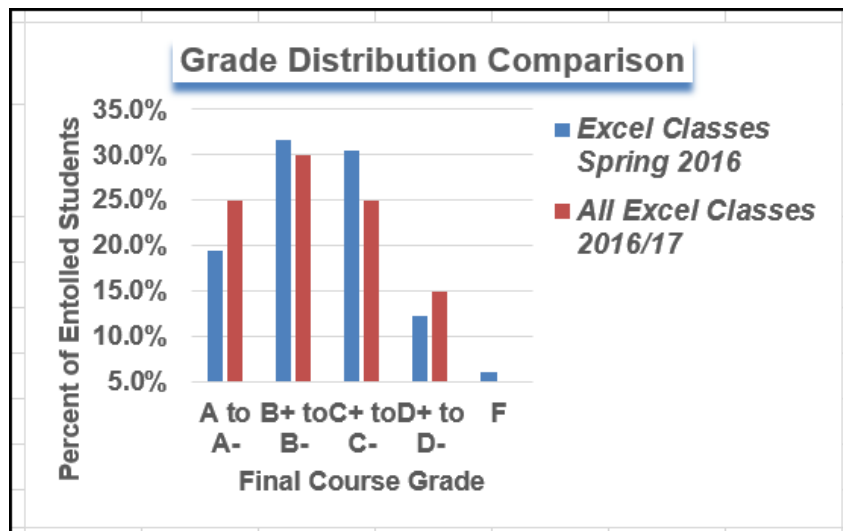
Figure 173: X and Y Axis Titles Added

Skill Refresher

X Axis and Y Axis Titles

- Click anywhere on the chart to activate it.
- Click *Chart Tools Design* ⇒ *Chart Layouts* ⇒ *Add Chart Element*.
- Select one of the options from the second drop-down list.
- Click in the axis title to remove the generic title and type a new title.

4.2.4   *Data Series Labels and Formats*

Adding labels to the data series of a chart is a key formatting feature. A data series is the item that is being displayed graphically on a chart. For example, the blue bars on the *Grade Distribution Comparison* chart represent one data series. Labels can be added at the end of each bar to show the exact percentage the bar represents. In addition, other formatting enhancements can be added to the data series, such as changing the color of the bars or adding an effect. The following steps explain how to add these labels and formats to the chart.

1. Click on any of the red bars representing the *All Excel Classes* data series on the *Grade Distribution Comparison* chart in the **Grade Distribution** worksheet. Clicking one bar automatically activates all bars in the data series. If

a bar is clicked a second time, only that one bar is activated.

2. Right click and select **Format Data Series** to open the *Format Data Series* pane.

3. Click the **Fill and Line** (paint bucket) button to bring up the *Fill and Border* group of commands.

4. Click the word **Fill** (if needed) to expand the list of Fill options.

5. Select **Pattern Fill**. Then select *Dotted: 30%* (fifth column, top row). Changing the fill pattern to a pattern makes it easier to distinguish between the data series when the chart is printed or viewed in black and white. Experiment with the fill pattern by selecting different foreground and background colors.

6. Close the *Format Data Series* pane.
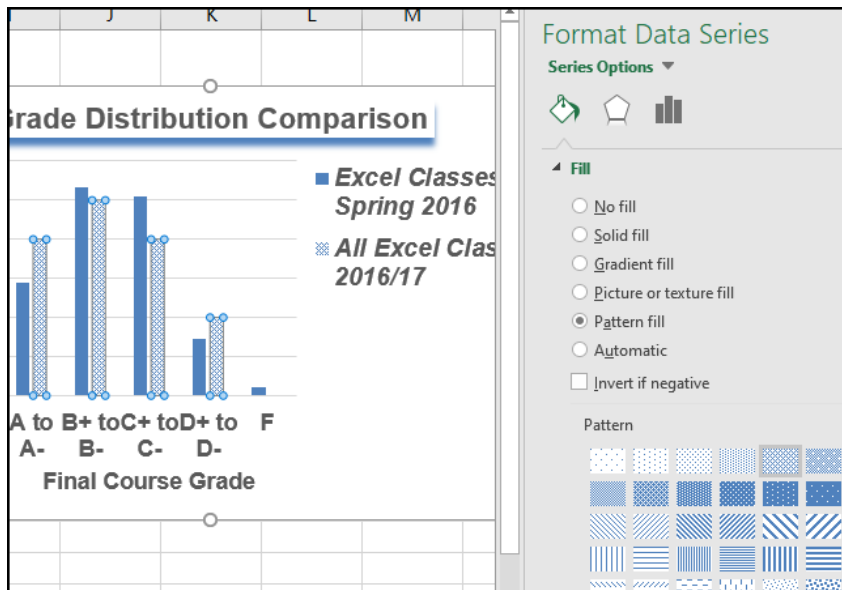
Figure 174: Changing the Fill of a Data Series

Next, add the Data Labels at the end of the columns.

1. Be sure that the entire chart is selected, not just one of the data series.

2. Click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Data Labels** ⇒ **Outside End** (see Figure 175.) (Excel 365 named the tab *Chart Design*.)

3. Click on one of the Data Labels for the first data series. Notice that all the data labels for that data series are selected.

4. Using **Home** ⇒ **Font**, change the font to Arial, Bold, Size 9.

5. Click on one of the data labels for the second data series. Using **Home** ⇒ **Font**, change the font to Arial, Bold, Size 9.

6. Save the **CH4-Charting** workbook.
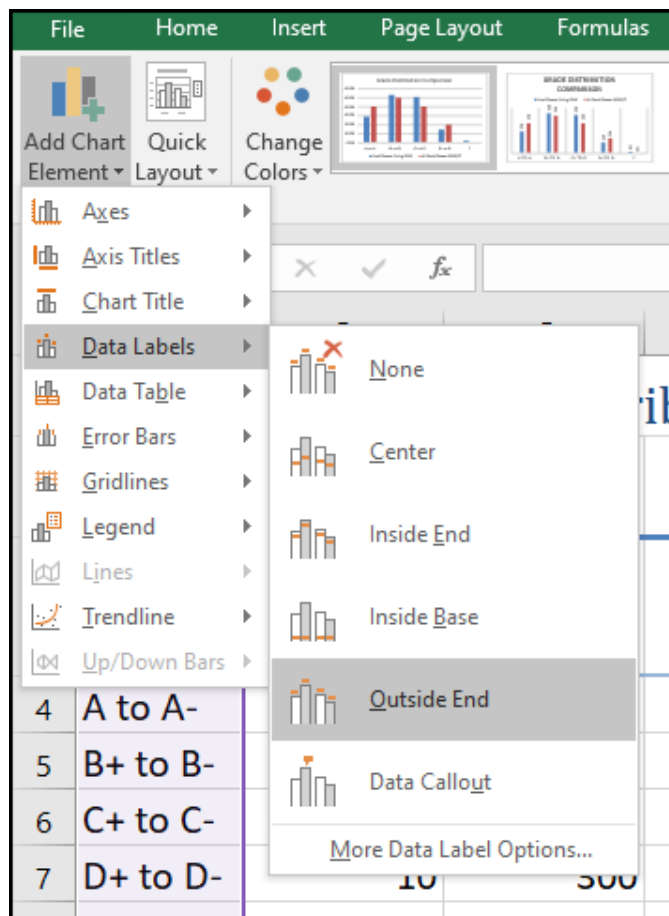
Figure 175: Adding Labels to a Data Series

Figure 176 shows the *Grade Distribution Comparison* chart with the completed formatting adjustments and labels added to the data series. Note that each individual data label can be moved if two data labels

overlap or if a data label falls in the middle of a grid line. To move an individual data label, click it twice and then click and drag.
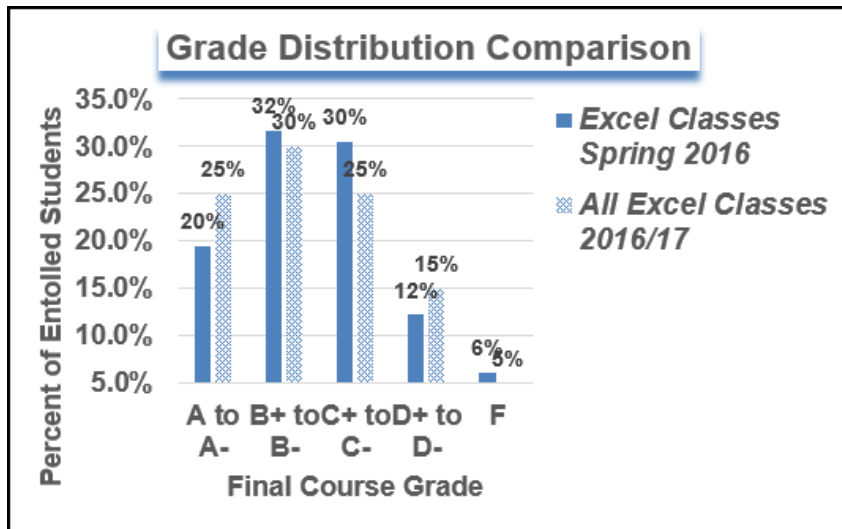
Figure 176: Completed Formatting Adjustments for the Data Series

Skill Refresher

Adding Data Labels

- Click anywhere on the chart to activate it.
- Click *Chart Tools Design ⇒ Chart Layouts ⇒ Add Chart Element*.
- Select *Data Labels*
- Select one of the preset positions from the drop-down list.

Skill Refresher

Formatting a Data Series

- Click any bar or line for a data series.
- Right click to activate the *Format Data Series* pane.
- Use the formatting tools in the pane to make changes to the data series.

4.2.5 *Adding Series Lines and Annotations to a Chart*

Series lines are used in stacked column charts to show the change from one stack to the next. Annotations are useful for clarifying the data presented in a chart or for identifying data sources. In addition to demonstrating these skills, this section will review several of the formatting skills that were covered earlier.

1. Locate the *Enrollment by Race* stacked column chart on the **Enrollment Statistics** worksheet. Activate the chart by clicking anywhere inside the chart perimeter.

2. Click **Chart Tools ⇒ Design ⇒ Location ⇒ Move Chart**. (`Excel 365` named this tab *Chart Design*.)

3. Select *New sheet* and type the following in the input box: *Enrollment by Race Chart*.

4. Click **OK**. The chart will be moved to a new worksheet and that sheet will be activated.

5. Click anywhere on the data table (on the X Axis) to activate it. When active, the data table will have a resizing handle at each of the four corners.

6. Using **Home ⇒ Font**, change the font to Arial, Bold, size 12.

7. Click on the Y Axis and apply the same formatting adjustments as used in the data table.

8. Click **Chart Tools Design ⇒ Chart Layouts ⇒ Add Chart Element ⇒ Axis Titles ⇒ Primary Vertical**. (`Excel 365` named the tab *Chart Design*.)

9. Double-click in the default Y Axis title and change it to *Percent Enrollment by Race*.

10. Click the border of the Y Axis title to select the entire title. When active, the title will have a resizing handle at each of the four corners.

11. Using **Home ⇒ Font**, change the font to Arial, Bold, size 14.

12. Click **Chart Tools Design ⇒ Chart Layouts ⇒ Add Chart Element ⇒ Axis Titles ⇒ More Axis Title Options**. (`Excel 365` named the tab *Chart Design*.)

13. Click the Y Axis title to select it. When active, the title will have a resizing handle at each of the four corners.

14. In the *Format Axis Title* pane change the fill color to *Blue, Accent 1, Lighter 80%* and the border color to *Dark Blue, Text 2, Lighter 60%* .

15. Check the horizontal axis to see if this process created an extra axis title there. If it did, delete it.

16. Activate the title of the chart by clicking it once. The *Format Chart Title* pane should be open. If not, right click the Chart title and select **Format Chart Title** from the menu. Change the fill and border to match the vertical Axis label.

17. Using **Home** ⇒ **Font**, change the font of the chart title to Arial, Bold, size 20.

18. Close the *Format Chart Title* pane.

19. Click **Chart Tools Design** ⇒ **Chart Layouts** ⇒ **Add Chart Elements** ⇒ **Lines** ⇒ **Series Lines**. (**Excel 365** named the tab *Chart Design*.) This adds lines to the chart, connecting each data series between the three stacks (see Figure 177).
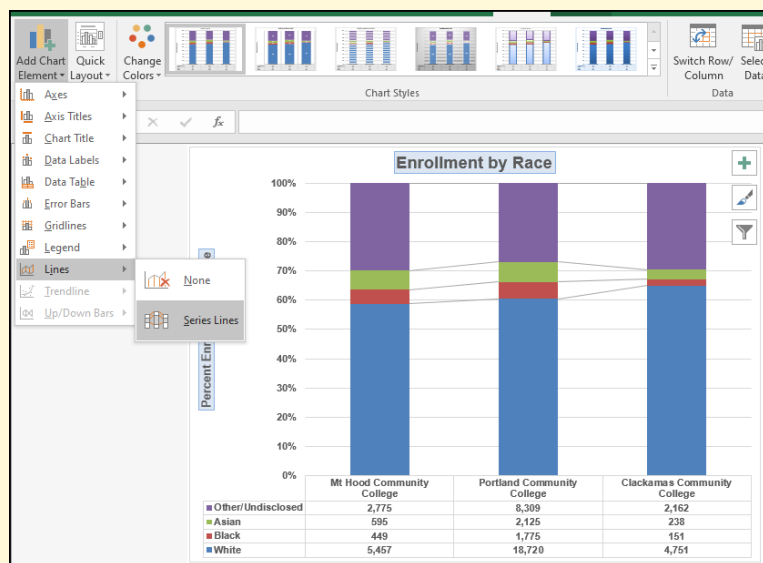
Figure 177: Selecting the Series Lines Option

20. Right click on any of the series lines added to the chart. Clicking one line will activate all lines on the chart. (If the *Format* pane is open there is no need to right click. Just left click on any of the series lines to change the format pane to *Format Series Lines*.)

21. Select **Format Series Lines**. This will open the *Format Series Lines* pane.

22. Change the width to 2.25 pt.

23. Close the *Format Series Lines* pane.

Figure 178 shows the appearance of the chart with the series lines connecting the two stacks. This formatting enhancement is common for stacked column charts. The lines help focus the audience's attention to changes in the percent of total trend.

Enrollment by Race

	Mt Hood Community College	Portland Community College	Clackamas Community College
Other/Undisclosed	2,775	8,309	2,162
Asian	595	2,125	238
Black	449	1,775	151
White	5,457	18,720	4,751
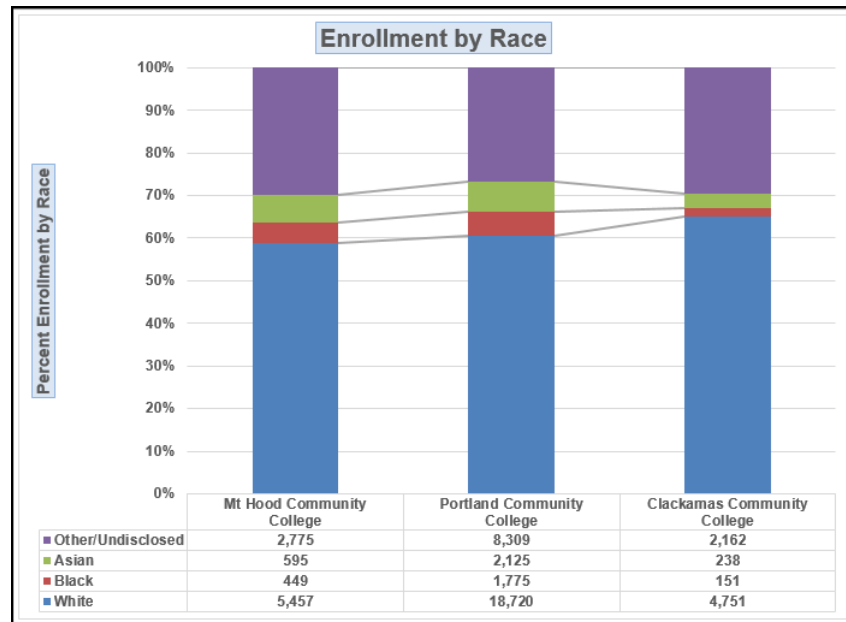
Figure 178: Series Lines Added to the Stacked Column Chart

The chart demonstrates the percentage differences in enrollment between the community colleges. But it would be handy to know the total enrollment at each of the colleges. To display that, add text boxes above each column. To start, make room for the text boxes.

1. Select the Plot Area. Place cursor on the top center handle of the Plot Area and drag down about 1/2 inch. (See Figure 179.)
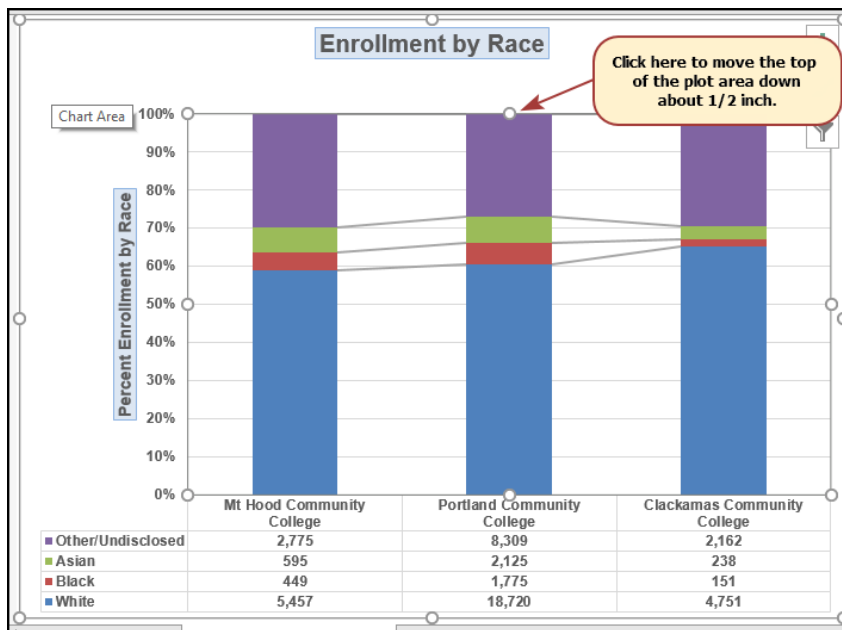
Figure 179: Resizing the Plot Area

4.2.6   *Add Additional Information to the Chart.*

1. Click **Insert** ⇒ **Text** ⇒ **Text Box**.

2. Place the mouse pointer on the left edge of the chart area approximately one-quarter inch from the top. Click and drag a rectangle approximately one and a half inches wide and one-quarter inch high. Do not worry if it is not exact, it will be moved and resized later.

3. Type *Total Enrollment* in the text box.

4. Select all the text in the text box. (The text can be selected by either dragging over it with the mouse or by clicking on the border of the text box once).

5. Click **Home** ⇒ **Font**. Change the font to Arial, size 14.

6. Resize and position the text box, so it fits above the 100% label on the Y Axis, as in 180

7. Repeat the process to add and format text boxes above each column. The boxes can be copy/pasted to save time.

8. In each text box, type the Total Enrollment for each school:

- Mt Hood — 9,276

- Portland — 30,929

- Clackamas — 7,302

9. Check to be sure the text boxes look like Figure 180 and then save the **CH4-Charting** workbook.
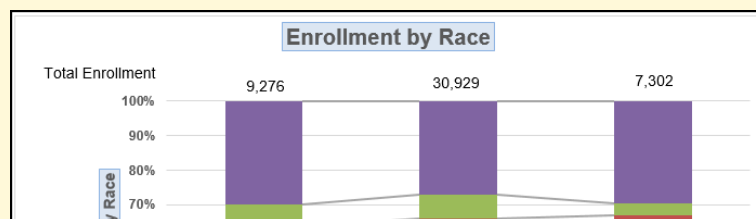
Figure 180: Enrollment Text boxes Added

10. Excel also makes several graphic objects like circles, arrows, and stars available to draw attention to elements on charts. It is important to keep in mind the purpose of a chart is to present information to the audience, not show off the skill of the designer, so do not overdo these types of graphic objects.

11. Click the chart to activate it if it is not already active.

12. Click **Insert** ⇒ **Illustrations** ⇒ **Shapes** ⇒ **Callouts** ⇒ **Rounded Rectangular Callout** (see Figure 181). (Excel 365 named this callout *Speech Bubble: Rectangle with Corners Rounded*.)
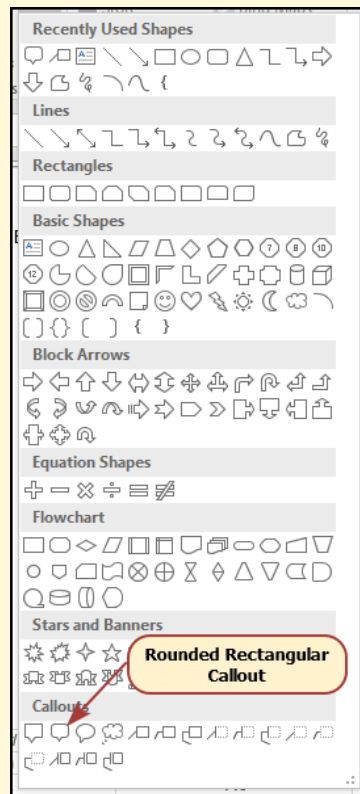
Figure 181: Selecting Rounded Rectangular Callout

13. Drag a square on the graph. Do not worry about exact placement since the text square and callout line will be resized and repositioned later. See Figure 182 for guidance.

14. The callout is initially filled with blue, but that does not offer enough contrast with the chart bar. The *Format Shape* panel opens when the callout is added. If the *Format Shape* panel did not open, right-click on the callout and select *Format Object*. Click the *Shape Options* tab on the format panel and make these adjustments.

    a) Select *Orange, Accent 6, Lighter 60%* as the fill color for the box.

    b) Select *Orange, Accent 6, Darker 25%* as the color for the line.

    c) Set the line width to 2.5 pt.

15. Click the *Text Options* tab on the format panel and make sure the text fill is black.

16. Double-click inside the callout box and enter *Diversity Program Result*.

17. Click the border of the callout box to select it.

18. Using **Home** ⇒ **Font**, change the font to Arial, 12pt, Bold font.

19. Click **Home** ⇒ **Alignment** ⇒ **Center**.

20. Using the drag handles, resize and position the callout box so it is like Figure 182.

21. Save the **CH4-Charting** workbook.
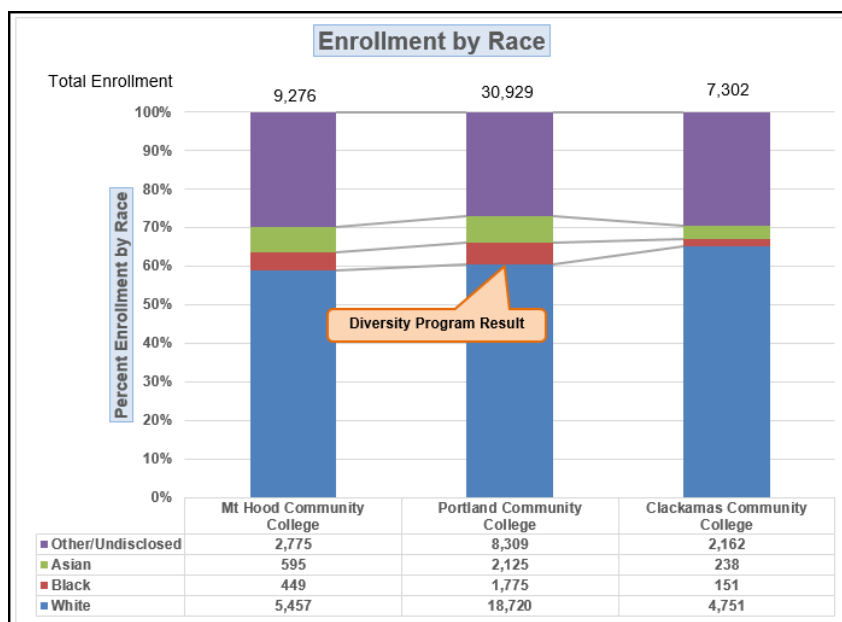
Figure 182: Completed Stacked Column Chart

Skill Refresher

Adding Series Lines

- Click anywhere on the chart area.
- Click *Chart Tools Design* ⇒ *Chart Layouts* ⇒ *Add Chart Elements* ⇒ *Lines* ⇒ *Series Lines*.

Skill Refresher

Adding Annotations

- Click anywhere on the chart area.
- Click *Insert ⇒ Text ⇒ Text Box*.
- Click and drag the size of the text box needed on the chart.
- Apply any desired format changes from the Home tab of the ribbon.
- Type the desired text.

Integrity Check

Annotations and Axis Titles

Although adding annotations and axis titles can be a tedious process, doing so creates a high level of integrity for charts. People can misinterpret the message being conveyed by the chart if they make inaccurate assumptions about the values displayed. Axis titles and annotations help prevent readers from making false assumptions and ensure that readers see the most accurate representation of the message being conveyed by the chart.

Key Take-Aways

Formatting Charts

- Applying appropriate formatting techniques is critical for making a chart easier to read.
- Many formatting commands in the *Home* tab of the ribbon can be applied to a chart.
- To change the number format for a data label, use the *Number* section in the *Format Data Labels* dialog box. Note that number format commands in the *Home* tab of the ribbon cannot be used for a data label.
- To change the number format for the values on the Y Axis, and the X Axis, use the *Number* section of the *Format Axis* dialog box. Note that number format commands in the *Home* tab of the ribbon cannot be used for axis labels.
- Axis titles and annotations help prevent false assumptions from being made and ensure that the reader sees the most accurate representation of the information presented on a chart.

4.3   USING CHARTS WITH MICROSOFT WORD AND MICROSOFT POWERPOINT

> **Learning Objectives**
>
> - Learn how to paste an image of an Excel chart into a Word document.
> - Learn how to paste a link to an Excel chart into a PowerPoint slide.

Charts that are created in Excel are used in Microsoft Word® documents or PowerPoint® presentations and Excel provides options for pasting a chart's image into either. Additionally, a link can be established between Excel and Word or PowerPoint so that if the data changes in the Excel file it is automatically updated in the Word or PowerPoint files. Both methods of sharing a chart are covered in this section.

4.3.1   *Pasting a Chart Image Into Word*

This exercise needs two files:

- The Excel spreadsheet used in this chapter: *CH4-Charting*. (Note: this section continues the previous exercise. Students who only need to complete this section can open *CH4-Charting Solution 1_2* to start where the previous exercise ended.)

- This Word document: *CH4-Diversity*

Excel charts can be valuable tools for explaining quantitative data in a written report. Reports that address business plans, public policies, budgets, and so on all involve quantitative data. For this example, assume that the *Enrollment by Race* stacked column chart (Figure 182) is being used in a student's written report. The following steps demonstrate how to paste an image, or picture, of this chart into a Word document.

> 1. Open the Word document, **CH4-Diversity**. (Note: the student files include both a Word document and PowerPoint presentation named Diversity. Be sure to open the Word document for this activity.) Save it as **CH4-Diversity Report**.
>
> 2. Click below the figure heading in the Word document that reads: *Figure 1: Enrollment by Race*. The image of the stacked column chart will be placed below this heading.

3. If needed, open the Excel file used in this chapter, **CH4-Charting**.

4. Click the *Enrollment by Race* chart in the **Enrollment by Race Chart** sheet to active the chart.

5. Click **Home** ⇒ **Copy Down Arrow** ⇒ **Copy as Picture**.

6. The *Copy Picture* dialog box will open. Select **OK** — Accepting the *Copy Pictures* defaults:

   • As shown on Screen

   • Picture

7. Go back to the **CH4-Diversity Report** Word document by clicking the file in the taskbar.

8. Confirm that the insertion point is below the *Figure 1: Enrollment by Race* heading (see Figure 183).

9. Click **Home** ⇒ **Paste** (or press Crtl + V).

learning centers. In 2014, over 30,000 students attended Portland Community College. PCC offers certificate programs, Associates degree programs through 149 major areas.

Mt Hood Community College (MHCC) serves students who live north and east of Portland proper. In 2014, over 9,000 students attended MHCC. Mt Hood offers certificate programs, Associates degree programs with 99 different majors.

Clackamas Community College (CCC) serves students who live south of the Portland area. In 2014 over 7,000 attended CCC. They were offered certificate and Associates degree programs with a possibility of 88 majors.

Each college has plans to increase diversity in both students and employees to more closely reflect the population of the metropolitan area.

Figure 1: Enrollment by Race

Your insertion point is here

Figure 183: Paste Picture in Word

Unfortunately, the picture is so big that it overlaps the next page. Use this procedure to change its size.

1. Click anywhere on the picture to activate it.

2. Click **Picture Tools** ⇒ **Format** ⇒ **Size** ⇒ **Shape Width Down Arrow**. Continue to click the down arrow until the width of the picture is 5.4 inches (see Figure 184). As the width is reduced the height is automatically reduced.

(The height should end up about 3.92 inches) (**Excel 365**) names the tab Picture Format.)

3. To center the chart on the page, make sure the chart is activated and click **Home** ⇒ **Paragraph** ⇒ **Center**.

4. Save the document and close Word.
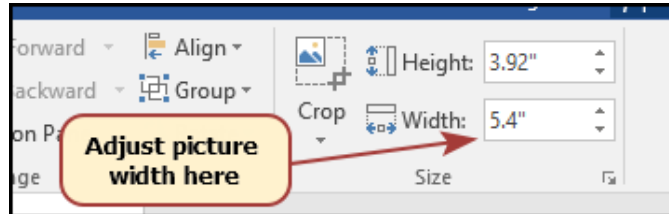
Figure 184: Changing the Size of a Picture in Word

Figure 185 shows the final appearance of the *Enrollment by Race Source* chart pasted into a Word document.

Note

Resizing Images

It is best to use either the *Shape Width* or *Shape Height* buttons to reduce the size of an embedded chart. Using either button automatically reduces both height and width in proper proportion. If the sizing handles are used, hold the [Shift] key while clicking and dragging on a corner sizing handle to keep the chart in proper proportion.

Figure 185: Final Appearance of Pasting a Chart Image into Word

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Skill Refresher

Pasting a Chart Image into Word

- Activate an Excel chart and click *Home ⇒ Copy*.
- Click on the location in the Word document where the Excel chart will be pasted.
- Click *Home ⇒ Paste Down Arrow ⇒ Picture*.
- Click *Picture Tools ⇒ Format*. Resize the picture by clicking the up or down arrow on the *Shape Width* or *Shape Height* buttons.

4.3.2 *Pasting a Linked Chart Image into PowerPoint*

This exercise requires two files:

- The Excel spreadsheet used in this chapter: *CH4-Charting*. (Note: this section continues the previous exercise. Students who only need to complete this section can open *CH4-Charting Solution 1_2* to start where the previous exercise ended.)

- A PowerPoint file: *CH4-Diversity*

Microsoft PowerPoint is perhaps the most used tool for delivering live presentations. The charts used in a live presentation are critical for efficiently delivering ideas to an audience. Like written documents, a wide range of presentations may require the explanation

of quantitative data. This demonstration includes a PowerPoint slide that could be used in a presentation. The *Enrollment by Race* chart will be pasted into this PowerPoint slide. However, instead of pasting an image, as demonstrated in the Word document above, a link will be established to the Excel file. As a result, if the chart in the Excel file is changed that change will be reflected in the PowerPoint file. The following steps explain how to link these two files.

1. Open **CH4-Diversity.pptx** and save it as **CH4-Diversity Presentation**. (Note: the student files include both a PowerPoint presentation and a Word document named Diversity. Be sure to open the PowerPoint presentation for this activity.)

2. Navigate to Slide 6 — *Diversity in Enrollment*. This is the slide where the linked chart will be placed.

3. If needed, open the Excel file used in this chapter, **CH4-Charting**. Click the *Enrollment by Race* chart in the **Enrollment by Race Chart** sheet to activate it.

4. Click **Home** ⇒ **Copy Down Arrow** ⇒ **Copy** (*NOT* Copy as Picture).

5. Go back to **CH4-Diversity Presentation** by clicking the file in the taskbar.

6. Make sure Slide 6, *Diversity in Enrollment*, is still active. Click on the outside edge of the empty *Click to add text* box on the right to activate it.

7. Click **Home** ⇒ **Paste Down Arrow** in the PowerPoint file.

8. Hover over each of the Paste Options until **Keep Source Formatting & Link Data (F)** is highlighted (see Figure 186). Select this option. This pastes an image of the Excel chart into the PowerPoint slide. In addition, a link is created so that any changes made to the chart (in Excel) appear on the PowerPoint slide.
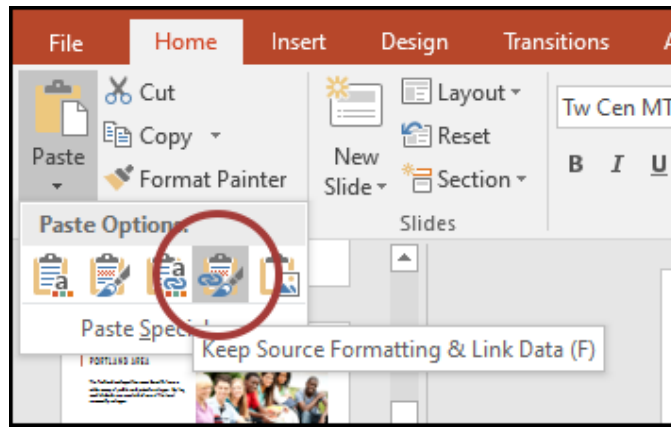
Figure 186: Creating a Link to an Excel Chart in PowerPoint

Next, the chart needs to be cleaned up a bit. First, apply a different chart style.

1. Click anywhere in the plot area of the column chart pasted into the PowerPoint slide. The same Chart Tools tabs found in Excel are displayed on the ribbon (see Figure 187).

2. Click **Chart Tools Design** ⇒ **Chart Style** ⇒ **Style** 8. (Excel 365 named the tab *Chart Design*.) This is the style with a dark brown background.

Figure 187: Selecting a New Chart Style

Linking this chart caused trouble with the text boxes, so delete them.

1. Select each text box by hovering the mouse over the outside edge of the text box until it changes into a four-headed arrow, then click.

2. Press the ⌈Delete⌋ key. Be sure that the insertion point is *NOT* blinking inside the text box. If it is, the contents of the text box will be edited instead of deleting the complete text box.

3. Reposition and resize the *Diversity Program Result* callout box so the text is visible and the callout points to the top of the first data item for Portland Community College.

The benefit of adding this chart to the presentation as a link is that it will automatically update when the data in the linked spreadsheet file is changed.

1. Return to the **CH4-Charting** Excel file.

2. Select the **Enrollment Statistics** worksheet (the one with the Enrollment data). Change the value in cell **D3** to 1000 to change the number of white students at Clackamas Community College to 1000. This is not true but is a large enough change to see the result in the linked charts.

3. Select the **Enrollment by Race Chart** worksheet. Notice how the chart has changed.

4. Return to **Diversity Presentation** by clicking the file in the taskbar.

5. On Slide 6, notice that the chart was updated to reflect the change in enrollment (see Figure 185).

6. If the chart has not changed, be sure that the chart is selected, click **Chart Tools Design** ⇒ **Chart Tools** ⇒ **Refresh Data**. (Excel 365 named the tab *Chart Design*.) The change made in the Excel workbook is now reflected on the PowerPoint slide.

7. If that still does not work, check to see if a "normal" link was created instead of a "Paste" Link. If so, delete the chart and follow the steps again from the beginning of this section.

8. Return the changed number to its original value. Open the **CH4-Charting** Excel file.

9. Select the **Enrollment Statistics** worksheet (the one with the Enrollment data). Change the value in cell **D3** to 4751, the original value.

10. Save all files and close PowerPoint. The files will be submitted at the end of the next section.

Figure 188 shows the appearance of the PowerPoint slide after the Excel chart was added.
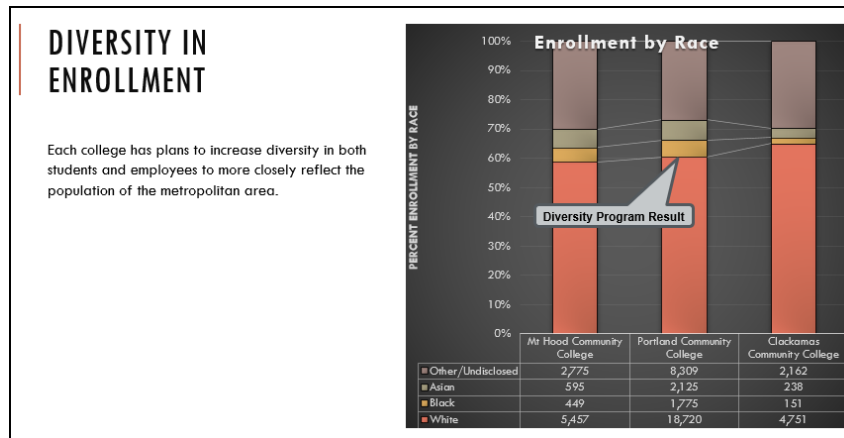
Figure 188: Final PowerPoint Slide

Skill Refresher

Pasting a Linked Chart Image into PowerPoint

- Activate an Excel chart and click the *Copy* button in the *Home* tab of the ribbon.
- Click in the PowerPoint slide where the Excel chart will be pasted.
- Click the down arrow of the *Paste* button in the *Home* tab of the ribbon.
- Click the *Keep Source Formatting & Link Data* option from the drop-down list.
- Click the *Refresh Data* button in the *Design* tab of the ribbon to ensure any changes in the Excel file are reflected in the chart.

Integrity Check

Refreshing Linked Charts in PowerPoint and Word

When creating a link to a chart in Word or PowerPoint, the data must be refreshed when there are changes in the Excel workbook. This is especially true if the changes are made in the Excel file prior to opening the Word or PowerPoint file that contains a link to a chart. To refresh the chart, make sure it is activated, then click *Chart Tools Design* ⇒ *Chart Tools* ⇒ *Refresh Data*. Forgetting this step can result in old or erroneous data being displayed in the chart.

Key Take-Aways

Using Excel Charts with Word or PowerPoint

- When pasting an image of an Excel chart into a Word document or PowerPoint file, use the *Picture* option from the *Paste* drop-down list of options to make it act as an image. Note that if the underlying data is updated the picture is not changed if it has been pasted as an image.
- When creating a link to a chart in Word or PowerPoint, the data may need to be refreshed if changes are made in the originating spreadsheet.

Integrity Check

Severed Link?

When creating a link to an Excel chart in Word or PowerPoint, the Excel workbook must stay in its original location on the computer or network. If the workbook is moved or deleted, an error message will be generated when the link in the Word or PowerPoint file is updated. An error is also generated if the Excel workbook is saved on a network drive that the computer cannot access. These errors occur because the link to the Excel workbook has been severed. Therefore, if a USB drive is being used for a presentation then all the linked Excel workbooks must be moved to the USB drive before establishing the Word or PowerPoint link.

4.4 PREPARING TO PRINT

Learning Objectives

- Review each worksheet in a workbook in Print Preview.
- Modify worksheets as needed to professionally print data and charts.

This section considers each of the worksheets created in the previous sections. Since these worksheets contain a combination of data and charts, there are specific things to watch for when they are printed.

A good start point is to look at each worksheet in Print Preview in *Backstage View*. Then make any necessary changes, such as changing

the orientation and scaling, or moving charts around on the worksheet. To make sure that no worksheets are missed, review them in the order they appear in the tabs.

4.4.1 *Previewing Chart Sheets for Printing*

The first worksheet, *Closing Prices*, is a chart sheet. This means that it contains only a chart with no data; but it still needs to be reviewed in *Print Preview*.

1. Open **CH4-Charting** if it is not already open. (Note: this section continues the previous exercise. Students who only need to complete this section can open *CH4-Charting Solution 1_3* to start where the previous exercise ended.)

2. Click on the **Closing Prices** worksheet tab.

3. Click **File** ⇒ **Print**.

4. Notice that the chart will print on the entire page in Landscape orientation.

5. There is nothing to change so close the print preview by clicking the arrow at the top left corner of the preview screen.

4.4.2 *Printing Worksheets with Data and Charts*

The next worksheet (*Stock Trend*) has data and two charts. To print the data and the charts, the page setup will need some modification.

1. Click the **Stock Trend** worksheet tab to open that worksheet.

2. Click **File** ⇒ **Print**.

3. Notice that this worksheet is currently printing on seven pages.

4. Click through each page and note the following.

   - The data is split between the first and third pages.
   - The line chart starts on the first page, but part of it is also on the second page.
   - The double-line chart starts on the third page and then finishes on the fifth page.

- The fourth and sixth pages are blank (or nearly blank).

- The last page has a column of seemingly random numbers.

5. Close the print preview by clicking the arrow at the top left corner of the preview screen.

The first thing to do is remove the numbers that are appearing on page seven. To do this, hide the column where they are stored. It is important to hide the column instead of deleting the numbers in case they are being utilized somewhere else in the workbook.

1. Scroll to the right on the worksheet until the numbers in **Column AH** are visible.

2. Click anywhere in **Column AH**.

3. Click **Home**⇒ **Cells** ⇒ **Format** ⇒ **Visibility** ⇒ **Hide & Unhide** ⇒ **Hide Columns** (see Figure 189).
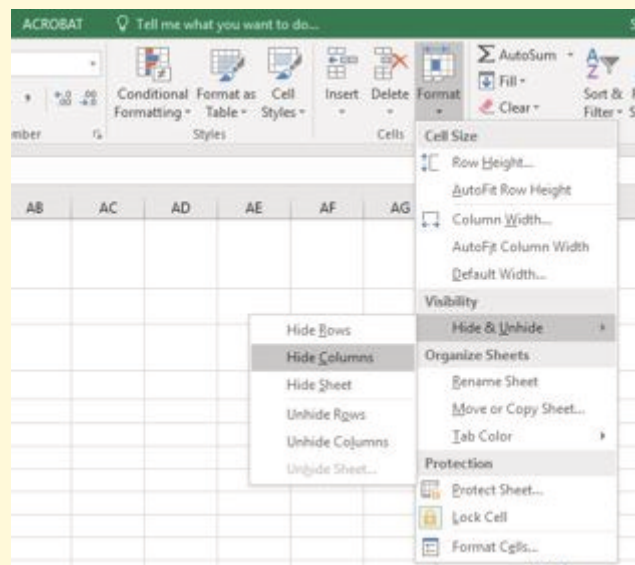
Figure 189: Hide Columns in Format Menu

4. The visible column headings should now go from **AG** to **AI**.

5. Click **File** ⇒ **Print**.

6. Notice that there are now five pages. The data and charts are still splitting across multiple pages, but the numbers in **Column AH** are no longer printing.

7. Remain in *Print Preview* for the next steps.

The data is still split between Page 2 and Page 3, and the charts are splitting oddly as well. The first step to fix these issues is to change the page orientation and scaling.

1. While still in *Print Preview*, change the page orientation to **Landscape**.

2. This puts all the data on one sheet, but the charts are still split between two pages.

3. Change the page scaling to **Fit Sheet on One Page**.

4. This fits everything on one page, but it is too small to be able to read.

5. Change the page scaling back to **No Scaling**.

The next thing to try is moving one, or both, of the charts.

1. Close the print preview by clicking the arrow at the top left corner of the preview screen.

2. Click **View** ⇒ **Workbook Views** ⇒ **Page Break Preview**. The screen should look like Figure 190. (Remember that the dotted blue lines indicate automatic page breaks.)

3. Move the *24 Month Comparison* (double-line) chart closer to the top of its page.

4. Move the *May 2014-2015 Trend for NASDAQ Sales Volume* (line chart) so that it is under the *24 Month Comparison* chart.

5. The link to the data source is still at the bottom of page 2 (in **A50:A51**) so it needs to be moved to **M31:M32**.

6. The screen should look similar to Figure 191.
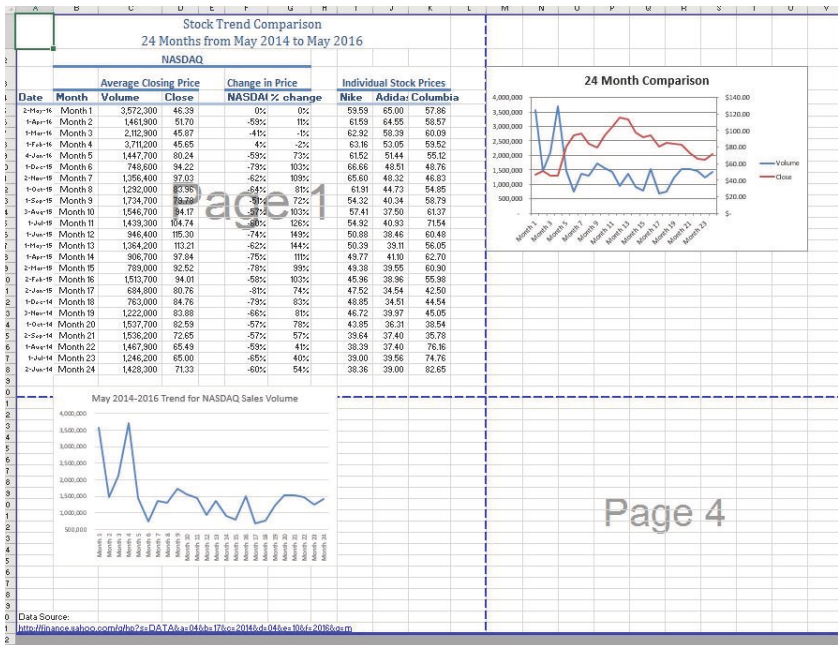
Figure 190: Page Break Preview before moving the charts in Step 3
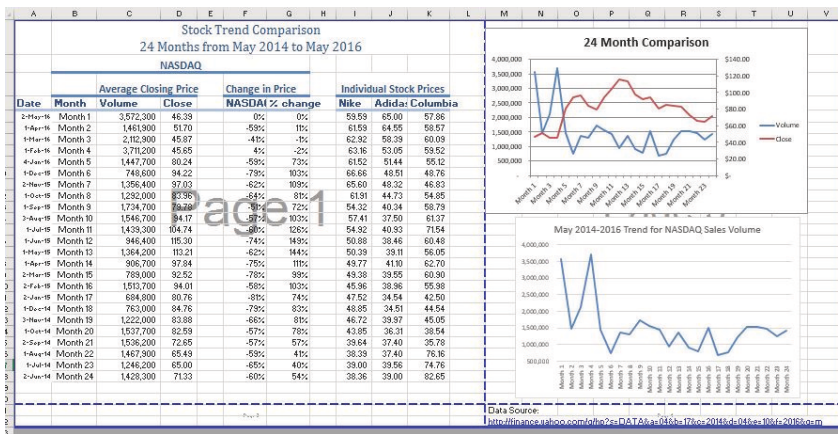
Figure 191: Page Break Preview after moving the charts and text

The data source link text should not print on its own page, but there is no room to move it onto the same page as the charts. To fix this, remove the automatic page break between the charts and the text in M31:M32.

1. Place the pointer on the horizontal blue dashed line (automatic page break) between the line chart and the Data Source link text.

2. When the pointer changes to the double arrow (pointing up and down), drag the page break down into the gray area. This removes the page break.

2. **Grade Distribution**: the chart is split across two pages. Fix this by changing the orientation (Landscape) and scaling (Fit Sheet on One Page).

3. **Enrollment by Race Chart**: this is a chart sheet, so it should not need any changes.

4.4.4 *Printing a Chart Only*

Sometimes a worksheet may have both data and a chart but only the chart should print. That is the case with the *Enrollment Statistics* worksheet.

1. Switch to the **Enrollment Statistics** worksheet.

2. Click the pie chart to activate it.

3. Click **File** ⇒ **Print**.

4. Only the chart is printing. (If it shows the data printing along with the chart, exit print preview and be sure to select just the chart on the worksheet.)

5. If needed, change the orientation to Landscape. This orientation looks better when printing just a chart.

6. Exit print preview.

4.4.5 *Hiding a Worksheet*

It is possible to hide an entire worksheet so it will not print nor will anyone looking at the workbook see it. Keep in mind that this is not a security feature since someone can simply unhide the sheet, but it makes it easier to focus on the data and charts that are important. For this section, hide the *Enrollment by Race Chart* sheet.

1. Right-click on the **Enrollment by Race Chart** tab.

2. Select **Hide** from the menu that appears. The **Enrollment by Race Chart** sheet should no longer be visible.

3. To unhide the worksheet, right-click on any other worksheet tab and select Unhide from the menu. A list of hidden worksheets will be displayed. Select the **Enrollment by Race Chart** and click **OK**.

4. Save the **CH4-Charting** workbook.

5. Compare all workbooks with their self-check answer key: **CH4-Charting Solution**, **CH4-Diversity Report Solution**, and **CH4-Diversity Presentation Solution**.

6. Close and submit all three files (**CH4-Charting**, **CH4-Diversity Report**, and **CH4-Diversity Presentation**) as directed by the instructor.

4.5   CHAPTER PRACTICE

Although Excel is primarily used in business and scientific applications, it is useful in other areas of study as well. In the following exercises, Excel is used to create charts using historical, health, and social justice data.

4.5.1   *Charting Historical Data (Comprehensive Review)*

Excel is an excellent tool for helping to display historical data. This exercise examines information on minimum wage data and life expectancy.

4.5.1.1   *Task1 – National Minimum Wage in the Us – 1960-2014*

Since the beginning of the previous century, the United States has set a minimum wage to set a "floor" beneath which wages cannot fall. Most states have set their own minimum wages, but none are lower than the national minimum wage[2].

1. Open the file named **PR4-Data** and then Save As **PR4-Historical Data**.

2. On the **Minimum Wage** worksheet, select the range **B4:C60**.

3. Click **Insert ⇒ Charts ⇒ Recommended Chart**. *Recommended Charts* allows users to first see how selected data would be represented on a variety of chart types before committing to a particular type of chart. Being able to see the data as it would look in a variety of charts helps when selecting the kind of chart that best matches the data. It does a particularly good job when using dates or years as labels, though sometimes Excel gets confused

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2 To learn more about the national minimum wage, look at https://en.wikipedia.org /wiki/Minimum_wage_in_the_United_States.

and thinks that dates are part of the data instead of labels.

4. Select the first *Line Chart* and press **OK**.

5. The line chart is created in the **Minimum Wage** worksheet.

6. Resize the chart using the following values. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 4**
Left	Left of **Column E**
Bottom	Bottom of **Row 20**
Right	Right of **Column M**

7. Click the chart title once and then click in front of the first letter. A blinking cursor appears in front of the letter. Type the following in front of the first letter in the chart title: *US National* (be sure to leave a space after the word *National*).

8. While the chart is still selected, click **Chart Tools Design** ⇒ **Chart Styles**. ([Excel 365] named the tab *Chart Design*.) If necessary, press the More button to see the available styles.

9. Float the cursor over the available styles to see how each will affect the chart. Select Style Four, which fills a vertical stripe pattern under the line.

10. The years across the X Axis are a little hard to read. Select the labels so there is a box surrounding the list of years.

11. Click **Home** ⇒ **Alignment** ⇒ **Orientation** ⇒ **Angle Counterclockwise**.

12. Click **A1** to select that cell.

13. Prepare the **Minimum Wage** worksheet for printing by changing the scaling on the *Print Preview* screen to *Fit Sheet on One Page*.

14. Close the print preview by clicking the arrow at the top left corner of the preview screen.

4.5.1.2 *Task2 – Oregon: Projected Life Expectancy at Birth*

In the past 40 years, between 1970 and 2010, life expectancy for Oregon men improved by 8.7 years and for women by 5.5 years. Oregon's life expectancy has remained slightly higher than the U.S. average. The life expectancy will continue to improve for both men and women; however, the gain for men has been outpacing the gain for women. Consequently, the difference between men's and women's life expectancies has continued to shrink[3].

1. On the **Life Expectancy** sheet, select **A5:B11**

2. Press F11 to automatically create a column chart on a new worksheet.

3. Double click the chart sheet tab name and change it to *Men*.

4. Take a good look at this chart. It is not what was expected. Excel has made a mistake and charted the *Birth Year* information as though it was data, instead of using it to label the Y Axis.

5. Click the chart to activate it.

6. Click **Chart Tools Design ⇒ Data ⇒ Select Data**. (Excel 365 named the tab *Chart Design*.) This opens the *Select Data Source* dialog box. The box at the top tells us the range that was selected, which looks fine.

The *Legend Entries* in the large box on the left side of the *Select Data Source* box need to be corrected. Also, the *Horizontal Axis Labels* are just a series of default numbers, but they need to be the range that contains the years.

1. In the *Legend Entries*, click in the small box in front of **Birth Year** to remove the check mark. This will remove the *Birth Year* as a data series on the chart.

2. In the *Horizontal (Category) Axis Labels* box, press the **Edit** button. This will open the *Axis Labels* dialog box. Press the **Select range** button.

3. Navigate to the **Life Expectancy** tab and select **A6:A11**. After *='Life Expectancy'!A6:A11* is displayed in the box, press the Select Range button. Press **OK**. Press **OK** a second time.

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3 This data was found at https://www.oregon.gov/das/OEA/Documents/OR_pop_trend2012.pdf.

4. Change the chart title so that it reads: *Life Expectancy for Oregon Men*.

5. Remove the Legend from the bottom of the chart by right-clicking on it and selecting **Delete** from the context menu.

6. Return to the *Life Expectancy* tab, select **A5:A11**, **C5:C11** (Select the first range, hold down the [Ctrl] key, select both noncontiguous ranges at the same time.

7. Repeat the above steps to create a matching chart for *Life Expectancy for Oregon Women*.

8. Return to the *Life Expectancy* tab, select **A5:D11**.

9. Use the **Recommended Charts** tool to create a line chart (it will be the first option).

10. Resize the chart using the following values. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 3**
Left	Left of **Column G**
Bottom	Bottom of **Row 18**
Right	Right of **Column N**

11. Change the *Chart Title* to *Oregon: Projected Life Expectancy at Birth*.

12. The green line across the bottom of the chart represents the difference between men's and women's life expectancy, but it is not helpful as it is. Right click on the green line to open the context menu. Select **Format Data Series**. In the *Format Data Series* pane, under the **Series Options** tab, select the radio button in front of **Secondary Axis**.

13. Close the *Format Data Series* pane.

14. Add a text box that explains the *Difference* calculation. While the chart is still selected:

    - Click **Insert** ⇒ **Text** ⇒ **Text Box**.

    - Notice that the cursor has turned into a cross hair (thin black plus sign)

- Click once in the lower left corner of the chart, near 0.0 on the Y Axis. This creates a text box.

- Type the following into the text box: *Difference = Female life expectancy minus male*. Press the Enter key after the word *life* to create a two-line entry.

- Move or resize the text box as desired.

15. Move or resize the chart so that it no longer is on top of the spreadsheet data.

16. Click **Chart Tools Design** ⇒ **Chart Styles** and select the first style. (Excel 365 named the tab *Chart Design*.)

17. Preview the **Life Expectancy** worksheet in *Print Preview* and make any necessary changes to ensure the entire worksheet is visible.

18. Save the **PR4-Historical Data** workbook.

19. Compare the worksheet with the self-check answer key (**PR4-Historical Data Solution**) and then close and submit the **PR4-Historical Data** workbook as directed by the instructor.

4.6   SCORED ASSESSMENT

4.6.1   *Charting Social Justice Data (Comprehensive Review)*

4.6.1.1   *Task 1 International Incarceration Rates*

1. Open the file named **SC4-Data** and then Save As **SC4-Social Justice**.

2. On the **International** tab, use a function in cell **D20** to find the average of the *Individuals Incarcerated* data.

3. Create a bar chart that looks like Figure 193:
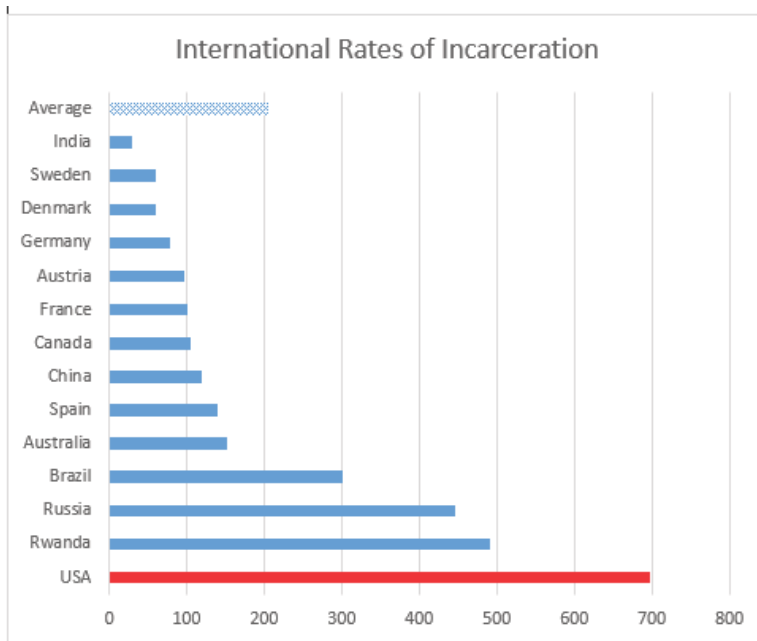
Figure 193: International Incarceration Rates

1. Move and or resize the chart so that it does not cover any of the data.

2. In cell **A25** write a brief note explaining why a bar (or column) chart is a better choice for this data than a pie chart.

3. Set the *Print Area* so that everything prints, except for the explanation that was added in cell **A25**.

4. Preview the **International** worksheet in *Print Preview* and make any changes needed to print professionally on one page.

4.6.1.2   *Task 2 Disenfranchisement Rate*

Felony disenfranchisement is the exclusion from voting of people otherwise eligible to vote (known as disfranchisement) due to conviction of a criminal offense; usually restricted to felonies, the most serious class of crimes. Jurisdictions vary as to whether they make such disfranchisement permanent or restore suffrage after a person has served a sentence or completed parole or probation. Affected individuals suffer "collateral consequences" including loss of access to jobs, housing, and other facilities.

Opponents have argued that such disfranchisement restricts and conflicts with principles of universal suffrage. It can affect civic and communal participation in general[4].

1. On the **Disenfranchisement Rate** sheet, use the **Recommended Charts** tool to create the three charts illustrated in Figures 194, 195, and 196.

2. Put each chart on its own individual sheet rather than an object in a spreadsheet.

3. Be sure that *years* are used as labels on the horizontal axis instead of numbers like 1, 2, 3.

4. Format the Washington and Oregon charts so the maximum for the left vertical axis is 20000 and the right vertical axis is .20.

5. Edit the text of the *Chart Titles* on all three charts and format the title font: Arial, bold, 18pt.
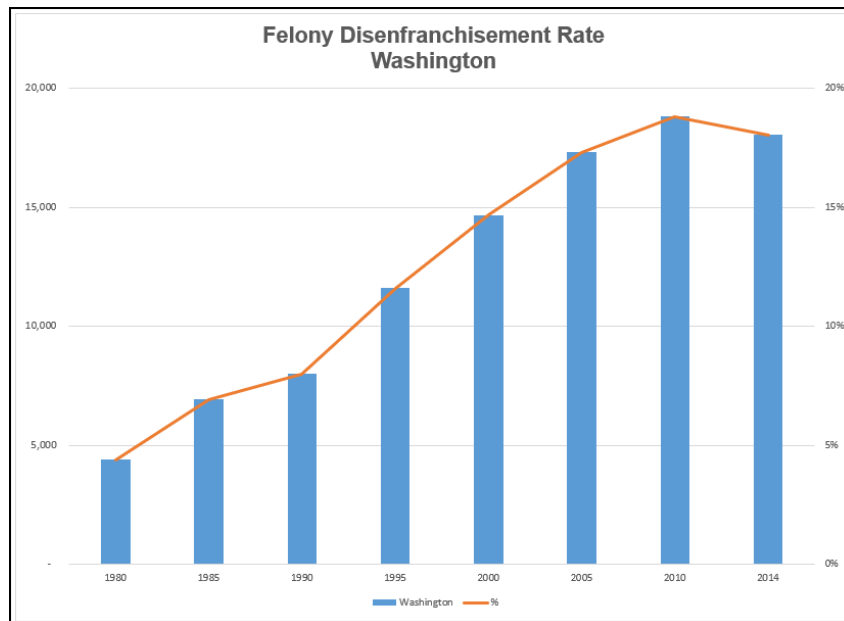
Figure 194: Felony Disenfranchisement Rate Washington
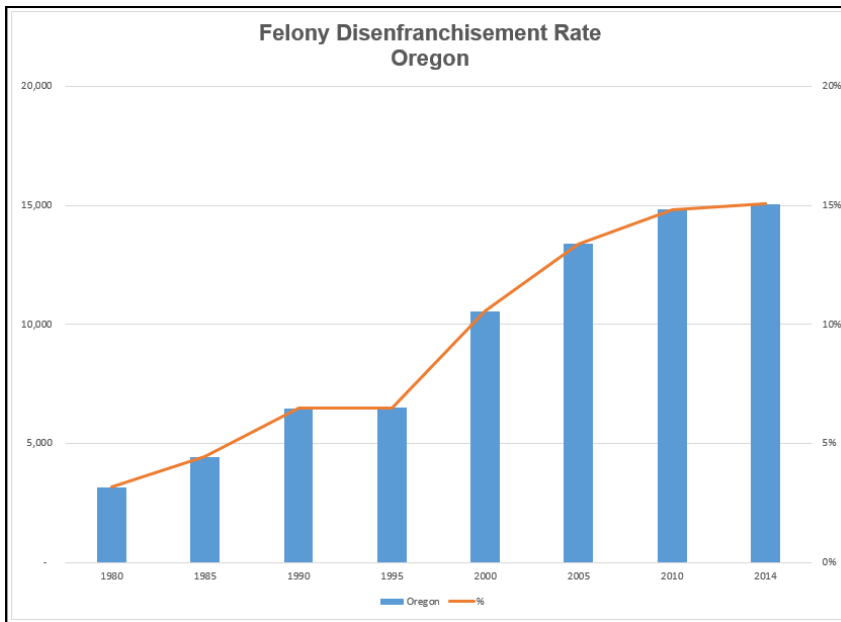
Figure 195: Felony Disenfranchisement Rate Oregon
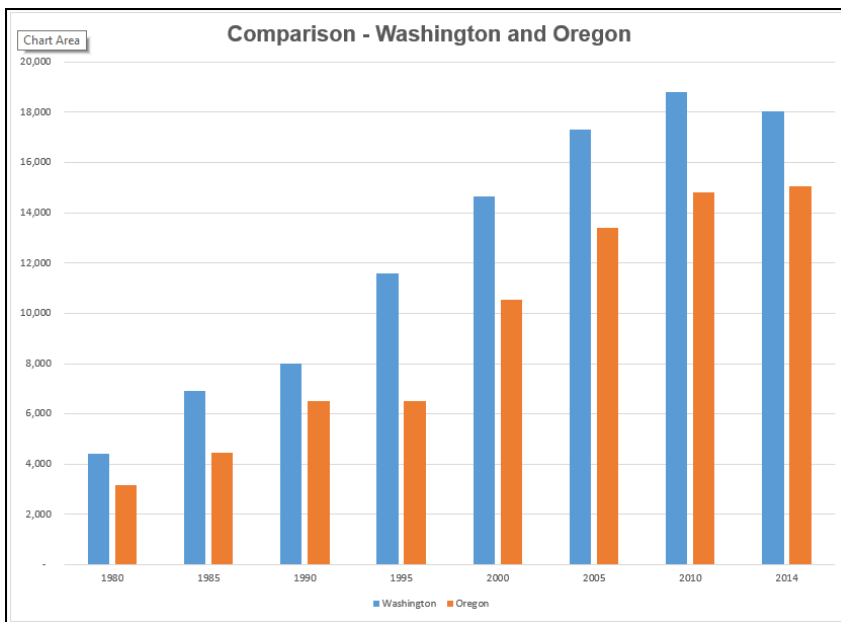
Figure 196: Comparison of Oregon and Washington

1. Preview the worksheet(s) in Print Preview and make any necessary changes for professional printing.

2. Save and close the **SC4-Social Justice** workbook.

3. Submit the **SC4-Social Justice** workbook as directed by the instructor.

5

TABLES

Excel workbooks are designed to store data and it is challenging to organize that data to yield meaningful information. Excel has many features that can help organize data and find needed information efficiently. Setting up data as a table from the onset allows users to sort, filter, total, and subtotal the data easily. In Excel, a table is a collection of data about a subject stored in adjacent rows and columns. Tables can improve the look and feel of a worksheet. This chapter explores how to set up, edit, and work with Excel tables effectively. These skills will be demonstrated in the context of a multi-sheet file that shows national average weather for two vastly different cities in the United States. Weather data is often voluminous and difficult to summarize since so much is collected every hour of every day and providing meaningful summaries of such data is a useful skill. The skills learned using weather data in this chapter can be transferred to data found in any discipline or field.

5.1 BASIC TABLE SKILLS

> **Learning Objectives**
>
> - Understand table structure.
> - Plan, create, and edit a table.
> - Freeze rows and columns.
> - Sort data in a table.

This section reviews the fundamental skills for setting up and maintaining an Excel table. The objective used for this chapter is the construction of a multi-sheet file to keep track of two cities' national weather data for the month of January. Organizing, maintaining, and reporting data are essentials skills for employees in most industries.

Figure 197 shows the completed workbook that will be created in this chapter. Notice that this workbook contains four worksheets. The first worksheet contains weather data for Portland, Maine, the second contains weather data for Portland, Oregon, the third organizes the Oregon data by week, and the fourth contains subtotals for the Oregon data.

Figure 197: Completed National Weather Workbook

5.1.1 *Creating a Table*

When data is presented in long lists or columns, it helps if the table is set up properly. Here are some rules of data-entry etiquette to follow when creating a table from scratch.

- Whenever possible, organize information using adjacent (neighboring) columns and rows.

- Start the table in the upper-left corner of the worksheet and work down the sheet.

- Do not skip columns and rows just to "space out" the information. To place white space between information in adjacent columns and rows, widen columns, heighten rows, or change the alignment.

- Reserve a single column at the left edge of the table for the table's row headings or identifying information.

- Reserve a single row at the top of the table for the table's column headings.

- If the table requires a title, put the title in the row(s) above the column headings.

Following these rules will help ensure that the sorts, filters, totals, and subtotals applied to the table with return the desired results. With these rules in mind, begin working on *National Weather* workbook.

1. Open data file **CH5-Data** and save the file as **CH5-National Weather**.

2. Click the **Portland ME** worksheet tab to activate it.

3. Notice that the data is in adjacent columns and rows. The upper-left corner of the table is in **A5** and the titles are above the column headings in **Row 5**.

4. Click cell **A5**.

5. Click **Insert ⇒ Tables ⇒ Table**.

6. The dialog box illustrated in Figure 198 pops up. Excel has correctly determined that the data range is A5:E33 and that the table has headers.

Figure 198: Create Table

7. Click **OK**.

8. Click **A5**.

9. Adjust all column widths so that the complete headings are visible in **Row 5** with the filter arrows showing. The filter arrows are the down-arrow buttons that appear in the header row when the table is created.

After this, the top of the worksheet will look like Figure 199.

Figure 199: Weather Table

Notice that a new ribbon tab, *Table Tools Design*, appears when the mouse is clicked inside the table. This ribbon tab contains controls to edit, style, and add functionality to the table. (Excel 365 . The tab is named *Table Design*, not *Table Tools Design*.)

1. Click the **Portland OR** worksheet tab to activate it.

2. Click cell **A5**.

3. Click **Insert** ⇒ **Tables** ⇒ **Table**.

4. Be sure Excel automatically determines the data is in **A5:E33** and that it has headers.

5. Click **OK**.

6. Click **A5**.

7. Adjust all column widths so that the complete headings are visible in **Row 5** with the filter arrows showing.

Skill Refresher

Create a Table

- Click on the top left cell in the data.
- Click *Insert* ⇒ *Tables* ⇒ *Table*.
- Make sure the data range is properly identified and *My table has headers* is checked.
- Click *OK*.
- Click on the top left cell again.
- Adjust all columns widths so the complete headings with the filter arrows are showing.

5.1.2   *Formatting Tables*

There are many ways to format an Excel table. One of the easiest to use is a preset *Table Style* using Light, Medium, or Dark colors. There are also a variety of *Table Style Options* as listed in Table 19.

Table Style	Description
Header Row	Top row of the table that includes column headings
Total Row	Row added to the bottom that applies column summary calculations
First Column	Formatting added to the left-most column in the table
Last Column	Formatting added to the right-most column in the table
Banded Rows	Alternating rows of color added to make it easier to see rows of data
Banded Columns	Alternating columns of color added to make it easier to see columns of data
Filter Button	Button that appear at the top of each column that lists options for sorting and filtering

Table 19: Table Style Options

Add formatting to both of the Portland weather tables in the following steps.

1. Click on the **Portland ME** sheet to activate it.

2. Click cell **A5**.

3. Click **Table Tools Design** ⇒ **Table Styles** ⇒ **More Down Arrow**. (Excel 365 . The tab is named *Table Design*, not *Table Tools Design*.)

4. A gallery of table styles will appear as in Figure 200.
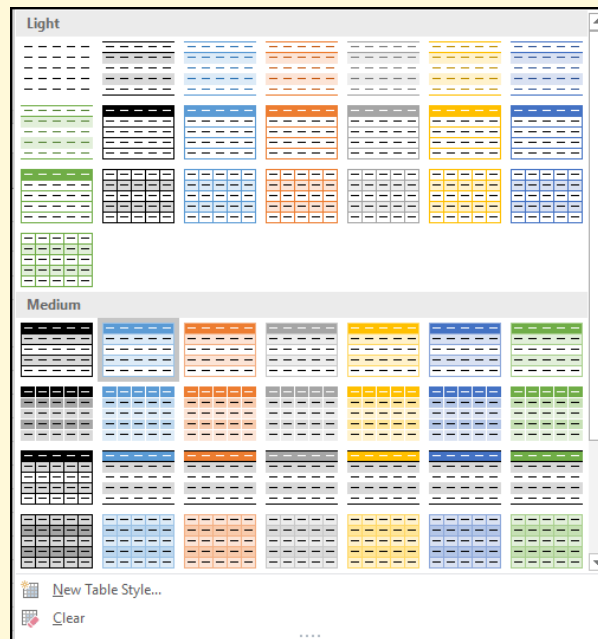
Figure 200: Table Styles

5. In the Table Styles gallery, in the Medium Section, click *Table Style Medium 7* (this is a green-colored style).

6. Uncheck **Table Style Design ⇒ Table Style Options ⇒ Banded Rows**.

7. The alternating colored rows will disappear. The data in the table is now more difficult to read.

8. Try some of the other options in the Table Style Options group. When finished, be sure that *Header Row*, *Banded Rows*, and *Filter Button* are the only ones checked, as in Figure 201.
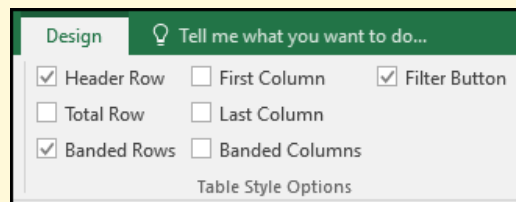
Figure 201: Ribbon Table Style Options

9. Save the **CH5-National Weather** workbook.

5.1.3 *Adding Data to Tables*

Over time, new data will need to be added to a table, and that should be added in a blank row. The easiest way to do this is to enter the data below the last row in the table, then sort the table to arrange its data. If data must be added in a specific place in the middle of a table, insert a blank row and add the data there.

Add the last three days of the months to the *Portland ME* and *Portland OR* worksheets. The following steps walks through this process.

1. Click on the **Portland ME** worksheet.

2. Click on **A34** (the left-most cell below the last row in the table).

3. Enter the data from the following table.

Day	High (°F)	Low (°F)	Rain (inches)	Snow (inches)
29	31.4	13.3	0.12	0.59
30	31.6	3.4	0.08	0.47
31	31.7	13.5	0.12	0.63

Table 20: Portland, Maine data

Notice that the banded row formatting continues as additional rows are added to the tables.

1. Click on the **Portland OR** worksheet.

2. Click on **A34** (the left-most cell below the last row in the table).

3. Enter the data from the following table.

Day	High (°F)	Low (°F)	Rain (inches)	Snow (inches)
29	48.8	36.2	0.16	0.00
30	49.0	36.2	0.11	0.32
31	49.1	36.1	0.16	0.00

Table 21: Portland, Oregon data

1. Save the **CH5-National Weather** workbook.

5.1.4 *Finding and Editing Data*

It is inevitable that data errors which need to be corrected will appear in a table. While it is possible to visually scan through a table to find errors, this can be a tedious and tiresome process, especially if the table is large. Excel can help with this through the *Find* command. When using *Find*, the best practice is to start with the cell pointer in cell A1 to ensure that all the data in the worksheet is included in the search.

A temperature of 3.4 degrees was entered erroneously in the *Portland ME* sheet. It should have been 13.4. To fix this error, complete the following steps.

1. Click on the **Portland ME** sheet.

2. Press the Ctrl + Home keys together to go to the top of the sheet (cell **A1**).

3. Click **Home** ⇒ **Editing** ⇒ **Find & Select** ⇒ **Find**.

4. In the **Find** box, type 3.4, and then click **Find Next**.
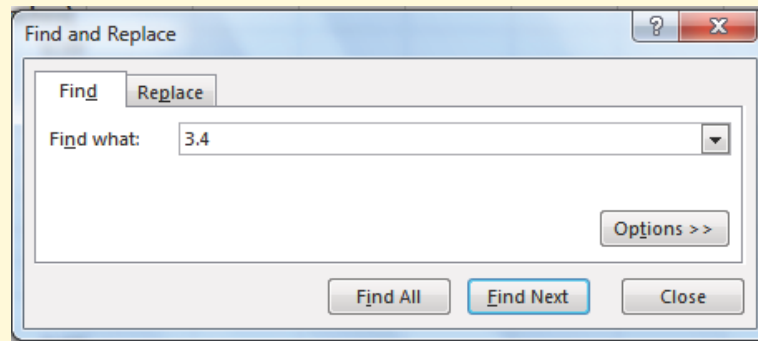
Figure 202: Find and Replace

5. Click the **Close** button.

6. Replace 3.4 in the *Low* column for Day 10 with 13.4.

7. Now switch to the **Portland OR** sheet and find the Snow error of 0.32 in Day 3. Change it to 0.12.

8. Save the **CH5-National Weather** workbook.

> **Skill Refresher**
>
> **Finding and Replacing Data**
>
> - Click *Home ⇒ Editing ⇒ Find & Select ⇒ Find*.
> - In the *Find* box, type the phrase to find then click *Find Next*.
> - Continue clicking *Find Next* until the desired phrase is found.
> - Click *Close* and edit the data.

5.1.5   *Freeze Rows and Columns*

When panes are "frozen" in a worksheet, Microsoft Excel keeps specific rows or columns visible in the table as it is scrolled on the screen. For example, if the first row in the spreadsheet contains labels, that row might be frozen to make sure that the column labels remain visible as the sheet is scrolled down. Follow these steps to freeze the worksheet headings and keep them visible on the screen.

1. Click on the **Portland ME** sheet.

2. Click in **A6**, the left-most cell *below* the headings row.

3. Click **View ⇒ Window ⇒ Freeze Panes ⇒ Freeze Panes** (see Figure 203).

4. Scroll up and down the sheet and notice that the headings are always displayed at the top of the table. Also, notice that a thin line appears under **Row 5** to mark the bottom of the frozen section.
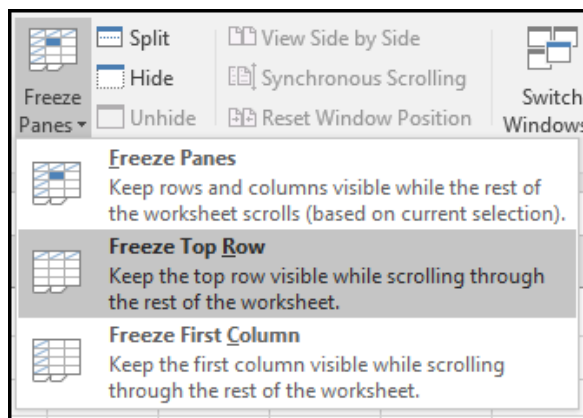
Figure 203: Freeze Pane

To unfreeze the headings, follow these steps.

1. Click **View** ⇒ **Window** ⇒ **Freeze Panes** ⇒ **Unfreeze Panes**

5.1.6 *Simple Sort*

Content in a table can be sorted alphabetically, numerically, and in many other ways. Sorting helps organize data by ordering one or more columns in the table. Table 22 describes the different sort orders available for each column of data.

Sort Order	Text	Numbers	Dates
Ascending	Alphabetical (A-Z)	Smallest to Largest	Chronological (oldest to newest)
Descending	Reverse Alphabetical (Z-A)	Largest to Smallest	Reverse Chronological (newest to oldest)

Table 22: Sort Options

Suppose it is important to know what the snowiest day was in January in Portland, Maine. One way to find that is to sort the *Snow* column in Descending order.

1. Click on the **Portland ME** sheet.

2. Click on the **Down Arrow** to the right of the header in **E5**, *Snow (inches)*.

3. Click on Click *ZA↓ Sort Largest to Smallest* (see Figure 204).
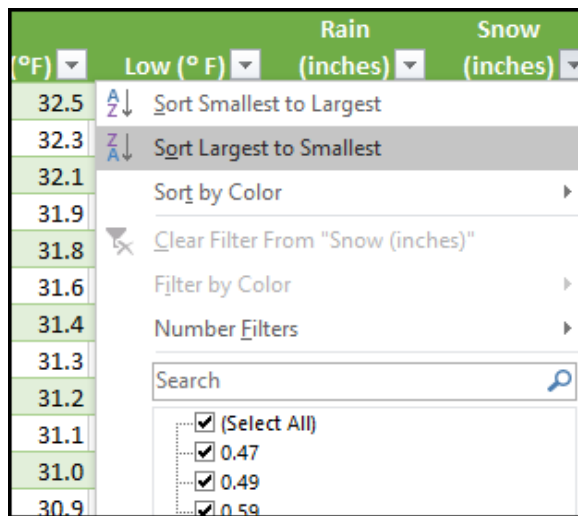
Figure 204: Sort by One Column

If this is done correctly, the snowiest day, January 3rd (in *Row* 6) with 0.73 inches of snow, will sort to the top of the list. Notice the filter arrow changes in the snow column to a downward pointing arrow to indicate that the column is sorted in descending order (largest to smallest).

	Day	High (°F)	Low (° F)	Rain (inches)	Snow (inches)
6	3	32.1	14.6	0.11	0.73
7	5	31.8	14.2	0.12	0.71
8	12	30.9	13.2	0.12	0.71
9	16	30.7	12.9	0.12	0.71
10	18	30.6	12.8	0.12	0.71
11	22	30.8	12.8	0.08	0.71
12	10	31.1	13.4	0.12	0.67

National Weather Data
January Daily Normals
Portland, Maine

Figure 205: Snowiest Days in Maine

1. Now switch to the **Portland OR** sheet and repeat these sort steps to find the snowiest day in Oregon. Check the worksheet with Figure 206.

	A	B	C	D	E
1			**National Weather Data**		
2			**January Daily Normals**		
3			**Portland, Oregon**		
4					
5	Day ▼	High (°F) ▼	Low (° F) ▼	Rain (inches) ▼	Snow (inches) ↓
6	30	49.0	36.2	0.11	0.32
7	3	45.2	35.0	0.16	0.12
8	15	46.8	35.9	0.16	0.11
9	9	46.0	35.5	0.16	0.08
10	25	48.3	36.2	0.12	0.08
11	1	45.0	34.9	0.16	0.00
12	2	45.1	35.0	0.19	0.00
13	4	45.3	35.1	0.16	0.00

Figure 206: Snowiest Days in Oregon

Skill Refresher

Sort a Column

- Click on the filter down arrow to the right of the header in the column to be sorted.
- Click on the choice *AZ↓* or *ZA↓* to sort the data in that column.

5.1.7 *Multi-Level Sort*

Sometimes a table needs to be sorted by more than one column at a time to efficiently analyze the data. For example, if the data included different types of loans from several bank offices, it would need to be sorted by the type of loan and then by bank office name to clearly see the different groups of loans. As another example, if a worksheet included a list of grades for students over their time in high school, the data should be sorted first by student name, then by grade level (freshman, sophomore, junior, and senior) so that each student's grades appear in chronological order.

For the weather data, determine how cold the snow days were in Oregon.

1. Click on the **Portland OR** sheet.

2. Click cell **A6**.

3. Click **Data** ⇒ **Sort & Filter** ⇒ **Sort**.

4. Click the down-arrow for *Column Sort By* and select *Snow (inches)*.

5. Click the down-arrow for *Order* and select *Largest to Smallest*.

6. To add a 2nd level sort, click **Add Level** at the top left corner of the dialog box.

7. Click the down-arrow for *Then by* and select *Low (°F)*.

8. In the same row, click the down-arrow for *Order* and select *Smallest to Largest*. The dialog box should look like Figure 207.
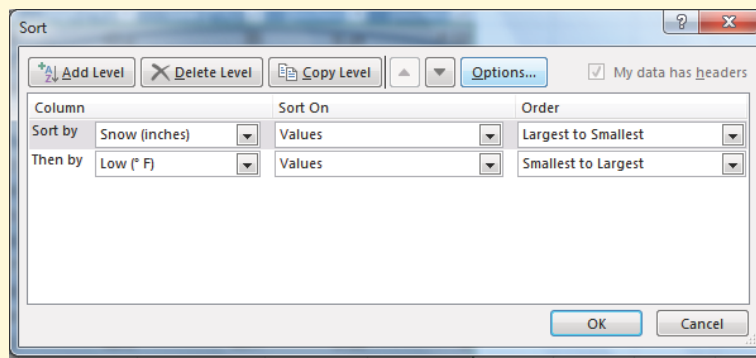
Figure 207: Multi-Level Sort

9. Click **OK**.

10. The table sort results should look like Figure 208. Notice for the two days with 0.08 inches of snow, the low temp of 35.5 on Day 9 is displayed before the low temp of 36.2 on Day 25. The lowest of the two was listed first. Also notice that the filter arrows changed on the sorted columns to show how they are sorted.

Figure 208: Multi-Level Sort Results

5.1.8 *Custom Sorts*

In most cases, the data should be sorted in "typical" sort order: numbers sorted highest to lowest, words sorted alphabetically, etc. Some data does not make sense when sorted this way. For example, if the days of the week are sorted alphabetically, the result would be Friday, Monday, Saturday, Sunday, Thursday, Tuesday, and Wednesday. This order would be of no use to anyone! Similarly, the months of the year would not make sense alphabetically.

To illustrate how days can be sorted, a *Week* number column was added to the *Weekly OR* sheet. Then, the *Day* column was changed from a number to names like Sunday. This sheet facilitates further analysis of the data to see if there are weekly trends in the weather. To look for those trends, sort the *Weekly OR* sheet by *Week* and then by *Day*.

1. Click on the **Weekly OR** worksheet.

2. Click cell **A5**

3. Click **Insert** ⇒ **Tables** ⇒ **Table**.

4. Click **OK**.

5. Click cell **A5**.

6. Click **Data** ⇒ **Sort & Filter** ⇒ **Sort**

7. Click the down-arrow for *Column Sort By* and select *Week*.

8. Click the down-arrow for *Order* and select *Smallest to Largest*.

9. To add a 2nd level sort, click **Add Level** at the top left corner of the dialog box.

10. Click the down-arrow for *Then by* and select *Day*.

11. In the same row, click the down-arrow for *Order* and select *Custom List*. The dialog box should look like Figure 209 will appear on the screen.
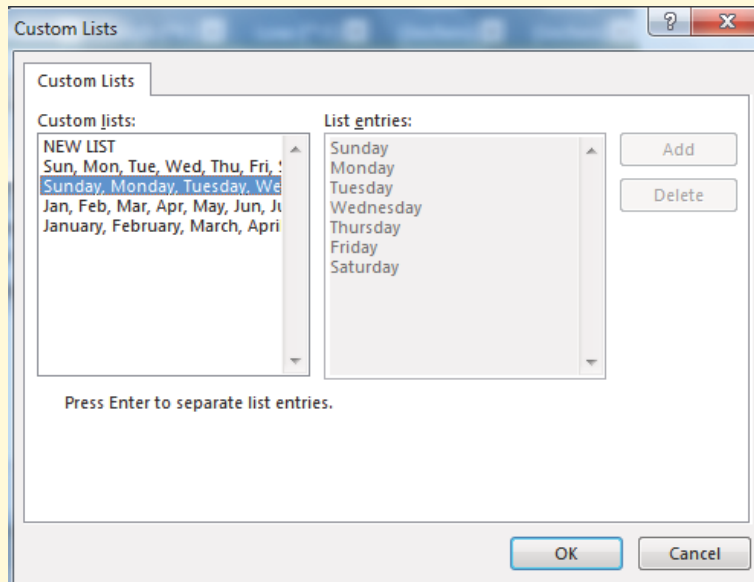
Figure 209: Custom Lists

12. Click on **Sunday, Monday, Tuesday, etc.** in the *Custom* lists on the left-side of the dialog box. NOTE: Make sure to select the list with the days of the week spelled out, not the abbreviations for the days of the week.

13. Click **OK**.

14. The *Sort* dialog box should look like Figure 210.
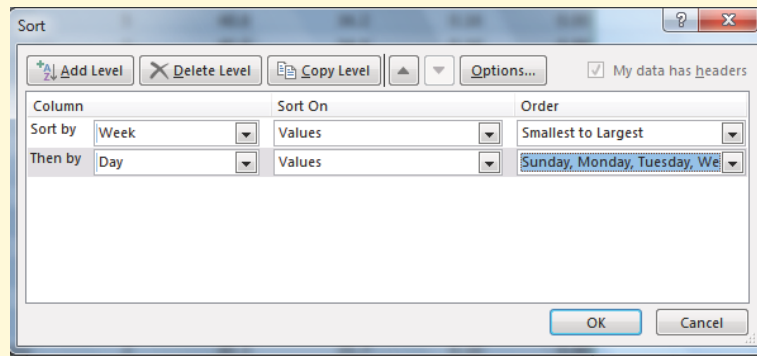
Figure 210: Sort Dialog Box

15. Click **OK**.

16. The sorted table should now look like Figure 211. Notice the data is in *Week* order and, within each week, in *Day* order.

17. Save the **CH5-National Weather** workbook.

	Day	Week	High (°F)	Low (° F)	Rain (inches)	Snow (inches)
1	National Weather Data					
2	January Daily Normals					
3	Portland, Oregon					
6	Sunday	1	45.0	34.9	0.16	0.00
7	Monday	1	45.1	35.0	0.19	0.00
8	Tuesday	1	45.2	35.0	0.16	0.12
9	Wednesday	1	45.3	35.1	0.16	0.00
10	Thursday	1	45.4	35.2	0.20	0.00
11	Friday	1	45.6	35.3	0.15	0.00
12	Saturday	1	45.7	35.4	0.16	0.00
13	Sunday	2	45.8	35.4	0.20	0.00
14	Monday	2	46.0	35.5	0.16	0.08
15	Tuesday	2	46.1	35.6	0.15	0.00
16	Wednesday	2	46.3	35.7	0.16	0.00
17	Thursday	2	46.4	35.7	0.20	0.00
18	Friday	2	46.5	35.8	0.15	0.00
19	Saturday	2	46.7	35.9	0.16	0.00
20	Sunday	3	46.8	35.9	0.16	0.11

Figure 211: Custom Sort

> **Key Take-Aways**
>
> **Basic Table Skills**
>
> - Tables are made up of adjacent rows and columns of data with a single row of column headings at the top.
> - Tables are created by clicking in the top left-most cell in the data and clicking *Insert ⇒ Group ⇒ Table*.
> - There are a gallery of styles and options to choose from to format a table.
> - To add data it is best to add it one row below the bottom of the table. The table can then be resorted to organize the data.
> - Freezing heading keeps column headings displayed while scrolling through the table data.
> - Filter arrows in the table headings sort the data by a single column. Click *Data ⇒ Sort & Filter ⇒ Sort* to sort by two or more columns at a time.
> - Custom Sorts can be used when data needs to be sorted in a special way (i. e.Days of the Week).

5.2 ADVANCED TABLE SKILLS

> **Learning Objectives**
>
> - Filter table data.
> - Add a total row to a table.
> - Insert subtotals into a table.

5.2.1 *Filtering Data*

When an Excel table is first created, filter arrows appear in all the column headings. Those arrows can be used to sort the data by a single column. These same arrows can also be used to filter or limit the displayed data within a column. There are many ways to filter data within a column depending on whether the data is text or numeric.

Notice there is sometimes more than one way to filter data (i. e.with a filter choice or a checked box). There are also single criteria filters and multi-criteria filters. As an introduction to filtering, look at just the first week of data in the *Weekly OR* sheet.

> 1. Click on the **Weekly OR** worksheet.
>
> 2. Click cell **B5**.

3. Click the filter arrow to the right of the *Week* heading.

4. Click the **Select All** checkbox to deselect all the checkbox choices.

5. Click on 1 to select just Week 1.

6. Click **OK**.

The table should look like Figure 212. Only seven rows of Week One are visible in the table. Notice in the Status Bar at the bottom of the screen the message "7 of 31 records found". Also notice that the filter arrow in the Week heading has changed to a funnel which indicates that this column is currently filtered.

	A	B	C	D	E	F
1			National Weather Data			
2			January Daily Normals			
3			Portland, Oregon			
4						
5	Day	Week	High (°F)	Low (°F)	Rain (inches)	Snow (inches)
6	Sunday	1	45.0	34.9	0.16	0.00
7	Monday	1	45.1	35.0	0.19	0.00
8	Tuesday	1	45.2	35.0	0.16	0.12
9	Wednesday	1	45.3	35.1	0.16	0.00
10	Thursday	1	45.4	35.2	0.20	0.00
11	Friday	1	45.6	35.3	0.15	0.00
12	Saturday	1	45.7	35.4	0.16	0.00

Figure 212: Filter

Follow this procedure to remove the filter.

1. Click the funnel next to the Week heading.

2. Click **Clear Filter from "Week"**.

Skill Refresher

Filter a Column

- Click the filter arrow to the right of the heading in the column to be filtered.
- Click the *Select All* checkbox to deselect all of the checkbox choices.
- Click on the checkboxes to filter by.
- Click *OK*.

Un-Filter a Column

- Click the funnel to the right of the heading in the column to be filtered.
- Select *Clear Filter*.

As an example of using a numeric filter, find the days in Portland ME when it was warmer than 32 degrees.

1. Click in the **Portland ME** worksheet.

2. Click cell **B5**.

3. Click on the filter arrow next to the *High* heading.

4. Click **Number Filters** ⇒ **Greater Than...**.

5. The *Custom AutoFilter* dialog box will appear on the screen.

6. Enter **32** in the space to the right of *is Greater than*. The *Custom AutoFilter* dialog box should now match Figure 213.

7. Click **OK**.
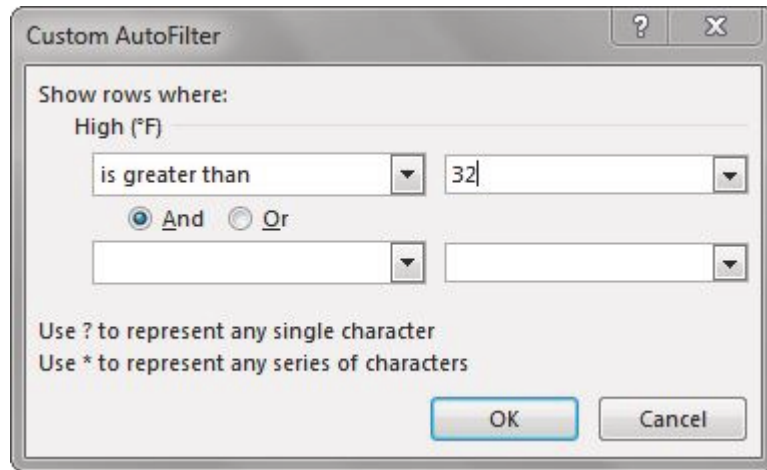
Figure 213: AutoFilter Dialog Box

It is now easy to see that it was above 32 degrees for only the first three days, as illustrated in Figure 214.

Figure 214: Maine Filter Results

Review sorting and filtering in the following steps.

1. Click on the **Weekly OR** worksheet.

2. Sort the table by *Week* (smallest to largest).

3. Filter the *Day* to only show *Monday*.

4. Compare the results to Figure 215.

5. After checking the results, clear the *Day* filter.

	A	B	C	D	E	F
1			National Weather Data			
2			January Daily Normals			
3			Portland, Oregon			
4						
5	Day	Week	High (°F)	Low (° F)	Rain (inches)	Snow (inches)
7	Monday	1	45.1	35.0	0.19	0.00
14	Monday	2	46.0	35.5	0.16	0.08
21	Monday	3	47.0	36.0	0.16	0.00
28	Monday	4	48.0	36.2	0.16	0.00
35	Monday	5	49.0	36.2	0.11	0.12
37						

Figure 215: Oregon Filter Results

5.2.2 *Filtering Using the Slicer*

Beginning in Excel 2013, slicers were added as another way to filter table data. A slicer is useful because it clearly indicates what data is shown in the table after the data has been filtered.

Try using the Slicer to filter the *Portland OR* data table.

1. Click on the **Portland OR** worksheet.

2. Click cell **A5**.

3. Click **Insert** ⇒ **Filters** ⇒ **Slicer**.

Potential Error

Slicer Connections

After clicking the *Slicer* button, if Excel displays an *Existing Connections* box with error messages about no connections, then the table was not active. To correct this error, click anywhere inside the table to activate it and then try the *Slicer* button again.

---

1. Click on **Day** in the *Insert Slicers* dialog box, and then click **OK** (see Figure 216).
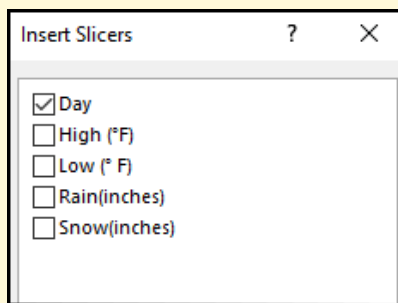
Figure 216: Slicer Dialog Box

2. Drag the slicer box so the top left corner is near the center of cell **G5**.

3. Notice that when the Slicer was inserted, a *Slicer Options* tab appears on the ribbon. (**Excel 365**. This tab is named *Slicer* rather than *Slicer Options*.) This tab contains links to change the style and size of the slicer box or individual slicer buttons.

4. Click **Slicer Tools Options** ⇒ **Slicer Styles** ⇒ **Expand Arrow**. The styles illustrated in Figure 217 will become available.
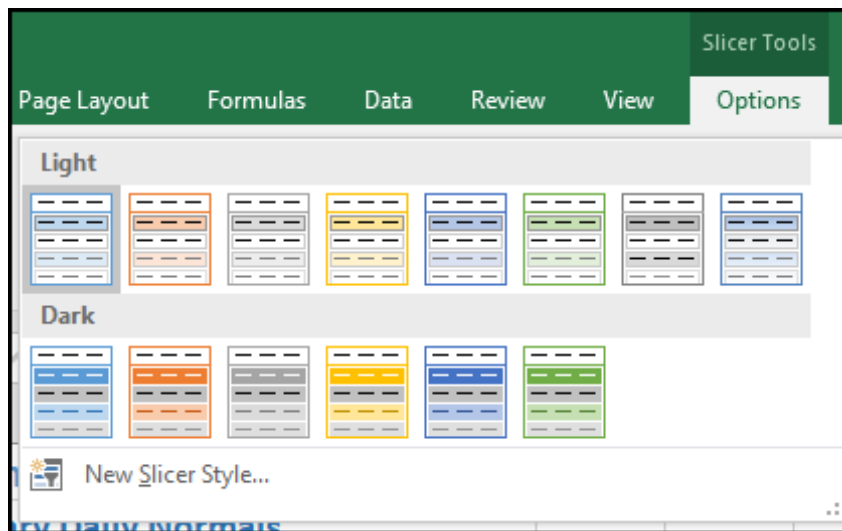
Figure 217: Slicer Styles

1. Select the first choice under *Dark*.

2. Click **Slicer Tools Options** ⇒ **Size** ⇒ **Width** and enter *1* inch. (Note: Do NOT set the size in the *Buttons* group.)

3. Click in the slicer and scroll down to Day 15. Click the **15** button to show only the data for day 15 in the data table.

4. Click the *Multiselect* button in the top center of the slicer to permit the selection of multiple lines.

5. Click the Slicer buttons for Days 10 through 14. The table should now show the data from Days $10 - 15$.

6. Using the filter arrow on the right edge of the *Day* header in **A5**, sort the column from smallest to largest to show the days in order as in Figure 218.

Figure 218: Slicer Results

7. Click the red **X** in the top right corner of the slicer to remove the filter and show the complete data file.

8. Using the filter arrow on the right edge of the *Day* header in **A5**, sort the column from smallest to largest to show the days in order.

9. Click in the top margin of the slicer to select the slicer tool. It should have a thick border and drag handles. Press Delete to remove the slicer.

5.2.3   *Total Rows*

By adding a total row to the bottom of the table, summary data is easily seen for one or more of the columns. Total rows can be added to tables as a whole or to only those that are filtered. Total rows can easily be toggled on and off as the need for summary data arises.

1. Click on the **Portland ME** worksheet.

2. Clear the filter from the *High* column by clicking the filter down-arrow and then *Clear Filter from High (°F)*.

3. Click cell **A5**.

4. Click **Table Tools Design** ⇒ **Table Style Options** ⇒ **Total Row**. (Excel 365). The tab is named *Table Design* rather than *Table Tools Design*.)

5. Scroll to the bottom of the table to the *Total Row*. Notice the total for the *Snow* data.

6. Click cell **D37** (in the *Rain* column), and then click the down-arrow that appears on the right of the cell.

7. Choose **Sum** to add a sum to the *Total Row* in the *Rain* column.

8. To see the Average rainfall for the month, click on the arrow again and choose **Average**.

9. Change the total in cell **E37** (*Snow*) to see the Average snowfall for the month.

10. Click **Home** ⇒ **Number** ⇒ **Decrease Decimal** to change the decimal places in **D37** and **E37** to 2. Compare the *Total Row* to Figure 219.

	A	B	C	D	E
26	15	30.7	13	0.11	0.59
27	17	30.7	12.9	0.08	0.59
28	19	30.7	12.8	0.12	0.59
29	20	30.7	12.8	0.11	0.59
30	21	30.7	12.8	0.12	0.59
31	23	30.9	12.9	0.12	0.59
32	25	30.9	13	0.22	0.59
33	26	31.0	13	0.11	0.59
34	27	31.2	13.1	0.08	0.59
35	4	31.9	14.4	0.08	0.49
36	30	31.6	3.4	0.08	0.47
37	Total			0.11	0.62

Figure 219: Total Row

Now switch to the *Weekly OR* sheet and add a Slicer and Total Row to this table.

1. Open the **Weekly OR** sheet.

2. If the *Day* column is still filtered, clear it by clicking the filter down-arrow and then clicking the *(Select All)* check-box.

3. Add a Slicer for the *Day* column to the sheet.

4. Drag the slicer so the top left corner is near the center of cell **H5**.

5. Resize the slicer as desired and apply any Slicer Style.

6. Select Monday through Friday in the Slicer so that Saturday and Sunday data do *NOT* show in the table.

7. Add a Total Row that averages the *High* and *Low* columns. The averages should be *High*: 47.0 and *Low*: 35.8.

8. Change the *Total* label to *Average* by clicking cell **A37** and typing *Average*.

9. Save the **CH5-National Weather** workbook.

Skill Refresher

Add a Total Row

- Click *Table Tools Design* $\Rightarrow$ *Table Style Options* $\Rightarrow$ *Total Row*.
- Scroll to the bottom of the table to find the Total Row.
- Click in one of the columns in the Total Row, and then click the down-arrow that appears to the right of the cell.
- Choose *Sum* to add a sum to the Total Row in the column.
- To see the Average for column, click on the arrow again and choose *Average*. Some other choices in the Total Row are Count (for words), Count Numbers, Max, and Min.

Skill Refresher

Add a Slicer

- Click *Insert ⇒ Filters ⇒ Slicer*.
- Check the box for the column to which a Slicer is added.
- Click *OK*.

5.2.4 *Subtotaling*

Subtotals and grand totals can be easily calculated for a column in a table. This is a powerful tool that to quickly display multiple levels of summary data within the table. This can provide Management with a report of higher-level summary data one minute, and then can be easily switched back to detailed data the next minute. *It is important to save often during this process and follow the steps carefully.* It is recommended to make a copy of the data to be subtotaled and place it in a new sheet, so the summary subtotaled data can be separately saved if desired.

The following steps summarize the process to add subtotals to a worksheet.

1. Sort by the column to subtotal on.

2. Convert the table back to a normal Excel range since a table cannot contain a subtotal.

3. Click *Data ⇒ Outline ⇒ Subtotal*.

4. To limit the displayed data further, click *Data ⇒ Sort & Filter ⇒ Filter*.

To practice subtotaling, determine what the weather looks like for each day of the week.

1. Click on the **Weekly OR** sheet.

2. Hover the mouse over the **Weekly OR** sheet tab at the bottom of the screen, hold the Ctrl key down and then click-and-drag the sheet to the right until it is past all the existing sheets.

3. When a sheet icon with a **+** sign is visible, let go of the mouse button and then the Ctrl key. A **Weekly OR (2)** sheet will appear.

4. Right-click on the new sheet tab, select **Rename**, type *Subtotal OR*, and then press Enter .

5. Save the **CH5-National Weather** workbook.

6. Remove all filters in the table by clicking **Data ⇒ Sort & Filter ⇒ Clear**.

7. Click in the top margin of the slicer to select the slicer tool. It should have a thick border and drag handles. Press Delete to remove the slicer.

8. Click **Data ⇒ Sort & Filter ⇒ Sort**.

9. Click the down-arrow for *Column Sort By* and select *Day*.

10. Click the down-arrow for *Order* and select *Custom List*.

11. Select the custom list Sunday, Monday, Tuesday, etc. (See Figure 209 through Figure 211 for a review of Custom Sorting.)

12. Click **OK** then click **OK** a second time.

13. Before adding subtotals, convert the table back to a regular range. To do this, click **Table Tools Design ⇒ Tools ⇒ Convert to Range** (see Figure 220). (**Excel 365** . This tab is called *Table Design* rather than *Table Tools Design*.)
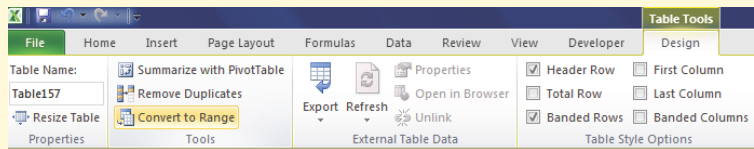
Figure 220: Convert to Range

14. When a box pops up with a warning about converting the table, click **Yes**.

15. Click cell **A6**.

16. Click **Data ⇒ Outline ⇒ Subtotal**.

17. In the *Subtotal Window*, make the choices shown in the Figure 221. It is essential to select the column that the data is sorted by in the *At each change in field* at the top of the window.

18. Click **OK**.
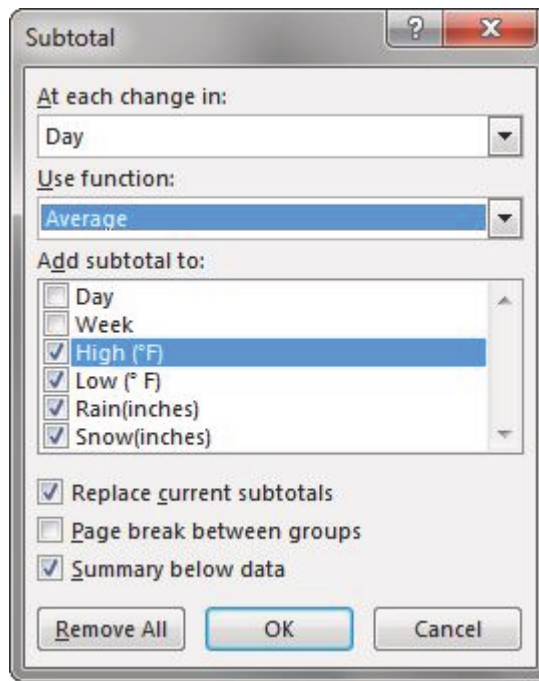
Figure 221: Subtotal Window

The data should look like Figure 222. Successful subtotaling shows only one subtotal for each group in the column sorted by. (*HINT*: If there is more than one Subtotal for the same group (i. e. one of the days of the week in the example), then the column was not sorted before subtotaling. Remove the subtotals using the *Remove All* button in Figure 221, sort the table, and then subtotal again.)

Figure 222: Subtotal Results

Notice the three *Outline* buttons circled in the upper-left corner of the spreadsheet. These control the amount of subtotaled data that is displayed. Table 23 describes the different *Outline* buttons.

Button	Content Displayed
Level 1	Only the grand average
Level 2	Subtotals and grand total
Level 3	Individual records, subtotals, and grand total

Table 23: Subtotal Outline Buttons

Click the three *Outline* buttons to see the difference in the data displayed.

1. Click on the 1 **Outline** button in the upper left-hand corner of the sheet.

2. Only the *Grand Average* row with averages for High, Low, Rain, and Snow should be visible.

3. Click on the 2 **Outline** button.

4. The average for each day of the week along with the *Grand Average* are now visible.

5. Click on the + **Sign** button to the left of the Sunday Average row.

6. This expands just the *Sunday Day* data and displays the individual records for this subset of the data. Clicking on + **Sign** buttons will expand a portion of the data at a time. Clicking on – **Sign** buttons hide a portion of the data at a time.

7. Click on the 3 **Outline** button.

8. All the individual records along with the subtotals, and *Grand Average* should be displayed.

9. Save the **CH5-National Weather** workbook.

Key Take-Aways

Advanced Table Skills

- Filtering is an easy way to see a subset of the data. Filtering arrows appear to the right of each column heading when the table has a header row.
- Data can be filtered by text or numerically.
- A slicer is another way to filter in Excel that provides a set of filtering buttons on the sheet.
- Adding a total row to a table is a quick, efficient way to see summary statistics for one or more columns in a table.
- Subtotaling provides a way to quickly add totals to groups within a column along with providing a grand total at the bottom of the table.
- Subtotal Outline buttons allow users to see add of the subtotaled data, just the totals and grand total, or simply the grand total.
- $+$ and $-$ buttons within subtotaling allow a user to expand and hide portions of the subtotaled data.

5.3   PREPARING TO PRINT

Learning Objectives

- Review options for professional page setup for printing.
- Understand how to insert a picture to enhance the visual appearance of a worksheet.
- Preview worksheets containing tables to ensure they will print in a professional manner.

5.3.1   *Previewing a Worksheet*

Now that the weather data has been sorted, filtered, and subtotaled as needed, it is time to print the worksheets. Start with the *Portland ME* worksheet.

1. Click on the **Portland ME** worksheet.

2. Click cell **A1**.

Notice that cells *A1*, *A2*, and *A3* are not merged and centered over the entire width of the table.

1. Select cell **A1** and click **Home** ⇒ **Alignment** ⇒ **Merge & Center**. This should split **A1** into four cells (**A1:D1**).

2. Select the range **A1:E1** and click **Home** ⇒ **Alignment** ⇒ **Merge & Center**. Cell **A1** should now be merged across **A1:E1**.

3. Repeat these steps for **A2** and **A3**.

Next, open *Print Preview* and determine what page setup options need to be set.

1. Click **File** ⇒ **Print**.

2. Notice that the table should be centered on the page.

3. At the bottom of the *Settings* section, click the link for **Page Setup**. This opens the *Page Setup* dialog box.

4. Click on the **Margins** tab. See Figure 223.
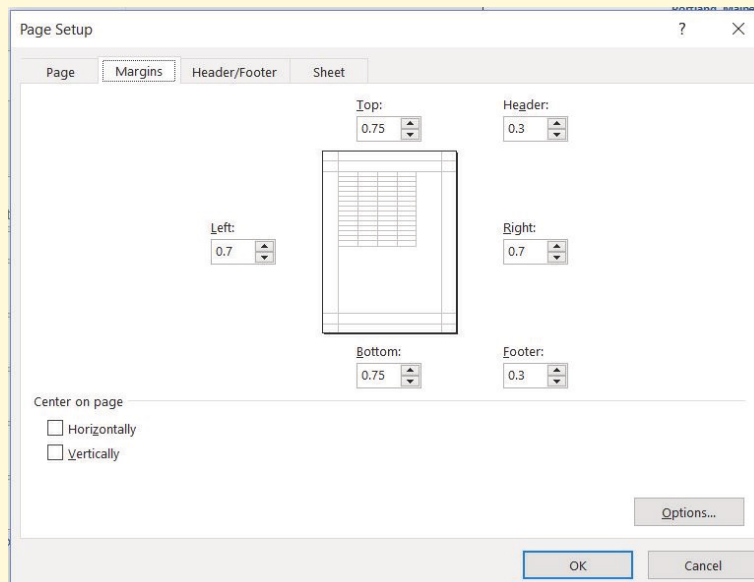
Figure 223: Page Setup

5. In the *Center on page* section, check the box for **Horizontally**.

6. Click **OK**. The table should now be centered horizontally on the page.

7. Next, add a footer with the workbook filename and worksheet name.

8. At the bottom of the *Print Preview Settings* section, click the link for **Page Setup**. This opens the *Page Setup* dialog box.

9. Click the **Header/Footer** tab then click the **Custom Footer** button.

10. In the *Left section:* box type *File:* (making sure to leave a space after the colon).

11. Click the **Insert File Name** button (see Figure 224).

12. In the *Right section:* box type *Worksheet:* (making sure to leave a space after the colon).

13. Click the **Insert Sheet Name** button.
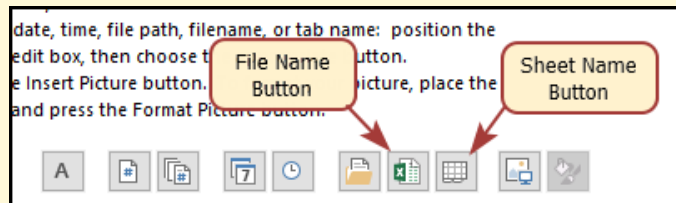
Figure 224: File/Sheet Name Button Locations

14. The completed Footer dialog box should look like Figure 225. Click the **OK** button twice to return to *Print Preview*.

15. Confirm that the footer appears correctly, then click the arrow at the top left corner of the screen to exit *Print Preview*.
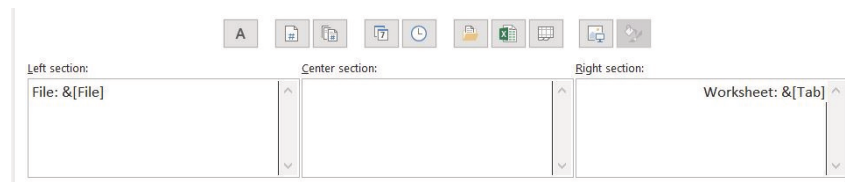
Figure 225: Custom Footer

5.3.2 *Inserting an Image to Enhance a Worksheet*

Next add a small weather-related graphic to the worksheet to enhance its appearance. In Excel, an image file from either the local hard drive or downloaded from an online source can be used. For this exercise, use the graphic in the student files for this chapter.

1. **Excel 2016** Click **Insert** ⇒ **Illustrations** ⇒ **Pictures**. (This inserts an image from the local computer. To search for an online image, click the **Online Pictures** button.) (See Figure 226.)

2. **Excel 365** Click **Insert** ⇒ **Illustrations** ⇒ **Pictures** ⇒ **This Device**. (This inserts an image from the local computer. To search for an online image, click the **Online Pictures** button in the *Pictures* dropdown menu.)
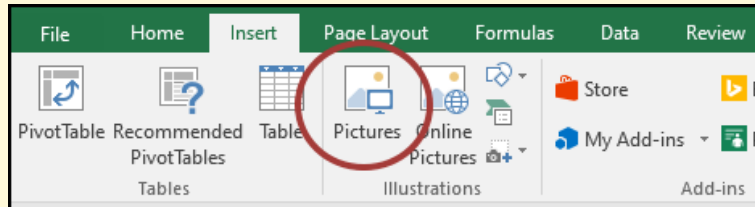
Figure 226: Insert Pictures

3. Navigate to the folder containing the Chapter 5 files and double-click the *CH5-Weather.png* image file.

The image now appears on the worksheet, but not in the desired location. It is also slightly larger than desired (see Figure 227).

		Rain	Snow
High (°F)	Low (°F)	(inches)	(inches)
32.1	14.6	0.11	0.73
31.8	14.2	0.12	0.71

Figure 227: Inserted Image

1. Place the mouse pointer in the image so that the pointer changes to crosshairs. Drag the image so that the top left corner is at the left edge of cell **E1**.

2. Using the resizing handle in the bottom right corner of the image, resize the image so that it does not cover any of the table. Hint: drag diagonally to the left and up. The bottom right corner of the image will end up near the left edge of cell **F4**.

3. Check *Print Preview* again to make sure the worksheet with the image added looks good.

4. Exit *Print Preview*.

5. Save the **CH5-National Weather** workbook.

5.3.3   *Previewing the Remaining Worksheets*

Before considering this workbook finished, confirm that the remaining worksheets are all printing appropriately.

1. Click the **Portland OR** worksheet.

2. Click **File ⇒ Print**.

3. No changes need to be made to this worksheet so click the arrow in the top left corner of the screen to exit *Print Preview*.

4. Click the **Weekly OR** worksheet.

5. Click **File ⇒ Print**.

6. Notice that the Slicer is printing on a second page. To fix this, set the *Page Scaling* to **Fit All Columns on One Page**.

7. If one or more Slicer buttons are cut off, exit *Print Preview*, and resize the Slicer so that all of the buttons display then return to *Print Preview*.

8. Confirm the worksheet, including the slicer, is printing appropriately.

9. Click the arrow in the top left corner of the screen to exit *Print Preview*.

10. Click the **Subtotal OR** worksheet.

11. Click **File ⇒ Print**.

12. Click **Page Setup** at the bottom of the *Settings* area.

13. Center this worksheet horizontally on the page.

14. Click the arrow in the top left corner of the screen to exit *Print Preview*.

15. Save the **CH5-National Weather** workbook.

16. Compare the worksheet with the self-check answer key (**CH5-National Weather Solution**) and then close and submit the **CH5-National Weather** workbook as directed by the instructor.

Key Take-Aways

Printing

- When working with Excel workbooks, the final step should always be to review the worksheets in *Print Preview* to make sure they are printing appropriately.
- Images can be added to a worksheet to enhance its appearance. Be sure to resize and move them appropriately so they do not detract from the data.

5.4 CHAPTER PRACTICE

5.4.1 *Tables for a Tourism Company*

Figure 228: Chapter Practice Completed Exercise

Travel and tour companies need to keep track of client data as well as travel/tour options and tour guides. Keeping up-to-date, accurate

records is essential to their bottom line. To run a tour company, employees must be able to manipulate their data quickly and easily. This exercise illustrates how to use the skills presented in this chapter to generate the data needed daily by a tourism company. Figure 228 shows one of the completed worksheets.

1. Open the data file **PR5-Data** and save the file as **PR5-Canyon Trails**.

2. In **J4**, calculate *Total Cost* (*Guests*Per Person Cost*). Copy the formula down the column.

3. Format **Column I** and **Column J** as *Accounting* with no decimal places.

4. Center all headings in **Row** 3.

5. Click cell **A3**. Insert a table with headers for the range **A3:J53**.

6. Adjust column widths within the table so that all the headings are completely visible.

7. Rename **Sheet** 1 to *Current Tours*. Sort this sheet alphabetically (A to Z) by *Last Name*.

8. Make a copy of the **Current Tours** sheet and rename it **Tours by Canyon**.

9. Place the **Tours by Canyon** sheet to the right of the **Current Tours** sheet.

10. Sort the **Tours by Canyon** worksheet by *Tour Canyon* (A to Z), then *Home Country* (A to Z), and then *Last Name* (A to Z).

11. Make another copy of the **Current Tours** sheet and rename it **US Guests**.

12. Place the **US Guests** sheet to the right of the **Tours by Canyon** sheet.

13. Filter the **US Guests** worksheet so that only guests with a *Home Country* of the United States show.

14. Sort the worksheet by *Tour State* (A to Z).

15. Add a Total Row that sums the *Guests* and *Total Cost* columns.

16. Make another copy of the **Current Tours** sheet and rename it **European Guests**.

17. Place the **European Guests** sheet to the right of the **US Guests** sheet.

18. On the **European Guests** worksheet, hide the *Average Age* column.

19. Insert a slicer in the **European Guests** sheet for *Home Country*. Move the slicer so its top left corner is near the center of **K3**. Click-and-drag the bottom right corner of the slicer so it is near the center of **N16**.

20. Select both *Germany* and the *United Kingdom* on the slicer.

21. Sort the filtered sheet by *Home Country* (A to Z) and then *Last Name* (A to Z).

22. Make one more copy of the **Current Tours** sheet and rename it **Tours by State**.

23. Place the **Tours by State** sheet to the right of the **European Guests** sheet.

24. Subtotal the sheet by *Tour State*, summing the *Total Cost* column. (Remember to sort the worksheet by *Tour State* before applying subtotals.)

25. Change the name of the **Tours by State** sheet to $5 - 7$ **Day Tours by State**. Filter out 3-day tours in the table.

26. Save the **PR5-Canyon Trails** workbook.

27. On each worksheet, make the following print setup changes.

    - Add a footer with the worksheet name in the center.
    - Change to **Landscape Orientation**.
    - Set the scaling to **Fit All Columns on One Page**.

28. For any worksheets that print on more than one page, add Print Titles to repeat the first three rows at the top of each page.

29. Make sure the sheets are in the following order from left to right: **Current Tours**, **Tours by Canyon**, **US Guests**, **European Guests**, and $5 - 7$ **Day Tours by State**.

30. Save the **PR5-Canyon Trails** workbook.

31. Compare the workbook with the self-check answer key (**PR5-Canyon Trails Solution**) and then close and submit the **PR5-Canyon Trails** workbook as directed by the instructor.

5.5   SCORED ASSESSMENT

5.5.1   *Tables for a Retail Company*

Retail companies with online and in-store sales have a huge quantity of data to keep track of. Keeping track of sales, costs, and profits on a daily basis is essential to making the most of a business. This exercise illustrates how to use the skills presented in this chapter to generate the data needed on a daily basis by a retail company. Figure 229 shows the completed worksheet.

Figure 229: Scored Assessment Completed Exercise

1. Open **SC5-Data** and save the file as **SC5-Dynamite Customer Sales**.

2. Click on the **Sales** worksheet.

3. In **I4**, enter a *Vlookup* function that will find the *Product Price* for the Product in **E4** using the table in the **Product Table** worksheet. In the *Vlookup* function, fill in the required parameters using the values below along with Figure 230 as a reference. (Notice that the *Table_array* parameter uses absolute cell references.)

    - **Lookup_value**: E4
    - **Table_array**: 'Product Table'!$A$1:$D$13
    - **Col_index_num**: 4
    - **Range_lookup**: False
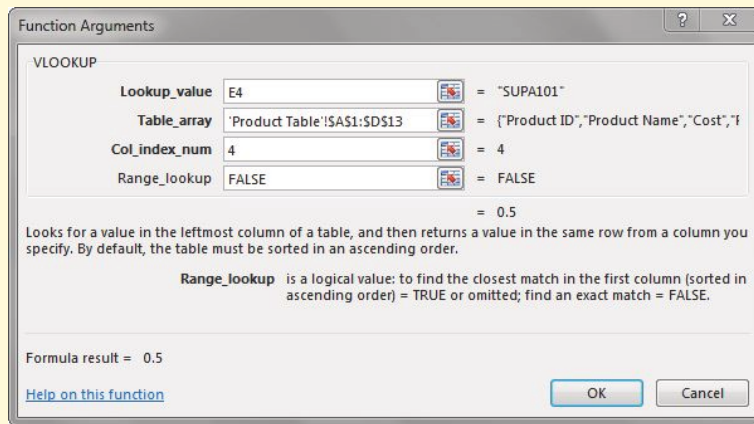
Figure 230: *Vlookup* window

4. Copy cell **I5** to **I6:I52**.

5. In **J4**, enter a *Vlookup* function that will find the *Product Cost* for the *Product* in **E4** using the table in the **Product Table** worksheet. Note that the COL_INDEX_NUM needs to be 3 instead of 4.

6. Copy **J4** to **J5:J52**.

7. In **K4**, calculate *Profit* (*Product Price – Product Cost*).

8. Copy **K4** to **K5:K52**.

9. Format **Columns I**, **Column J**, and **Column K** as *Accounting* with two decimal places.

10. Click cell **A3**. Insert a table with headers for the range **A3:K52**. *BE CAREFUL HERE*: Excel will try to insert a table starting with **A2**. Be certain the range starts with **A3**.

Online Sales by Date

1. Make a copy of the **Sales** sheet.

2. Rename **Sales (2)** to **Online Sales by Date**.

3. Place **Online Sales by Date** to the right of the **Sales** worksheet.

4. On the **Online Sales by Date** worksheet, filter *Sales Type* so that only *Online Sales* are displayed.

5. Sort the filtered data by *Date Sold* (Oldest to Newest).

June Sales by Country

1. Make a copy of the **Sales** sheet and rename it **June Sales by Country**.

2. Place **June Sales by Country** to the right of the **Online Sales by Date** worksheet.

3. On the **June Sales by Country** worksheet, filter *Date Sold* to only show *June* dates by using the *Date Filter Between*.

4. Sort the worksheet by *Country* (A to Z) and then by *Name* (A to Z).

Sales by Product

1. Make another copy of the **Sales** sheet and rename it **Sales by Product**.

2. Place **Sales by Product** to the right of the **June Sales by Country** worksheet.

3. In the **Sales by Product** worksheet, hide the *Region* column.

4. Insert a slicer for *Product Sold*. Move the slicer so its top left corner is near the center of **L3**. Click-and-drag the bottom right corner of the slicer so it is near the center of **O16**.

5. Select both *DETA100* and *DETA200* in the slicer (all other products should be off).

6. Sort the filtered sheet by *Product Sold* (A to Z).

7. Add a *Total Row* that includes the average for the *Product Price*, *Product Cost*, and *Profit* columns.

8. Change the heading in **A53** to *Average*.

Subtotals by Date

1. Make a copy of the **Sales** sheet and rename it **Subtotals by Date**.

2. Place **Subtotals by Date** to the right of the **Sales by Product** worksheet.

3. In the **Subtotals by Date** worksheet, subtotal the sheet by *Date Sold* (Oldest to Newest), summing the *Profit* column.

4. Click the **2 Outline** button to show just the subtotals by date and the Grand Total.

Subtotals by Type

1. Make a copy of the **Sales** sheet and rename it **Subtotals by Type**.

2. Place **Subtotals by Type** to the right of the **Subtotals by Date** worksheet.

3. Subtotal the sheet by *Sales Type*, summing the *Profit* column.

4. Add a second subtotal that subtotals by *Type* and averages the *Profit* column. (*Hint*: uncheck **Replace Current Subtotals** in the *Subtotal* dialog box.)

5. Notice that four outline buttons appear with the second subtotal. Experiment to determine which outline button to click to display the *Average* and *Total* subtotals for both *Online* and *Retail* along with the *Grand Average* and *Grand Total*.

Print Settings

1. For each worksheet, click **Insert ⇒ Text ⇒ Header & Footer** to add a custom footer with the worksheet name in the center.

2. Preview each worksheet in *Print Preview* and make any necessary changes for professional printing. (*Hint*: Orientation, page scaling, and print titles might need to be adjusted.)

3. Double-check that the sheets are in the following order from left to right: **Sales**, **Online Sales by Date**, **June Sales by Country**, **Sales by Product**, **Subtotals by Date**, **Subtotals by Type**, and **Product Table**.

4. Save and close the **SC5-Dynamite Customer Sales** workbook.

5. Submit the **SC5-Dynamite Customer Sales** workbook as directed by the instructor.

MULTIPLE SHEETS

6

Excel workbooks often contain a large amount of data and worksheets can quickly become overwhelming. When one worksheet becomes cumbersome, data can be broken out into smaller subsets and placed in separate worksheets within the same Excel file. Separating out workbook data into smaller pieces can lead to better data organization within a file and increase its ease of use. For example, when a retail company needs to track overall sales along with individual store sales, it makes sense to place each store's sales data in a separate worksheet within a file. Adding a summary worksheet that sums across all the worksheets will total the entire company sales data in the same file. This chapter will show how to set up a workbook to make using multiple worksheets quick and easy.

When spreading data across several worksheets, it is essential that each worksheet is laid out in the same way. To facilitate this, a template can be used. A template is the basic pattern for each new worksheet that can be used repeatedly to make sure each new worksheet has the same setup, formatting, formulas, etc. as the existing worksheets in a file. In this chapter, both predefined Excel templates and those created from scratch will be used to meet the specific needs of the work required.

6.1 MULTIPLE WORKSHEET BASICS

> **Learning Objectives**
>
> - Navigating through a file with multiple worksheets.
> - Adding, deleting, copying, and moving worksheets.
> - Grouping and ungrouping worksheets.

The Excel workbooks used throughout this textbook have included multiple worksheets, so this concept will not be new. This chapter develops a personal budget file that contains income and expenses for an entire year. The file contains a worksheet for each month of the year as well as a summary worksheet that totals all twelve monthly worksheets. The chapter begins with exercises designed to demonstrate moving through worksheets, organizing them, and making sure that all twelve monthly worksheets are consistent. Figure 231 shows the *January* worksheet in the *Personal Budget* file along with all the worksheet tabs along the bottom of the window.

Figure 231: January Worksheet in the Personal Budget File

6.1.1 *Navigating Through File with Multiple Worksheets*

1. Open **CH6-Data** and save the file as **CH6-Personal Budget**. Notice that the file has an **Expenses Summary** worksheet tab at the far left followed by monthly worksheets.

2. Click on the different worksheet tabs at the bottom of the screen to move through the worksheets. The **Expenses Summary** worksheet is formatted differently from the monthly worksheets, but all the monthly worksheets are identical in layout and format.

3. Take a second look at the months and notice the monthly expenses and income for September through October has not been added and there is no worksheet for December.

4. Add the following data in the **September**, **October**, and **November** worksheets.

Item	September	October	November
Power	$135	$135	$135
Water	$30	$30	$30
Groceries	$300	$325	$400
Miscellaneous	$100	$50	$100
Bonus			
Freelance	$500		$150
Other		$100	

Table 24: Data for September/October/November

6.1.2 *Copying a Worksheet*

To make a *December* worksheet, copy the *November* worksheet.

1. Point the mouse at the **November** worksheet tab at the bottom of the screen.

2. Hold down the left mouse button and then press and hold down the `Ctrl` key.

3. Drag the mouse to the right and drop the copied worksheet to the right of the **November** worksheet.

4. There should now be a **November (2)** worksheet to the right of the **November** worksheet as shown in Figure 232.
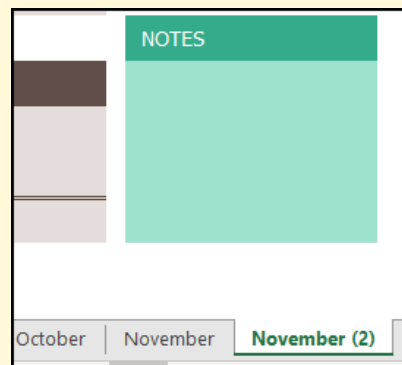
Figure 232: Additional November Worksheet

5. Right-click on the **November (2)** worksheet name at the bottom of the screen and choose **Rename**.

6. Type *December* and press `Enter`.

7. Click on the **December** worksheet tab to activate it. Note, be sure to activate the cell and not just the *Monthly Budget* image.

8. Click cell **B1** and change *November* to *December*.

9. Make the following data changes.

    - Miscellaneous: $300
    - Bonus: $250 (holiday bonus)
    - Freelance: delete amount

10. Save the **CH6-Personal Budget** workbook.

11. Point the mouse at the **December** worksheet tab at the bottom of the screen.

12. Hold down the left mouse button and then press and hold down the Ctrl key.

13. Drag the mouse to the right and drop the copied worksheet to the right of the **December** worksheet.

14. There should now be a **December (2)** worksheet to the right of the **December** worksheet.

15. Rename the **December(2)** worksheet to *Practice*.

Skill Refresher

Copying a Worksheet

- Point the mouse at the worksheet to copy at the bottom of the screen.
- Hold down the left mouse button and then press and hold down the Ctrl key.
- Drag the mouse to the right (still holding down the left-mouse button and the Ctrl key) until the black down-pointing arrow is to the right of the existing worksheet.
- Let go of the mouse button and then the Ctrl key. There should now be a *Sheetname (2)* to the right of the original worksheet.
- Rename the *Sheetname (2)* worksheet as desired.

6.1.3 *Moving and Deleting Worksheets*

Sometimes worksheets do not end up in the right order, and they need to be moved.

1. Point to the **Practice** worksheet and hold down the left mouse button.

2. Notice this time that there is still a black arrow to the left of the **Practice** worksheet, but the piece of paper is blank. It does not have a plus sign (+) because the worksheet is moving instead of copying.

3. While still holding the left mouse button, drag to the left until a black arrow marker is between the **October** and **November** worksheets.

4. Release the mouse button.

5. Try moving the **Practice** worksheet back to the right of the **December** worksheet.

Since the *Practice* worksheet is not needed, use the following procedure to delete it.

1. Right-click on the **Practice** worksheet tab at the bottom of the screen.

2. Click **Delete**. Figure 233 shows the warning message box that will appear, though it may look slightly different depending on the version of Excel being using.

3. Click **Delete**.
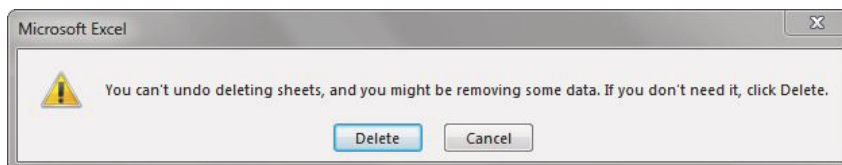
Figure 233: Warning Message Box

Important!

Deleting a Worksheet

Once a worksheet is deleted, *Undo* will not bring it back, *so be careful*.

6.1.4 *Grouping and Ungrouping Worksheets*

Look at the monthly worksheets again. Notice that there is a place in each of these worksheets to calculate three pieces of *Summary* data: *Income*, *Expenses*, and *Balance*; but there are no formulas in these cells. There is also a place for the *% of Income Spent*, but a formula is needed in I6 to calculate this. If these formulas were individually added in each of the twelve monthly worksheets, it would take a long time and since this task is very repetitive it would also be likely that mistakes would be made along the way. By grouping all the month worksheets together, the formulas are entered only once but appear in all the worksheets.

1. Click the **January** worksheet tab to make it active.

2. Hold the Shift key down and click on the **December** worksheet tab to group them.

All 12 worksheets are selected. This can be verified in two ways: the worksheet tabs that have been selected are in bold font at the bottom of the screen and the title bar at the top of the screen adds the word *Group* to the end of the title. These are both visible in Figure 234.
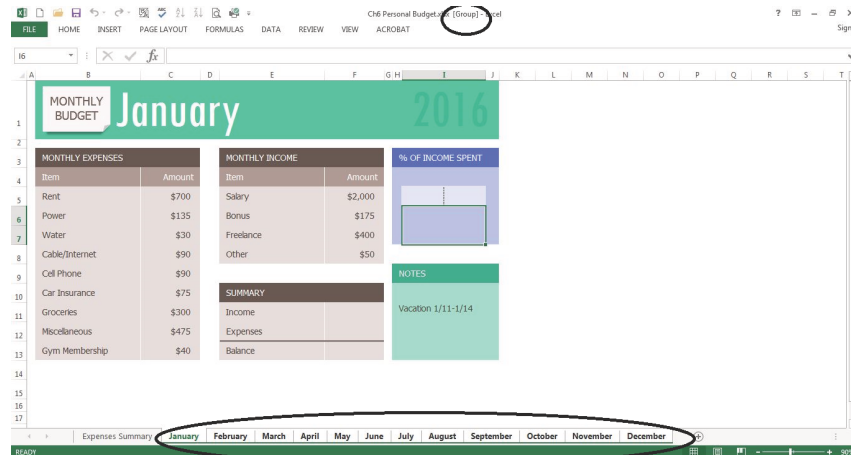
Figure 234: Grouped Worksheets

It is important to remember that any changes made to the January worksheet will be made to all the grouped worksheets. This makes it easy to make changes to all the worksheets at once, but they must be ungrouped after making changes or data on linked worksheets can be inadvertently destroyed.

1. Click cell **F11** in the **January** worksheet and enter the formula **=SUM(F5:F8)**.

2. In cell **F12**, enter the formula *=SUM(C5:C13)*.

3. In cell **F13**, subtract *Expenses* from *Income*. In the **January** worksheet, the balance should be $690. *Hint*: if the answer is negative, then *Income* was subtracted from *Expenses* and the formula needs to be corrected.

4. Click cell **I6**. (**I6** and **I7** are merged, but that does not matter.)

5. Enter a formula that divides *Expenses* (**F12**) by *Income* (**F11**). The answer will show as a percentage since this cell has already been formatted to do this. *Hint*: If the percentage is greater than 100% the numbers are reversed.

Notice that a data bar was set up in I5 to visually show the income spent, which is a skill that is covered elsewhere in the course. The *January* worksheet should now look like Figure 235.

Figure 235: January Worksheet with Formulas

1. Now that the monthly worksheets are done, they need to be ungrouped. Right-click on one of the grouped worksheet tabs and choose **Ungroup Sheets**. Notice the worksheets tabs are no longer bold and the word *Group* is no longer in the title bar.

2. Click on several of the month worksheets to see that all the formulas have been added.

3. Click on the **December** worksheet. The worksheet should look like Figure 236.

Figure 236: December Worksheet with Formulas

Look at the *Notes* in the *September* worksheet. It says that the rent was raised in September, so the *Gym Membership* needs to be cancelled and $0 should be entered for that amount in October, November, and December.

1. Group the **October**, **November**, and **December** worksheets. If this is done successfully these three worksheet names should be bold and the word *Group* will appear in the Title bar.

2. Click the **October** worksheet tab to activate it.

3. Click cell **C13** (*Gym Membership*) and change the amount to $0. Press Enter .

4. Ungroup the worksheets. The *Balance* should be October: $605, November: $530, and December: $430.

5. Save the **CH6-Personal Budget** workbook.

Skill Refresher

To Group Worksheets

- Click on the leftmost worksheet group; then hold the Shift key down and click on the rightmost worksheet to group.

To Ungroup Worksheets

- Right-click on one of the grouped worksheets and choose *Ungroup Worksheets*.

Key Take-Aways

Worksheets

- Worksheets can be easily moved, copied, deleted, and renamed.
- When grouped, identically formatted worksheets can be changed at the same time.

6.2 FORMULAS WITH 3-D REFERENCES

Learning Objectives

- Entering formulas that reference another worksheet, which are called 3-D references.
- Using the SUM function to total values on multiple worksheets.

The *Summary* worksheet in many multiple worksheet workbooks is utilized to present totaled information from the other worksheets in the file. This is done to give a quick synopsis of all the other worksheets in one convenient location. For this reason, the *Summary* worksheet is usually the first worksheet in multiple-sheet files. Summary worksheets "pull" data from the other worksheets using three-dimensional (3-D) cell references. To distinguish between A3 in the *Summary* worksheet, A3 in the *January* worksheet, A3 in the *February* worksheet, etc.; a 3-D cell reference includes the worksheet name along with the cell reference. The syntax to reference a cell in a different worksheet is *=SheetName!CellRange*. So, the cell reference for A15 in the *March* worksheet would be *=March!A15*.

> **Best Practice**
>
> **Summary Worksheet**
>
> Even if there are no 3-D formulas to summarize on a summary worksheet, it is considered a best practice to include a summary worksheet with information about the data contained in the workbook, the date the workbook was last updated, and contact information for the person who created the workbook.

6.2.1   *Create the Expenses Summary Worksheet*

1. Click the **Expenses Summary** worksheet tab to activate it.

2. Click cell **C5** and enter *=January!C5*. Press Enter . This will get the amount $700 from cell **C5** in the **January** worksheet.

3. Delete the formula in **C5** in the **Expenses Summary** worksheet.

4. This time, click cell **C5** and type **=**. Then click on the **January** worksheet, click cell **C5**, and press Enter .

5. This will put the same formula, *=January!C5*, in cell **C5** in the **Expenses Summary** worksheet and will return the value $700. In general, it is more time-consuming to create a 3-D formula by clicking on separate worksheets, but it is less prone to error.

6. In cell **C6** in the **Expenses Summary** worksheet, try entering a formula for the *Power* amount in the **April** worksheet. That amount should be $135.

7. Delete the formulas in cells **C5** and **C6** in the **Expenses Summary** worksheet.

For the *Annual Amounts* in C5:C13 in the *Expenses Summary* worksheet, the amount from a single month's worksheet is not needed; instead, the sum of all the entries in all the monthly worksheets should be entered. So, a 3-D sum for all twelve monthly worksheets should be entered. Here is a helpful hint on the steps that will sum cells on multiple worksheets.

Skill Refresher

To SUM Across Worksheets

- Click on the cell where the 3-D SUM should appear.
- Type *=SUM(*
- Click on the leftmost worksheet in the group of worksheets to sum.
- Hold the [Shift] key down and click on the rightmost worksheet in the group of worksheets to sum.
- Click on the cell in the worksheet that should be summed.
- Press [Enter].

Follow these steps to sum the monthly amounts in the *Expenses Summary* worksheet.

1. Click cell **C5** in the **Expenses Summary** worksheet.

2. Type *=SUM(*. (Make sure to type the open parentheses.)

3. Click on the **January** worksheet.

4. Hold the [Shift] key down and click on the **December** worksheet.

5. Click cell **C5** again (this will be on the **January** worksheet) and press [Enter]. Cell **C5** should display the sum of $8,400.

6. Click on **C5** in the **Expenses Summary** worksheet. The formula bar should show the following: *=SUM(January:December!C5)*. This means Excel will calculate the sum of **C5** on the **January** through **December** worksheets.

7. For another 3-D sum, click cell **C6**.

8. Type *=SUM(*. (Make sure to type the open parentheses.)

9. Click on the **January** worksheet.

10. Hold the [Shift] key down and click on the **December** worksheet.

11. Click cell *C6* again and press [Enter]. Cell **C6** on the **Expenses Summary** worksheet should now display the sum of $1,610.

12. Click cell **C6** in the **Expenses Summary** work-sheet. The formula bar should show the following: *=SUM(January:December!C6)*.

13. Copy **C6** to **C7:C13**. The **Expenses Summary** worksheet should match Figure 237.

14. Save the **CH6-Personal Budget** workbook.

ANNUAL EXPENSES (TO DATE)	
Item	Amount
Rent	$8,400
Power	$1,610
Water	$360
Cable / Internet	$1,080
Cell Phone	$1,080
Car Insurance	$900
Groceries	$4,175
Miscellaneous	$2,535
Gym Membership	$360

Figure 237: Complete Expenses Summary Formulas

While the 3-D formulas are complete in the *Expenses Summary* work-sheet, the summary feels like it is lacking something, so add a visual representation of the summary numbers to the worksheet.

1. Select cells **B5:C13** in the **Expenses Summary** work-sheet.

2. Click **Insert** ⇒ **Charts** ⇒ **Pie Chart** ⇒ **First 2-D Pie**.

3. Resize the pie chart using the values below. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart to make it "lock into" position.

Chart Side	Locked To
Top	Top of **Row 3**
Left	Left of **Column D**
Bottom	Bottom of **Row 13**
Right	Right of **Column J**

4. Click **Chart Design** ⇒ **Chart Layouts** ⇒ **Quick Layout** ⇒ **Layout** 7. That layout places the legend on the right side of the chart and removes the title (see Figure 238).
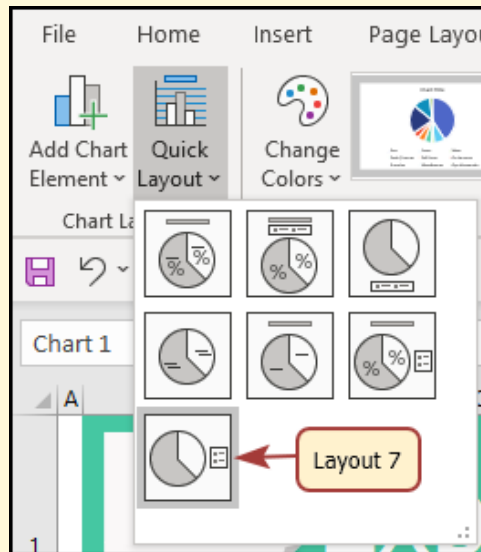
Figure 238: Quick Layout Options

5. Click **Chart Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Data Labels** ⇒ **Outside End**.

6. The complete **Expenses Summary** worksheet should look like Figure 239 below.

7. Save the **CH6-Personal Budget** workbook.

8. Compare the workbook with the self-check answer key (**CH6-Personal Budget Solution**) and then close and submit the **CH6-Personal Budget** workbook as directed by the instructor.

Figure 239: Completed Expenses Summary Worksheet

Skill Refresher

3-D References in Formulas

- To reference a cell in another worksheet, use the formula syntax =*SheetName!CellAddress*.

- To enter a 3-D reference:

  1. Click on the cell where the formula should appear and type =.
  2. Click the worksheet with the cell to reference.
  3. Click the cell and press [Enter] .

Key Take-Aways

3-D References

- 3-D references in formulas allow data from one or more worksheets to be used on another worksheet.

6.3   TEMPLATES

Learning Objectives

- Use an existing Microsoft Excel template to create a new workbook.
- Create a custom template that can be used to create new workbook.

A template is a predefined pattern for a workbook. Hundreds of templates created by Microsoft are available to use inside Excel and these templates are extremely helpful to quickly start and complete a new task in Excel. Templates include all the formulas, formatting, etc. needed in a professional Excel workbook. All that is left to do is enter the data. Predefined Microsoft templates include everything from billing statements to blood pressure trackers to business cards. Categories include: Business, Personal, Industry, Financial Management, Logs, Calculators, and Lists.

Sometimes a specific template is needed that has not already been created by Microsoft. Taking the time to create a custom template allows users to create new workbooks from it repeatedly. If a new version of some workbook is needed on a regular basis, templates will make this work much easier. This chapter explores both types of templates: predefined and custom.

6.3.1   *Predefined Templates*

Microsoft has made many predefined templates available in Excel. Follow these steps to explore this resource.

1. Click **File** ⇒ **New**.

2. Click in the *Search* box for Online template.

3. Type *Travel* and press ⏎Enter.

4. Click the **Travel Expense Report** and click **Create**. Note: If this template is not available, ask the instructor which template to use.

The screen should look like Figure 240 below. Notice the design, layout, and formulas have already been set up.

Figure 240: Travel Expenses Report Template

Complete the following steps to investigate this template.

1. Enter the student's name in **C3** (*Name*).

2. Enter *CLL* in **C5** (*Department*).

3. Press `Ctrl` +`~` (that is *Ctrl+tilde*) to see where the formulas are in the worksheet. Working in the formula view helps find formulas, so they will not be accidentally deleted.

4. In formula view, carefully delete just the data in **C10:I13**. Do not delete any formulas!

5. Press `Ctrl` +`~` (that is *Ctrl+tilde*) again to return to Normal view.

6. Enter dates and expenses for an imaginary trip in **Row** 10, **Row** 11, and **Row** 12.

7. Save the completed workbook as **CH6-Travel Expenses**.

8. Compare the workbook with the self-check answer key (**CH6-Travel Expenses Solution**) and then close and submit the **CH6-Travel Expenses** workbook as directed by the instructor.
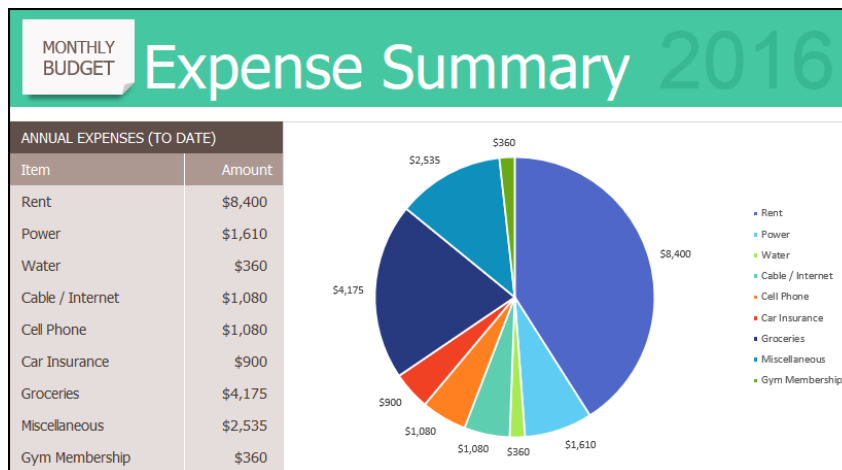

Skill Refresher

Predefined Template

- Click *File ⇒ New*.
- Type the desired template description in the *Search* box, and press `Enter`.

6.3.2   *Custom Templates*

To create a custom template, either start with a blank workbook or use an existing workbook . Either way, the template can be used to create new workbooks that have a uniform appearance and set of functions. For this exercise, the existing *CH6-Personal Budget* file will be converted into a template but the assignments at the end of the chapter build a template from scratch.

1. Open the **CH6-Personal Budget** file.

2. Group the month worksheets (**January** through **December**).

3. Press ⌃Ctrl +~ (that is *Ctrl+tilde*) to switch to Formula view.

4. Delete only the data from these worksheets, not labels or formulas.

   - Select **C5:C13** (with all the worksheets still grouped) and press ⌃Delete .

   - Select **F5:F8** (with all the worksheets still grouped) and press ⌃Delete .

   - Select **H11:J13** (with all the worksheets still grouped) and press ⌃Delete .

5. Press ⌃Ctrl +~ (that is *Ctrl+tilde*) to switch back to Normal view.

6. Ungroup the worksheets.

7. Look through the worksheets to check that only the data has been deleted. Notice the error message *#DIV/O* appears in **I6** since the data for this formula has been deleted. The **January** worksheet should look like Figure 241.
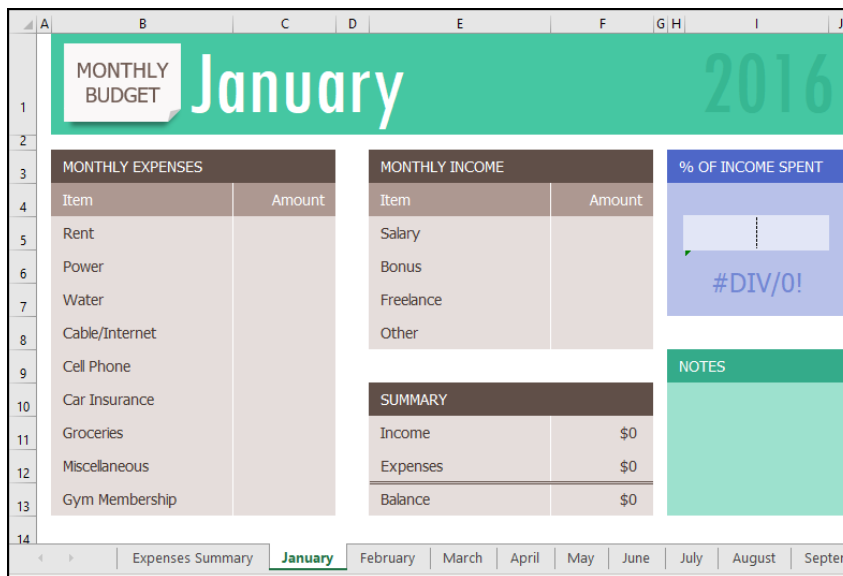
Figure 241: January Template Worksheet

Note: There are only formulas and the pie chart in the *Expenses Summary* worksheet, so nothing needs to be deleted from this worksheet to setup the template.

1. Click **File** ⇒ **Save As**.

2. Choose the location to save the file.

3. In the *Save as type* pull-down list, select **Excel Template (*.xltx)**.

4. At the top of the screen, double-check that the location selected to save the file has not changed. If it has, navigate to the folder where the template will be saved. *Be Careful Here!* By default, Excel will try to save this to a default template file location on the local hard drive.

5. Type in the file name **CH6-Personal Budget Template**. Carefully compare the screen with Figure 242. Keep in mind that the template file may be getting saved to a different place on the computer since Excel will normally save templates to a specific folder on the local hard drive.

6. Click **Save**.

7. Compare the workbook with the self-check answer key (**CH6-Personal Budget Template Solution**) and then close and submit the **CH6-Personal Budget Template** workbook as directed by the instructor.
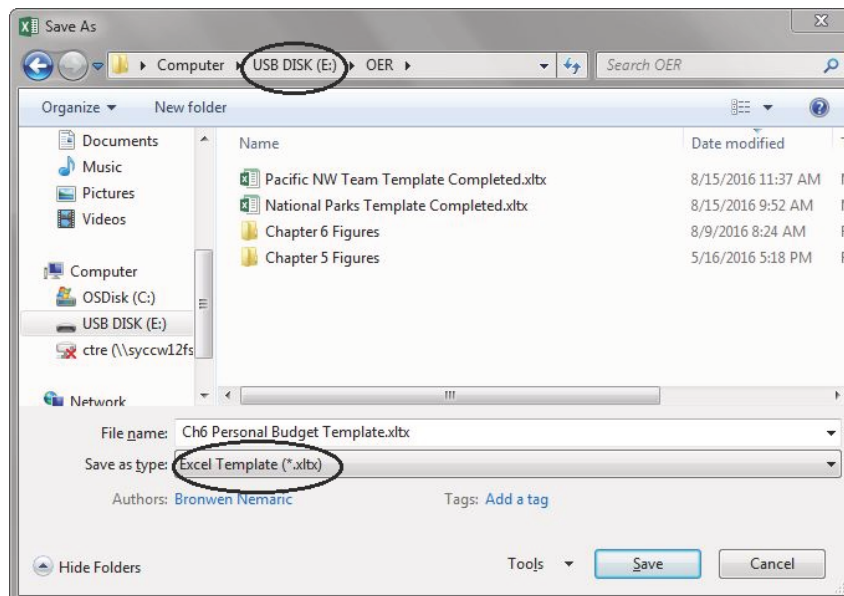
Figure 242: Save As Template

Skill Refresher

Save a Template

- Click *File ⇒ Save As*.
- Choose the location to save the file.
- In the *Save as type* pull-down list, select *Excel Template (*.xltx)*.
- At the top of the screen, double-check that the location to save the file to has not changed. If it has, navigate to the folder where the template will be saved. *Be Careful Here!* By default, Excel will save templates to a default file location on the local hard drive.
- Enter the file name.
- Click *Save*.

Use the new budget template to start a Personal Budget file for 2017.

1. Click **File ⇒ Open**.

2. Navigate to the folder containing the **CH6-Personal Budget Template** and open that file.

3. Click **File ⇒ Save As**.

4. Choose the location to save the 2017 version of the file.

5. Change the *Save as Type* to **Excel Workbook (*.xlsx)**.

6. Enter the File name **CH6-2017 Personal Budget**. Compare the screen to Figure 243.
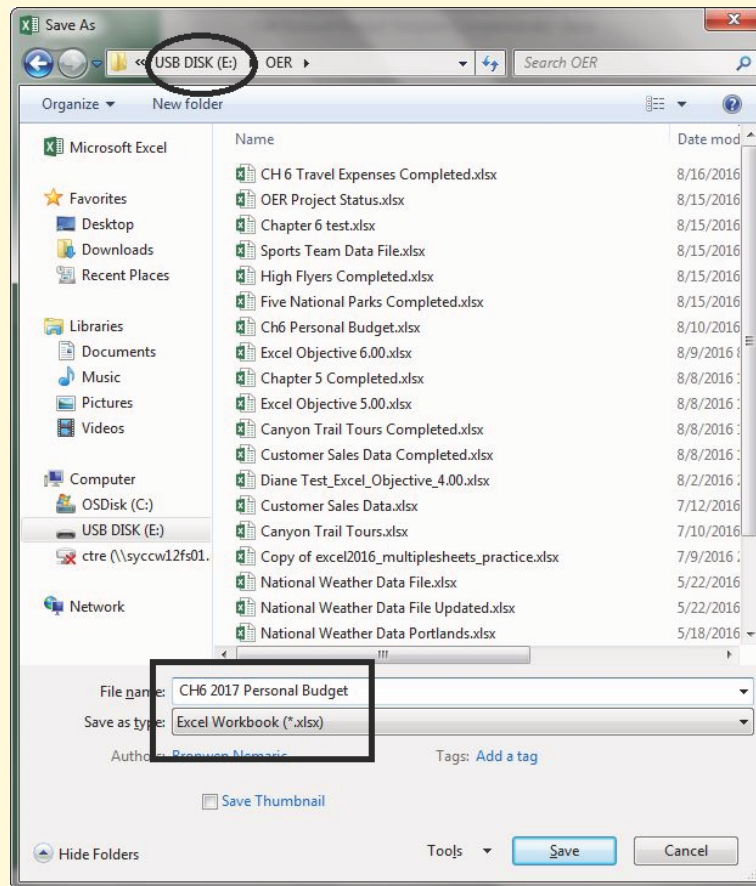
Figure 243: Save As 2017 Budget File

7. Click **Save**.

8. Group all the worksheets together including the **Expenses Summary** worksheet.

9. Click on **H1**. Type 2017 and press Enter .

10. Ungroup the worksheets.

11. Click the **January** worksheet tab to activate it.

12. Enter the data found in Figure 244.

Figure 244: January 2017 Data

13. Click the **Expenses Summary** worksheet tab to activate it. The data and the pie chart should show the *January* data since that is the only data in the twelve monthly worksheets. The worksheet should look like Figure 245.

14. Save the **CH6-2017 Personal Budget** workbook.
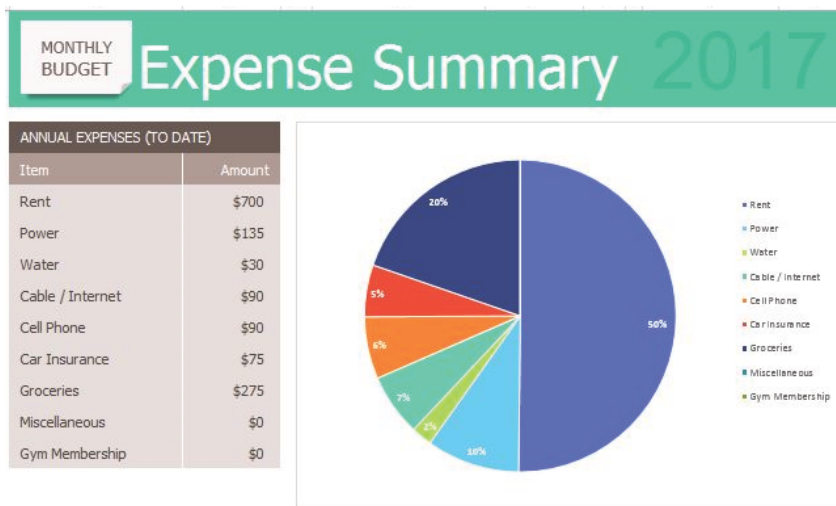
Figure 245: Expense Summary Worksheet

Key Take-Aways

Templates

- Templates save time and effort when compared to designing and creating workbook files from scratch.
- There are many predefined templates in Excel.
- Custom templates can be created for special purposes.

6.4 PREPARING TO PRINT

Learning Objectives

- Printing all the worksheets in a workbook at one time.
- Preparing multiple worksheets for printing using grouping.

Just like consistency in formatting is important when working with workbooks containing multiple worksheets with the same type of data, so is consistency in page setup. Now that the *2017 Personal Budget* workbook is complete, prepare it for printing by changing the page orientation and adding a header. All 13 worksheets will also be printed at one time.

6.4.1 *Applying Page Setup Options to Grouped Worksheets*

As always, review the workbook in Print Preview before considering it complete.

1. Click **File ⇒ Print**.

2. To view all the worksheets at one time, select **Print Entire Workbook** in the first box in the *Settings* section. There should be 26 pages to scroll through in *Print Preview*. At this point, clicking the **Print** button would print all the worksheets rather than just the active sheet.

3. Exit *Print Preview* by clicking the arrow button in the top left corner of the screen. The page orientation of all the worksheets can be changed at one time, but not in *Print Preview*.

4. Group all the worksheets together, including the **Expenses Summary** worksheet through the **December** worksheet.

5. Click **Page Layout** ⇒ **Page Setup** ⇒ **Orientation** ⇒ **Landscape**.

6. Click **Page Layout** ⇒ **Page Setup Launcher** ⇒ **Header/Footer Tab** ⇒ **Custom Footer**.

7. In the center section of the custom footer, insert the worksheet name using the **Insert Sheet Name** button (that is the last button in the fourth group; it looks like a tiny worksheet). The Footer dialog box should look like Figure 246.

8. Click **OK** to close the *Footer* dialog box. Click **OK** again to close the *Page Setup* dialog box.

9. Click **File** ⇒ **Print** to return to *Print Preview*. Check to see if each worksheet is printing on one page, in landscape orientation, with the correct worksheet name appearing in the footer.
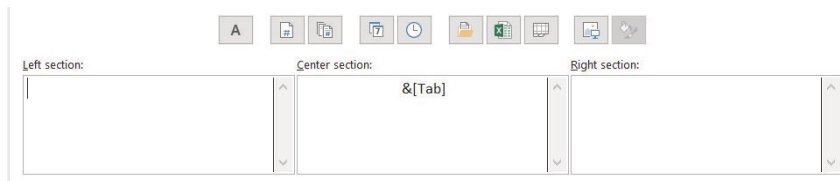
Figure 246: Insert Worksheet Name

Print Preview makes it clear that the *Expenses Summary* worksheet is not set to print correctly since part of the chart is appearing on a second page. This can be easily fixed by changing the *Scaling*, but to change the scaling of only the *Expenses Summary* worksheet, not the entire workbook, the worksheets need to be ungrouped.

1. Exit *Print Preview* by clicking the arrow button in the top left corner.

2. Ungroup the worksheets.

3. If needed, click the **Expenses Summary** worksheet tab to activate it.

4. Click **Page Layout** ⇒ **Scale to Fit** ⇒ **Width Down-Arrow**. Select 1 page. This has the same result as selecting **Fit All Columns on One Page** in the *Scaling* setting in *Print Preview* (see Figure 247).
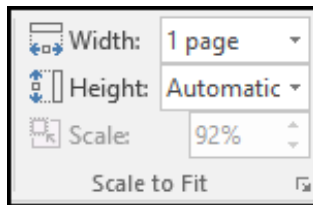
Figure 247: Scale to Fit

1. Click **File ⇒ Print**.

2. Confirm that the **Expenses Summary** worksheet is now printing on one page only. There should only be 13 pages in the printout.

3. Exit *Print Preview*.

4. Save the **CH6-2017 Personal Budget** workbook.

5. Compare the workbook with the self-check answer key (**CH6-2017 Personal Budget Solution**) and then close and submit the **CH6-2017 Personal Budget** workbook as directed by the instructor.


Key Take-Aways

Printing

- To print all the worksheets in a workbook at one time select *Print Entire Workbook* in the *Print Settings*.
- Page setup options, such as scaling, orientation, and headers/footers, can be applied to multiple worksheets at one time by grouping them.

6.5   CHAPTER PRACTICE

6.5.1   *A Multiple Worksheet Template for a Sports Team*

The coaches of the *Pacific Northwest Soccer Club* want a consistent way to keep track of their team statistics. To help with this, create a template for season stats for each team. The *High Flyers* team coach will use the template to enter that team's statistics into a workbook.

1. Open the data file **PR6-Data** and save the file as **PR6-Pacific NW Sports Team**.

2. On the **Season Stats** worksheet, copy **A8:F19** to the same range in the **Player Stats** worksheet.

3. Group the worksheets and add the following formulas to both worksheets.

   - In **B19**, enter **=COUNTA(B9:B18)** to count the number of *X's* in those rows for children who played that game.

   - Copy **B19** to **C19** to count the number of *X's* in those rows for children who started the game.

   - In **D19**, enter **=SUM(D9:D18)** to calculate the total number of shots taken.

   - Copy **D19** to **E19** to calculate the total number of goals.

   - In **F9**, calculate *Goal Percentage* by dividing the number of *Goals* by the number of *Shots*. This will display an error message because there are zeros in **Column D**. An *IF* statement that tests the value of **Column D** will keep error messages from appearing. Change **F9** to an *IF* formula using the following three parameters.

     - **Test**: is **D9** greater than zero

     - **If the Test is True**: number of *Goals* divided by the number of *Shots*

     - **If the Test is False**: zero

   - Copy **F9** to **F10:F19**.

   - Format **F9:F19** as percentages.

   - Using **Home** ⇒ **Font** ⇒ **Fill Color**, set **Row** 10, **Row** 12, **Row** 14, **Row** 16, and **Row** 18 to *No Fill*.

4. Ungroup the worksheets.

5. Compare the workbook with the self-check answer key (**PR6-Pacific NW Sports Team Solution**) and then save the file as a template called **PR6-Pacific NW Team Template**. Make sure to save the template to a USB drive and not the default folder for templates on the local hard drive.

6. Make a new file using the **PR6 Pacific NW Team Template** and save it as a regular Excel workbook named **PR6-High Flyers**.

7. In the **Season Stats** worksheet, enter the following data:

  - **C2** – High Flyers
  - **C3** – Fall and the current year (i. e.Fall 2020)
  - **C4** – Pacific Northwest Soccer

8. Make up a coach's name, phone number, and email address for row 6.

9. Make four copies of the **Player Statistics** worksheet. Rename the player worksheets **Player 1**, **Player 2**, **Player 3**, **Player 4**, and **Player 5**.

10. Group all five *Player* worksheets.

11. Click cell **C2** and enter **='Season Stats'!C2**.

12. Copy **C2** to **C3:C4**.

13. Ungroup the worksheets.

14. Click the **Player 1** worksheet tab to activate it.

15. In cell **C5**, enter the *Player Name*: *Juan Ramirez*.

16. Enter other data from Table 26:

Game	Played	Started	Shots	Goals
Game 1	x	x	2	1
Game 2	x	x	3	1
Game 3				
Game 4	x			
Game 5	x	x	2	0
Game 6	x			
Game 7				
Game 8	x	x	1	1
Game 9	x	x	4	2
Game 10	x	x	3	3

Table 26: Player 1 Worksheet

1. Save the **PR6-High Flyers** workbook.

2. Click the **Player 2** worksheet tab to activate it.

3. In cell **C5**, enter the *Player Name*: *Zach Johnson*.

4. Enter other data from Table 27:

Game	Played	Started	Shots	Goals
Game 1	x	x	1	1
Game 2	x	x	2	1
Game 3	x	x	1	1
Game 4	x	x	1	1
Game 5	x	x	2	0
Game 6	x	x	5	2
Game 7	x	x	4	2
Game 8	x	x	1	1
Game 9	x	x	4	1
Game 10	x	x	3	2

Table 27: Player 2 Worksheet

1. Save the **PR6-High Flyers** workbook.

2. Click the **Player 3** worksheet tab to activate it.

3. In cell **C5**, enter the *Player Name*: *Vito Lawrenz*.

4. Enter other data from Table 28:

Game	Played	Started	Shots	Goals
Game 1	x	x	0	0
Game 2	x	x	1	1
Game 3	x	x	2	0
Game 4	x		1	1
Game 5	x	x	2	0
Game 6	x	x	3	1
Game 7	x	x	2	1
Game 8	x	x	1	1
Game 9	x	x	1	1
Game 10	x	x	1	1

Table 28: Player 3 Worksheet

1. Save the **PR6-High Flyers** workbook.

2. Make up information for the names and data in the **Player 4** and **Player 5** worksheets.

3. Click the **Season Stats** worksheet to activate it.

4. Click cell **B9**.

5. Enter a 3-D formula to *COUNTA* in **B9** on worksheets **Player 1** through **Player 5**.

6. Copy **B9** to **B10:B18**.

7. Copy **B9** to **C9:C18**.

8. Change the formulas in **B19** and **C19** from *COUNTA* to *SUM*.

9. Click cell **D9**.

10. Enter a 3-D formula to *SUM* cells **D9** on worksheets **Player 1** through **Player 5**.

11. Copy **D9** to **D10:D18**.

12. Copy **D9** to **E9:E18**.

13. Using **Home** ⇒ **Font** ⇒ **Fill Color**, set **Row** 10, **Row** 12, **Row** 14, **Row** 16, and **Row** 18 to *No Fill*.

14. Click **File** ⇒ **Print** to preview the worksheets in *Print Preview*. Notice that only part of the data is printing for each worksheet. This is because a *Print Area* was incorrectly set when the file was first created. This print area needs to be cleared for each worksheet individually (modifying print areas cannot be done on grouped worksheets).

15. Exit *Print Preview* by clicking the arrow in the top left corner of the screen.

16. Click the tab to activate each of the six worksheets one at a time and then click **Page Layout** ⇒ **Page Setup** ⇒ **Print Area** ⇒ **Clear Print Area** for each worksheet.

17. Click **File** ⇒ **Print** to preview the worksheets in *Print Preview*. Notice that now all six sheets print correctly.

18. Save the **PR6-High Flyers** workbook.

19. Compare the workbook with the self-check answer key (PR6-High Flyers Solution) and then close and submit the **PR6-High Flyers** workbook and **PR6-Pacific NW Team Template**.

6.6 SCORED ASSESSMENT

6.6.1 *A Multiple Worksheet Template for National Parks Data*

A template for National Parks usage data along with a Summary of the parks visitation data will be developed. To do this, create a template with summary and individual park worksheets and then use that template to enter park data for five national parks.

1. Open a new blank workbook.

2. Change the name of **Sheet1** to **Park Data**.

3. Design a professional quality worksheet to display individual park data. Include areas to enter the name of a park and the park statistics as found in Tables 29, 30, and 31 below. (*Note*: do not copy the physical layout of the data tables.) Figure 248 is one example of how this could be set up, though students are encouraged to explore alternate layouts. (*Note*: the camping graphic is available in the student files as *CH6-Camping.png*.)

Figure 248: Sample setup

4. Make a copy of the **Park Data** worksheet and rename it **Summary Park Data**. Make sure both worksheets are laid out exactly the same. The **Summary Park Data** worksheet tab should be first and the **Park Data** worksheet tab should be second.

5. Save the file as a template called **SC6-National Parks Template**. Make sure this gets saved to a USB drive and not the default template folder on the hard drive.

6. Close **SC6-National Parks Template**.

7. Make a new file using the template and save it as a regular Excel workbook with a name of **SC6-Five National Parks**.

8. Make four copies of the **Park Data** worksheet. Rename the five *Park Data* worksheets after the five parks listed in Table 29.[a]

9. Enter the park name in cell **B3** on each of the *Park Data* sheets.

10. To make the sheets a bit more readable, right-align cell **B3** on each of the *Park Data* worksheets.

11. Click cell **A3** on the Summary Park Data worksheet. Enter *Summary* into that cell.

12. Enter the park data for each of the parks in the five worksheets.

a Note: The National Park 2015 Data is from: https://irma.nps.gov/Stats/S SRSReports.

Name	Recreation Visitors	Non-recreation Visitors	Recreation Hours	Non-recreation Hours
Acadia NP	2,811,184	47,100	14,452,151	47,100
Blue Ridge PKWY	15,054,603	1,942,260	93,977,122	971,136
Crater Lake NP	614,712	49,600	4,033,484	24,800
Yellowstone NP	4,097,710	1,156,118	82,016,845	711,795
Yosemite NP	4,150,217	155,081	78,505,877	3,993,223

Table 29: National Park Data, Pt 1

Name	Concessioner Lodging	Concessioner Camping	Tent Campers	RV Campers
Acadia NP	0	0	135,000	32,094
Blue Ridge PKWY	53,688	0	61,481	33,499
Crater Lake NP	34,629	55,596	7,548	0
Yellowstone NP	552,940	584,979	104,149	69,830
Yosemite NP	938,418	0	588,701	284,372

Table 30: National Park Data, Pt 2

Name	Back-country Campers	Misc Overnight Stays
Acadia NP	1,233	8,343
Blue Ridge PKWY	2,101	1,294
Crater Lake NP	3,253	0
Yellowstone NP	44,898	11,715
Yosemite NP	211,966	39,214

Table 31: National Park Data, Pt 3

1. On each of the Park Data worksheets, apply comma format to **B5:B14** and reduce the number of decimal places to zero.

2. On the **Summary Park Data** worksheet, create formulas for all the fields that sum the same fields in the five park worksheets. So, cell **B5** on **Summary Park Data** should contain a sum of the *Recreation Visitors* for all five parks.

3. On the **Summary Park Data** worksheet, apply comma format to **B5:B14** and reduce the number of decimal places to zero.

4. Click **File ⇒ Print** and check the entire workbook in *Print Preview* to ensure that it is printing professionally. Make any changes needed.

5. Save the **SC6-Five National Parks** workbook.

6. Close and submit both the **SC6-Five National Parks** and **SC6-National Parks Template** files as directed by the instructor.

Part III

ADVANCED EXCEL

This part covers importing and analyzing data using pivot tables and what-if analysis. It then covers using Excel to create forecasts based on the data available. Finally, it presents various ways that Excel can be used for statistical analysis of data. Students who complete this part will be prepared to use Excel for any data analysis function required in their work or studies.

WORKING WITH DATA

Excel is designed to work with data, and this chapter demonstrates how data is imported and analyzed with tools like pivot tables. The chapter begins with information about validating data input and safeguarding workbooks.

7.1 SAFEGUARDING

> **Learning Objectives**
>
> - Validate data input to decrease typing errors.
> - Lock worksheet cells, or entire worksheets, so users do not accidentally change or delete formulas.

It is occasionally desirable to safeguard certain cells in a worksheet, or the entire worksheet, to keep a user from accidentally changing something important. For example, if several cells include complex formulas then those should be secured so users will not accidentally delete them. There are two methods generally used to safeguard worksheets: data validation and worksheet protection.

7.1.1 *Data Validation*

Excel's data validation rules can be used in a variety of ways.

- Restrict the data entered in a cell.

- Circle all cells that do not conform to specified validation rules.

- Limit the user to a list of possibilities.

One of the easiest ways to restrict data is to provide a drop-down list of choices for the user.

1. Open **CH7-Safeguard** and save the workbook as **CH7-Protected**.

2. There is only one worksheet, named **Validation**. Notice there is a list of Zip codes in cells **K2:K10**. The goal is to permit the user to only select from this list of Zip codes while inputting data in **Column E** to help reduce data entry errors.

3. The first step is to name the list of zip codes.

   a) Select **K2:K10**.

   b) Click **Formulas** ⇒ **Defined Names** ⇒ **Define Name**.
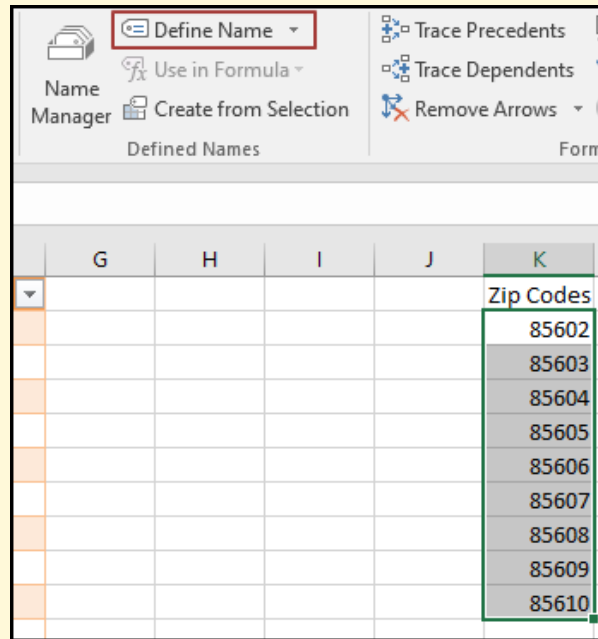
Figure 249: Selecting a Range of Cells to Name

   c) By default, Excel will suggest the name found in the cell at the top of the range, **K1** in this case, and that is often acceptable. Notice that Excel replaced the space between "Zip" and "Codes" with an underscore.

   d) Click **OK**.

Figure 250: Naming a Range of Cells

4. Select **E2**, which is the first cell that needs data valida-
   tion.

5. Click **Data** ⇒ **Data Tools** ⇒ **Data Validation**. (*Note*,
   click the button, not the down arrow on the right side of
   the button.)
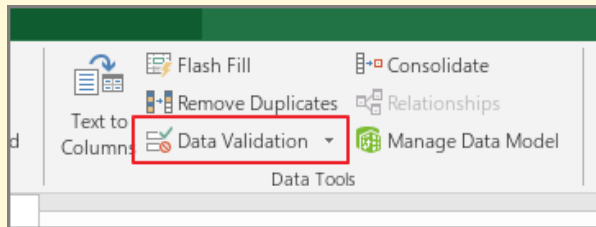
Figure 251: The Data Validation Button

6. Select **List** in the *Allow* field.
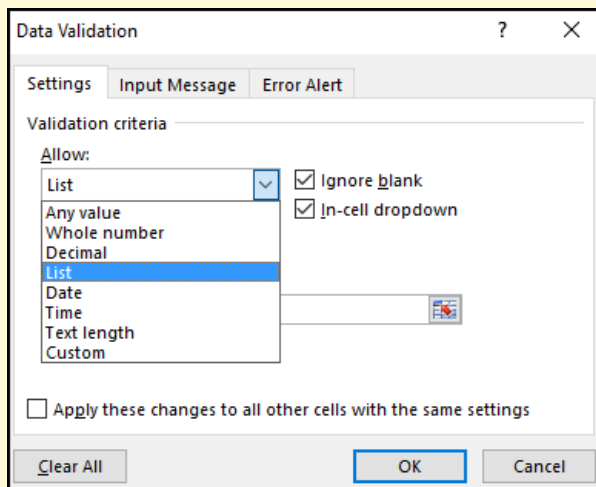
Figure 252: Selecting A Validation List

7. Check **Ignore blank**. If this is left unchecked then it
   would force the user to enter a zip code, but when this
   is checked the user can leave the zip code field blank.

8. Check **In-cell dropdown**. This creates a drop-down list
   so the user can select a zip code from a list rather than
   enter it manually.

9. Enter **=Zip_Codes** for the *Source* (notice the underscore
   between the word "Zip" and "Codes"). This tells Excel
   that the acceptable list of zip codes for cell **E2** is found
   in the *Zip Codes* list.

10. Click **OK**.
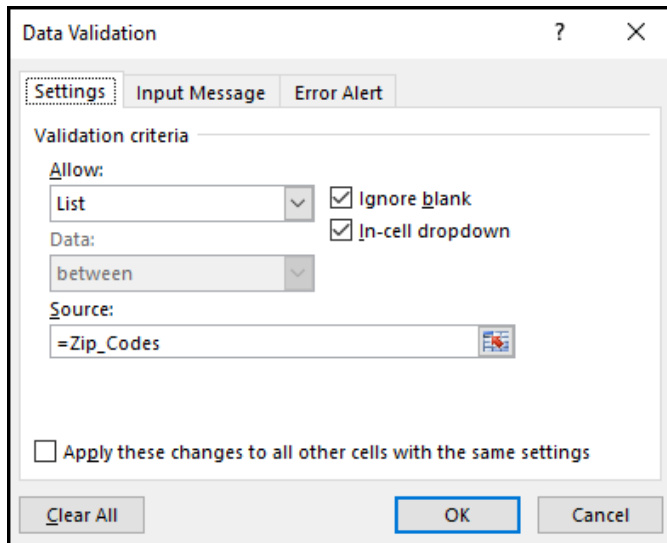
Figure 253: Setting the Data Validation List

After following the above steps, a drop-down selection box will appear whenever the user clicks into cell **E2**, as illustrated in Figure 254.
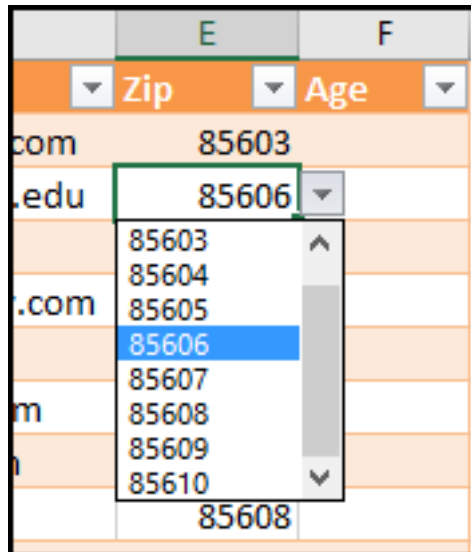
Figure 254: Valid Selections

1. Copy **E2** to **E3:E11** so all those cells will also get the drop-down *Zip Codes* validation list.

2. Select any of the *Zip Codes* to fill **E2:E11**.

> **Note**
>
> **Validation List Location**
>
> For this exercise the list of valid zip codes was contained on the same worksheet as the cells to be validated. However, the validation list is normally found on a different worksheet so it can be protected and, optionally, hidden from the user.

A second validation method is used when the user can enter data that cannot be selected from a list. For example, if users are required to enter their age then a drop-down list containing every possible age is not reasonable. In this case, Excel can be set up to ensure that the data entered is within certain specific bounds. For example, an "age" entry could be between 20 and 65 for working adults (or maybe some other range). Data validation can use a full set of Boolean comparisons (between, equal to, greater than, etc.). As part of the process, various messages can be displayed when the cell is selected to help guide the user. Finally, the action taken when invalid data is entered (*Stop*, *Warning*, or *Information*) can be specified.

1. Notice that the **Validation** worksheet includes an entry for *Age*. The expectation is that users will enter their age, but it is important to restrict this data to numbers between 20 and 65 so they do not accidentally enter a number out of the range or even text.
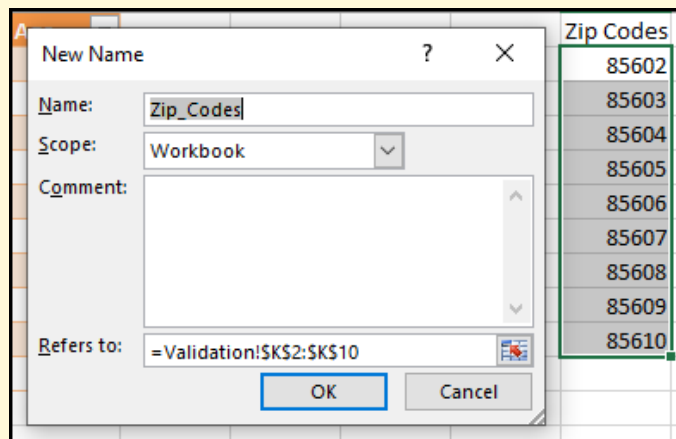
2. Select **F2**, which is the first cell that needs data validation.

3. Click **Data** ⇒ **Data Tools** ⇒ **Data Validation**. (*Note*, click the button, not the down arrow on the right side of the button.)

4. Select **Whole number** in the *Allow* field.

5. Select **Between** in the *Data* field.

6. Enter **20** in the *Minimum* field.

7. Enter **65** in the *Maximum* field.
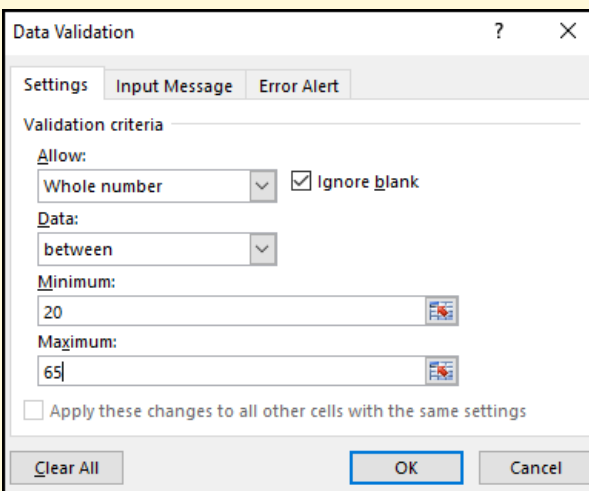
Figure 255: Settings for Validating Numeric Data

8. Click the *Input Message* tab and enter **Age** for the *Title* and **Input an age between** 20 **and** 65. for the *Input Message*.

9. Click the *Error Alert* tab and select the **Stop** style then enter **Age** for the *Title* and **Input an age between** 20 **and** 65. for the *Input Message*.

10. Click **OK**.

11. Copy **F2** to **F3:F11**.

12. Click in **F2** to activate that cell. Notice that the help message pops up. Enter some number in **F2**. If that number is between 20 and 65 then the entry works without error, but if anything else is entered, an error message pops up and forces a correct number to be entered.

13. Enter 19 in **F2** to force an error.

14. Click **Cancel** on the *Age* error message.

15. Delete the data in **F2**.
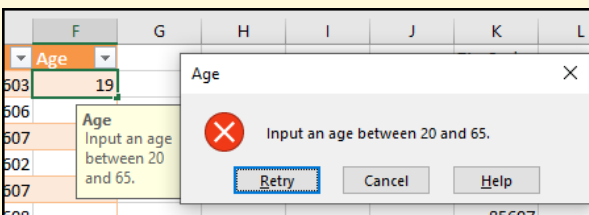
Figure 256: Stopping on Data Entry Error

16. Click **F2** to activate that cell.

17. Click **Data** ⇒ **Data Tools** ⇒ **Data Validation**. (*Note*, click the button, not the down arrow on the right side of the button.)

18. Click the *Error Alert* tab on the *Data Validation* dialog box.

19. This cell was initially set to *Stop* on an error. Perhaps, though, it would be acceptable for the user to finish the data entry even if it contained an error. Change the Style drop-down to **Warning**.

20. Click **OK**.

21. Copy **F2** to **F3:F11**.

22. Click in **F2** to activate that cell. Notice that the help message pops up. Enter some number in **F2**. If that number is between 20 and 65 then the entry works without error, but if anything else is entered, a warning message pops up and permits the user to continue with the bad number or retry.
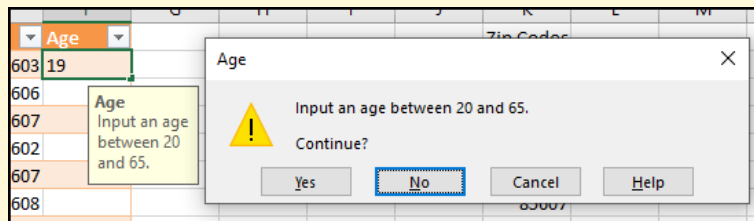
Figure 257: Warning on Data Entry Error

23. Enter these numbers into cells **F2:F11**: 19, 50, 67, 40, 53, 35, 60, 23, 65, 21. A warning should pop up for **F2** and **F4** since those entries are out of the acceptable range, but click **Yes** on the warning popup box so the data is entered.

24. Click **Data** ⇒ **Data Tools** ⇒ ⇒ **Data Validation Down Arrow** ⇒ **Circle Invalid Data**.
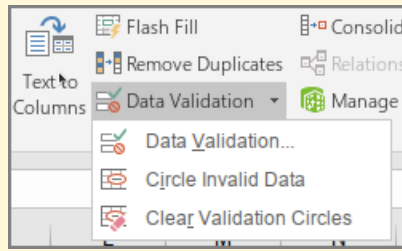
Figure 258: Data Validation Options

25. Notice that the cells containing bad data are now circled so they can be corrected.

Figure 259: Circled Data Errors

26. Click **Data** ⇒ **Data Tools** ⇒ **Data Validation Down Arrow** ⇒ **Clear Validation Circles** to clear the validation circles.

Note

Data Validation

Data validation will not automatically update the error circles as new data is entered. Therefore, after data is entered in a worksheet the *Circle Invalid Data* button must be clicked to check that data.

7.1.2   *Worksheet Protection*

After entering the data validation rules, it may be desirable to lock the **Validation** worksheet so users cannot accidentally delete the formulas or change the *Zip Codes* validation list. Before adding protection to a worksheet, cells that need to remain open for editing must be unlocked. That way, after the entire sheet is locked those selected

cells can still be edited. Follow these steps to unlock cells that should remain editable.

1. Select **A2:F11**. These are the only cells that users should be able to modify.

2. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Lock Cell**.

3. Click cell **A2**.

4. Click **Home** ⇒ **Cells** ⇒ **Format** ⇒ **Protect Sheet**.

5. On the *Protect Sheet* dialog box, check **Protect worksheet and contents of locked cells**.

6. Uncheck all options except **Select Unlocked Cells**.

7. Click **OK**.

8. Notice that now the mouse cannot click in any cell except **A2:F11**

9. Save the **CH7-Protected** workbook.

10. Compare the workbook with the self-check answer key (**CH7-Protected Solution**) and then close and submit the **CH7-Protected** workbook as directed by the instructor.

Important!

About Passwords

Worksheets can be password protected, but there is no way to recover the worksheet if the password is forgotten. Therefore, it is essential to use a password that is easy to remember but difficult to guess.

Important!

Security

While it is easy to lock worksheets to keep users from accidentally changing a formula, this should not be considered any sort of security. Users can easily unlock the worksheet and make whatever changes they want. This is just a way to stop users from accidentally making changes.

> **Key Take-Aways**
>
> **Safeguarding**
>
> - Data entry can be validated to decrease the chance of bad data being entered due to simple typing errors.
> - Worksheets can be protected so users cannot accidentally change formulas or data.

7.2   IMPORTING DATA

> **Learning Objectives**
>
> - Import data from the web and local files.

To use Excel's powerful tools for analysis, data must first be imported into a spreadsheet. Data can be imported from many sources, but two common ones are from the web and from a datafile located on the local computer. Data is very often posted on the web for researchers to use in their projects. The United States federal government, for example, has more than $200,000$ datasets freely available in fields like taxes, crime, trade, education, and dozens of other topics[1]. Sometimes, that data can be imported directly into Excel but more often it must be downloaded to a local computer and then imported into Excel from that file. This section demonstrates both of those procedures.

7.2.1   *Import from the Web*

Data contained in a table on a website can be imported directly into an Excel workbook. Follow these steps to import data from a website.

> 1. Open a new blank workbook.

---

1 See https://www.data.gov/

> **Important Note**
>
> **Downloading From the Web**
>
> `Excel 2016` includes a feature to get data from the web at *Data ⇒ Get External Data ⇒ From Web*. Unfortunately, that feature relies on the computer's browser and Excel's download function is blocked by modern browsers. Therefore, the process described in this section is the only way to reliably download data from the web into Excel.

For this exercise, the "Juggling World Records" page on Wikipedia will be used since it includes several different tables.

1. `Excel 2016` Click **Data ⇒ Get & Transform ⇒ New Query ⇒ From Other Sources ⇒ From Web**

2. `Excel 365` Click **Data ⇒ Get & Transform Data ⇒ Get Data ⇒ From Other Sources ⇒ From Web**
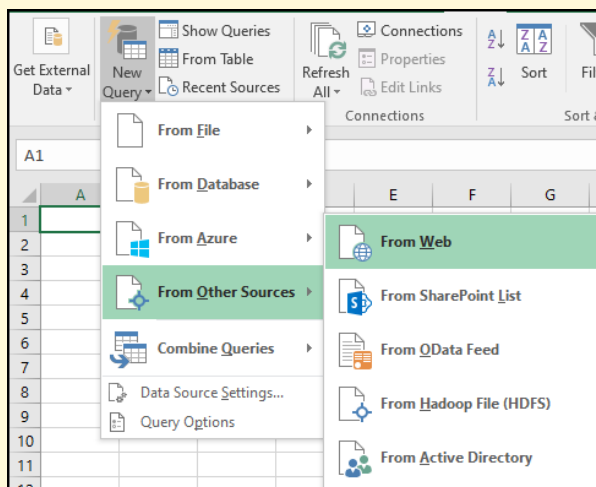
Figure 260: Import From Web Menu

3. Select the **Basic** option and enter *https://bit.ly/AdExcelC* in the *From Web* popup, as shown in Figure 261.
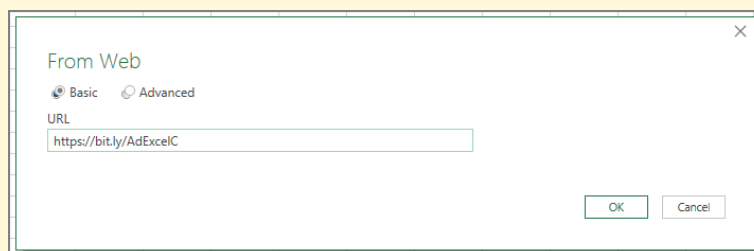
Figure 261: From Web URL Window

4. Press **OK**

5. It may take a few seconds for Excel to make a connection.

6. Excel permits several options to be set before accessing the Web content, but the defaults are acceptable. Click **Connect**.
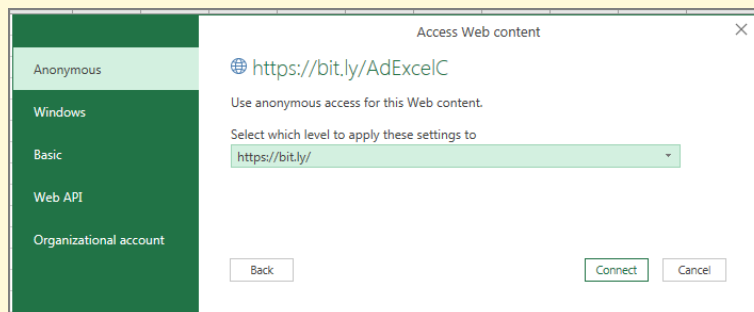
Figure 262: Access Web Content Options

7. A box will pop up with a list of all tables on the page. In Figure 263, the first table has been selected and a preview of that table can be seen.
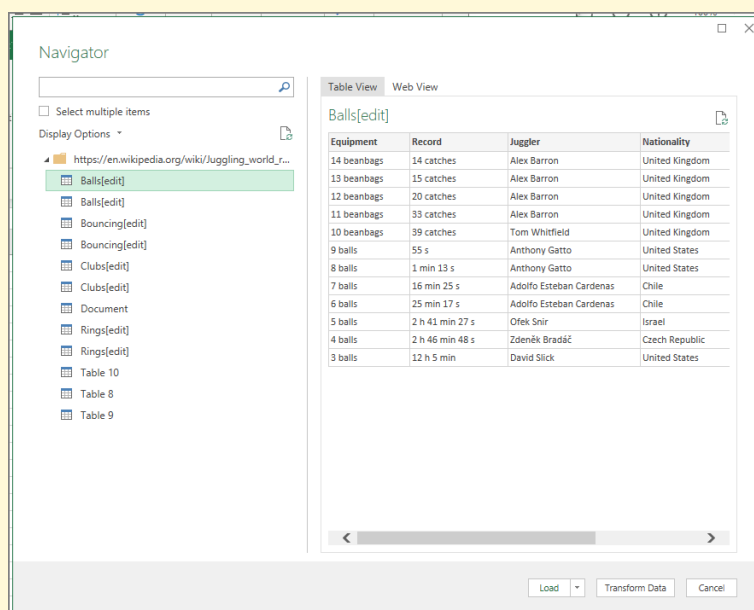
Figure 263: Listing of Webpage Tables

8. Select the first table and click **Load**

9. After Excel retrieves the data, it is imported into a table on a new worksheet, as shown in Figure 264.

Figure 264: Imported Data Table

The imported data contains records for number of balls juggled as found on a Wikipedia page. Excel displays a *Queries & Connections* box on the right side of the screen. That box lists the Web queries that were used to import data tables. Since there has only been one query then only one item appears in this box, but if more queries are run, they will also be listed here.

1. Close the *Queries & Connections* box by clicking the **X** in the top right corner of the box.

2. Delete the **Sheet1** worksheet.

3. Rename the **Sheet2** worksheet to **Juggling**.

The webpage data is imported into Excel as a table, so tools like filtering, sorting, and slicing the data are readily available. As with any Excel table, this data table can be recolored and formatted as desired[2].

7.2.2 *Transforming Data*

Normally, raw data includes unnecessary rows and columns that will need to be "cleaned up" a bit before it can be imported. This is a process that is called *Transforming* and Excel makes that process easy to complete.

1. **Excel 2016** Click **Data ⇒ Get & Transform ⇒ New Query ⇒ From Other Sources ⇒ From Web**

2. **Excel 365** Click **Data ⇒ Get & Transform Data ⇒ Get Data ⇒ From Other Sources ⇒ From Web**

---

2 See Chapter 5, TABLES, page 261 for more information about tables.

3. Enter *https://bit.ly/AdExcelB* in the *From Web* popup, as shown in Figure 261 and click **OK**.

4. For this exercise, an online table with FBI crime statistics from 2017 is being used as a source. Select Table 0, as shown in Figure 265.

5. Notice in the preview that this table includes crime statistics for the years 2016 and 2017. It also includes various non-state regions, like "Northeast." For this exercise, only the state-level data for 2017 is needed and it is much easier to filter that before the data is imported than to remove it later.

6. Excel 2016 Click **Edit** under the preview area.

7. Excel 365 Click **Transform Data** under the preview area.

Figure 265: Selecting Table 0

8. The *Microsoft Power Query Editor* window pops up where the data can be filtered and edited in many ways before it is imported. For this exercise, only two simple filters will be applied.

Figure 266: Power Query Editor

9. Click the down arrow beside the *Year* column heading and select only 2017 data and then click **OK**.
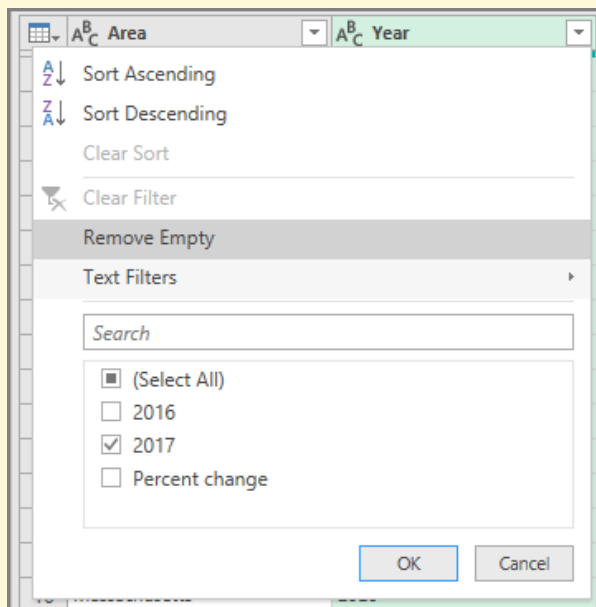
Figure 267: Filtering on 2017 Records

10. In the same way, click the down arrow beside the *Area* column heading and uncheck all rows that are not state names, like "East North Central," and then click **OK**. (Note: leave *District of Columbia* and *Puerto Rico* in the list.)

11. Click **Home** ⇒ **Close** ⇒ **Close & Load**

12. Excel loads the data in a table on a new sheet. Rename the worksheet to **Crime**.

13. Save the workbook as **CH7-WebData**.

14. Compare the workbook with the self-check answer key
    (**CH7-WebData Solution**) and then close and submit the
    CH7-WebData workbook as directed by the instructor.

7.2.3 *Import from Data File*

It is common for web data to be downloaded via a data file. Those
data files are, typically, in a *.CSV* format (that stands for "Comma
Separated Values"). This is a simple text file and can be opened with
a program no more complicated than *Notepad*; but *.CSV* files are typ-
ically opened with Excel or some other data analysis tool. Figure 268
shows the first few lines of the sales data file used in this lesson
opened in *Notepad*.

```
1    OrderDate,Region,Rep,Item,Units,Unit Cost,Total
2    1/6/2019,East,Jones,Pencil,95,1.99,189.05
3    1/23/2019,Central,Kivell,Binder,50,19.99,999.5
4    2/9/2019,Central,Jardine,Pencil,36,4.99,179.64
5    2/26/2019,Central,Gill,Pen,27,19.99,539.73
6    3/15/2019,West,Sorvino,Pencil,56,2.99,167.44
7    4/1/2019,East,Jones,Binder,60,4.99,299.4
8    4/18/2019,Central,Andrews,Pencil,75,1.99,149.25
9    5/5/2019,Central,Jardine,Pencil,90,4.99,449.1
10   5/22/2019,West,Thompson,Pencil,32,1.99,63.68
11   6/8/2019,East,Jones,Binder,60,8.99,539.4
12   6/25/2019,Central,Morgan,Pencil,90,4.99,449.1
13   7/12/2019,East,Howard,Binder,29,1.99,57.71
14   7/29/2019,East,Parent,Binder,81,19.99,"1,619.19"
15   8/15/2019,East,Jones,Pencil,35,4.99,174.65
16   9/1/2019,Central,Smith,Desk,2,125,250
17   9/18/2019,East,Jones,Pen Set,16,15.99,255.84
18   10/5/2019,Central,Morgan,Binder,28,8.99,251.72
19   10/22/2019,East,Jones,Pen,64,8.99,575.36
20   11/8/2019,East,Parent,Pen,15,19.99,299.85
21   11/25/2019,Central,Kivell,Pen Set,96,4.99,479.04
```

Figure 268: CSV File

Complete the following steps to load a *.CSV* file into Excel.

1. Open a new blank workbook.

2. **Excel 2016** Click **Data** ⇒ **Get & Transform** ⇒ **New Query**
   ⇒ **From File** ⇒ **From CSV**.

3. **Excel 365** Click **Data** ⇒ **Get & Transform Data** ⇒ **Get
   Data** ⇒ **From File** ⇒ **From Text/CSV** Figure 269 illus-
   trates this button.
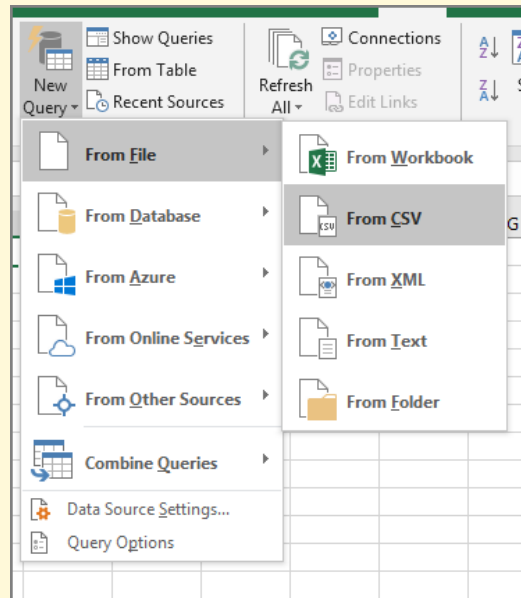
Figure 269: Import CSV File

4. Navigate to **CH7-Data.csv**.

5. Click the file name and then **Import**. Figure 270 shows the *Import Data* dialog box.
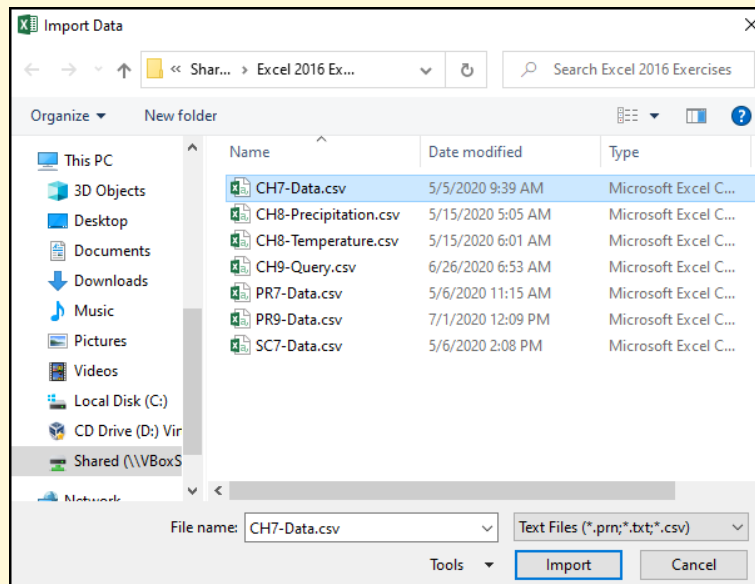
Figure 270: Selecting the CSV file

6. Excel will begin to import the .CSV data. Excel makes its "best guess" about the type of data in the file, as illustrated in Figure 271.
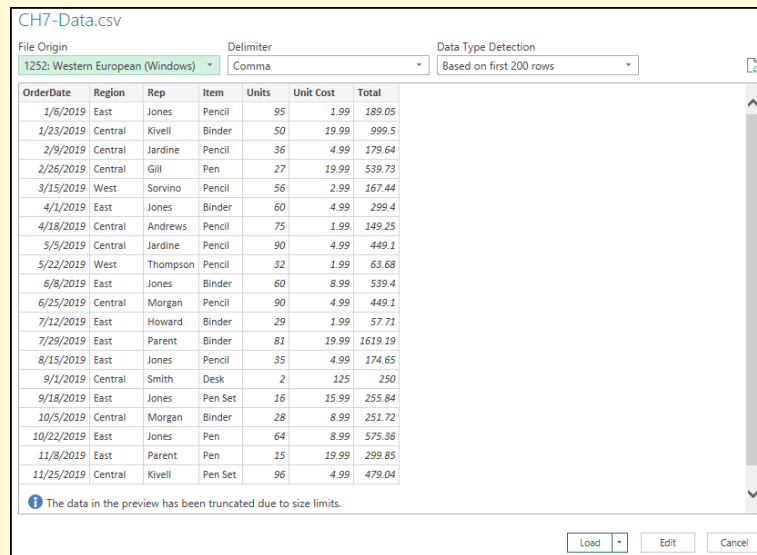
Figure 271: CSV Import Wizard

7. The sample text contained in the box illustrated in Figure 271 looks correct, so Excel has correctly determined that the CSV file contains "1252 Western European (Windows)" text that uses a comma delimiter. Click **Load**.

8. Excel loads the .CSV data into a new worksheet.

9. Close the *Queries & Connections* panel by clicking the **X** in the top right corner of the box.

Figure 272 shows the first few lines of the worksheet which has the imported data in a table that can be manipulated like any other table.

	A	B	C	D	E	F	G
1	OrderDate	Region	Rep	Item	Units	Unit Cost	Total
2	1/6/2019	East	Jones	Pencil	95	1.99	189.05
3	1/23/2019	Central	Kivell	Binder	50	19.99	999.5
4	2/9/2019	Central	Jardine	Pencil	36	4.99	179.64
5	2/26/2019	Central	Gill	Pen	27	19.99	539.73
6	3/15/2019	West	Sorvino	Pencil	56	2.99	167.44
7	4/1/2019	East	Jones	Binder	60	4.99	299.4
8	4/18/2019	Central	Andrews	Pencil	75	1.99	149.25
9	5/5/2019	Central	Jardine	Pencil	90	4.99	449.1
10	5/22/2019	West	Thompson	Pencil	32	1.99	63.68
11	6/8/2019	East	Jones	Binder	60	8.99	539.4
12	6/25/2019	Central	Morgan	Pencil	90	4.99	449.1
13	7/12/2019	East	Howard	Binder	29	1.99	57.71
14	7/29/2019	East	Parent	Binder	81	19.99	1619.19
15	8/15/2019	East	Jones	Pencil	35	4.99	174.65
16	9/1/2019	Central	Smith	Desk	2	125	250
17	9/18/2019	East	Jones	Pen Set	16	15.99	255.84
18	10/5/2019	Central	Morgan	Binder	28	8.99	251.72
19	10/22/2019	East	Jones	Pen	64	8.99	575.36
20	11/8/2019	East	Parent	Pen	15	19.99	299.85

Figure 272: The Worksheet With Imported Data

1. Rename **Sheet2** to **Sales Data**.

2. Delete **Sheet1**.

3. Save the workbook as **CH7-Sales Summary**.

Key Take-Aways

Importing Data

- Data can be imported from tables found on websites using *Data ⇒ Get External Data ⇒ From Web*.
- Data can be imported from CSV files downloaded from websites using *Data ⇒ Get & Transform ⇒ New Query ⇒ From File ⇒ From CSV*.

7.3   PIVOT TABLES

Learning Objectives

- Create a pivot table.
- Manipulate a pivot table to change the information displayed.

Pivot tables dynamically summarize data and are a favorite tool for analysts since they are highly customizable and enormously powerful. These tools are called pivot tables because the data displayed can be easily pivoted from rows to columns and back. Pivot tables are sometimes called contingency tables or crosstabs and are frequently seen in reports where tabular data is presented. A common example of a pivot table is found in newspapers and magazines during elections where the editor creates a table showing the number of voters by party, gender, race, or other factors. For this exercise, sales data from a small supplier will be analyzed.

7.3.1   *Introduction to Pivot Tables*

1. Open the **CH7-Sales Summary** workbook that was created in section 7.2.3 if it is not already opened.

2. Click in cell **A1** in the **Sales Data** worksheet.

3. Click **Insert** ⇒ **Tables** ⇒ **PivotTable**. In Figure 273, the **PivotTable** button can be found at the left end of the ribbon.
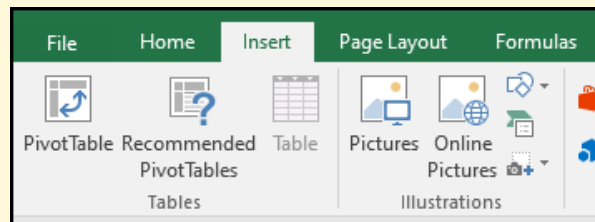
Figure 273: PivotTable Button On The Ribbon

4. In the *Create PivotTable* popup, as seen in Figure 274, ensure that Excel automatically selected either the name of the data table, *CH7_Data*, or the range $A$1:$G$44, which is all the data on the worksheet. Also, ensure **New Worksheet** is selected as the location of the new pivot table.

5. Click **OK**.
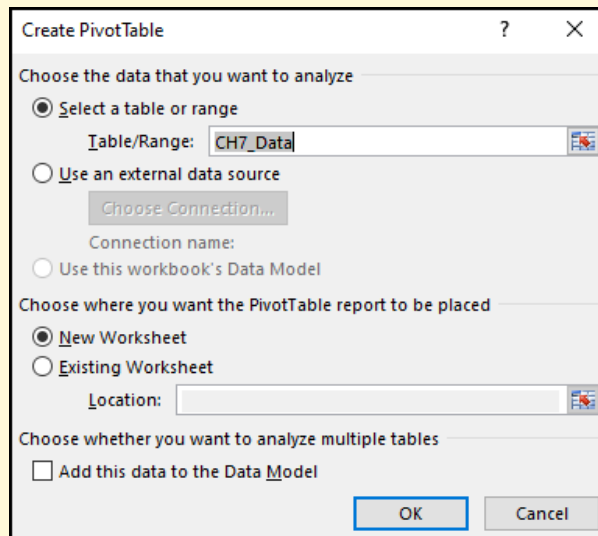
Figure 274: Create PivotTable Wizard

6. A pivot table is created on a new worksheet. Rename that sheet **Sales Pivot**.

7. Move the **Sales Pivot** worksheet to the right of **Sales Data** if it is not already placed there.

8. A blank pivot table has six areas of interest for this lesson, as shown in Figure 275.

   - **A**. The **Pivot Table** will appear in the large area on the left (it is blank in the illustration).

   - **B**. The **Field List** contains the names of all the fields available in the data set. These are the column headers in the data table.

   - **C**. **Filters** is where complex filters can be created to restrict the data displayed on the pivot table.

   - **D**. **Column Labels** define the columns on the pivot table.

   - **E**. **Row Labels** define the rows on the pivot table.

   - **F**. **Values** define the numeric data calculated and displayed in the pivot table.
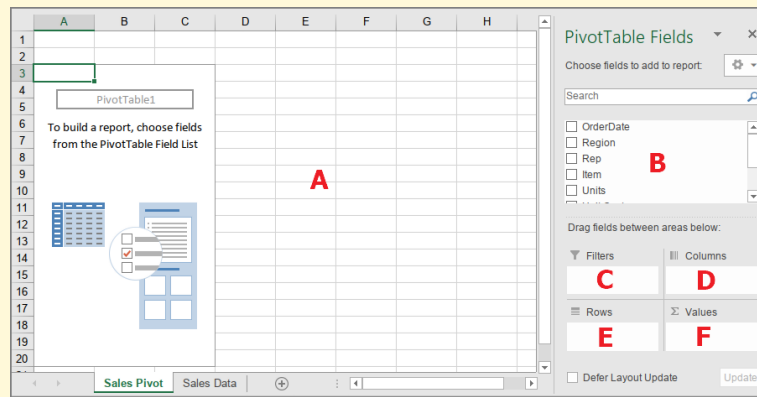
Figure 275: Pivot Table Areas

9. Drag and drop *Region* in the *Field List* to the *Rows* area.

10. Drag and drop *Item* in the *Field List* to the *Rows* area under *Region*.

11. Drag and drop *Units* in the *Field List* to the *Values* area. Excel automatically displays the number of units sold for each item, the total sold by region, and a Grand Total. With just a few clicks of the mouse, Excel has created a useful decision-making chart for managers. Figure 276 illustrates the pivot table at this point.

Figure 276: Sales Units

12. Click and drag *Item* from the *Row Labels* area to the *Column Labels* area. (Note, this can also be done by clicking the down-arrow for *Item* and selecting **Move to Column**

Labels.) The same data is still being displayed, but it has been rearranged to make it easier to compare regions. Also notice that Excel automatically created two Grand Totals, one for the rows and one for the columns. Figure 277 illustrates the pivot table at this point.

Figure 277: Sales Units With Columns

13. Uncheck *Units* in the *Field List*. This removes it from the pivot table and leaves only labels with no numbers.

14. Check *Total* in the *Field List*. This is the total value of the items sold and Excel places *Total* in the *Values* area since it contains numbers. The table now reports the total value of all sales by region and item.

15. Change the value displayed to average rather than sum.

    a) Click the down arrow in *Sum of Total* in the *Values* area, as illustrated in Figure 278.
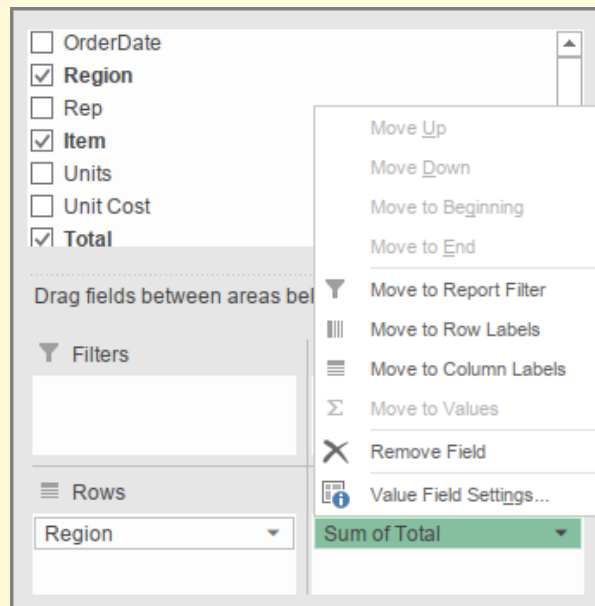
Figure 278: Values popup

b) Select **Value Field Settings**.

c) Select **Average** in the popup, as illustrated in Figure 279.

d) Click **OK**.
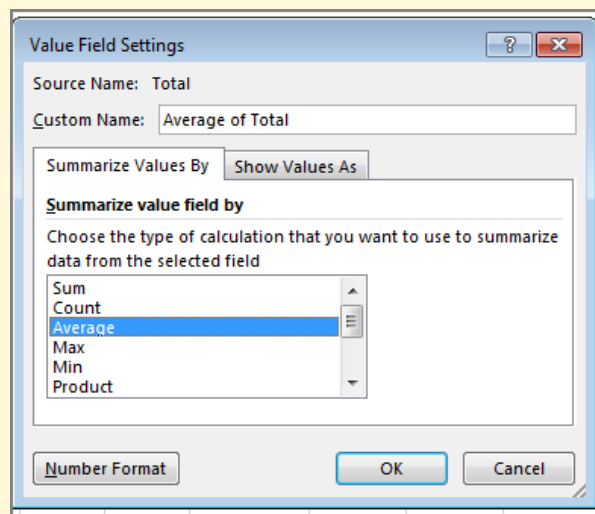
Figure 279: Selecting Average Values

16. The PivotTable is instantly changed to display the average sales by region and item.

17. The average is displayed to seven decimal places. Since this is money, it would be best to round the averages to two decimal places.

    a) Click the down arrow in *Average of Total* in the *Values* area.

    b) Select **Value Field Settings**.

    c) Click the **Number Format** button at the bottom left corner of the *Value Field Settings* popup, as illustrated in Figure 280.
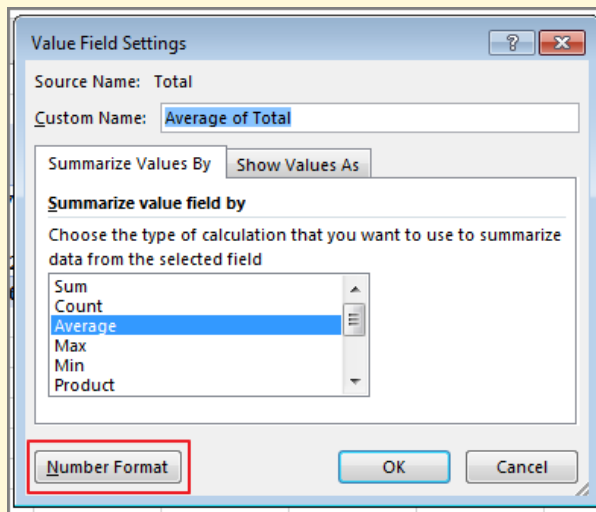
Figure 280: The Number Format Button

    d) Choose **Number** and set 2 decimal places (the default setting).
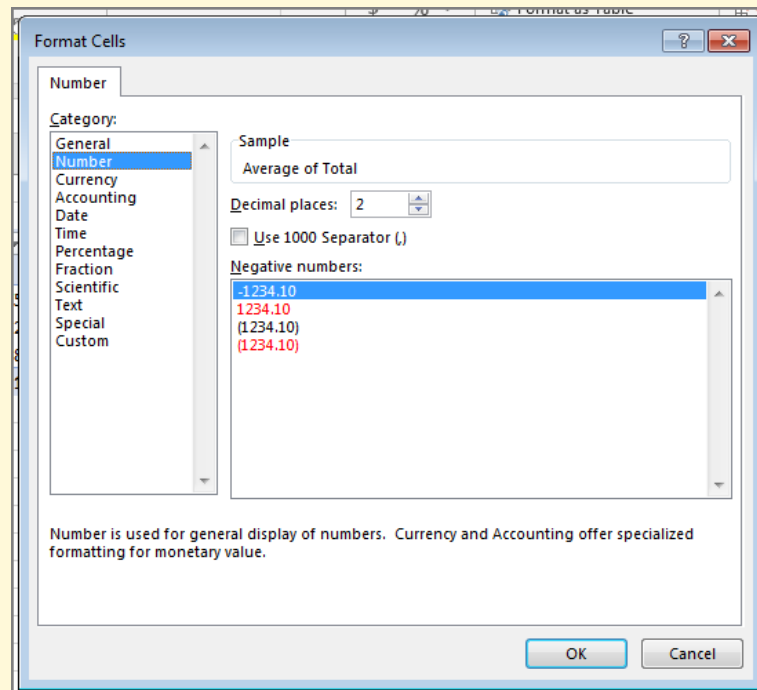
Figure 281: Setting Two Decimal Places

    e) Click **OK**.

    f) Click **OK**.

18. The pivot table is instantly changed to display the averages rounded to two decimal places, so it is more like money.

19. Click **Analyze** ⇒ **PivotTable** ⇒ **PivotTable Name** and enter *Sales*, as illustrated in Figure 282.
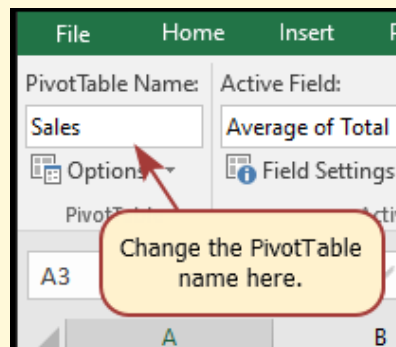
Figure 282: Renaming the Pivot Table
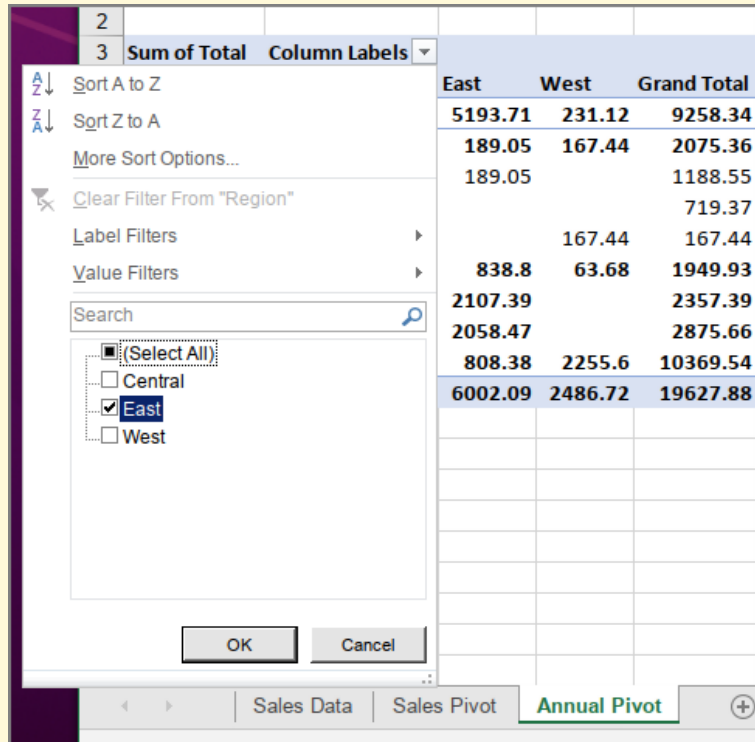
7.3.2 *Using Calendar Data in a Pivot Table*

1. Create a new pivot table by clicking in cell **A1** in the **Sales Data** worksheet.

2. Click **Insert** ⇒ **Tables** ⇒ **PivotTable**.

3. In the *Create PivotTable* popup, ensure that Excel automatically selected the data table name, *CH7_Data*, or the data range $A$1:$G$44, which is all the data on the worksheet. Also, ensure **New Worksheet** is selected as the location of the new pivot table.

4. Click **OK**.

5. A pivot table is created on a new worksheet. Rename that worksheet **Annual Pivot** and move it to the right of **Sales Pivot**.

6. Click **Analyze** ⇒ **PivotTable** ⇒ **PivotTable Name** and enter *Annual* for the *Pivot Table Name*.

7. Check *OrderDate* in the *Field List*. By default, Excel places that item in the pivot table *Row Labels* area since it contains dates. Notice that Excel automatically expands the dates into years and quarters.

8. Drag *Total* from the *Field List* to *Values*. The pivot table now shows the total sales by date. Clicking the plus sign beside the years and quarters in the pivot table drills down to specific quarters and months of interest.

9. Drag *Region* from the *Field List* to *Columns*. This creates columns for each region in the pivot table so now management can find sales by month and region.

Figure 283: Sales Units With Columns

10. To filter the data, click the down arrow to the right of the *Column Labels* or *Row Labels* headers on the pivot table (see Figure 284). Check only those regions or dates that should be included in the pivot table. For example, click the down arrow to the right of the *Column Labels* and uncheck everything except *East* then click **OK**. Notice how the pivot table is updated to include only the East region. Also notice that the dropdown includes options to sort the data in the pivot table.

Figure 284: Filtering Regions

11. All regions should be included for the rest of this exercise, so click the down arrow to the right of the *Column Labels* and check *Select All* then click **OK**.

12. While managers normally like having dates grouped by month/quarter/year, that can be easily modified. Click cell **A5** in the pivot table so only that one cell is selected. Click **Analyze** ⇒ **Group** ⇒ **Group Field**.
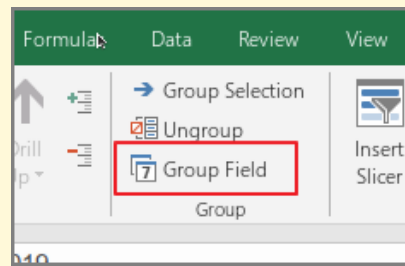
Figure 285: The Group Field Button

13. In the *Grouping* popup box, the start/end dates for the data can be specified to limit the data shown in the pivot table. For this exercise, leave the dates at their default (two entire years), but click *months* so it is no longer highlighted then click **OK**. Figure 286 illustrates the *Grouping* popup box after the **Months** item is inactivated. This will remove the *Months* drill down capability and only show years and quarters in the pivot table. By using this option, details can be removed from the pivot table so trends may become more visible.
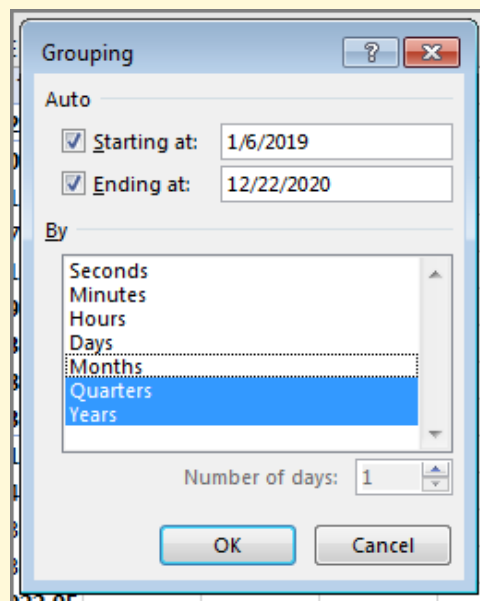
Figure 286: Removing Months From The Group

14. Drag *Rep* from the Field List to the Filters area. Notice that the pivot table now has a selector in cell **B1** so a specific representative (or group of representatives) can be used to filter data on the pivot table. Click the down arrow for the *Rep* filter, select **Andrews**, and click **OK**. No-

tice that the pivot table is instantly updated to include only Andrews' sales data.
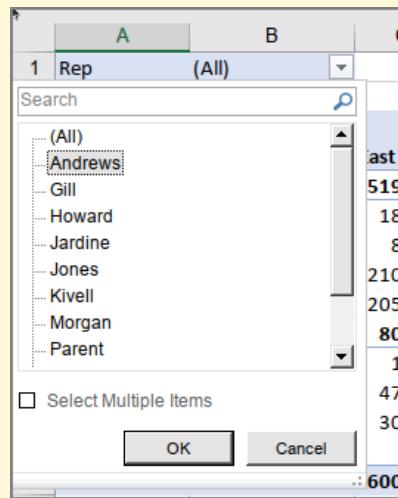
Figure 287: Filtering For One Representative

15. This pivot table will be used to create a pivot chart in the next section; however, the filter is not needed. Uncheck *Rep* in the Field List to remove that from the filter area.

16. Save the **CH7-Sales Summary** workbook.

Key Take-Aways

Pivot Tables

- Pivot tables are a very powerful analysis tool that are easy to create and use.

7.4   RECOMMENDED PIVOT TABLES

Learning Objectives

- Evaluate and select a recommended pivot table.

1. Open the **Sales Summary** workbook that was created in section 7.2.3 if it is not already opened.

2. Click cell **A1** in the **Sales Data** worksheet.

3. Click **Insert** ⇒ **Tables** ⇒ **Recommended PivotTables**.

4. Excel will analyze the data and create several recommended pivot tables. These can be clicked and previewed in the *Recommended PivotTables* popup. Figure 288 illustrates the *Recommended PivotTables* popup.
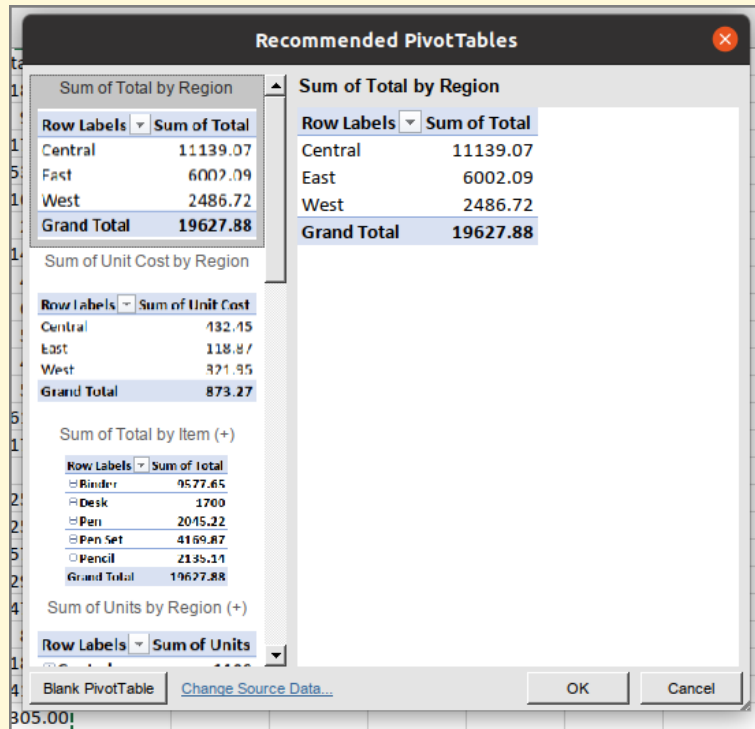
Figure 288: Recommended PivotTables

5. Click on the first recommended pivot table, **Sum of Total by Region**, and click **OK**.

6. Excel creates the pivot table in a new worksheet. Name that worksheet **Sales By Region**. Move **Sales By Region** to the right of **Annual Pivot**.

7. Click **Analyze** ⇒ **PivotTable** ⇒ **PivotTable Name** and enter *By Region*.

8. The new pivot table includes all the same features as those created manually so formatting and variable manipulation is available to modify this table.

9. Save the **CH7-Sales Summary** workbook.

> **Key Take-Aways**
>
> **Recommended Pivot Tables**
>
> - Excel automatically analyzes data in a worksheet and recommends appropriate pivot tables for the data.
> - If a recommended pivot table is selected, it can be easily manipulated to meet the goals of the research project.

7.5   PIVOT CHARTS

> **Learning Objectives**
>
> - Create and format a pivot chart.

One of the strengths of creating a pivot table is that the table can be used to create a chart and as the table is modified the chart is also automatically modified. Follow these directions to explore the power of pivot charts.

1. Open the **Sales Summary** workbook that was created in section 7.2.3 if it is not already opened.

2. Open the **Sales Data** worksheet.

3. Activate cell **A1** by clicking in it.

4. Click **Insert** ⇒ **Charts** ⇒ **Pivot Chart**.
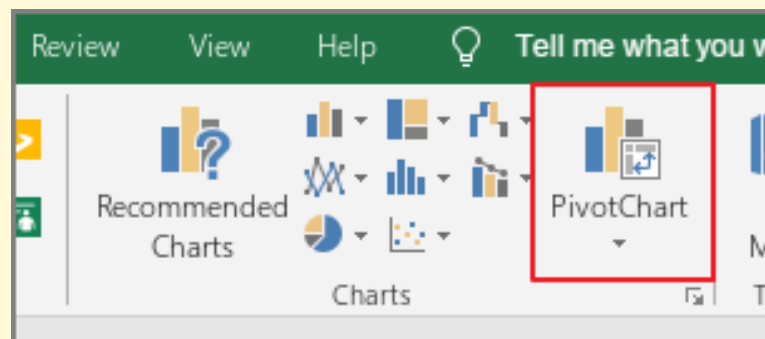
Figure 289: The Pivot Chart Button

5. In the *Create PivotChart* popup, ensure that Excel automatically selected either the data table by name, *CH7_Data*, or the data range, $A$1:$G$44, which is all

the data on the worksheet. Also, ensure **New Worksheet** is selected as the location of the new pivot chart.

6. Click **OK**.

7. Excel will open a new pivot chart worksheet. This worksheet is like a pivot table worksheet and creating a chart is like creating a table.

8. Rename the pivot chart worksheet to **Sales By Item**.

9. Move **Sales By Item** to the right of **Sales By Region**.

10. In the *Field List*, click the checkboxes for **Rep** and **Total**. Excel creates a bar chart that shows the total sales for each Representative, as illustrated in Figure 290.
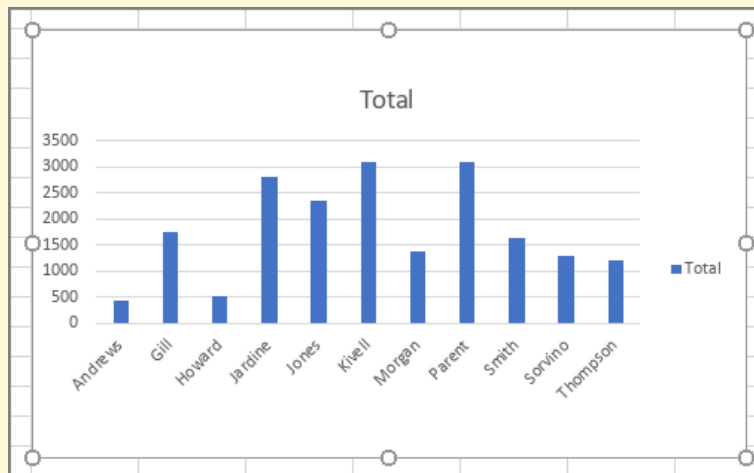
Figure 290: Sales By Representative

11. Uncheck **Rep** and check **Item**.

12. The bar chart automatically updates to display the total sales for each item in the inventory. This chart, though, would be better if it were a pie chart.

13. Click the down arrow for the **Sum of Total** item in the *Values* area of the pivot table.

14. Select **Value Field Settings** in the popup options menu.

15. Click the **Show Values As** tab in the *Value Field Settings* popup box.

16. Choose **% of Grand Total** in the drop-down menu near the middle of the *Value Field Settings* box.
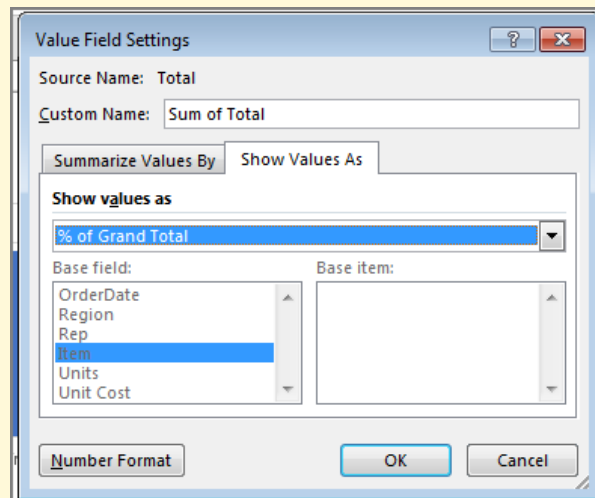
Figure 291: Values As a Percentage Of The Total

17. Click **OK**.

18. The values in the pivot table change to percentages rather than numbers.

19. Click **Design** ⇒ **Type** ⇒ **Change Chart Type**.

20. Select **Pie Chart** and click **OK**.
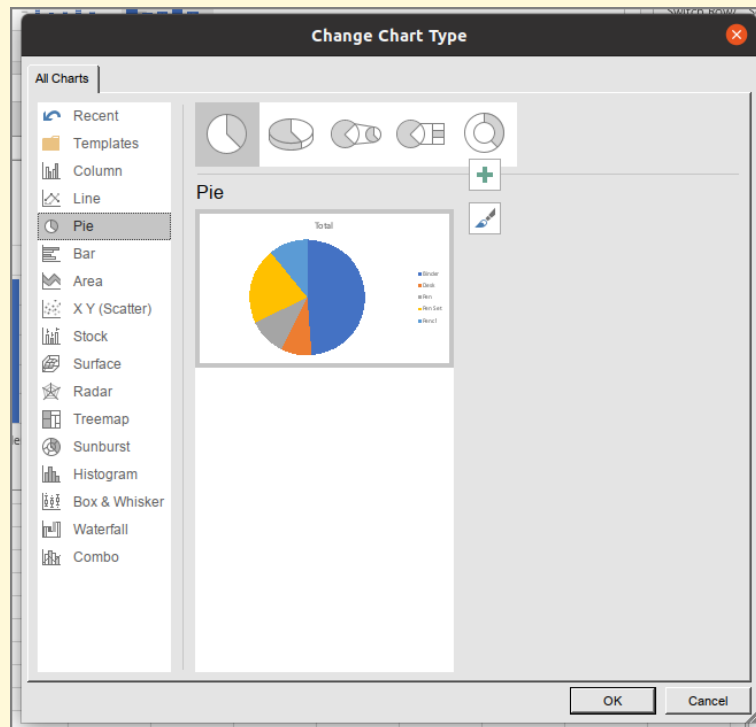
Figure 292: Selecting a Pie Chart

21. Click the + sign at the top right of the pie chart and then click **Data Labels** to display the percent of each slice.
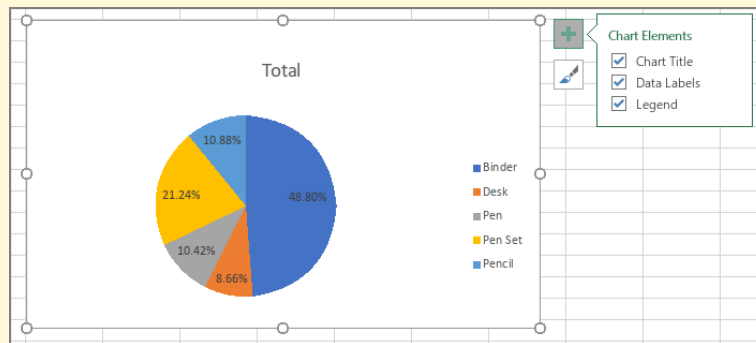
Figure 293: Adding Data Labels

22. Click off the chart so it is no longer selected and then right-click on the chart title. Select **Edit Text** from the popup menu.
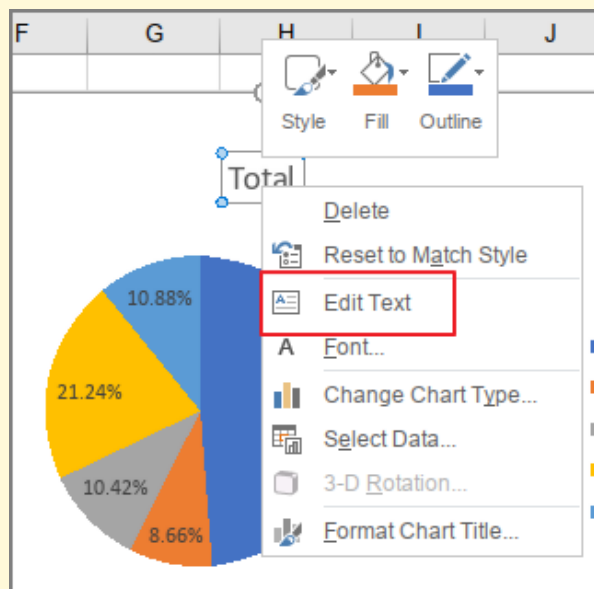
Figure 294: Editing The Title

23. Enter *Sales by Item* as the chart title and then click off the chart so it is no longer selected.

24. The chart colors and other chart elements can be changed using options found at **Design** ⇒ **Group** ⇒ **Button**.

25. Save the **CH7-Sales Summary** workbook.

Key Take-Aways

Pivot Charts

- Creating a pivot chart uses the same process as a pivot table.
- Once a pivot chart has been created, it can be modified using all the chart tools.

7.6 PREPARING TO PRINT

Learning Objectives

- Review each worksheet in a workbook in Print Preview.
- Modify worksheets as needed to professionally print data and charts.

Just like consistency in formatting is important when working with workbooks containing multiple worksheets with pivot tables and charts, so is consistency in page setup. The *CH7-Sales Summary* workbook should be prepared for printing by modifying some of the settings and adding a header and footer.

1. Open the **CH7-Sales Summary** workbook that was created in section 7.2.3.

2. Click **File ⇒ Print** to enter the print preview. To view all the worksheets at one time, select **Print Entire Workbook** in the first box in the Settings section. There are 6 pages to scroll through in *Print Preview*.

   - Page one is just the raw data. There is no point in printing that worksheet so it should be hidden.
   - Page five has part of a pivot chart, but it continues onto another page.
   - A header and footer should be added.

3. Exit *Print Preview* by clicking the arrow in the top left corner of the page.

4. Right-click on the **Sales Data** worksheet tab and select **Hide**. This hides the worksheet so it is not printed, but the worksheet and data are all still available in the workbook so the pivot tables will still be functional.

5. Activate the **Sales By Item** worksheet by clicking that tab. Notice that part of the chart is printing on a second page as indicated by a dotted line running down the edge of column J.

6. Resize the chart using the following values. For each side of the chart, press the [Alt] key while dragging the resize handle on the chart.

Chart Side	Locked To
Top	Top of **Row 9**
Left	Left of **Column B**
Bottom	Bottom of **Row 23**
Right	Right of **Column G**

7. Right-click the **Sales Pivot** worksheet and click **Select All Sheets** to group all four worksheets.

8. Click **Page Layout** ⇒ **Page Setup** ⇒ **Launcher**.

9. Click the **Header/Footer** tab.

10. Click **Custom Header…**.

11. Click in the right section to activate it and then click the **Insert Date** button.

12. Click **OK**.

13. Click **Custom Footer…**.

14. Click in the center section to activate it and then click the **Insert Sheet Name** button.

15. Click **OK**.

16. Click **OK** to close the *Page Setup* dialog box.

17. Right-click the **Sales Pivot** worksheet and select **Ungroup Sheets**.

18. Click **File** ⇒ **Print** to enter the print preview. To view all the worksheets at one time, select **Print Entire Workbook** in the first box in the Settings section. There are 4 pages to scroll through in *Print Preview*. Confirm that each worksheet is printing on one page with the date in the header and the worksheet name in the footer.

19. Save the **CH7-Sales Summary** workbook.

20. Compare the workbook with the self-check answer key (**CH7-Sales Summary Solution**) and then close and submit the **CH7-Sales Summary** workbook as directed by the instructor.

> ### Key Take-Aways
>
> **Preparing to Print**
>
> - Formatting for print is an essential part of creating a workbook.

7.7   CHAPTER PRACTICE

7.7.1   *Project Team Analysis*

1. Load the data.

   a) Start Excel and open a new blank workbook.

   b) Save the workbook as **PR7-Project**.

   c) `Excel 2016` Click **Data ⇒ Get & Transform ⇒ New Query ⇒ From File ⇒ From CSV**

   d) `Excel 365` Click **Data ⇒ Get & Transform Data ⇒ Get Data ⇒ From File ⇒ From Text/CSV**

   e) Navigate to **PR7-Data.csv**.

   f) Click the file name and then **Import**.

   g) When the import wizard opens, click **Load**.

   h) Rename **Sheet2** to **Project Data**.

   i) Delete **Sheet1**.

   j) Close the *Workbook Queries* panel.

2. **Question 1**: What type of project is the most fiscally productive?

   a) Activate cell **A1** by clicking in the cell.

   b) Click **Insert ⇒ Tables ⇒ Recommended PivotTables**.

   c) Select the pivot table named **Sum of Amount Billed by Project Type** and click **OK**.

   d) Rename the pivot table to *Billed* and then rename the worksheet to *Billed*.

e) Move the **Billed** worksheet to the right of the **Project Data** worksheet.

f) Click the down arrow to the right of *Sum of Amount Billed* in the *Values* area and select **Value Field Settings**.

g) Change the *Custom Name* of this field to *Total Billed*.

h) Click **OK**.

i) Right-click in cell **B2** to activate it.

j) In the popup menu, select **Sort** ⇒ **Sort Largest to Smallest**. This sorts the total billed from the largest to smallest amount.

k) Save the **PR7-Project** workbook.

3. **Question 2**: Which client spends the most?

a) Click in cell **A1** in the **Project Data** worksheet to activate it.

b) Click **Insert** ⇒ **Tables** ⇒ **Pivot Table**.

c) Create a pivot table on a new worksheet.

d) Name the pivot table and worksheet *Clients*.

e) Move the **Clients** worksheet to the right of the **Billed** worksheet.

f) Drag *Client* from the *Field List* to the *Rows* area.

g) Drag *Amount Billed* from the *Field List* to the *Values* area.

h) Change the name of the values header from *Sum of Amount Billed* to *Total Billed*.

i) Sort the *Total Billed* column so the largest number is at the top.

j) Save the **PR7-Project** workbook.

4. **Question 3**: Which quarter was the most profitable?

a) Click in cell **A1** in the **Project Data** worksheet to activate it.

b) Click **Insert** ⇒ **Tables** ⇒ **Pivot Table**.

c) Create a pivot table on a new worksheet.

d) Name the pivot table and worksheet *Quarterly*.

e) Move the **Quarterly** worksheet to the right of the **Clients** worksheet.

f) Drag *Date Completed* from the *Field List* to the *Rows* area.

g) Drag *Amount Billed* from the *Field List* to the *Values* area.

h) Change the name of the values header from *Sum of Amount Billed* to *Total Billed*.

i) Click the *plus* buttons beside 2016 and 2017 to view the amount billed by quarter.

j) Save the **PR7-Project** workbook.

5. **Question 4**: Which team completed the largest proportion of the projects?

a) Click in cell **A1** in the **Project Data** worksheet to activate it.

b) Click **Insert** ⇒ **Charts** ⇒ **PivotChart**.

c) Create a pivot chart on a new worksheet.

d) Name the pivot chart and worksheet *Teams*.

e) Move the **Teams** worksheet to the right of the **Quarterly** worksheet.

f) Drag *Team Leader* from the *Field List* to the *Axis (Categories)* area.

g) Drag *Hours Spent* from the *Field List* to the *Values* area.

h) Change the name of the values header from *Sum of Hours Spent* to *Total Hours*.

i) Sort the *Total Hours* column so the largest number is at the top.

j) Change the title of the chart to *Total Hours Spent*.

k) Since there is only one data point, the legend is not needed, so remove it. Click the + sign near the top right corner of the chart and uncheck the **Legend** item.

6. Save the **PR7-Project** workbook.

7. Compare the workbook with the self-check answer key (**PR7-Project Solution**) and then close and submit the **PR7-Project** workbook as directed by the instructor.

7.8 SCORED ASSESSMENT

7.8.1 *Employee Analysis*

1. Load the data.

   a) Start Excel and open a new blank workbook.

   b) Save the workbook as **SC7-Employees**.

   c) `Excel 2016` Click **Data ⇒ Get & Transform ⇒ New Query ⇒ From File ⇒ From CSV**

   d) `Excel 365` Click **Data ⇒ Get & Transform Data ⇒ Get Data ⇒ From File ⇒ From Text/CSV**

   e) Navigate to **SC7-Data.csv**.

   f) Click the file name and then **Import**.

   g) When the import wizard opens, click **Load**.

   h) Rename **Sheet2** to **Employee Data**.

   i) Delete the **Sheet1** worksheet.

   j) Close the *Workbook Queries* panel.

2. **Question 1**: What is the average salary for each role?

   a) Create a pivot table that lists the roles in the business (Accounting, Associate, etc.), the number of people in each role, and the average salary for that role. Hint: the *Role* field should be dragged to both the *Rows* area and the *Values* area.

   b) The pivot table and worksheet should be named **Avr Salary** and that worksheet should be to the right of the **Employee Data** worksheet.

   c) The *Salary* field should be changed from sum to average and renamed *Avr Salary*. It should also be formatted as currency with two decimal places.

   d) *Count of role* in the *values* field should be renamed *Count*.

   e) Sort the list so the highest salary is first.

   f) Save the **SC7-Employees** workbook.

   g) Figure 295 illustrates how the pivot table should look.

Row Labels	↓	Count	Avr Salary
CEO		1	$125,000.00
CFO		1	$120,000.00
Section Supervisor		2	$67,216.00
Accounting		2	$65,898.00
Human Resources		3	$64,306.67
Team Leader		5	$61,577.60
Purchasing		2	$51,447.50
Associate		13	$31,914.31
Intern		1	$27,000.00
Grand Total		30	$51,893.90

Figure 295: Average Salary By Role

3. **Question 2**: What is the average age of the employees when broken down by sex and marital status?

   a) Create a pivot table that lists the average age by marital status and sex for all employees.

   b) The pivot table and worksheet should be named **Avr Age** and that worksheet should be to the right of the **Avr Salary** worksheet.

   c) The average age should be formatted as a number with zero decimal places.

   d) Save the **SC7-Employees** workbook.

   e) Figure 296 illustrates how the pivot table should look.

Row Labels ▾	Average of age
⊟ **Divorced**	**46**
Female	50
Male	43
⊟ **Married**	**46**
Female	44
Male	51
⊟ **Separated**	**47**
Female	44
Male	54
⊟ **Single**	**31**
Female	32
Male	30
⊟ **Widowed**	**63**
Female	66
Male	59
Grand Total	**46**

Figure 296: Average Age

4. **Question 3**: How many employees have been hired each year from 2007?

   a) Create a pivot table that lists the employee count by year. (*Hint*: count the username field since each employee has a unique username.)

   b) The pivot table and worksheet should be named **Year Hired** and that worksheet should be to the right of the **Avr Age** worksheet.

   c) The username field should be labeled *count*.

   d) The *hired* field should display only years, not quarters or months.

   e) The list should be sorted by year (which is the default).

   f) Save the **SC7-Employees** workbook.

   g) Figure 297 illustrates how the pivot table should look.

Row Labels ▼	Count
2007	4
2008	2
2010	4
2011	6
2012	3
2013	3
2014	1
2015	3
2016	2
2017	1
2018	1
Grand Total	30

Figure 297: Number Hired By Year

5. **Question 4**: How many employees work in each role?

   a) Create a pivot chart (*note*, this is a chart, not a table) that shows the count by role. (*Hint*: count the username field since each employee has a unique username.)

   b) The pivot chart and worksheet should be named **Count By Role** and that worksheet should be to the right of the **Year Hired** worksheet.

   c) The username field should be labeled *Number*.

   d) The data should be sorted such that the role with the most employees ("Associate") should be first.

   e) The chart's title should be *Count by Role*

   f) The chart should not have a legend.

   g) Save the **SC7-Employees** workbook.

   h) Figure 298 illustrates how the pivot chart should look.
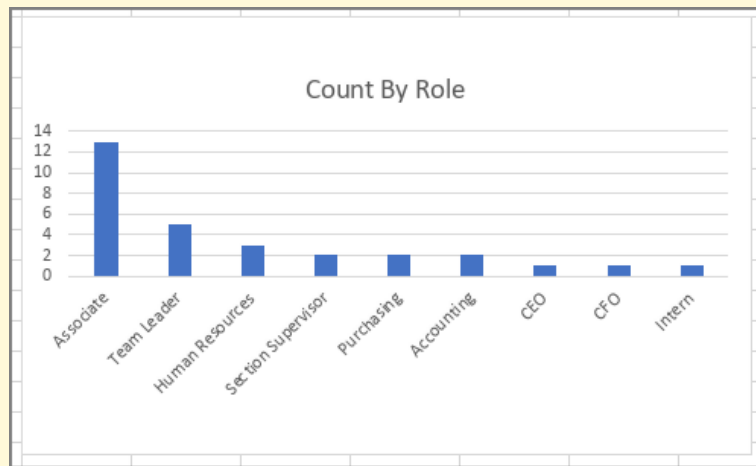
Figure 298: Count By Role

6. Prior to submitting this workbook, use the Print Preview to make sure the worksheets are printing properly.

   a) Hide the **Employee Data** worksheet.

   b) On the **Count by Role** worksheet, the pivot chart needs to be moved under the pivot table.

   c) Add a footer to each sheet that displays the sheet name in the center section of the footer.

7. Save and close the **SC7-Employees** workbook.

8. Submit the **SC7-Employees** workbook as directed by the instructor.

FORECASTING

One of the most powerful features of Excel is the ability to analyze data and create charts with trend lines that would help businesspeople forecast future conditions. Excel also contains several tools designed for "what-if" analysis where businesspeople can project the results of changing market variables or corporate decisions. This chapter introduces all these features.

8.1 ADVANCED CHARTS

> **Learning Objectives**
>
> - Sparklines graphically represent data trends in a single cell.
> - Trendlines simplify graphs to display a single trend line.
> - Forecast Worksheets create a trendline but include confidence levels and forecast trends into the future.
> - 3D Maps produce maps that join geography- and time-based data.

8.1.1 *Sparklines*

Sparklines are tiny graphs that visually represent data in a single worksheet cell. These are powerful ways to help managers quickly "see" the data.

1. Open workbook **CH8-Sparkline Data**.

2. Save the workbook as **CH8-Sparkline**.

3. Open the **Precipitation** worksheet. This worksheet contains the average monthly precipitation for ten United States cities[a].

4. Click cell **N4** to activate that location.

5. Click **Insert** ⇒ **Sparklines** ⇒ **Line**.
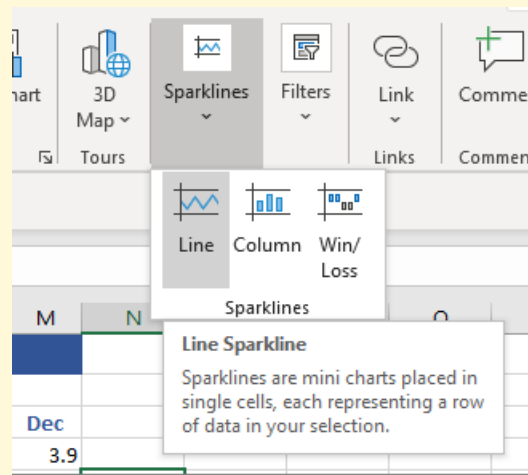
Figure 299: The Sparklines Button

6. For the Data Range, enter *B4:M4*.

7. For the Location Range, enter *$N$4*.

8. Click **OK**.

---

a The climate data was found at https://www.usclimatedata.com/climate/un
ited-states/us
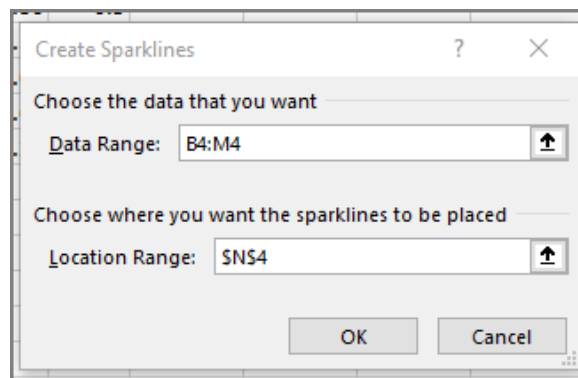
Figure 300: The Sparklines Diaglog Box

Excel creates a tiny line graph that shows the monthly precipitation for the entire year.
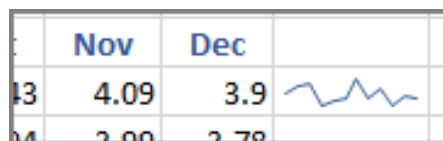
Figure 301: One Sparkline

1. Copy/paste cell **N4** to **N5:N13**. The fill handle will make this easier.

ov	Dec	
4.09	3.9	
3.99	3.78	
0.76	0.49	
3.43	2.56	
3.31	2.8	
0.36	0.5	
4.31	4.24	
0.65	0.88	
5.63	5.49	
3.23	3.23	
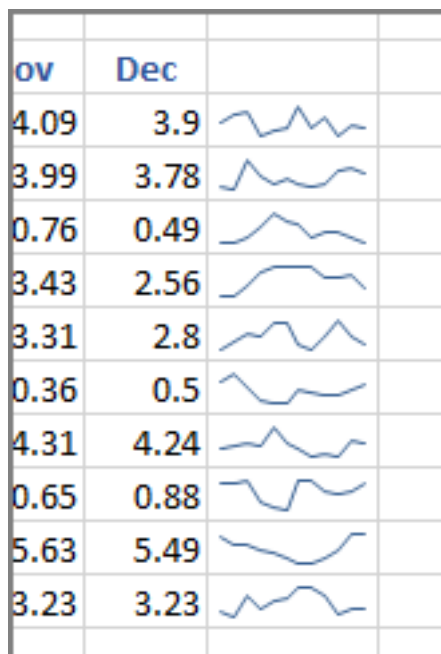
Figure 302: All Sparklines In Place

Now Excel displays a sparkline for each of the cities. While it is not possible to see the details for any specific month and city, it is easy to spot trends. For example, Portland OR has less precipitation in the late summer while Chicago IL seems to start out slow in January and then grow through the spring and early summer. A business manager could use a sparkline to easily detect trends in data.

1. Select **N4:N13** and notice the *Sparkline Design* tab includes several options to modify the appearance of the sparkline.

2. Click **Sparkline Design** ⇒ **Type** ⇒ **Column**.

v	Dec	
.09	3.9	
.99	3.78	
.76	0.49	
.43	2.56	
.31	2.8	
.36	0.5	
.31	4.24	
.65	0.88	
.63	5.49	
.23	3.23	
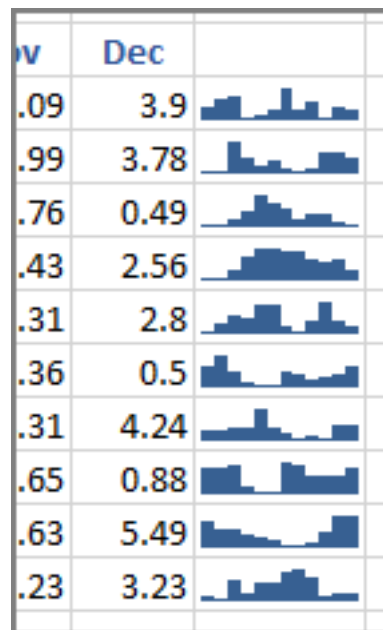
Figure 303: Column Sparklines

The sparklines change into column graphs. The information does not change, but it may be easier to spot trends with one type of graph or the other, so it is a best practice to try both.

1. Open the **Temperature** worksheet in the **CH8-Sparkline** workbook. This worksheet contains the average low temperature for five Alaskan cities[a].

2. Click cell **N4** to activate that location.

3. Click **Insert** ⇒ **Sparklines** ⇒ **Win/Loss**.

4. For the Data Range, enter *B4:M4*.

5. For the Location Range, enter *$N$4*.

6. Click **OK**.

7. Copy **N4** to **N5:N8**.

a The climate data is from https://www.usclimatedata.com/climate/united-states/us
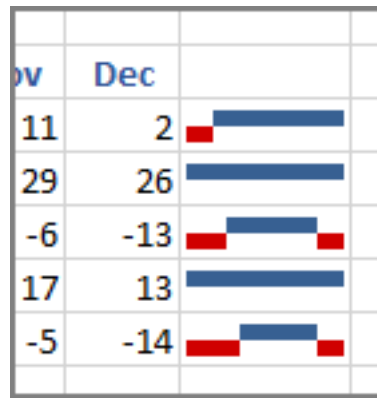
Figure 304: Win/Loss Sparkline

Excel creates a bar graph that shows positive values in blue and negative values in red. This does not show the magnitude of each value, but only whether it is positive or negative in nature. This type of sparkline is useful for quickly determining things like if a stock price is increasing or decreasing.

1. Save the **CH8-Sparkline** workbook.

2. Compare the workbook with the self-check answer key (**CH8-Sparkline Solution**) and then close and submit the **CH8-Sparkline** workbook as directed by the instructor.

8.1.2   Trend Lines

Excel can easily create trend lines on graphs to indicate data trends. These lines can optionally be extended to forecast how the data may soon move.

1. Open workbook **CH8-Dow Data**. This workbook contains the closing Dow Jones average for each month from 1981–1990.

2. Save the workbook as **CH8-Dow**.

3. Click cell **A1** to activate that location.

4. Click **Insert** ⇒ **Charts** ⇒ **Recommended Charts**.

5. Select the line chart (it is the second selection).

6. Click **OK**.

7. Click in the chart area to activate it.

8. Click **Chart Design** ⇒ **Chart Layouts** ⇒ **Add Chart Element** ⇒ **Trendline** ⇒ **Exponential**. Note: it is reasonable to click on each of the types of trendlines to see which seems to fit the data best.
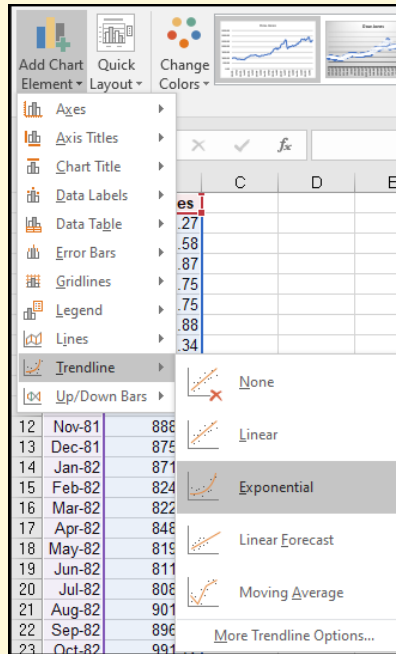
Figure 305: Adding A Trendline

9. Excel draws a dotted trendline that shows the growth of the Dow over the ten-year period.
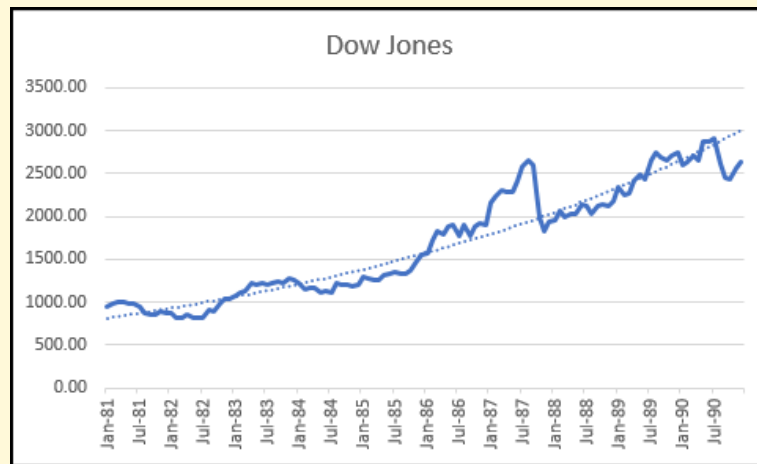
Figure 306: Trendline Added to Graph

10. Double-click the dotted trendline to activate it and open the *Format Trendline* properties panel.

11. Enter **10** for the *Forward Forecast* period to extend the trendline out five years (ten six-month periods).
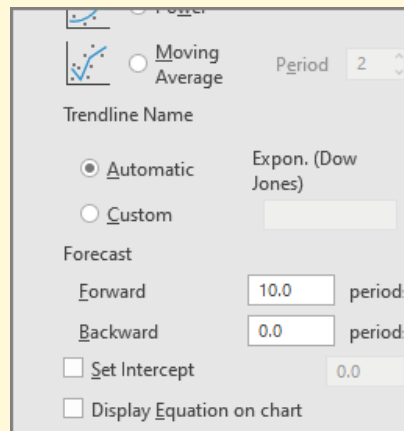
Figure 307: Extending The Trendline for 10 Periods

12. Excel forecasts a generally upward trend for the five-year period.
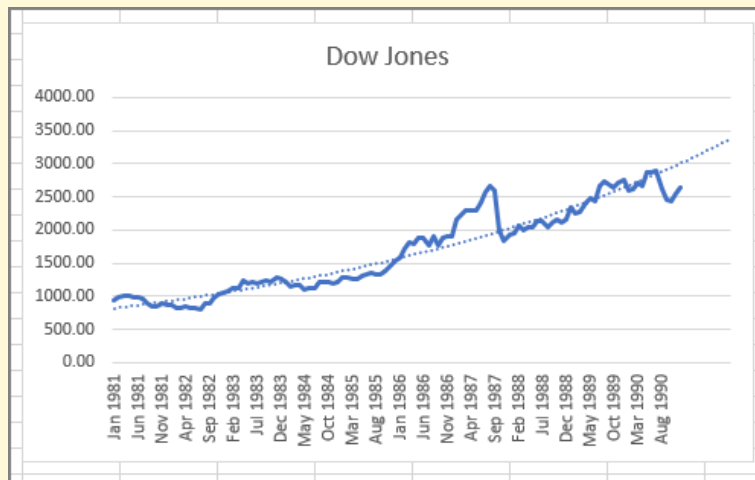
Figure 308: Trendline With Forecast

8.1.3 *Forecast Worksheet*

The trend lines described above are easy to add to a chart, but Excel includes a tool called *Forecast Worksheet* that creates a forecast along with confidence levels.

1. Click cell **A1** to activate that location.

2. Click **Data** ⇒ **Forecasts** ⇒ **Forecast Sheet**.
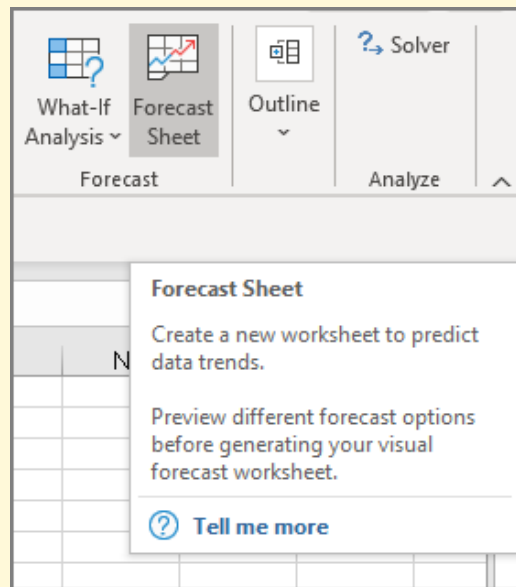
Figure 309: The Forecast Sheet Button

3. The *Create Forecast Worksheet* wizard opens with a preview of the worksheet (see Figure 311). There are numerous options available, but the default options are appropriate for this exercise. Here are what the other options do.

- **Forecast End**. Set an end date for the forecast, which are the orange lines in the illustration.

- **Forecast Start**. Set the start date for the forecast.

- **Confidence interval**. This is a statistical value that indicates a 95% certainty that as time progresses the graph will fall between the upper and lower limits shown. The confidence interval can be adjusted, but 95% is common.

- **Seasonality**. Excel will search for any sort of seasonal cycles and adjust the forecast accordingly.

- **Timeline and Values Range**. This is the data that was used to create the graph. If Excel got the wrong data ranges, then they can be adjusted here.

- **Fill Missing Points Using**. This tells Excel how to deal with data points that are missing. It will either fill those missing values with zero or interpolate a value between the two neighboring values. Interpolation is usually the best option.

- **Aggregate Duplicates Using**. There are several options available for aggregating duplicates in the data, but *Average* is usually the best option.

4. Click **Create**.
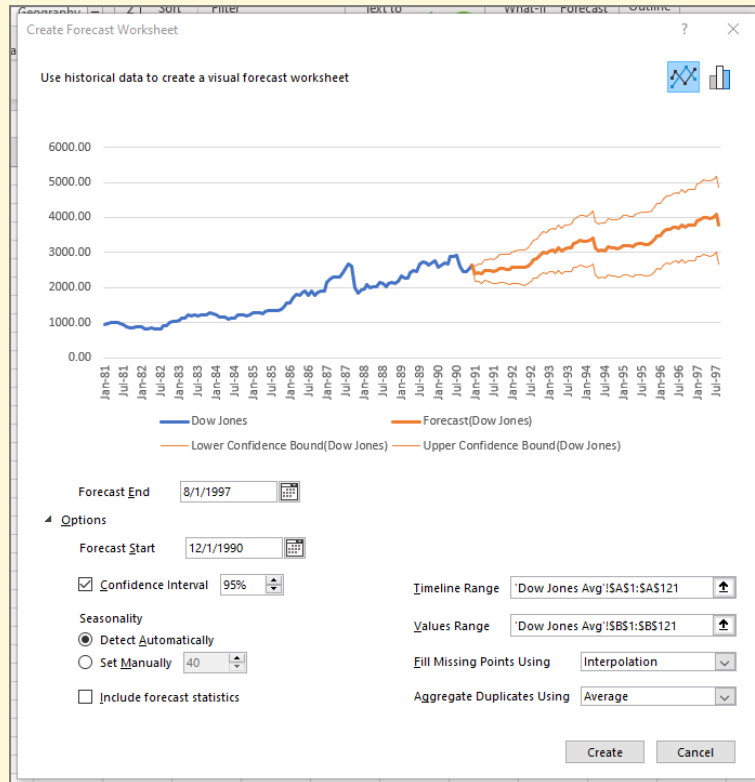
Figure 310: Dow Forecast

5. Excel creates a new worksheet containing the chart along with a table listing all the values used to create the chart.

6. Rename **Sheet1** to *Forecast*.

7. Scroll to the bottom of the table to see the values Excel forecast to extend the graph. Those values can be used to forecast the Dow Jones for a specific date; so, the Dow was forecast to be at 2389.37 in January 1991.

8. Save the **CH8-Dow** workbook.

9. Compare the workbook with the self-check answer key (**CH8-Dow Solution**) and then close and submit the **CH8-Dow** workbook as directed by the instructor.

Following is a second example of a forecast worksheet that uses beer production data because it shows a clear seasonal trend over time.

1. Open workbook **CH8-Beer Data**. This workbook contains the total monthly United States beer production, in barrels, for January 1980, until December 1991.

2. Save the workbook as **CH8-Beer**.

3. Click in **A1** to select that location.

4. Click **Data** ⇒ **Forecast** ⇒ **Forecast Sheet**.

5. Accept the default options and click **Create**.

6. The graph clearly shows the cyclic nature of beer production and forecasts a similar cycle out to December 1994.

7. Rename **Sheet1** to *Forecast*.

8. Save the **CH8-Beer** workbook.

9. Compare the workbook with the self-check answer key (**CH8-Beer Solution**) and then close and submit the **CH8-Beer** workbook as directed by the instructor.
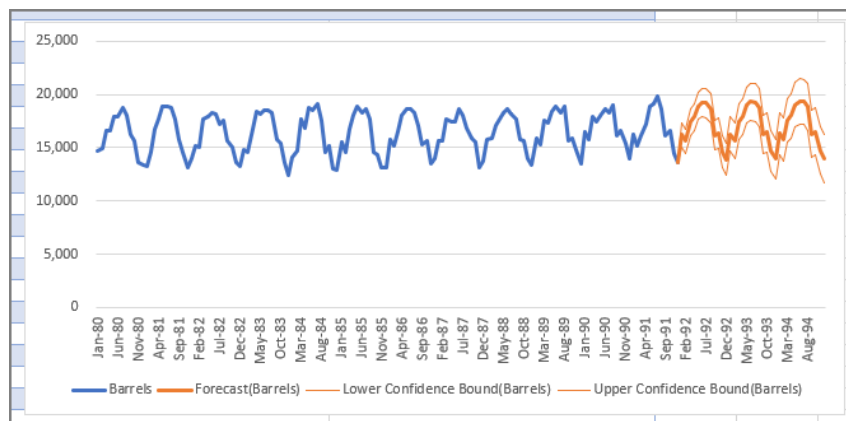
Figure 311: Beer Production Forecast

A forecast sheet is a simple method business owners use to predict business cycles like customer demand so owners can manage inventory, hire help, or take other actions.

8.1.4   3D Maps

Excel includes a feature called *3D Maps* that merge geographically oriented maps with a timeline so business owners can look for trends over time in various geographical areas they service. As an example, if a company markets to an entire state then the owner can create a *3D Map* that shows sales by county over the preceding five years, and that may make important trends obvious.

   3D Maps combines map and timeline data in a feature called *Tours*. The process can be somewhat intimidating at first but becomes easier with practice.

8.1.4.1   Arizona Population Growth

1. Open workbook **CH8-Map Data**. This workbook contains two worksheets.

   - **AZ Population**. This worksheet lists the population for all Arizona counties from 1969 until 2018, by year.[a] Note: La Paz County was separated from Yuma County on January 1, 1983 so the Yuma data contains counts of people who lived in what became La Paz County through 1982 and excludes it beginning with 1983.

   - **GDP**. This worksheet contains the real *Gross Domestic Product* (in millions of dollars) for each of the fifty states, and Washington D.C., from 2010 until 2015, by economic sector.[b] The table also includes a *Quantity Index* for each year which indicates the percent change in each value when compared to the base year, 2009.

2. Save the workbook as **CH8-Maps**.

3. In the **AZ Population** worksheet, click cell **A1** to activate that location.

4. Click **Insert** ⇒ **Tours** ⇒ **3D Map**.

---

[a] This data was found at the United States Bureau of Economic Analysis, https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=7#reqid=70&step=1&isuri=1&acrdn=7

[b] The GDP information was found at http://proximityone.com/gdpbyindustry.htm.
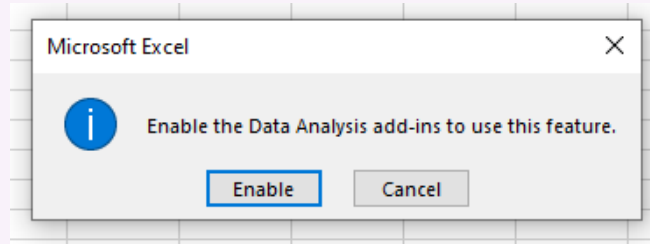
1. The *3D Maps* editor box, Figure 313, looks complex. Here is an explanation of each of the four main areas.
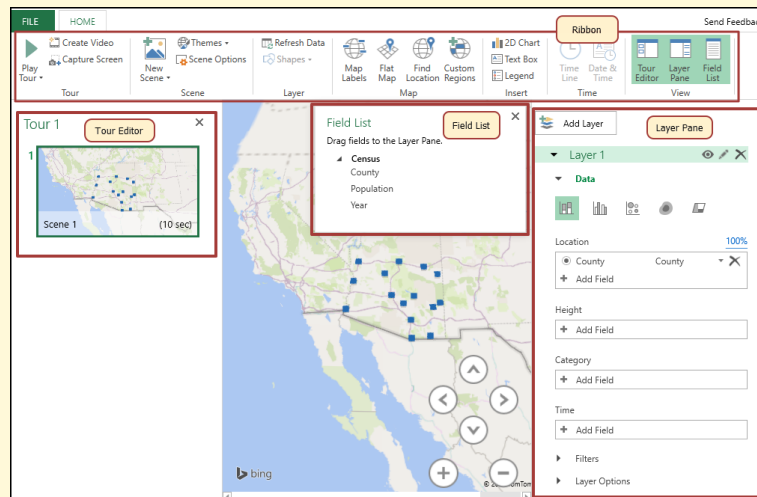
Figure 313: 3D Map Editor

- **Ribbon**. The *3D Map* ribbon (Figure 314) serves the same function as in any Microsoft program. It contains buttons to activate the most used mapping functions. The various buttons will be used throughout this lesson and their functions will become clear through use.
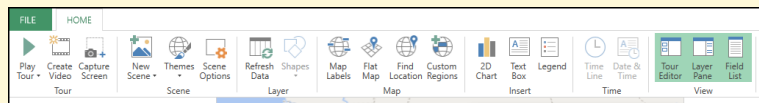
Figure 314: 3D Map Ribbon

- **Tour Editor**. Each *3D Map* is divided into scenes that are contained in a *Tour*. The *Tour Editor*, on the left side of the screen, (Figure 315) is where settings like the length of time for each scene is defined.
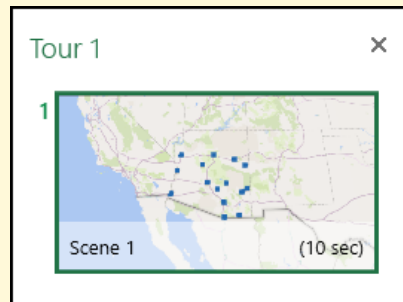
Figure 315: 3D Map Tour Editor

- **Field List**. The various fields (columns) in the original dataset are listed here (Figure 316) so they can be used on the map. This is a pop-up dialog box and can be moved as desired.
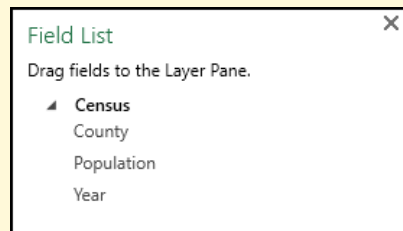
Figure 316: 3D Map Field List

- **Layer Pane**. 3D Maps are composed of multiple layers and this pane is where settings for each of the layers are specified.
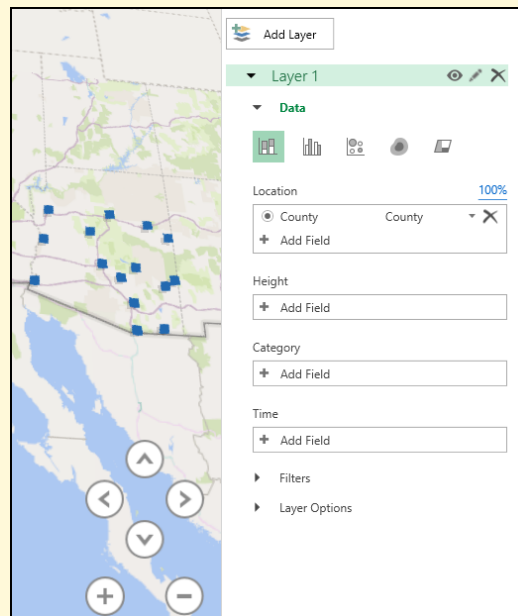
Figure 317: 3D Map Layer Pane

2. The *Layers Pane* is where most of the work is done for a *3D Map*. It is divided into three main sections.

- **Data**. This section is where the data used in the map is manipulated. Figure 318 illustrates the settings found in the data section.

  - **Type of Visualization**. At the top of the pane are five buttons that change the map display setting to a stacked column, clustered column, bubble, heat map, and region. Changing the visualization is as easy as clicking one of the buttons, so they should all be applied to see which gives the best representation of the data.

  - **Location**. This setting divides the map into geographical locations. Maps can use data for country, state, county, city, and many other regional types. For example, a sales map may show sales by state or sales by city.

  - **Height**. This setting determines the height of the data column on a graph. The data needs to be numeric so it can be converted into a column height.

  - **Category**. This setting contains categories for the values graphed by height. For example, a

sales map may include categories for electronics, clothing, or other merchandise.

  – **Time**. This setting contains the time value being graphed. *3D Maps* can be created to display a period, like the value of monthly or weekly sales, but maps can also be created that do not have a time component.

- **Filters**. This section permits the creation and application of complex filters for the data being charted.

- **Layer Options**. This section is where various options, like color, are set for the displayed data.
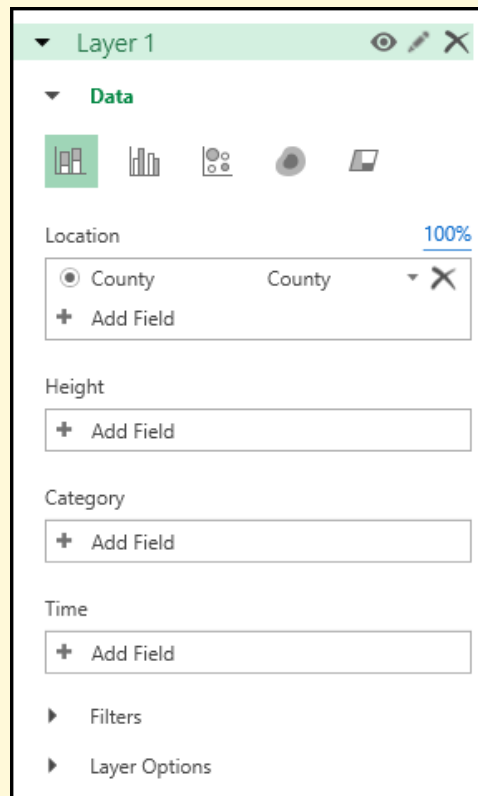
Figure 318: Layers Pane

3. By default, Excel detects the data field that contains geographical information and automatically adds that field to the **Location** setting. For *AZ Population*, county names are the geographical information and that field is added to the *Location* setting. As soon as the county names are added, a stacked column is placed in each county on the map. Since there is no *Height* data available yet, those columns are only flat squares on the map.

4. Click and drag *Population* in the *Field List* to the **Height** setting. Excel immediately applies the sum of the population values to the counties and the columns react accordingly (see Figure 319). Notice the middle column, for Maricopa county, is quite long while the other counties are shorter. Also, Excel creates a legend box to show that the blue columns are the population.
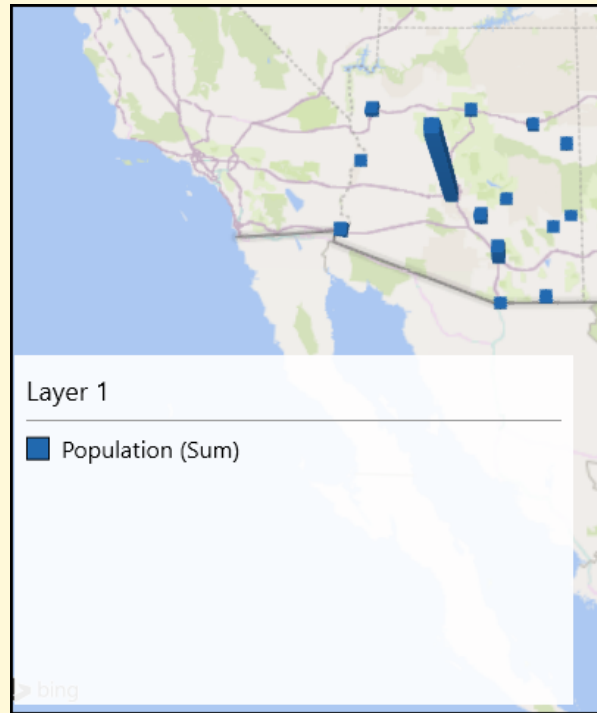
Figure 319: Population Added to Height

5. By default, *Population* will display the sum of population over time. For example, if Cochise County had 40,000 people one year and 50,000 the next, Excel will display 90,000 as the county population. Instead of summing the population over the years, it is more appropriate to display only the current year. Click the drop-down arrow for *Population*, select **No Aggregation**. After changing the aggregation, the columns change to an orange color.

6. Click the triangle beside **Layer Options** to open that setting.

7. Set the Thickness for the column to 200%.

8. Click the color drop-down for *Population (No Aggregation)* and choose blue.

9. Click and drag *Year* in the *Field List* to the **Time** setting. Not much changes, but a timeline bar is added to the bottom of the map. The small triangle marker under the timeline can be moved left and right to display the population for any desired point of time.

10. Click the down arrow to the right of *Year* in the *Time* setting and select **Year** in the drop-down list.

11. Click **Play Tour** at the left edge of the ribbon. Excel will "play" the entire timeline in ten seconds (that timing can be changed). When the video is finished playing, click the left-arrow button in the lower left corner of the video screen to return to the map editor.

12. Click the **Pencil** icon to edit *Layer 1* in the *Layers Pane* and change the name of the layer to *Population*.

13. Click **Add Layer** at the top of the *Layer Pane*. Excel adds a new layer under the *Population* layer.

14. Rename *Layer 2* to *Counties*.

15. By default, Excel places the *County* data field in *Location*. Leave this in place.

16. Click and drag *County* from the *Field List* to *Category*. The *County* data field is now in two settings, *Location* and *Category*. Excel now treats each county as a separate category and colors the columns different colors for each county.

17. Click **Region** on the visualization bar (it is the last option). The *Region* button is outlined in red in Figure 320. The counties are now colored so they are easy to see.
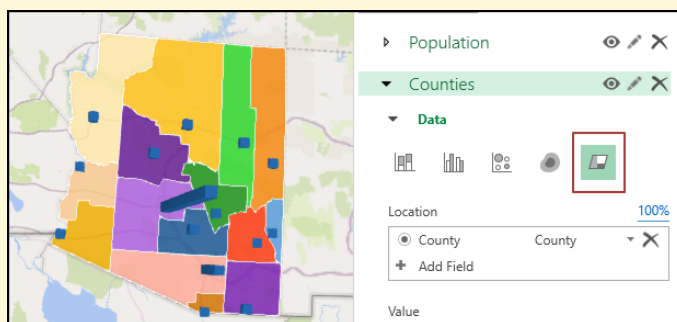
Figure 320: County Areas Colored

18. The county colors are a bit bright, so click the triangle beside **Layer Options** to open that setting.

19. Move the *Opacity* slider to about 50%. That will dim the county colors while leaving the population columns the same.

20. Notice that each county's color can be set using the color dropdown, so it would be easy to highlight a county in some bright color like red while using duller colors for the other counties.

21. Click the **Play Tour** button to see what the tour looks like with the county colors.

22. Click the *Population* layer to activate it again.

23. Click through each of the five types of visualizations and play the tour using each visualization to see which type works best for this data. For this tutorial, leave the visualization on *Heat Map*.

At this point, this tour is nearly done. However, there are just a few settings that can be tweaked a bit.

1. Click *Tour 1* at the top of the *Tour Editor* and enter *Population*.

2. Excel's *3D Map* is drawn on a globe so data for countries around the world can be displayed. It is better for this map to be displayed flat rather than on a globe. Click **Flat Map** in the ribbon to convert the map from a globe to a flat map. The map can always be reverted to a globe if desired.

3. Having the time displayed on the tour is distracting, so format the displayed date to only show the year. Right-click the date displayed on the screen and select **Edit**. In the edit box, choose the *Time Format* that only shows the year without the month and day, then click **Accept**.

4. The legend is not needed for this map, so click that box and delete it. Note: both layers create a legend, and both should be deleted. Either legend can be turned back on if desired by clicking the **Legend** button on the ribbon.

5. Click and drag the map to center Arizona in the display. Also, experiment with the four arrow and plus/minus buttons to adjust the display.

6. Click the **Scene Options** button on the ribbon. Change the name of the scene to *Population*. The defaults for the other options are appropriate for this tour but could be adjusted for other tours.

7. Close the *Scene Options* dialog box.

8. Click **Themes** to explore the themes available for tours. The first theme, which is default, is appropriate for this tour, but it is easy to apply other themes.

9. Click **Map Labels** to turn on the labels. While only the largest cities are named, the labels help to identify Phoenix and Tucson.

10. Click **Tour Editor**, **Layer Pane**, and **Field List** to turn off those dialog boxes. These can always be turned back on if desired.

11. Figure 321 illustrates the final Population Map.
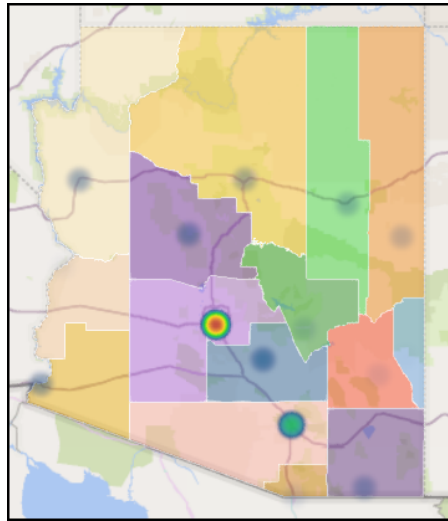
Figure 321: Final Population Map

There are only two other buttons on the ribbon that have not been described.

1. **Create Video**. This will create a video of the tour that would be suitable to play online (YouTube) or on a desktop.

2. **Capture Screen**. This button copies the screen to the clipboard so it can later be pasted in a PowerPoint slide or other report.

3. To save the map, click **File** ⇒ **Close**. The map is saved as part of the workbook and will be available the next time the workbook is opened.

Excel also adds a text box to the active worksheet to let users know that there are *3D Map* tours available in the workbook (see Figure 322).

3D Maps Tours
This workbook has 3D Maps tours available.
Open 3D Maps to edit or play the tours.
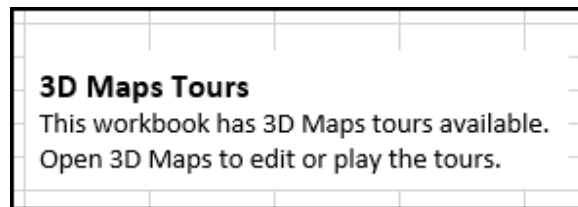
Figure 322: 3D Maps Are Available

8.1.4.2   *Gross Domestic Product*

As a second example of a *3D Map*, the states' *Gross Domestic Product* (GDP) for several different sectors will be mapped.

1. Open the **GDP** worksheet in **CH8-Maps**.

2. Click in **A1** to activate that cell.

3. Click **Insert** ⇒ **Tours** ⇒ 3**D Map**.

4. The *Population* tour is listed and could be edited but click **New Tour** to map the GDP data.

5. If necessary, activate the *Tour Editor*, *Layer Pane*, and *Field List* by clicking those buttons in the ribbon.

6. If Excel did not automatically place the *State* data field in the **Location** setting, then click and drag *State* in the *GDP Field List* to the **Location** setting.

7. Click the down arrow to the right of *State* in the **Location** setting and select **State/Province** in the drop-down list.

8. Click and drag *GDP2015* in the *GDP Field List* to the **Height** setting.

9. Click the down-arrow to the right of *GDP2015 (Sum)* and select **Maximum**.

10. Click and drag *Sector* in the *GDP Field List* to the **Category** setting.

11. Click the pencil icon beside *Layer 1* and change the name of this layer to *GDP 2015*.

12. Change the visualization type to **Clustered Column** (the second selection).

13. Excel displays all 15 sectors for each state, but that is too many to be useful. Click the triangle arrow beside **Filters** to open that setting then click **Add Filter**.

14. Select **Sector** from the filters list.

15. In the *Sector* filter, check **Agriculture, forestry, fishing, and hunting**; **Construction**; **Manufacturing**; and **Mining**.

16. Click **Flat Map** and then adjust the map to fit on the screen. Remember that Alaska and Hawaii need to be visible on the map. Also, experiment with the four arrow and plus/minus buttons to adjust the display to get the best view of the columns.

17. Move and resize the legend so it displays all four sectors without a lot of wasted space and it does not cover Hawaii.

18. The colors used for the four sectors are difficult to differentiate. Click the triangle arrow beside **Layer Options** to open that setting. In the *Color* section, select each of the sectors and choose a color that makes it easy to differentiate from other sectors.

19. Also, in the *Layer Options*, adjust the thickness of the columns to about 200%.

20. Click *Tour 1* at the top of the *Tour Editor*. Enter *GDP* as the name of the tour.

21. Click the **Scene Options** button on the ribbon. Change the name of the scene to *Industry*. In the Effects section, select a transition of 3 seconds, *Fly Over* as the effect, and adjust the *Effect Distance* slider to about 75% to the right.

22. Close the *Scene Options* dialog box.

23. Click **Text Box** to add a text box to the tour. For *Title*, enter *Industry*. For Description, enter *GDP for four industrial sectors: Agriculture, Construction, Manufacturing, and Mining.* Select white as the background color for the text box.

24. Click **Create** to create the text box and close the dialog.

25. Position and resize the text box over Canada so it does not cover data displayed for the United States.

26. Click **Map Labels** to turn on the labels.

27. Figure 323 illustrates the final Industry Map.
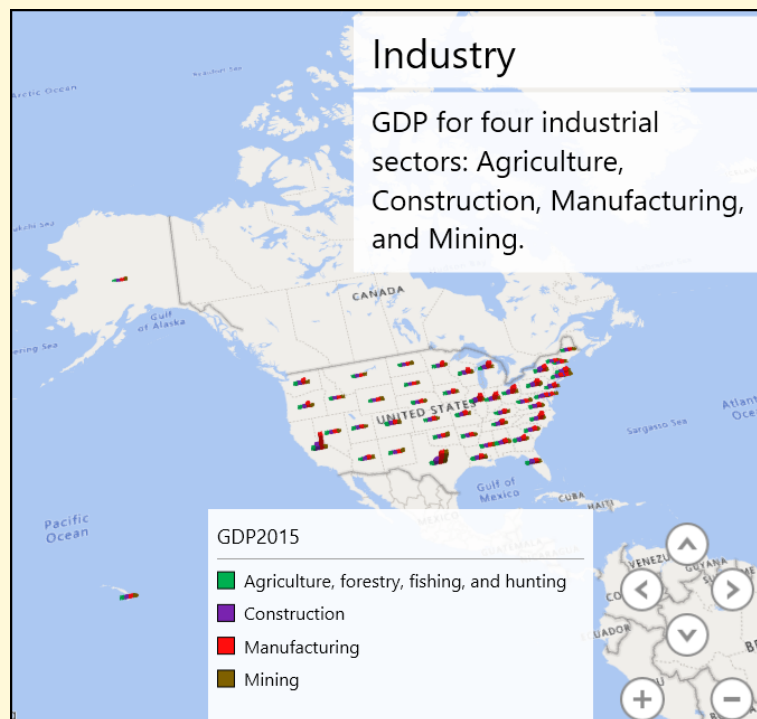
Figure 323: Industry 3D Map

28. Play the tour to see what it looks like. The map size and orientation (using the arrow buttons on the map), along with the locations for the legend and text box can be adjusted for the best possible display.

29. Add a second scene for this tour. Click the **New Scene** drop-down arrow and select **Copy Industry**. Excel will create a copy of the *Industry* scene so only a few changes need to be made to continue the tour.

30. Click the **Scene Options** button on the ribbon. Change the name of the scene to *Service* and the *Effect* to **Circle**. Close the *Scene Options* dialog.

31. While the *Service* scene is active, open the **Filters** setting and uncheck everything, then check **Education services, health care, and social assistance**; **Finance, insurance, real estate, rental, and leasing**; **Information**; and **Other services, except government**.

32. Click the triangle arrow beside **Layer Options** to open that setting. In the *Color* section, select each of the sectors and choose a color that makes it easy to differentiate from other sectors.

33. Double-click the text box and change the title to *Service* and the description to *GDP for four service sectors: Education, Finance, Information, and Other*.

34. Click **OK**.

35. Add a final scene for this tour. Click the **New Scene** drop-down arrow and select **Copy Service**. Excel will create a copy of the *Service* scene so only a few changes need to be made to continue the tour.

36. Click the **Scene Options** button on the ribbon. Change the name of the scene to *Retail* and the *Effect* to **Push In**. Close the *Scene Options* dialog box.

37. While the *Retail* scene is active, open the **Filters** setting and uncheck everything, then check **Professional and business services**; **Retail trade**; and **Transportation and warehousing**.

38. Click the triangle arrow beside **Layer Options** to open that setting. In the *Color* section, select each of the sectors and choose a color that makes it easy to differentiate from other sectors.

39. Double-click the text box and change the title to *Retail* and the description to *GDP for three retail sectors: Professional Services, Retail Trade, and Transportation and Warehousing.*

40. Click **OK**.

41. Click **Tour Editor**, **Layer Pane**, and **Field List** to turn off those dialog boxes. These can always be turned back on if desired.

42. Play the tour to see the completed *3D Maps Tour*.

43. To save the map, click **File ⇒ Close**. The map is saved as part of the workbook and will be available the next time the workbook is opened.

44. Save the **CH8-Maps** workbook.

45. Compare the workbook with the self-check answer key (**CH8-Maps Solution**) and then close and submit the **CH8-Maps** workbook as directed by the instructor.

The two maps created in this lesson are simple but demonstrate the two most powerful *3D Maps* concepts: 1) Using a timeline to focus on a change in data over a defined term, and 2) building a tour by combining two or more scenes. Excel's *3D Map* is a powerful decision-support tool and any time spent mastering it is worthwhile.

Key Take-Aways

Advanced Charts

- Sparklines graphically represent data trends in a single cell. These are quick and easy to add to a worksheet and provide managers readily available important information.
- Trend lines simplify graphs by displaying a single trend line to summarize the general direction of the data. There are several different trend lines available in Excel and those lines can be modified to enhance their appearance.
- Forecast Worksheets create a trend line that includes confidence levels. These worksheets are also more robust than simple trend lines and can analyze cyclic or seasonal data.
- 3D Maps are powerful visual representations of both geographic and time dimensions to enhance decision-making.

8.2 WHAT-IF ANALYSIS

> ### Learning Objectives
>
> - Data tables permit numeric analysis of the result of changing inputs.
> - Scenarios create various sets of inputs to compare the resulting output.
> - Goal seeking finds an optimum input to achieve a specific goal.
> - The Solver performs complex analysis of a scenario and adjusts various parameters for an optimum outcome.

8.2.1 *Data Tables*

Data tables display a range of results for a formula or function as one or two input variables are automatically cycled through a list. Managers can quickly compare potential options to determine a course of action.

8.2.1.1 *One-Variable Data Table*

As an example of a one-variable data table, imagine that the owner of a small theater wants to predict revenue for the upcoming season. If the revenue from a single ticket sale can be calculated, then that can be put into a formula so revenue projections can be derived.

1. Open a new blank workbook.

2. Save the workbook as **CH8-Data Table**.

3. Rename **Sheet1** to *Revenue*.

4. Enter the following labels (see Figure 324).

   - In cell **A1** enter *Ticket Sales Last Season*.

   - In cell **A2** enter *Revenue Per Ticket*.

   - In cell **A3** enter *Revenue Last Season*.

   - In cell **A4** enter *Projected Growth*.

   - In cell **A5** enter *Revenue This Season*.

5. Adjust the width of **Column A** so the labels fit in the column.

6. Name cells **B1:B5**. Do this by clicking each cell then click **Formulas** ⇒ **Defined Names** ⇒ **Define Name**. Use the default names Excel suggests.

- Cell **B1**: *Ticket_Sales_Last_Season*
- Cell **B2**: *Revenue_Per_Ticket*
- Cell **B3**: *Revenue_Last_Season*
- Cell **B4**: *Growth*
- Cell **B5**: *Revenue_This_Season*

7. Enter the following values in **Column B**.

- In cell **B1** enter *20000*. This is the number of tickets sold last season and will serve as a start point for this season's projection.
- In cell **B2** enter *8*. This is the average revenue, $8.00, that a single ticket generates.
- In cell **B3** enter *=Ticket_Sales_Last_Season * Revenue_Per_Ticket* . This is the total revenue from last season.
- In cell **B4**, enter *0*. For this analysis, the first assumption is that there is zero growth in ticket sales over last season. This provides a baseline for the other analysis.
- In cell **B5**, enter *=Ticket_Sales_Last_Season * Revenue_Per_Ticket + (Projected_Growth * Ticket_Sales_Last_Season)*

8. Format the following cells.

- Cell **B1**: Comma
- Cell **B2**: Accounting
- Cell **B3**: Comma
- Cell **B4**: Percent
- Cell **B5**: Comma

	A	B
1	Ticket Sales Last Season	20,000.00
2	Revenue Per Ticket	$ 8.00
3	Revenue Last Season	$160,000.00
4	Projected Growth	0%
5	Revenue This Season	$160,000.00

Figure 324: The Data Table Parameters

9. Next, set up the data table area.

- In cell **D2**, enter *Projection*. Bold that cell.

- In cell **D3**, enter *Growth*.

- In cell **E3**, enter *Revenue*.

- Leave cell **D4** blank.

- In cells **D5:D14**, enter 0.005, 0.01, 0.015, 0.02, 0.025, 0.03, 0.035, 0.04, 0.045 and 0.05. *Note*: autofill will help with this task.

- Format **Column D** as percent's and increase the decimal places to two. When done, cell **D5** should read 0.50%.

- In cell **E4**, enter *=Revenue_This_Season*. This will "seed" the revenue formula used in cell *B5* into the data table.

10. Select **D4:E14** to contain the data table.

11. Click **Data** ⇒ **Forecast** ⇒ **What-If Analysis** ⇒ **Data Table**.

12. Leave the *Row input cell* box empty since this data table only calculates data in a column. In the *Column input cell* box, enter *Projected_Growth*, which is the name for cell *B4*, the projected growth rate. Figure 325 illustrates the completed Data Table dialog box.

	A	B	C	D	E
1	Ticket Sales Last Season	20,000.00			
2	Revenue Per Ticket	$ 8.00		**Projection**	
3	Revenue Last Season	160,000.00		Growth	Revenue
4	Projected Growth	0%			
5	Revenue This Season	160,000.00		0.50%	
6				1.00%	
7		Data Table ? ✕		1.50%	
8				2.00%	
9		Row input cell: :d_Growth ⬆		2.50%	
10		Column input cell: ⬆		3.00%	
11				-0.50%	
12		OK Cancel		-0.10%	
13				-0.15%	
14				-0.20%	
15					

Figure 325: Setting Up the Data Table

13. Click **OK**.

14. Format **Column E** as *Comma* format.

15. Save the **CH8-Data Table** workbook.

	A	B	C	D	E
1	Ticket Sales Last Season	20000			
2	Revenue Per Ticket	8		**Projection**	
3	Revenue Last Season	160000		Growth	Revenue
4	Projected Growth	0			160,000.00
5	Revenue This Season	160000		0.50%	160,100.00
6				1.00%	160,200.00
7				1.50%	160,300.00
8				2.00%	160,400.00
9				2.50%	160,500.00
10				3.00%	160,600.00
11				3.50%	160,700.00
12				4.00%	160,800.00
13				4.50%	160,900.00
14				5.00%	161,000.00
15					

Figure 326: One-Variable Data Table

The data table displays the projected revenue for each of the growth rates in **Column D**. This analysis assumes that the number of tickets sold will increase. However, it is possible that ticket sales will decrease. Change the values in cells $D5:D14$ so some are negative and notice that the projected revenue automatically updates to display losses.

	A	B	C	D	E
1	Ticket Sales Last Season	20,000.00			
2	Revenue Per Ticket	$ 8.00		**Projection**	
3	Revenue Last Season	160,000.00		Growth	Revenue
4	Projected Growth	0%			160,000.00
5	Revenue This Season	160,000.00		0.50%	160,100.00
6				1.00%	160,200.00
7				1.50%	160,300.00
8				2.00%	160,400.00
9				2.50%	160,500.00
10				3.00%	160,600.00
11				-0.50%	159,900.00
12				-0.10%	159,980.00
13				-0.15%	159,970.00
14				-0.20%	159,960.00
15					

Figure 327: One-Variable Data Table With Negative Values

8.2.1.2   *Two-Variable Data Table*

A mortgage is one of the most common loans. A mortgage for a home is a huge investment and borrowers must think carefully about the size of the monthly payment compared to their disposable income. A two-variable data table is helpful in this type of decision.[1]

Mortgages are commonly written for 10- to 30-year terms and the interest rate can vary widely, depending on many factors. For this example, assume the interest rate is between 5% and 8.5%.

1. Open a new worksheet in the **CH8-Data Table** workbook.

2. Name the worksheet **Mortgage**.

3. Enter the following labels.

   - In cell **A1** enter *Loan Amount*.

   - In cell **A2** enter *Term in Years*.

   - In cell **A3** enter *Interest Rate*.

   - In cell **A4** enter *Payment*.

4. Adjust the width of **Column A** so the labels fit in the column.

5. Name cells **B1:B4**. Do this by clicking each cell then click **Formulas ⇒ Defined Names ⇒ Define Name**. Use the default names Excel suggests.

   - Cell **B1**: *Loan_Amount*

   - Cell **B2**: *Term_In_Years*

   - Cell **B3**: *Interest_Rate*

   - Cell **B4**: *Payment*

6. To start the data table, enter these values in **Column B**.

   - In cell **B1** enter *100000*. This is the amount being borrowed.

   - In cell **B2** enter *10*. This is the number of years to pay off the loan.

   - In cell **B3** enter *0.05*. This is the interest rate being charged for the loan. *Note*: the data table may be easier to read if cell **B3** is formatted as *percent* rather than *general*. If the format is changed, be certain that it reads 5%.

---

[1] See Chapter 2, MATHEMATICAL COMPUTATIONS, page 75 for more information about computing loans like mortgages.

- In cell **B4**, enter *=PMT(Interest_Rate/12,Term_in_Years*12,Loan_Amount)*. Given the information in **B1:B3**, Excel calculates a payment of $1,060.66 per month. This is a negative amount since the payment is going out of the borrower's savings.

7. Next, set up the data table area.

8. In cell **D4**, enter *=Payment*. This will "seed" the **PMT** formula into the data table.

9. In cells **D5:D12**, enter *0.05*, *0.055*, *0.06*, *0.065*, *0.07*, *0.075*, *0.08*, and *0.085*.

10. Format **D5:D12** as percent with two decimal places.

11. In cells **E4:I4**, enter *10*, *15*, *20*, *25*, and *30*.

12. Select **D4:I12** to contain the data table.

13. Click **Data** ⇒ **Forecast** ⇒ **What-If Analysis** ⇒ **Data Table**.

14. In the *Row input cell* box, enter the reference for the data found in *Row 4*. In the example, *Row 4* contains the loan term, and that is found in cell **$B$2**. Note: this must be an absolute reference (with the dollar signs) or the data table function will fail.

15. In the *Column input cell* box, enter the reference for the data found in *Column D*. In the example, *Column D* contains the interest rate, and that is found in cell **$B$3**. Note: this must be an absolute reference (with the dollar signs) or the data table function will fail.

	A	B	C	D	E	F	G	H	I
1	Loan Amount	100000							
2	Term in Years	10							
3	Interest Rate	5%							
4	Payment	($1,060.66)		($1,060.66)	10	15	20	25	30
5				5.00%					
6				5.50%					
7		Row input cell: $B$2		6.00%					
8		Column input cell: $B$3		6.50%					
9				7.00%					
10		OK Cancel		7.50%					
11				8.00%					
12				8.50%					

Figure 328: Setting Up The Two-Variable Data Table

16. Click **OK**.

The data table displays the payment due for each combination of interest rate and loan term. Borrowers could then use this information to negotiate a rate and term that fits their budget. *Note*: the payments are negative since they represent money leaving the borrower's bank account.

	A	B	C	D	E	F	G	H	I	J
				=PMT(B3/12,B2*12,B1)						
1	Loan Amount	100000								
2	Term in Years	10								
3	Interest Rate	5%								
4	Payment	($1,060.66)		($1,060.66)	10	15	20	25	30	
5				5.00%	-1060.66	-790.794	-659.956	-584.59	-536.822	
6				5.50%	-1085.26	-817.083	-687.887	-614.087	-567.789	
7				6.00%	-1110.21	-843.857	-716.431	-644.301	-599.551	
8				6.50%	-1135.48	-871.107	-745.573	-675.207	-632.068	
9				7.00%	-1161.08	-898.828	-775.299	-706.779	-665.302	
10				7.50%	-1187.02	-927.012	-805.593	-738.991	-699.215	
11				8.00%	-1213.28	-955.652	-836.44	-771.816	-733.765	
12				8.50%	-1239.86	-984.74	-867.823	-805.227	-768.913	
13										

Figure 329: Completed Two-Variable Data Table

1. Save the **CH8-Data Table** workbook.

2. Compare the workbook with the self-check answer key (**CH8-Data Table Solution**) and then close and submit the **CH8-Data Table** workbook as directed by the instructor.

8.2.2 *Scenarios*

Users may have data in a worksheet and want to change some of the variables to see the effect. For example, a business owner may want to consider "best case" and "worst case" values and then compare the results. This type of analysis is called a scenario in Excel.

1. Open workbook **CH8-Scenario**.

2. Save the workbook as **CH8-Williams Budget**.

This workbook is a simple household budget for the Williams family. There are two working adults, Morgan and Phoenix. They are planning for several potential changes in their budget, including taking a "once-in-a-lifetime" vacation, starting college classes, and purchasing a new home. To help them decide on their best course of action, they are going to develop scenarios.

1. Click **Data** ⇒ **Forecast** ⇒ **What-If Analysis** ⇒ **Scenario Manager**.

2. Click **Add** in the *Scenario Manager* box.
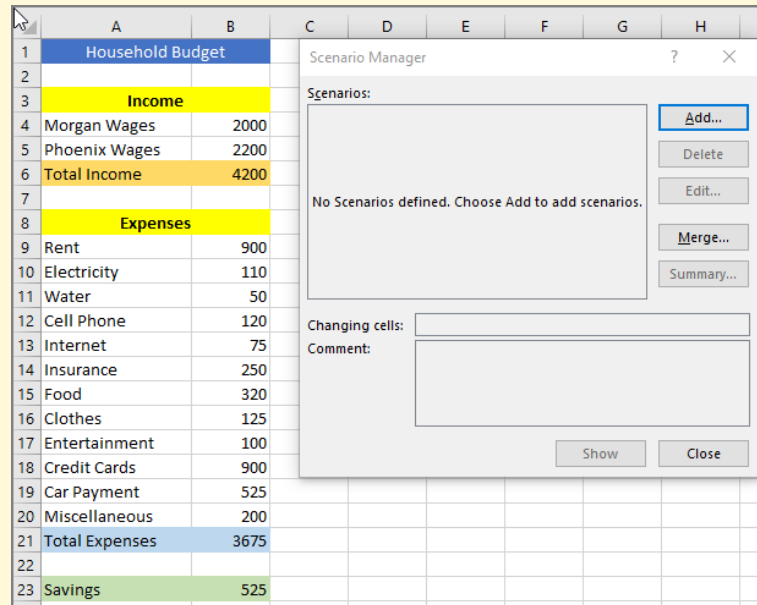
Figure 330: The Scenario Manager Dialog

3. Enter these values in the *Add Scenario* box.

   - **Scenario name**: *Current*. The first scenario will be the current budget and will work as a baseline for the other scenarios.

   - **Changing Cells**: *$B$4,$B$5,$B$9:$B$20*. These are the cells that the user can change for each scenario.

   - **Comment**: *Baseline Budget*. This is a brief description of the purpose for this scenario.

   - **Prevent Changes**: Checked. This prevents the user from making changes to the Changing Cells other than with the scenario manager.

   - **Hide**: Unchecked. This hides all the changing cells.

Figure 331: Adding A New Scenario

4. Click **OK**.

5. The *Scenario Values* box will pop up. This is where the user can insert various values for the changeable cells. For this first scenario, none of the values will be changed, so click **OK**.

Figure 332: Changing Scenario Values

6. The *Scenario Manager* will pop up. It now indicates that there is one scenario named *Current*. This scenario can be deleted or edited if desired but click **Add** to create a new scenario.
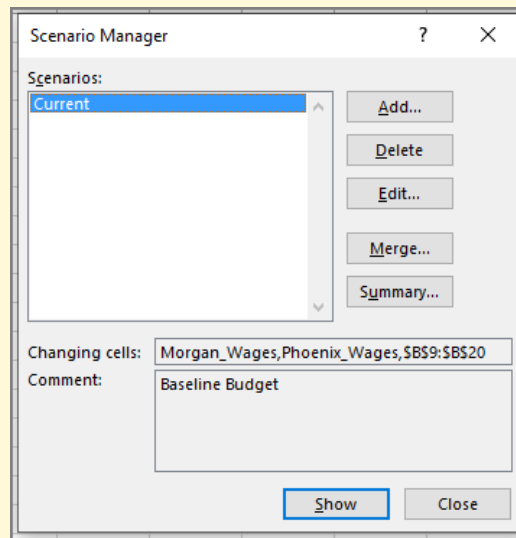
Figure 333: Scenario Manager With One Scenario

7. Enter *Vacation* for the scenario name, accept the default changing cells, and enter ***Budget for our vacation*** as a comment. Leave *Prevent Changes* checked and *Hide* unchecked.

8. Click **OK**.
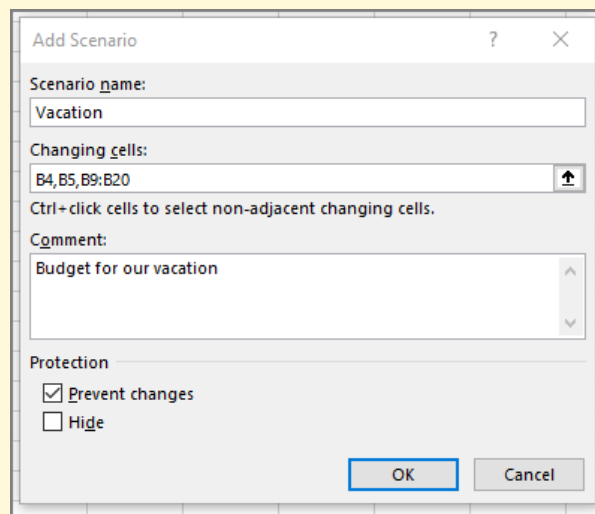
Figure 334: The Vacation Scenario

9. Morgan and Phoenix believe that they need to increase their monthly savings significantly for their vacation. They decide to cut their food budget to 250, clothes to 50, entertainment to 50, and miscellaneous to 50. Enter those amounts in the *Scenario Values* box.
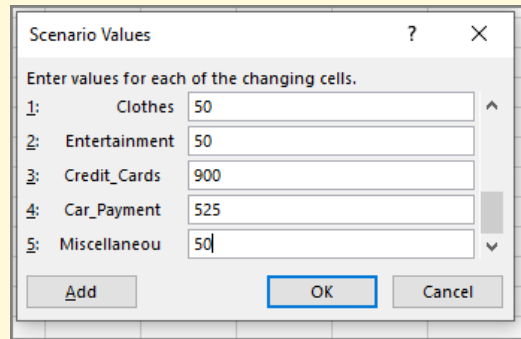
Figure 335: Vacation Scenario Values

10. Click **OK**.

11. To see the result of the Vacation budget, select *Vacation* and click **Show** on the *Scenario Manager* box.

Figure 336: Vacation Scenario Results

12. Morgan and Phoenix can now jump between the *Current* and *Vacation* budgets by selecting them in the *Scenario Manager* box and clicking the **Show** button.

13. To reset the budget back to its baseline, select *Current* and click **Show** in the *Scenario Manager* box.

14. Next, they want to consider a budget for if one of them starts college. For that, they believe that they will have to find a smaller apartment near the campus and cut their other expenses significantly.

15. Click **Add** in the *Scenario Manager*.

16. Name the new scenario *College* and enter *Starting college classes* as a comment. Accept all other default values for this scenario and click **OK**.

17. In the *Scenario Values* box, enter 700 for rent, 100 for electricity, 200 for insurance, 175 for food, 50 for clothes, 50 for entertainment, and 50 for miscellaneous, then click **OK**.

18. To reset the budget back to its baseline, select *Current* and click **Show** in the *Scenario Manager* box.

19. Finally, Morgan and Phoenix want to consider purchasing a new house. Click **Add** in the *Scenario Manager* box to create a new scenario.

20. Name the new scenario *House* and enter *Possible new house* as a comment. Accept all other default values for this scenario.

21. Even though they will not have rent, they will have a mortgage payment. For this worksheet, enter 1250 as rent to cover the cost of a mortgage payment. Enter 150 for electricity, 75 for water, 350 for insurance, 250 for food, 75 for clothes, 50 for entertainment, and 100 for miscellaneous.

22. At this point, there are four scenarios, and each can be viewed by clicking its name and **Show** in the *Scenario Manager* box.
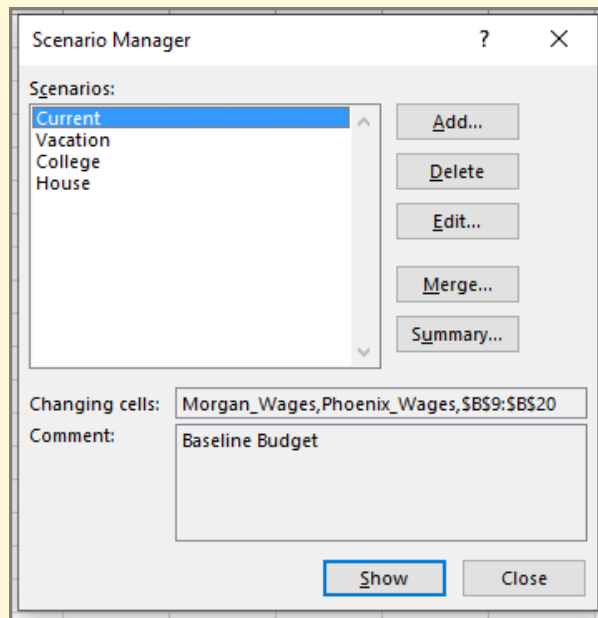
Figure 337: The Completed Scenario Manager

23. It is possible to see a summary of all four scenarios in a single report. Click **Summary** in the *Scenario Manager* box.

24. Excel offers to create a summary worksheet or a pivot table. For this exercise, select the **Scenario summary** radio button, which will create a report.
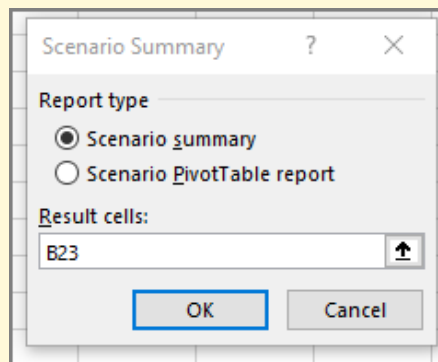
Figure 338: Scenario Summary Options

25. The result cell, **B23**, is the *Savings* cell and this is the best option for reporting the results of each scenario.

26. Click **OK**.

27. Excel produces a nice report that shows the values that were changed for each scenario and the result on their savings.

Scenario Summary					
	Current Values:	Current	Vacation	College	House
Changing Cells:					
Morgan_Wages	2000	2000	2000	2000	2000
Phoenix_Wages	2200	2200	2200	2200	2200
Rent	900	900	900	700	1250
Electricity	110	110	110	100	150
Water	50	50	50	50	75
Cell_Phone	120	120	120	120	120
Internet	75	75	75	75	75
Insurance	250	250	250	200	350
Food	320	320	250	175	250
Clothes	125	125	50	50	75
Entertainment	100	100	50	50	50
Credit_Cards	900	900	900	900	900
Car_Payment	525	525	525	525	525
Miscellaneous	200	200	50	50	100
Result Cells:					
Savings	525	525	870	1205	280

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 339: Scenario Summary Report

28. Save the **CH8-Williams Budget** workbook.

29. Compare the workbook with the self-check answer key (**CH8-Williams Budget Solution**) and then close and submit the **CH8-Williams Budget** workbook as directed by the instructor.

8.2.3 *Goal Seeking*

Sometimes it is desirable to calculate a specific output for a formula by changing one of the input variables and this process is called "Goal Seeking" in Excel. As a demonstration of Goal Seeking, imagine that a mortgage of $100000 is being negotiated and the buyer wants to keep payments under $900 per month. If the mortgage will run 180 months (15 years), what interest rate will lead to the maximum monthly payment possible under $900?

1. Open a new blank workbook.

2. Rename **Sheet1** to *Optimum Rate*.

3. Save the workbook as **CH8-Goal Seek**.

4. Enter these labels in the first column.

- In cell **A1** enter *Loan Amount*.
- In cell **A2** enter *Term in Months*.
- In cell **A3** enter *Interest Rate*.
- In cell **A4** enter *Payment*.

5. Adjust the width of **Column A** so the labels fit in the column.

6. Enter the following known values.

   - In cell **B1** enter 100000. This is the amount being borrowed.
   - In cell **B2** enter 180. This is the number of months to pay off the loan.
   - In cell **B4** enter *=PMT(B3/12,B2,B1)* to calculate the payment.

7. Because there is no value in cell *B3*, Excel assumes a 0% interest rate and returns a payment of $555.56. That value can be ignored for now.

Use *Goal Seek* to determine the optimum interest rate for the payment desired.

1. Click **Data** ⇒ **Forecast** ⇒ **What-If Analysis** ⇒ **Goal Seek**.

2. In the *Set cell* box, enter the reference for the cell that contains the formula to be resolved. In the example, this formula is in cell **B4**.

3. In the *To value* box, enter the desired result *-900*. *Note* this number is negative because it represents money being paid out of a checking account.

4. In the *By changing cell* box, enter the reference for the cell that contains the value to adjust, or **B3** in this example. *Note*: The cell that *Goal Seek* changes must be referenced by the formula in the cell specified in the *Set cell* box.
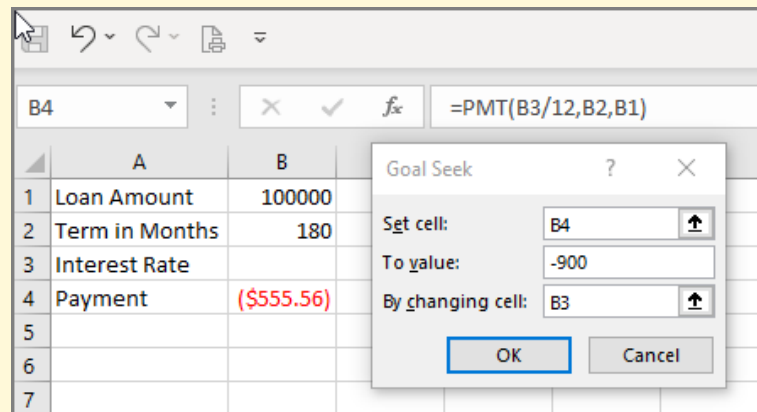
Figure 340: Setting Up Goal Seeking

5. Click **OK**.

Excel calculates an interest rate of 0.07021 (7%) to yield a monthly payment of $900.

1. To save the calculated amounts in the worksheet, click *OK* but to cancel this process and return to the original worksheet values, click *Cancel*. For this exercise, click **OK**.

2. Save the **CH8-Goal Seek** workbook.

3. Compare the workbook with the self-check answer key (**CH8-Goal Seek Solution**) and then close and submit the **CH8-Goal Seek** workbook as directed by the instructor.
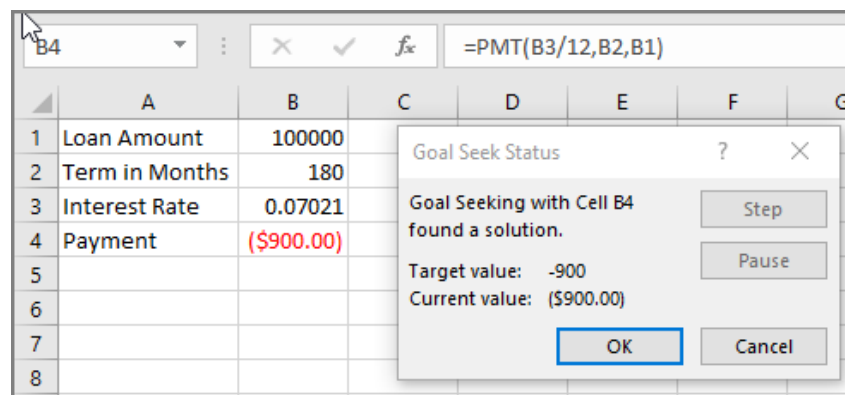
Figure 341: Results of Goal Seeking

8.2.4   *Solver*

The Excel Solver is used to find an optimum solution for complex business problems. As an example, Solver would evaluate multiple parameters to find the best mix of products for a company to manufacture. For this exercise, the *PeopleMover Transportation* company wants to create a spreadsheet that will help their planners determine the best mix of motor coaches for a contract.

1. Open workbook **CH8-Solver**.

2. Save the workbook as **CH8-PeopleMover**.

This workbook has only one worksheet, *Planner*. The worksheet has some information already filled in. The company has four different coaches: *Deluxe*, *Large*, *Mid-Size*, and *Mini*. For each type of coach, the passenger capacity is listed. Also, the cost of operating the coach per mile is specified. Finally, the number that the company has on hand is listed. For example, a *Deluxe* coach can carry 56 passengers at a cost of $2.80 per mile to operate. The company has two *Deluxe* coaches on hand.

Cells *A14:B15* on the worksheet is where information about a trip is entered. For example, the worksheet is set up for a trip of 300 miles that a group of 350 people want to take.

The goal is to have Excel calculate the optimum mix of coaches to get a total capacity (cell *B11*) greater than the number of riders (*B15*) at a minimum cost (cell *B12*). This is a perfect job for *Solver*.

Solver is part of Excel, but it is considered an Add-in and must be activated before it can be used. Note: this process only needs to be done one time, so if *Solver* is already activated, this part of the exercise can be skipped.

1. Click **File** to open the backstage view.

2. In the backstage view, click **Options** at the bottom of the left-hand menu.
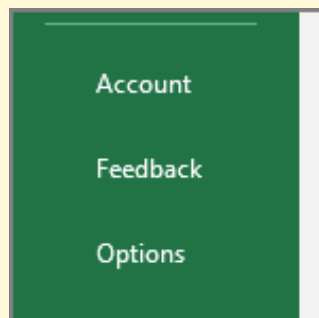
Figure 342: The Options Button in the Backstage View

3. Click **Add-ins** in the left-hand menu of the *Excel Options* pop-up box.

4. Select *Excel Add-ins* in the drop-down menu at the bottom of the *Add-ins* tab.

5. Click **Go**.
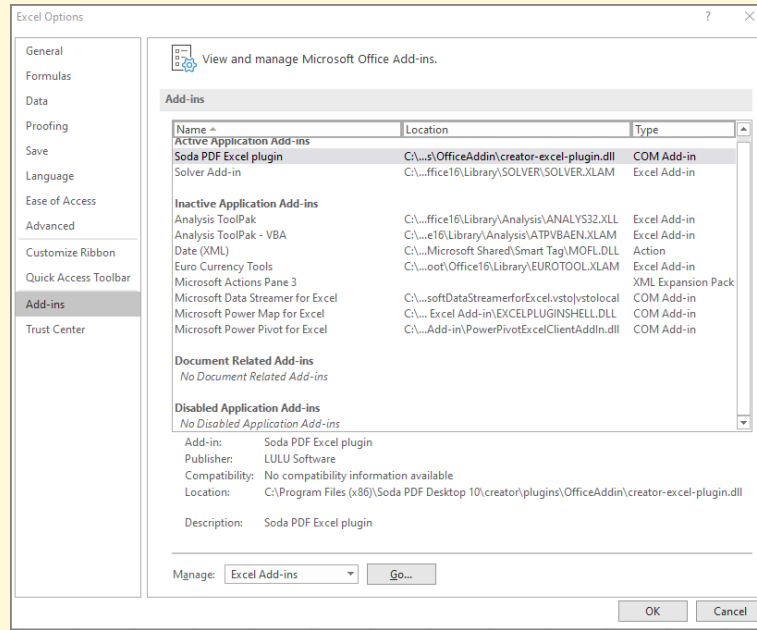
Figure 343: The Add-ins Manager

6. Click the checkbox beside *Solver Add-in* in the *Add-ins* pop-up box.
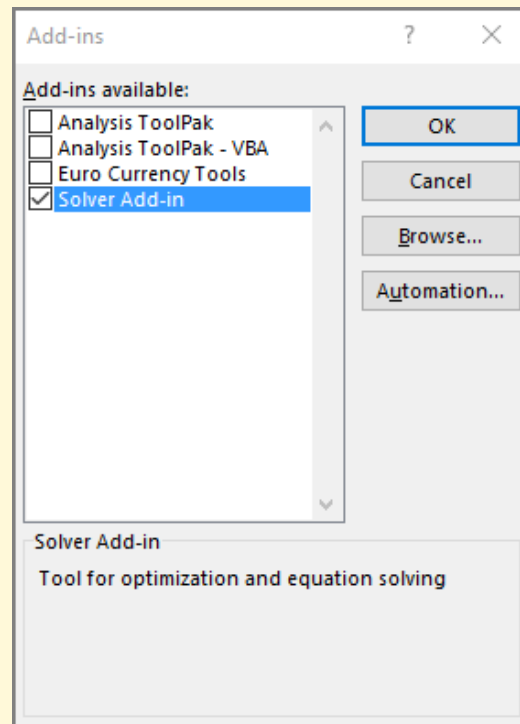
Figure 344: Activating The Solver Add-In

7. Click **OK**.

8. Notice that there is a new *Solver* button at *Data ⇒ Analyze*.

9. To set up the solver, click **Data ⇒ Analyze ⇒ Solver**.

10. In the *Set Objective* box, click the selector button and then click cell **B12** to select it. This sets the *Solver* to solve for the total cost of the coaches. (Note: since cell **B12** has a name, the *Solver* may display the name *Ttl_Cost* instead of **B12**.)

11. For *To*, Select the **Min** radio button. This sets the *Solver* to look for the minimum cost for the mix of coaches it recommends.

12. For *By Changing Variable Cells* enter *$E$6:$E$9*. This tells Excel to change the number of coaches allotted to minimize the cost for the number of passengers to carry.

13. Click **Add** beside the *Subject to the Constraints* box to add the constraints for the *Solver*.

14. Specify that cell **E6** must be $\leq$ cell **D6**. That means that the number of *Deluxe* coaches allotted for the trip must be less than or equal to the number on hand.

15. Click **Add** to add another constraint.

16. Specify that cell **E6** must be an **int** since it is not possible to allot a partial coach.

17. Click **OK** to return to the *Solver Parameters* dialog box.

18. There are now two constraints, but the cell names are used rather than the location identifiers. The first constraint requires the number of coaches allotted be less than the number on hand and the second requires only complete coaches be allotted.

19. Add constraints for Large, Mid-Size, and Mini coaches that are like those for the Deluxe coach.

20. Add a constraint that **B11** must be $\geq$ **B15** since all riders need to have a seat on a coach.

21. Check the box for "Make Unconstrained Variables Non-Negative" since it is not possible to have a negative number of coaches or riders.

22. For *Select a Solving Method*, the default is **GRG Nonlinear**. This is normally a good option to use.
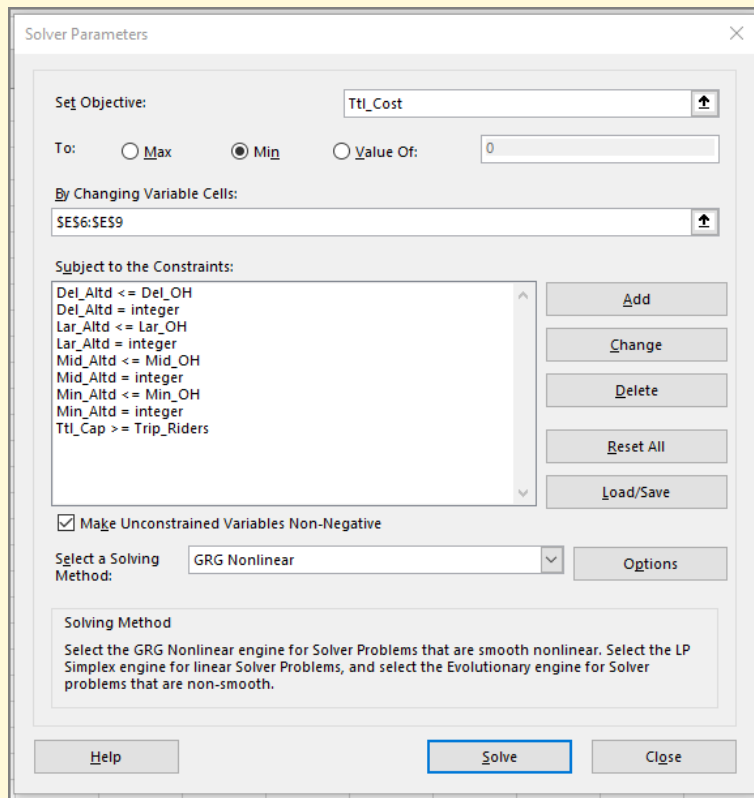
Figure 345: The Solver Parameters

23. Click **Solve**.

After a few seconds, the Solver will calculate the mix of coaches
that yields the least cost. Notice that the *Solver* changed the *Allotted*
values for each of the coaches along with the *Total Capacity* and *Total
Cost* to match the optimal solution. Also, notice that the total coach ca-
pacity is 354 for the solution while there are only 350 riders, so there
will be four empty seats on the coaches. This solution will cost *Peo-
pleMover Transportation* $4,575.00 so they would have to price tickets
appropriately.
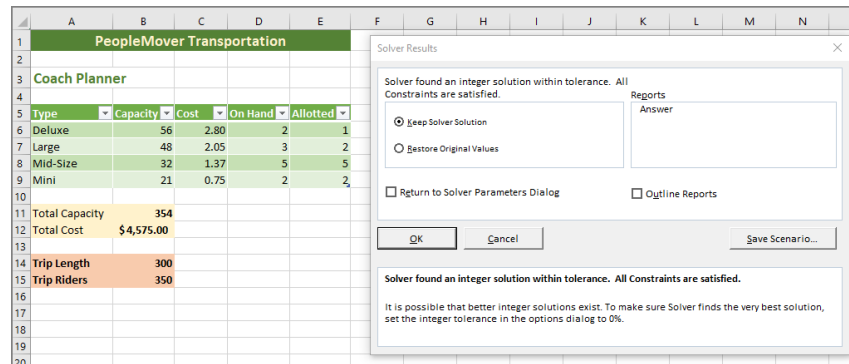
Figure 346: Solver Results

1. Click **Keep Solver Solution** and **OK** to save this solution. (To return to the original values without saving, click *Restore Original Values* and *OK*. Finally, this solution can be saved as a scenario so it can be compared with other solutions.)

2. Save **CH8-PeopleMover**.

3. Compare the workbook with the self-check answer key (**CH8-PeopleMover Solution**) and then close and submit the **CH8-PeopleMover** workbook as directed by the instructor.


Key Take-Aways

What-If Analysis

- Data tables are built by processing numeric inputs using Excel functions and formulas.
- Scenarios create various sets of inputs to compare the resulting output.
- Goal seeking finds an optimum input to achieve a specific goal.
- The Solver finds optimal solutions to complex business problems.

8.3   CHAPTER PRACTICE

8.3.1   *Electoral College Votes*

The United States Electoral College is a unique institution that is responsible for electing the President. In theory, people vote for electors

in November who then later meet to vote for the President. This exercise draws a *3D Map* of the Electoral College presidential votes since 1912.

1. Open **PR8-Data**. This workbook contains the results of the electoral college vote[a] for all US Presidential elections from 1912 until 2016. Notes: In the 1912 election, Theodore Roosevelt ran under the "Progressive" party, but his votes are listed as "Republican" in this document since there was no Republican candidate that year. Alaska and Hawaii first sent delegates to the electoral college in 1960 and Washington DC in 1964.

2. Save the workbook as **PR8-Elections**.

3. Click in **A1** to activate that cell.

4. Click **Insert** ⇒ **Tours** ⇒ **3D Map**.

5. If Excel did not automatically place the *State* data field in the **Location** setting, then click and drag *State* in the *Electoral_College Field List* to the **Location** setting.

6. Click the down arrow to the right of *State* in the *Location* setting and select **State/Province** in the drop-down list.

7. Click the pencil icon beside *Layer 1* and change the name of this layer to *Votes*.

8. Click and drag *Votes* in the *Electoral_College Field List* to the **Height** setting.

9. Click and drag *Year* in the *Electoral_College Field List* to the **Time** setting.

10. Click the down arrow to the right of *Year* in the *Time* setting and select **Year** in the drop-down list.

11. Click and drag *Party* in the *Electoral_College Field List* to the **Category** setting.

12. Change the visualization type to **Bubble**.

13. Click the down arrow to the right of *Votes* in the *Size* setting and select **No Aggregation** in the drop-down list.

14. Click **Flat Map** and then adjust the map to fit on the screen. Remember that Alaska and Hawaii need to be visible on the map. Also, experiment with the four arrow and plus/minus buttons to adjust the display.

15. Under Layer Options, change the color for *Republican* to red and *Other* to green.

16. Play the tour to see what it looks like.

17. Click *Tour 1* at the top of the *Tour Editor*. Enter *Election* as the name of the tour.

18. The displayed date shows the day, month, and year, but election results only change every four years. To make the date display more appropriate, right-click it and select **Edit**. In the edit box, choose the *Time Format* that only shows the year without the month and day. Change the background color of the date display to white. Click **Accept** to lock in these changes.

19. Once the date is adjusted, resize and position it so it does not cover any of the states.

20. Add a text box with the title of *Elections* and this description: *Results of the Electoral College votes for 1912-2016*. Set the background color of the text box to white. Once the box is created, resize and position it so it does not cover any of the states.

21. Resize and position the legend box so it does not cover any of the states.

22. Click the **Scene Options** button on the ribbon and change the name of the scene to *Elections*.

23. Click **Map Labels** to turn on the labels.

24. Click **Tour Editor**, **Layer Pane**, and **Field List** to turn off those dialog boxes. These can always be turned back on if desired.

25. Play the tour to view the final version.
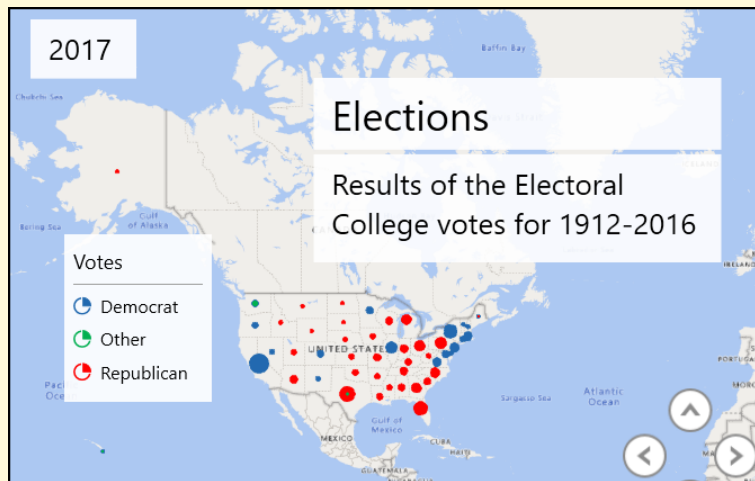
Figure 347: Electoral College Map

26. Click **Create Video** to create a video version of the tour.

27. In the *Create Video* dialog box, select **Quick Export & Mobile**, then click **Create**. Save the video in the same folder as **PR8-Elections**. Note: The video is being created at the lowest possible resolution so the file is small to make it easier to submit it to the instructor; to create a video designed to be presented to clients, it should be created at a higher resolution.

28. To save the map, click **File ⇒ Close**. The map is saved as part of the workbook and will be available the next time the workbook is opened.

29. Save the **PR8-Elections** workbook.

30. Compare the workbook with the self-check answer key (**PR8-Elections Solution**) and then close and submit the **PR8-Elections** workbook and **PR8-Election** video as directed by the instructor.

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a The electoral college data was found at the United States National Archives, https://www.archives.gov/electoral-college

8.4 SCORED ASSESSMENT

8.4.1 *Product Mix*

The *Giant Electronics* company is a local small business that sells discounted electronic devices, like televisions and computers. The own-

ers, Addison and Kelsey, are planning for their annual spring promotion and want to create a good mix of sale items.

1. Open workbook **SC8-Data**.

2. Save the workbook as **SC8-Product Mix**.

This workbook has only one worksheet, *Planner*. The worksheet already has some information filled in. Addison and Kelsey are planning to promote four items, a television, a computer, various game cartridges, and a camera. The worksheet shows the cost for each item; for example, each television set costs them $899. The price they intend to sell each item is also noted. For example, televisions will sell for $1049. The profit for each item is calculated by subtracting the cost from the price. Finally, the *To Order* column lists how many of each item they should order for their sale.

In cell *B11*, under the Planner table, Addison and Kelsey indicate how much they want to invest in the sale. The worksheet initially indicates a $50,000 investment.

Cell *B13* has a formula that calculates the total cost of whatever they decide to order and *B14* has a formula that calculates the total profit for those items.

1. Click **Data** ⇒ **Analyze** ⇒ **Solver**.

2. In the *Set Objective* box, click the selector button and then click cell **B14** to select it. This sets the Solver to solve for the total profit of the sale items. (Note: since cell **B14** has a name, the Solver may display the name *Total_Profit* instead of **$B$14**.)

3. For *To*, Select the **Max** radio button. This sets the Solver to look for the maximum profit for the mix of products it recommends.

4. The constraints are already defined. These will be changed later, but the initial configuration requires the total cost to be less than the investment. The configuration also requires all orders to be integers (it is not possible to order a fraction of a television) and there are some constraints on the number of items that can be ordered.

5. Make sure the *GRG Nonlinear* is the solving method.
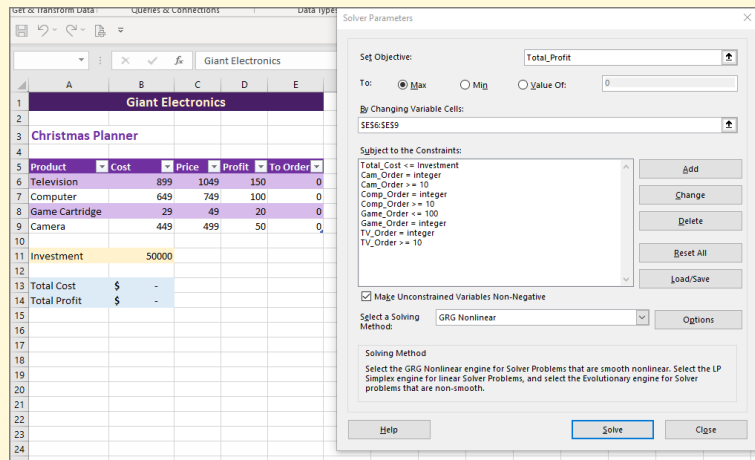
Figure 348: Solver Initial Setup

6. Click **Solve**.
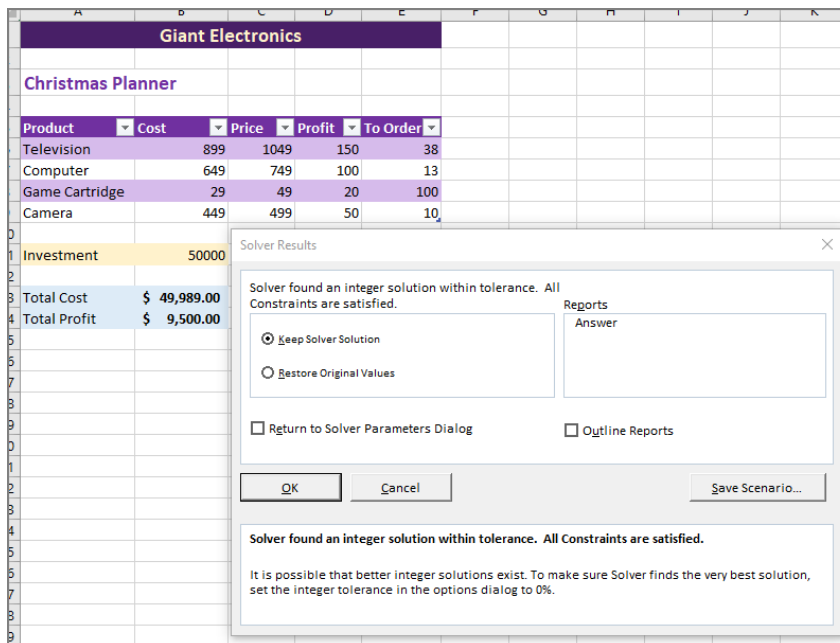
Figure 349: Solver Initial Solution

Solver determined that the optimum mix of products was 38 televisions, 13 computers, 100 Game cartridges, and 10 cameras. This will cost Addison and Kelsey $49,989, just under their $50,000 limit and will net them a profit of $9,500.

1. Click **Save Scenario**.

2. Name the scenario *Initial Attempt* and click **OK**.

3. Click *Restore Original Values* in the Results dialog box to return the Planner table to its original state.

4. Click *Answer* in the Reports dialog box. This makes Excel generate a report named *Answer Report 1*.

5. Click **OK**.

6. Excel creates a report on a new worksheet named **Answer Report 1**. This makes it easy to come back to this solution later.

7. Click **Data ⇒ Forecast ⇒ What-If ⇒ Scenario Manager**. Notice that Excel placed that first scenario, *Initial Attempt*, in the scenario manager for later reference.

8. Click **Close** to close the scenario manager.

Addison and Kelsey decide that they want to sell more than 10 cameras and they think that 100 game cartridges are too many.

1. Click **Data ⇒ Analyze ⇒ Solver**.

2. Click *Cam_Order >= 10* to select it and then click **Change**.

3. Change the constraint to 20 and click **OK**.

4. Click *Game_Order <= 100* to select it and then click **Change**.

5. Change the constraint to 50 and click **OK**.

6. Click **Solve**.

7. Notice that Excel has now adjusted the order column so only 50 game cartridges and 20 cameras will be ordered. Also notice that the profit has dropped to $8,500.

8. Click **Save Scenario**, name it *20 Cameras*, and click **OK**.

9. Click *Answer* in the Reports dialog box. This makes Excel generate a report named *Answer Report 2*.

10. Select *Restore Original Values* and click **OK**.

Addison and Kelsey would like to boost their profit a bit so they decide to adjust the selling price for two items. They think the television could sell for $1199 and the computer for $999.

1. Click **C6** to activate that cell and enter 1199 for the new television selling price.

2. Click **C7** to activate that cell and enter 999 for the new computer selling price.

3. Click **Data ⇒ Analyze ⇒ Solver**.

4. Click **Solve** on the *Solver Parameters* dialog box.

5. Click **Save Scenario**, name it *Expensive Televisions*, and click **OK**.

6. Click *Answer* in the Reports dialog box. This makes Excel generate a report named *Answer Report 3*.

7. Select *Restore Original Values* and click **OK**.

Addison and Kelsey could continue adjusting the sale prices and the maximum number of each item to order to come to what they believe is the optimum mix of products for their spring sale.

Take a look at *Answer Report 1*, *Answer Report 2*, and *Answer Report 3* to compare the results of each scenario. It would be easier to see all three scenarios in a single report.

1. Click **Data ⇒ Forecast ⇒ What-If Analysis ⇒ Scenario Manager**.

2. Notice that all three scenarios are listed. To create a single report containing all scenarios, click **Summary**.

3. In the Scenario Summary diaglog box, make sure *Scenario Summary* is selected and the result cells are **B13,B14**.

4. Click **OK**. The report illustrated in Figure 350 is created.

Scenario Summary					
		Current Values:	Initial Attempt	20 Cameras	Expensive Televisions
Changing Cells:					
TV_Order		0	38	36	10
Comp_Order		0	13	11	47
Game_Order		0	100	50	50
Cam_Order		0	10	20	20
Result Cells:					
Total_Cost	$ -	$	49,989.00	$ 49,933.00	$ 49,923.00
Total_Profit	$ -	$	18,450.00	$ 16,650.00	$ 21,450.00
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 350: Solver Scenario Summary

5. Save and close the **SC8-Product Mix** workbook.

6. Submit the **SC8-Product Mix** workbook to the instructor.

8.5 ADDENDUM: FILLED MAP

Information

Filled Maps

This section concerns creating a 2-D Filled Map in an Excel workbook. These maps are very useful and easy to create, but are only available for Excel 2016 installations that include a subscription to Excel 365.

After Excel 2016 was released, Microsoft added a new feature, *Filled Maps*. This feature was added to Excel installations that included an Office 365 subscription, but not to stand-alone installations. As a result, some Excel 2016 installations will have *Filled Maps* available but others will not. This addendum was included with this chapter for students who have access to *Filled Maps*, but it is not considered part of the formal Excel training course.

1. Open workbook **CH8-Cancer Rate**. This workbook contains the rate of cigarette smoking along with cancer rates for various types of cancer that seem to be related to smoking. The data was captured in a study completed in 1960.

2. Save the workbook as **CH8-Cancer Map**.

3. Click cell **A3:B43** to activate that range of cells.

4. Click **Insert ⇒ Charts ⇒ Maps ⇒ Filled Map**.
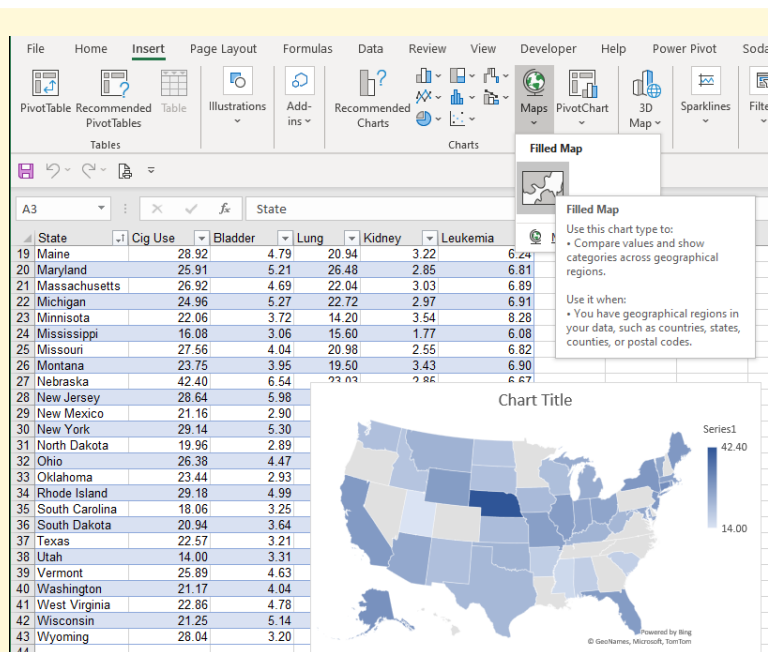
Figure 351: Creating a Filled Map

5. Excel creates a map of the United States with the cigarette use rate indicated by color. Nebraska has the highest rate of cigarette use and states that are gray, like Oregon, did not have data in the input table.

6. Click the chart title two times to enable editing. Change that title to *Cigarette Use*.

7. Click the paint brush tool at the top right corner of the map to change the style and colors for the map. Click **Color** in the popup menu.

8. Select **Monochromatic Palette 6**, a green palette.
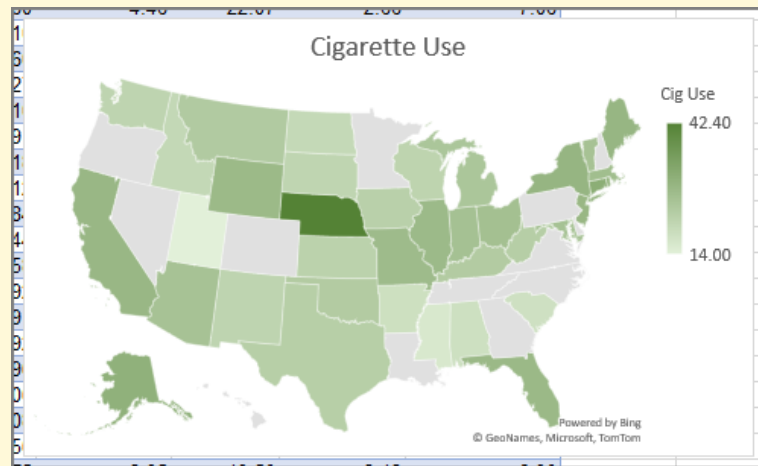
Figure 352: Completed Map

9. Save the **CH8-Cancer Map** workbook.

10. Compare the workbook with the self-check answer key (**CH8-Cancer Map Solution**) and then close the **CH8-Cancer Map** workbook. Note: this is an addendum to the chapter so the workbook is not submitted.

In the same way that the cigarette use rate was mapped, any of the types of cancer can be mapped. The limitation is that only one variable, plus the state names, can be mapped at one time. However, if managers had sales data available, this would be a great way to determine, for example, where their best customers live so they can plan some sort of promotion.

ADVANCED TOPICS

Excel includes many advanced features not covered elsewhere in this book and they were gathered in this final chapter. Most of these features are only occasionally used but when needed, they provide an essential resource.

9.1 DATABASE FUNCTIONS

Learning Objectives

- Learn to use Excel's functions that make a spreadsheet behave more like a database.

A database is a collection of data that is used by business leadership to support decisions. A database is commonly used to contain personnel, supply, manufacturing, sales, and many other types of information. A database is normally created with a program like Microsoft Access, but that program is complex with a steep learning curve. Simple data tables with a few database properties can be created and manipulated in Excel, as shown in this section.

9.1.1 *Create a Data Table*

1. Open workbook **CH9-Database**

2. Save the workbook as **CH9-Sales**.

3. This workbook has only one worksheet, **Sales**.

This worksheet contains the May 2020, sales report for *MongoSales Corp*. The report includes the sales representative name, the district, name, and Zip Code for the company that purchased items, the date of the purchase, the item purchased, the number of units purchased, price per unit, and total sale value. (*Note*: this is dummy data.) The worksheet needs to be converted to a table to use it as a database.

1. Click cell **A1** to activate that cell.

2. Click **Insert ⇒ Tables ⇒ Table**.

3. Excel automatically selects cells **$A$1:$I$69**, which is the entire dataset. Be certain **My table has headers** is checked (Figure 353).
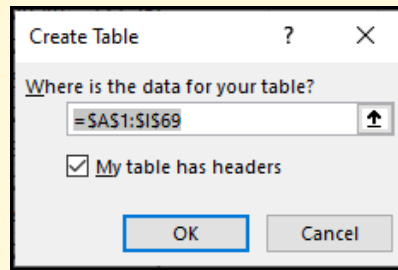
Figure 353: Creating a Data Table

4. Click **OK**.

Excel creates a data table (Figure 354), which has many of the properties expected of a database.

Figure 354: Top Of the Data Table

1. At **Table Tools** ⇒ **Properties** ⇒ **Table Name** enter *Sales* as the new table name in a text box near the left edge of the ribbon.

In a database, columns are referred to as "Fields" and rows as "Records." Notice that each of the fields in the data table includes a drop-down arrow. That opens a menu with filtering functions that can be applied to the database. Figure 355 illustrates the filter for the *Item* field.
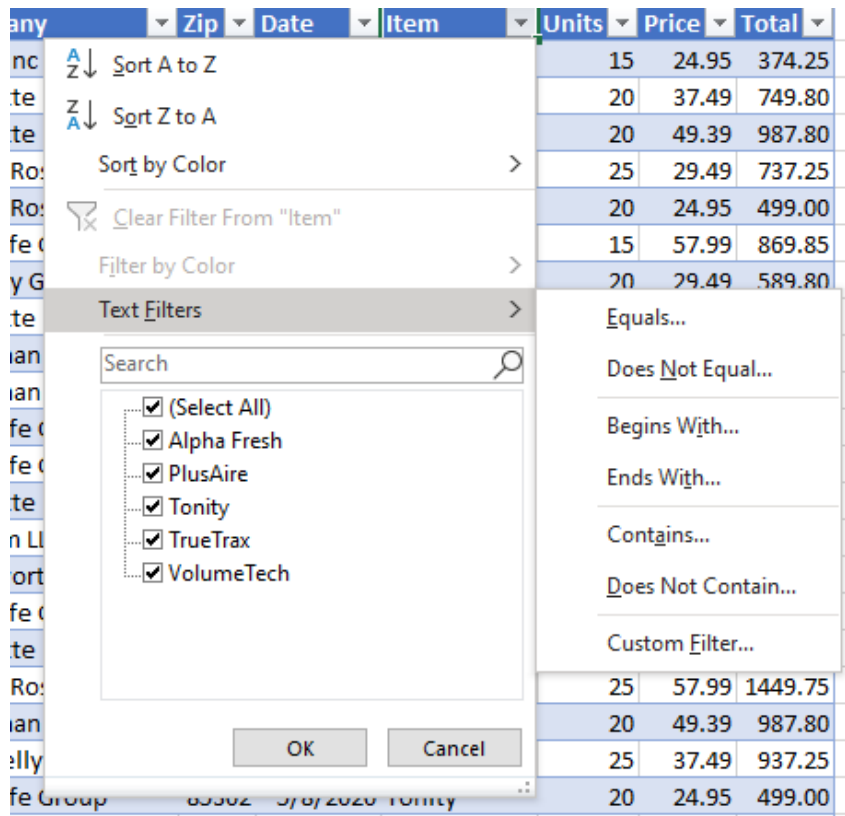
Figure 355: Item Filter

The database can be sorted on the item field by clicking either of the top two buttons in the filter drop-down (named "Sort A to Z" and "Sort Z to A"). Clicking the *Text Filters* button opens a submenu where powerful filters can be created. (Note, the *Filters* button for fields with other types of data, like numbers or dates, will match the data type.) Also, the checkboxes at the bottom of the popup can be used to hide or view records that match the selected item. Thus, to only see the "Alpha Fresh" records, uncheck all boxes except that one.

9.1.2 *The Database Functions*

Along with simple sorting and filtering, Excel provides the following functions that are designed to be used with a database.

- **DAVERAGE**. Calculates the average of values in a field that meet specified conditions.

- **DCOUNT**. Returns the number of cells containing numbers in a field that meet specified conditions.

- **DCOUNTA**. Returns the number of non-blank cells in a field that meet specified conditions.

- **DGET**. Returns a single value from a field that meet specified conditions.

- **DMAX**. Returns the maximum value from a field that meet specified conditions.

- **DMIN**. Returns the minimum value from a field that meet specified conditions.

- **DPRODUCT**. Calculates the product of values in a field that meet specified conditions.

- **DSTDEV**. Calculates the standard deviation (based on a sample of a population) of values in a field that meet specified conditions.

- **DSTDEVP**. Calculates the standard deviation (based on an entire population) of values in a field that meet specified conditions.

- **DSUM**. Calculates the sum of values in a field that meet specified conditions.

- **DVAR**. Calculates the variance (based on a sample of a population) of values in a field that meet specified conditions.

- **DVARP**. Calculates the variance (based on an entire population) of values in a field that meet specified conditions.

These functions all use similar syntax: =*FuncName(Database, Field, Criteria)*. In the function, the *FuncName* is the name of the function, like *DSUM*. The *Database* name will be *Sales* in this exercise since that is the name of the table. The *Field* is one of the field names, like *Rep* or *District*. Finally, the *Criteria* is a range that contains the factors that limit the output of the function. This is best explained with some examples.

1. Set up an area where the sum of all orders sent to Zip 85260 will be calculated (see Figure 356).

   - In cell **K2**, enter *Zip*

   - In cell **K3**, enter *85260*

   - In cell **L2**, enter *Sum* .

   - In cell **L3**, enter *=DSUM(Sales[#All], "Total", K2:K3)*.

2. Here is what the various parts of the formula in **L3** mean.

- **DSUM**. This is the *Data Sum* function that totals all the specified data.

- **Sales[#All]**. This instructs Excel to use the entire *Sales* data table. By using this nomenclature rather than specific cell locations (like **A1:I69**), the formula will continue to work even if records are later added to or removed from the table.

- **Total**. This is the field that contains the numbers to be summed. Notice that the field name is put in quote marks.

- **K2:K3**. This is the location of the criteria Excel will use to sum the sales amounts. In this case, the *Zip Code* must be equal to 85260.

J	K	L	M	N	
	Zip	Sum			
	85260	=DSUM(Sales[#All],"Total",K2:K3)			

Figure 356: Setting Up the Data File Calculation

3. Once the formula and criteria are entered, Excel calculates the total value of sales to that *Zip Code* and displays 14747.55.

4. Change the *Zip Code* in **K3** to *85251*. The value in cell **L3** will be automatically updated to 748.50, which is the total value in sales to that *Zip Code*.

5. Copy/paste cells **K2:L3** to **K5:L6**. When pasted, Excel will automatically update the criteria range in the formula to **K5:K6**.

6. Change the value of **K5** to *District* and **K6** to *east*. **L6** now displays 22546.95, which is the total value of sales to the *east* district.

7. Copy/paste **K5:L6** to **K8:L9**.

8. Change the formula in **L9** to calculate the average value of the total sales by changing *DSUM* to *DAVERAGE*. The formula in **L9** should now be: *=DAVERAGE(Sales[#All], "Total", K8:K9)*

9. Change **K8** to *Rep* and **K9** to *Pratton*. **L9** should now display 736.7236842, which is the average sale value for

> *Pratton*. The average sale for other sellers can be easily checked by entering their names in **K9**, one at a time.
>
> 10. Save the **CH9-Sales** workbook.

One important feature for any database lookup is the ability to specify "Boolean" matches; that is, a match that includes an AND term or an OR term. For example, that would answer a question like, "What is the total value of the sales of TrueTrax made by Findlay?" Follow these steps to create Boolean expressions.

> 1. Copy/paste **K8:K9** to **K11:K12** and paste **K8:K9** to **L11:L12**. Be sure **K11** is *Rep*, then change **K12** to *Findlay*, **L11** to *Item* and **L12** to *TrueTrax*.
>
> 2. Copy/paste **L8:L9** to **M11:M12**. Change the formula in **M12** to *=DSUM(Sales[#All], "Total", K11:L12)*.

K	L	M
Zip	Sum	
85251	=DSUM(Sales[#All],"Total",K2:K3)	
District	Sum	
east	=DSUM(Sales[#All],"Total",K5:K6)	
Rep	Avr	
Pratton	=DAVERAGE(Sales[#All],"Total",K8:K9)	
Rep	Item	Sum
Findlay	TrueTrax	=DSUM(Sales[#All],"Total",K11:L12)

Figure 357: Calculating an AND Expression

> 3. Cell **M12** is now 1739.7, which is the total value of Findlay's *TrueTrax* sales. Note, if the value in **M12** is not right, check for typos in the *Rep* and *Item* names.
>
> 4. Data criteria items that appear in the same row are combined with an AND, so the range **K11:L12** would be read "Calculate the sum of all lines that include a representative named Findlay AND an item named TrueTrax."
>
> 5. Note: The order of the ANDed terms is important. They must be in the same order in the criteria section as they are in the data table. Therefore, if *Item* were in **K11** and *Rep* in **L11** the formula would fail since these two variables are in the opposite order as the data fields in the table.

6. Other sales representative names can be entered in cell **K12** or other items in **L12** to check on those sales.

7. To combine two or more terms with an OR, place those terms on separate lines, as demonstrated next.

8. Copy/paste **K11:M12** to **K14:M15**.

9. Rather than calculate the total value of *Findlay's* sales, count the number of items sold. Change **M14** to *Units Sold*.

10. Change the formula in **M15** to: *=DSUM(Sales[#All], "Units", K14:L15)*. Notice that the only change to the formula is that it will sum the *Units* field instead of the *Total* field.

11. To include *PlusAir*, in cell **K16**, enter *Findlay* and in cell **L16**, enter *PlusAir*.

12. Change the formula in **M15** to *=DSUM(Sales[#All], "Units", K14:L16)*. Notice that the only change is to increase the criteria range to **K14:L16**. Now, Excel will count the total number of lines that include both *Findlay* and *TrueTrax* OR *Findley* and *PlusAir*. Excel reports that *Findlay* sold 50 *TrueTrax* OR *PlusAir* units.

J	K	L	M	N
	Zip	Sum		
	85251	748.5		
	District	Sum		
	east	22546.95		
	Rep	Avr		
	Pratton	736.7236842		
	Rep	Item	Sum	
	Findlay	TrueTrax	1739.7	
	Rep	Item	Units Sold	
	Findlay	TrueTrax	50	
	Findlay	PlusAir		

Figure 358: Calculating an OR Expression

Finally, it is often desirable to set up a range for a data calculation. For example, it is possible to count the total number of *Tonity* sales made between May 5 and May 20.

1. In both cells **K18** and **L18**, enter *Date* (the *Date* will be entered two times in the criteria); in cell **M18**, enter *Item*; and in cell **N18**, enter *Count*.

2. In cell **K19**, enter *>=5/10/2020*; in cell **L19**, enter *<=5/20/2020*; and in cell **M19**, enter *Tonity*.

3. In cell **N19**, enter *=DCOUNT(Sales[#All], "Total", K18:M19)*. Notice that this is a *DCOUNT* formula, so the number of lines that contain a *Tonity* item sold between 5/10/2020 and 5/20/2020 (inclusive) will be counted.

Date	Date	Item	Count	
>=5/10/2020	<=5/20/2020	Tonity		7

Figure 359: Specifying a Date Range

4. Excel reports seven *Tonity* sales were made between the two specified dates.

5. Save the **CH9-Sales** workbook.

6. Compare the workbook with the self-check answer key (**CH9-Sales Solution**) and then close and submit the **CH9-Sales** workbook as directed by the instructor.

Creating a data table is easy in Excel, then the *Data* formulas make it easy to create complex calculations by simply specifying the desired criteria in a range of cells.

Key Take-Aways

Database Functions

- Set up the database functions by creating a data table.
- Use any of the "D..." functions to easily count, sum, or statistically analyze a data table using complex Boolean operations.

9.2 USEFUL FUNCTIONS

> **Learning Objectives**
>
> - Practice with 8 of Excel's most useful text functions.
> - Practice with 12 of Excel's most useful numeric functions.

Excel includes more than 300 functions that are designed to process both text and numbers. Most of those functions are only useful in specific situations and most users will never know that they exist; however, many functions are so commonly used that they show up in many spreadsheet projects. This section provides information and practice with 20 of the most useful Excel functions.

A contact roster will be used for the exercises in this section. This file contains information that would be used by sales representatives as they work with a company's clients. The roster needs to be cleaned up a bit for more efficient use. (Note: this roster contains fake data.)

> 1. Open workbook **CH9-Contact Data**
>
> 2. Save the workbook as **CH9-Contact**.
>
> 3. This workbook has only one worksheet, **Contacts**.

9.2.1 *Text Functions*

Excel includes scores of functions designed to be used with cells that contain text rather than numbers and this section explores the most used text functions.

9.2.1.1 *To Columns*

Often, a field in a data file contains two or more separate pieces of information. This makes it impossible to complete tasks like sorting on the individual pieces of information. The *Name* data field (*Column B*) in the *Contacts* worksheet includes both first and last names, but those should be placed in different fields. This is such a common operation; Excel has a function that splits data separated by a comma into two different fields.

> 1. Insert a new column to the left of **Column C**. This column will eventually contain the first name and **Column B** will contain the last name.

2. Click **B2** and then shift-click **B101** to select all the data in **Column B**. (Note: a useful keyboard shortcut is to click **B2** then Ctrl + Shift + Down Arrow to select all data in the column.)

3. Click **Data** ⇒ **Data Tools** ⇒ **Text to Columns**.

4. Excel starts a data wizard to help split the data. The first screen is used to adjust from delimited to fixed width data type, but the default, delimited, is correct, so click **Next**.
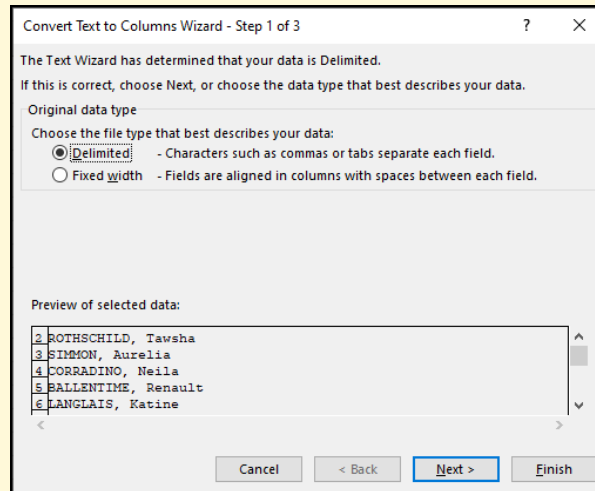
Figure 360: Convert Text to Columns Wizard Screen 1

5. The second wizard box determines what sort of delimiter is used with the data. For this field, the first and last names are separated by a comma, so check the **Comma** delimiter and uncheck the **Tab** delimiter. The sample data at the bottom of the Wizard screen should show the first and last names divided. Click **Next**.
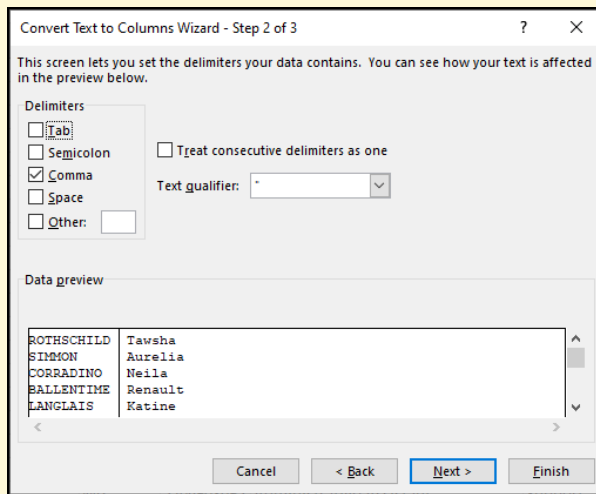
Figure 361: Convert Text to Columns Wizard Screen 2

6. The third wizard box determines the type of data each column contains. Since the default, *General*, is appropriate, click **Finish**.
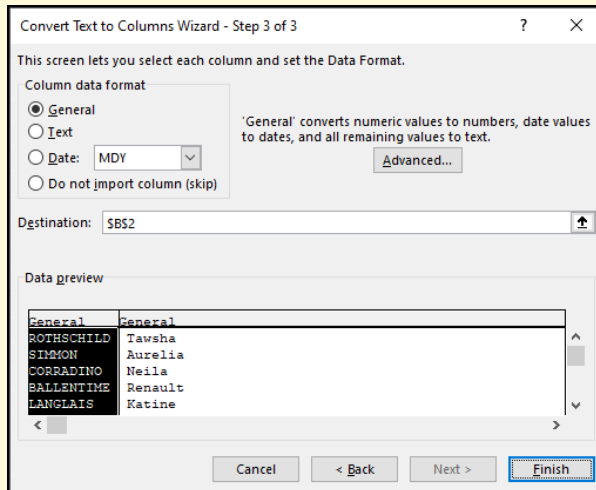
Figure 362: Convert Text to Columns Wizard Screen 3

7. Excel splits the names into two columns.

8. In cell **B1** enter *Last_Name* (with an underscore).

9. In cell **C1** enter *First_Name* (with an underscore).

10. Adjust **Column B** and **Column C** so they are the optimum width.

Figure 363: Names Divided Into Two Columns

9.2.1.2 *Trim*

$$= \mathrm{TRIM(text)}$$

The TRIM function is used to trim unwanted spaces from the start or end of text in a cell.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. When the name was separated into *Last_Name* and *First_Name* columns, Excel automatically added a space at the start of the *First_Name* field. That space, though, will be a problem in later exercises.

3. Insert a new column to the left of **Column D**. The newly inserted column becomes **Column D**.

4. In cell **D2**, enter *=TRIM(C2)*.

5. Copy **D2** to **D3:D101**. This removes the leading space from the first names.

6. Select and copy **D2:D101**.

7. Click **C2** then **Home** ⇒ **Clipboard** ⇒ **Paste** ⇒ **Values**. Note: it is important to paste the values, not just a simple paste. Otherwise, **C2:C101** will be filled with the *TRIM* formula rather than the value generated by that formula.

Figure 364: Paste Values Button

8. Delete **Column D**.

9. Though it is not visible, the data in **Column F** (the *Role* column) has a random number of spaces trailing many of the entries, which is a common problem caused by sloppy data entry.

10. Insert a new column to the left of **Column G**. The newly inserted column becomes **Column G**.

11. In cell **G2**, enter *=TRIM(F2)*.

12. Copy **G2** to **G3:G101**. This removes the trailing space from all entries in the role data.

13. Select and copy **G2:G101**.

14. Click **F2** then **Home** ⇒ **Clipboard** ⇒ **Paste** ⇒ **Values**. Note: it is important to paste the values, not just a simple paste. Otherwise, **F2:F101** will be filled with the *TRIM* formula rather than the value generated by that formula.

15. Delete **Column G**.

9.2.1.3   *Upper/Lower/Proper*

$= \mathsf{UPPER}(\mathsf{text})$

$= \mathsf{LOWER}(\mathsf{text})$

$= \mathsf{PROPER}(\mathsf{text})$

Often, the text case needs to be changed. The UPPER function changes text to upper case, the LOWER function changes text to lower case, and the PROPER function changes to title case (the first letter of each word is capitalized).

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. For some reason, the last names in **Column B** are uppercase. Uppercase text is commonly found, but that type of text is difficult to read.

3. Insert a new column to the left of **Column C**. The newly inserted column becomes **Column C**.

4. Enter this formula in **C2**: *=PROPER(B2)*.

5. Copy **C2** to **C3:C101**. This changes the last names to proper case.

6. Select and copy **C2:C101**.

7. Click **B2** then **Home** ⇒ **Clipboard** ⇒ **Paste** ⇒ **Values**. Note: it is important to paste the values, not just a simple paste. Otherwise, **B2:B101** will be filled with the *PROPER* formula rather than the value generated by that formula.

8. Delete **Column C**.

9.2.1.4   *Left/Right/Mid*

$= \mathsf{LEFT}(\mathsf{text}, [\mathsf{num\_chars}])$

$= \mathsf{RIGHT}(\mathsf{text}, [\mathsf{num\_chars}])$

$= \mathsf{MID}(\mathsf{text}, \mathsf{start\_num}, [\mathsf{num\_chars}])$

The LEFT, RIGHT, and MID functions are used to extract letters from a text field. For example, cell *B2* contains *Rothschild*. The function *=LEFT(B2,4)* would extract "Roth," the left four letters in that field. The function *=RIGHT(B2,5)* would extract "child," the right five letters in that field. The function *=MID(B2,5,3)* would extract "sch," the three letters starting in position five in that field. These functions,

along with CONCATENATE in the next section, are used to change the format of the phone number (*Column E*) from ten digits to (xxx) xxx-xxxx.

9.2.1.5 *Concatenate*

$$= \text{CONCATENATE}(\text{text1}, \text{text2}, [\text{text3}], ...)$$

Frequently, text stored in various workbook cells needs to be combined to create new information. The CONCATENATE function makes this possible. The various text phrases to combine are entered one after another, separated by commas. This exercise uses CONCATE-NATE along with LEFT, RIGHT, and MID to change the format of the phone number in *Column E* from ten digits to (xxx) xxx-xxxx.

`Excel 365` Note: this function was renamed *CONCAT* in Excel 365.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column F**. The newly inserted column becomes **Column F**.

3. Enter this in **F2**: *=CONCATENATE("(", LEFT(E2,3),") ", MID(E2,4,3), "-", RIGHT(E2,4))*

4. The formula concatenates (or joins) an open parenthesis, the left three digits of the phone number, a closing parenthesis with a space, the three middle digits of the phone number, a dash, and the right four digits of the phone number. The formula looks complex but is easy to understand if it is built up one small piece at a time.

5. Copy **F2** to **F3:F101**. This changes the format of the phone number to (xxx) xxx-xxxx.

6. Select and copy **F2:F101**.

7. Click **E2** then **Home** ⇒ **Clipboard** ⇒ **Paste** ⇒ **Values**. Note: it is important to paste the values, not just a simple paste. Otherwise, **E2:E101** will be filled with the *CONCATENATE* formula rather than the value generated by that formula.
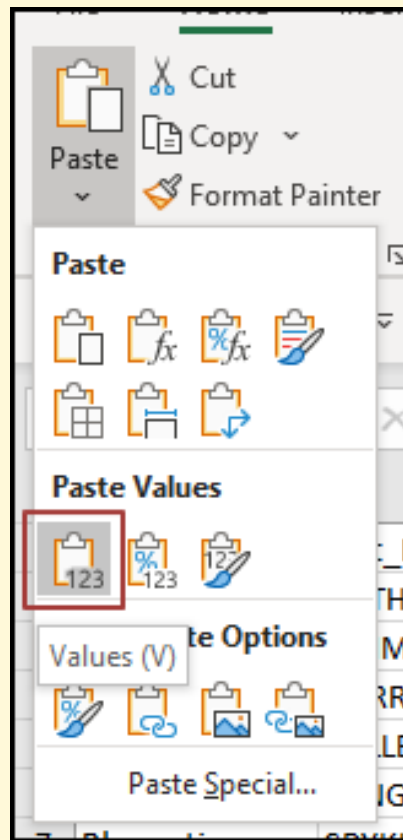
8. Delete **Column F**.

9. Adjust the width of **Column E** to properly display the formatted phone number.

10. Save the **CH9-Contact** workbook.

9.2.1.6 *Search*
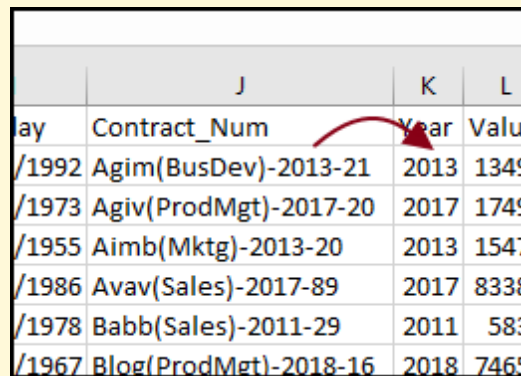
$$= \text{SEARCH}(\text{find\_text}, \text{within\_text}, [\text{start\_num}])$$

The SEARCH function is used to find a phrase in a cell that contains text. This is like the LEFT/RIGHT/MID functions except with SEARCH the exact starting position of the target data is not known in advance. Therefore, SEARCH could be used to find the phrase "good" in strings like "good morning" and "the greater good" where the target phrase starts in different locations in each string. Optionally, a start point for the search can be specified. SEARCH returns the position where the target phrase starts, so SEARCH would report that "good" in "good morning" starts at position one but in "the greater good" it starts at position 13. For this exercise, the year needs to be extracted from the *Contract_Num* field (*Column J*). The starting position for the year varies but is always after the first dash (see Figure 365), so SEARCH is needed instead of a simple LEFT/RIGHT/MID function. Note: SEARCH is not case sensitive, but the related Excel function FIND is case sensitive. Other than that, the two functions are identical. Thus, to locate the word "College" in a cell, use SEARCH if the capital letter should be ignored but FIND if the capital letter is important.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column K**. The newly inserted column becomes **Column K**.

3. In cell **K1**, enter *Year*. This column will contain the extracted year.

4. In cell **K2**, enter *=VALUE(MID(J2, SEARCH("-", J2)+1,4))*. If the formula is entered without error, cell **K2** will display 2013, the year in the contract number in cell **J2**. This is a complex formula, but it can be broken down, starting in the middle of the formula:

   - **SEARCH("-",J2)**. Search for a hyphen in data field **J2**.

   - **MID(J2, SEARCH("-", J2)+1,4)**. Using the MID function, extract from data field **J2**, starting one letter past the position of the hyphen, for four characters.

   - **=VALUE(MID(J2, SEARCH("-", J2)+1,4))**. Convert the extracted text to a number rather than store it as text. Note: Excel would store an extracted phrase as text, but since these are years it is sensible to store

them as numbers so various statistical functions can later be used.

5. Copy **K2** to **K3:K101**. This finds the year from each of the contract numbers.

6. Select and copy **K2:K101**.

7. Click **K2** then **Home** ⇒ **Clipboard** ⇒ **Paste** ⇒ **Values**. Note: This looks odd since the cells are being pasted back into the same locations from which they were copied, but this is a good way to remove a formula from a cell without creating an additional data column. It is important to paste the values, not just a simple paste. Otherwise, **K2:K101** will be filled with the *SEARCH* formula rather than the value generated by that formula.

8. Adjust the width of **Column K** to optimally fit the year data.

Figure 365: Extracting the Year from the Contract Number

9.2.1.7 *VLookup*

$$= VLOOKUP(value, table, col\_index, [approx])$$

VLOOKUP is a useful, but complex, Excel function. It is used to look up and return a value from a table. VLOOKUP will look up some target value in column one of a data range and return the value from an indexed column number. This concept is much easier to understand with an example. Consider Table 33.

ID	Name	Phone	Section
0134	Jones	(520) 123-4567	Sales
0293	Marks	(520) 398-2219	HR
0342	Nash	(520) 721-9043	Orders

Table 33: VLookup Example Table

The formula *=VLOOKUP(0293,A2:D5,4)* would lookup *0293* in the first column of the data table in *A2:D5* and then return the value in the fourth column of that table, *HR*.

The last parameter in the VLOOKUP function, "approx," determines if the match in column can be approximate or if an exact match is required. If the value for this item is TRUE then an approximate match is acceptable (this is the default), but if it is FALSE then the match must be exact.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P3** enter *Company*.

3. In cell **P4** enter *Last Name*.

4. In cell **P5** enter *Phone*.

5. In cell **P6** enter *Role*.

6. Adjust the width of **Column P** to optimally fit the data.

7. In cell **Q3** enter *Agimba*. This is the name of the first company, found in cell **A2**.

8. In cell **Q4** enter *=VLOOKUP($Q$3,$A$1:$F$101,2,FALSE)*. This formula will lookup the company found in cell **Q3**, "Agimba," in column one of the table found in **A1:F101** and then return the value found in column two of that table (see Figure 366). When completed, cell **Q4** should contain *Rothschild*, which is the name of the representative at *Agimba*. If the cell contains an error message check the formula for typing errors and check the spelling of *Agimba* in cell **Q3**. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table. Also notice that the last item in the formula is "FALSE" which makes Excel look for an exact match rather than an approximate match.

9. In cell **Q5** enter *=VLOOKUP($Q$3,$A$1:$F$101,5,FALSE)*. This is the same formula entered in *Q4*, but the column returned is 5 instead of 2. This formula will lookup the company found in cell **Q3**, "Agimba," in column one of the table found in **A2:F101** and then return the value found in column five of that table. When completed, cell **Q5** should contain "(520) 555-1082," which is Agimba's phone number. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table. Also notice that the last item is "FALSE" which makes Excel look for an exact match rather than an approximate match.

10. In cell **Q6** enter *=VLOOKUP($Q$3, $A$1:$F$101, 6, FALSE)*. This is the same formula entered in *Q5*, but the column returned is 6 instead of 5. This formula will lookup the company found in cell **Q3**, "Agimba," in column one of the table found in **A2:F101** and then return the value found in column six of that table. When completed, cell **Q6** should contain "Business Analyst," which is the role of the contact at Agimba. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table. Also notice that the last item is "FALSE" which makes Excel look for an exact match rather than an approximate match.

Figure 366: VLookup Formula for Q4

11. Adjust the width of **Column Q** to optimally fit the data.

12. If the company in cell **Q3** is changed then the data displayed in **Q4:Q6** will be updated to match the new name.

Try entering *Blogtag* and *Eidel* in **Q3** to check the update feature.

9.2.1.8 *Index Match*

$$= \text{INDEX}(data, \text{MATCH}(value, lookup\_column, \text{FALSE}), column)$$

This is the most complex formula in this book and is a combination of two simpler functions: INDEX and MATCH. On the surface, it does almost exactly what VLOOKUP does, so many people do not bother to learn the INDEX MATCH formula. However, VLOOKUP requires the lookup field to be in column one of the data table while INDEX MATCH can look up data in any column. Also, if the data table is changed in some way (a new column added, for example), VLOOKUP will no longer work but INDEX MATCH will adapt to the new table structure. So, the time taken to learn this lookup formula will result in a more robust lookup function.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P8** enter *Contract Num*.

3. In cell **P9** enter *Company*.

4. In cell **P10** enter *Phone*.

5. In cell **P11** enter *Last Name*.

6. Adjust the width of **Column P** to optimally fit the data.

7. In cell **Q8** enter *Agim(BusDev)-2013-21*. This is the contract number for the first data row, found in cell **J2**.

8. In cell **Q9** enter *=INDEX($A$2:$F$101, MATCH($Q$8, $J$2:$J$101, FALSE), 1)* (see Figure 367). (Note: if *Q9* displays an error then check the formula in **Q9** and the value in **Q8** for typing errors.) This is a complex formula and it will help to break it down into smaller chunks, starting in the middle:

   - **MATCH($Q$8,$J$2:$J$101,FALSE)**. In the center of the complex formula is a *MATCH* function. That will look for the value in cell **Q8** (the contract number) in **J2:J101** (the contract data field). An exact match is required since the last parameter is FALSE. If the contract number is found, then MATCH will return the row number for that contract.

- **=INDEX($A$2:$F$101,RowNum,1)**. *INDEX* will use the row number (*RowNum*) returned by the *MATCH* function and return the data in column one (Company name) of the data table in **A2:F101**.

9. When completed, cell **Q9** should contain "Agimba," which is the name of the company for the contract number in cell **Q8**. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table.

10. In cell **Q10** enter *=INDEX($A$2:$F$101, MATCH($Q$8, $J$2:$J$101,FALSE),5)*. This is the same formula entered in *Q9*, but the last number is changed from 1 to 5 to return the phone number field. This formula will match the contract number found in cell **Q8** and then return the value found in column five of the data table. When completed, cell **Q10** should contain "(520) 555-1082," which is the phone number for the company. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table.

11. In cell **Q11** enter *=INDEX($A$2:$F$101, MATCH($Q$8, $J$2:$J$101,FALSE),2)*. This is the same formula entered in *Q10*, but the last number is changed from 5 to 2 to return the last name field. This formula will look up the contract number found in cell **Q8** and then return the value found in column two of the data table. When completed, cell **Q11** should contain "Rothschild," which is the last name of the contact for this contract. Notice that the formula uses absolute references so if it is copied to other cells it will still refer to the correct table.

f_x	=INDEX($A$2:$F$101,MATCH($Q$8,$J$2:$J$101,FALSE),1)			
	P	Q	R	S	T
	Contract Num	Agim(BusDev)-2013-21			
	Company	Agimba			
	Phone	(520) 555-1082			
	Last Name	Rothschild			

Figure 367: Index-Match Formula for Q9

12. If the contract number in **Q8** is changed then the data displayed in **Q9:Q11** will be updated to match the

new number. Try entering *Buzz(Sales)-2014-117* and *Link(RD)-2013-21* in **Q8** to check the update feature.

13. Save the **CH9-Contact** workbook.

9.2.2 *Number Functions*
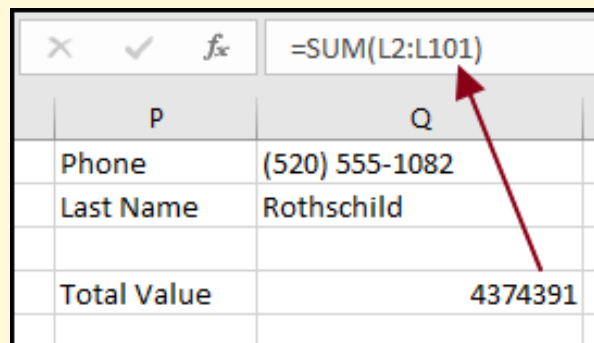
Excel has hundreds of functions designed to be used with cells that contain numbers and this section explores the most used number functions.

9.2.2.1 *Sum*

$$= SUM(number1, [number2], [number3], ...)$$

This function adds all the values in a specified range.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P13**, enter *Total Value*.

3. In cell **Q13**, enter *=SUM(L2:L101)*. This formula will total all the contract values found in **Column L**.

4. When completed, cell **Q13** should contain 4374391. This number could be formatted with Excel's formatting tools to be easier to read.

	=SUM(L2:L101)
P	Q
Phone	(520) 555-1082
Last Name	Rothschild
Total Value	4374391

Figure 368: Sum Formula for Q13

9.2.2.2 *Average*

$$= AVERAGE(number1, [number2], [number3], ...)$$

This function calculates the average for the values in a specified range.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P14**, enter *Average Value*.

3. In cell **Q14**, enter *=AVERAGE(L2:L101)*. This formula will calculate the average of the contract values found in **Column L**.

4. When completed, cell **Q14** should contain 43743.91. This number could be formatted with Excel's formatting tools to be easier to read.

Figure 369: Average Formula for Q14

9.2.2.3   *Min/Max*

$$= \text{MIN}(\text{number1}, [\text{number2}], [\text{number3}], ...)$$
$$= \text{MAX}(\text{number1}, [\text{number2}], [\text{number3}], ...)$$

These functions find the minimum or maximum value in a specified range.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P15**, enter *Max Value*.

3. In cell **Q15**, enter *=MAX(L2:L101)*. This formula will find the maximum contract value in **Column L**.

4. When completed, cell **Q15** should contain 88050.

5. In cell **P16**, enter *Min Value*.

6. In cell **Q16**, enter *=MIN(L2:L101)*. This formula will find the minimum contract value in **Column L**.

7. When completed, cell **Q16** should contain 5140.

Figure 370: Max Formula for Q15

9.2.2.4 *Round*

$$= \text{ROUND}(\texttt{number}, \texttt{num\_digits})$$

This function rounds a number to a specified number of digits. If the number of digits is a positive number, then it will be rounded to a decimal value but if the number of digits is negative then it will be rounded to the nearest multiple of ten. Table 34 will help to clarify this concept.

Number	Num_Digits	Result	Notes
5678.1234	3	5678.123	3 decimal places
5678.1234	2	5678.12	2 decimal places
5678.1234	1	5678.1	1 decimal place
5678.1234	0	5678	Nearest whole number
5678.1234	-1	568	Nearest 10
5678.1234	-2	57	Nearest 100
5678.1234	-3	6	Nearest 1,000

Table 34: Rounding Places

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **P18**, enter *Rounded Value*.

3. In cell **Q18**, enter *=ROUND(Q13,-4)*. This formula will round the *Total Value* in cell **Q13** to the nearest 10,000.

4. When completed, cell **Q18** should contain 4370000. This number could be formatted with Excel's formatting tools to be easier to read.

5. Save the **CH9-Contact** workbook.

9.2.2.5 *If*

$$= \mathrm{IF}(\texttt{logical\_test}, [\texttt{value\_if\_true}], [\texttt{value\_if\_false}])$$

The IF function fills a cell with some value based on the result of an "if" decision. As an example of the IF function, a cell on the *Contacts* worksheet will be used to indicate if the value of a contract is greater than a specified threshold.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column M**. The newly inserted column becomes **Column M**.

3. In cell **M1**, enter *Priority*.

4. Adjust the width of **Column M** to properly display cell **M1**.

5. In cell **M2**, enter *=IF(L2>50000, "High", "Low")*. This formula will check the value in cell **L2** and if it is greater than 50000 it will enter the word *High* in **M2** otherwise it will enter the word *Low*.

6. When completed, cell **M2** should contain *Low*.

7. Copy cell **M2** to **M3:M10**. Notice that if the value in **Column L** is greater than 50000 then **Column M** will display *High*, otherwise it will display the word *Low*.

8. Commonly, *IF* functions are nested to get a more granular output. For this worksheet, to get a *Priority* (**Column M**) of *High*, *Med*, or *Low*, the formula will need to be adjusted.

9. In cell **M2**, enter *=IF(L2>60000, "High", IF(L2>30000, "Med", "Low"))*. Here is an explanation of the formula:

   - If the value in **L2** is greater than 60,000 then Excel will print *High* and be done.

- If the value in **L2** is less than or equal to 60,000 then Excel will check to see if it is greater than 30,000. If so, Excel will print *Med*.

- If the value in **L2** is less than or equal to 30,000, Excel will print *Low*.

10. Copy the formula in **M2** to **M3:M101**. Notice that some values are flagged as *High* priority, some as *Med* priority, and some as *Low* priority.

=IF(L2>60000,"High",IF(L2>30000,"Med","Low"))

	M	N	O	P
ue	Priority	Last_Contact		
491	Low	3/22/2020		
490	Low	1/30/2020		Compa
477	Low	4/30/2020		Last Na
380	High	4/22/2020		Phone
335	Low	3/10/2020		Role

Figure 371: IF Formula for M2

9.2.2.6 SumIf/SumIfS

$$= SUMIF(range, criteria, [sum\_range])$$

$$= SUMIFS(sum\_range, range1, criteria1, [range2], [criteria2], ...)$$

These two functions will calculate a sum but only if certain specified criteria are true. The difference between the two functions is that SUMIF can only have one criterion while SUMIFS can have two or more criteria. Both functions are used in the following exercise.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **Q19**, enter *Low Pri Ttl*.

3. In cell **Q20**, enter *Low Pri 2018*.

4. In cell **Q21**, enter *High Pri Ttl*.

5. In cell **Q22**, enter *High Pri 2018*.

6. In cell **R19**, enter *=SUMIF($M$2:$M$101, "Low", $L$2:$L$101)*. This formula will find the total value (**Column L**) for contracts that have *Low* priority (**Column M**).

7. In cell **R20**, enter *=SUMIFS($L$2:$L$101, $M$2:$M$101, "Low", $K$2:$K$101, 2018)*. This formula will find the total value (**Column L**) for contracts that have *Low* priority (**Column M**) and were signed in 2018 (**Column K**).

8. In cell **R21**, enter *=SUMIF($M$2:$M$101, "High", $L$2:$L$101)*. This formula will find the total value (**Column L**) for contracts that have *High* priority (**Column M**).

9. In cell **R22**, enter *=SUMIFS($L$2:$L$101, $M$2:$M$101, "High", $K$2:$K$101, 2018)*. This formula will find the total value (**Column L**) for contracts that have *High* priority (**Column M**) and were signed in 2018 (**Column K**).

10. When completed, cell **R19** should contain 616037.

11. When completed, cell **R20** should contain 56504.

12. When completed, cell **R21** should contain 2364510.

13. When completed, cell **R22** should contain 149989.

| | =SUMIFS($L$2:$L$101,$M$2:$M$101,"High",$K$2:$K$101,2018) | | | |
P	Q	R	S	T
	Low Pri Ttl	616037		
	Low Pri 2018	56504		
	High Pri Ttl	2364510		
	High Pri 2018	149989		

Figure 372: SUMIF Formula for R23

14. Save the **CH9-Contact** workbook.

9.2.2.7 *CountIf/CountIfS*

$$= COUNTIF(range, criteria)$$

$$= COUNTIFS(range1, criteria1, [range2], [criteria2], ...)$$

These two functions will count the number of cells that meet specified criteria. The difference between the two functions is that COUNTIF can only have one criterion while COUNTIFS can have two or more criteria. Both functions are used in the following exercise.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **Q24**, enter *Low Pri Count*.

3. In cell **Q25**, enter *Low Pri 2018*.

4. In cell **Q26**, enter *High Pri Count*.

5. In cell **Q27**, enter *High Pri 2018*.

6. In cell **R24**, enter *=COUNTIF($M$2:$M$101, "Low")*. This formula counts the number of contracts with a *Low* priority (**Column M**).

7. In cell **R25**, enter *=COUNTIFS($M$2:$M$101, "Low", $K$2:$K$101, 2018)*. This formula counts the number of contracts with a *Low* priority (**Column M**) and were signed in 2018 (**Column K**).

8. In cell **R26**, enter *=COUNTIF(M2:M101, "High")*. This formula counts the number of contracts with a *High* priority (**Column M**).

9. In cell **R27**, enter *=COUNTIFS(M2:M101, "High", K2:K101, 2018)*. This formula will count the number of contracts with a *High* priority (**Column M**) and were signed in 2018 (Column K).

10. When completed, cell **R24** should contain 39.

11. When completed, cell **R25** should contain 3.

12. When completed, cell **R26** should contain 30.

13. When completed, cell **R27** should contain 2.

	=COUNTIFS($M$2:$M$101,"High",$K$2:$K$101,2018)		
P	Q	R	S
	Low Pri Count	39	
	Low Pri 2018	3	
	High Pri Count	30	
	High Pri 2018	2	

Figure 373: COUNTIF Formula for R28

9.2.2.8 *Randbetween*

$$= \mathrm{RANDBETWEEN(bottom, top)}$$

It is common to need to generate a random number between two other numbers, like a random number between 1 and 10, and the RANDBETWEEN function makes that easy. For this exercise, assume that each of the companies in the data set need to be randomly assigned to one of three groups for an advertising campaign. The easiest way to do that is to assign a random number between one and three to each of the companies.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. In cell **O1**, enter *Campaign*.

3. Adjust the width of **Column O** to properly display cell **O1**.

4. In cell **O2**, enter *=RANDBETWEEN(1,3)*. This formula will enter a random number between one and three, inclusive, into cell **O2**.

5. Copy cell **O2** to **O2:O101**. This will fill **Column O** with random numbers between one and three.

6. Note, in Figure 374, the numbers in cells **O2**, **O3**, and **O4** were randomly assigned so the student's work may display different values in those cells.

Figure 374: RANDBETWEEN Formula for O2

One problem with the RANDBETWEEN function is that new random numbers will be generated whenever any cell on the worksheet is changed. This makes it impossible to come back to the column of random numbers later and expect to find the same values. Follow these steps to correct that shortcoming.

1. Select and copy **O2:O101**.

2. Paste Values to **O2:O101**. Note: it is important to paste the values, not just a simple paste. Otherwise, **O2:O101** will be filled with the *RANDBETWEEN* formula rather than the value generated by that formula. Note: the values are being saved into the same cells that were used to generate the values. This is a common way used to strip a formula from a cell.

3. Save the **CH9-Contact** workbook.

9.2.2.9   *Today/Now*

$= TODAY()$

$= NOW()$

These two functions insert the current date into a worksheet cell. These functions must include the final parenthesis, even if they are empty. The only difference between the two functions is that TODAY inserts only the date while NOW inserts the date and time. Note: the format for the date and time is determined by settings on the computer. These functions are mostly used in the header or footer in print settings.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column P**. The newly inserted column becomes **Column P**.

3. In cell **P1**, enter *Contact_Days* (notice the underscore in the entry).

4. Adjust the width of **Column P** to properly display cell **P1**.

5. In cell **P2**, enter *=VALUE(TODAY()-N2)*. This will subtract the last contact date from today's date to determine how many days have passed since the last contact. Note: Excel will automatically format cell **P2** as a date since *TODAY()* is in the formula, but *VALUE* makes Excel display the number of days instead of a date.

6. Copy **P2** to **P3:P101**. Note, Figure 375 shows the number of days as of the date the image was captured, so the student's work will have a different number of days.

Figure 375: Using the Today() Function

9.2.2.10   *Date/DateDif*

$$= DATE(year, month, day)$$

$$= DATEDIF(start_date, end_date, unit)$$

Excel stores dates as exceptionally large numbers and then calculates the displayed date as the number of days since January 1, 1900. For example, January 1, 2020 is stored in Excel as 43831.

The DATE function converts a date in human-readable form to the number that Excel uses. Thus, *DATE(2020,01,01)* will be converted to 43831.

The DATEDIF function calculates the difference in two dates. According to the Microsoft website, "Excel provides the DATEDIF function to support older workbooks from Lotus 1-2-3." For some reason, since Excel 2000, there has been no help in the Excel system for DATEDIF, but the function still works without any problems.

The *Unit* parameter in the DATEDIF function determines if the difference in two dates is calculated in years (*Y*), months (*M*), or days (*D*).

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column J**. The newly inserted column becomes **Column J**.

3. By default, Excel formats cells in an inserted column like the cells in the column to the left of the new column. Therefore, cell **J2** is formatted as a date since **I2** is a date. This is normally appropriate, but for this exercise, every cell in **Column J** needs to be formatted as *General* rather than dates. Select **Column J** and then click **Home** ⇒ **Number** ⇒ **Drop-Down Arrow** ⇒ **General** to force all cells in the entire column to display using the *General* format.

4. In cell **J1**, enter *Age*.

5. In cell **J2**, enter *=DATEDIF(I2,TODAY(),"Y")*. This will calculate the number of years between the *birthday* and today's date.

6. Copy **J2** to **J3:J101**. Note, Figure 376 shows the age as of the date the image was captured, but student work may have a different age.

Figure 376: Using the Datediff() Function

7. It is appropriate to leave the formula in this column instead of removing it as was done for other columns in this exercise. That way, when the workbook is opened in the future, the values in the *Age* column will be automatically updated.

8. Adjust the width of **Column J** so all data is properly displayed.

9.2.2.11   *AND/OR*

$$= AND(logical1, [logical2], ...)$$

$$= OR(logical1, [logical2], ...)$$

These two related functions test different logical conditions and return either *TRUE* or *FALSE* depending on the outcome of the test.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column K**. The newly inserted column becomes **Column K**.

3. In cell **K1**, enter *Sales*.

4. In cell **K2**, enter *=AND(G2 = "Sales", J2 <40)*. This will output *TRUE* if **G2** contains *Sales* and **J2** is less than 40.

5. Adjust the width of **Column K** to properly display the value in **K2**.

6. Copy **K2** to **K3:K101**.

Figure 377: Using the AND Function

7. Normally, *AND* and *OR* functions are combined with an *IF* function to make the result more readable.

8. Change the formula in **K2** to this: *=IF(AND(G2 = "Sales", J2 <40),"Yes","")*. This will print *Yes* for lines where the Role (**Column F**)is *Sales* and *Age* (**Column J**) is less than 40 but print nothing otherwise.

9. Copy **K2** to **K3:K101**. Now most cells in **Column K** will be blank but a few will contain *Yes* where the contact is in the sales department and the age is less than 40.

9.2.2.12 *NOT*

$$= \text{NOT}(\texttt{logical})$$

This function will test different a logical condition and return either *TRUE* or *FALSE* depending on the outcome of the test.

1. This exercise uses the **Contacts** worksheet in the **Contact** workbook.

2. Insert a new column to the left of **Column E**. The newly inserted column becomes **Column E**.

3. In cell **E1**, enter *Common*.

4. In cell **E2**, enter **=NOT(D2="Dr")**. This will output *TRUE* if **E2** contains anything other than *Dr*.

5. Copy **E2** to **E3:E101**.

Figure 378: Using the NOT Function

6. Change **E2** to: **=AND(NOT(D2="Dr"), NOT(D2="Rev"))**. This formula uses AND to look for Salutations (**Column D**) that are not *Dr* AND not *Rev*.

7. As one final improvement in the formula, change **E2** to **=IF(AND(NOT(D2="Dr"), NOT(D2="Rev")), "Yes", "")**. This will print *Yes* for lines where the Salutation (**Column D**) is anything other than "Dr" and "Rev" but print nothing otherwise.

8. Copy **E2** to **E3:E101**.

9. Adjust the width of **Column E** so all data is properly displayed.

10. Save the **CH9-Contact** workbook.

11. Compare the workbook with the self-check answer key (**CH9-Contact Solution**) and then close and submit the **CH9-Contact** workbook as directed by the instructor.

> **Key Take-Aways**
>
> **Useful Functions**
>
> - Excel includes hundreds of functions for both text and numbers, but some are more generally useful than others.
> - Excel's most useful text functions include To Columns, Trim, Concatenate, Upper/Lower/Proper, Left/Right/Mid, VLookup, and Index Match.
> - Excel's most useful number functions include Sum, Average, Min/Max, Round, If, SumIf, CountIf, RandBetween, Today/Now, Date/DateDif, AND/OR, and NOT.

9.3 STATISTICS

> **Learning Objectives**
>
> - Use Correlation, Descriptives, and Histogram from the Data Analysis pack.

9.3.1 *Activating the Analysis Toolpak*

Excel includes an *Analysis Toolpak* that contains 19 advanced statistics and engineering functions, but it is considered an Add-in and must be activated before it can be used. Most Excel users will never need these types of statistics analysis tools, but they are available if needed.

1. Click **File** ⇒ **Options**.
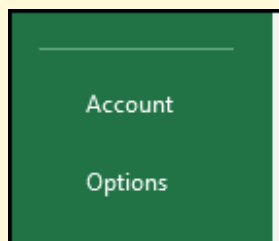
Figure 379: The Options Button in the Backstage View

2. Click **Add-ins** in the left-hand menu of the *Excel Options* pop-up box (see Figure 380).

3. Select *Excel Add-ins* in the drop-down menu at the bottom of the *Add-ins* tab.

4. Click **Go**.
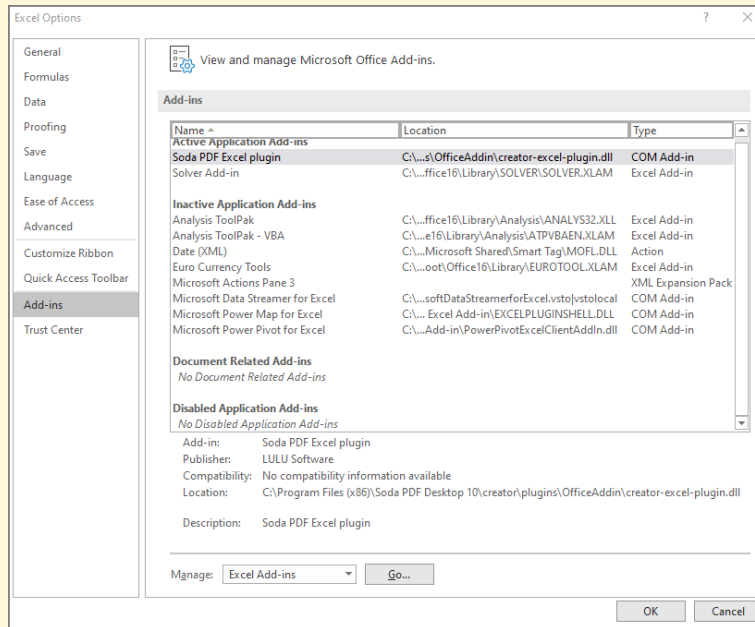
Figure 380: The Add-ins Manager

5. Click the checkbox beside *Analysis Toolpak Add-in* in the *Add-ins* pop-up box.
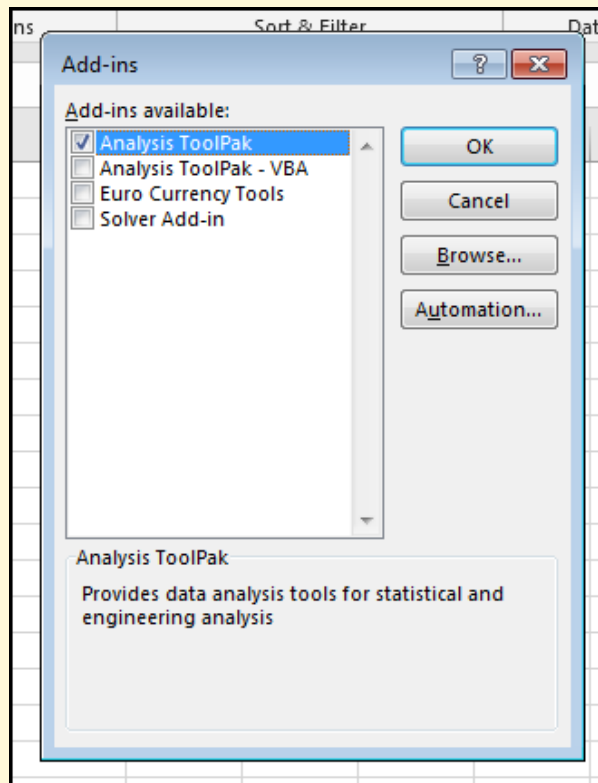
Figure 381: Activating The Analysis Toolpak Add-In

6. Click **OK**.

Excel adds a new button at **Data** ⇒ **Analysis** ⇒ **Data Analysis**.
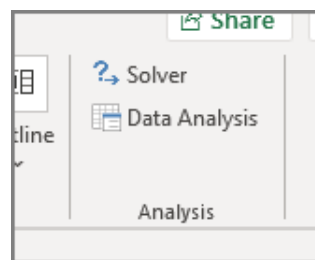
Figure 382: The Data Analysis Button

9.3.2   *Working With Simple Statistics*

1. Open workbook **CH9-Stats**.

2. Save the workbook as **CH9-Cafe**.

3. This workbook has only one worksheet, **Cafe**.

The Cafe worksheet contains 100 results of a survey of customers in a small cafe. Note: this is dummy data created for this book.

9.3.2.1 *Correlation*

A fundamental statistical calculation is the correlation between two variables. A correlation is a number between -1.0 and $+1.0$, where 0.0 means there is no correlation between the two variables and either $+1.0$ or -1.0 means there is a perfect correlation. A positive correlation means that as one variable increases the other also increases. For example, as people age, they tend to weigh more so a positive correlation would be expected between age and weight. A negative correlation, on the other hand, means that as one variable increases the other decreases. For example, as people age, they tend to run slower so a negative correlation would be expected between age and running speed. For the Cafe data, it would be reasonable to wonder if there is some sort of relationship between the length of the meal and the bill. Longer meals should correlate to higher bills, so a positive correlation would be important for a researcher to know.

1. **Excel 2016** Click **Data** ⇒ **Analysis** ⇒ **Data Analysis**. (Note: the statistics functions are identical in Excel 2016 and Excel 365, but their group on the ribbon has a slightly different name.)

2. **Excel 365** Click **Data** ⇒ **Analyze** ⇒ **Data Analysis**. (Note: the statistics functions are identical in Excel 2016 and Excel 365, but their group on the ribbon has a slightly different name.)

3. In the *Data Analysis* dialog box, select *Correlation* and click **OK**.
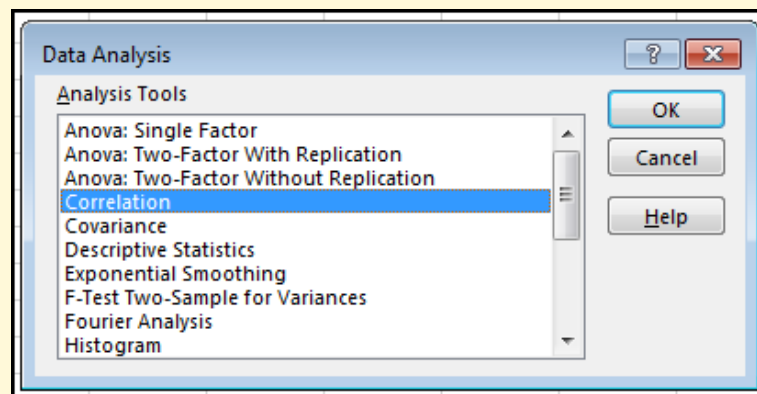
Figure 383: Data Analysis Selection Box

4. The *Correlation* dialog box pops up.
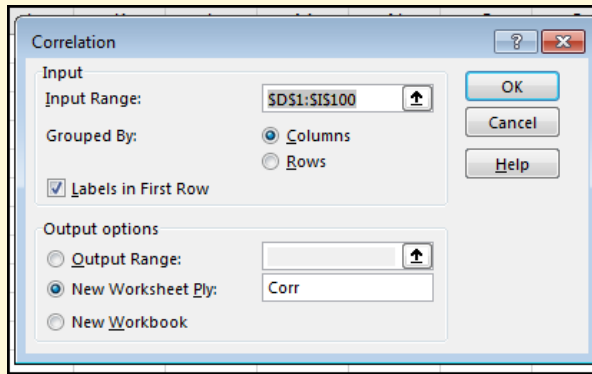
Figure 384: Correlation Parameters

5. Input Range: *$D$1:$I$100*

6. Grouped By: Columns

7. Labels in First Row: Checked

8. Output: New Worksheet Ply: *Corr*

9. Click **OK**.

10. Excel creates a new worksheet named *Corr* that contains a correlation table that displays the correlations between the six variables contained in the selected range. Notice that the correlation between *Length* and *Bill* is 0.611327, which is strong. However, also note that the correlation between *PtySize* (the number in the group) and *Bill* is 0.866466, which is much stronger. It would stand to reason that a larger group of diners would generate a higher bill.

	A	B	C	D	E	F	G
1		Length	Bill	Age	PtySize	Food	Svc
2	Length	1					
3	Bill	0.611327	1				
4	Age	-0.09254	0.088292	1			
5	PtySize	0.546868	0.866466	-0.01474	1		
6	Food	0.100028	0.091793	-0.23365	0.10113	1	
7	Svc	0.13181	0.121783	-0.23517	0.105583	0.858734	1

Figure 385: Correlation Table

9.3.2.2 *Descriptives*

Descriptive statistics summarize a variable with multiple useful calculations. Follow these steps to generate descriptives for *Age*.

1. Click the **Cafe** worksheet to open it.

2. Click **Data** ⇒ **Analysis** ⇒ **Data Analysis**.

3. In the *Data Analysis* dialog box, select *Descriptive Statistics* and click **OK**.

4. The *Descriptive Statistics* dialog box pops up.
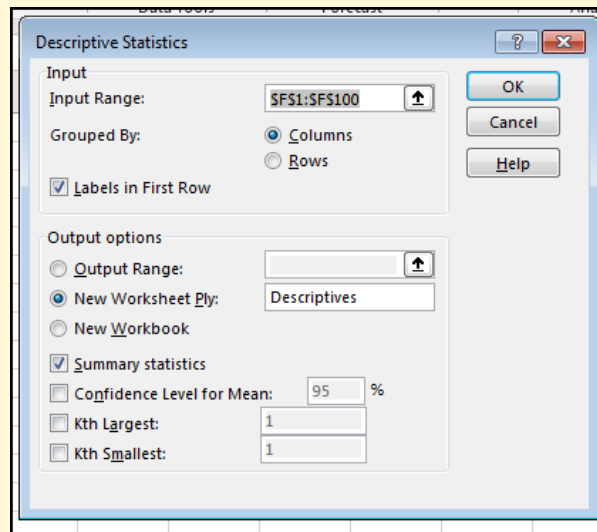
Figure 386: Descriptive Statistics Parameters

5. Input Range: *$F$1:$F$100*

6. Grouped By: Columns

7. Labels in First Row: Checked

8. Output: New Worksheet Ply: *Descriptives*

9. Summary Statistics: Checked

10. Click **OK**.

11. Excel creates a new worksheet named Descriptives that contains a table that displays various descriptive statistics for *Age*. For example, the mean age is 41.47475.

◢	A	B
1	*Age*	
2		
3	Mean	41.47475
4	Standard Error	1.077625
5	Median	41
6	Mode	51
7	Standard Deviation	10.72223
8	Sample Variance	114.9662
9	Kurtosis	-0.67118
10	Skewness	0.108715
11	Range	45
12	Minimum	21
13	Maximum	66
14	Sum	4106
15	Count	99
16		

Figure 387: Descriptive Statitics

9.3.2.3 *Histogram*

A histogram is a graphic representation of a numeric variable. For a histogram, the values are placed in "bins" and the number in each bin is counted and graphed.

1. Click the **Cafe** worksheet to open it.

2. Click **Data** ⇒ **Analysis** ⇒ **Data Analysis**.

3. In the *Data Analysis* dialog box, select *Histogram* and click **OK**.

4. The *Histogram* dialog box pops up.
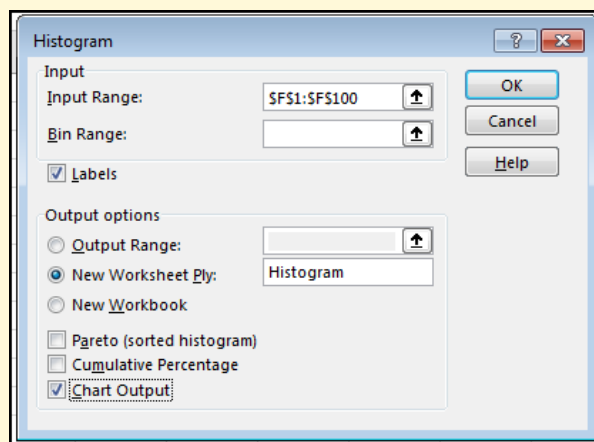
Figure 388: Histogram Parameters

5. Input Range: *$F$1:$F$100*

6. Bin Range: leave blank

7. Labels: Checked

8. Output: New Worksheet Ply: *Histogram*

9. Chart Output: Checked

10. Click **OK**.

11. Excel creates a new worksheet named Histogram that contains a table that displays the counts for each age "bin." For example, 15 people were between the ages of 36 and 40 (inclusive). Also, the histogram graph is displayed for a quick view of how the age data is distributed.

12. Save the **CH9-Cafe** workbook.

13. Compare the workbook with the self-check answer key (**CH9-Cafe Solution**) and then close and submit the **CH9-Cafe** workbook as directed by the instructor.
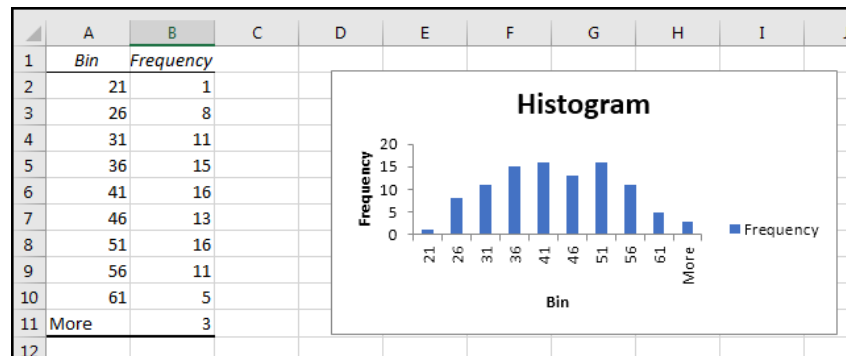
Figure 389: Histogram of Age

Key Take-Aways

Statistics

- A correlation numerically describes the relationship between two variables.
- Descriptives create numerous statistics for a variable.
- A histogram graphically represents the distribution for a numeric variable.

9.4 MACROS

> **Learning Objectives**
>
> - Automate simple tasks with a macro.

View ⇒ Macros ⇒ Macros allows users to automate repetitive tasks. The top part of the button will open the *View Macros* dialog box and the bottom half reveals options for macros.

1. Open a new blank workbook. (*Note*: the macro is placed in a new workbook, so it does not accidentally interfere with the exercises in any other workbook.)

2. Click **A1** to select that cell.

3. Click **View ⇒ Macros ⇒ Macros** (be sure to click the small arrow at the bottom of the **Macros** button).

4. Select **Use Relative References**.

5. In the same popup, select **Record Macro**.

6. Name the macro *MyName* (note, macro names cannot contain spaces).

7. Click in the *Shortcut Key* box and type Q (this is a capital Q).

8. Store the macro in this workbook.

9. Enter this description: *Inserts my name*.
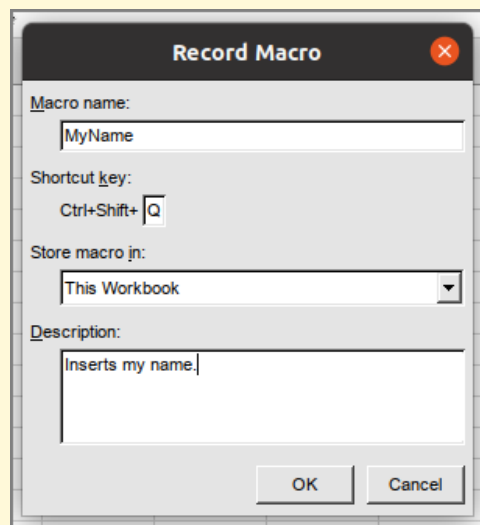
Figure 390: The Record Macro Settings Box

10. Click **OK**.

11. Type your first and last name and press Enter .

12. Click **View** ⇒ **Macros** ⇒ **Macros** (be sure to click the small arrow at the bottom of the **Macros** button).

13. Click **Stop Recording**.

Select another cell on the worksheet and press Ctrl + Shift + Q . Remember that relative references were activated for the macro, otherwise the name would have always been created in cell *A1* (the original cell) instead of the current cell.

1. Click **View** ⇒ **Macros** ⇒ **Macros** (be sure to click the top of the **Macros** button).

2. This opens the *Macro Manager* dialog box where macros can be edited, deleted, or have various options set.
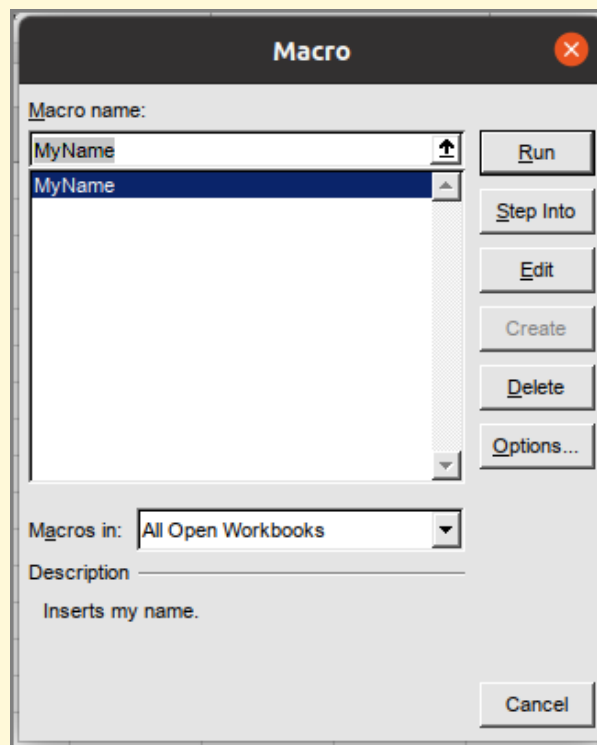
Figure 391: The Macro Manager Box

3. Click **Cancel** to close the Macro manager.

Remember that all workbooks containing macros must be saved using the "macro-enabled" option (that creates a file extension of *.xlsm*).

Figure 392 shows a drop-down menu at the bottom right corner of the *Save-As* screen where *Excel Macro-Enabled Workbook* must be selected.
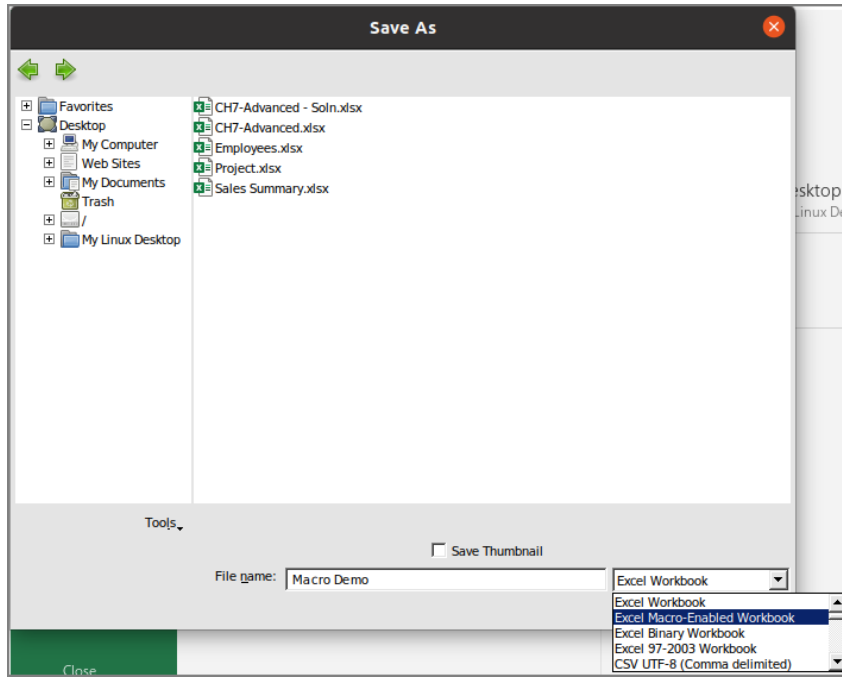
Figure 392: Saving a Workbook With a Macro

Since this macro will not be reused in the future, close the workbook without saving.

Key Take-Aways

Using Excel Macros

- Macros automate simple tasks to save time in data entry.
- Workbooks containing macros must be saved with the "Macro-Enabled" setting.

9.5 EXCEL PREFERENCES

Learning Objectives

- Explore and optionally change Excel preferences.

Like all Microsoft Office products, Excel has scores of preferences and this section lists those that are most adjusted by users.

To find the preferences, click *File ⇒ Options*.
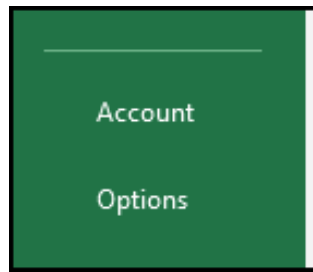
Figure 393: The Backstage Options Button

The Options area is divided into 11 different tabs and each tab includes settings for many preferences. Here is a brief overview of the different option tabs.

Category	Settings
General	These are the commonly modified settings, such as the interface, user name, and Start screen.
Formulas	Settings to control calculations, error-checking, and formulas.
Proofing	Options for spell-check and auto-correct.
Save	Settings that govern saving, autorecovery, and web server options.
Language	Chose the primary and other languages used for editing, tooltips, and help.
Ease of Access	Settings that concern accessibility, including an accessibility checker and various settings for sounds and font.
Advanced	Numerous settings that are not often changed, divided into five areas.
Customize Ribbon	Add and remove items from the ribbon, also rearrange or rename the ribbon tabs and groups.
Quick Access Toolbar	Add and remove items from the Quick Access Toolbar, rearrange the toolbar, and specify its location.
Add-ins	Activate or remove various add-ins.
Trust Center	Manage certificates and other Excel security features.

Table 35: Summary of Excel Options

It is not the intent of this book to describe every possible preference but following is a list of those that users commonly modify.

9.5.1 *General*

ENABLE LIVE PREVIEW When changing visual items, like fonts or colors, this previews the change live in the current sheet. This can get annoying, so some users turn it off.

SCREEN TIP STYLE Screen tips are the pop-up boxes with brief help for the various buttons on the ribbon. Some users find these distracting and the can be turned off with this setting.

USE THIS AS THE DEFAULT FONT Use this to change the default font used in new workbooks. Also, the default font size can be set if a larger size is needed.

INCLUDE THIS MANY SHEETS New workbooks include three blank worksheets by default, but that number can be changed here. Often, one worksheet is enough for new workbooks and then other worksheets can added as needed.

USER NAME This is the author's name that is saved with the workbook.

SHOW THE START SCREEN WHEN THIS APPLICATION STARTS Uncheck this box to turn off the start screen.

COLLAPSE THE RIBBON AUTOMATICALLY Checking this box will automatically collapse the ribbon into a menu to save space on the screen. The ribbon will drop down when any of the menu items are clicked. It is also easy to pin the ribbon open while working.

9.5.2 *Formulas*

RESET IGNORED ERRORS Sometimes users have Excel ignore errors as they are developing a worksheet. This button will reset the ignored errors, so all errors are again displayed.

9.5.3 *Proofing*

This tab includes the various settings for spell-check, like ignore uppercase words. It also includes the Autocorrect options. Normally, the default settings for these items is adequate but that can be changed at this tab.

9.5.4 *Save*

SAVE AUTORECOVER INFORMATION EVERY Set how often Excel autosaves a workbook. The default is 10 minutes, but that can be decreased if desired.

DEFAULT LOCAL FILE LOCATION This is the default location for files on initial save or a "Save As" operation.

9.5.5 *Language*

Excel uses the Windows system language and that is normally acceptable. However, this tab makes it possible to change the default Office language for both viewing and editing.

9.5.6 *Ease of Access*

This tab makes several accessibility options available.

9.5.7 *Advanced*

AFTER PRESSING ENTER, MOVE SELECTION By default, Excel moves the selector (active cell) down when the enter key is pressed, but some users prefer the selector to move right and that can be set here.

SHOW THIS NUMBER OF RECENT WORKBOOKS When Excel opens, it displays the file names for recently opened workbooks. Use this preference to set the number of recent workbooks to display. The default (and maximum number) is 50.

RULER UNITS Most Americans are comfortable using inches on the ruler, but Excel can also use metric units. The unit used is set with this preference.

AT STARTUP, OPEN ALL FILES IN Specify a folder on the hard drive and any Excel files in that folder will be automatically opened when Excel starts. This is a great timesaver while working on a project for several weeks where the same Excel files need to be opened.

9.5.8 *Customize Ribbon*

The ribbon is highly customizable from this tab. Users can add/remove items from the ribbon, change the order of the items on the ribbon, create new groups, rename items, and generally whatever they want to do to make the ribbon work best for themselves. Customizations can even be exported in a file that can be imported on another computer so users can make Excel on all the computers they use look the same.

In addition to the customizations on this tab, the General Tab includes an option to collapse the ribbon automatically.

9.5.9   *Quick Access Toolbar*

The Quick Access Toolbar is one of the most useful Excel feature. Users can add links to their most often used Excel functions, so they are easily available without clicking on any ribbon links. The Quick Access Toolbar is set up with the links the user wants. Optionally, the Quick Access Toolbar can be moved to under the ribbon.

The *Quick Access Toolbar* is found at the upper left side of the Excel screen above the Ribbon, as shown in Figure 394. This area provides access to the most frequently used commands, such as *Save* and *Undo*. The *Quick Access Toolbar* can be customized by activating commands that are extensively used or inactivating commands that are not needed. By placing these commands in the *Quick Access Toolbar*, it is not necessary to navigate through the Ribbon to find them. To customize the *Quick Access Toolbar*, click the down arrow as shown in Figure 394. This will open a menu of commonly used commands that can be added to the *Quick Access Toolbar* by checking them. If the desired command is not on the list, select the *More Commands* option, which opens a screen containing every command on the ribbon. As an additional modification, the *Quick Access Toolbar* and be placed below the ribbon by clicking *Show Below the Ribbon* and many users prefer it in that location.
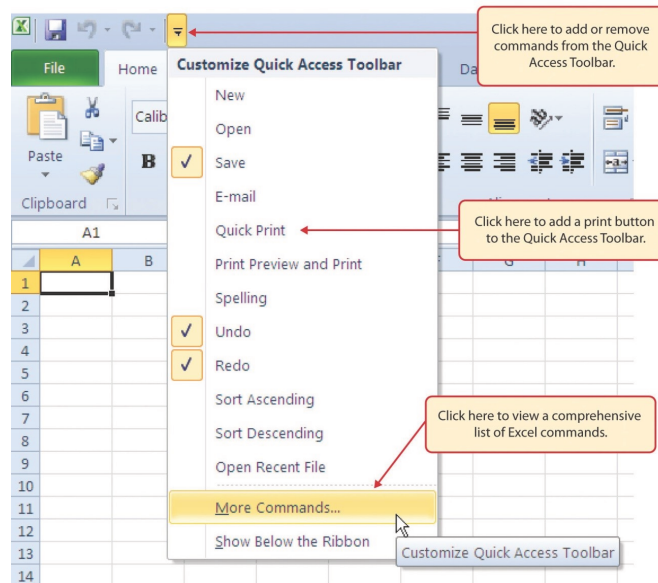
Figure 394: Modifying the Quick Access Toolbar

9.5.10   *Add-ins*

Any add-ins present in Excel can be activated/deactivated from this tab.

9.5.11 *Trust Center*

Users can check security certificates or other security settings on this tab.

> **Key Take-Aways**
>
> **Preferences**
>
> - Excel includes scores of options that users can change according to their individual preferences.

9.6 JUST FOR FUN

Excel has had a long and expansive lifetime. It should not be surprising that along the way people who use Excel would find interesting things to do with Excel that are not exactly in the users' manual. This final section of the book lists a few of the fun facts about Excel along with the things people have done with this versatile application.

9.6.1 *Interesting Bug*

Excel started as a competitive product for Lotus 123. Unfortunately, Lotus 123 counted the year 1900 as a leap year, though it was not. When Excel was first created, Microsoft decided to use the same serial numbering convention for storing dates so the two programs were compatible; but that meant the year 1900 was also listed as a leap year in Excel. While this would have been a very easy bug to correct, that would mean that every date after Feb 29, 1900 would have been one day off. For this reason, Microsoft decided to leave that leap day in the program. Consequently, to this day, Feb 29, 1900 exists in Excel even though there was never a Feb 29, 1900 on the calendar. (Reference: https://www.datarails.com/6-cool-facts-excel/)

9.6.2 *Renaming Genes*

Some genes had to be renamed since Excel automatically formatted the original names as dates. For example, there is a gene that was originally named MARCH1 (for Membrane Associated Ring-CH-Type Finger 1), but whenever MARCH1 is entered in Excel it is formatted as a date. As a result, the HUGO Gene Nomenclature Committee changed the name of this gene to MARCHF1. 27 other genes with the same problem were renamed. (Reference: https://www.engadget.com/scientists-rename-genes-due-to-excel-151748790.html)

9.6.3 *Art with Excel*

Tatsuo Horiuchi, a 73-year-old Japanese artist, creates some of the most impressive still life art using only Excel as his canvas. Examples of his work, along with a brief explanation of how he creates them, can be found at https://www.demilked.com/73-year-old-excel-paintings-tatsuo-horiuchi/.

Figure 395: Mr. Horiuchi's Art

9.6.4 *Excel and Sudoku*

For fans of *Sudoku*, Peter Mladek created an Excel workbook with macros that can create endless *Sudoku* puzzles. While loading Excel workbooks containing macros found on the web can be risky, this workbook has been around since 2004 and been used by countless thousands of people; so it would be reasonable to trust it. The free version builds a puzzle and optionally fills the cells with possible solutions. Registering the workbook for $ 9.99 opens advanced features that include a solution aid and puzzle creator. Sudoku fans should check out http://www.sudoku-xls.com/ for more information.

9.7 CHAPTER PRACTICE

9.7.1 *Cars Analysis*

This exercise uses data on 392 car models that was collected by David Donoho and Ernesto Ramos for the 1982 *Exposition of Statistical Graphics Technology* hosted by the *Committee on Statistical Graphics of the American Statistical Association (ASA)*. The dataset is commonly used in statistics classes and can be found at several online locations, including https://github.com/sandialabs/slycat-data.

1. Start Excel and open a new blank workbook.

2. Save the workbook as **PR9-Cars**.

3. **Excel 2016** Load the data.

   a) Click **Data** ⇒ **Get External Data** ⇒ **From Text**.

   b) Navigate to **PR9-Data.csv**.

   c) Click the file name and then **Import**.

   d) Work through the import wizard.

      i. The data in the CSV file has headers.

      ii. The data uses a comma delimiter.

      iii. Import the data into a new worksheet.

   e) Click cell **A1** then click **Insert** ⇒ **Tables** ⇒ **Table**.

   f) The *Create Table* dialog box has the correct defaults, so click **OK**.

   g) Click **Yes** on the dialog box with the warning about overlapping "external data ranges" to complete the data import.

4. **Excel 365** Load the data.

   a) Click **Data** ⇒ **Get & Transform Data** ⇒ **From Text/CSV**.

   b) Navigate to **PR9-Data.csv**.

   c) Click the file name and then **Import**.

   d) Excel correctly identifies the data fields in the file, so click **Load** to import the data into a table in a new worksheet.

5. Delete **Sheet1**.

6. Rename **Sheet2** to **Cars**.

7. Click **A1** to activate the table.

8. In **Table Design** ⇒ **Properties** ⇒ **Table Name**, enter *Cars*.

9. Even though the data loads properly, there are a few adjustments that need to be made. First, the **Origin** column only lists three different locations by number, but these should be changed to their text equivalent for easier analysis.

   a) Click the down-arrow on the right side of the *Origin* column header for **Column I**.

b) Uncheck all items except 1 and then click **OK**.

Figure 396: Filtering for Location 1

c) All rows that do not contain a 1 for *Origin* are hidden.

d) Enter *American* in **I3** (the cell at the top of the column after rows have been hidden).

e) Copy/paste **I3** to all other visible cells in **Column I**. Note: using the autofill handle makes this task easier.

f) Click the filter symbol on the right side of the *Origin* column header for **Column I**.

g) Uncheck all items except 2 and then click **OK**.

h) All rows that do not contain a 2 for *Origin* are hidden.

i) Enter *European* in **I2** (the cell at the top of the column after rows have been hidden).

j) Copy/paste **I2** to all other visible cells in **Column I**. Note: using the autofill handle makes this task easier.

k) Click the filter symbol on the right side of the *Origin* column header for **Column I**.
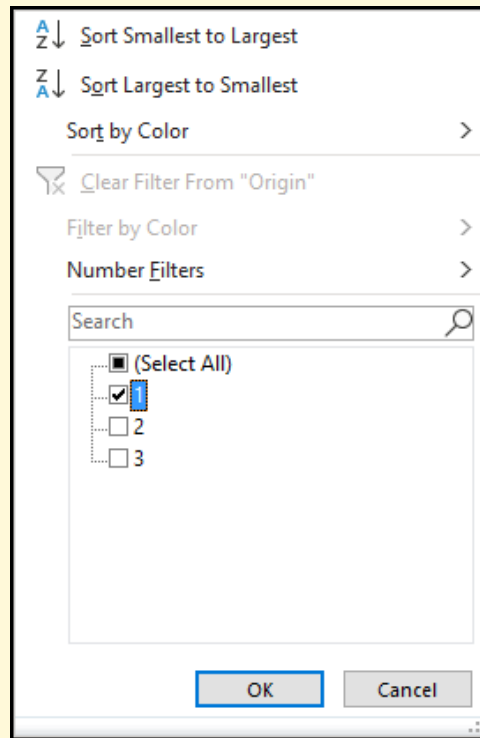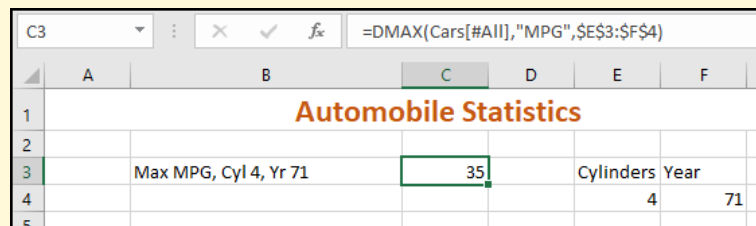
l) Uncheck all items except 3 and then click **OK**.

m) All rows that do not contain a 3 for *Origin* are hidden.

n) Enter *Japanese* in **I4** (the cell at the top of the column after rows have been hidden).

o) Copy/paste **I4** to all other visible cells in **Column I**. Note: using the autofill handle makes this task easier.

p) Click the filter symbol on the right side of the *Origin* column header for **Column I**.

q) Check **(Select All)** then **OK** to reveal all rows in the data set.

r) Adjust the width of **Column I** to fit the data.

s) Save the **PR9-Cars** workbook.

10. Next, data in the **Model** column needs to be split out so the automobile make and model are separated.

a) Insert a column to the left of **Column B**. The new column becomes **Column B** with a header of *Column1*.

b) Enter this formula in **B2**: **=PROPER(LEFT(A2,FIND(" ",A2)-1))**. If Excel does not paste that formula to the bottom of the table, then copy/paste it to **B3:B393**. Excel extracts the make of the car, which is the first word in **Column A**.

c) Adjust the width of **Column B** to fit the data.

d) Insert a column to the left of **Column C**. The new column becomes **Column C** with a header of *Column2*.

e) Copy **B2:B393**.

f) Paste Values to **C2**. Note: it is important to paste the values, not just a simple paste. Otherwise, **Column C** will be filled with the formula rather than the value generated by that formula.

g) Delete **Column B**.

h) Insert a column to the left of **Column C**. The new column becomes **Column C** with a header of *Column3*.

  i) Enter this formula in **C2**: *=PROPER(RIGHT(A2,LEN(A2)-FIND(" ",A2)))*. If Excel does not paste that formula to the bottom of the table, then copy/paste it to **C3:C393**. Excel extracts the model of the car, which is everything except the first word in **Column A**.

  j) Insert a column to the left of **Column D**. The new column becomes **Column D** with a header of *Column4*.

  k) Copy **C2:C393**.

  l) Paste Values to **D1**. Note: it is important to paste the values, not just a simple paste. Otherwise, **Column D** will be filled with the formula rather than the value generated by that formula.

  m) Delete **Column C**.

  n) At this point, the data in **Column A** should be split between **Column B** and **Column C**.

  o) Delete **Column A**.

  p) Enter *Make* in **A1**.

  q) Enter *Model* in **B1**.

11. Click the filter symbol on the right side of the *Make* column header for **Column A**.

12. Select **Sort A to Z**.

13. Adjust the width of **Column A** and **Column B** to fit the data.

14. The data preparation is complete so save the **PR9-Cars** workbook.

Once a data table is prepared it can be used for analysis. For this exercise, several different analysis techniques are used.

1. Create a new worksheet and name it *Summary*.

2. Move **Summary** to the left of **Cars** so it is the first worksheet in the workbook.

3. Click the **Summary** tab to activate that sheet.

4. Select **A1:G1** and click **Home** ⇒ **Alignment** ⇒ **Merge & Center**.

5. In cell **A1**, enter *Automobile Statistics*.

6. Format cell **A1**.

   - Calibri font, 18 pt
   - Bold style
   - Font color: Orange, Accent 2, Darker 25%

7. In cell **E3**, enter *Cylinders*.

8. In cell **E4**, enter *4*.

9. In cell **F3**, enter *Year*.

10. In cell **F4**, enter *71*.

11. In cell **B3**, enter *Max MPG, Cyl 4, Yr 71*.

12. Adjust the width of **Column B** to fit the text in **B3**.

13. In cell **C3**, enter *=DMAX(Cars[#All], "MPG", $E$3:$F$4)*.

14. Excel reports 35 as the maximum MPG for 1971 cars with 4 cylinders.

C3	▾	:	×	✓	ƒx	=DMAX(Cars[#All],"MPG",$E$3:$F$4)		
	A		B		C	D	E	F
1			**Automobile Statistics**					
2								
3			Max MPG, Cyl 4, Yr 71		35		Cylinders	Year
4							4	71
5								

Figure 397: Calculating the Max MPG

15. In cell **B4**, enter *Avr MPG, Cyl 4, Yr 71*.

16. In cell **C4**, enter *=DAVERAGE(Cars[#All], "MPG", $E$3:$F$4)*.

17. Excel reports 25.66667 as the average MPG for 1970 cars with 4 cylinders.

18. In cell **F4**, enter 72. Notice that Excel automatically updates **C3** and **C4** to reflect the values for 1972 cars.

19. In cell **F4**, enter 71 to change back to that year and match the labels in **B3** and **B4**.

20. In cell **B5**, enter *Avr MPG, Cyl 4-6, Yr 71*.

21. In cell **E5**, enter 6

22. In cell **F5**, enter 71.

23. In cell **C5**, enter *=DAVERAGE(Cars[#All], "MPG", $E$3:$F$5)*.

24. Excel reports 23.8 as the average MPG for 1971 cars with 4 or 6 cylinders.

Excel reads the criteria range such that items in a single row are joined with an "AND" and multiple rows are joined with an "OR." Thus, the criteria in *E3:F5* reads *(Cars with 4 cylinders AND year 71) OR (Cars with 6 cylinders AND year 71)*. Complex Boolean conditions can be specified using multiple rows and columns.

If a cell in a criteria range is empty, then Excel matches it to all entries in the data table.

1. Delete the data in **F5**. Notice that the value in **C5** changes to 20.94526. The criteria in this case reads *(Cars with 4 cylinders AND year 70) OR (Cars with 6 cylinders AND all model years*.

2. In cell **F5**, enter 71.

3. In cell **G3**, enter *Origin*.

4. In cell **G4**, enter *American*.

5. In cell **B6**, enter *Avr MPG, Cyl 6, Yr 71, American*.

6. Adjust the width of **Column B** to fit the text in **B6**.

7. In cell **C6**, enter *=DAVERAGE(Cars[#All], "MPG", $E$3:$G$4)*.

8. Excel reports 24.75 as the average MPG for 1971 cars with 4 cylinders made in America.

9. Complete the summary worksheet using the following information. Adjust the width of **Column B** as necessary to display the text entered there.

Cell	Content
B7	*Max MPG, American*
C7	*=DMAX(Cars[#All],"MPG",$G$3:$G$4)*
F8	*Year*
G8	*Origin*
F9	*< 76*
G9	*American*
B8	*Min MPG, Yr<76, American*
C8	*=DMIN(Cars[#All],"MPG",$F$8:$G$9)*
F10	*< 76*
G10	*European*
B9	*Avr MPG, Yr<76, American or European*
C9	*=DAVERAGE(Cars[#All],"MPG",$F$8:$G$10)*

The Figure 398 shows the Summary Table at this point, but it could easily be extended with various combinations of criteria to extract whatever information is desired from the cars data.

Automobile Statistics					
			Cylinders	Year	Origin
Max MPG, Cyl 4, Yr 71	35		4	71	American
Avr MPG, Cyl 4, Yr 71	27.66667		6	71	
Avr MPG, Cyl 4-6, Yr 71	23.8				
Avr MPG, Cyl 6, Yr 71, American	24.75				
Max MPG, American	39				
Min MPG, Year<76, American	9			Year	Origin
Avr MPG, Yr<76, American or European	18.29032			<76	American
				<76	European

Figure 398: Summary Table

1. Save the **PR9-Cars** workbook.

2. Click in **B12** to activate that cell.

3. Click **Data** ⇒ **Analyze** ⇒ **Data Analysis**.

4. Select **Correlation** in the *Data Analysis* dialog box, then click **OK**.
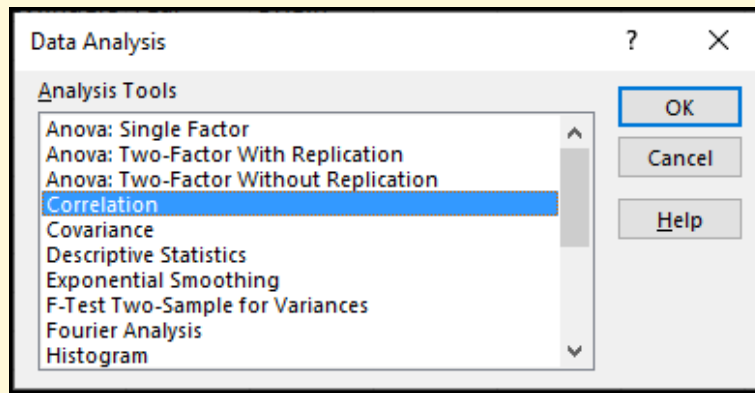
Figure 399: Data Analysis Popup

5. Enter the following in the *Correlation* dialog box.

- **Input Range**: *'Cars'!$C$1:$H$393*

- **Grouped By**: Columns

- **Labels in first row**: Checked

- **Output Range**: $B$12
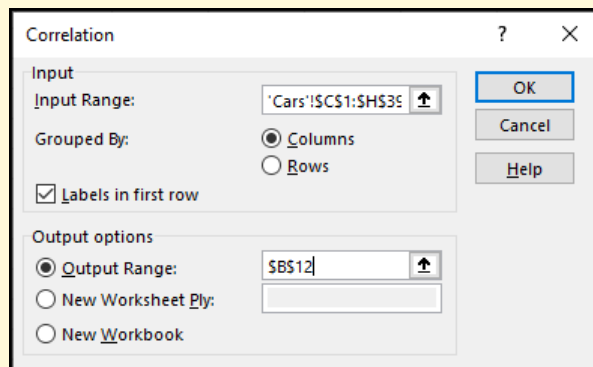
Figure 400: Correlation Parameters

6. Click **OK**.

7. Adjust the column widths so all information in **Row 12** is visible.

8. Excel calculates the various correlations and displays them in **B12:H18**. There are several rather extreme correlations in the table, but all would be expected. For example, the correlation between weight and MPG is −0.83224, so heavier cars get fewer miles per gallon.

	MPG	Cylinders	Displacement	Horsepower	Weight	Acceleration
MPG	1					
Cylinders	-0.77762	1				
Displacement	-0.80513	0.950823	1			
Horsepower	-0.77843	0.842983	0.897259362	1		
Weight	-0.83224	0.897527	0.932992684	0.864537738	1	
Acceleration	0.423329	-0.50468	-0.543800174	-0.68919551	-0.41684	1

Figure 401: Correlation Results

9. Click in **B21** to activate that cell.

10. Click **Data ⇒ Analyze ⇒ Data Analysis**.

11. Select **Histogram** in the *Data Analysis* dialog box, then click **OK**.

12. Enter the following in the *Histogram* dialog box.

   - **Input Range**: *'Cars'!$C$1:$C$393*
   - **Labels**: Checked
   - **Output Range**: $B$21
   - **Chart Output**: Checked

Figure 402: Histogram Parameters

13. Click **OK**.

14. Excel displays the histogram data and chart.

15. Adjust the chart so the top left corner is in **D22** and the bottom right corner is in **K38**.

16. Using the *Chart Elements* selector, remove the legend from the histogram.

17. Change the title of the histogram to *Automobile MPG*.

18. Change the *X-Axis* title to *MPG*.

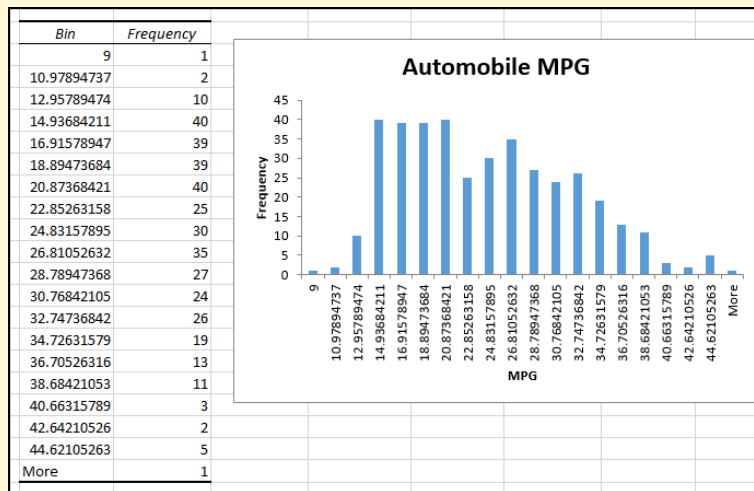| Bin	Frequency
9	1
10.97894737	2
12.95789474	10
14.93684211	40
16.91578947	39
18.89473684	39
20.87368421	40
22.85263158	25
24.83157895	30
26.81052632	35
28.78947368	27
30.76842105	24
32.74736842	26
34.72631579	19
36.70526316	13
38.68421053	11
40.66315789	3
42.64210526	2
44.62105263	5
More	1

Figure 403: Histogram Results

19. Save the **PR9-Cars** workbook.

20. Compare the workbook with the self-check answer key (**PR9-Cars Solution**) and then close and submit the **PR9-Cars** workbook as directed by the instructor.

9.8 SCORED ASSESSMENT

9.8.1 *Weather Analysis*

The *National Oceanic and Atmospheric Administration (NOAA)* makes all their weather data available for researchers to investigate.[1]

1. Open workbook **SC9-Data**.

2. Save the workbook as **SC9-Climate**.

This workbook has two worksheets. The **Data** sheet contains the raw data that will be analyzed for this exercise and the **Notes** sheet contains definitions for the abbreviations used on the **Data** sheet.

1. Calculate the number of hours of daylight for each day.

   a) Insert a new column to the left of **Column N**.

---

1 The data for this exercise was downloaded and adapted from https://www.ncdc.noaa.gov/cdo-web/.

b) In cell **N1**, enter *Daylight*.

c) In cell **N2**, enter *=M2-L2*.

d) Copy/paste **N2** to **N3:N363**.

e) Click **Home** ⇒ **Number** ⇒ **Down Arrow** ⇒ **More Number Formats**.

f) In the *Format Cells* dialog box, select **Time** in the *Category* list and then select **37:30:55** in the *Type* list. This will format the data in **Column N** to the number of hours/minutes elapsed between sunrise and sunset.
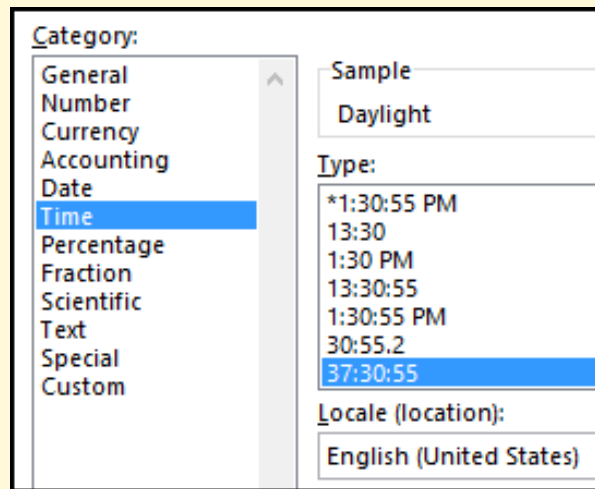
Figure 404: Formatting The Daylight Column

2. Use the following steps to convert the data to a table.

a) Click in **A1** to activate that cell.

b) Click **Insert** ⇒ **Tables** ⇒ **Table**.

c) Excel will automatically select the entire data set, **$A$1:$O$363**. Be sure **My table has headers** is checked.

d) Click **OK**.

e) Name the table *Climate*.

Figure 405: Climate Table Name

3. Create a new worksheet and name it *Summary*.

4. Move **Summary** to the left of **Data** so it is the first work-sheet in the workbook.

5. Click the **Summary** tab to activate that sheet.

6. Select **A1:G1** and click **Merge & Center**.

7. In cell **A1**, enter *2019 Ft Huachuca Climate Information*.

8. Format cell **A1**.

   - Calibri font, 18 pt
   - Bold style
   - Font color: Blue, Accent 1

9. In cell **B3**, enter *Date*. (Note: this will be the starting date for formulas on this sheet, but the title in **B3** must match the field name on the *Climate* table.)

10. In cell **C3**, enter *Date*. (Note: this will be the ending date for formulas on this sheet, but the title in **C3** must match the field name on the *Climate* table.)

11. In cell **B4**, enter $>= 1/1/2019$ (Note: do not leave spaces in this formula).

12. In cell **C4**, enter $<= 1/31/2019$ (Note: do not leave spaces in this formula).

13. In cell **B5**, enter *Max Temp*.

14. Adjust the width of **Column B** and **Column C** so everything is visible.

15. In cell **C5**, enter this formula: *=DMAX(Climate[#All], "TMAX", $B$3:$C$4)*.

16. Cell **C5** will display 72, which is the greatest *TMAX* for January, 2019.

C5		⋮	×	✓	*fx*	=DMAX(Climate[#All],"TMAX",$B$3:$C$4)	
◢	A	B		C	D	E	F	G
1		**2019 Ft Huachuca Climate Information**						
2								
3		Date		Date				
4		>=1/1/2019		<=1/31/2019				
5		Max Temp		72				

Figure 406: Maximum January Temperature

17. Change the dates to $>= 3/1/2019$ and $<= 3/31/2019$ to find that the maximum March temperature is 82.

18. Change the dates back to $>= 1/1/2019$ and $<= 1/31/2019$ to complete the other activities on the summary sheet.

19. In cell **B6**, enter *Min Temp*.

20. In cell **C6**, enter this formula: *=DMIN(Climate[#All], "TMIN", $B$3:$C$4)*.

21. Cell **C6** will display 21, which is the least *TMIN* for January, 2019.

22. In cell **B7**, enter *Precipitation*. (The width of **Column B** may need to be changed to see the word *Precipitation*.)

23. In cell **C7**, enter this formula: *=DSUM(Climate[#All], "PRCP", $B$3:$C$4)*.

24. Cell **C7** will display 0.9, which is the total precipitation for January, 2019.

25. In cell **B8**, enter *Wind Speed*.

26. In cell **C8**, enter this formula: *=DAVERAGE(Climate[#All], "AWND", $B$3:$C$4)*.

27. Cell **C8** will display 8.002258065, which is the average wind speed for January, 2019.

28. To make **C8** easier to read, click **Home** ⇒ **Number** ⇒ **Decrease Decimal** to reduce **C8** to two decimal places, 8.00.

29. In cell **B9**, enter *Max Wind*.

30. In cell **C9**, enter this formula: *=DMAX(Climate[#All], "WSF5", $B$3:$C$4)*.

31. Cell **C9** will display 42.90, which is the greatest wind gust for January, 2019.

32. Copy/paste **B3:C4** to **B11:C12**.

33. In cell **D11**, enter *Moon*.

34. In cell **D12**, enter *New*.

35. In cell **C12**, enter <= 12/31/2019.

36. In cell **B13**, enter *Coldest New Moon*. (The width of **Column B** may need to be changed to see the words *Coldest New Moon*.)

37. In cell **C13**, enter this formula: *=DMIN(Climate[#All], "TMIN", $B$11:$D$12)*.

38. Cell **C13** will display 32, which was the coldest temperature recorded on a night with a new moon in 2019.

39. Copy/paste **B11:D12** to **B15:D16**.

40. In cell **D15**, enter *DailyWeather* (Note: there is no space between the two words).

41. In cell **D16**, enter **TS**. Note: the asterisks are "wildcard" characters and will create a match on any cell that contains *TS* somewhere in the cell.

42. In cell **B17**, enter *Largest Storm*.

43. In cell **C17**, enter this formula: *=DMAX(Climate[#All], "PRCP", $B$15:$D$16)*.

44. Cell **C17** will display 2.32, which was the most rainfall on a day that recorded thunder in 2019.

A	B	C	D	E	F
	2019 Ft Huachuca Climate Information				
	Date	Date			
	>=1/1/2019	<=1/31/2019			
	Max Temp	72			
	Min Temp	21			
	Precipitation	0.9			
	Wind Speed	8.00			
	Max Wind	42.90			
	Date	Date	Moon		
	>=1/1/2019	<=12/31/2019	New		
	Coldest New Moon	32			
	Date	Date	DailyWeather		
	>=1/1/2019	<=12/31/2019	*TS*		
	Largest Storm	2.32			

Figure 407: Various Summary Statistics

45. Save the **SC9-Climate** workbook.

Next, create a chart that shows the amount of daylight throughout the year. (Note: the process for creating charts is covered in more detail in Chapter 4, page 187.)

1. Click the **Data** worksheet to activate it.

2. Click the top of **Column N** to activate that column.

3. Click **Insert** ⇒ **Charts** ⇒ **Insert Line or Area Chart**.

4. In the *Line Chart* dialog box, select the first option, **2-D Line**.

5. Excel will create a line chart that shows the amount of daylight throughout the year.
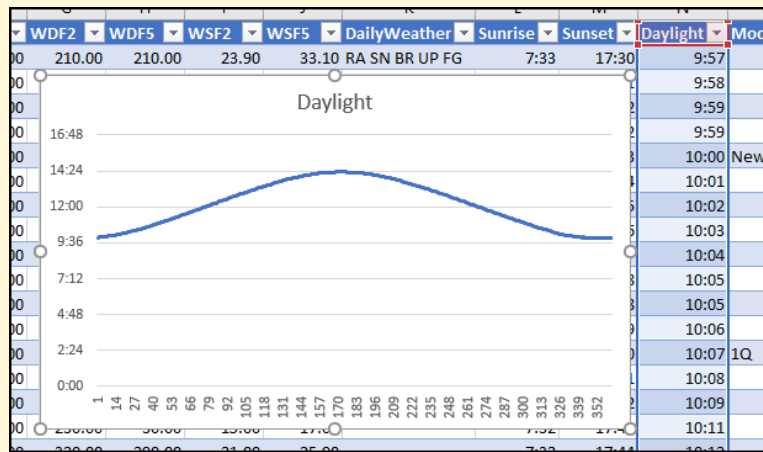
Figure 408: Daylight Chart: Start

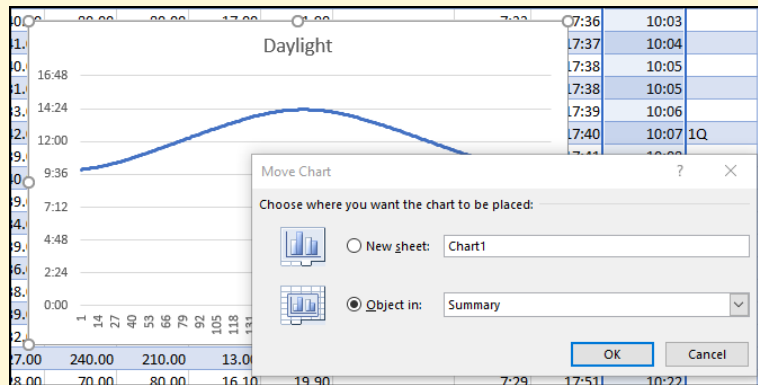6. Right-click the chart and select **Move Chart**. Move it as an object in the **Summary** worksheet.

Figure 409: Daylight Chart: Moving to Summary Worksheet

7. Drag/drop the chart so the top-left corner is about at the center of cell **B20**.

8. By default, the horizontal axis simply counts the number of entries from 1 to 363, but it should display the dates found in *Column A*.

9. Click the chart area to display the three buttons on the right side of the chart. Click the **Chart Filters** button, which looks like a funnel.
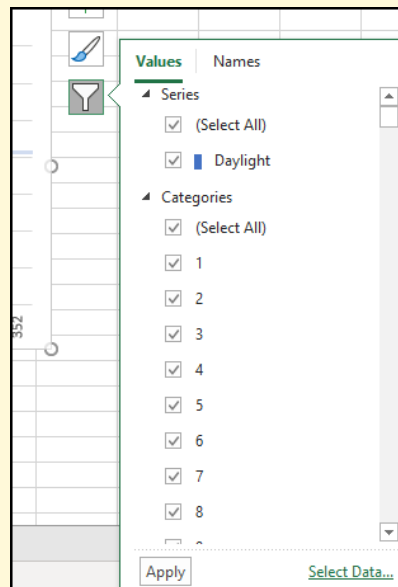
Figure 410: Daylight Chart: Chart Filters

10. Notice that the *Categories* filter is just a list of numbers, starting at one. Click the **Select Data** button at the bottom right corner of the *Values* dialog box. The *Select Data Source* dialog box appears.
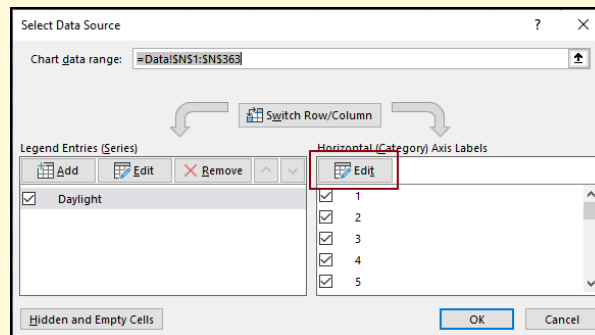

Figure 411: Daylight Chart: Select Data Source

11. Click **Edit** for the *Horizontal (Category) Axis Labels*. That button is marked in Figure 411.

12. Enter *=Data!$A$2:$A$363* for the Axis label range.
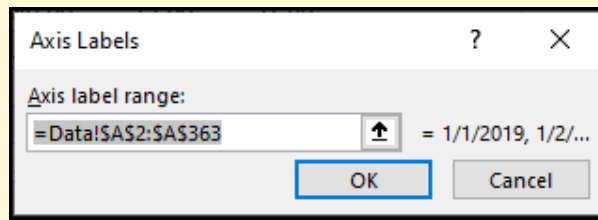
Figure 412: Daylight Chart: Axis Labels

13. Excel changes the labels for the *X-Axis* to the dates found in **Column A** of the **Data** worksheet. Click **OK** on the *Select Data Source* dialog box to finish this selection.

14. To adjust the scale for the *Y-Axis* (the hours of daylight), right-click on the vertical axis values and select **Format Axis**.

15. In the *Format Axis* dialog box, enter 0.35 for the *Minimum Bounds* (the *Maximum Bounds* will automatically adjust).

Figure 413: Daylight Chart: Adjusting Y-Axis Scale

16. Save the **SC-Climate** workbook.

17. Close and submit the **SC9-Climate** workbook as directed by the instructor.

Part IV

APPENDIX

This part contains additional information about Excel that is outside the scope of the Center for Lifelong Learning class.
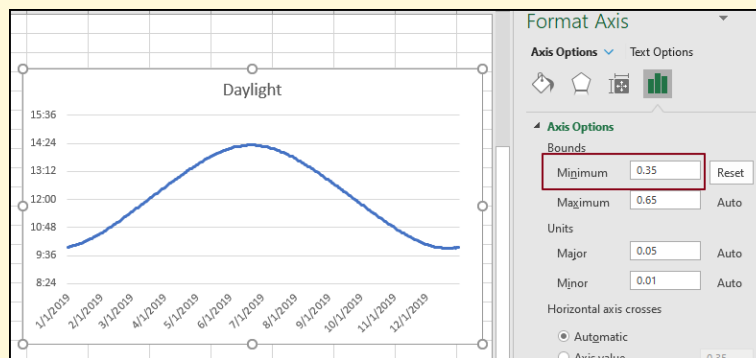
FUNCTION QUICK REFERENCE

According to Microsoft's specification sheet for Excel, there are 341 worksheet functions. No user needs to be familiar with all of these functions, but this appendix lists those found in this book, which are the most commonly used.

A.1 AND

Returns TRUE if all of its arguments evaluate to TRUE and FALSE if one or more arguments evaluate to FALSE.

SYNTAX:

AND(logical1, [logical2], ...)

LOGICAL1 *Required.* The first condition to be tested that can evaluate to either TRUE or FALSE.

LOGICAL2, ... *Optional.* Additional conditions to be tested that can evaluate to either TRUE or FALSE, up to a maximum of 255 conditions.

EXAMPLE:

Consider the worksheet illustrated in Figure 414.

	A	B	C
1	Region	Reps	Sales
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 414: AND Example Worksheet

If the following function were entered in cell E2:
=AND(B2>1,B2<10)
it would return TRUE.

A.2 AVERAGE

Returns the average (arithmetic mean) of the arguments.

<u>Syntax:</u>

AVERAGE(number1, [number2], ...)

NUMBER1 *Required*. The first number, cell reference, or range for which you want the average.

NUMBER2, ... *Optional*. Additional numbers, cell references or ranges for which you want the average, up to a maximum of 255.

<u>Example:</u>

Consider the worksheet illustrated in Figure 415.

Figure 415: AVERAGE Example Worksheet

If the following function were entered in cell E2:
    =AVERAGE(B2:B5)
it would return 5.75.

A.3   CONCATENATE

Joins two or more text strings into one string. **IMPORTANT**: This function was replaced with *CONCAT* in Excel 365, but the syntax is the same for both functions.

<u>Syntax:</u>

CONCATENATE(text1, [text2], ...)

TEXT1 *Required*. The first item to join. The item can be a text value, number, or cell reference.

TEXT2, ... *Optional*. Additional text items to join. You can have up to 255 items, up to a total of 8,192 characters.

<u>Example:</u>

Consider the worksheet illustrated in Figure 416.

Figure 416: CONCATENATE Example Worksheet

If the following function were entered in cell E2:
    =CONCATENATE(A2,A4)
it would return *NorthEast*.

A.4   COUNT

Counts the number of cells that contain numerical values. Cells with non-numeric content are ignored.

SYNTAX:

COUNT(value1, [value2], ...)

VALUE1   *Required*. The first item, cell reference, or range within which the cells containing numbers must be counted.

VALUE2, …   *Optional*. Up to 255 additional items, cell references, or ranges within which the cells containing numbers must be counted.

EXAMPLE:

Consider the worksheet illustrated in Figure 417.

Figure 417: COUNT Example Worksheet

If the following function were entered in cell E2:
    =COUNT(B2:B5)
it would return 4.

A.5   COUNTIF

Counts the number of cells that meet a criterion.

<u>SYNTAX:</u>

COUNTIF(range, criteria)

RANGE *Required*. The group of cells to count. *Range* can contain numbers, arrays, a named range, or references that contain numbers. Blank and text values are ignored.

CRITERIA *Required*. A number, expression, cell reference, or text string that determines which cells will be counted.

<u>EXAMPLE:</u>

Consider the worksheet illustrated in Figure 418.

	A	B	C
1	Region	Reps	Sales
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 418: COUNTIF Example Worksheet

If the following function were entered in cell E2:
   =COUNTIF(B2:B5,">5")
it would return 2.

A.6   COUNTIFS

Applies criteria to cells across multiple ranges and counts the number of times all criteria are met.

<u>SYNTAX:</u>

COUNTIFS(range1, criteria1, [range2, criteria2], ...)

RANGE1 *Required*. The first range in which to evaluate the associated criteria.

CRITERIA1 *Required*. The criteria in the form of a number, expression, cell reference, or text string that determines which cells will be counted.

RANGE2, CRITERIA2, … *Optional*. Additional ranges and criteria. Up to 127 range/criteria pairs are allowed.

Consider the worksheet illustrated in Figure 419.

Figure 419: COUNTIFS Example Worksheet

If the following function were entered in cell E2:
   =COUNTIFS(B2:B5,">3",B2:B5,"<8")
it would return 2.

A.7   DATE

Combines three separate values to form a date.

SYNTAX:

DATE(year,month,day)

YEAR *Required.* The value of the year argument can include one to four digits. Excel interprets the year argument according to the date system the computer is using.

MONTH *Required.* An integer representing the month of the year from 1 to 12 (January to December).

DAY *Required.* An integer representing the day of the month from 1 to 31.

EXAMPLE:

If the following function were entered in cell A1:
   =DATE(2020,3,4)
it would return the date 3/4/2020 formatted according to the settings on the local computer.

A.8   DATEDIF

Calculates the number of days, months, or years between two dates. **Warning**: Excel provides the *DATEDIF* function in order to support older workbooks from Lotus 1-2-3. The *DATEDIF* function may calculate incorrect results under certain scenarios.

SYNTAX:

DATEDIF(start_date,end_date,unit)

START_DATE *Required*. A date that represents the first, or start-ing date of a given period. Dates may be entered as text strings within quotation marks (for example, "1/30/2001") or as the result of other formulas or functions.

END_DATE *Required*. A date that represents the last, or ending, date of the period.

UNIT *Required*. The type of information to be returned. "Y" is the number of complete years in the period, "M" is the number of complete months in the period, "D" is the num-ber of complete days in the period.

EXAMPLE:

Consider the worksheet illustrated in Figure 420.

Figure 420: DATEDIF Example Worksheet

If the following function were entered in cell C2:
    =DATEDIF(A1,A2,"Y")
it would return 65. This is how a person's age can be calculated with Excel.

A.9   IF

Makes logical comparisons between a value and what was expected. This is one of the most popular Excel functions.

SYNTAX:

IF(logical_test, value_if_true, [value_if_false])

LOGICAL_TEST *Required*. The condition being tested.

VALUE_IF_TRUE *Required*. The value returned if the result of logical_test is TRUE.

UNIT *Optional*. The value returned if the result of logical_test is FALSE.

Consider the worksheet illustrated in Figure 421.

Figure 421: IF Example Worksheet

If the following function were entered in cell E2:
   =IF(C2>15000,"Bonus","Regular")
it would return *Bonus*.

A.10   INDEX

Returns a value or the reference to a value from within a table or range.

SYNTAX:

INDEX(array, row_num, [column_num])

ARRAY *Required*. A range of cells or an array constant.

ROW_NUM *Required*, unless column_num is present. Selects the row in *array* from which to return a value. If row_num is omitted, column_num is required.

COLUMN_NUM *Optional*. Selects the column in array from which to return a value. If column_num is omitted, row_num is required.

EXAMPLE:

Consider the worksheet illustrated in Figure 422.

Figure 422: INDEX Example Worksheet

If the following function were entered in cell E2:

=INDEX(A1:C5,4,3)
it would return 13405.

A.11   LEFT

Returns the first character or characters in a text string, based on the number of characters specified.

SYNTAX:

LEFT(text, [num_chars])

TEXT   *Required*. The text string that contains the characters to be extracted.

NUM_CHARS   *Optional*. Specifies the number of characters to be extracted. If num_chars is omitted, it is assumed to be 1.

EXAMPLE:

Consider the worksheet illustrated in Figure 423.

Figure 423: LEFT Example Worksheet

If the following function were entered in cell E2:
=LEFT(A2,3)
it would return *Nor*.

A.12   LOWER

Converts all uppercase letters in a text string to lowercase.

SYNTAX:

LOWER(text)

TEXT   *Required*. The text string that contains the characters to be converted to lowercase.

EXAMPLE:

Consider the worksheet illustrated in Figure 424.

Figure 424: LOWER Example Worksheet

If the following function were entered in cell E2:

=LOWER(A2)

it would return *north*.

A.13   MATCH

Searches for a specified item in a range of cells and then returns the relative position of that item in the range. This function is commonly combined with *Index* to lookup data in a table.

SYNTAX:

MATCH(lookup_value, lookup_array, [match_type])

LOOKUP_VALUE *Required*. The value that to be matched in *lookup_array*.

LOOKUP_ARRAY *Required*. The range of cells being searched.

MATCH_TYPE *Optional*. The number −1, 0, or 1 specifies how Excel matches *lookup_value* with values in *lookup_array*. 1 finds the largest value that is less than or equal to *lookup_value*. 0 finds the first value that is exactly equal to *lookup_value*. −1 finds the smallest value that is greater than or equal to *lookup_value*. If omitted, the default is 1.

EXAMPLE:

Consider the worksheet illustrated in Figure 425.

Figure 425: MATCH Example Worksheet

If the following function were entered in cell E2:

=MATCH(3,B1:B5,0)

it would return 4 since the 3 is in the fourth row in *Column B*.

A.14   MAX

Returns the largest value in a set of values.

SYNTAX:

MAX(number1, [number2], ...)

NUMBER1, NUMBER2, … *Required.* Up to 255 numbers for which the maximum value is returned. This is usually a reference to a range of numbers.

EXAMPLE:

Consider the worksheet illustrated in Figure 426.

	A	B	C
1	Region	Reps	Sales
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 426: MAX Example Worksheet

If the following function were entered in cell E2:
   =MAX(B1:B5)
it would return 18580.

A.15   MID

Returns a specific number of characters from a text string, starting at the position specified, based on the number of characters specified.

SYNTAX:

MID(text, start_num, num_chars)

TEXT *Required.* The text string that contains the characters to be extracted.

START_NUM *Required.* The position of the first character to be extracted in *text*. The first character in *text* has a start_num of 1, and so on.

NUM_CHARS *Required.* Specifies the number of characters to be extracted.

EXAMPLE:

Consider the worksheet illustrated in Figure 427.

Figure 427: MID Example Worksheet

If the following function were entered in cell E2:

=MID(A2,2,3)

it would return *ort*.

A.16 MIN

Returns the smallest value in a set of values.

SYNTAX:

MIN(number1, [number2], ...)

NUMBER1, NUMBER2, ... *Required.* Up to 255 numbers for which the minimum value is returned. This is usually a reference to a range of numbers.

EXAMPLE:

Consider the worksheet illustrated in Figure 428.

Figure 428: MIN Example Worksheet

If the following function were entered in cell E2:

=MIN(B1:B5)

it would return 13405.

A.17 NOW

Returns the serial number of the current date and time. If the cell format was *General* before the function was entered, Excel changes the cell format so that it matches the date and time format of the regional settings. Note: to get only the date without the time, use the *TODAY* function.

SYNTAX:

NOW()

The *NOW* function has no arguments.

EXAMPLE:

If the following function were entered in cell A1:

    =NOW()

it would return the current date and time. When this was written the value returned was *12/27/2020 12:42*.

A.18 NOT

Reverses the value of its logical argument.

SYNTAX:

NOT(logical)

LOGICAL *Required*. A value or expression that can be evaluated to TRUE or FALSE. If *logical* is FALSE, NOT returns TRUE; if logical is TRUE, NOT returns FALSE.

EXAMPLE:

Consider the worksheet illustrated in Figure 429.

	A	B	C
1	Region	Reps	Sales
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 429: NOT Example Worksheet

If the following function were entered in cell E2:

    =NOT(B2>3)

it would return FALSE. Note, B2 > 3 is TRUE, but the NOT function changes the value returned to FALSE.

A.19 OR

Returns TRUE if any of its arguments evaluate to TRUE and FALSE if all arguments evaluate to FALSE.

SYNTAX:

OR(logical1, [logical2], ...)

LOGICAL1 *Required*. The first condition to be tested that can evaluate to either TRUE or FALSE.

LOGICAL2, … *Optional*. Additional conditions to be tested that can evaluate to either TRUE or FALSE, up to a maximum of 255 conditions.

<u>EXAMPLE:</u>

Consider the worksheet illustrated in Figure 430.

	A	B	C
1	Region ▼	Reps ▼	Sales ▼
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 430: OR Example Worksheet

If the following function were entered in cell E2:
   =OR(B2>1,B2<10)
it would return TRUE.

A.20 PMT

Calculates the payment for a loan based on constant payments and a constant interest rate.

<u>SYNTAX:</u>

PMT(rate, nper, pv, [fv], [type])

RATE *Required*. The interest rate for the loan.

NPER *Required*. The total number of payments for the loan.

PV *Required*. The present value, or the total amount that a series of future payments is worth now; also known as the principal.

FV *Optional*. The future value, or a cash balance attained after the last payment is made. If *fv* is omitted, it is assumed to be 0.

TYPE *Optional*. Indicates when payments are due, 0 for the end of the period or 1 for the beginning of the period.

<u>EXAMPLE:</u>

If the following function were entered in cell A1:

=PMT(0.05/12,5*12,-25000)
it would return 471.78. So, a loan of $25000 at 5% interest rate per year for a term of 5 years would generate a monthly payment of 471.78.

A.21   PROPER

Capitalizes the first letter in a text string and any other letters in text that follow any character other than a letter. Converts all other letters to lowercase letters.

SYNTAX:

PROPER(text)

TEXT *Required*. The text string that contains the characters to be partially capitalized.

EXAMPLE:

Consider the worksheet illustrated in Figure 431.

Figure 431: PROPER Example Worksheet

If the following function were entered in cell E2:
=PROPER(A2)
it would return *North*.

A.22   RANDBETWEEN

Returns a random integer number between the numbers specified. A new random integer number is returned every time the worksheet is calculated.

SYNTAX:

RANDBETWEEN(bottom, top)

BOTTOM *Required*. The smallest integer to be returned.

TOP *Required*. The largest integer to be returned.

EXAMPLE:

If the following function were entered in cell A1:
  =RANDBETWEEN(10,99)
it would return a random integer between 10 and 99 (inclusive).

A.23   RIGHT

Returns the last character or characters in a text string, based on the number of characters specified.

SYNTAX:

RIGHT(text, [num_chars])

TEXT   *Required*. The text string that contains the characters to be extracted.

NUM_CHARS   *Optional*. Specifies the number of characters to be extracted. If *num_chars* is omitted, it is assumed to be 1.

EXAMPLE:

Consider the worksheet illustrated in Figure 432.

	A	B	C
1	Region ▼	Reps ▼	Sales ▼
2	North	5	18580
3	South	7	16852
4	East	3	13405
5	West	8	13931

Figure 432: RIGHT Example Worksheet

If the following function were entered in cell E2:
  =RIGHT(A2,3)
it would return *rth*.

A.24   ROUND

Rounds a number to a specified number of digits.

SYNTAX:

ROUND(number, num_digits)

NUMBER   *Required*. The number to be rounded.

NUM_DIGITS   *Required*. The number of digits to which *number* is rounded. If *num_digits* is greater than 0 then number is rounded to the specified number of decimal places. If

num_digits is 0 the number is rounded to the nearest integer. If *num_digits* is less than 0, the number is rounded to the left of the decimal point.

EXAMPLE:

Consider the worksheet illustrated in Figure 433.

Figure 433: ROUND Example Worksheet

If the following function were entered in cell E2:
   =ROUND(C5,-2)
it would return 13900.

A.25   SEARCH

Returns the location of one text string inside another.

SYNTAX:

SEARCH(find_text, within_text, [start_num])

FIND_TEXT *Required*. The text to be found.

WITHIN_TEXT *Required*. The text to be searched.

START_NUM *Optional*. Starting position in the text to be searched. This defaults to 1.

EXAMPLE:

If the following function were entered in cell A1:
   =SEARCH("or","horse")
it would return 2 since the word *or* starts at position 2 in *horse*.

A.26   SUM

Sums the values in a range.

SYNTAX:

SUM(number1,[number2],...)

NUMBER1 *Required*. The first number to be added.

NUMBER2, … *Optional*. Up to 255 additional numbers to be added.

EXAMPLE:

Consider the worksheet illustrated in Figure 434.

Figure 434: SUM Example Worksheet

If the following function were entered in cell E2:
   =SUM(B1:B5)
it would return 23.

A.27   SUMIF

Sums the values in a range that meet a specified criteria.

SYNTAX:

SUMIF(range, criteria, [sum_range])

RANGE *Required*. The range of cells to be evaluated by criteria.

CRITERIA *Required*. The criteria in the form of a number, expression, a cell reference, text, or a function that defines which cells will be added.

SUM_RANGE *Optional*. The actual cells to add if cells other than those specified in the range argument are to be added. If the *sum_range* argument is omitted, Excel adds the cells that are specified in the *range* argument (the same cells to which the criteria is applied).

EXAMPLE:

Consider the worksheet illustrated in Figure 435.

Figure 435: SUMIF Example Worksheet

If the following function were entered in cell E2:
   =SUMIF(B2:B5,">5")
it would return 15, which is the sum of 7 and 8.

A.28   SUMIFS

Sums the values in a range that meet multiple specified criteria.

SYNTAX:

SUMIFS(range, crit_range1, crit1, [crit_range2, crit2], ...)

RANGE *Required.* The range of cells to be summed.

CRIT_RANGE1 *Required.* The range that is tested using *crit1*.

CRIT1 *Required.* The criteria that defines which cells in *crit_range1* will be added.

CRIT_RANGE2, CRIT2, … *Optional.* Additional ranges and their associated criteria. Up to 127 range/criteria pairs can be entered.

EXAMPLE:

Consider the worksheet illustrated in Figure 436.

Figure 436: SUMIFS Example Worksheet

If the following function were entered in cell E2:
   =SUMIFS(B2:B5,B2:B5,">3",B2:B5,"<8")
it would return 12, which is the sum of 5 and 7.

A.29   TODAY

Returns the serial number of the current date. If the cell format was *General* before the function was entered, Excel changes the cell format so that it matches the date and time format of the regional settings. Note: to get both the date and time, use the *NOW* function.

SYNTAX:

TODAY()

The *TODAY* function has no arguments.

EXAMPLE:

If the following function were entered in cell A1:
   =TODAY()
it would return the current date. When this was written the value returned was *12/27/2020*.

A.30   TRIM

Removes all spaces from text except for single spaces between words.

SYNTAX:

TRIM(text)

TEXT *Required*. The text from which excess spaces should be removed.

EXAMPLE:

If the following function were entered in cell A1:
   =TRIM(" Two   Spaces ")
it would return *Two Spaces*.

A.31   UPPER

Converts all lowercase letters in a text string to uppercase.

SYNTAX:

UPPER(text)

TEXT *Required*. The text string that contains the characters to be converted to uppercase.

EXAMPLE:

Consider the worksheet illustrated in Figure .

Figure 437: UPPER Example Worksheet

If the following function were entered in cell E2:
   =UPPER(A2)
it would return *NORTH*.

A.32   VLOOKUP

Looks up a value in a table or range by row.

SYNTAX:

VLOOKUP(value, array, col_num, [range_lookup])

VALUE *Required*. The value to be looked up.

ARRAY *Required*. A range of cells to be searched for the *value*.

COL_NUM *Required*. Selects the column in *array* from which to return a value. The columns are numbered starting with 1 which is the far left column.

RANGE_LOOKUP *Optional*. Specifies whether an approximate match, TRUE, or exact match, FALSE, is desired. The default is approximate.

EXAMPLE:

Consider the worksheet illustrated in Figure 438.

Figure 438: VLOOKUP Example Worksheet

If the following function were entered in cell E2:
   =VLOOKUP(7,B2:C5,2)
it would return 16852.

b

DYNAMIC ARRAYS

Excel 365 NOTE: This appendix concerns *dynamic arrays*, a feature that was first included in Excel 365 and is only available in versions of Excel that are included with a Microsoft Office subscription. Therefore, students who are using Excel 2016 will not be able to use the information in this appendix.

B.1 DEFINITION

Dynamic arrays are grids of data created by calculating values based on the formula in a single cell. From its inception, Excel has always used a "one cell, one formula" approach, so designers who wanted to fill a grid of values would have to copy/paste a formula into each cell in that grid. This was time consuming and error-prone. Dynamic arrays, though, use a formula in a single cell to calculate values in many other cells, saving time and improving accuracy.

The introduction of dynamic arrays includes several new functions that make working with a data array easier. As an example, UNIQUE() will search an array and return only the unique (non-repeating) values. Additionally, dynamic array functions are automatically updated if items are added or removed from the data array.

These concepts are easiest to understand with examples.

1. Click **File** ⇒ **Open** ⇒ **Browse**.

2. Navigate to **APA-Data** and click **Open**.

3. Click **File** ⇒ **Save As** ⇒ **Browse**.

4. Navigate to the desired file location and save it with the name **APA-Dynamic**.

5. Click the **Sales** worksheet tab to open the worksheet.

This simple worksheet lists the names, regions, and number of monthly units sold for several sales representatives in a company.

B.2 FUNCTIONS

B.2.1 *Sort()*

$$= \text{SORT}(\text{array}, [\text{sort\_index}], [\text{sort\_order}], [\text{by\_col}])$$

One of the simplest dynamic array functions is *SORT()*. The syntax above indicates that the only required variable is the array to be sorted, the others are optional. The following steps use the function in its simplest form.

1. Click **E1** and enter *Sort*.

2. Click **E2** to activate that cell.

3. Since the array is in a named table, a column can be sorted by entering the names of the table and column, like *=SORT(Sales[Name])*. Alternatively, the cell range for the Name column can be entered, *=SORT(A2:A21)*, but using the table and column names is a better option since those would still be accurate if the table is later modified.

Notice that even though the formula was only entered in one cell, E2, it filled an entire range, E2 : E21 with the sorted data. The sorted data is dynamic so if any of the names in *Column A* are changed the list in *Column E* is updated to reflect that change.

1. Click **A14** to activate that cell.

2. Type *Alvin* to change the name *Avye*.

3. Notice that the list of names in **Column E** is automatically updated so **E4** contains the changed value, *Alvin*, and the previous value, *Avye,* is gone.

4. Click cell **A12** to activate that cell.

5. Click **Home** ⇒ **Cells** ⇒ **Delete** ⇒ **Delete Table Rows**.

6. The name *Aidan* has been deleted and the list of names in **Column E** is automatically updated to reflect the missing row.

7. Click cell **A13** to activate that cell.

8. Click **Home** ⇒ **Cells** ⇒ **Insert** ⇒ **Insert Table Rows Above**.

9. Click cell **A12** to activate that cell.

10. Type *Bosley* then press Tab .

11. Type *Northeast* then press Tab .

12. Type *146* then press Enter .

13. The name *Bosley* has been added and the list of names in **Column E** is automatically updated to reflect the new row.

Figure 439: Sort Array

Click in E2 and notice that the formula displayed in the formula bar is in normal font. Then click in E3 and notice that the formula displayed in the formula bar is grayed out and cannot be edited. Also notice that the range E2:E21 is surrounded with a blue border, indicating that this is a *spilled array* that is generated automatically from the formula in cell E2.

Best Practice

Array Data

In general, it is best to keep the data referenced by a dynamic array in a data table with at least one column or one row of separation between the data table and a dynamic array. The data table can be in a different worksheet but must be in the same workbook as the dynamic array.

B.2.2 *Sortby()*

$$= \text{SORTBY}(\text{array}, \text{array1}, [\text{order1}], [\text{array2}, \text{order2}], \dots)$$

SORTBY() makes it possible to sort one range by another range for more complex sorts. As an example, the following steps sorts the *Sales* table by *Name* and *Region*.

1. Click **F1** and enter *Sortby*.

2. Click **F2** and enter
   =SORTBY(Sales[[Name]:[Region]],Sales[Region],1, Sales[Name],1) .

Figure 440: Sortby Array

Columns F:G now contains all of the names sorted alphabetically by region. The *SORTBY()* function used in F2 looks complex, but it is not that difficult to understand. Each of the sections of the command are separated by commas and described below.

SALES[[NAME]:[REGION]] — Sort the data in the *Name* and *Region* columns from the *Sales* table.

SALES[REGION] — Use the *Region* column as the primary sort field.

1 — Sort the regions alphabetically from first to last.

SALES[NAME] Use the *Name* column as the secondary sort field; that is, sort the names alphabetically within the regions.

1 — Sort the names alphabetically from first to last.

The *SORTBY()* function is very powerful and even permits sorting by columns that are not in the final output array. For example, to sort the array in F2:G21 by *Units*, change the function in F2 to: *=SORTBY(Sales[[Name]:[Region]], Sales[Region], 1, Sales[Units], -1)*. With this new sort order, Stewart becomes the first name in the Midwest region since he sold the most number of units in that region.

B.2.3 *Unique()*

$$= \mathsf{UNIQUE}(\mathsf{array},[\mathsf{col}],[\mathsf{once}])$$

Follow these steps to find the unique values in a column of data.

1. Click **H1** and enter *Unique*.

2. Click **H2** and enter *=UNIQUE(Sales[Region])*.

Figure 441: Unique Regions

Cells H2:H6 contains the unique values found in the *Region* column. Complete the following steps to test the dynamic characteristic of *Column H*.

1. Click **B5** and enter *Mountain*.

2. Notice that the dynamic range **H2:H7** is updated to include the new *Mountain* region.

3. Click **B5** and enter *Pacific*, which was the original value.

4. Notice that the dynamic range **H2:H7** is updated to exclude the *Mountain* region.

B.2.4   *Nesting Functions*

Dynamic array functions, like any functions, can be nested to improve their usefulness. The unique regions in *Column H* would be more useful if they were in alphabetical order.

> 1. Click **H2** and change the formula in that cell to *=SORT(UNIQUE(Sales[Region]))*.

Now the list of regions in *Column H* will be sorted in alphabetical order.

B.2.5   *Filter()*

$$= \mathsf{FILTER}(\mathsf{array}, \mathsf{include}, [\mathsf{if\_empty}])$$

Dynamic arrays can be filtered to focus on specific items. The following steps remove all regions except Pacific.

> 1. Click **I1** and enter *Filter*.
>
> 2. Click **I2** and enter *=FILTER(Sales[Name],Sales[Region]="Pacific")*.

A dynamic array is created in I2:I5 that lists the names of everyone assigned to the Pacific region. This list would be more useful if it were alphabetized so a *SORT()* function can be added.

> 1. Click **I2** and change the formula in that cell to *=SORT(FILTER(Sales[Name],Sales[Region]="Pacific"))*.

Follow these steps to test the dynamic filter.

> 1. Click **B2** and enter *Pacific*.
>
> 2. Notice that *Colby* is now in the *Filter* list in **Column I**.
>
> 3. Click **B2** and enter *Midwest* to return this cell to its original value.
>
> 4. Notice that *Colby* is no longer in the *Filter* list in **Column I**.

B.2.6   *Referencing A Dynamic Array*

Dynamic arrays can grow or shrink depending on the data being analyzed but formulas that refer to that array need to work, no matter its size. To do that, add a hash ($\boxed{\#}$) after the array reference. This is illustrated in the following steps.

> 1. Click **J1** and enter *Pacific Reps*.
>
> 2. Click **J2** and enter *=COUNTA(I2#)*.

H	I	J	
Unique	Filter	Pacific Reps	
Midwest	Alvin	4	
Northeast	Holmes		
Pacific	Jack		
Southeast	Martha		
Southwest			

Figure 442: Referring to a Dynamic Array

Cell J2 displays 4 since there are four representatives listed in the dynamic array starting in I2. Complete the following steps to test the dynamic charactistics of this array.

> 1. Click **B2** and enter *Pacific*.
>
> 2. Notice that *Colby* is now in the *Filter* list in **Column I** and the number of representatives in **J2** has changed to 5.
>
> 3. Click **B2** and enter *Midwest* to return this cell to its original value.
>
> 4. Notice that *Colby* is no longer in the *Filter* list in **Column I** and the number of representatives in **J2** has returned to 4.

The formula in cell J2 counts all of the lines in the dynamic array starting in I2 no matter how long that array grows.

B.2.7   *Xlookup()*

$$= \text{XLOOKUP}(\text{value}, \text{array}, \text{return}, [\text{not\_found}], [\text{match}], [\text{search}])$$

XLookup is a modern and flexible replacement for older functions like *VLOOKUP*, *HLOOKUP*, and *LOOKUP*. Complete the following steps to explore this powerful function.

1. Click **K1** and enter *XLookup*.

2. Click **K2** and enter *Colby*

3. Click **L2** and enter
   =XLOOKUP(K2,Sales[Name],Sales[[Region]:[Units]]).

Figure 443: XLookup Function

The *XLookup* function searches in the *Name* column for the name found in cell K2. When it finds that value, it returns the *Region* and *Units* values for that name. In the example above, *Colby* returns *Midwest* and 276 from the *Sales* table. One of the strengths of using dynamic arrays is that if the *Sales* table is modified by adding or deleting rows or columns, the *XLookup* function will continue to work.

B.2.8   *XMatch()*

$$= \mathrm{XMATCH}(\mathrm{value}, \mathrm{array}, [\mathrm{match}], [\mathrm{search}])$$

XMatch is a modern and flexible replacement for the older *MATCH* function. It performs a lookup and returns a position in vertical or horizontal ranges. Complete the following steps to explore this powerful function.

1. Click **K4** and enter *XMatch*.

2. Click **K5** and enter *Colby*

3. Click **L5** and enter
   =XMATCH(K5,Sales[Name]).

Figure 444: XMatch Function

Cell L5 will display 1 since the value in K5, *Colby*, is in row one of the *Sales* table. By itself, this is of limited value, but combining *XMatch* with *Index* creates a powerful lookup function that can return the value in any column for any found row in a data table.

1. Click **K7** and enter *XMatch+Index*.

2. Click **K5** and enter *Colby*

3. Click **L5** and enter
   =INDEX(Sales,XMATCH(K8,Sales[Name]),3).

Figure 445: XMatch+Index Function

This returns 276, which is how many units Colby sold. If the data table contained dozens of columns and hundreds of rows, *XMatch+Index* is very useful in pinpointing the specific data needed.

b.2.9 *Randarray()*

$$= \text{RANDARRAY}([\text{rows}], [\text{columns}], [\text{min}], [\text{max}], [\text{whole\_number}])$$

Use the following steps to create a dynamic array of random numbers.

1. Click **D24** and enter *Random*.

2. Click **D25** and enter *=RANDARRAY(3,4,10,99,TRUE)*

Figure 446: Random Array

This creates an array of three rows and four columns that contain random numbers between 10 and 99. The final *TRUE* restricts the random numbers to integers rather than decimals. NOTE: The function creates an array of random numbers so the illustration in this book will not match the student's work.

B.2.10   *Sequence()*

$$= SEQUENCE(rows, [columns], [start], [step])$$

Follow these steps to create a dynamic array that contains a sequence of numbers.

1. Click **D29** and enter *Sequence*.

2. Click **D30** and enter *=SEQUENCE(5,3,25,3)*

Figure 447: Sequence

This creates a sequence of numbers filling five rows and three columns starting at 25 and stepping by 3.