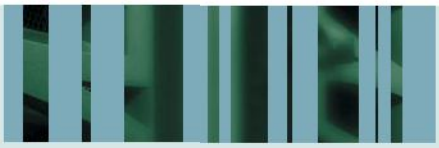


Estimated Time: 2 hours

LESSON 3

Using Formulas and Functions

OBJECTIVES

Upon completion of this lesson, you should be able to:

- Enter formulas in a worksheet.
- Understand cell references.
- Copy formulas.
- Use functions.
- Review and edit formulas.

DATA FILES

To complete this lesson, you will need these data files:

Step EX 3-1.xlsx
Project EX 3-1.xlsx
Project EX 3-3.xlsx
Activity EX 3-3.xlsx

VOCABULARY

absolute reference
argument
arithmetic operators
Auto Fill
comparison operators
constants
error value
fill handle
formula
functions
mixed reference
operator
order of operations
relative reference
syntax

Introduction

The real power of a spreadsheet program such as Excel is its ability to perform simple and complex calculations on worksheet data. In this lesson, you will learn how to enter formulas to perform calculations. You will also be introduced to Excel's functions—those predefined formulas that allow you to construct complex mathematical, statistical, financial, and other formulas. The commands for working with formulas and functions are located on the Formulas tab on the Ribbon.

Entering Formulas

VOCABULARY
formula
operator
arithmetic operators
constants

A ***formula*** is a set of instructions used to perform calculations on values in a worksheet. Formulas can set up a relationship between two or more cells. You might, for instance, want Excel to total the numbers in a range of cells. An Excel formula must begin with the equal sign (=) and is followed by the set of instructions for completing a calculation.

A formula's instructions contain operators and the values you want calculated. An ***operator*** is a sign or symbol that indicates what calculation is to be performed. The most commonly used operators are the ***arithmetic operators*** used for addition, subtraction, multiplication, division, and exponentiation.

For example, the formula =3+2 entered in a cell will return a resulting value of 5 in the cell in which the formula is entered. In this case, the values are ***constants***, which are numbers entered directly into a formula that do not change. More commonly, formulas in Excel use cell references to identify the cells containing the values you want to use in the formula. If cell C1 contains the value of 3 and cell D1 contains the value of 2, you could use the formula =C1+D1 to return a value of 5. The benefit to using cell references in a formula is that the results automatically update if the values in those cells change.

You can also use a combination of constants and cell references in a formula. For example, in the formula =C9+5, the equal sign (=) indicates that it is a formula, C9 is a cell reference, the plus sign (+) is an operator, and the number 5 is a constant. Excel calculates the formula's result by adding five to the value in cell C9. If the value in C9 changes, the formula result would also be updated.

Table EX 3–1 lists the arithmetic operators and examples of how they are used in formulas.

EXTRA FOR EXPERTS

When entering a formula, you can minimize typing errors by using the Formula AutoComplete feature. When you enter an equal sign (=) and then begin typing, a drop-down list of functions, arguments, and names beginning with those letters are displayed. Click to select from the list and enter it into the formula.

TABLE EX 3–1 Arithmetic operators

OPERATOR	OPERATION	EXAMPLE	DESCRIPTION
+ (plus sign)	Addition	A7+D9	Adds the values in cells A7 and D9
– (minus sign)	Subtraction	A7–D9	Subtracts the value in D9 from the value in A7
*** (asterisk)**	Multiplication	A7*D9	Multiplies the values in cells A7 and D9
/ (forward slash)	Division	A7/D9	Divides the value in A7 by the value in D9
% (percent sign)	Percent	A7*25%	Calculates 25% of the value in A7
^ (caret)	Exponentiation	A7^4	Raises the value in A7 to the fourth power

One way to enter a formula in a cell is to type it. For example, if you want to add the values in cells B5 through B8 and enter the result in cell B9, you can enter the formula =B5+B6+B7+B8 in cell B9 and press Enter. The result is displayed in the cell, but the cell actually contains the formula. You can see the formula in the formula bar when the cell is active, as shown in **Figure EX 3–1**.

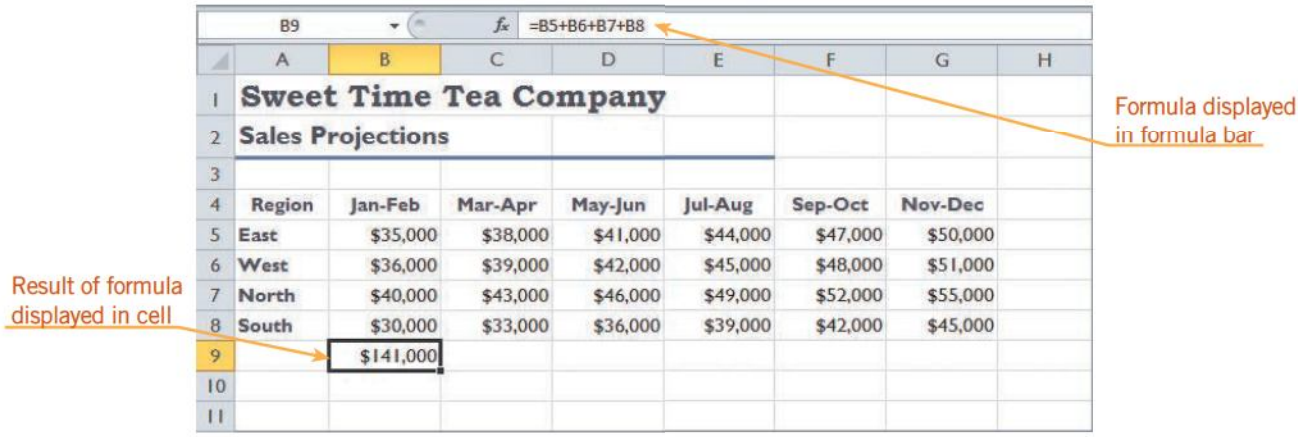


FIGURE EX 3–1 Entering formulas

You get the same result by using the mouse: Click to activate cell B9, type =, click cell B5, type +, click B6, type +, click B7, type +, click B8, and press Enter. This method of pointing and clicking to enter cell references eliminates the need to look up cell references and avoids potential typing errors.

If you see a problem in your results after you enter a formula, you can view the formula by selecting the cell and reviewing the formula in the formula bar. Often it is the cell references that contain an error. Excel uses a simple color-coding method to identify the cell references used in the formula. You can display the color-coded cells by double-clicking a cell containing a formula. Excel displays each cell reference in the formula and the border of the corresponding cell in the worksheet with a distinct color, as shown in **Figure EX 3–2**.

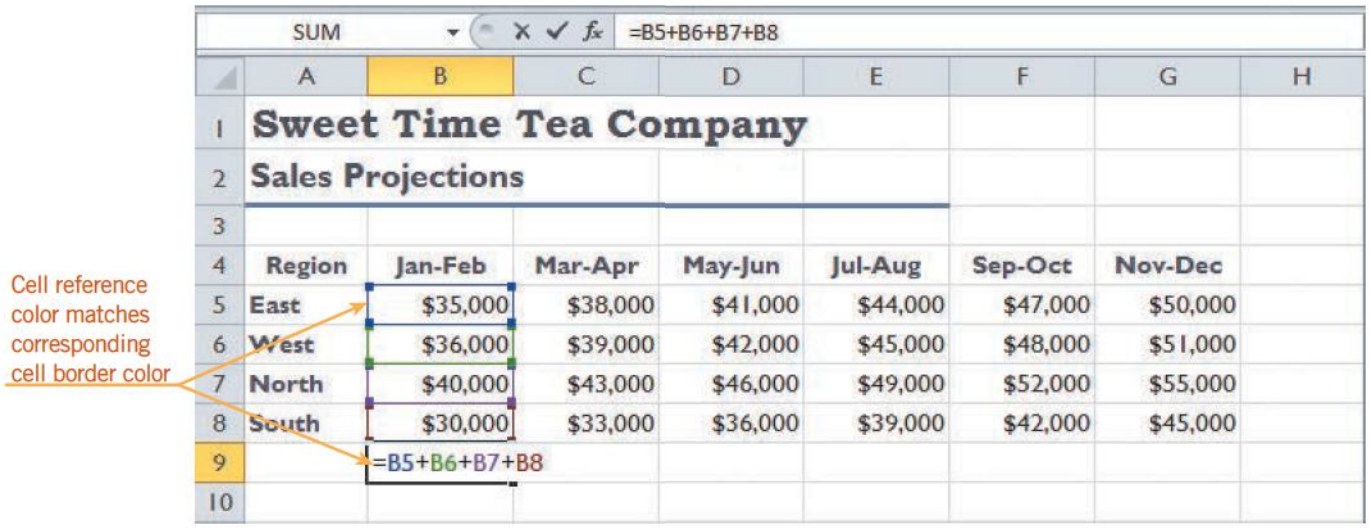


FIGURE EX 3–2 Color-coded cells

VOCABULARY
order of operations
comparison operators

Some formulas will contain more than one arithmetic operator. Excel follows the ***order of operations***, a specific sequence used to calculate the value of a formula. When you use operators, Excel performs calculations in the normal algebraic precedence. That means the calculations are executed from left to right in the following order:

1. Exponentiation (^)
2. Multiplication (*) or division (/)
3. Addition (+) or subtraction (–)

If you want to change the order of operations, you use parentheses to group expressions in your formula. The expression inside the parentheses gets calculated first. The example below shows how the order of operations can affect the resulting value of a formula.

$$3 + 7 * 2 = 17$$

Multiplication calculation is done first, then addition: $7 \times 2 = 14 + 3 = 17$

$$(3 + 7) * 2 = 20$$

Parentheses calculation is done first: $3 + 7 = 10 \times 2 = 20$

Using ***comparison operators***, shown in **Table EX 3–2**, you can compare two values to obtain a logical value, either TRUE or FALSE.

TABLE EX 3–2 Comparison operators

OPERATOR	MEANING	EXAMPLE	DESCRIPTION
=	Equal to	A7=D9	Displays the value TRUE if the values in cell A7 and D9 are equal; displays the value FALSE if the two values are not equal
>	Greater than	A7>D9	Displays the value TRUE if the value in cell A7 is greater than the value in cell D9; displays the value FALSE if the value in cell A7 is less than or equal to the value in cell D9
<	Less than	A7<D9	Displays the value TRUE if the value in cell A7 is less than the value in cell D9; displays the value FALSE if the value in cell A7 is greater than or equal to the value in cell D9
>=	Greater than or equal to	A7>=D9	Displays the value TRUE if the value in cell A7 is greater than or equal to the value in cell D9; displays the value FALSE if the value in cell A7 is less than the value in cell D9
<=	Less than or equal to	A7<=D9	Displays the value TRUE if the value in cell A7 is less than or equal to the value in cell D9; displays the value FALSE if the value in cell A7 is greater than the value in cell D9
<>	Not equal to	A7<>D9	Displays the value TRUE if the value in cell A7 is not equal to the value in cell D9; displays the value FALSE if the value in cell A7 is equal to the value in cell D9

Step-by-Step EX 3.1

1. Start Excel.
2. Open **Step EX 3-1** from the folder containing the data files for this lesson.
3. Save the workbook as **Trip Budget *XXX*** (replace *XXX* with your initials).
4. In cell **B12**, type **=B8+B9+B10+B11**. Your worksheet window should look similar to **Figure EX 3–3**.

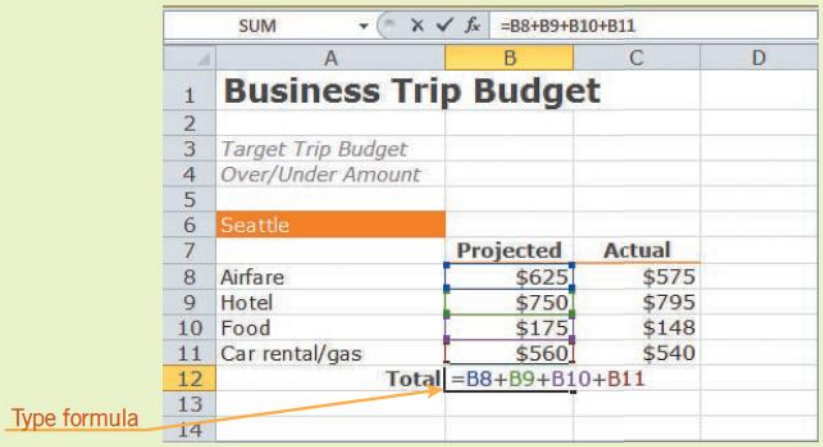


FIGURE EX 3–3
Typing a formula

5. Click the **Enter** button on the formula bar to enter the formula. Notice the formula is displayed in the formula bar, and the resulting value, $2,110, is displayed in cell B12.
6. In cell **C12**, type **=**, click cell **C8**, type **+**, click cell **C9**, type **+**, click cell **C10**, type **+**, and then click cell **C11**.
7. Press **Enter** to enter the formula in cell C12 and display the resulting value, $2,058.
8. Save the workbook and leave it open for use in the next Step-by-Step.

Understanding Cell References and Copying Formulas

Excel uses relative, absolute, and mixed cell references. These are especially important to understand when you are copying formulas. You can copy formulas the same way you copy data, using the Cut, Copy, and Paste commands, or you can use the Auto Fill feature.

Auto Fill is a feature that you can use to automatically fill in worksheet data in any direction. You can use it to copy data or formatting. You can also use it to quickly copy a formula down a column or across a row by dragging the fill handle of the cell containing the formula. The ***fill handle*** is a little black square in the lower-right corner of the

VOCABULARY
Auto Fill
fill handle

EXTRA FOR EXPERTS

The fill handle can also be used to fill in a series. For example, you can click a cell containing the word *June* and then drag the fill handle to automatically fill in the previous or following months in adjacent cells.

VOCABULARY

relative reference

absolute reference

selected cell. When you point to the fill handle, the pointer turns to a black cross that you can click and drag over adjacent cells as far as you want to copy the formula. When you release the mouse button, the range is filled with the results of the copied formulas.

When you finish using the fill handle, the Auto Fill Options button is displayed next to the fill handle.You can click it to open a menu to choose to fill only the formatting or to fill without formatting.

Copying formulas is not as straightforward as copying formatting or text entries. When you copy, or move, a formula to another location in the worksheet, it can change depending on what type of cell references it contains.

A ***relative reference*** means the reference to a cell changes in relation to the location of the formula. For example, if you enter the formula =B9+B10 in cell B11, you are indicating Excel needs to add the contents in cells B9 and B10, the two cells immediately above cell B11. If you copy that same formula to C11, Excel adjusts the formula to add the values in the two cells immediately above cell C11 (cells C9 and C10). This saves you the time of typing a new formula each time. **Figure EX 3–4** shows a formula with relative references that has been copied.

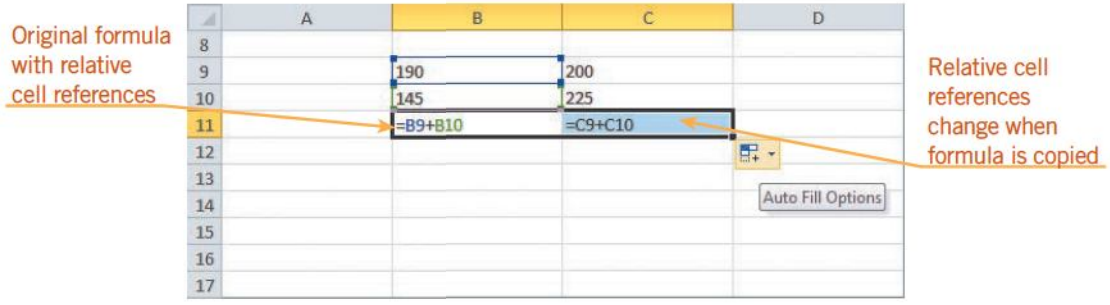


FIGURE EX 3–4 Using relative cell references in a formula

An ***absolute reference*** is a permanent reference to a cell and does not change in relation to the location of the formula. You create an absolute reference by typing a dollar sign before the column letter and before the row number ($B$9). If you copy a formula with absolute references ($B$9+$B$10) from one cell to another cell, it stays exactly the same, as shown in **Figure EX 3–5**. Absolute references can be useful when you want to reference the same cell repeatedly in different formulas or use the same formula in a different location in the workbook.

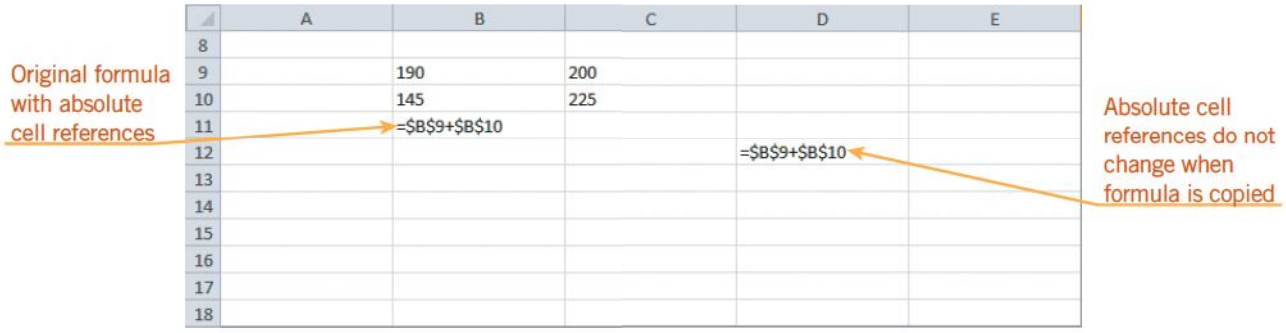


FIGURE EX 3–5 Using absolute cell references in a formula

Sometimes you may only want one part of the formula to change when it is copied, and another part of the formula to stay the same. A ***mixed reference*** contains both relative and absolute cell references. For example, the cell reference \$B9 has an absolute column and a relative row; B\$10 has a relative column and an absolute row. When you copy a formula with a mixed cell reference, the relative reference changes based on the new location, but the absolute reference does not. **Figure EX 3–6** shows a formula with relative column references and absolute row references and how it changes when copied.

VOCABULARY

mixed reference

EXTRA FOR EXPERTS

An easy way to switch a cell reference in an existing formula without having to retype the formula is to use the F4 key. Select the cell that contains the formula, select the cell reference that you want to change in the formula bar, and then press F4 to cycle through the cell reference types.

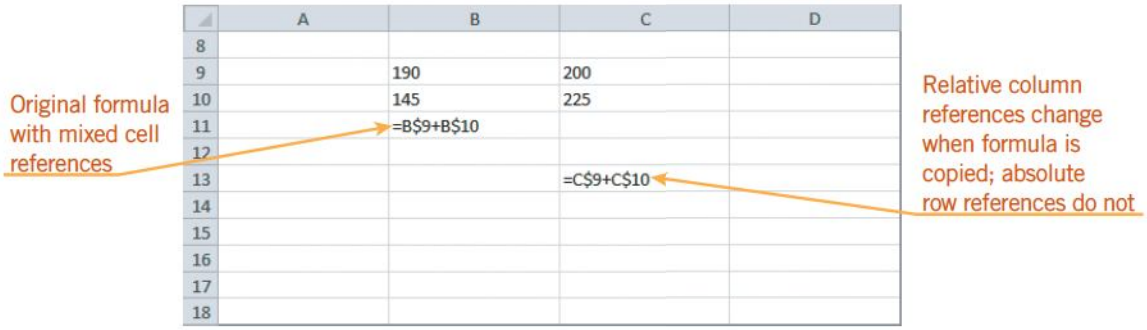


FIGURE EX 3–6 Using mixed cell references in a formula

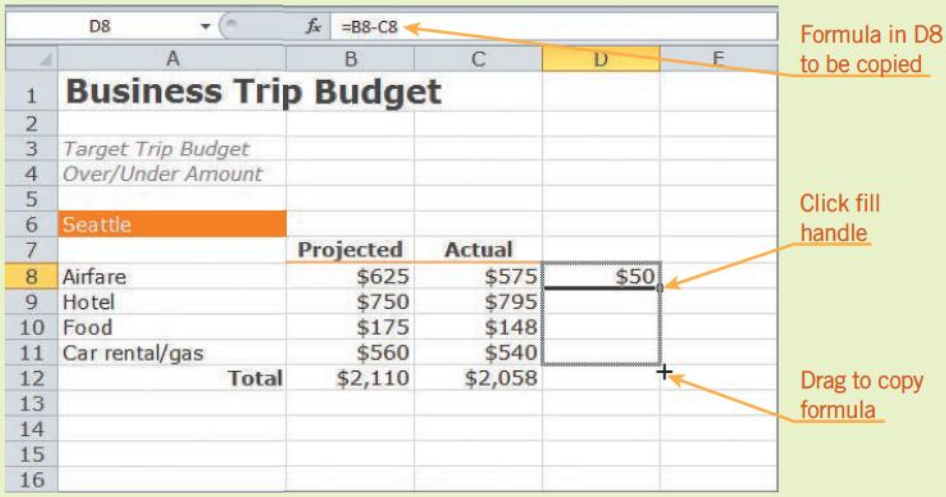
Step-by-Step EX 3.2

The Trip Budget *XXX* workbook from Step-by-Step EX 3.1 should be open in the Excel program window.

1. Click cell **D8**, type **=B8-C8**, and then press **Enter** to enter a formula with relative references and display the value \$50 in the cell.
2. Click cell **D8** and point to the fill handle. The pointer changes to a black cross +.

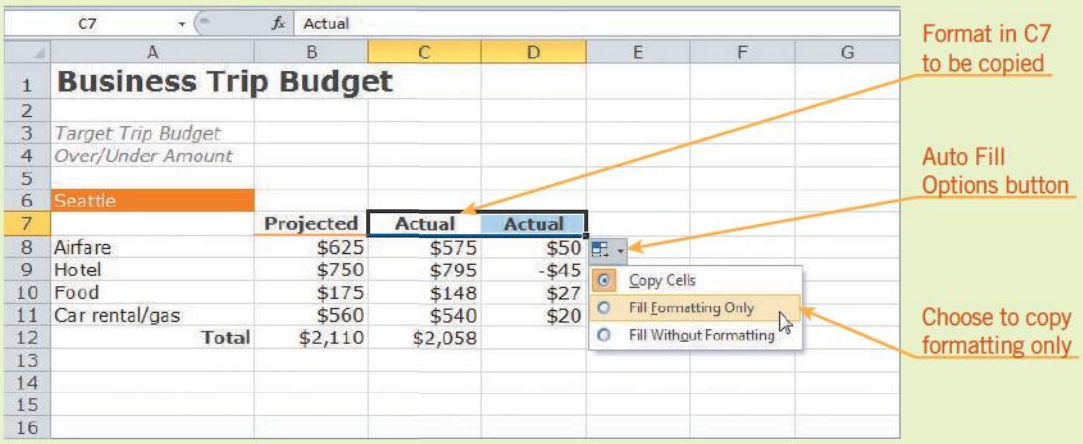
3. Click and drag the **fill handle** to cell **D11**, as shown in **Figure EX 3–7**. When you release the mouse button, the formula in cell D8 is copied and the cells are filled with formula results.

FIGURE EX 3–7
Copying a formula using Auto Fill



4. In cell **D7**, type **Difference** and press **Enter**.
5. Click cell **C7** and then click and drag the fill handle to cell **D7**. When you release the mouse button, the data is copied and the Auto Fill Options button is displayed.
6. Click the **Auto Fill Options** button, and click **Fill Formatting Only**, as shown in **Figure EX 3–8**, to copy the formatting, but not the data.

FIGURE EX 3–8
Copying formatting using Auto Fill



7. Click a blank cell in the worksheet, and notice that the formatting in cell D7 is now the same as the formatting in cell C7.
8. In cell **B3**, type **=$B$12*110%** and press **Enter** to enter a formula with absolute references and display the value of $2,321 in the cell.
9. In cell **B4**, type **=$B$3-C12** and press **Enter** to enter a formula with mixed references and display the value of $263 in the cell.
10. Save the workbook and leave it open for use in the next Step-by-Step.

Using Functions

Excel provides the user with built-in formulas, called ***functions***, that enable you to perform complex calculations easily. Instead of entering all the cell references and operators as you have done in previous exercises, you can use a function in a formula to tell Excel to perform a calculation. For example, the SUM function totals the values in a range of cells, which is easier than typing each cell reference separately.

A function must follow a set of established rules, called ***syntax***, that specifies how the function must be entered. The standard syntax for Excel functions is:

=Function name (argument1, argument2...)

Most functions require an argument. An ***argument***, which follows the function name and is enclosed in parentheses, refers to the text, numbers, or cell references on which the function is to be performed. For example, in the function =SUM(B8:B11), the range B8:B11 is the argument. If you use more than one argument in a function, separate them with a comma.

Hundreds of functions are available in Excel, and they are organized into categories based upon their general purpose, such as Financial, Date and Time, and Statistical. **Table 3–3** lists examples of some functions from the various categories.

VOCABULARY
functions
syntax
argument

TABLE EX 3–3 Examples of functions

FUNCTION	CATEGORY	RETURNS	EXAMPLE
OR	Logical	TRUE if any of the arguments are true; FALSE if none of the arguments are true	=OR(A8<100) returns TRUE if the value in A8 is less than 100 and FALSE if the value in A8 is greater than or equal to 100
LOWER	Text	All letters in the cell as lowercase	=LOWER(A15) converts all the letters in A15 to lowercase
DATE	Date & Time	The number that represents the date	=DATE(2013,6,12) returns 6/12/2013 (when cell is formatted with General or Date format)
SQRT	Math & Trig	The square root of the number in the argument	=SQRT(A6) calculates the square root of the value in A6
COUNT	Statistical	The number of cells in a range that contain numbers	=COUNT(A2:A7) counts all the cells in the range that contain numbers
TBILLYIELD	Financial	The yield for a Treasury bill	=TBILLYIELD(A2,B2,C2) calculates the yield on a Treasury bill with a settlement date in A2, a maturity date in B2, and the price per $100 face value of C2

To quickly total a range of cells without manually typing the formula, you can use the Sum function. When you click the Sum button on the Home tab in the Editing group, or on the Formulas tab in the Function Library group, you usually do not need

to even select a range. If you select a cell to the right or below a range of numbers, Excel automatically includes that range in the formula, as shown in **Figure EX 3–9**.

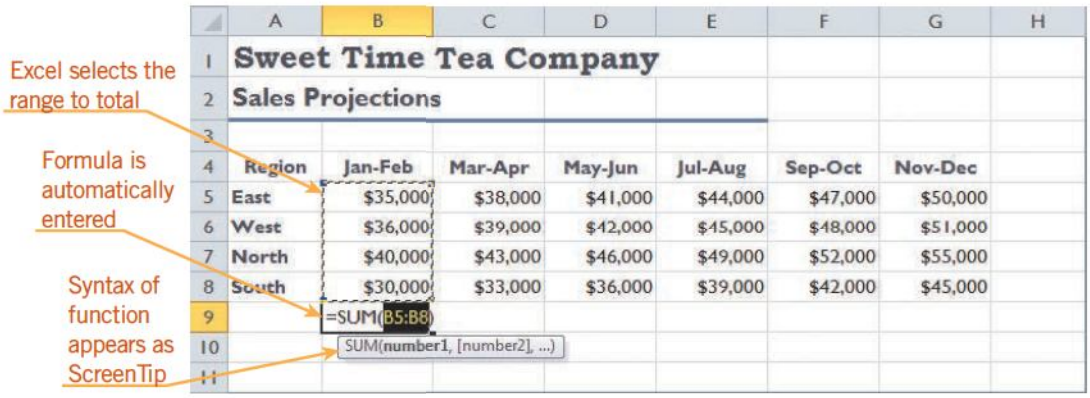


FIGURE EX 3–9 Using the Sum function

EXTRA FOR EXPERTS

When you select a range, the results of three common statistical functions—Average, Count, and Sum—for the selected cells are displayed in the status bar at the bottom of the program window. You can change which summary calculations are displayed by right-clicking the status bar to open the Customize Status Bar menu and clicking to select or deselect options.

When you click the Sum button arrow in the Function Library group on the Formulas tab, or the Sum button arrow in the Editing group on the Home tab, a menu of the most common statistical functions is displayed, as shown in **Figure EX 3–10**. The Average function returns the average of a set of values; the Count Numbers function counts the number of cells in a range that contain numbers; the Max function returns the largest value in a set of values; and the Min function returns the smallest value in a set of values. You can also use the buttons in the Function Library group on the Formulas tab to choose functions from other categories.

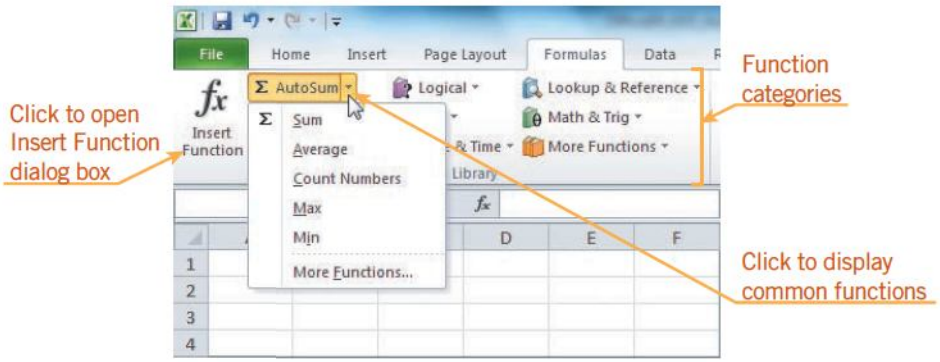


FIGURE EX 3–10 Sum menu options

Another way to choose a function is to click the Insert Function button in the Function Library group on the Formulas tab to open the Insert Function dialog box, shown in **Figure EX 3–11**.

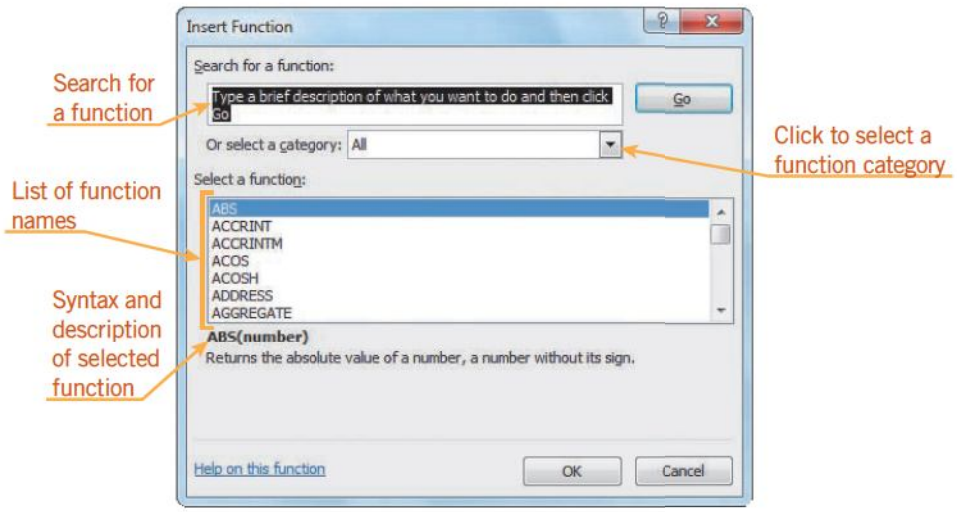


FIGURE EX 3–11 Insert Function dialog box

Once you select a function in the Insert Function dialog box or on the Ribbon, Excel opens the Function Arguments dialog box, shown in **Figure EX 3–12**. The Function Arguments dialog box displays the name of the function, each of its arguments, the current result of a function, and the current result of the entire formula. The Function Arguments dialog box makes it easy to enter arguments for functions. You can either type the arguments into this dialog box, or click the Collapse button to reduce the size of the Function Arguments dialog box temporarily, and click the cells to be used as cell references in the argument. When you finish selecting cells for the argument, click the Expand button to redisplay the dialog box at full size. If no arguments are required, the Function Arguments dialog box displays a message, and you can simply click the OK button to close the dialog box and enter the function.

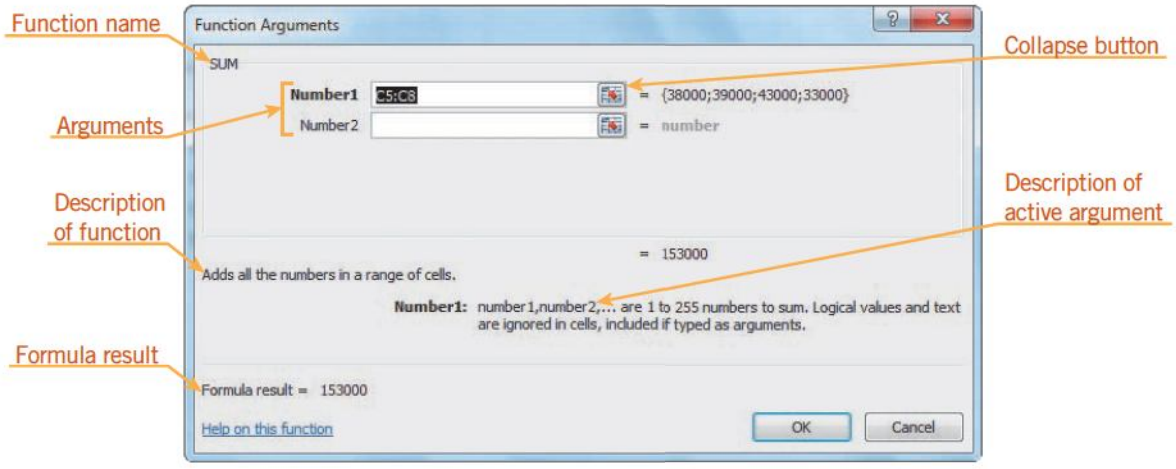


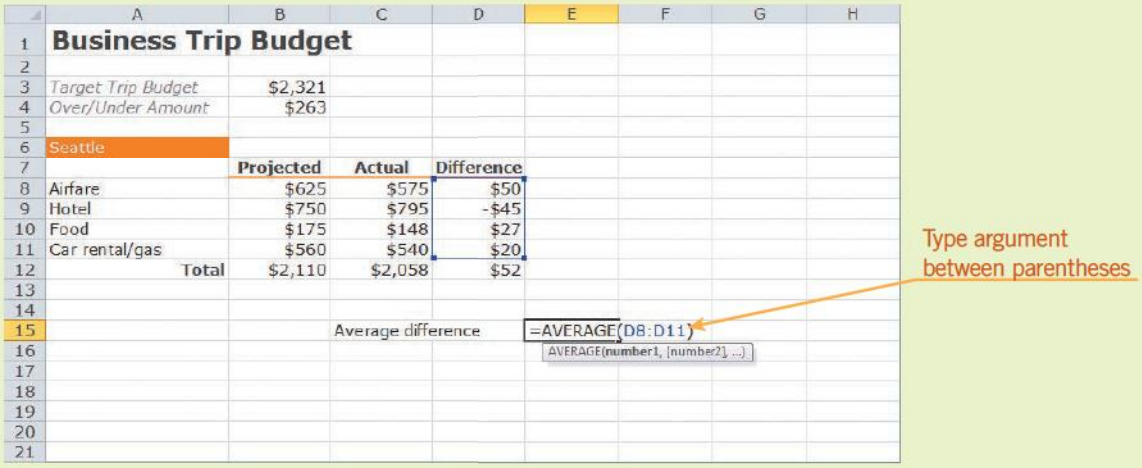
FIGURE EX 3–12 Function Arguments dialog box

Step-by-Step EX 3.3

The Trip Budget *XXX* workbook from Step-by-Step EX 3.2 should be open in the Excel program window.

1. Click cell **D12**. Click the **Formulas** tab on the Ribbon, and then click the **Sum** button in the Function Library group to enter the SUM function in cell D12. Notice that Excel automatically selects the range D8:D11.
2. Press **Enter** to enter the formula and display a value of $52 in cell D12.
3. In cell C15, type **Average difference**, and then press **Enter**.
4. Select cell **E15**. Click the **Sum** button arrow on the Formulas tab in the Function Library group to open a menu.
5. On the menu, click **Average** to enter the AVERAGE function in cell E15. Notice the blinking insertion point appears between the argument parentheses. With the blinking insertion point between the parentheses, type **D8:D11**. Your worksheet should look similar to **Figure EX 3–13**.

FIGURE EX 3–13
Insert AVERAGE function



6. Press **Enter** to calculate the average difference between the projected and actual budget amounts and display the value of $13 in cell E15.
7. In cell C16, type **Under budget?**, and then press **Enter**.
8. Click cell **E16**. On the Formulas tab, in the Function Library group, click the **Logical** button to open a menu.
9. On the menu, click **OR** to open the Function Arguments dialog box.
10. In the Function Arguments dialog box, click the **Collapse** button in the Logical1 box to collapse the dialog box.
11. Click cell **B4** to add an argument to the function in cell E16, as shown in **Figure EX 3–14**, and then click the **Expand** button to expand the Function Arguments dialog box. Notice the cell reference *B4* is displayed in the Logical1 text box in the Function Arguments dialog box.

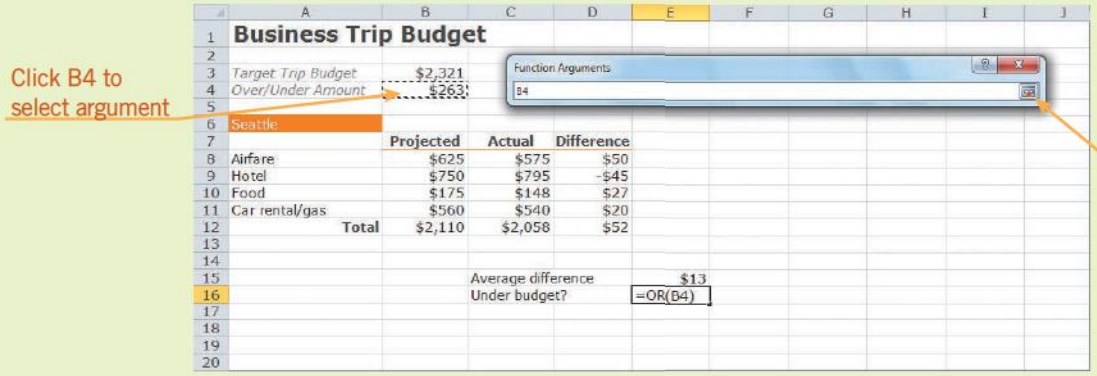


FIGURE EX 3–14
Inserting an argument

12. In the Logical1 text box, after B4, type **>0**. This argument indicates to Excel that if the value in cell B4 is greater than 0, then the value TRUE should be displayed in cell E16.
13. Click the **OK** button to enter the formula and display TRUE in cell E16, since the current value in B4 is greater than zero.
14. Save the workbook and leave it open for use in the next Step-by-Step.

Reviewing and Editing Formulas

You can choose to display the formulas in a worksheet instead of the resulting values. This can be helpful if you want to print a copy of your worksheet showing all the formulas for documentation, or if you want to review the formulas for accuracy. To display the formulas, click the Show Formulas button in the Formula Auditing group on the Formulas tab. Or you can quickly switch between displaying values and formulas by using the keyboard shortcut Ctrl+`.

Sometimes you may need to check the formulas in your worksheet for accuracy. The buttons in the Formula Auditing group on the Formulas tab can help you check for errors and troubleshoot your formulas. When you click the Error Checking button, Excel checks for common errors in your worksheet and opens the Error Checking dialog box with options for resolving the error, as shown in **Figure EX 3–15**.

FIGURE EX 3–15 Error Checking dialog box

Excel indicates when a formula you have entered results in an error by displaying an ***error value***. For example, when the cell containing a formula result displays *#DIV/0!*, Excel is indicating that a number in the formula is divided by zero, or the

VOCABULARY
error value

EXTRA FOR EXPERTS

A circular reference is a type of error that occurs when a formula refers to its own cell reference. In this case, a warning box is displayed to identify the problem and prompt you to correct it. If the formula containing the error is complex, you can click the OK button in this warning box to open a Help window with information on how to locate and correct the circular reference.

formula references a cell that contains no value. A cell with an error also displays a triangle in the upper-left corner. When you click the cell, a button is displayed next to the cell and you can point to it to display a ScreenTip describing the type of error. If a cell contains a series of number symbols, ######, the cell is not wide enough to display the results of the formula. In this case, you can display the value by widening the column.

Table EX 3–4 lists common error values and what they indicate.

TABLE EX 3–4 Error values

ERROR VALUE	DESCRIPTION OF ERROR
#DIV/0!	Formula contains a number divided by zero or by a cell containing no value
#NA	A value in the formula is not available in the worksheet
#NAME?	Formula contains incorrect text; this often occurs when a function name is misspelled
#NULL!	Formula specifies an intersection of two ranges which do not intersect
#NUM!	Invalid use of a number in the formula, or when text is used in a formula or function's argument when a number is required
#REF!	Formula or function uses a cell reference that is no longer valid, which can occur if a cell or range of cells was deleted from the worksheet
#VALUE!	Incorrect data type used in the function or formula
#####	Cell is not wide enough to display formula results

If you want to change or edit a formula, you can activate the cell containing the formula, type your changes in the formula bar, and then press Enter. You can also double-click the cell containing the formula, or activate the cell and then press F2, which highlights each cell or range of cells with a different color so you can easily edit the formula in the cell.

Step-by-Step EX 3.4

The Trip Budget *XXX* workbook from Step-by-Step EX 3.3 should be open in the Excel program window.

1. Double-click cell **B3** to display the formula in the cell.
2. In the formula bar, delete 110, type **105**, and then press **Enter** to edit the formula and calculate the new results. The new value of $2,216 is displayed in cell B3. (If necessary, format cell B3 for zero decimal places.) Notice the value in cell B4 also changes (to $158).

3. If necessary, click the **Formulas** tab on the Ribbon, and then click the **Show Formulas** button in the Formula Auditing group. The formulas are displayed in the worksheet, as shown in **Figure EX 3–16**.

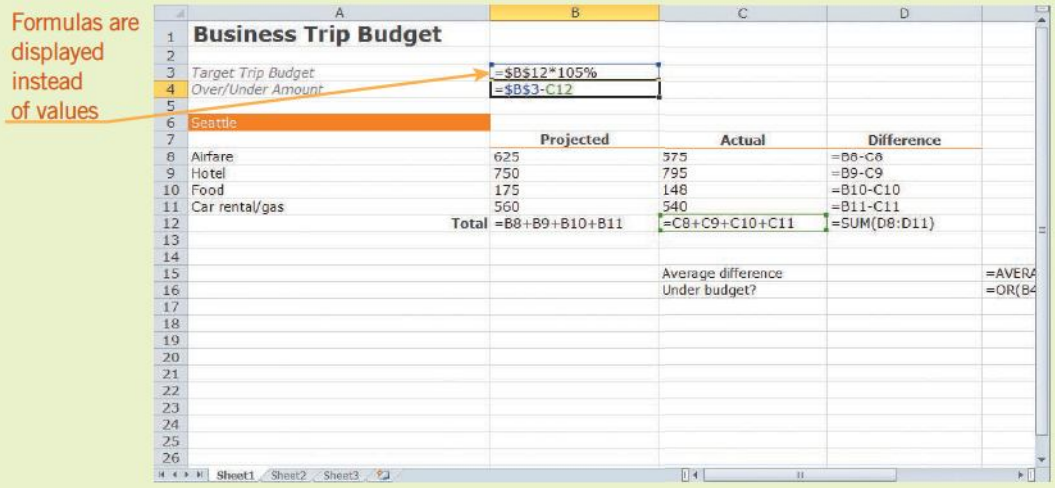


FIGURE EX 3–16
Displaying formulas

4. On the Formulas tab, in the Formula Auditing group, click the **Show Formulas** button again to display the values.
5. Delete rows 3 and 4. Notice that cell E14 now contains the error value #REF!, and a green triangle appears in the upper-left corner of the cell, because the formula in this cell references one of the cells you just deleted.
6. Click cell **E14** and point to the Error Checking button to the left of the cell to display the ScreenTip explaining the type of error, as shown in **Figure EX 3–17**.

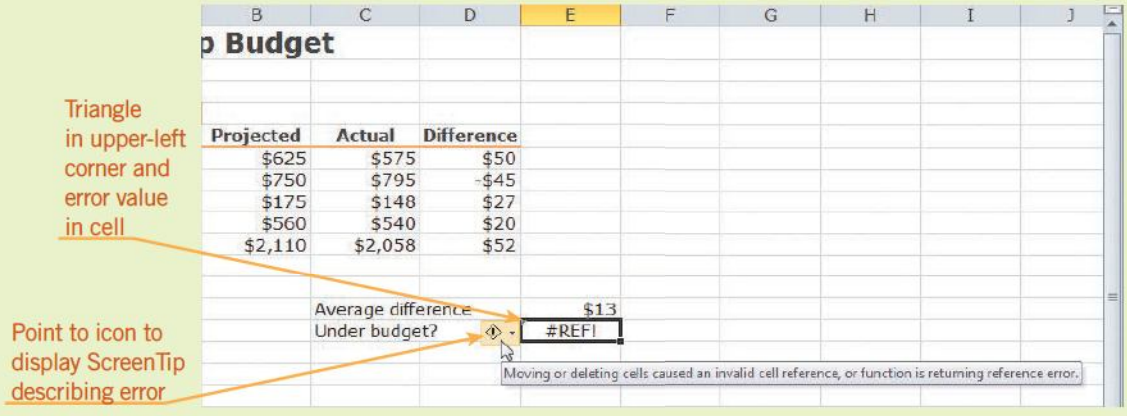


FIGURE EX 3–17
Cell with an error

7. Double-click cell **E14** to display the formula in the cell.

8. In the formula in cell E14, delete #REF!, and click **D10** to correct the formula, as shown in **Figure EX 3–18**.

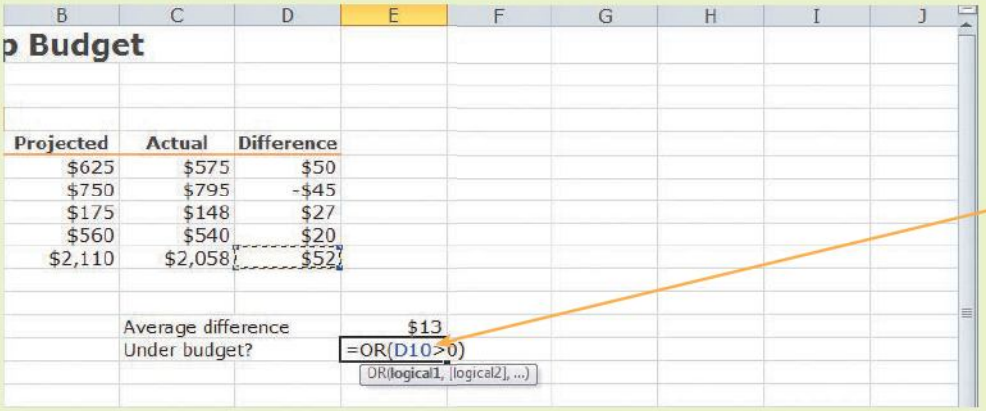


FIGURE EX 3–18 Correcting a formula

9. Press **Enter** to edit the formula and resolve the error. The value TRUE appears in cell E14.
10. Save and close the workbook and then close Excel.

SUMMARY

In this lesson, you learned:

- Ways to enter a formula.
- The different types of cell references.
- How to copy a formula.
- Functions are easy-to-use predefined formulas that can be used in worksheets to perform various calculations.
- Various ways to review and edit formulas.

VOCABULARY REVIEW

Define the following terms:

absolute reference
argument
arithmetic operators
Auto Fill
comparison operators
constants
error value
fill handle
formula
functions
mixed reference
operator
order of operations
relative reference
syntax

REVIEW QUESTIONS

MULTIPLE CHOICE

Select the best response for the following statements.

1. All formulas must begin with _____.
   A. parentheses ( )
   B. the equal sign (=)
   C. a caret (^)
   D. the greater than sign (>)
2. Each cell reference in the formula is coded with a different _____.
   A. font
   B. point size
   C. border
   D. color
3. A forward slash (/) is an example of a(n) _____.
   A. arithmetic operator
   B. cell reference
   C. argument
   D. order of operations
4. What is the result of the following formula: =C6+D6*3, where cell C6 contains the value of 4 and cell D6 contains the value of 5?
   A. 17
   B. 19
   C. 23
   D. 27
5. Which of the following is a relative reference?
   A. B4
   B. $B4
   C. B$4
   D. $B$4
6. Which is *not* an option on the Auto Fill Options menu?
   A. Copy Cells
   B. Clear Cells
   C. Fill Formatting Only
   D. Fill Without Formatting
7. To edit a formula, double-click the cell containing the formula or select the cell and press the _____ key.
   A. Ctrl
   B. Alt
   C. F2
   D. F4
8. Excel indicates when a formula you have entered results in an error by displaying _____ in the cell.
   A. a ScreenTip
   B. an error value
   C. a fill handle
   D. nothing
9. A(n) _____ refers to the values or cell references on which a function is to be performed.
   A. operator
   B. mixed reference
   C. constant
   D. argument
10. A function must follow a set of established rules, called _____, which specifies how the function must be entered.
    A. syntax
    B. order of operations
    C. relative reference
    D. calculation

FILL IN THE BLANK

Complete the following sentences by writing the correct word or words in the blanks provided.

1. The commands for working with formulas and functions are located on the _____ tab on the Ribbon.
2. A(n) _____ is a set of instructions used to perform calculations on values in a worksheet.
3. Numbers entered directly into a formula that do not change are called _____.
4. A(n) _____ is a sign or symbol that indicates what calculation is to be performed.
5. A(n) _____ reference is a permanent reference to a cell and does not change in relation to the location of the formula.
6. _____ is a feature that you can use to automatically fill in worksheet data in any direction.
7. The _____ is a little black square in the lower-right corner of the selected cell used to copy formulas or cell formatting.
8. A(n) _____ is a built-in formula.
9. To enter cell references as an argument, click the Collapse button to reduce the size of the _____ dialog box temporarily so it is not in your way.
10. A cell with an error has a(n) _____ in the upper-left corner.

PROJECTS

PROJECT EX 3–1

1. Open the file **Project EX 3-1** from the folder containing the data files for this lesson.
2. Save the workbook as **Open Water *XXX*** (replace *XXX* with your initials).
3. In cell A23, enter the row heading **Total**. Apply bold formatting to cell A23.
4. Click cell **B23**. Use the Sum function to get a total for the range B5:B22.
5. Copy the formula in cell B23 to the range C23:M23.
6. In cell N4, enter the column heading **Total**.
7. Click cell **N5**. Use the Sum function to get a total for the range B5:M5.
8. Copy the formula in cell N5 to the range N6:N23.
9. Use the AutoFit feature to widen column N so the value in cell N23 is displayed instead of ######.
10. Save the workbook and leave it open for use in the next project.

PROJECT EX 3–2

The Open Water *XXX* workbook from Project EX 3-1 should be open in the Excel program window.

1. Save the workbook as **Open Water2 *XXX*** (replace *XXX* with your initials).
2. In cell A25, type **Highest Sales**.
3. In cell B25, enter a function to determine the highest amount of sales in the range B5:B22. (*Hint*: Use the Max function on the Sum menu, and edit the range in the formula bar as necessary.)
4. Use the Auto Fill feature to copy the function in cell B25 to the range C25:M25.
5. In cell A26, type **Lowest Sales**.
6. In cell B26, enter a function to determine the lowest amount of sales in the range B5:B22. (*Hint*: Use the Min function on the Sum menu and edit the range in the formula bar as necessary.)
7. Use the Auto Fill feature to copy the function in cell B26 to the range C26:M26.
8. In cell A27, type **Average Sales**.
9. In cell B27, enter a function to determine the average amount of sales in the range B5:B22. (*Hint*: Use the AVERAGE function, and edit the range in the formula bar as necessary.)
10. Use the Auto Fill feature to copy the function in cell B27 to the range C27:M27.
11. Save and close the workbook.

ON YOUR OWN

Open the **Open Water2 *XXX*** workbook, and create a formula that determines which employee had the highest total sales for the year. Save and close the workbook.

PROJECT EX 3–3

1. Open the file **Project EX 3-3** from the folder containing the data files for this lesson.
2. Save the workbook as **Tea Invoice *XXX*** (replace *XXX* with your initials).
3. In cell E10, enter **Total**.
4. In cell E11, enter a formula to multiply the value in cell C11 by the value in cell D11.
5. Use the Auto Fill feature to copy the formula in cell E11 to the range E12:E15.
6. In the range E11:E15, change the number format to **Currency** with two decimal places.
7. In cell E18, use the Sum command to get a total for the range E11:E17.
8. In cell E19, create a formula that calculates a 7% sales tax on the value in cell E18. (*Hint*: Use the formula =7%*E18.)
9. In cell E20, type **7.95**, and change the number format to **Currency** with two decimal places.
10. In cell E21, enter a formula with absolute references that totals of the values of the cells in the range E18:E20.
11. Save the workbook and leave it open for use in the next project.

WEB PROJECT

Visit Web sites of companies that sell cell phone plans. Create a worksheet containing information about at least three different options—including the price of the cell phone, cost of the cell plan per month, how many minutes are included, cost of features such as text messaging, and any additional charges. Use a formula to determine the best plan for your budget. Use functions to determine the highest price plan, the lowest price plan, and the average price of the plans.

PROJECT EX 3–4

The Tea Invoice *XXX* workbook from Project EX 3-3 should be open in the Excel program window.

1. Save the workbook as **Tea Invoice2 *XXX*** (replace *XXX* with your initials).
2. In cell E19, edit the formula from a 7% sales tax to 6% sales tax.
3. Display the formulas in the worksheet.
4. Check the worksheet for errors.
5. Display the values in the worksheet.
6. Only sales totals over $300 qualify for a discount. In cell B23, enter **Qualifies for discount?**.
7. In cell C23, create a formula using the OR function with E21>300 as the argument. (*Hint*: Use the Function Arguments dialog box.)
8. Save and close the workbook.

ON YOUR OWN

Open the **Tea Invoice2 *XXX*** workbook, and then in cell A8 create a function that inserts the current date and time. (*Hint*: Use the NOW function.) Adjust the column widths as necessary. Save and close the workbook.

TEAMWORK PROJECT

With a partner, open the Insert Function dialog box. Browse through all the various categories, and familiarize yourselves with the various functions available in each one. Click a function to see the description displayed below it. Choose one that you want to know more about, and click the Help on this function link to get more information. Learn as much as possible about it. Present your findings to the class, and include a worksheet you have created that demonstrates the use of the function.

CRITICAL THINKING

ACTIVITY EX 3–1

In Excel, you can create a defined name that you assign to a cell or range of cells and then use the defined name as a reference in formulas. Use Excel Help to learn the different ways you can define a name for a range, how to use defined names in a formula, and how to use the Name Manager to create, edit, delete, or find names in a workbook. Open an existing workbook, and then create at least one defined name for a range of cells and use the defined name in a formula.

ACTIVITY EX 3–2

Search for the video in Excel Help titled *Fix broken formulas* and watch it. List at least three ways to avoid common error messages when creating formulas.

ACTIVITY EX 3–3

You can also use the fill handle to complete a series, which can be useful. Use Excel Help to find out how this Auto Fill feature works. Then open the file **Activity EX 3-3** from the folder containing the data files for this lesson and save it as **Auto Fill *XXX*** (replace *XXX* with your initials). Using the existing data, create a vertical Auto Fill series for each of the items listed below:

- A series of months from March through August
- A series of days from Monday through Friday
- A series of times from 2:00 through 9:00
- A series of labels from Employee1 through Employee5
- A series of years from 2013 through 2021 (*Hint*: You have to select two entries before filling the rest.)

Save and close the workbook and then close Excel.