4 Using Basic Formulas

LESSON SKILL MATRIX

Skills	Exam Objective	Objective Number
Understanding and Displaying Formulas	Display formulas.	1.4.10
Understanding Order of Operations	Define order of operations.	4.1.2
Building Basic Formulas		
Using Cell References in Formulas	Demonstrate how to use references (relative, mixed, absolute).	4.1.1
Using Cell Ranges in Formulas	Create named ranges.	2.3.4
	Reference cell ranges in formulas.	4.1.3

KEY TERMS

- **absolute cell reference**
- **calculation operator**
- **cell reference**
- **constant**
- **external reference**
- **formula**
- **mixed cell reference**
- **named range**
- **nested parentheses**
- **operand**
- **order of operations**
- **relative cell reference**
- **scope**
- **value**
- **variable**

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When moving to a new rental home, you might need to make some up-front purchases for the new place, such as curtains, storage containers, and a few pieces of furniture. In addition, you have to pay rent each month, which generally is the same amount from one month to another (a recurring expense). Other monthly expenses change depending on usage and seasonal variations, such as electricity, water, and similar services. You can use Excel to track and budget for all of these expenses. In this lesson, you learn about the fundamentals of formulas and the order of operations. You then work on a simple household expenses worksheet, using simple formulas to summarize information from the data in the worksheet. Along the way, you find out how to make any worksheet more flexible by using cell references in formulas and naming cell ranges.

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SOFTWARE ORIENTATION

Excel enables you to create many formulas by simply typing in a cell or using your mouse pointer to select cells to include in a formula. For example, you can create basic formulas for addition, subtraction, multiplication, and division using these methods. However, as you have discovered in previous lessons, the user interface offers tools that make it easier to work with data. In this lesson, you use a few command groups on the FORMULAS tab to display formulas and name ranges to be used in formulas.

Use Figure 4-1 as a reference throughout this lesson as you become familiar with some of the command groups on the FORMULAS tab and use them to work with formulas. You learn more about commands on the FORMULAS tab in the next lesson, which addresses functions.
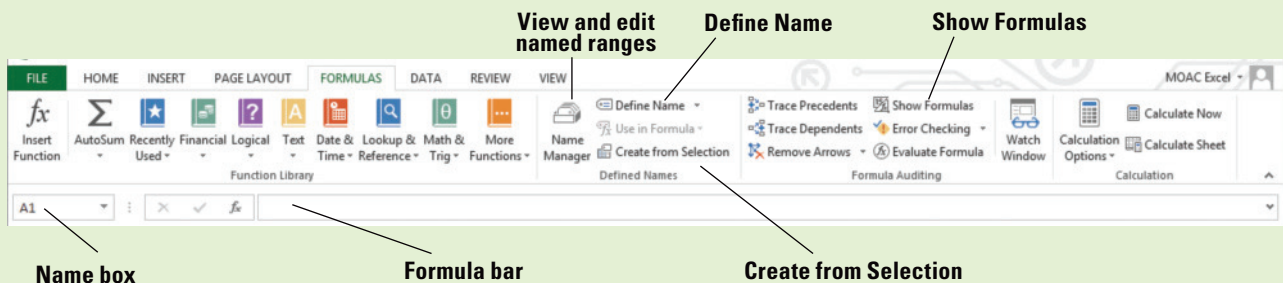

Figure 4-1

The FORMULAS tab in Excel 2013

UNDERSTANDING AND DISPLAYING FORMULAS

Bottom Line

The real strength of Excel is its capability to perform common and complex calculations. The formula is one of the essential elements of Excel, which enables you to add, subtract, multiply, and divide numbers. When you enter a formula in a cell, the formula is stored internally and the results are displayed in the cell. You can view the underlying formula in the formula bar when the cell is active, when you double-click the cell to edit it, and by using the FORMULAS tab.

STEP BY STEP   **Display Formulas**

GET READY. Before you begin these steps, LAUNCH Microsoft Excel and OPEN a new blank workbook.
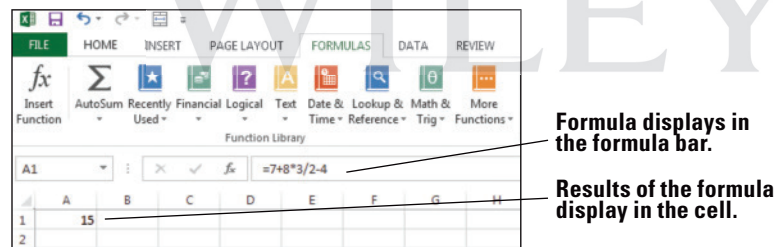
1. Click cell **A1**.
2. Type **=7+8*3/2-4** and press **Enter**. You just entered a formula.

Take Note   Formulas should be typed without spaces, but if you type spaces, Excel eliminates them when you press Enter.

3. Click cell **A1**. Notice that the result of the formula displays in the cell, but the formula itself appears in the formula bar (see Figure 4-2).

Figure 4-2

Viewing a formula in the formula bar

Formula displays in the formula bar.

Results of the formula display in the cell.

4. Double-click cell **A1**. The formula appears in both the active cell and the formula bar. You can edit the formula in this mode.
5. Press **Enter**.
6. On the FORMULAS tab, in the Formula Auditing group, click **Show Formulas**. The formula in cell A1 displays (see Figure 4-3).

Figure 4-3

Displaying a formula using the Show Formulas command

Show Formulas is selected.

A formula displayed in a cell
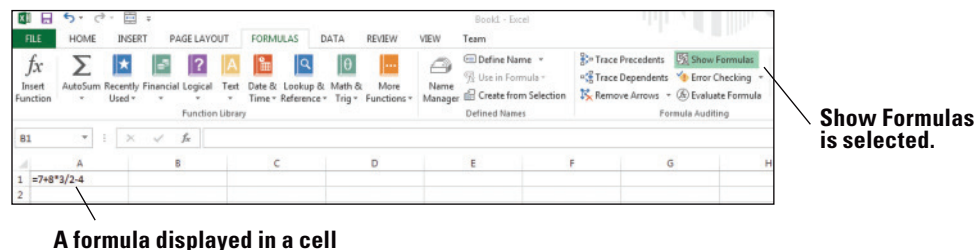
Take Note   While you are displaying formulas, you will not see the results of those formulas.

CERTIFICATION READY?   **1.4.10**

How do you display a formula in Excel?

7. Click **Show Formulas** again to turn off formula display.
8. SAVE the workbook in your Lesson 4 folder as *04 Formula Practice Solution*.

PAUSE. LEAVE the workbook open to use in the next exercise.

A **formula** is an equation that performs calculations, such as addition, subtraction, multiplica-

tion, and division, on values in a worksheet. In Excel, a **value** can be a number, a cell address, a date, text, or Boolean data, but is usually a number or cell address in terms of formulas. A formula consists of two elements: operands and calculation operators. **Operands** identify the values to be used in the calculation. An operand can be a constant value, or a variable such as a cell reference, a range of cells, or another formula. A **constant** is a number or text value that is entered directly into a formula. A **variable** is a symbol or name that represents something else, which can be a cell address, a range of cells, and so on. **Calculation operators** specify the calculations to be performed. To allow Excel to distinguish formulas from data, all formulas begin with an equal sign (=).

Take Note   You can begin a formula with a plus (+) sign or a minus (–) sign as the beginning calculation operator, but Excel changes it to an equal sign when you press Enter. Excel doesn't recognize a construct like 3+4= as a legitimate formula. Excel treats it like an ordinary string of characters.

Excel uses four types of calculation operators: arithmetic, comparison, text concatenation, and reference. This lesson covers several arithmetic operators and the equal sign, which is a comparison operator. The arithmetic operators are listed in Table 4-1.

Table 4-1

Excel Arithmetic Operators

Arithmetic Operator	Name	Calculation	Example
+	Plus sign	Addition	5+2
–	Minus sign	Subtraction	5–2
		Negation	–5
*	Asterisk	Multiplication	5*2
/	Forward slash	Division	5/2
%	Percent sign	Percent	20%
^	Caret	Exponentiation	5^2

When you build a formula, it appears in the formula bar and in the cell itself. When you complete the formula and press Enter, the value displays in the cell and the formula displays in the formula bar if you select the cell. You can edit a formula in the cell or in the formula bar the same way you can edit any data entry.

When you click the Show Formulas button on the FORMULAS tab, all formulas in your worksheet display. Click the Show Formulas button again to toggle off display of formulas.

UNDERSTANDING ORDER OF OPERATIONS

Bottom Line   If you use more than one operator in a formula, Excel follows a specific order—called the **order of operations**—to calculate the formula. Parentheses play an important role in controlling the order of operations.

STEP BY STEP   **Understand Order of Operations**

GET READY. USE the worksheet from the previous exercise.

1. Click cell **A1** to make it the active cell.
2. Click in the formula bar.
3. Insert parentheses around **7 + 8**.

4. Insert parentheses around **3 / 2**.

5. Insert parentheses around **(7 + 8) * (3 / 2)**, as shown in the formula bar in Figure 4-4. Press **Enter**. The result in A1 changes to *18.5.*

6. SAVE the workbook in your Lesson 4 folder as *04 Order of Operations Solution* and CLOSE it.

PAUSE. LEAVE Excel open to use in the next exercise.

Excel applies the rules of mathematics to determine how formulas are calculated. The following is the order in which arithmetic operators are applied:

• Negative number (–)

• Percent (%)

• Exponentiation (^)

• Multiplication (*) and division (/) (left to right)

• Addition (+) and subtraction (–) (left to right)

For example, consider the original equation:

$7 + 8 * 3 / 2 – 4 = 15$

CERTIFICATION READY? **4.1.2**

How do you determine the order of operations for arithmetic operators in an Excel formula?

Following arithmetic operator priorities, the first operation is 8 multiplied by 3 and that result is divided by 2. Then 7 is added and 4 is subtracted.

You can use parentheses in a formula to override the standard order of operations. Excel performs calculations on formulas inside parentheses first. Parentheses inside of parentheses are called **nested parentheses**. Calculations are performed on formulas in the innermost set of parentheses first, and from left to right if nested parentheses are at the same level. Therefore, the result of the following equation with parentheses is different from the previous one:

$((7 + 8) * (3 / 2)) – 4 = 18.5$

Following arithmetic operator priorities, the first operation is the sum of 7 + 8 multiplied by the quotient of 3 divided by 2. Then, 4 is subtracted.

Troubleshooting   While modifying a complex formula, if you decide to revert back to the original formula and start over, just press Esc. If you've already pressed Enter, you'll need to click the Undo button on the Quick Access Toolbar.

BUILDING BASIC FORMULAS

Bottom Line

You do basic math in your head or using scratch paper every day. Excel is handy for performing basic calculations also. Although you probably won't use Excel to add or subtract a few numbers, it's important to learn how to create simple formulas in Excel, which serve as the building blocks for more complex calculations. This section shows you how to create basic formulas that let you perform addition, subtraction, multiplication, and division.

Creating a Formula that Performs Addition

You can add two or more numbers in Excel using the plus sign between each number. To use proper Excel format, you must include the equal sign at the beginning of the formula.

Create a Formula that Performs Addition

GET READY. LAUNCH Microsoft Excel if it is not already open.

1. OPEN the *04 Budget Start* data file for this lesson.
2. In cell A18, type **January Rent plus Deposit** and press **Enter**.
3. In cell B18, type the equal (**=**) sign, type **1200+500**, and press **Enter**. This is the simplest way to enter an addition formula. Excel adds the values in the formula and displays the result, *1700*, which is your first month's rent plus a $500 deposit. Your worksheet now looks like that shown in Figure 4-5.

Figure 4-5

The result of an addition formula

The result of =1200+500

4. SAVE the workbook in your Lesson 4 folder as *04 Budget Basic Formulas Solution.*

PAUSE. LEAVE the workbook open to use in the next exercise.

When entering formulas that perform addition, if a positive number is entered first, it is not necessary to enter a plus sign.

If you make a mistake in your data entry, you can select the cell with the erroneous formula, press F2 to enter cell editing mode, and edit your formula. Once you make your corrections, press Enter to revise.

Creating a Formula that Performs Subtraction

Subtraction works the same way as addition, except that you enter a minus (–) sign rather than a plus (+) sign between the values in the formula.

Create a Formula that Performs Subtraction

GET READY. USE the worksheet you modified in the previous exercise.

1. Double-click cell **A18**.
2. Click after the word "Deposit," type **, minus Discount**, and press **Enter**.
3. Right-click cell **A18**, select **Format Cells**, click the **Alignment** tab, select the **Wrap text** check box, and click **OK**. Now you can see all of the new text added to A18.

🔍 **Cross Ref**   You learn about different kinds of formatting techniques in Lesson 6.

4. Click cell **B18** to make it the active cell.
5. Click in the formula bar.

6. Position the cursor immediately after **=1200+500**, type **-100**, and press **Enter**. Your landlord gave you a $100 discount for moving into your rental home early, so you are subtracting $100 from your first month's rent. The value in cell B18 changes to *1600* to reflect the new formula (see Figure 4-6).

Figure 4-6

The result of a subtraction formula

Cell B18 has been modified to include subtraction in the formula, resulting in 1600.

7. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

When you modified the formula to subtract 100 from 1700, you could have entered =1200+500–100 or = –100+1200+500. Either formula yields a positive 1600.

Creating a Formula that Performs Multiplication

Multiplication not only uses the values in cells, but other numbers that you enter. The symbol for multiplication is the asterisk (*).

STEP BY STEP   **Create a Formula that Performs Multiplication**

GET READY. USE the worksheet you modified in the previous exercise.

1. In cell A19, type **Annual Rent per Lease** and press **Enter**.
2. In cell B19, type **=1200*12** and press **Enter**. The result displays in cell B19, which is the total amount of rent you will pay in one year (see Figure 4-7).

Figure 4-7

The result of a multiplication formula

The result of =1200*12

3. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

Creating a Formula that Performs Division

Division works the same way as multiplication, except that the symbol for division is the forward slash (/).

STEP BY STEP   **Create a Formula that Performs Division**

GET READY. USE the worksheet you modified in the previous exercise.

1. In cell A20, type **Average Electricity** and press **Enter**.
2. In cell B20, type **=N8/12** and press **Enter**. The result displays in cell B20, which is the average monthly amount you will pay for electricity in one year (see Figure 4-8).

Figure 4-8

The result of a division formula

The result of =N8/12

3. SAVE the workbook and CLOSE it.

PAUSE. LEAVE Excel open to use in the next exercise.

USING CELL REFERENCES IN FORMULAS

Bottom Line

As you learned in Lesson 1, "Overview," each cell in an Excel worksheet has a unique identifier indicating its column and row, such as A1 (column A, row 1) or E4 (column E, row 4). When you create a formula, you can reference a cell's identifier rather than typing the number that appears in that cell. A **cell reference** identifies a cell's location in the worksheet, based on its column letter and row number. Using a cell reference rather than the data displayed in a cell gives you more flexibility in your worksheet. If the data in a cell changes, any formulas that reference the cell change as well. For example, if cell E1 contains the number 12 but is later changed to 15, any formula that references cell E1 updates automatically. The same principle applies to a cell that contains a formula and is referenced in another formula.

Using Relative Cell References in a Formula

A **relative cell reference** is one that adjusts the cell identifier automatically if you insert or delete columns or rows, or if you copy the formula to another cell. A relative cell reference is, therefore, one whose references change "relative" to the location where it is copied or moved.

STEP BY STEP   **Use Relative Cell References in a Formula**

GET READY. OPEN the *04 Budget Cell References* data file for this lesson.

1. Click cell **B18**.

2. Click in the formula bar and replace 1200 with cell **B3**. Notice that cell B3 is highlighted and surrounded by a blue border while you're modifying the formula (see Figure 4-9).

Figure 4-9

Entering a relative cell reference

Entering a relative cell reference

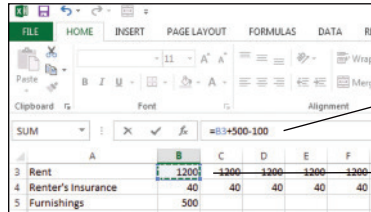Cell B3 is highlighted and surrounded by a blue border.

Take Note   You can use either uppercase or lowercase when you type a cell reference in a formula. For example, it does not matter whether you type B4 or b4 in the formula you enter.

3. Press **Enter**. The formula in cell B18 now uses a relative cell reference to cell B3.

4. Copy cell **B18** to cell **B21**. The displayed result changes to *400*.

5. Notice in the formula bar that the formula in cell B21 is =B6+500-100, but the formula you copied is =B3+500-100. That's because the original cell reference of cell B3 changed to cell B6 when you copied the formula down three cells, and cell B6 is blank. The cell reference is adjusted relative to its position in the worksheet.

6. An alternate way to use a cell reference is to click the cell being referenced while creating or modifying a formula. With cell B21 still active, click in the formula bar and select **B6**.

7. Click cell **B3**. Cell B3 becomes highlighted and surrounded by a blue dashed border, and cell B3 appears in the formula bar rather than cell B6 (see Figure 4-10). Press **Enter**.

Figure 4-10

Using the mouse to enter a relative cell reference

Entering a relative cell reference

Cell B3 is highlighted and surrounded by a blue dashed border.

CERTIFICATION READY?   4.1.1

How do you use a relative cell reference in a formula?

8. SAVE the workbook in your Lesson 4 folder as *04 Budget Cell References Solution*.

PAUSE. LEAVE the workbook open to use in the next exercise.

You use relative cell references when you want the reference to automatically adjust when you copy or fill the formula across rows or down columns in ranges of cells. By default, new formulas in Excel use relative references.

In this exercise, you learn two methods for creating formulas using relative references:

• By typing the formula directly into the cell

• By clicking a cell to include in the formula rather than typing the cell reference

The second method is usually quicker and eliminates the possibility of typing an incorrect cell identifier, especially if you need to create a formula with many cell references. For example, it might be easy to make a mistake typing =D2+D7+D9+D12+D14 rather than just clicking each cell to add it to the formula.

You can also reference a range of cells in a formula, which you learn about later in this lesson.

Cell referencing raises another important point about Excel. When you perform math on a series of numbers on paper, they're usually right next to each other in a column or a single row. In a worksheet, the numbers don't have to be adjacent: You can create formulas that reference cells anywhere in the worksheet.

Take Note   When constructing a worksheet, plan on using relative cell references unless you know there will be a reason not to adjust the cell identifier when you insert or delete columns and rows.

Using Absolute Cell References in a Formula

Sometimes you do not want a cell reference to change when you move or copy it. To make an absolute cell reference, use the dollar sign ($) before the column and row of the cell you want to reference.

Use an Absolute Cell Reference in a Formula

GET READY. USE the worksheet you modified in the previous exercise.

1. Click cell **B18**.

2. Click in the formula bar and insert dollar signs in the B3 cell reference so it looks like **$B$3**.

3. Press **Enter**. The formula in cell B18 now uses an absolute cell reference to cell B3.

4. Copy cell **B18** to cell **B21**. The displayed result is *1600*, which matches B18.

5. Copy cell **B21** to cell **C21**. The displayed result is still *1600*.

6. Notice in the formula bar that the formulas in cells B21 and C21 are both =$B$3+500-100. Figure 4-11 shows the formula for cell C21. Regardless of where you copy the formula in the worksheet, the formula still refers to cell B3.

Figure 4-11

An absolute cell reference

An absolute cell reference contains dollar signs.

Cells B21 and C21 show the results of the same absolute cell reference.

7. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

An **absolute cell reference** refers to a specific cell or range of cells regardless of where the formula is located in the worksheet. Absolute cell references include two dollar signs in the formula, preceding the column letter and row number. The absolute cell reference $B$3, for example, refers to column (B) and row (3). When you copy the formula to any other cell in the worksheet, the absolute reference will not adjust to the destination cells.

Workplace Ready

ABSOLUTE CELL REFERENCES FOR PAYROLL TRACKING

Assume you work for a company that hires seasonal workers. All seasonal employees are paid the same hourly wage, but the number of hours each person works each week may vary. You are responsible for creating weekly payroll reports.

You can enter the hourly wage in one cell, and then use absolute cell references in calculations to refer to the hourly wage. In the following figure, each employee's gross pay is calculated using an absolute cell reference to the hourly wage in cell B1, which is $13.17. You could substitute 13.17 for $B$1 in each formula, but if the hourly wage changes, you would need to modify every formula.

Using an absolute cell reference lets you change just the value in cell B1, and then all formulas that reference that cell would change automatically.

In addition, if you add columns for taxes and deductions, regardless of where the Gross Pay column is located, all formulas in that column would still reference cell B1.

Absolute cell reference

Using Mixed Cell References in a Formula

You can also create a mixed reference in which a column or a row is absolute, and the other is relative. For example, if the cell reference in a formula is $A5 or A$5, you would have a mixed reference in which one component is absolute and one is relative.

| STEP BY STEP | **Use a Mixed Cell Reference in a Formula** |

GET READY. USE the worksheet you modified in the previous exercise.

1. Click cell **B21**.
2. Click in the formula bar and delete the dollar sign before **3** in the formula so it looks like **$B3**.
3. Press **Enter**. The formula in cell B21 now uses a mixed cell reference.
4. Copy cell **B21** to cell **C22**. The displayed result is *440*, which is different from the result in B21. That's because the formula in C22 references cell B4 (see Figure 4-12). The dollar sign before the B in the formula is absolute, but the row number is relative.

Figure 4-12

A mixed cell reference

A mixed cell reference contains one dollar sign.

Cell C22 shows the result of a mixed cell reference.

5. Delete the contents of cell **B21**, cell **C21**, and cell **C22**.
6. SAVE the workbook.

CERTIFICATION READY? 4.1.1

How do you use a mixed cell reference in a formula?

PAUSE. LEAVE the workbook open to use in the next exercise.

A **mixed cell reference** is a cell reference that uses an absolute column or row reference, but not both.

In the exercise, the column portion of the cell reference is absolute and remains unchanged in the formula regardless of where the formula is copied. The row portion of the formula is relative (no dollar sign precedes the row number of 3), so that part of the cell reference changes when the cell is copied.

If you copy a formula across rows or down columns, the relative reference automatically adjusts, and the absolute reference does not adjust. For example, when you copied the formula containing the mixed reference $B3 to a different cell in column C, the reference in the destination cell changed to $B4. The column reference remained the same because that portion of the formula is absolute. The row reference adjusted because it is relative.

Using External Cell References

You've been creating or modifying cell references that refer to cells in the same worksheet. However, you can also refer to cells in another worksheet in the same workbook or to another workbook entirely. References to cells located in a separate workbook are considered *external references*. Unless you specify another worksheet or workbook, Excel assumes your cell references are to cells in the current worksheet.

Referring to Data in Another Worksheet

An **external reference** refers to a cell or range in a worksheet in another Excel workbook, or to a defined name in another workbook. (You learn how to define range names later in this lesson.) You might need to use this strategy, for example, to create a summary of data in one worksheet based on data in another worksheet. The basic principles for building these formulas are the same as those for building formulas referencing data within a worksheet.

STEP BY STEP   **Refer to Data in Another Worksheet**

GET READY. USE the worksheet you modified in the previous exercise.

1. Click the **Summary** sheet tab in the *04 Budget Cell References Solution* workbook.

2. Click cell **D8**. You want the average payment for electricity to appear in this cell, similar to the content that appears in B20 in the Expense Details worksheet. However, your formula must reference the Expense Details worksheet to gather the data.

3. Type **=SUM('Expense Details'!N8)/12** and press **Enter**. This formula divides the value of cell N8 in the Expense Details worksheet by 12. The result is *176*, rounded due to cell formatting applied to the worksheet (see Figure 4-13).

Figure 4-13

Creating a link to a worksheet in the same workbook

The formula includes a reference to the Expense Details worksheet, which is in the same workbook as the Summary worksheet.

Cell D8 shows the result of a cell reference to a cell in the Expense Details worksheet.

🔍 **Cross Ref**   You learn about cell formatting in Lesson 6, "Formatting Cells and Ranges."

4. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

The general format of a formula that references a cell in a different worksheet is *SheetName!CellAddress*. That is, you enter the external worksheet name followed by an exclamation point, and then the cell address in the external worksheet. For worksheet names that include one or more spaces, you need to enclose the name in single quotation marks, similar to 'Sheet Name'!CellAddress.

You can also refer to a range of cells in an external worksheet. For example, in the exercise, you can use a similar formula, =SUM('Expense Details'!B8:M8)/12, to accomplish the same task. The portion B8:M8 is called a *range*, as you learned in Lesson 2, "Working with Microsoft Excel 2013." This formula adds the values in the range B8:M8 and then divides them by 12 to produce the average monthly payment for electricity over one year. You see how to work with cell ranges after the next section.

Microsoft calls references to cells in another worksheet or in another workbook *links* because you are essentially linking to data in those remote locations.

Excel provides several functions to help you create formulas more easily. One of the most common functions, SUM, adds the values in a series of cells specified in a range. The construct =SUM(D2:D5) is the same as specifying =D2+D3+D4+D5.

Cross Ref   You learn about basic functions in Lesson 5, "Using Functions" and advanced formulas and functions in Lesson 10, "Using Advanced Formulas."

Referencing Data in Another Workbook

The procedure for referencing data in another workbook is nearly the same as referencing data in another worksheet in the same workbook. The difference is that, when creating a reference to cells in another workbook, you must enclose the other workbook name in square brackets ([ ]) and both workbooks must be open.

STEP BY STEP   **Reference Data in Another Workbook**

GET READY. USE the worksheet you modified in the previous exercise.

1. Open a second workbook, the data file named *04Budget2012*.
2. In *04 Budget Cell References Solution*, on the Summary sheet, click cell **C3**.
3. Type **=([04Budget2012.xlsx]Summary!B3)**, as shown in Figure 4-14, and press **Enter**. The formula links to cell B3 on the Summary sheet in the workbook named *04Budget2012*.

Figure 4-14

An external reference to a cell in another workbook

The formula includes an external reference to the Summary Worksheet in the 04Budget2012 workbook.

Cell C3 contains the formula with an external reference.

4. SAVE the workbook and CLOSE it.
5. CLOSE *04Budget2012*.

PAUSE. LEAVE Excel open to use in the next exercise.

The paired brackets [ ] identify the name of the workbook file, and Summary! identifies the worksheet within that file.

If the data in the referenced cell in the 04Budget2012 worksheet changes, so will the data in the corresponding cell on the Summary worksheet in 04 Budget Cell References Solution. This holds true even if you save 04 Budget Cell References Solution under a different file name.

If you don't have the external workbook open when creating the formula, the Update Values dialog box appears. You must navigate to the location of 04Budget2012.xlsx, select the file, and click OK.

If you close both workbooks and reopen only 04 Budget Cell References Solution , the full path to the 04Budget2012 workbook displays in the formula bar (see Figure 4-15).

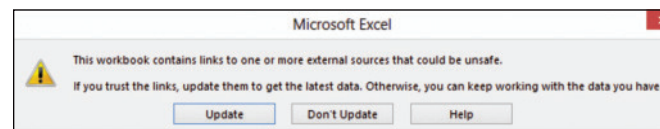**Figure 4-15**

The full path to the linked workbook
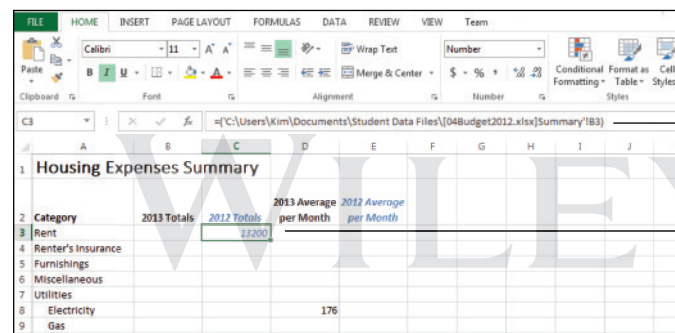
The formula includes the full path to the external workbook.

The result of the formula

If you close and then reopen the workbook that contains the cell reference to the external workbook, a message appears prompting you to update your links (see Figure 4-16).

Figure 4-16

A message dialog box prompting you to update links

USING CELL RANGES IN FORMULAS

Bottom Line

In Excel, groups of cells are called *ranges*. The cell groups are either contiguous or non-contiguous. You can name (define) ranges, change the size of ranges after you define them, and use named ranges in formulas. The Name box and the Name Manager help you keep track of named ranges and their cell addresses. You can also use the Paste Names command to create a list of named ranges and their addresses in a worksheet.

Naming a Range

When you refer to the same cell range over and over, it might be more convenient to give it a name. Excel recognizes the name as the cell range and uses the values in those cells to do what you specified. For instance, if you have a series of sales figures in a column, instead of referring to them as the range *C4:C10*, you can name them *SalesQ3*. Any time you use the name *SalesQ3* in a formula,

Excel would then use the values in those cells.

Name a Range of Cells

GET READY. OPEN the *04 Budget Ranges* data file for this lesson.

1. Click **Enable Content**, if prompted. Click the **Expense Details** sheet tab.
2. Select **B3:B14**. These are the cells to be named.
3. To the left of the formula bar, click the **Name** box.
4. Type a one-word name for the list, such as **Q1Expenses**, and press **Enter**. The range name appears in the Name box (see Figure 4-17). Excel saves this name and uses it in any subsequent reference to this range. (Don't worry about the apparent misnaming of the range. You modify this range to include additional months in an exercise later in this lesson.)

Troubleshooting   When naming a range, if a message appears stating that the name already exists, display the Name Manager (discussed in the "Changing the Size of a Range" section) and edit the existing name or delete it and enter a different name.

Figure 4-17

Using the Name box to name a range

The **range name appears in the Name box.**

The **highlighted cells that are part of the range**

5. An alternative way to name a range is to use the New Name dialog box. Select **B16:M16**.
6. On the FORMULAS tab, in the Defined Names group, click **Define Name**. The New Name dialog box appears (see Figure 4-18).

Figure 4-18

Using the New Name dialog box to name a range


7. Excel uses the row heading as the range name, shown in the Name text box. You can change the name if you like. For this exercise, leave the default name.
8. Open the **Scope drop-down list**. Your options are Workbook, Expense Details, and Summary. The last two entries correspond to individual sheets in the workbook. Close the drop-down list, leaving **Workbook** selected.

9. Enter comments in the Comments text box, if you like.

10. Leave the cell address that appears in the Refers to text box. This is the range you selected. Notice that the sheet name is also included automatically.

11. Click **OK**. The name *Utilities_Subtotals* is saved for the range B16:M16.

12. A third way to name a range is to use the Create Names from Selection dialog box. Select **N2:N14**. This selection includes the column heading label.

13. On the FORMULAS tab, in the Defined Names group, click **Create from Selection**. The Create Names from Selection dialog box appears (see Figure 4-19).

Figure 4-19

Using the Create Names from Selection dialog box to name a range
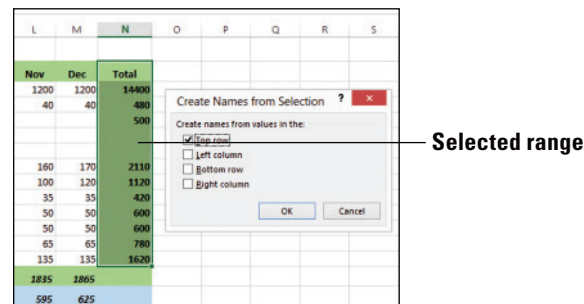
14. Excel determines that you want to use the column heading label as the range name. Click **OK**. The range is saved with the name *Total*.

15. Open the Name box drop-down list (see Figure 4-20). You have three named ranges from which to select.

Figure 4-20

Three named ranges appear in the Name box drop-down list

16. SAVE the workbook in your Lesson 4 folder as *04 Budget Ranges Solution*.

PAUSE. LEAVE the workbook open to use in the next exercise.
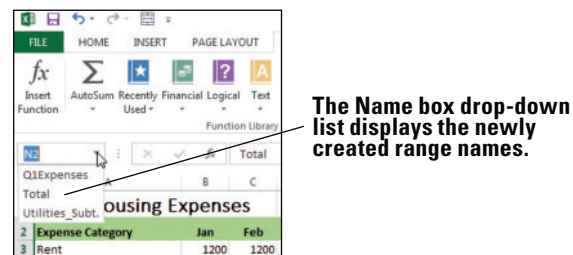
CERTIFICATION READY? 2.3.4

How do you name ranges in a worksheet?

As you learned in Lesson 2, a range is a group of adjacent cells that you select to perform operations on all of the selected cells. You refer to a cell range by separating the first and last cell in the range by a colon, such as B1:B9 and D4:G9. The totals and subtotals in 04 Budget Ranges use cell ranges in their formulas.

A **named range** is a group of cells, and occasionally a single cell, with a designated name. The most common reason to name a range is to refer to it in formulas and functions. Naming ranges or an individual cell according to the data they contain is a time-saving technique, even though it might not seem so when you work with limited data files in practice exercises. However, naming a range in a large or complex worksheet enables you to go to the location quickly, similar to a bookmark.

After selecting a range of cells, you can name the range using three different methods:

• By typing a name in the Name box next to the formula bar

• By using the New Name dialog box

• By using the Create Names from Selection dialog box

Rules and guidelines for naming ranges include the following:

• Range names can be up to 255 characters in length.

• Range names may begin with a letter, the underscore character (_), or a backslash (\). The rest of the name may include letters, numbers, periods, and underscore characters, but not a backslash.

• Range names may not consist solely of the letters "C", "c", "R", or "r", which are used as shortcuts for selecting columns and rows.

• Range names may not include spaces. Microsoft recommends you use the underscore character (_) or period (.) to separate words, such as Fruit_List and Personal.Budget.

• Range names cannot be the same as a cell reference, such as A7 or $B$3.

All names have a scope, either to a specific worksheet or to the entire workbook. The **scope** of a name is the location within which Excel recognizes the name without qualification. Excel requires that a name must be unique within its scope, but you can use the same name in different scopes. In the New Name dialog box, if you select a worksheet name from the Scope list, the scope is at the local worksheet level. If you select Workbook, the scope is at the global workbook level.

If you defined a named range after you entered a cell reference in a formula, you might want to update the existing cell reference to the defined name. Select an empty cell, click the arrow next to Define Name, and click Apply Names. In the Apply Names dialog box, click one or more names, and click OK.

Take Note   You can use the same name for equivalent ranges in other worksheets within a workbook. Include the name of the worksheet in brackets before the range name to identify which worksheet you're referring to.

After creating named ranges, you can select a name in the Name box drop-down list to select the named range on the worksheet.

Changing the Size of a Range

You might want to change the size of a range to include or exclude data that you didn't consider when you created the range.
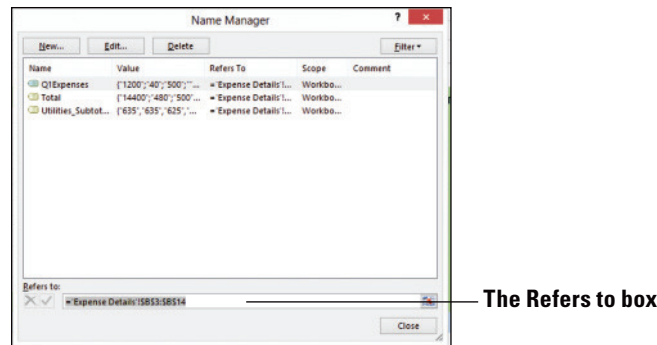

STEP BY STEP   **Change the Size of a Range**

GET READY. USE the worksheet you modified in the previous exercise.

1. Click the **Expense Details** sheet, if it's not already active.
2. On the FORMULAS tab, in the Defined Names group, click **Name Manager**.
3. Select **Q1Expenses**.
4. At the bottom of the dialog box, highlight everything in the Refers to box (see Figure 4-21).

The Refers to box

5. In the Expenses Details worksheet, select **B3:D14**. The content in the Refers to box in the Name Manager dialog box reflects the new range (see Figure 4-22).

Figure 4-22

The new range appears in the
Refers to box.

New range selected

**The content in the
Refers to box has
been changed**
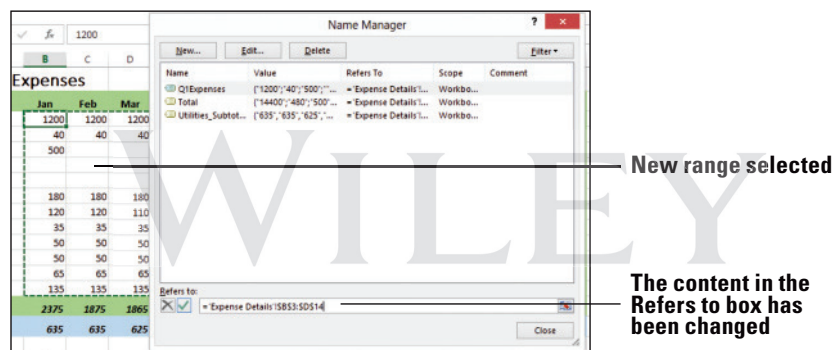
6. Click **Close**, and then click **Yes** when asked if you want to save your changes.
7. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

To change the parameters of a named range, you can easily redefine the range by using the Name Manager on the FORMULAS tab. The Name Manager contains all the information about named ranges.

Creating a Formula that Operates on a Named Range

You can use the name of any range in a formula, just as you can use a cell identifier.

STEP BY STEP   **Create a Formula that Operates on a Named Range**

GET READY. USE the worksheet you modified in the previous exercise.

Another Way
You can just enter
the formula and range name,
such as =sum(Q1Expenses)
directly into the cell.

1. In the Expense Details sheet, click **A21**.
2. Type **First Quarter Expenses** and press **Enter**.
3. In cell B21, type **=SUM(**.
4. On the FORMULAS tab, in the Defined Names group, click **Use in Formula**.
5. Select **Q1Expenses** from the list (see Figure 4-23), type **)** to close the equation, and press **Enter**. The total amount of expenses for January through March appears in cell B21.

Figure 4-23

Using a named range in a formula
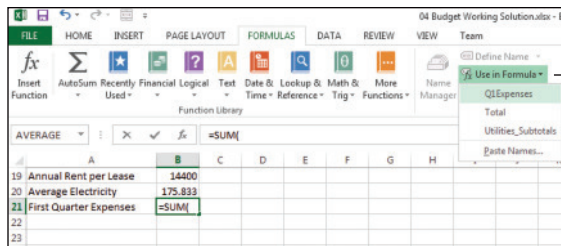
Selecting Q1Expenses from the Use In Formulas drop-down list

CERTIFICATION READY? 4.1.3

How do you reference named ranges in a formula?

6. SAVE the workbook.

PAUSE. LEAVE the workbook open to use in the next exercise.

Keeping Track of Named Ranges

As you've seen, the Name box drop-down list contains a list of named ranges for the current worksheet. When you select a named range from the Name box, the range is highlighted in the worksheet. The Name Manager dialog box enables you to work with all of the defined names in the workbook. The Paste Names command lets you maintain a list of named ranges and their cell addresses as data in a worksheet.

STEP BY STEP **Keep Track of Named Ranges**

GET READY. USE the worksheet you modified in the previous exercise.

1. Open the **Name box drop-down list**. The names of all named ranges available in that workbook display.
2. To verify your change to the size of the Q1Expenses range in a previous exercise, select **Q1Expenses**. The range B3:D14 appears highlighted.
3. On the FORMULAS tab, in the Defined Names group, click **Name Manager**. Each named range is listed in the dialog box. You can use Name Manager to create a new range, rename a range, delete a range, and verify the scope of a range, among other tasks.
4. Click **Close** to close the Name Manager.
5. To display range names and their cell ranges as data in the worksheet, select a cell with blank cells to the right and below it, such as cell **P2**.
6. On the FORMULAS tab, in the Defined Names group, click **Use in Formula** and then select **Paste Names**. The Paste Name dialog box opens.
7. Click **Paste List**. Widen the width of column **P** to display all range names fully. Range names display in column P and their cell ranges display in column Q (see Figure 4-24).

Figure 4-24

Range names and cell addresses pasted into a worksheet

8. SAVE the workbook and CLOSE it.

CLOSE Excel.

You can use the Name Manager as a convenient way to confirm the value and reference of a named range or to determine its scope. In addition, you can add, change, or delete names.

It is easier to remember names than to memorize cells and cell ranges. You can create a list of defined names in a workbook using the Paste List command. Doing so makes it simpler to keep track of your data.

SKILL SUMMARY

In this lesson you learned how:	Exam Objective	Objective Number
To display formulas.	Display formulas.	1.4.10
To follow the order of operations.	Define order of operations.	4.1.2
To build basic formulas.		
To use relative, mixed, and absolute cell references in formulas.	Demonstrate how to use references (relative, mixed, absolute).	4.1.1
To create named ranges in worksheets.	Create named ranges.	2.3.4
To reference cell ranges in formulas.	Reference cell ranges in formulas.	4.1.3

Knowledge Assessment

Multiple Choice

Select the best response for the following statements.

1. Which of the following is *not* an arithmetic operator?
   a. +
   b. −
   c. *
   d.]

2. In Excel, what is the result of =1 + 3 * 2 / 2 - 1?
   a. 2
   b. 3
   c. 4
   d. 6

3. Per the order of operations, which of the following is calculated first?
   a. Addition (+) and subtraction (−) (left to right)
   b. Exponentiation (ˆ)
   c. Percent (%)
   d. Negative number (−)

4. Which of the following refers to an unnamed range in the current worksheet?
   a. =SUM(C2:E12)
   b. =Q3Expenses!A19
   c. =[Media.xlsx]MasterList!$D$10
   d. =SUM(budget.summary)

5. Which of the following shows a formula for a reference to another worksheet in the same workbook?
   a. =SUM(C2:E12)
   b. =Q3Expenses!A19
   c. =[Media.xlsx]MasterList!$D$10
   d. =SUM(budget.summary)

6. Which of the following shows a formula for a reference to another workbook?
   a. =SUM(C2:E12)
   b. =Q3Expenses!A19
   c. =[Media.xlsx]MasterList!$D$10
   d. =SUM(budget.summary)

7. Which of the following is an acceptable name for a named range?
   a. C7
   b. subtotal_west
   c. subtotal west
   d. subtotal/west

8. Which of the following is an example of an absolute cell reference?
   a. A9
   b. A$9
   c. $A$9
   d. A9:E9

9. Which of the following is an example of a mixed cell reference?
   a. A9
   b. A$9
   c. $A$9
   d. A9:E9

10. Which of the following can you *not* do using the Name Manager?
   a. Enter values into a range.
   b. Change a range name.
   c. Delete a named range.
   d. Verify the scope of a range.

True / False

Circle T if the statement is true or F if the statement is false.

T F 1. To allow Excel to distinguish formulas from data, all formulas begin with an equal sign (=).

T F 2. Regarding a named range, the scope of a name is the location within which Excel recognizes the name without qualification.

T F 3. Excel recognizes a construct like 3+4= as a legitimate formula.

T F 4. Range names may begin with the caret (^) character.

T F 5. You cannot use a named range in a formula that references another worksheet.

T F 6. Range names cannot be the same as a cell reference, such as C10 or $D$8.

T F 7. Once you name a range, you can change the size of the range using the Name Manager.

T F 8. You can create a new range by selecting the cells and typing a name in the Name box next to the formula bar.

T   F 9. The order of operations determines which parts of a formula are calculated before other parts of the formula.

T   F 10. The formula = 6 * 2 / 3 produces the same result as =6 * (2 / 3).

Competency Assessment

Project 4-1: Create Basic Formulas

Practice creating addition, subtraction, multiplication, and division formulas.

GET READY. Before you begin these steps, LAUNCH Microsoft Excel and OPEN a blank workbook.

1. Click cell **A1** and type **=20+15**. Press **Enter**. Excel calculates the value in A1 and displays *35* in the cell.

2. In A2, type **=34+51+22**. Press **Tab**. The sum of the three numbers, *107*, appears in the cell.

3. Click **A2** to display the formula for that cell in the formula bar.

4. With A2 selected, click the formula bar. Select **51** and type **15**. Press **Enter**. Notice that the formula result changes to *71.*

5. In A3, type **=35.3+41.6+17.4**. Press **Enter**. The value *94.3* appears in A3.

6. In B1, type **=375−68**. Press **Enter**. The value *307* appears in the cell.

7. In B2, type **=45−13−8**. Press **Enter**. The value in B2 should be *24*.

8. In B3, create a formula to subtract **125** from **189**. The value in B3 should be *64*.

9. In C1, type **=125*4** and press **Enter**. The value that appears in C1 is *500*.

10. In C2, type **=2*7.50*2** and press **Enter**. The value in C2 is *30*.

11. In C3, type **=5+2*8**. The value in C3 is *21.*

12. In D1, create the formula **=795/45** and press **Enter**. Excel returns a value of *17.66667* in D1.

13. In D2, create the formula **=65−29*8+97/5** and press **Enter**. The value in D2 is *−147.6*.

14. In D3, create the formula **=-12+10+20.5/3** and press **Enter**. Excel returns a value of *4.833333* in D3.

15. In E1, type **=2^4** and press **Enter**. The value *16* displays in E1. This formula calculated 2 raised to the 4th power.

16. In E2, type **=25*(1+35%)** and press **Enter**. Excel returns a value of *33.75*. The formula increased 25 by 35%.

17. In E3, type **=3^2*(1+25%)** and press **Enter**. Excel returns a value of *11.25* in E3.

18. SAVE the workbook in your Lesson 4 folder as *04 Project Math Solution* and CLOSE it.

PAUSE. LEAVE Excel open to use in the next project.

Project 4-2: Work with the Order of Operations

Practice working with the order of operations.

GET READY. Before you begin these steps, OPEN the *04 Project Operations Practice* workbook.

1. Select **C3** and modify the formula by inserting **parentheses** around **5+2**. Press **Enter**. The new formula should be =(5+2)*8. The value in C3 changes from *21* to *56*.

2. Select **D2**. Click in the formula bar and place **parentheses** around **65−29**. Press **Enter**. The new formula should be =(65−29)*8+97/5. The value in D2 changes from *−147.6* to *307.4.*

3. Select **D2**. Click in the formula bar and place **parentheses** around **97/5**. Press **Enter**. The new formula should be =(65−29)*8+(97/5). The value in D2 remains the same at *307.4*.

4. Select **D2**. Click in the formula bar and change the **parentheses** so the formula looks like =(65−(29*8)+97)/5. Press **Enter**. The value in D2 changes to *−14.*

5. SAVE the workbook in your Lesson 4 folder as *04 Project Operations Solution* and CLOSE it.

LEAVE Excel open to use in the next project.

Project 4-3: Link to Data in Other Worksheets within a Workbook

You work for A. Datum Corporation as an accountant. You have a workbook with several sheets that contain budgets for western division offices located in Alaska, Washington, Oregon, and California. You created a summary sheet and named the sheet tab WesternSummary. You will link to information in the four other worksheets to present summary data in one place. Each area worksheet is organized the same way to make it easy to find the same kind of data for each area.

GET READY. Before you begin these steps, OPEN the *04_ADatum_Start* workbook.

1. On the WesternSummary sheet, click cell **B3** and enter the formula **=Alaska!B8**. The formula links to the data in cell B8 (the Gross Sales total) on the Alaska worksheet and displays it in cell B3 of the WesternSummary worksheet.

2. In B4, enter the formula **=Washington!B8** to link to the Washington office gross sales total.

3. Create similar formulas to display the Oregon and California gross sales data on the WesternSummary sheet.

4. Compare the figures in column B on the WesternSummary sheet to the appropriate cells in the other worksheets to verify that your formulas are correct. If not, adjust the formulas on the WesternSummary sheet to correct them.

5. Create similar formulas to display the COGS totals in column C, the commissions totals in column D, and the net sales totals in column E on the WesternSummary sheet. (To save time, you can select **B3:B6** and drag the fill handle to the right to fill all additional totals.)

6. Compare the figures on the WesternSummary sheet to the other worksheets to verify that your formulas are correct. If not, adjust the formulas to correct them.

7. SAVE the workbook in your Lesson 4 folder as *04_ADatum_USWest Solution* and CLOSE it.

LEAVE Excel open to use in the next project.

Project 4-4: Use External References

You now want to create a summary in a workbook named *04_ADatum_GlobalSales* and link to information in the 04_ADatum_USWest workbook.

GET READY. LAUNCH Excel if it is not already running.

1. OPEN *04_ADatum_USWest* and *04_ADatum_GlobalSales* from your data files.

2. In *04_ADatum_GlobalSales*, on the GlobalSummary sheet, click cell **B4** to make it active.

3. Enter the formula **=([04_ADatum_USWest]WesternSummary!B8)**. The formula links to the data in cell B8 on the WesternSummary sheet in the 04_ADatum_USWest workbook.

4. Copy **B4** to **C4**.

5. SAVE the *04_ADatum_GlobalSales* workbook and leave it open.

6. In *04_ADatum_USWest*, on the California tab, change the data in cell B6, which is the Gross Sales figure for Release 3.4, to **284,125**.

7. Check the WesternSummary sheet to verify that the linked cell updated automatically.

8. Save the *04_ADatum_USWest* workbook and close it.

9. CLOSE *04_ADatum_GlobalSales* without saving the workbook.

10. Reopen *04_ADatum_GlobalSales*.

11. Click **Enable Content**, if prompted.

12. Click **Update** if the message window appears.

13. OPEN *04_ADatum_USWest*.

14. Verify that the data in cell B4 in *04_ADatum_GlobalSales* matches the corresponding data in *04_ADatum_USWest*.

15. SAVE *04_ADatum_USWest* in your Lesson 4 folder as *04_ADatum_USWestSales Solution*.

16. SAVE *04_ADatum_GlobalSales* in your Lesson 4 folder as *04_ADatum_GlobalSales Solution*.

17. CLOSE both workbooks.

LEAVE Excel open for the next project.

Mastery Assessment

Project 4-5: Name a Range and Use the Range in a Formula

Blue Yonder Airlines wants to analyze the sales and expense data from its four-year history.

GET READY. LAUNCH Excel if it is not already running.

1. OPEN the *04 Income Analysis* workbook for this lesson.

2. On the Sales sheet, select **B4:E4** and use the **Define Name** command on the FORMULAS tab to name the range. Accept the defaults in the dialog box.

3. Select **B5:E5** and use the Name box to name the range. Use the row heading as the range name using an underscore to separate the words.

4. Select **A6:E6**. Use the **Create from Selection** command on the FORMULAS tab to name the range. Use the default option in the dialog box.

5. Create a named range for **A7:E7** using the method of your choice.

6. Create a formula in cell F4 that sums the values in B4:E4 using the range name.

7. Repeat Step 6 for the other three income sources.

8. Create range names on the Expenses sheet using the method of your choice.

9. Total the four expense categories on the Expenses sheet as you did on the Sales sheet. Be careful to select the worksheet range name rather than the workbook range name in each case. You use this workbook again in Lesson 5 and create formulas with functions on the Analysis sheet.

10. SAVE the workbook in your Lesson 4 folder as *04 Income Analysis Solution* and then CLOSE the file.

LEAVE Excel open to use in the next project.

Project 4-6: Create a Personal Budget

Most people agree that it is vitally important for a business to have a realistic budget. It is equally important for an individual to have a personal budget—a plan for managing income and expenses. Using a personal budget worksheet prepopulated with data, create range names to identify specific blocks of data, and then use those range names in formulas you create to compare budgeted to actual costs.

GET READY. LAUNCH Excel if it is not already running.

1. OPEN the *04 Personal Budget Start* workbook for this lesson.

2. On the Expenses sheet, name cell B7 **Income_Total**. If you use the Define Name command, use the defaults in the New Name dialog box.

3. Name cells B10:B14 **Home_Total**.

4. Create named ranges similar to Step 3 for budgeted amounts for the Daily Living Total, Transportation Total, and Entertainment Total categories.

5. Create a formula in cell D4 that subtracts the actual amount from the budgeted amount. The cells in column D are formatted to display a dash if the budgeted amount and the actual amount are the same. Copy the formula in D4 to **D5:D6**.

6. Create a formula in cell D7 that subtracts the actual amount from the budgeted amount using the Income_Total range name.

7. Beginning with the Home section, create a formula in the non-Total cells in column D that subtracts the actual amount from the budgeted amount using the range name for the budgeted amount. For example, the formula in cell D10 would be =Home_Total-C10. Be aware that the formulas might result in a positive number, no difference, or negative numbers.

8. Beginning with the Home section, create a formula in the Total cells in column D that subtracts the actual amount from the budgeted amount. Use the cell address for the budgeted amount.

9. In cells E10 through E14, create a formula that divides the budgeted amount by the income total. Use the range names Home_Total and Income_Total in the formula.

10. In cell E15, create a formula that divides the budgeted amount by the income total using a cell reference to the Home total and the range name Income_Total.

11. Complete column E per Steps 9 and 10 for the remaining cells.

12. The figure that displays in cell B36 is based on a named range, but part of the range is incorrect. Use the Name Manager or the Show Formulas command to analyze the formula for the Expenses range and correct it.

13. SAVE the workbook in your Lesson 4 folder as *04 Personal Budget Solution* and then CLOSE the file.

CLOSE Excel.