Chapter 5

Formulas and Functions

Learning Objectives

After completing this chapter, you should be able to:

- explain what formulas and functions are;
- calculate data with formulas and functions;
- create formulas;
- reference absolute and relative cell;
- copy formulas; and
- apply functions.

Understanding Formulas

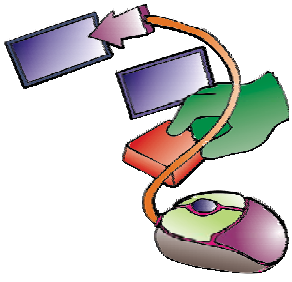
Formulas and functions are the real driving force of Excel's spreadsheet capabilities. You can use formulas to perform all kinds of calculations on your Excel data. You can build formulas using mathematical operators, values, and cell references. For example, you can add the contents of a column of monthly sales figures to calculate a total number of sales. If you are new in writing formulas, this section explains all the basics required to build your own formulas in Excel.

Formula Structure

Ordinarily, when you write a mathematical formula, you will write the values and the operators, followed by an equal sign, such as 2 + 2 =. In Excel, formula structure works a bit differently. All Excel formulas begin with an equal sign (=), such as =2+2. The equal sign immediately tells Excel to recognize any subsequent data as a formula rather than a regular cell entry.

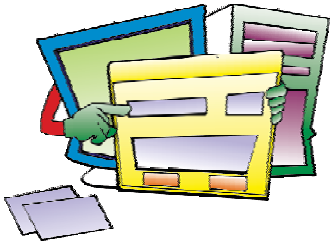
Referencing Cells

Although you can enter specific values in your Excel formulas, you can also easily reference data in specific cells. For example, you can add two cells together or multiply the contents of one cell by a value. Every cell in a worksheet has a unique address, also called a cell reference. By default, cells are identified by a specific column letter and row number, so cell D5 identifies the fifth cell down in column D. To help making your worksheets easier to use, you can assign your own unique names to cells. For example, if a cell contains the figure of the total weakly sales. you can name one cell as sales.



Cell Ranges

A group of related cells in a worksheet is called a range. Cell ranges are identified by their anchor points, the upper left corner of the range and the lower right corner of the range. The range reference includes both anchor points separated by a colon. For example, the range name A1:B3 includes cells A1, A2, A3, B1, B2, and B3. You can also assign unique names to your ranges to make it easier to identify their contents. Range names must start with a letter or underscore and can include uppercase and lowercase letters. Spaces are not allowed in range names.



Calculating Data with Formulas and Functions

Mathematical Operators

You can use mathematical operators in Excel to build formulas. Basic operators include the following:

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Percentage
^	Exponentiation
=	Equal to
<	Less than
≤	Less than or equal to
>	Greater than
≥	Greater than or equal to
<>	Not equal to

Operator Precedence

Excel performs a series of operations from left to right, which gives some operators precedence over others. When you are creating equations, the order of operations determines the results. For example, if you want to determine the average of values in A2, B2, and C2, and you enter the equation **=A2+B2+C2/3**, you will calculate the wrong answer. This is because Excel divides the value in cell C2 by 3, and then adds that result to the A2+B2. Following operator precedence, division takes precedence over addition. The correct way to type the average formula is **=(A2+B2+C2)/3**. By enclosing the values in parentheses, Excel adds the cell values first before dividing the sum by 3. The following table gives order of operator precedence:

First	All operations enclosed in parentheses
Second	Exponential equations
Third	Multiplication and division
Fourth	Addition and subtraction

Reference Operators

You can use Excel's reference operators to control how a formula groups cells and ranges to perform calculations. For example, if your formula needs to include the cell range D2:D10 and cell E10, you can instruct Excel to evaluate all the data contained in these cells using a reference operator. Your formula might look like this: **=SUM(D2:D10,E10).**

Operator	Example	Operation
:	=SUM(D3:E12)	**Range operator**. Evaluates the reference as a single reference, including all the cells in the range from both corners of the reference.
,	=SUM(D3:E12,F3)	**Union operator**. Evaluates the two references as a single reference.
Spacebar	=SUM(D3:D20 D10:E15)	**Intersect operator**. Evaluates the cells common to both references.
Spacebar	=SUM(Totals Sales)	**Intersect operator**. Evaluates the intersecting cell(s) of the column labeled Totals and the row labeled Sales.

Creating Formulas

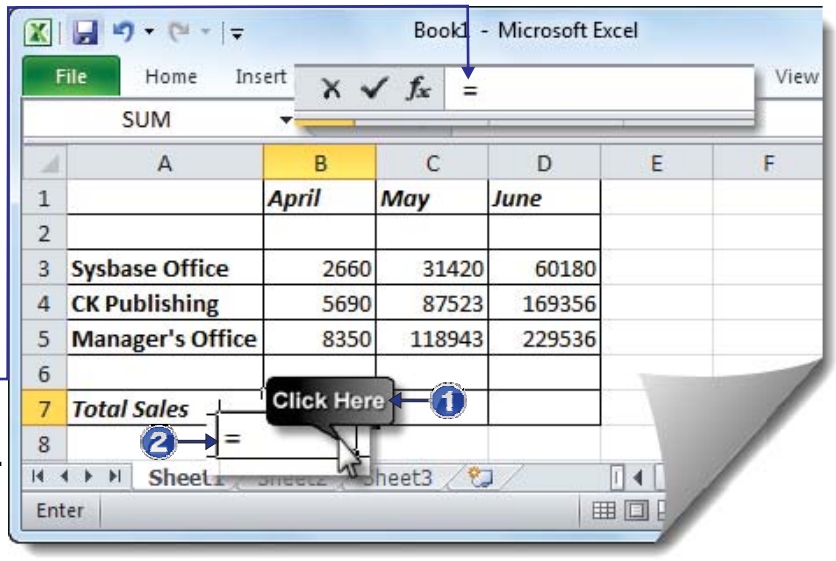
You can write a formula to perform a calculation on data in your worksheet cells. All formulas in Excel begin with an equal sign (=). You can reference values in cells by entering the cell name, also called a cell reference. For example, if you want to add the contents of cells C3 and C4 together, your formula would look like this: =C3+C4.

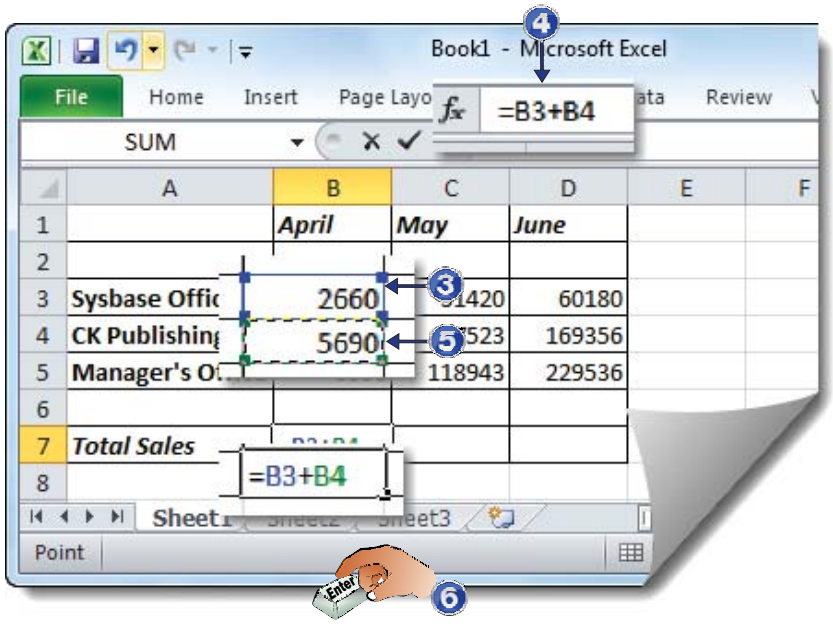
You can create a formula in the Formula bar at the top of the worksheet. Formula results always appear in the cell in which you assign a formula.

Create Formulas

Work File: Formulas.xlsx

1. Click the cell to which you want to assign a formula.
2. Type **=**.
   Excel displays the formula in the Formula bar and in the active cell.
3. Click the first cell that you want to reference in the formula.
   Excel inserts the cell reference into the formula.
4. Type an operator for the formula.
5. Click the next cell you want to reference in the formula.
   Excel inserts the cell reference into the formula.
6. Press Enter to accept your changes.





- You can also click Enter (☑) on the Formula bar to accept changes.
- You can click Cancel (☒) to cancel the formula. The formula results appear in the cell.
- To view the formula, simply click the cell. The Formula bar then displays any formula assigned to the active cell.

Note: If you change any of the values in the cells referenced in your formula, the formula results automatically update to reflect the changes.

Referencing Absolute and Relative Cells

By default, Excel treats the cells you include in formulas as relative locations rather than set locations in the worksheet. This is called relative cell referencing. For example, when you copy a formula to a new location, the formula automatically adjusts using relative cell addresses. If you want to address a particular cell location no matter where the formula appears, you can assign an absolute cell reference. Absolute references are preceded with a $ sign in the formula, such as =D2+E2.

Reference Absolute and Relative Cells

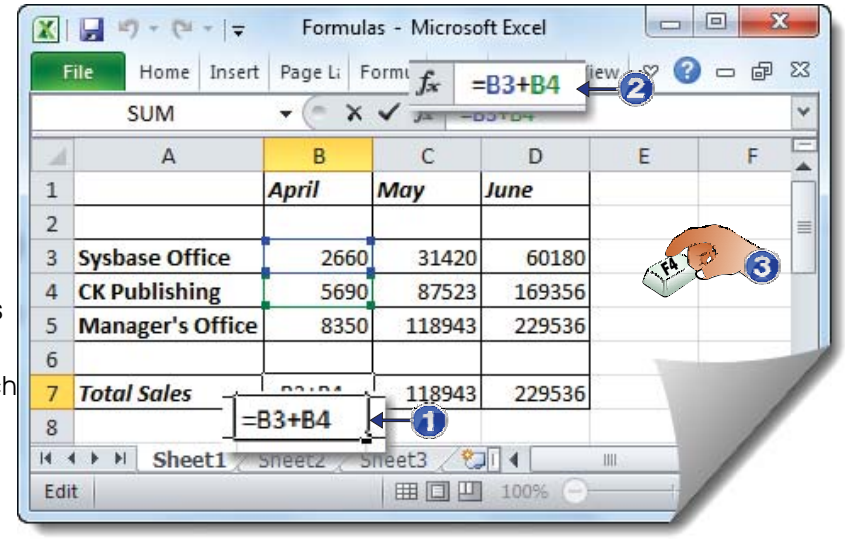
Work File: Formulas.xlsx

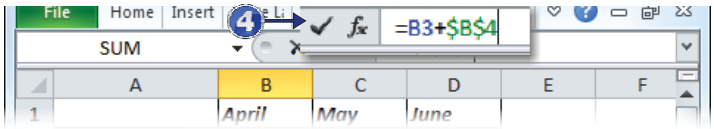
Assign Absolute References

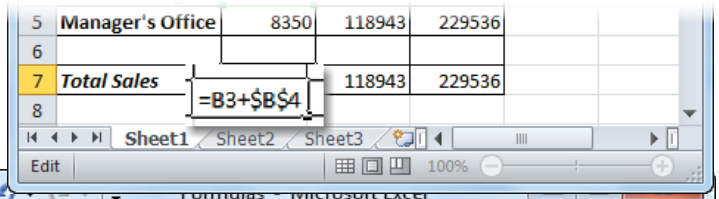
1. Click the cell containing the formula that you want to change.
2. Select the cell reference.
3. Press F4.
   - You can also type in the dollar signs to make a reference absolute.

   Excel enters dollar signs ($) before each part of the cell reference, making the cell reference absolute.
   - You can continue pressing to cycle through mixed, relative, and absolute references.
4. Press Enter or click ☑.

   Excel assigns the changes to the formula.

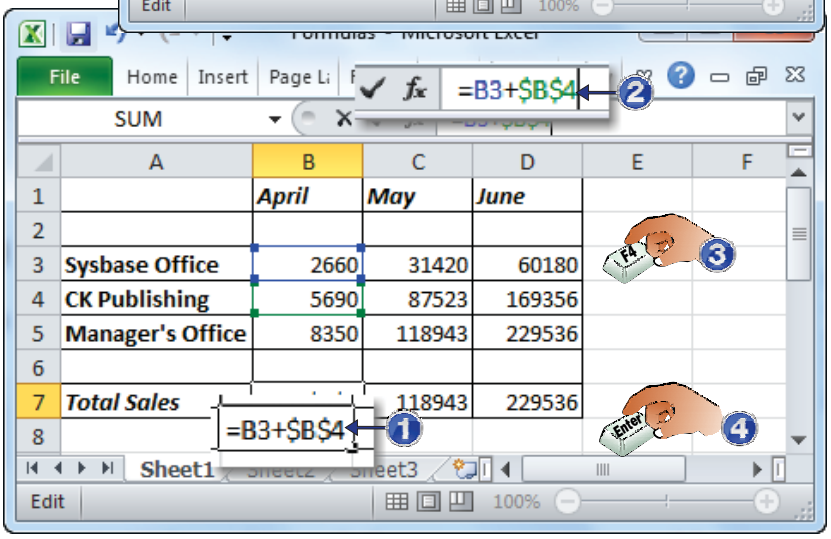






Assign Relative References

1. Click the cell containing the formula that you want to change.
2. Select the cell reference.
3. Press F4 to cycle to relative addressing.
   - You can press F4 multiple times to cycle through mixed, relative, and absolute references.You can also delete the dollar signs to make a reference relative.
4. Press Enter or click ☑.
   - Excel assigns the changes to the formula.



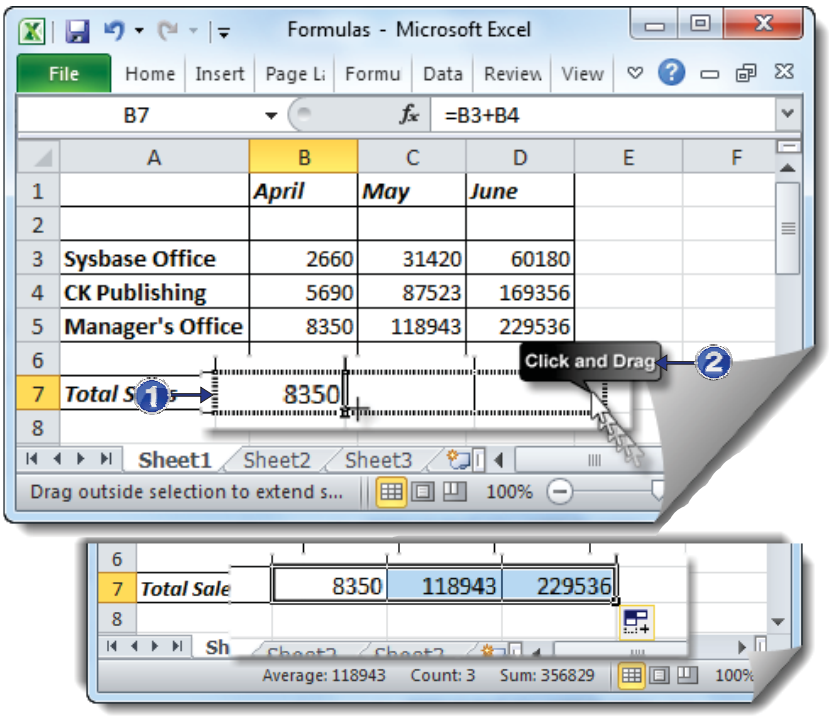
Copying Formula

You can use Excel's AutoFill feature to quickly copy formulas across rows or columns in your worksheets. If the cell references in a formula are relative, Excel automatically adjusts the formula for the destination cell.

Copy Formula

Copy A Relative Formula

Work File: Formulas.xlsx



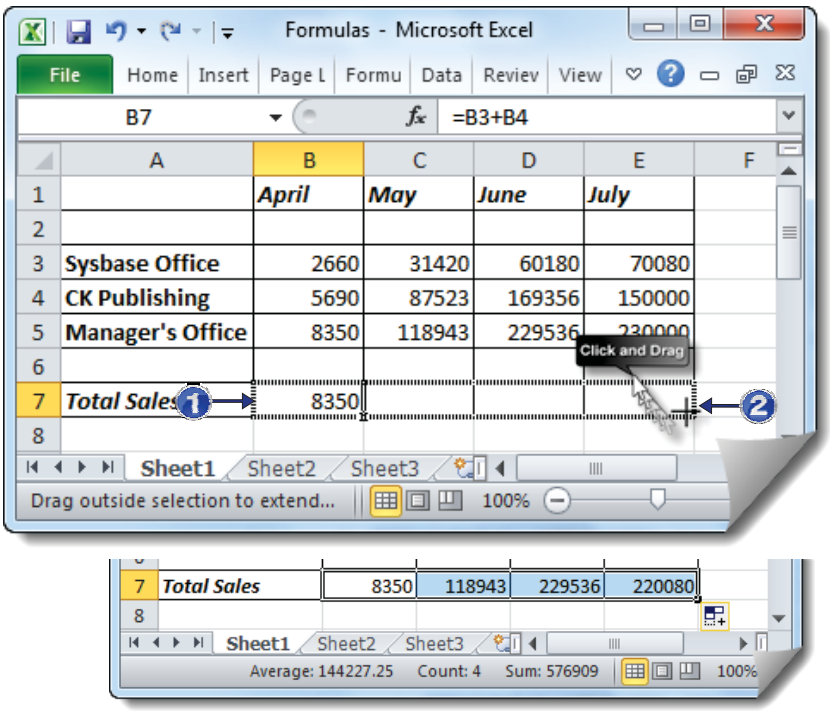
1. Click the cell containing the formula that you want to copy.
2. Click and drag the cell's fill handle across or down the number of cells to which you want to copy the formula.

Excel copies the formula into each cell you drag over. In the case of relative cell referencing, Excel adjusts the formula relative to each cell into which you copy the formula.

- In this example, the copied formula from cell B7 originally referred to cells in column B, but now refers to cells in column C.

Copy An Absolute Formula

Work File: Formulas.xlsx



1. Click the cell containing the formula that you want to copy.
2. Click and drag the cell's fill handle across or down the number of cells to which you want to copy the formula.

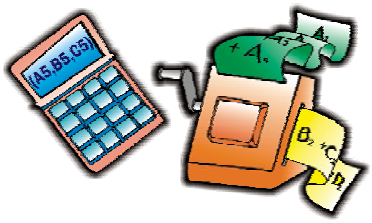
Excel copies the formula into each cell you drag over. In the case of absolute cell referencing, Excel keeps the absolute cell reference the same regardless of where you copy the formula.

- In this example, the copied formula from cell B16 originally referred to absolute cells in column B, and C14 now references the same absolute cells.

Understanding Functions

Excel has a collection of mathematical, financial, statistical and logical functions. If you are looking for a quicker way to enter formulas, you can tap into a wide variety of built-in formulas, called functions. Functions are ready-made formulas that perform a series of operations on a specified range of values. Excel offers over 300 functions you can use to perform mathematical calculations on your worksheet data.

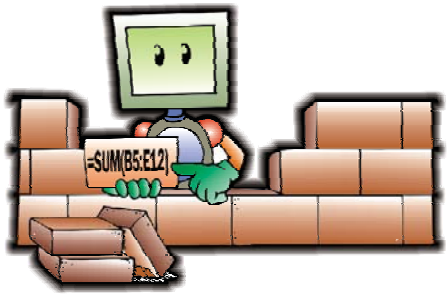
Function Elements



Functions are formulas, all functions must start with an equal sign (=). It is distinct and each function has name. For example, the function that sums data is called the SUM function, and the function for averaging values is AVERAGE. You can type functions directly into your worksheet cells or use the Formulas tab of the ribbon. You can also use the Insert Function Wizard or Function Argument dialog boxes to help construct functions. These offer help in selecting and applying functions to your data.

Constructing Arguments

Functions typically use arguments to indicate the cell addresses upon which you want the function to calculate. Arguments are enclosed in parentheses. When applying a function to individual cells in the worksheet, you can use a comma to separate the cell addresses, such as =SUM(A5,B5,C5). When applying a function to a range of cells, you can use a colon to designate the first and last cells in the range, such as =SUM(B5:E12). If your range has a name, you can insert the name, such as =SUM(Sales).



Common Functions

The table below lists some of the most popular Excel functions you can use with your own spreadsheet work.

Function	Category	Description	Syntax
SUM	Math & Trig	Adds values	=SUM(number1,number2,...)
ROUND	Math & Trig	Rounds a number specified by the number of digits	=ROUND(number,number_digits)
COUNT	Statistical	Returns a count of text or numbers in a range	=COUNT(value1,value2,...)
AVERAGE	Statistical	Averages a series of arguments	=AVERAGE(number1,number2,...)
MIN	Statistical	Returns the smallest value in a series	=MIN(number1,number2,...)
MAX	Statistical	Returns the largest value in a series	=MAX(number1,number2,...)
MEDIAN	Statistical	Returns the middle value in a series	=MEDIAN(number1,number2,...)
PMT	Financial	Finds the periodic payment for a fixed loan	=PMT(interest_rate,number_of_periods, present_value,future_value,type)
RATE	Financial	Returns an interest rate	=RATE(number_of_periods,payment, present_value,future_value,type,guess)
DAYS360	Date & Time	Returns the number of days between two dates using a 360-day calendar	=DAYS360( )
IF	Logical	Returns one of two results you specify based on whether the value is TRUE or FALSE	=IF(logical_text,value_if_true,value_if_false)
AND	Logical	Returns TRUE if all the arguments are true, and False if any are false	=AND(logical1,logical2,...)
OR	Logical	Returns TRUE if any argument is true and FALSE if all arguments are false	=OR(logical1,logical2,...)

Applying a Function

Functions are ideal to use to speed up your Excel calculations. You can use the Insert Function dialog box to look for a particular function from among function categories.

Apply a Function

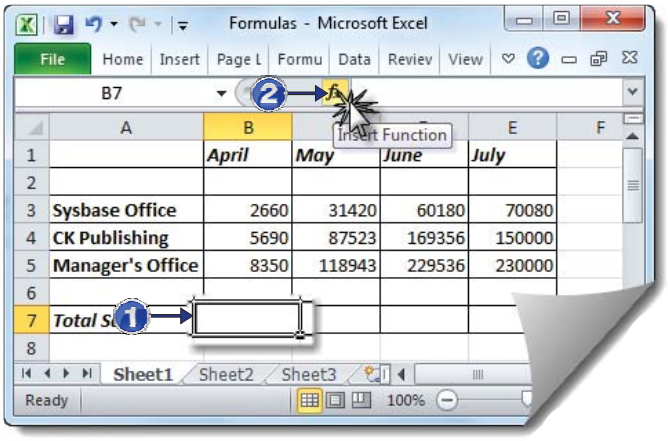
1. Click the cell to which you want to assign a function.
2. Click the Insert Function icon (*fx*) on the Formula bar.

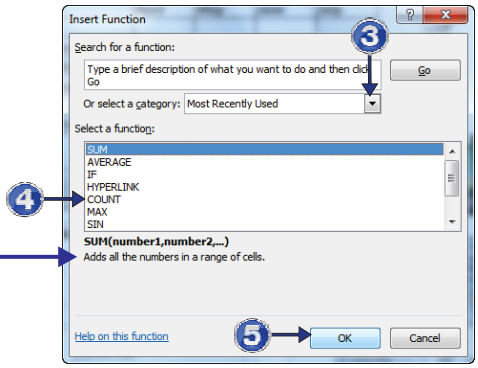
   Excel inserts an equal sign automatically to denote a formula and displays the Insert Function dialog box.

   - You can also click the Formulas tab and click (*fx*).
3. Click to select a category.
   - Excel's built-in functions are grouped into ten categories.
4. Click the function that you want to apply.

   A description of the function appears here.
5. Click OK.

Work File: Formulas.xlsx



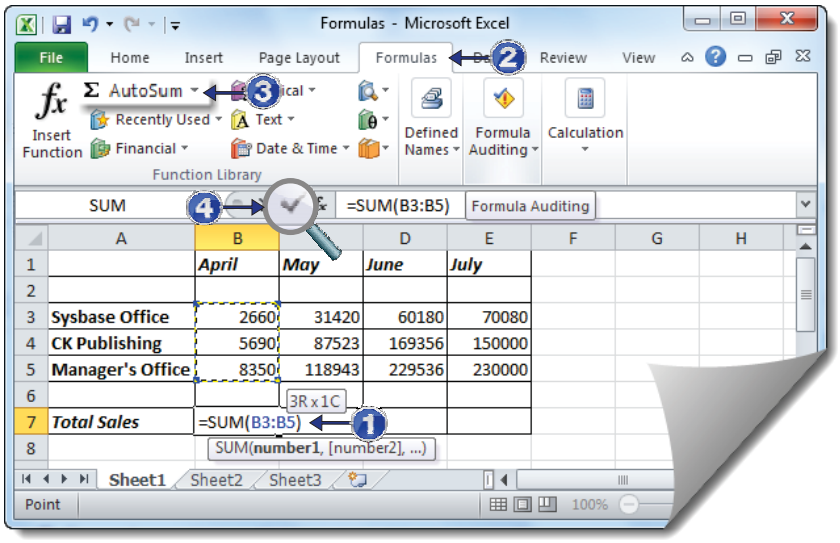


Applying AutoSum Function

One of Excel's popular functions available is the AutoSum function. AutoSum automatically totals the contents of cells. For example, you can quickly total a column of sales figures quickly. AutoSum works by guessing which surrounding cells you want to total, or you can specify exactly which cells to sum.

Apply Autosum Function

Work File: Formulas.xlsx



1. Click in the cell where you want to insert a sum total.
2. Click the Formula tab.
3. Click AutoSum.

   AutoSum immediately attempts to total the adjacent cells.

   - To sum another range of cells instead of AutoSum's guess, select the cells that you want to include in the sum.

4. Press Enter or click ☑.

   •Excel totals the selected cells.