More Excel 2010 Formulas

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Overview

A formula is a sequence of values, cell references, names, functions, or operators in a cell that together produce a new value. Formulas are equations that perform calculations on values in your worksheet. A formula always starts with an equal sign (=).

You can create a simple formula by using *constants* and calculation *operators*. A **constant** is a value that is not calculated. For example, the number 210 and the text "Quarterly Earnings" are constants. An **operator** is a sign or symbol that specifies the type of calculation to perform within an expression. There are mathematical, comparison, logical, and reference operators. An expression, or a value resulting from an expression, is not a constant.

You can also create a formula by using a *function*. A **function** is a prewritten formula that takes a value or values, performs an operation, and returns a value or values. Use functions to simplify and shorten formulas on a worksheet, especially those that perform lengthy or complex calculations.

Depending on the type of formula that you create, a formula can contain any or all of the following parts.

- **Functions**: A function starts with an equal sign (=), and you can enter arguments for the function within its parentheses. Each function has a specific argument syntax.
- **Cell references**: You can refer to data in worksheet cells by including cell references in the formula. For example, the cell reference **A2** returns the value of that cell or uses that value in the calculation.
- **Constants**: You can also enter constants, such as numbers or text values, directly into a formula.
- **Operators**: Operators are the symbols that are used to specify the type of calculation that you want the formula to perform. For example, the ^ (caret) operator raises a number to a power, and the * (asterisk) operator multiplies numbers.

To achieve the calculation result that you want, you can use a single function or nested functions that calculate single or multiple results. You can delete any formula when it's no longer needed.

Calculation operators and precedence

Operators specify the type of calculation that you want to perform on the elements of a formula. There is a default order in which calculations occur, but you can change this order by using parentheses.

Types of operators

There are four different types of calculation operators: arithmetic, comparison, text concatenation, and reference.

Arithmetic operators

To perform basic mathematical operations such as addition, subtraction, or multiplication; combine numbers; and produce numeric results, use the following arithmetic operators.

Arithmetic operator	Meaning	Example
+ (plus sign)	Addition	3+3
– (minus sign)	Subtraction Negation	3–1 –1
* (asterisk)	Multiplication	3*3

Arithmetic operator	Meaning	Example
/ (forward slash)	Division	3/3
% (percent sign)	Percent	20%
^ (caret)	Exponentiation	3^2

Comparison operators

You can compare two values with the following operators. When two values are compared by using these operators, the result is a logical value either TRUE or FALSE.

Comparison operator	Meaning	Example
= equal sign	Equal to	A1=B1
> greater than sign	Greater than	A1>B1
< less than sign	Less than	A1<B1

Comparison operator	Meaning	Example
>= greater than or equal to sign	Greater than or equal to	A1>=B1
<= less than or equal to sign	Less than or equal to	A1<=B1
<> not equal to sign	Not equal to	A1<>B1

Text concatenation operator

Use the ampersand (&) to join, or concatenate, one or more text strings to produce a single piece of text.

Text operator	Meaning	Example
& (ampersand)	Connects, or concatenates, two values to produce one continuous text value	("North"&"wind")

Reference operators

Combine ranges of cells for calculations with the following operators.

Reference operator	Meaning	Example
: (colon)	Range operator, which produces one reference to all the cells between two references, including the two references	B5:B15
, (comma)	Union operator, which combines multiple references into one reference	SUM(B5:B15,D5:D15)

The order in which Excel performs operations in formulas

In some cases, the order in which a calculation is performed can affect the return value of the formula, so it's important to understand how the order is determined and how you can change the order to obtain desired results.

Calculation order

Formulas calculate values in a specific order. A formula in Excel always begins with an equal sign (=). The equal sign tells Excel that the succeeding characters constitute a formula. Following the equal sign are the elements to be calculated (the operands), which are separated by calculation operators. Excel calculates the formula from left to right, according to a specific order for each operator in the formula.

Operator precedence

If you combine several operators in a single formula, Excel performs the operations in the order shown on the next page. If a formula contains operators with the same precedence — for example, if a formula contains both a multiplication and division operator — Excel evaluates the operators from left to right.

To keep things simple, the "Order of Operations" in a basic Excel formula is as follows:

1) **Parenthesis**
2) **Exponents**
3) **Multiplication or Division** – if both operators appear in the same formula, Excel evaluates the operators from left to right.
4) **Addition or Subtraction** – if both operators appear in the same formula, Excel evaluates the operators from left to right.

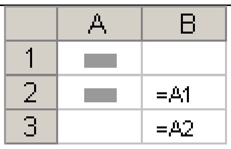
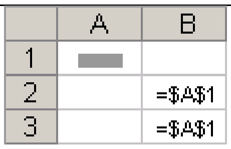
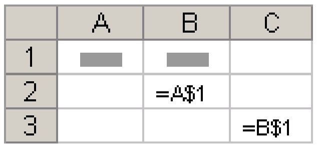
Tip: To recall the order of operations, try remembering:

Please **E**xcuse **M**y **D**ear **A**unt **S**ally.

To change the order of evaluation, enclose in parentheses the part of the formula to be calculated first.

Example, the following formula produces 11 because Excel calculates multiplication before addition. The formula multiplies 2 by 3 and then adds 5 to the result.	**=5+2*3**
In contrast, if you use parentheses to change the syntax, Excel adds 5 and 2 together and then multiplies the result by 3 to produce 21.	**=(5+2)*3**

The difference between absolute, relative and mixed references

Relative references: A relative cell reference in a formula, such as A1, is based on the relative position of the cell that contains the formula and the cell the reference refers to. If the position of the cell that contains the formula changes, the reference is changed. If you copy or fill the formula across rows or down columns, the reference automatically adjusts. By default, new formulas use relative references. For example, if you copy or fill a relative reference in cell B2 to cell B3, it automatically adjusts from =A1 to =A2.	 Copied formula with relative reference
Absolute references: An absolute cell reference in a formula, such as $A$1, always refers to a cell in a specific location. If the position of the cell that contains the formula changes, the absolute reference remains the same. If you copy or fill the formula across rows or down columns, the absolute reference does not adjust. By default, new formulas use relative references, and you may need to switch them to absolute references. For example, if you copy or fill an absolute reference in cell B2 to cell B3, it stays the same in both cells =$A$1.	 Copied formula with absolute reference
Mixed references: A mixed reference has either an absolute column and relative row, or absolute row and relative column. An absolute column reference takes the form $A1, $B1, and so on. An absolute row reference takes the form A$1, B$1, and so on. If the position of the cell that contains the formula changes, the relative reference is changed, and the absolute reference does not change. If you copy or fill the formula across rows or down columns, the relative reference automatically adjusts, and the absolute reference does not adjust. For example, if you copy or fill a mixed reference from cell A2 to B3, it adjusts from =A$1 to =B$1.	 Copied formula with mixed reference

Define and use names in formulas

By using names (a word or string of characters in Excel that represents a cell, range of cells, formula, or constant value), you can make your formulas much easier to understand and maintain. You can define a name for a cell range, function, constant, or table. Once you adopt the practice of using names in your workbook, you can easily update, audit, and manage these names.

A name is a meaningful shorthand that makes it easier to understand the purpose of a cell reference, constant, formula, or table, each of which may be difficult to comprehend at first glance. You can create your own defined name, and Microsoft Office Excel sometimes creates a defined name for you, such as when you set a print area. The following information shows common examples of names and how they can improve clarity and understanding.

Example Type	Example with no name	Example with a name
Reference	=SUM(C20:C30)	=SUM(FirstQuarterSales)
Constant	=PRODUCT(A5,8.3)	=PRODUCT(Price,WASalesTax)
Formula	=SUM(VLOOKUP(A1,B1:F20,5,FALSE), -G5)	=SUM(Inventory_Level,-Order_Amt)
Table	C4:G36	=TopSales06

The scope of a name

All names have a scope, either to a specific worksheet (also called the local worksheet level) or to the entire workbook (also called the global workbook level). The scope of a name is the location within which the name is recognized without qualification. For example:

- If you have defined a name, such as Budget_FY10, and its scope is Sheet1, that name, if not qualified, is recognized only in Sheet1, but not in other sheets without qualification.

  To use a local worksheet name in another worksheet, you can qualify it by preceding it with the worksheet name, as the following example shows:

  Sheet1!Budget_FY10
- If you have defined a name, such as Sales_Dept_Goals, and its scope is the workbook, that name is recognized for all worksheets in that workbook, but not for any other workbook.

A name must always be unique within its scope. Excel prevents you from defining a name that is not unique within its scope. However you can use the same name in different scopes. For example, you can define a name, such as GrossProfit that is scoped to Sheet1, Sheet2, and Sheet3 in the same workbook. Although each name is the same, each name is unique within its scope. You might do this to ensure that a formula that uses the name, GrossProfit, is always referencing the same cells at the local worksheet level.

You can even define the same name, GrossProfit, for the global workbook level, but again the scope is unique. In this case, however, there can be a name conflict. To resolve this conflict, by default Excel uses the name that is defined for the worksheet because the local worksheet level takes precedence over the global workbook level. If you want to override the precedence and you want to use the workbook name, you can disambiguate the name by prefixing the workbook name as the following example shows:

WorkbookFile!GrossProfit

You can override the local worksheet level for all worksheets in the workbook, with the exception of the first worksheet, which always uses the local name if there is a name conflict and cannot be overridden.

Learn about syntax rules for names

The following is a list of syntax rules that you need to be aware of when you create and edit names.

- **Valid characters**: The first character of a name must be a letter, an underscore character (_), or a backslash (\). Remaining characters in the name can be letters, numbers, periods, and underscore characters.

  Note: You cannot use the uppercase and lowercase characters "C", "c", "R", or "r" as a defined name, because they are all used as a shorthand for selecting a row or column for the currently selected cell when you enter them in a **Name** or **Go To** text box.
- **Cell references disallowed**: Names cannot be the same as a cell reference, such as Z$100 or R1C1.
- **Spaces are not valid**: Spaces are not allowed as part of a name. Use the underscore character (_) and period (.) as word separators, such as, Sales_Tax or First.Quarter.
- **Name length**: A name can contain up to 255 characters.
- **Case sensitivity**: Names can contain uppercase and lowercase letters. Excel does not distinguish between uppercase and lowercase characters in names. For example, if you created the name Sales and then create another name called SALES in the same workbook, Excel prompts you to choose a unique name.

Defining and entering names

You define a name by using the:

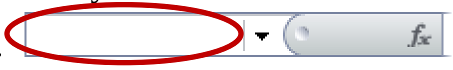
- **Name box on the formula bar**: This is best used for creating a workbook level name for a selected range.
- **Create a name from selection**: You can conveniently create names from existing row and column labels by using a selection of cells in the worksheet.
- **New Name dialog box**: This is best used when you want more flexibility in creating names, such as specifying a local worksheet level scope or creating a name comment.

Note: By default, names use absolute cell references **-** the exact address of a cell, regardless of the position of the cell that contains the formula. An absolute cell reference takes the form $A$1.

You can enter a name by:

- **Typing**: Typing the name, for example, as an argument to a formula.
- **Using Formula AutoComplete**: Use the Formula AutoComplete drop-down list, where valid names are automatically listed for you.
- **Selecting from the Use in Formula command**: Select a defined name from a list available from the **Use in Formula** command in the **Defined Names** group on the **Formulas** tab.

Define a name for a cell or cell range on a worksheet

1) Select the cell, range of cells, or nonadjacent selections that you want to name.
2) Click the **Name** box at the left end of the formula bar. 

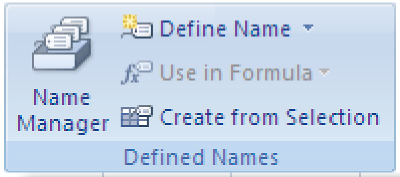
3) Type the name that you want to use to refer to your selection.
4) Press **ENTER**.
5) A name reference is created at the global worksheet level.

Note: You cannot name a cell while you are changing the contents of the cell.

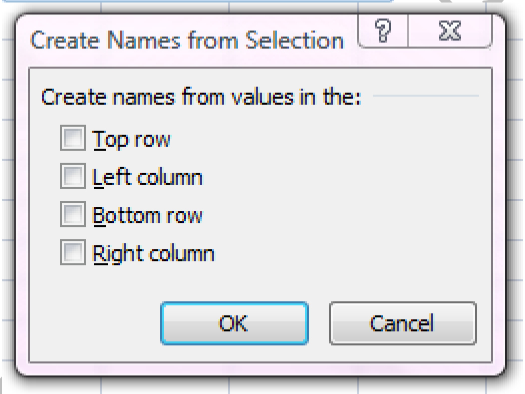
Define a name by using a selection of cells in the worksheet

You can convert existing row and column labels to names.

1) Select the range that you want to name, including the row or column labels.



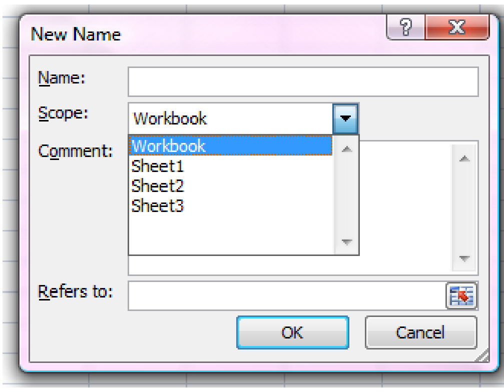
2) On the **Formulas** tab, in the **Defined Names** group, click **Create from Selection**.



3) In the **Create Names from Selection** dialog box, designate the location that contains the labels by selecting the **Top row**, **Left column**, **Bottom row**, or **Right column** check box.
   a) Name references are created at the global workbook level.

Note: A name created by using this procedure refers only to the cells that contain values and does not include the existing row and column labels.

Define a name by using the New Name dialog box



1) On the **Formulas** tab, in the **Defined Names** group, click **Define Name**.
2) In the **New Name** dialog box, in the **Name** box, type the name that you want to use for your reference.
3) To specify the scope of the name, in the **Scope** drop-down list box, select **Workbook** or the name of a worksheet in the workbook.
4) Optionally, in the **Comment** box, enter a descriptive comment up to 255 characters.
5) In the **Refers to** box, do one of the following:
   a) To enter a cell reference, type the cell reference.

      Tip: The current selection is entered by default. To enter other cell references as an argument, click **Collapse Dialog** (which temporarily shrinks the dialog box), select the cells on the worksheet, and then click **Expand Dialog** .
   b) To enter a constant, type = (equal sign) and then type the constant value.
   c) To enter a formula, type = and then type the formula.
   d) To finish and return to the worksheet, click OK.

Tip: To make the **New Name** dialog box wider or longer, click and drag the grip handle at the bottom.

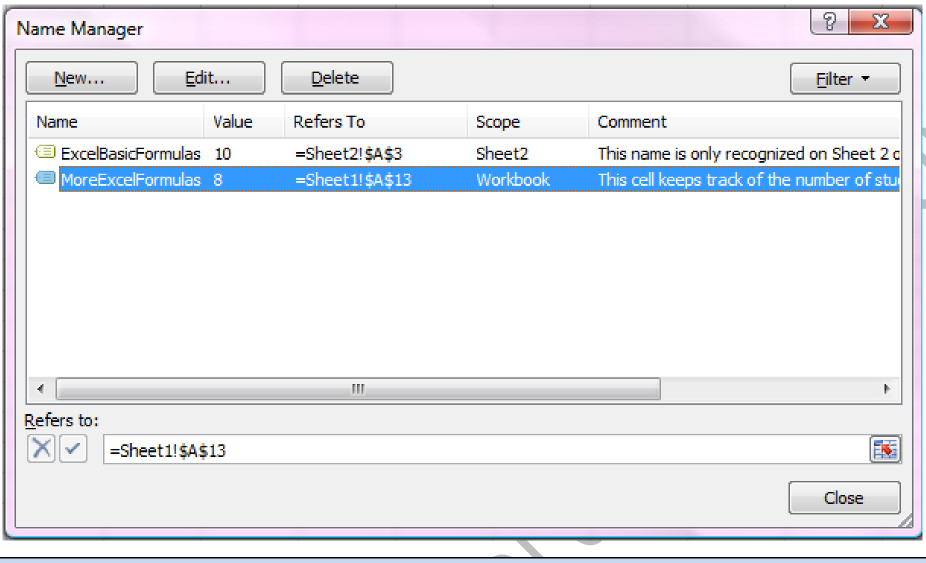
Manage names by using the Name Manager dialog box

Use the **Name Manager** dialog box to work with all of the defined names and table names in the workbook. For example, you may want to find names with errors, confirm the value and reference of a name, view or edit descriptive comments, or determine the scope. You can also sort and filter the list of names, and easily add, change, or delete names from one location.

To open the **Name Manager** dialog box, on the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.

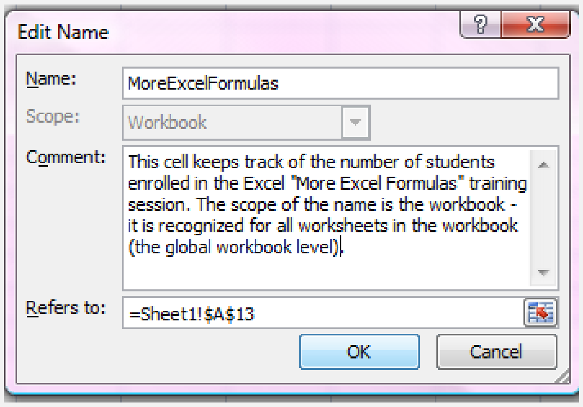
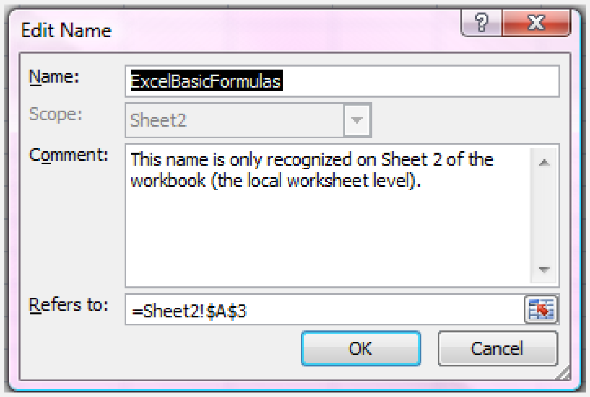
View names

The **Name Manager** dialog box displays the following information about each name in a list box:



Name	Value	Refers To	Scope	Comment
ExcelBasicFormulas	10	=Sheet2!$A$3	Sheet2	This name is only recognized on Sheet 2 c
MoreExcelFormulas	8	=Sheet1!$A$13	Workbook	This cell keeps track of the number of stu

Refers to: =Sheet1!$A$13

This Column:	**Displays:**
Icon and Name	One of the following: A defined name, which is indicated by a defined name icon. A table name, which is indicated by a table name icon. (Tables are not covered in this handout)
Value	The current value of the name, such as the results of a formula, a string constant, a cell range, an error, an array of values, or a placeholder if the formula cannot be evaluated.
Refers To	The current reference for the name.
Scope	A worksheet name, if the scope is the local worksheet level. "Workbook", if the scope is the global worksheet level.  Edit Name Name: MoreExcelFormulas Scope: Workbook Comment: This cell keeps track of the number of students enrolled in the Excel "More Excel Formulas" training session. The scope of the name is the workbook - it is recognized for all worksheets in the workbook (the global workbook level). Refers to: =Sheet1!$A$13 OK Cancel  Edit Name Name: ExcelBasicFormulas Scope: Sheet2 Comment: This name is only recognized on Sheet 2 of the workbook (the local worksheet level). Refers to: =Sheet2!$A$3 OK Cancel
Comment	Additional information about the name up to 255 characters.

Change a name

If you change a defined name or table name, all uses of that name in the workbook are also changed.

1) On the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.
2) In the **Name Manager** dialog box, click the name that you want to change, and then click **Edit**.

   Tip: You can also double-click the name.
3) In the **Edit Name** dialog box, in the **Name** box, type the new name for the reference.
4) In the **Refers to** box, change the reference, if necessary, and then click **OK**.
5) In the **Name Manager** dialog box, in the **Refers to** box, change the cell, formula, or constant represented by the name, if necessary.
6) To cancel unwanted or accidental changes, click **Cancel** ✕, or press ESC.
7) To save changes, click **Commit** ✓, or press ENTER.

   Note: The **Close** button only closes the **Name Manager** dialog box. It is not required to commit changes that have already been made.

Delete one or more names

1) On the **Formulas** tab, in the **Defined Names** group, click **Name Manager**.
2) In the **Name Manager** dialog box, click the name that you want to change.
3) Select one or more names by doing one of the following:
   a) To select a name, click it.
   b) To select more than one name in a contiguous group, click and drag the names, or press SHIFT and click the mouse button for each name in the group.
   c) To select more than one name in a noncontiguous group, press CTRL and click the mouse button for each name in the group.
4) Click **Delete**. (You can also press DELETE on your keyboard.)
5) Click **OK** to confirm the deletion.

Create Formulas

Create a simple formula by using constants and calculation operators

1) Click the cell in which you want to enter the formula.
2) Type = (equal sign).
3) To enter the formula, do one of the following:
   a) Type the constants and operators that you want to use in the calculation.
   b) Click the cell that contains the value that you want to use in the formula, type the operator that you want to use, and then click another cell that contains a value.

   Tip: You can enter as many constants and operators as you need to achieve the calculation result that you want.
4) Press ENTER.

Create a formula by using cell references and names

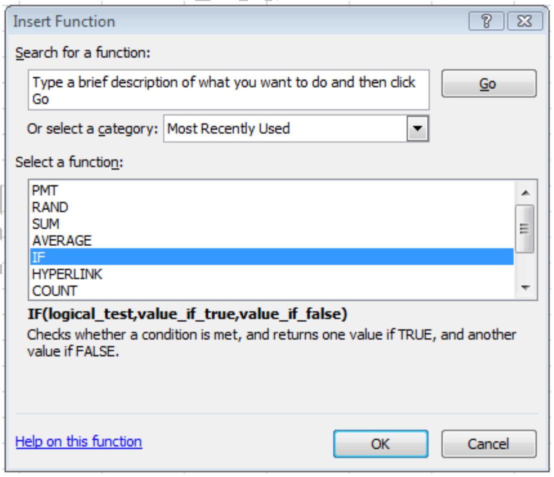
The example formulas at the end of this section contain relative references to and names of other cells. The cell that contains the formula is known as a dependent cell when its value depends on the values in other cells. For example, cell B2 is a dependent cell if it contains the formula =C2.

1) Click the cell in which you want to enter the formula.
2) In the formula bar , type = (equal sign).
3) Do one of the following:
   a) **To create a reference**: select a cell, a range of cells, a location in another worksheet, or a location in another workbook.
   b) **To enter a reference to a named range**: press **F3**, select the name in the **Paste name** box, and click **OK**.

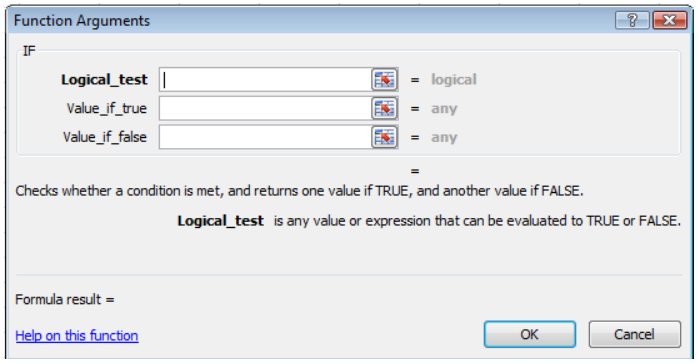
   Tip: You can also manually type the defined name.
4) Press **ENTER**.

Create a formula by using a function

1) Click the cell in which you want to enter the formula.
2) To start the formula with the function, click **Insert Function** button on the formula bar.
   a) The Insert Function dialog box opens.
   b) You can enter a question that describes what you want to do in the **Search for a function** box (for example, "add numbers" returns the **SUM** function), or browse from the categories in the **Or Select a category** box.
3) Select the function that you want to use / click **OK**.
   a) The Function Arguments dialog box opens
4) Enter the arguments.
5) After you complete the formula, press **ENTER**, or click **OK.**



IF(logical_test,value_if_true,value_if_false)
Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.



Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.

Logical_test is any value or expression that can be evaluated to TRUE or FALSE.

Delete a formula

When you delete a formula, the resulting values of the formula is also deleted. However, you can instead remove the formula only and leave the resulting value of the formula displayed in the cell.

1) **To delete formulas along with their resulting values, do the following**:
   a) Select the cell or range of cells that contains the formula.
   b) Press **DELETE**.

2) **To delete formulas without removing their resulting values, do the following**:

a) Select the cell or range of cells that contains the formula.

b) On the **Home** tab, in the **Clipboard** group, click **Copy**.

c) On the **Home** tab, in the **Clipboard** group, click the arrow below **Paste** , and then click **Paste Values**.

IF function

The **IF** function returns one value if a condition you specify evaluates to TRUE, and another value if that condition evaluates to FALSE.

For example, the formula **=IF(A1>10,"Over 10","10 or less")** returns "Over 10" if A1 is greater than 10, and "10 or less" if A1 is less than or equal to 10.

Syntax

IF(logical_test, value_if_true, [value_if_false])

The IF function syntax has the following arguments:

- **logical_test**: Required. Any value or expression that can be evaluated to **TRUE** or **FALSE**.
  - For example, A10=100 is a logical expression; if the value in cell A10 is equal to 100, the expression evaluates to TRUE. Otherwise, the expression evaluates to FALSE.
  - This argument can use any comparison calculation operator.
- **value_if_true**: Required. The value that you want to be returned if the ***logical_test*** argument evaluates to **TRUE**.
  - For example, if the value of this argument is the text string "Within budget" and the ***logical_test*** argument evaluates to TRUE, the **IF** function returns the text "Within budget."
  - If ***logical_test*** evaluates to TRUE and the ***value_if_true*** argument is omitted (that is, there is only a comma following the ***logical_test*** argument), the **IF** function returns 0 (zero).
  - To display the word TRUE, use the logical value TRUE for the ***value_if_true*** argument.
- **value_if_false**: Optional. The value that you want to be returned if the ***logical_test*** argument evaluates to **FALSE**.
  - For example, if the value of this argument is the text string "Over budget" and the ***logical_test*** argument evaluates to FALSE, the **IF** function returns the text "Over budget."
  - If ***logical_test*** evaluates to FALSE and the ***value_if_false*** argument is omitted, (that is, there is no comma following the ***value_if_true*** argument), the **IF** function returns the logical value FALSE.
  - If ***logical_test*** evaluates to FALSE and the value of the ***value_if_false*** argument is omitted, (that is, there is a comma following the ***value_if_true*** argument, the **IF** function returns the value 0 (zero).

Up to 64 **IF** functions can be nested as ***value_if_true*** and ***value_if_false*** arguments to construct more elaborate tests.

Example 1

	A	B
1	Data	
2	50	23

Formula	Description	Result
=IF(A2<=100,"Within budget","Over budget")	If the number in cell A2 is less than or equal to 100, the formula returns "Within budget." Otherwise, the function displays "Over budget."	Within budget
=IF(A2=100,A2+B2,"")	If the number in cell A2 is equal to 100, A2 + B2 is calculated and returned. Otherwise, empty text ("") is returned.	Empty text ("")

Example 2

	A	B
1	**Actual Expenses**	**Predicted Expenses**
2	1500	900
3	500	900
4	500	925

Formula	Description	Result
=IF(A2>B2,"Over Budget","OK")	Checks whether the expenses in row 2 are over budget	Over Budget
=IF(A3>B3,"Over Budget","OK")	Checks whether the expenses in row 3 are over budget	OK

Example 3

	A
1	**Score**
2	45
3	90
4	78

Formula	Description	Result
=IF(A2>89,"A",IF(A2>79,"B", IF(A2>69,"C",IF(A2>59,"D","F"))))	Assigns a letter grade to the score in cell A2	F
=IF(A3>89,"A",IF(A3>79,"B", IF(A3>69,"C",IF(A3>59,"D","F"))))	Assigns a letter grade to the score in cell A3	A
=IF(A4>89,"A",IF(A4>79,"B", IF(A4>69,"C",IF(A4>59,"D","F"))))	Assigns a letter grade to the score in cell A4	C

The preceding example demonstrates how you can nest **IF** statements. In each formula, the fourth **IF** statement is also the **value_if_false** argument to the third **IF** statement. Similarly, the third **IF** statement is the

value_if_false argument to the second **IF** statement, and the second **IF** statement is the **value_if_false** argument to the first **IF** statement. For example, if the first **logical_test** argument (Average>89) evaluates to TRUE, "A" is returned. If the first **logical_test** argument evaluates to FALSE, the second **IF** statement is evaluated, and so on. You can also use other functions as arguments.

SUMIF function

You use the **SUMIF** function to sum the values in a range that meet criteria that you specify.

For example, suppose that in a column that contains numbers, you want to sum only the values that are larger than 5. You can use the following formula:

=SUMIF(B2:B25,">5")

In this example, the criteria is applied to the same values that are being summed. If you want, you can apply the criteria to one range and sum the corresponding values in a different range. For example, the formula **=SUMIF(B2:B5, "John", C2:C5)** sums only the values in the range C2:C5, where the corresponding cells in the range B2:B5 equal "John."

Syntax

SUMIF(range, criteria, [sum_range])

The **SUMIF** function syntax has the following arguments:

- **range**: Required. The range of cells that you want evaluated by criteria. Cells in each range must be numbers or names, arrays, or references that contain numbers. Blank and text values are ignored.
- **criteria**: Required. The criteria in the form of a number, expression, a cell reference, text, or a function that defines which cells will be added.
    - For example, criteria can be expressed as 32, ">32", B5, 32, "32", "apples", or TODAY().

  Important: Any text criteria or any criteria that includes logical or mathematical symbols must be enclosed in double quotation marks (**"**). If the criteria is numeric, double quotation marks are not required.
- **sum_range**: Optional. The actual cells to add, if you want to add cells other than those specified in the range argument. If the ***sum_range*** argument is omitted, Excel adds the cells that are specified in the ***range*** argument (the same cells to which the criteria is applied).

Notes:

- The ***sum_range*** argument does not have to be the same size and shape as the ***range*** argument. The actual cells that are added are determined by using the upper leftmost cell in the ***sum_range*** argument as the beginning cell, and then including cells that correspond in size and shape to the ***range*** argument. For example:

If range is	And sum_range is	Then the actual cells are
A1:A5	B1:B5	B1:B5
A1:A5	B1:B3	B1:B5
A1:B4	C1:D4	C1:D4
A1:B4	C1:C2	C1:D4

Example 1

	A	B	C
1	**Property Value**	**Commission**	**Data**
2	100,000	7,000	250,000
3	200,000	14,000	
4	300,000	21,000	
5	400,000	28,000	

Formula	Description	Result
=SUMIF(A2:A5,">160000",B2:B5)	Sum of the commissions for property values over 160,000.	63,000
=SUMIF(A2:A5,">160000")	Sum of the property values over 160,000.	900,000
=SUMIF(A2:A5,300000,B2:B5)	Sum of the commissions for property values equal to 300,000.	21,000
=SUMIF(A2:A5,">" & C2,B2:B5)	Sum of the commissions for property values greater than the value in C2.	49,000

Example 2

	A	B	C
1	**Category**	**Food**	**Sales**
2	Vegetables	Tomatoes	2300
3	Vegetables	Celery	5500
4	Fruits	Oranges	800
5		Butter	400
6	Vegetables	Carrots	4200
7	Fruits	Apples	1200

Formula	Description	Result
=SUMIF(A2:A7,"Fruits",C2:C7)	Sum of the sales of all foods in the "Fruits" category.	2000
=SUMIF(A2:A7,"Vegetables",C2:C7)	Sum of the sales of all foods in the "Vegetables" category.	12000
=SUMIF(B2:B7,"*es",C2:C7)	Sum of the sales of all foods that end in "es" (Tomatoes, Oranges, and Apples).	4300
=SUMIF(A2:A7,"",C2:C7)	Sum of the sales of all foods that do not have a category specified.	400

SUMIFS function

Adds the cells in a range that meet multiple criteria. For example, if you want to sum the numbers in the range A1:A20 only if the corresponding numbers in B1:B20 are greater than zero (0) and the corresponding numbers in C1:C20 are less than 10, you can use the following formula:

=SUMIFS(A1:A20, B1:B20, ">0", C1:C20, "<10")

Important: The order of arguments differ between the **SUMIFS** and **SUMIF** functions. In particular, the ***sum_range*** argument is the first argument in **SUMIFS**, but it is the third argument in **SUMIF**. If you are copying and editing these similar functions, make sure you put the arguments in the correct order.

Syntax

SUMIFS(sum_range, criteria_range1, criteria1, [criteria_range2,criteria2], …)

The **SUMIFS** function syntax has the following arguments:

- **sum_range**: Required. One or more cells to sum, including numbers or names, ranges, or cell references that contain numbers. Blank and text values are ignored.
- **criteria_range1**: Required. The first range in which to evaluate the associated criteria.
- **criteria1**: Required. The criteria in the form of a number, expression, cell reference, or text that define which cells in the ***criteria_range1*** argument will be added.
- **criteria_range2, criteria2, …**:Optional. Additional ranges and their associated criteria. Up to 127 range/criteria pairs are allowed.

Notes:

- Each cell in the ***sum_range*** argument is summed only if all of the corresponding criteria specified are true for that cell.
    - For example, suppose that a formula contains two ***criteria_range*** arguments. If the first cell of ***criteria_range1*** meets ***criteria1***, and the first cell of ***criteria_range2*** meets ***critera2***, the first cell of ***sum_range*** is added to the sum, and so on, for the remaining cells in the specified ranges.
- Cells in the ***sum_range*** argument that contain TRUE evaluate to 1; cells in ***sum_range*** that contain FALSE evaluate to 0 (zero).
- Unlike the range and criteria arguments in the **SUMIF** function, in the **SUMIFS** function, each ***criteria_range*** argument must contain the same number of rows and columns as the ***sum_range*** argument.

Example 1

	A	B	C
1	**Quantity Sold**	**Product**	**Salesperson**
2	5	Apples	1
3	4	Apples	2
4	15	Artichokes	1
5	3	Artichokes	2
6	22	Bananas	1
7	12	Bananas	2
8	10	Carrots	1
9	33	Carrots	2

Formula	Description	Result
=SUMIFS(A2:A9, B2:B9, "=A*", C2:C9, 1)	Adds the total number of products sold that begin with "A" and that were sold by Salesperson 1.	20
=SUMIFS(A2:A9, B2:B9, "<>Bananas", C2:C9, 1)	Adds the total number of products (not including Bananas) sold by Salesperson 1.	30

Example 2

Adding amounts from bank accounts based on interest paid

	A	B	C	D	E
1	**Totals**	**Account 1**	**Account 2**	**Account 3**	**Account 4**
2	Amount in dollars	100	390	8321	500
3	Interest paid (2000)	1%	0.5%	3%	4%
4	Interest paid (2001)	1%	1.3%	2.1%	2%
5	Interest paid (2002)	0.5%	3%	1%	4%

=SUMIFS(B2:E2, B3:E3, ">3%", B4:E4, ">=2%")	Total amounts from each bank account where the interest was greater than 3% for the year 2000 and greater than or equal to 2% for the year 2001.	500
=SUMIFS(B2:E2, B5:E5, ">=1%", B5:E5, "<=3%", B4:E4, ">1%")	Total amounts from each bank account where the interest was between 1% and 3% for the year 2002 and greater than 1% for the year 2001.	8711

Example 3

Adding rainfall for specific days

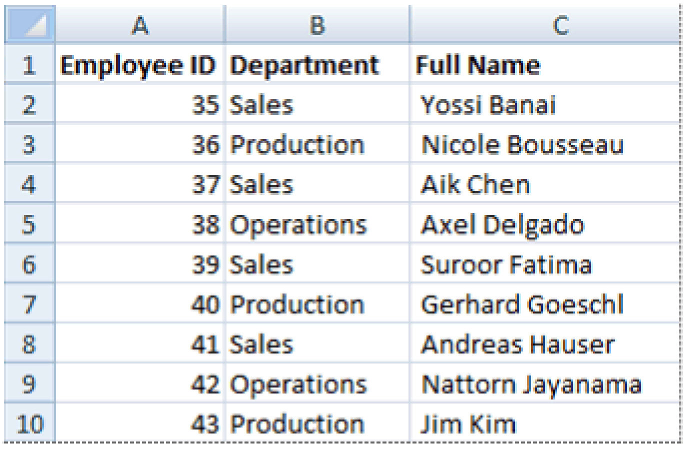
	A	B	C	D	E
1	**Daily Measurements**	**1st Day**	**2nd Day**	**3rd Day**	**4th Day**
2	Rain (total inches)	3.3	0.8	5.5	5.5
3	Average temperature (degrees)	55	39	39	57.5
4	Average wind speed (miles per hour)	6.5	19.5	6	6.5

Formula	Description	Result
=SUMIFS(B2:E2, B3:E3, ">=40", B4:E4, "<10")	Adds the total amount of rainfall for days when the average temperature was at least 40 degrees Fahrenheit and the average wind speed was less than 10 miles per hour. Only cells B2 and E2 are summed because, for each column (B through E), the values in both rows 3 and 4 must meet criteria1 and criteria2, respectively. Cells B3 and B4 meet both criteria, as do E3 and E4. However, neither C3 nor C4 meet either criteria. Finally, although D4 meets criteria2, D3 fails to meet criteria1.	8.8

VLOOKUP function

You can use the **VLOOKUP** function to search the first column of a range of cells, and then return a value from any cell on the same row of the range.

For example, suppose that you have a list of employees contained in the range A2:C10. The employees' ID numbers are stored in the first column of the range, as shown in the following illustration.



	A	B	C
1	Employee ID	Department	Full Name
2	35	Sales	Yossi Banai
3	36	Production	Nicole Bousseau
4	37	Sales	Aik Chen
5	38	Operations	Axel Delgado
6	39	Sales	Suroor Fatima
7	40	Production	Gerhard Goeschl
8	41	Sales	Andreas Hauser
9	42	Operations	Nattorn Jayanama
10	43	Production	Jim Kim

If you know the employee's ID number, you can use the **VLOOKUP** function to return either the department or the name of that employee.

To obtain the name of employee number 38, you can use the formula **=VLOOKUP(38, A2:C10, 3, FALSE)**. This formula searches for the value 38 in the first column of the range A2:C10, and then returns the value that is contained in the third column of the range and on the same row as the lookup value ("Axel Delgado").

The V in **VLOOKUP** stands for vertical. Use **VLOOKUP** instead of **HLOOKUP** when your comparison values are located in a column to the left of the data that you want to find.

Syntax

VLOOKUP(lookup_value, table_array, col_index_num, [range_lookup])

The VLOOKUP function syntax has the following arguments:

- **lookup_value**: Required. The value to search in the first column of the table or range.
  - The ***lookup_value*** argument can be a value or a reference.
  - If the value you supply for the ***lookup_value*** argument is smaller than the smallest value in the first column of the ***table_array*** argument, **VLOOKUP** returns the #N/A error value.
- **table_array**: Required. The range of cells that contains the data.
  - You can use a reference to a range (for example, **A2:D8**), or a range name.
  - The values in the first column of ***table_array*** are the values searched by ***lookup_value***. These values can be text, numbers, or logical values. Uppercase and lowercase text are equivalent.
- **col_index_num**: Required. The column number in the ***table_array*** argument from which the matching value must be returned.
  - A ***col_index_num*** argument of 1 returns the value in the first column in ***table_array***; a ***col_index_num*** of 2 returns the value in the second column in ***table_array***, and so on.
  - If the ***col_index_num*** argument is:
    - Less than 1, **VLOOKUP** returns the #VALUE! error value.
    - Greater than the number of columns in ***table_array***, **VLOOKUP** returns the #REF! error value.
- **range_lookup**: Optional. A logical value that specifies whether you want **VLOOKUP** to find an exact match or an approximate match:
  - If ***range_lookup*** is either TRUE or is omitted, an exact or approximate match is returned. If an exact match is not found, the next largest value that is less than ***lookup_value*** is returned.
    - **Important**: If ***range_lookup*** is either TRUE or is omitted, the values in the first column of ***table_array*** must be placed in ascending sort order; otherwise, **VLOOKUP** might not return the correct value.
  - If ***range_lookup*** is FALSE, the values in the first column of ***table_array*** do not need to be sorted.
    - If the ***range_lookup*** argument is FALSE, **VLOOKUP** will find only an exact match.
    - If there are two or more values in the first column of ***table_array*** that match the ***lookup_value***, the first value found is used. If an exact match is not found, the error value #N/A is returned.

Example 1

This example searches the Density column of an atmospheric properties table to find corresponding values in the Viscosity and Temperature columns. (The values are for air at 0 degrees Celsius at sea level, or 1 atmosphere.)

	A	B	C
1	**Density**	**Viscosity**	**Temperature**
2	0.457	3.55	500
3	0.525	3.25	400
4	0.606	2.93	300
5	0.675	2.75	250
6	0.746	2.57	200
7	0.835	2.38	150
8	0.946	2.17	100
9	1.09	1.95	50
10	1.29	1.71	0

Formula	Description	Result
=VLOOKUP(1,A2:C10,2)	Using an approximate match, searches for the value 1 in column A, finds the largest value less than or equal to 1 in column A which is 0.946, and then returns the value from column B in the same row.	2.17
=VLOOKUP(1,A2:C10,3,TRUE)	Using an approximate match, searches for the value 1 in column A, finds the largest value less than or equal to 1 in column A, which is 0.946, and then returns the value from column C in the same row.	100
=VLOOKUP(0.7,A2:C10,3,FALSE)	Using an exact match, searches for the value 0.7 in column A. Because there is no exact match in column A, an error is returned.	#N/A
=VLOOKUP(0.1,A2:C10,2,TRUE)	Using an approximate match, searches for the value 0.1 in column A. Because 0.1 is less than the smallest value in column A, an error is returned.	#N/A
=VLOOKUP(2,A2:C10,2,TRUE)	Using an approximate match, searches for the value 2 in column A, finds the largest value less than or equal to 2 in column A, which is 1.29, and then returns the value from column B in the same row.	1.71

Example 2

This example searches the Item-ID column of a baby products table and matches values in the Cost and Markup columns to calculate prices and test conditions.

	A	B	C	D
1	**Item-ID**	**Item**	**Cost**	**Markup**
2	ST-340	Stroller	$145.67	30%
3	BI-567	Bib	$3.56	40%
4	DI-328	Diapers	$21.45	35%
5	WI-989	Wipes	$5.12	40%
6	AS-469	Aspirator	$2.56	45%

Formula	**Description**	**Result**
= VLOOKUP("DI-328", A2:D6, 3, FALSE) * (1 + VLOOKUP("DI-328", A2:D6, 4, FALSE))	Calculates the retail price of diapers by adding the markup percentage to the cost.	$28.96
= (VLOOKUP("WI-989", A2:D6, 3, FALSE) * (1 + VLOOKUP("WI-989", A2:D6, 4, FALSE))) * (1 - 20%)	Calculates the sale price of wipes by subtracting a specified discount from the retail price.	$5.73
= IF(VLOOKUP(A2, A2:D6, 3, FALSE) >= 20, "Markup is " & 100 * VLOOKUP(A2, A2:D6, 4, FALSE) &"%", "Cost is under $20.00")	If the cost of an item is greater than or equal to $20.00, displays the string "Markup is nn%"; otherwise, displays the string "Cost is under $20.00".	Markup is 30%
= IF(VLOOKUP(A3, A2:D6, 3, FALSE) >= 20, "Markup is: " & 100 * VLOOKUP(A3, A2:D6, 4, FALSE) &"%", "Cost is $" & VLOOKUP(A3, A2:D6, 3, FALSE))	If the cost of an item is greater than or equal to $20.00, displays the string Markup is nn%"; otherwise, displays the string "Cost is $n.nn".	Cost is $3.56

Notes:

- When searching text values in the first column of ***table_array***, ensure that the data in the first column of ***table_array*** does not contain leading spaces, trailing spaces, inconsistent use of straight (' or ") and curly (‘ or “) quotation marks, or nonprinting characters. In these cases, **VLOOKUP** might return an incorrect or unexpected value.
- When searching number or date values, ensure that the data in the first column of ***table_array*** is not stored as text values. In this case, **VLOOKUP** might return an incorrect or unexpected value.
- If range_lookup is FALSE and ***lookup_value*** is text, you can use the wildcard characters — the question mark (?) and asterisk (*) — in ***lookup_value***. A question mark matches any single character; an asterisk matches any sequence of characters. If you want to find an actual question mark or asterisk, type a tilde (~) preceding the character.

HLOOKUP function

Searches for a value in the top row of a table or an array of values, and then returns a value in the same column from a row you specify in the table or array. Use HLOOKUP when your comparison values are located in a row across the top of a table of data, and you want to look down a specified number of rows. Use VLOOKUP when your comparison values are located in a column to the left of the data you want to find.

The H in HLOOKUP stands for "Horizontal."

Syntax

HLOOKUP(lookup_value,table_array,row_index_num,range_lookup)

- **lookup_value** is the value to be found in the first row of the table.
  - Lookup_value can be a value, a reference, or a text string.
- **table_array** is a table of information in which data is looked up.
  - Use a reference to a range or a range name.
  - The values in the first row of table_array can be text, numbers, or logical values.
  - If range_lookup is TRUE, the values in the first row of table_array must be placed in ascending order: ...-2, -1, 0, 1, 2,... , A-Z, FALSE, TRUE; otherwise, HLOOKUP may not give the correct value.
  - If range_lookup is FALSE, table_array does not need to be sorted.
  - Uppercase and lowercase text are equivalent.
  - Sort the values in ascending order, left to right.
- **row_index_num** is the row number in table_array from which the matching value will be returned.
  - A row_index_num of 1 returns the first row value in table_array, a row_index_num of 2 returns the second row value in table_array, and so on.
  - If row_index_num is less than 1, HLOOKUP returns the #VALUE! error value; if row_index_num is greater than the number of rows on table_array, HLOOKUP returns the #REF! error value.
- **range_lookup** is a logical value that specifies whether you want HLOOKUP to find an exact match or an approximate match.
  - If TRUE or omitted, an approximate match is returned. In other words, if an exact match is not found, the next largest value that is less than lookup_value is returned.
  - If FALSE, HLOOKUP will find an exact match. If one is not found, the error value #N/A is returned.

Notes:

- If HLOOKUP can't find lookup_value, and range_lookup is TRUE, it uses the largest value that is less than lookup_value.
- If lookup_value is smaller than the smallest value in the first row of table_array, HLOOKUP returns the #N/A error value.
- If range_lookup is FALSE and lookup_value is text, you can use the wildcard characters, question mark (?) and asterisk (*), in lookup_value.

Example

	A	B	C
1	**Axles**	**Bearings**	**Bolts**
2	4	4	9
3	5	7	10
4	6	8	11

Formula	Description (Result)
=HLOOKUP("Axles",A1:C4,2,TRUE)	Looks up Axles in row 1, and returns the value from row 2 that's in the same column. (4)
=HLOOKUP("Bearings",A1:C4,3,FALSE)	Looks up Bearings in row 1, and returns the value from row 3 that's in the same column. (7)
=HLOOKUP("B",A1:C4,3,TRUE)	Looks up B in row 1, and returns the value from row 3 that's in the same column. Because B is not an exact match, the next largest value that is less than B is used: Axles. (5)
=HLOOKUP("Bolts",A1:C4,4)	Looks up Bolts in row 1, and returns the value from row 4 that's in the same column. (11)

Avoid common errors when creating formulas

The following table summarizes some of the most common errors that you can make when entering a formula and how to correct those errors:

Make sure that you…	More information
Match all open and close parentheses	Make sure that all parentheses are part of a matching pair. When you create a formula, Excel displays parentheses in color as they are entered.
Use a colon to indicate a range	When you refer to a range of cells, use a colon (:) to separate the reference to the first cell in the range and the reference to the last cell in the range. For example, A1:A5.
Enter all required arguments	Some functions have required arguments. Also, make sure that you have not entered too many arguments.
Nest no more than 64 functions	You can enter, or nest, no more than 64 levels of functions within a function.
Enclose other sheet names in single quotation marks	If the formula refers to values or cells on other worksheets or workbooks, and the name of the other workbook or worksheet contains a nonalphabetical character, you must enclose its name within single quotation marks (').
Include the path to external workbooks	Make sure that each external reference (A reference to a cell or range on a sheet in another Excel workbook, or a reference to a defined name in another workbook.) contains a workbook name and the path to the workbook.
Enter numbers without formatting	Do not format numbers as you enter them in formulas. For example, even if the value that you want to enter is $1,000, enter 1000 in the formula.