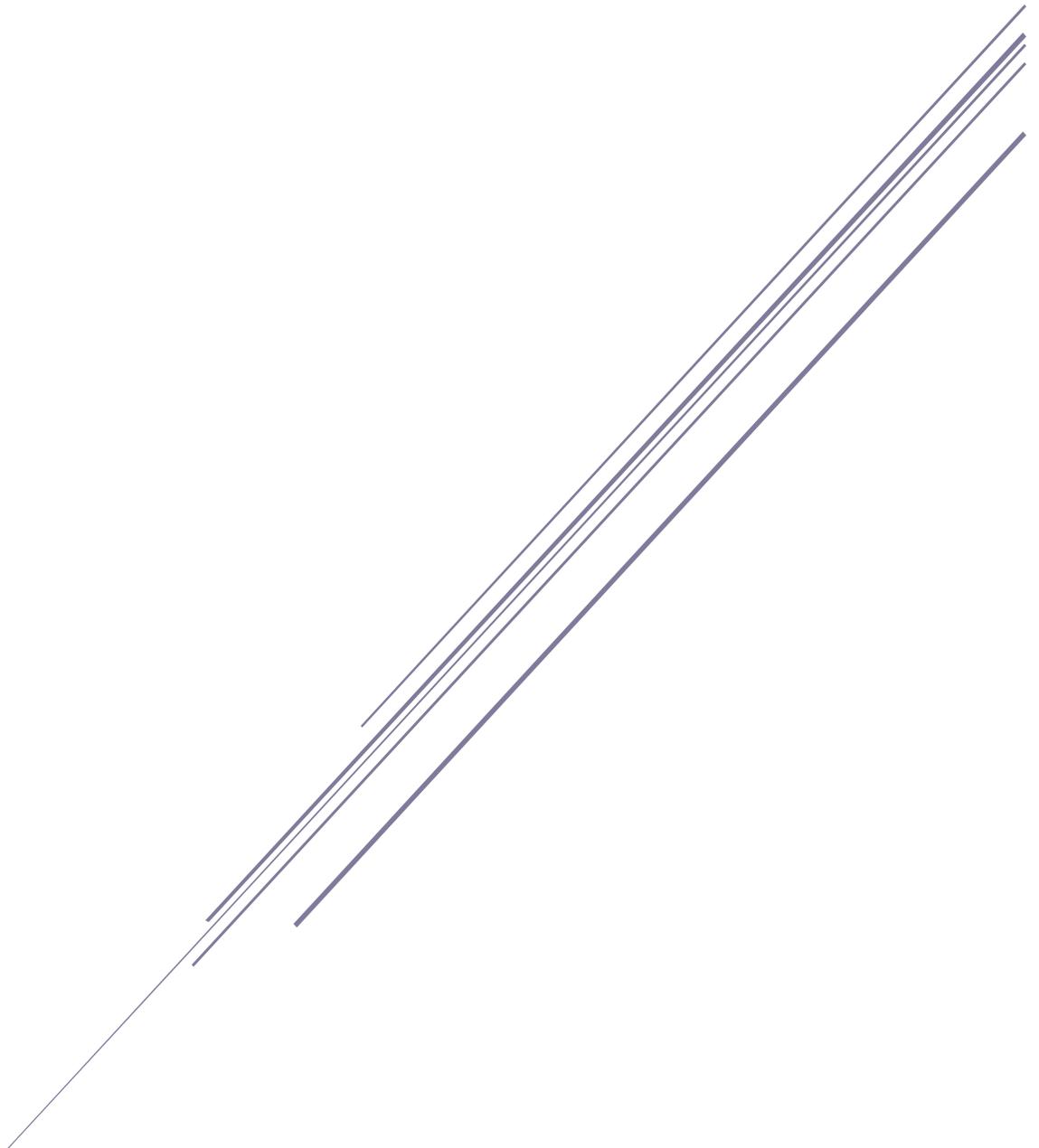


EXCEL 2010

Advanced



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Overview of formulas & functions

Formulas are equations that perform calculations on values in your worksheet. A formula starts with an equal sign (=). For example, the following formula multiplies 2 by 3 and then adds 5 to the result.

=5+2*3

A formula can also contain any or all of the following: functions (function: 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.), references, operators (operator: A sign or symbol that specifies the type of calculation to perform within an expression. There are mathematical, comparison, logical, and reference operators.), and constants (constant: A value that is not calculated and, therefore, does not change. For example, the number 210, and the text "Quarterly Earnings" are constants. An expression, or a value resulting from an expression, is not a constant.).

The diagram shows the formula `=PI()*A2^2` with four numbered callouts in green circles: 1 points to `PI()`, 2 points to `A2`, 3 points to `2`, and 4 points to the `^` operator. A red bracket underlines the `A2^2` portion of the formula.

Parts of a formula

- 1 Functions: The PI() function returns the value of pi: 3.142...
- 2 References: A2 returns the value in cell A2.
- 3 Constants: Numbers or text values entered directly into a formula, such as 2.
- 4 Operators: The ^ (caret) operator raises a number to a power, and the * (asterisk) operator multiplies.

Notes:

Formulas

Using a formula can help you analyse data on a worksheet. With a formula you can perform operations, such as addition and multiplication. Think of a formula as one side of an equation whose result is shown in the cell.



An Excel formula always begins with an equal sign (=).

Operators

+	Addition	-	Subtraction
/	Division	*	Multiplication
%	Percent	^	Exponentiation

Examples

=B4+B8

=C6*12.5%

=C9/9

=Z42-Z41

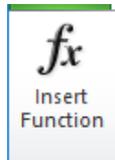
=20^2*.15

=(B6*5)+C5

*Note: You can use Excel as a calculator if required. eg. =56*49*

Notes:

Functions



A function is a built-in formula that takes a value or values, performs an operation and returns a value. The values that you give to a function are called arguments and are enclosed in parentheses.

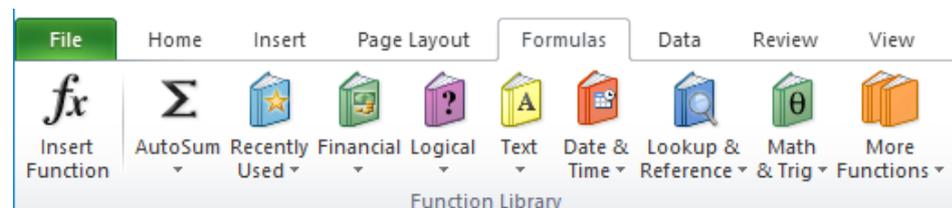
For example, instead of typing the formula

`=B1+B2+B3`

use the SUM function to build the formula

`=SUM(B1:B3)`

To access the function list choose the Formulas Tab, Function Library. Help in the Function dialog is especially useful to give a full description and example of any function.



Some commonly used functions:

- `= AVERAGE` returns the average of its arguments
- `= TODAY()` displays current date calculated from the computer's clock
- `= NOW()` displays current time calculated from the computer's clock
- `= MAX ()` returns the maximum value in a list of arguments

More functions to try

- `=CONVERT` converts a number from one measurement system to another
- `=SUMIF` adds the cell specified by a given condition or criteria
- `=PMT` calculates the payment for a loan based on constant payments and a constant interest rate

Function Arguments ? X

PMT

Rate	<input type="text"/>		= number
Nper	<input type="text"/>		= number
Pv	<input type="text"/>		= number
Fv	<input type="text"/>		= number
Type	<input type="text"/>		= number

=

Calculates the payment for a loan based on constant payments and a constant interest rate.

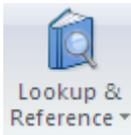
Rate is the interest rate per period for the loan. For example, use 6%/4 for quarterly payments at 6% APR.

Formula result =

[Help on this function](#)

Notes:

Lookup Functions



VLOOKUP Looks in the first column of an array and moves across the row to return the value of a cell.

Exercise

	A	B
1	Frequency	Colour
2	4.14	red
3	4.19	orange
4	5.17	yellow
5	5.77	green
6	6.39	blue
7	7.32	violet

Under the Lookup & Reference Category select VLOOKUP

Function Arguments ? X

VLOOKUP

Lookup_value = any

Table_array = number

Col_index_num = number

Range_lookup = logical

=

Looks for a value in the leftmost column of a table, and then returns a value in the same row from a column you specify. By default, the table must be sorted in an ascending order.

Lookup_value is the value to be found in the first column of the table, and can be a value, a reference, or a text string.

Formula result =

[Help on this function](#) OK Cancel

Notes:

Nested functions

In certain cases, you may need to use a function as one of the arguments (argument: The values that a function uses to perform operations or calculations. The type of argument a function uses is specific to the function. Common arguments that are used within functions include numbers, text, cell references, and names.) of another function. For example, the following formula uses a nested AVERAGE function and compares the result with the value 50.



`=IF(AVERAGE(F2:F5)>50,SUM(G2:G5),0)`

1 The AVERAGE and SUM functions are nested within the IF function.

Valid returns When a nested function is used as an argument, it must return the same type of value that the argument uses. For example, if the argument returns a TRUE or FALSE value, then the nested function must return a TRUE or FALSE. If it doesn't, Microsoft Excel displays a #VALUE! error value.

Nesting level limits A formula can contain up to seven levels of nested functions. When Function B is used as an argument in Function A, Function B is a second-level function. For instance, the AVERAGE function and the SUM function are both second-level functions because they are arguments of the IF function. A function nested within the AVERAGE function would be a third-level function, and so on.

I recently discovered INDEX and MATCH - use the INDEX function to find the value in the intersecting cell where a row and a column meet.

The INDEX function actually uses the result of the MATCH function as its argument.

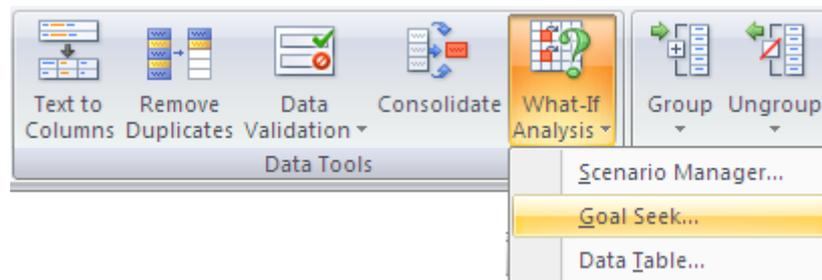
=INDEX(B4:E6,MATCH(A8,A4:A6,0),MATCH(B8,B3:E3,0))

The screenshot shows the Microsoft Excel 2010 interface. The 'FORMULAS' ribbon is active, displaying the 'Function Library' with categories: Insert Function, AutoSum, Recently Used, Financial, Logical, Text, Date & Time, and Lookup. Below the ribbon, the formula bar shows the formula for cell H8: `=INDEX(B4:E6,MATCH(A8,A4:A6,0),MATCH(B8,B3:E3,0))`. The spreadsheet grid shows the following data:

	A	B	C	D	E	F
1						
2						
3		IT	HR	ME	AD	
4	a	23	6	9	4	
5	b	3	4	8	7	
6	c	8	5	23	19	
7						
8	c	ME		Formula	23	

Goal Seek

Use Goal Seek to find the result you want by adjusting an input value



Exercise using Goal Seek and the PMT function

If you know the result that you want from a formula, but are not sure what input value the formula needs to get that result, use the Goal Seek feature.

Because you want to calculate the loan interest rate needed to meet your goal, use the PMT function. The PMT function calculates a monthly payment amount. In this example, the monthly payment amount is the goal that you seek.

Prepare the worksheet

1. First, add labels in the first column to make it easier to read.
 1. In cell A1, type **Loan Amount**.
 2. In cell A2, type **Term in Months**.
 3. In cell A3, type **Interest Rate**.
 4. In cell A4, type **Payment**.
2. Next, add the values that you know.
 1. In cell B1, type **100000**. This is the amount that you want to borrow.
 2. In cell B2, type **180**. This is the number of months that you want to pay off the loan.

NOTE Although you know the payment amount that you want, you do not enter it as a value, because the payment amount is a result of the formula. Instead, you add the formula to the worksheet and specify the payment value at a later step, when you use Goal Seek.

3. Next, add the formula for which you have a goal. For the example, use the **PMT** function:

- In cell B4, type **=PMT(B3/12,B2,B1)**. This formula calculates the payment amount. In this example, you want to pay \$900 each month. You don't enter that amount here, because you want to use Goal Seek to determine the interest rate, and Goal Seek requires that you start with a formula.

The formula refers to cells B1 and B2, which contain values that you specified in preceding steps. The formula also refers to cell B3, which is where you will specify that Goal Seek put the interest rate. The formula divides the value in B3 by 12 because you specified a monthly payment, and the **PMT** function assumes an annual interest rate.

Because there is no value in cell B3, Excel assumes a 0% interest rate and, using the values in the example, returns a payment of \$555.56. You can ignore that value for now.

4. Finally, format the target cell (B3) so that it displays the result as a percentage.

- On the **Home** tab, in the **Number** group, click **Percentage**.
- Click **Increase Decimal** or **Decrease Decimal** to set the number of decimal places.

Use Goal Seek to determine the interest rate

1. On the **Data** tab, in the **Data Tools** group, click **What-If Analysis**, and then click **Goal Seek**.
2. In the **Set cell** box, enter the reference for the cell that contains the formula (formula: A sequence of values, cell references, names, functions, or operators in a cell that together produce a new value. A formula always begins with an equal sign (=).) that you want to resolve. In the example, this reference is cell B4.

3. In the **To value** box, type the formula result that you want. In the example, this is -900. Note that this number is negative because it represents a payment.
4. In the **By changing cell** box, enter the reference for the cell that contains the value that you want to adjust. In the example, this reference is cell B3.

NOTE The cell that Goal Seek changes must be referenced by the formula in the cell that you specified in the **Set cell** box.

5. Click **OK**.

Goal Seek runs and produces a result, as shown in the following illustration.

The value in cell B4 is the result of the formula =PMT(B3/12,B2,B1).

	A	B
1	Loan Amount	\$ 100,000
2	Term in Months	180
3	Interest Rate	7.02%
4	Payment	(\$900.00)

Goal seek to determine the interest rate in cell B3 based on the payment in cell B4.

Notes:

Formula Auditing

Display formulas on a worksheet

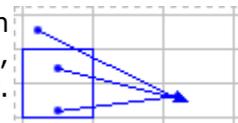
You can easily inspect all the formulas on a worksheet at the same time by switching between a view that shows formulas in their cells and the default view that shows the values of formulas in their cells. This affects all formulas on the worksheet.

1. On the Formulas Tab select Show Formulas from the Formula Auditing group
or
2. Press CTRL + ` (accent) to toggle



Trace Precedents & Dependents

Precedent cells are cells that are referred to by a formula in another cell. For example, if cell D10 contains the formula =B5, cell B5 is a precedent to cell D10.



Dependent cells contain formulas that refer to other cells.

For example, if cell D10 contains the formula =B5, cell D10 is a dependent of cell B5.

To assist you in checking your formulas, you can use the **Trace Precedents** and **Trace Dependents** commands to graphically display, or trace the relationships between these cells and formulas with tracer arrows (tracer arrows: Arrows that show the relationship between the active cell and its related cells. Tracer arrows are blue when pointing from a cell that provides data to another cell, and red if a cell contains an error value, such as #DIV/0!).

Do one of the following.

Trace cells that provide data to a formula (precedents)

1. Select the cell that contains the formula for which you want to find precedent cells.
2. To display a tracer arrow to each cell that directly provides data to the active cell, on the **Formulas** tab, in the **Formula Auditing** group, click **Trace Precedents** .

Blue arrows show cells with no errors. Red arrows show cells that cause errors. If the selected cell is referenced by a cell on another worksheet or workbook, a black arrow points from the selected cell to a worksheet icon .

The other workbook must be open before Excel can trace these dependencies.

3. To identify the next level of cells that provide data to the active cell, click **Trace Precedents**  again.
4. To remove tracer arrows one level at a time, starting with the precedent cell farthest away from the active cell, on the **Formulas** tab, in the **Formula Auditing** group, click the arrow next to **Remove Arrows**, and then click **Remove Precedent Arrows** . To remove another level of tracer arrows, click the button again.

Trace formulas that reference a particular cell (dependents)

1. Select the cell for which you want to identify the dependent cells.
2. To display a tracer arrow (tracer arrows: Arrows that show the relationship between the active cell and its related cells. Tracer arrows are blue when pointing from a cell that provides data to another cell, and red if a cell contains an error value, such as #DIV/0!.) to each cell that is dependent on the active cell, on the **Formulas** tab, in the **Formula Auditing** group, click **Trace Dependents** .

Blue arrows show cells with no errors. Red arrows show cells that cause errors. If the selected cell is referenced by a cell on another worksheet or workbook, a black arrow points from the selected cell to a worksheet icon . The other workbook must be open before Excel can trace these dependencies.

1. To identify the next level of cells that depend on the active cell, click **Trace Dependents**  again.
2. To remove tracer arrows one level at a time, starting with the dependent cell farthest away from the active cell, on the **Formulas** tab, in the **Formula Auditing** group, click the arrow next to **Remove Arrows**, and then click **Remove Dependent Arrows** . To remove another level of tracer arrows, click the button again.

Note: If Excel beeps when you click **Trace Dependents**  or **Trace Precedents** , either Excel has traced all levels of the formula, or you are attempting to trace an item that cannot be traced.

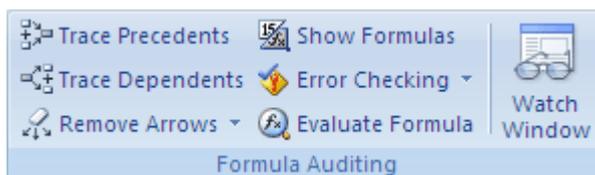
To remove all tracer arrows on the worksheet, on the **Formulas** tab, in the **Formula Auditing** group, click **Remove Arrows** .

Evaluate a nested formula one step at a time

Sometimes, understanding how a nested formula calculates the final result is difficult because there are several intermediate calculations and logical tests. However, by using the **Evaluate Formula** dialog box, you can see the different parts of a nested formula evaluated in the order the formula is calculated. For example, the formula **=IF(AVERAGE(F2:F5)>50,SUM(G2:G5),0)** is easier to understand when you can see the following intermediate results:

Steps shown in the dialog box	Description
=IF(AVERAGE(F2:F5)>50,SUM(G2:G5),0)	The nested formula is initially displayed. The AVERAGE function and the SUM function are nested within the IF function.
=IF(40>50,SUM(G2:G5),0)	The cell range F2:F5 contains the values 55, 35, 45, and 25, and so the result of the AVERAGE(F2:F5) function is 40.
=IF(False,SUM(G2:G5),0)	Because 40 is not greater than 50, the expression in the first argument of the IF function (the logical_test argument) is False.
0	The IF function returns the value of the third argument (the value_if_false argument). The SUM function is not evaluated because it is the second argument to the IF function (value_if_true argument), and it is returned only when the expression is True.

1. Select the cell that you want to evaluate. Only one cell can be evaluated at a time.
2. On the **Formulas** tab, in the **Formula Auditing** group, click **Evaluate Formula**.



3. Click **Evaluate** to examine the value of the underlined reference. The result of the evaluation is shown in italics.

If the underlined part of the formula is a reference to another formula, click **Step In** to display the other formula in the **Evaluation** box. Click **Step Out** to go back to the previous cell and formula.

NOTE The **Step In** button is not available for a reference the second time the reference appears in the formula, or if the formula refers to a cell in a separate workbook.

4. Continue until each part of the formula has been evaluated.
5. To see the evaluation again, click **Restart**.
6. To end the evaluation, click **Close**.

Absolute versus Relative References

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.

	A	B
1	█	
2	█	=A1
3		=A2

Copied formula with relative reference

Absolute references An absolute cell reference in a formula, such as \$A\$1, always refer 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.

	A	B
1	█	
2		=\$A\$1
3		=\$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.

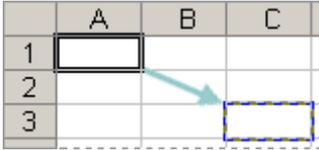
	A	B	C
1	█	█	
2		=A\$1	
3			=B\$1

Copied formula with mixed reference

Verify that the cell references in the formula produce the result that you want. If necessary, switch the type of reference by doing the following:

1. Select the cell that contains the formula.
2. In the formula bar (formula bar: A bar at the top of the Excel window that you use to enter or edit values or formulas in cells or charts. Displays the constant value or formula stored in the active cell.) , select the reference that you want to change.
3. Press **F4** to switch between the combinations.

The following table summarizes how a reference type updates if a formula that contains the reference is copied two cells down and two cells to the right.

For a formula being copied:	If the reference is:	It changes to:
	\$A\$1 (absolute column and absolute row)	\$A\$1
	A\$1 (relative column and absolute row)	C\$1
	\$A1 (absolute column and relative row)	\$A3
	A1 (relative column and relative row)	C3

NOTE: Copy formulas into adjacent cells by using the fill handle (fill handle: The small black square in the lower-right corner of the selection. When you point to the fill handle, the pointer changes to a black cross.) . After verifying that the cell references in the formula produce the result that you want, select the cell that contains the copied formula, and then drag the fill handle over the range that you want to fill.

Data Validation

To make data entry easier, or to limit entries to certain items that you define, you can create a drop-down list of valid entries that is compiled from cells elsewhere in the workbook.

To create a drop-down list from a range of cells, use the **Data Validation** command in the **Data Tools** group on the **Data** tab.

1. To create a list of valid entries for the drop-down list, type the entries in a single column or row without blank cells. For example:

	A
1	Names
2	Baker
3	Smith
4	Hendrix

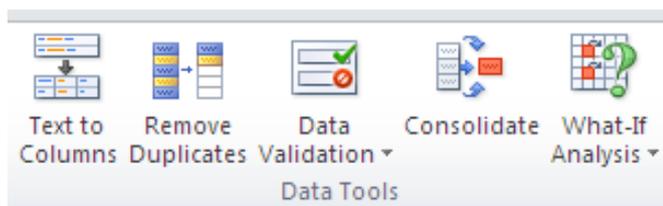
2. **NOTE** You may want to sort the data in the order that you want it to appear in the drop-down list.
3. If you want to use another worksheet, type the list on that worksheet, and then define a **name** for the list.

How to define a name

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



3. Type the name for the cells, for example, **Fields**.
4. Press ENTER.
4. Select the cell where you want the drop-down list.
5. On the **Data** tab, in the **Data Tools** group, click **Data Validation**.



6. In the **Data Validation** dialog box, click the **Settings** tab.
7. In the **Allow** box, click **List**.
8. To specify the location of the list of valid entries, do one of the following:

- Enter the name that you defined for your list in the **Source** box.

Make sure that the reference or name is preceded with an equal sign (=).
For example, enter **=Fields**.

9. Make sure that the In-cell dropdown check box is selected.
10. To specify whether the cell can be left blank, select or clear the Ignore blank check box.
11. Optionally, display an input message when the cell is clicked.

How to display an input message

1. Click the **Input Message** tab.
 2. Make sure that the **Show input message when cell is selected** check box is selected.
 3. Type the title and text for the message (up to 225 characters).
12. Specify how you want Microsoft Office Excel to respond when invalid data is entered.

How to specify a response to invalid data

Click the **Error Alert** tab, and make sure that the **Show error alert after invalid data is entered** check box is selected.

1. Select one of the following options for the **Style** box:
 - To display an information message that does not prevent entry of invalid data, click **Information**.
 - To display a warning message that does not prevent entry of invalid data, click **Warning**.
 - To prevent entry of invalid data, click **Stop**.
2. Type the title and text for the message (up to 225 characters).

NOTE If you don't enter a title or text, the title defaults to "Microsoft Excel" and the message to: "The value you entered is not valid. A user has restricted values that can be entered into this cell."

Sort & Filter

Sort

1. Select a column of alphanumeric data in a range of cells, or make sure that the active cell is in a table column containing alphanumeric data.
2. On the **Data** tab, in the **Sort & Filter** group, do one of the following:
 - To sort in ascending alphanumeric order, click  **Sort A to Z**.
 - To sort in descending alphanumeric order, click  **Sort Z to A**.

Filter

1. Select a range of cells containing alphanumeric data.
2. On the **Data** tab, in the **Sort & Filter** group, click **Filter**.



2. Click the arrow  in the column header.
3. Do one of the following:

Select from a list of text values

- In the list of text values, select or clear one or more text values to filter by.

Create criteria

- Point to Text Filters and then click one of the comparison operator (comparison operator: A sign that is used in comparison criteria to compare two values. Operators include: = Equal to, > Greater than, < Less than, >= Greater than or equal to, <= Less than or equal to, and <> Not equal to.) commands, or click Custom Filter.

For example, to filter by text that begins with a specific character, select **Begins With**, or to filter by text that has specific characters anywhere in the text, select **Contains**.

- In the Custom AutoFilter dialog box, in the box on the right, enter text or select the text value from the list.

For example, to filter by text that begins with the letter "J", enter **J**, or to filter by text that has "bell" anywhere in the text, enter **bell**.

If you need to find text that shares some characters but not others, use a wildcard character.

How to use wildcard characters

The following wildcard characters can be used as comparison criteria for text filters.

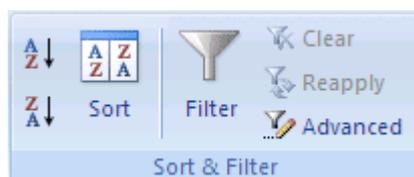
Use	To find
? (question mark)	Any single character For example, sm?th finds "smith" and "smyth"
* (asterisk)	Any number of characters For example, *east finds "Northeast" and "Southeast"
~ (tilde) followed by ?, *, or ~	A question mark, asterisk, or tilde For example, fy06~? finds "fy06?"

- Optionally, filter by one more criteria.

Filter or Sort by cell color, font color, or icon set

If you have manually or conditionally formatted a range of cells, by cell color or font color, you can also filter by these colors. You can also filter by an icon set created through a conditional format.

1. Select a range of cells containing formatted by cell color, font color, or an icon set.
2. On the **Data** tab, in the **Sort & Filter** group, click **Filter**.



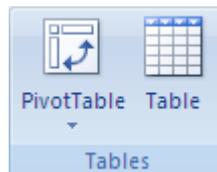
2. Click the arrow  in the column header.
3. Select **Filter by Color**, and then depending on the type of format, select **Filter by Cell Color**, **Filter by Font Color**, or **Filter by Cell Icon**.
4. Depending on the type of format, select a color, font color, or cell icon.

Pivot Tables & Charts

1. Select a cell in a range of cells, or put the insertion point inside of a Microsoft Office Excel table.

Make sure that the range of cells has column headings.

2. Select the type of report to generate by doing one of the following:
 - To create a PivotTable report, on the **Insert** tab, in the **Tables** group, click **PivotTable**, and then click **PivotTable**.



Excel displays the **Create PivotTable** dialog box.

- To create a PivotTable and PivotChart report, on the **Insert** tab, in the **Tables** group, click **PivotTable**, and then click **PivotChart**.

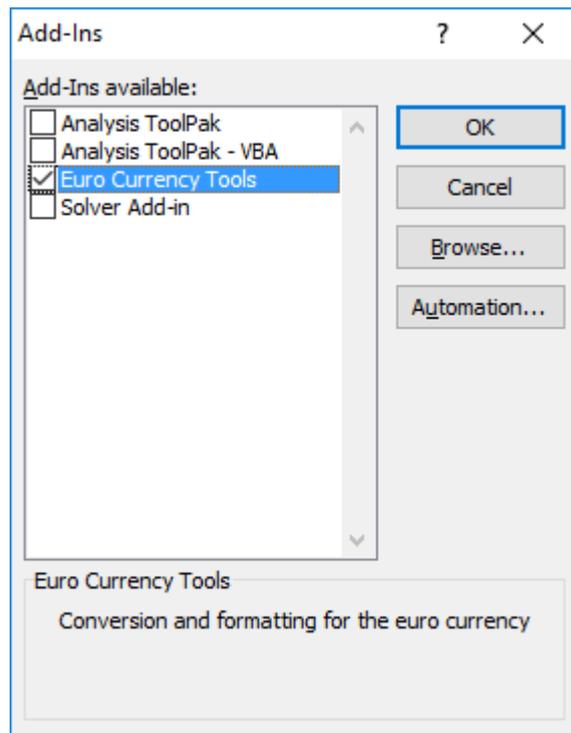
Excel displays the **Create PivotTable with PivotChart** dialog box.

TIP Consider using a table name reference instead of a range of cells, because rows added to a table are automatically included in the PivotTable report when you refresh the data.

NOTE If the range is in another worksheet in the same workbook or another workbook, type the workbook and worksheet name by using the following syntax: **([workbookname]sheetname!range)**.

Add-ins

1. Select File **Options**.
2. Click the **Add-Ins** category.
3. In the **Manage** box, click **Excel Add-ins**, and then click **Go**.
4. To load an Excel add-in, do the following:
 1. In the **Add-Ins available** box, select the check box next to the add-in that you want to load, and then click **OK**.



TIP: If the add-in that you want to use is not listed in the **Add-Ins available** box, click **Browse**, and then locate the add-in. Add-ins that are not available on your computer can be downloaded from [Downloads](#) on Office Online.

2. If the add-in is not currently installed on your computer, click **Yes** to install it. Follow the setup instructions as needed.