

Formulas and Functions

FORMULAS

Formulas are equations that specify calculations that you want Excel to perform. For example, you might use a formula to have Excel add 8 and 3.

Formulas **must** begin with an equal sign (=) followed by the equation. Use the following symbols in the equation to indicate which calculation is to be performed:

USE	TO PERFORM
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponential
%	Percent

For the above example, to add 8 and 3, enter the following formula in a cell:

=8+3

If your formula has a variety of calculations, Excel performs them in the following order:

()	Expressions in parentheses
%	Percent
^	Exponential
* or /	Multiplication or Division
+ or -	Addition or Subtraction

To ensure that calculations are performed in the order you want, you can put them in parentheses. For example: if you want to add 2 and 4 and multiply by 5 to get 30

= 2 + 4 * 5 will result in 22

because Excel does multiplication before addition and multiplies 4 and 5 and then adds 2

= (2 + 4) * 5 will give you the correct result (30)

because Excel first does the calculation in parentheses and adds 2 and 4 to get 6 and then multiplies by 5

Cell References

A cell reference identifies a cell or a range of cells on a worksheet and tells Excel where to look for the data you want to use in a formula.

When entering formulas in Excel, it is best to refer to cells rather than entering a number in the formula. This is the power of Excel because as numbers in the cells change over the course of time, you won't have to modify the formulas!

	A	B	C
1	8	3	=A1+B1

Display Formulas

If you make active a cell that has a formula, the results of the formula are displayed in the cell. To see the actual formula:

- double-click in the cell
or
- look at the formula bar:

The contents of the active cell are displayed in the formula bar on the right side.



If you want to display all of the formulas in the cells, press CTRL+` - this acts like a toggle switch – press CTRL+` again and the formula results are displayed in the cells. You can also click TOOLS > FORMULA AUDITING > FORMULA AUDITING MODE on the menubar. You may want to do this to print the worksheet with the formulas.

Color Coded Cell References

Notice that when you type a cell reference, the cell name is changed to a color and the box around the cell is the same color.

Instead of typing a cell number, you can click in the appropriate cell and then add the operation sign.

To change color-coded cell references:

1. Double-click in the cell that contains the formula you want to change.
2. Do one of the following:
 - To move a cell or range reference to a different cell or range, point to the edge of the cell and the mouse pointer becomes a black cross with arrows.
Click and drag the color-coded border of the cell or range to the new cell or range.
 - To include more or fewer cells, point to a corner of the cell and the mouse pointer becomes a black line with arrows.
Click and drag the color-coded corner of the cell or range to the new cell or range.
 - In the formula, select the reference and type a new one.
3. Press the ENTER key.

Relative Cell Reference versus Absolute Cell Reference

Earlier, this handout referred to cell references. With references, you can use data contained in different parts of a worksheet in one formula or use the value from one cell in several formulas.

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.

For example, if you copy a relative reference in cell B2 to cell B3, it automatically adjusts from =A1 to =A2.

	A	B
1	■	
2	■	=A1
3		=A2

Absolute References

An absolute cell reference in a formula is indicated by the '\$' symbol, such as \$A\$1. It 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.

For example, if you copy 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

Mixed References

There are times when you may need to have both relative and absolute references in one cell reference. This is called a mixed reference. 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, but 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 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

TIP: Double click in a cell, click on the cell reference and press F4 to toggle through the types of cell references from

- relative to
- absolute to
- relative column, absolute row to
- absolute column, relative row.


FUNCTIONS

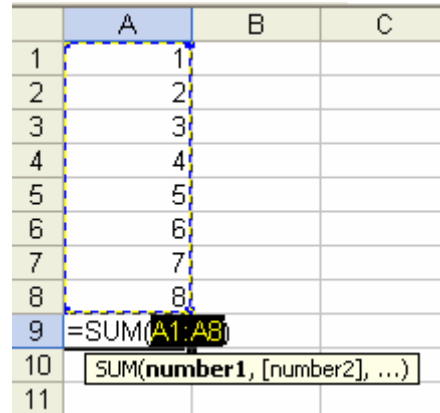
Functions are predefined formulas.

A commonly used procedure is called AutoSum that uses the SUM function to add all numbers in a series of rows or columns.

For example, assume there are numbers in cells A1 through A8. If you want to add these numbers and put the result in cell A9, you can type the formula:
=A1+A2+A3+A4+A5+A6+A7+A8 in cell A9.


Or, you can use the SUM function:

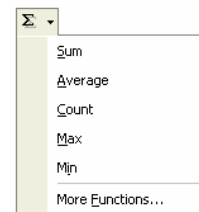
- Click in cell A9
- Click the AutoSum button 
- A marquee line will be displayed around the cells that Excel assumes you want to add
- If the correct cells are selected, press the ENTER key
- If the incorrect cells are selected, modify the cells in the function (just like modifying the color-coded cells addressed earlier).



	A	B	C
1	1		
2	2		
3	3		
4	4		
5	5		
6	6		
7	7		
8	8		
9	=SUM(A1:A8)		
10	SUM(number1, [number2], ...)		
11			

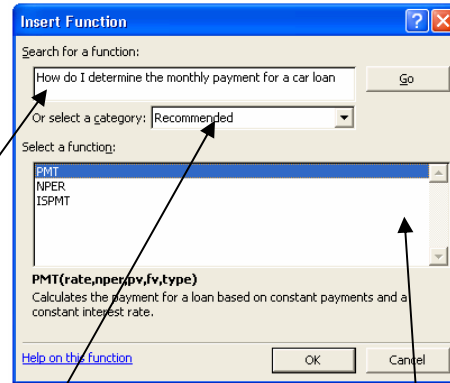
If you know the name of a function, you can simply type it into a cell. But, if you are not sure or want to see what functions are available, do one of the following:

1. AutoSum on the Toolbar - There is a drop down arrow next to the AutoSum icon on the Standard toolbar. Click this arrow and a list of the most common functions will be available for use.
2. Function Wizard - You can also go to the Function Wizard for a list of all functions by:
 - Clicking on 'More Functions' from the AutoSum drop down list
 - Clicking INSERT > FUNCTION on the menubar
 - Clicking the 'Insert Function' button  on the formula bar.

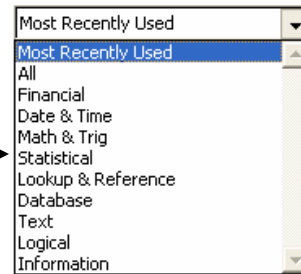


Function Wizard – You can type a natural language query, such as "How do I determine the monthly payment for a car loan" in the Function Wizard. The Wizard will return a list of recommended functions you can use to accomplish your task.

Type your question in the search box.



You can also look at the functions that are available in different categories. Click the down arrow next to the "Or select a category" box to display:



Regardless of which method you use to display functions, the appropriate functions will be displayed in the "Select a function" box.

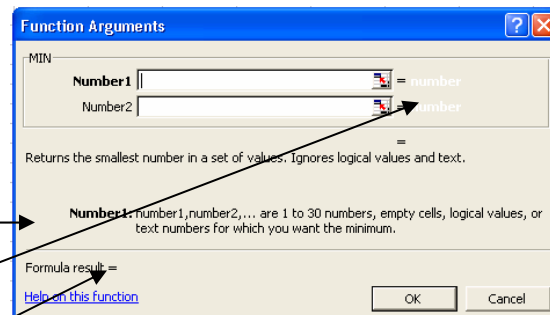
Select a function in the "Select a function" box and a brief description and the function format will be displayed under the box. If you need further information, click on [Help on this function](#) in the lower left corner of the dialog box.

Select the function you want by double clicking or click once and click the "OK" button.

The "Function Arguments" dialog box will be displayed:



It again describes the function. Further, it describes the arguments needed by the function.

And, it shows the results of each argument and the total result as you add arguments.



You can define cells for arguments in several ways:

1. Type the cell reference name in the argument box
2. Click in the cell on the worksheet

- Click the “Collapse Dialog” button  to temporarily hide the dialog box and display the “Function Arguments” dialog box. Click the cells on the worksheet, then click the “Expand Dialog” button .

Function ScreenTips – Start typing a function in a cell and a yellow pop-up screen tip appears showing all of the arguments for the function. The argument in black is the active argument. In addition, if you point to the function name in the pop-up, you can link to the Help topic for that function.

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.

Help Examples - Help has many examples, especially using functions. You can copy and paste a lot of these examples into a spreadsheet for easier understanding and reference. Each help example is preceded by a link 'How?.' Click on this link for information on how to copy and paste.

Calculate a running balance

- Set up a worksheet like the following example, or copy it to a blank worksheet.
 - [How?](#)


Example


	A	B	C
1	Deposits	Withdrawals	Balance
2	\$1,000	\$625	=SUM(A2,-B2)
3	1000	740	=SUM(C2,A3,-B3)

- Click anywhere outside cell C3 to see the calculated total.
- To maintain the running balance, add a row for each new entry.
 - [How?](#)

Basically, you copy the whole example except the column and row headers and paste it into a worksheet.

RESOLVING PROBLEMS

- When a **green triangle** appears in the top-left corner of the cell , the cell may contain an error. The errors that result in the green triangle are defined at TOOLS > OPTIONS > ERROR CHECKING on the menubar.

When you click in the cell with the green triangle, the “Error Checking Options” button  appears next to the cell.

If you point to this button a yellow pop-up will be displayed that shows what error has occurred.

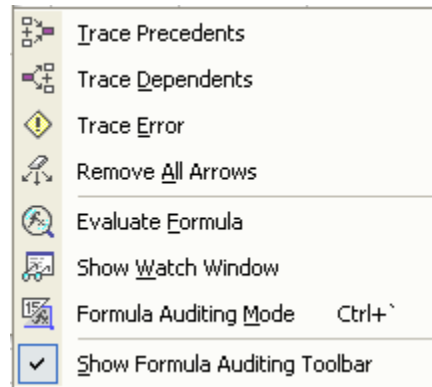
Also, a down arrow will be displayed. Click on this down arrow to see what options are available.

- Sometimes, the error is so critical that the contents of the cell will be replaced by one of the following error codes:

ERROR	CAUSE
#####	Occurs when a column is not wide enough, or a negative date or time is used.
#VALUE!	Occurs when the wrong type of argument or operand is used.
#DIV/0!	Occurs when a number is divided by zero (0).
#NAME?	Occurs when Excel doesn't recognize text in a formula.
#N/A	Occurs when a value is not available to a function or formula.
#REF!	Occurs when a cell reference is not valid.
#NUM!	Occurs with invalid numeric values in a formula or function.
#NULL!	Occurs when you specify an intersection of two areas that do not intersect. The intersection operator is a space between references.

- **Circular Reference** - When a formula refers back to its own cell, either directly or indirectly, it is called a circular reference. This can be a critical error. A dialog box will be displayed explaining a ‘circular reference.’ A circular reference toolbar may be displayed (if not, click VIEW > TOOLBARS > CIRCULAR REFERENCE on the menubar) and the cell with the circular reference will be displayed on the status bar.

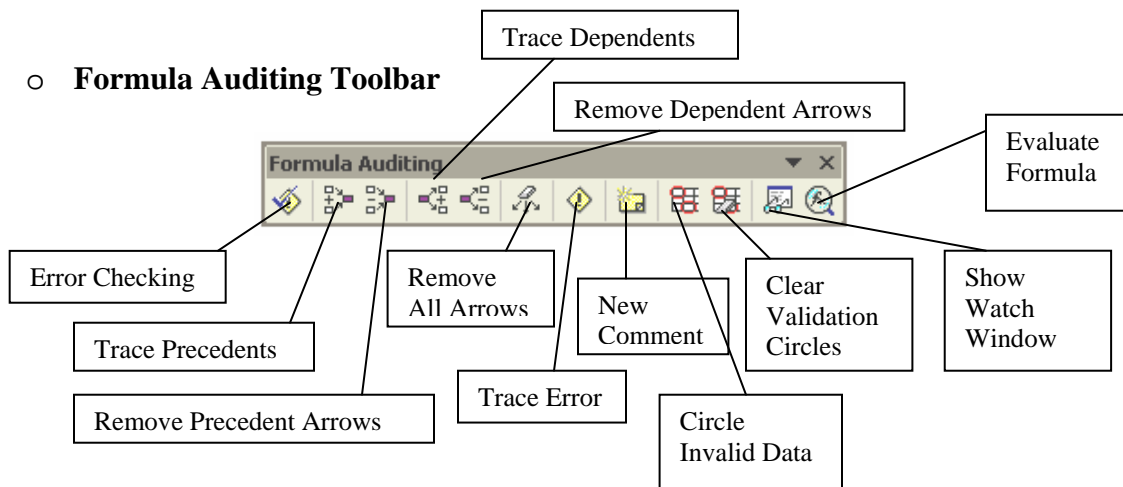
- Click **TOOLS > FORMULA AUDITING** on the menubar to display the following:




All of these options are contained on the Formula Auditing Toolbar which is explained next, except **FORMULA AUDITING MODE**:


As you know, if you want to display all of the formulas in the cells, press **CTRL+`** - this acts like a toggle switch – press **CTRL+`** again and the formula results are displayed in the cells. This is called **FORMULA AUDITING MODE**. You can now also access this option through the menubar: click **TOOLS > FORMULA AUDITING > FORMULA AUDITING MODE**.

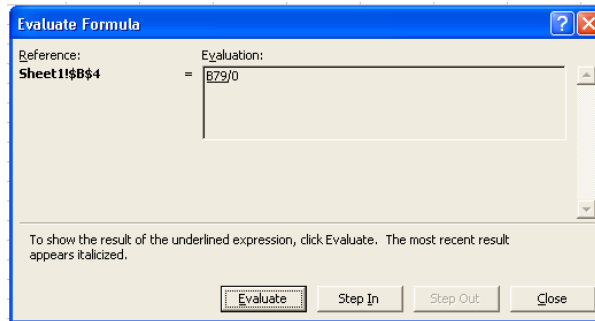
- **Formula Auditing Toolbar**



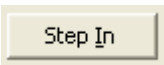
To display, click **TOOLS > FORMULA AUDITING > SHOW FORMULA AUDITING TOOLBAR** on the menubar. Displaying this toolbar will also be an option under the down arrow for the “Error Checking Options” button .



- **Formula Evaluator** - You can see the various parts of a nested formula evaluated in the order the formula is calculated.


Click on  at the right end of the toolbar. The 'Evaluate Formula' dialog box will be displayed:

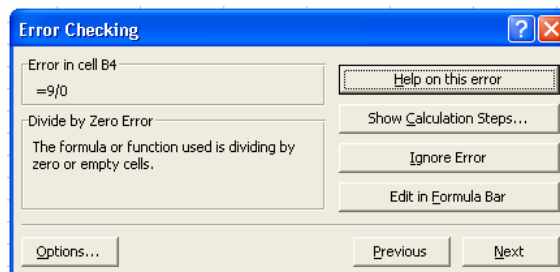


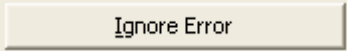
This dialog box will allow you to see every step as the formula is calculated.

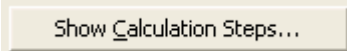
The  button will only be active when the formula has a cell reference. Click on the 'Step In' button and the focus will be on the referenced cell. Click the 'Step Out' button (active only when you've 'stepped in') to return focus to the cell with the formula.

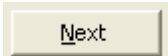
-   on the Formula Auditing toolbar will graphically display (or trace) with blue arrows, the relationships between cells and formulas. You can trace the precedent cells (cells that provide data to a formula) or the dependent cells (formulas that reference a particular cell).

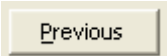
- The 'error checking' button  will display cells with the green triangle in the upper left corner one cell at a time. Each potential error will be displayed in an 'error checking' dialog box:




If you click on the 'Ignore Error' button , the green triangle will be removed from the cell.

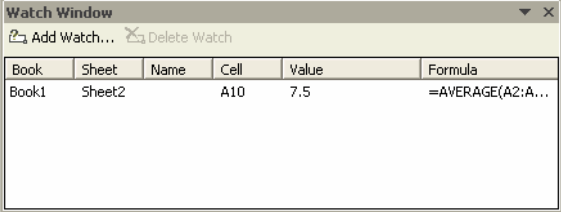
If you click on the 'Show Calculation Steps' button , Excel will display the 'Evaluate Formula' dialog box.

Click the  button, to go to the next cell with a green triangle.

Click the  button to return to the prior cell with a green triangle.

- Click  to display the **Watch Window**.

The Watch Window will keep track of cells and their formulas on the Watch Window toolbar, even when the cells are out of view. This moveable toolbar tracks cell properties including workbook, worksheet, name, cell, value, and formula.



Book	Sheet	Name	Cell	Value	Formula
Book1	Sheet2		A10	7.5	=AVERAGE(A2:A...

You can also display the Watch Window by clicking on VIEW > TOOLBARS on the menubar or TOOLS > FORMULA AUDITING > SHOW WATCH WINDOW on the menubar.