

Excel 2007

Introduction to Formulae and Functions

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Introduction

This workbook has been prepared to help you use Excel to do calculations using basic Excel formulae and functions. It is aimed at those who have a good understanding of the basic use of Excel for entering data. It assumes knowledge of moving around a worksheet, formatting cells, and controlling worksheet display and printing.

Creating Simple Formulae

Formulae allow the calculation of data or values. These calculations range from simple arithmetic (addition, multiplication etc.) to more complex statistical, logical and database functions.

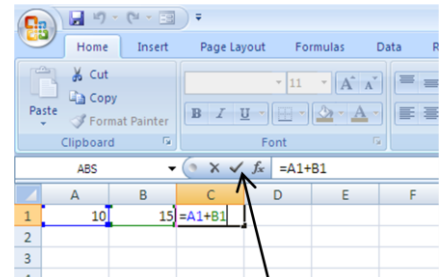
You enter a formula by typing it in the cell where you want its result to appear. When you confirm entry of a formula, Excel will display the result on the worksheet, but the underlying calculation appears in the formula bar.

Formulae always start with an = (equals) sign.

Place the formula in the cell where the result is to be displayed.

Formulae should refer to the **cell address** not the **contents** of the cells, i.e. to add the two numbers shown above the correct formula is:

=A1+B1
not
=10+15



Click on the tick to show the result or press **Return**.

- The result is displayed in the cell when the **Tick** button on the formula bar is clicked, or the **Return** key is pressed.
- You can cancel a formula if necessary by clicking on the **X** button on the formula bar or pressing the **Esc** key.
- When the contents of a cell referred to in a formula change, the formula automatically calculates and displays the new result.
I.e. if the value in cell A1 is changed to 15 in the example above, the formula automatically recalculates to display the result 30.

Some common formulae

Operator	Description	Excel Formula
+	Addition	=A1+A2 add A1 and A2
-	Subtraction	=A1-A2 subtract A2 from A1
*	Multiplication	=A1*A2 multiply A1 by A2
/	Division	=A1/A2 divide A1 by A2
^	Exponential	=A1^A2 raise A1 to the power A2
%	Percentage	=A1 % express A1 as a percentage

		=A1*10% returns 10% of A1
--	--	---------------------------

These operations can also be combined together. For example:

=A1-A2/(A1+A2)

or

=(A1+B2-D4)*50

Use brackets to ensure that the different parts of the formula are calculated in the correct order. For example: =(3+2)*4 is not the same as =3+2*4.

The order of precedence

Excel evaluates operators following the conventional rules – it will apply the calculations in a formula in the following order:

BODMAS: Brackets Of Division Multiplication Addition Subtraction

()	brackets first
^	power of
/ and *	division and multiplication
+ and -	addition and subtraction

Formula	Result	
=3+2*4	11	Take care to observe these rules when creating your own formulae.
=(3+2)*4	20	Incorrect syntax will result in error.

Editing a formula

1. Double-click on the cell containing the formula. The cell will switch from displaying the result of the formula to the formula itself.
2. Click the mouse over the part of the formula you wish to change to insert the cursor there. Type any new character or use the **Backspace** or **Delete** keys to remove characters.
3. Press **Enter** to confirm your changes, or **Esc** to exit the cell without saving your changes.

or

1. Move to the cell containing the formula you wish to change.
2. The formula will be displayed in the *formula bar*.
3. Click into the *formula bar* and make the necessary changes.
4. Click on the **tick** to the left of the formula to confirm your change, or the **cross** to close the formula without saving your changes.

or

1. Move to the cell containing the formula you wish to change and press the **F2** key.

2. Use the arrow keys to move the cursor to the edit position. Make your changes and exit the cell as explained above.

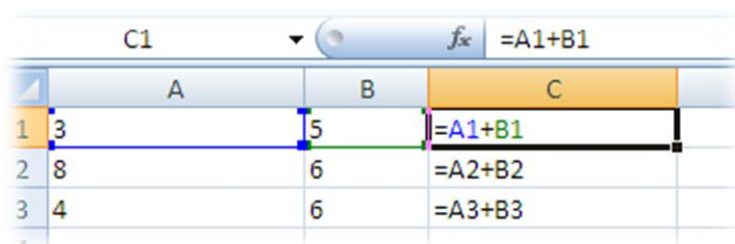
Copying formulae

Formulae can be copied using the **Copy** and **Paste** buttons in the same way as data can be copied in a worksheet.

1. Select the cell containing the formula to be copied.
2. From the **Home tab**, click on the **Copy** icon
3. Move the cursor to the new location.
4. From the **Home tab**, click on the **Paste** icon

The formula will be copied relatively, ie the cell references will change to the relative position to where they are copied. For example, if you had a formula in C1 which contained the formula A1+B1, and then copied the formula to C2 and C3, then the formula in C2 would read A2+B2, in C3 would be A3+B3, and so on.

This is because the formula in C1 is adding the 2 cells to the left, and will do so wherever you copy the formula to – it will always add the 2 cells to the left of it.



	A	B	C
1	3	5	=A1+B1
2	8	6	=A2+B2
3	4	6	=A3+B3

Using the fill handle

As formulae are copied to adjacent cells most of the time, it is much quicker and easier to use the “Fill Handle” to copy one formula to many cells.

1. Move to the cell that has the formula that you want to fill.
2. Position your mouse pointer over the fill handle. It will change to a black plus. **+**
3. Drag the black plus down or right over the cells where you want your copied formula to generate results. You will see an outline around those cells.
4. Release the mouse when the outline includes all the cells where you want results.

Clipboard		Font	
C4		fx =B4*10%	
	A	B	C
1	Fine Furniture Emporium		
2			
3	Item	Original Price	Discount 10%
4	Red Sofa	800	80
5	Green Sofa	750	
6	Oak Table	420	
7	Oak Chair	180	
8	Prine Table	300	
9	Pine Chair	150	
10			

Using keystrokes

You can fill a column or a row of formulae using the keyboard.

1. Select the cell containing the formula to fill and the cells where you want to copy to:

Clipboard		Font	
C4		fx =B4*10%	
	A	B	C
1	Fine Furniture Emporium		
2			
3	Item	Original Price	Discount 10%
4	Red Sofa	800	80
5	Green Sofa	750	
6	Oak Table	420	
7	Oak Chair	180	
8	Prine Table	300	
9	Pine Chair	150	
10		2600	
11			

2. Press **Ctrl+D** to fill down.

or

Press **Ctrl+R** to fill right.

There are no keystrokes to fill up or left. Instead, repeat step one above and then click **Edit** on the menu bar, choose **Fill** and select the direction for the fill from the resulting sub-menu.

The Fill Handle can also be used to fill up and left.

Functions

As well as performing your own arithmetic operations on values in a worksheet. Excel also provides many built-in *functions* which automate a number of types of calculation. Functions are pre-programmed formulae – you are probably already familiar with the use of functions on a calculator (for example, the square-root function, trigonometric functions, logarithms etc.). Excel has more than 300 functions covering a range of statistical, mathematical, financial and logical operations. If you have many numbers in a group of cells that you wish to combine in a formula, typing the formula becomes laborious. Using a function offers a shortcut method.

Examples of the most commonly used functions include the *Average* function, which calculates the mean of a group of cell values, the *Sum* function, which adds together a group of cell values, and the *Min* and *Max* functions, which determine the lowest and highest values in a group of cells.

Functions and arguments

Functions are usually written with the equals sign (=) followed by the *function name* and then parentheses containing the *argument*. Usually the argument just contains the range of cells which the function will operate on. For example, the *Average* function is written as:

function name — `= AVERAGE(A1:A4)` — argument

The argument of a function is placed in brackets. To specify a range of cells a colon is used between the first and the last cell address. For example, (A1:A4) will specify cells A1, A2, A3 and A4.

The Sum function

The *Sum* function is a useful function and popular. It simply adds together a range of cell values. The formula:

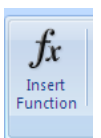
`=A1+A2+A3+A4+A5+A6+A7+A8`

can be replaced by:

`=SUM(A1:A8)`

This adds up the contents of the cells A1 to A8.

- The function can be typed at the keyboard like any other formula.
- The function can be created using the Insert Function dialog box by selecting the *Formulas* tab and clicking on the Insert Function button
- The SUM function can be created using the AutoSum button (this is the easiest method).

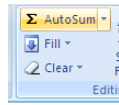


AutoSum

The AutoSum feature allows you to add all numbers in a contiguous row or column.

To use AutoSum:

1. Click a cell below the column of numbers or to the right of the row of numbers.



2. Click the **AutoSum** button on the *Home* tab. The same button also appears on the *Formulas* tab.

	A	B	C	D
1	Fine Furniture Emporium			
2				
3	Item	Original Price	Discount 10%	
4	Red Sofa	800	80	
5	Green Sofa	750	75	
6	Oak Table	420	42	
7	Oak Chair	180	18	
8	Prine Table	300	30	
9	Pine Chair	150	15	
10	Total	=SUM(B4:B9)		
11				
12				

3. Excel automatically guesses the range of cell references that you wish to sum (these can be amended if necessary).
4. If Excel doesn't select the correct range, highlight the cells that want to calculate with the mouse.
5. Confirm the formula entry by clicking on the tick (to left of the formula bar).

Note: Always check automatically generated formulae before accepting them, as Excel doesn't always guess correctly.

You can add several ranges, or cells, together by pressing the comma to separate them. For example:

=Sum(B4:B6,B9,C8:C12,D5) Adds up cells B4,B5,B6,B9,C8,C9,C10,C11,C12 and D5

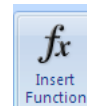
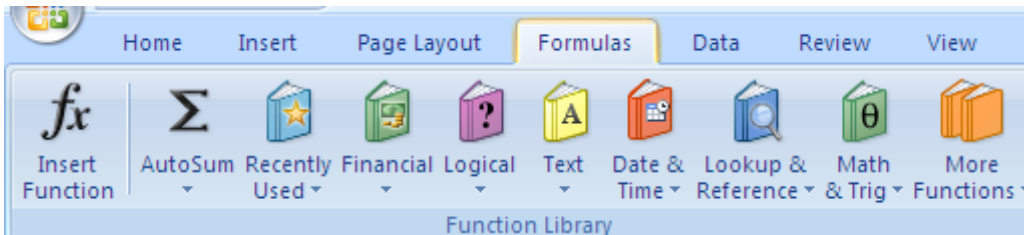
	A	B	C	D	E	F
1	1ST QUARTER FIGURES					
2						
3		January	February	March	Total	Average
4	All Bran	23	23	12		
5	Muesli	45	54	43		
6	Cornflakes	33	76	23		
7	Rice Krispies	43	43	53		
8	Weetabix	21	84	23		
9	Branflakes	53	34	64		
10	Shredded Wheat	22	25	22		
11	Porridge	42	84	36		
12	Honey Nut Loops	43	21	32		
13	Fruity Loops	10	0	10		
14						
15		=SUM(B4:B6,B9,C8:C12,D5)				
16						
17						
18						


Other Functions

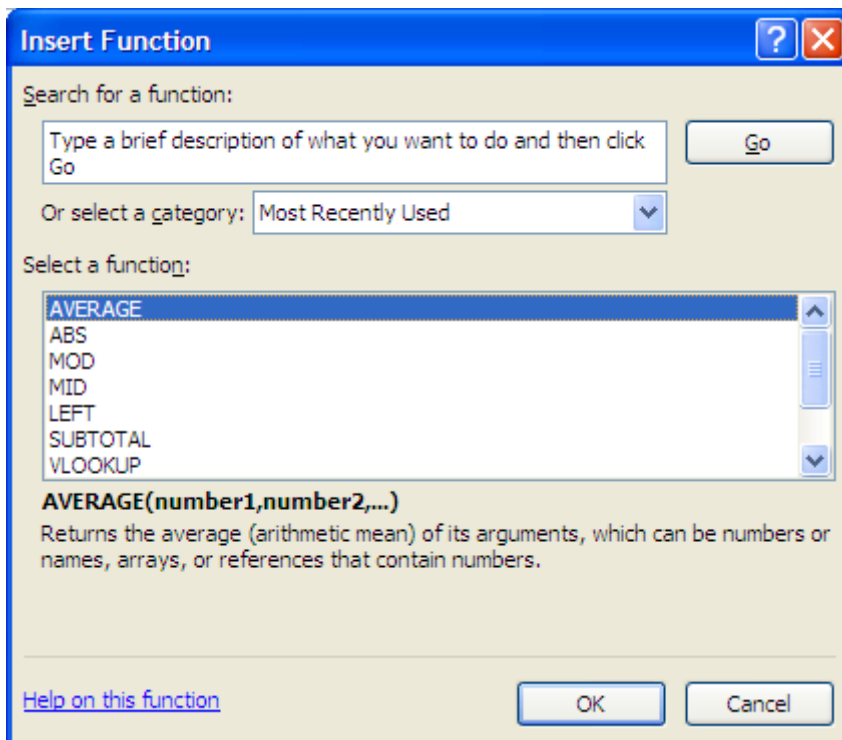
Clicking on the arrow at the side of the AutoSum button, will give you a list of other popular functions: Average, Count Numbers, Max, Min. They are entered in exactly the same way as the Sum function.

Using the Formulas Tab

If you know the name of a function, you can simply type it in together with the argument or range of cells you want to apply it to. However, an easy way to work with functions is to use the *Formulas* tab. (The AutoSum button here is the same as the one on the *Home* tab.)

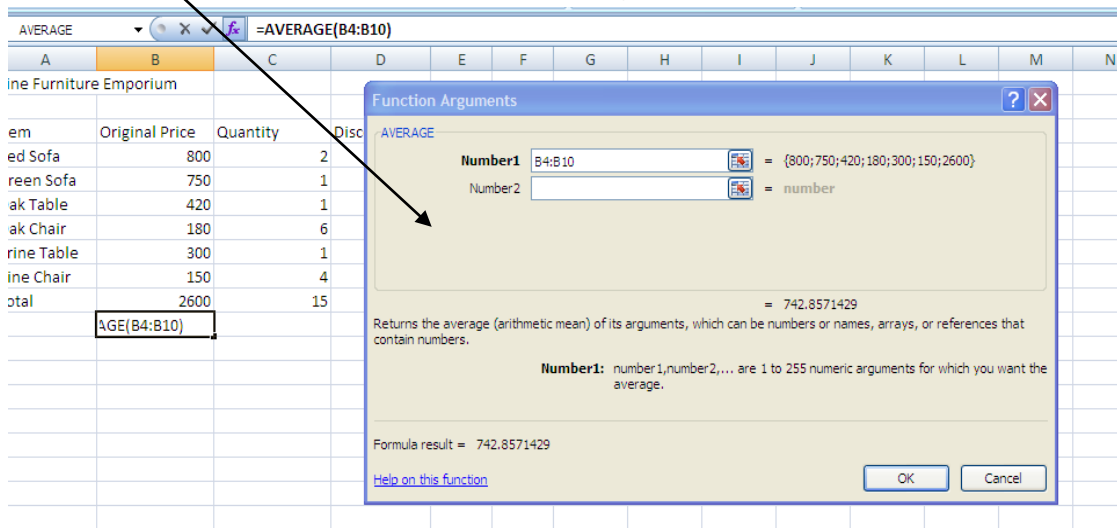


1. Position the cursor in the cell which is to contain the result, and click on the  on the Formulas tab.
2. The *Insert Function* dialog box is displayed:



3. Using the *Search for a function* box, you can type a description of what you want to do. The *Most Recently Used* category often offers the most likely choices. Select an appropriate category. The functions in that category are shown in the lower half of the window.

If in this example we choose **AVERAGE** and click on **OK**, the *Function Arguments* dialog box will display as shown below. It may well obscure the part of the worksheet you want to work on. However it can be moved simply by clicking and dragging anywhere in the grey shaded box. It can also be shrunk by clicking on the **Shrink/Enlarge** buttons.



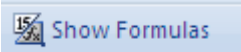

Note that *Insert Function* guesses the range of cells to be used in the calculation (B4:B10 in the example). Click **OK** if this is correct. Alternatively type the range in, or highlight the cells required in the worksheet.

Notice that a moving border appears around the specified cells as the range is entered in the dialog box. Click **OK**.

You can view the completed formula by clicking in the cell, and looking at the contents of the *Formula bar*.

View Formulas

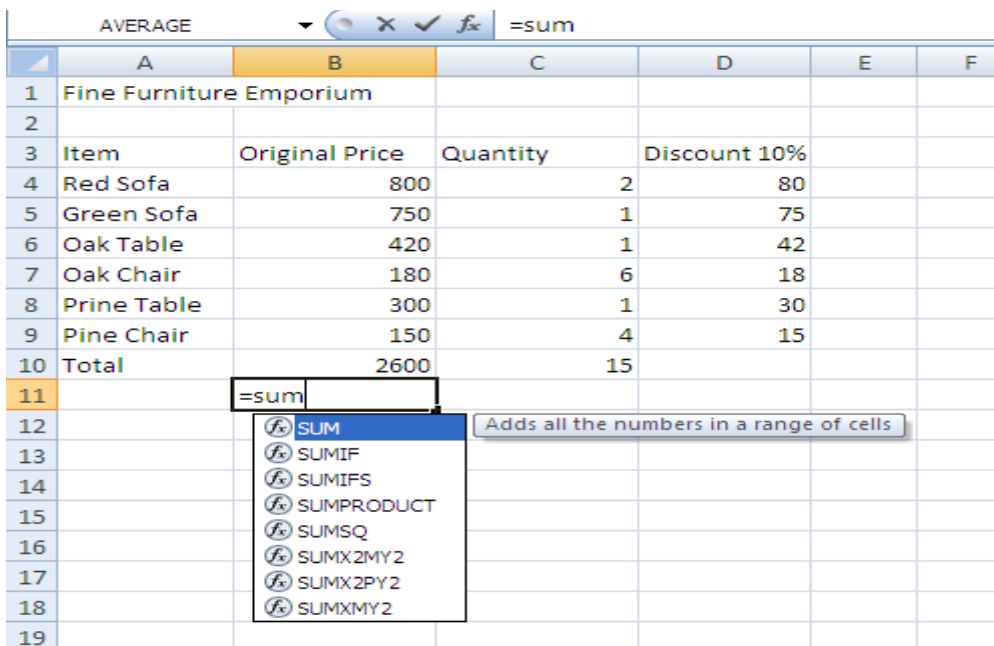
It can be very useful to view the formulas on the worksheet rather than the results. You can then print them off or just check that they are correct.

- On the **Formulas** tab click on the **Show Formulas** button . This is a toggle button, so click on it again to go back to seeing the results of formulas.
- You can also use a quick key combination: You can use the shortcut keyboard keys: **CTRL + `**  [Grave Accent Key] to show formulas in Excel. (The ` Grave Accent key is the one below the Escape key on the far upper left side of the keyboard). *This will toggle, so pressing the same combination will turn of showing formulas.*

Function Box

The *Function Box* groups the most commonly used functions for quick and easy access.

When you become more familiar with functions, you may prefer to type them directly into a cell. Excel helps you to remember the syntax of the function by displaying a drop-down list of functions and also the Function Box becomes active:



1. Position the cursor where you want to insert the function. Type in the equals sign and start typing the function name you want to use into the cell.
2. Excel will present a list of functions beginning with the letters you type in.
3. Excel also displays the *Function Box* to the left of the *Formula* bar. Click the drop-down list arrow to the right of the *Function* box to display a list of function names.
4. Select the function you require by clicking its name from the list.
5. If your function isn't listed, click the **More Functions** option to access the *Insert Function* dialog box.
6. Excel will place the chosen function on the worksheet in the selected cell. You can see the selected function being built on the Formula bar.

With some functions, Excel tries to guess which cells you want included as the function arguments. Click **OK** to accept Excel's guess and confirm the function, or select the correct cells as described above.

Calculation with dates

Excel also allows you to perform calculations with dates. All dates are stored in Excel as sequential numbers. By default, January 1 1900 is serial number 1, and January 1, 2004 is serial number 40933 because it is 40,933 days after January 1, 1900. Excel stores times as decimal fractions because time is considered a portion of a day.

Because dates and times are values, they can be added, subtracted, and included in other calculations. You can view a date as a serial value and a time as a decimal fraction by changing the format of the cell that contains the date or time to *General* format.

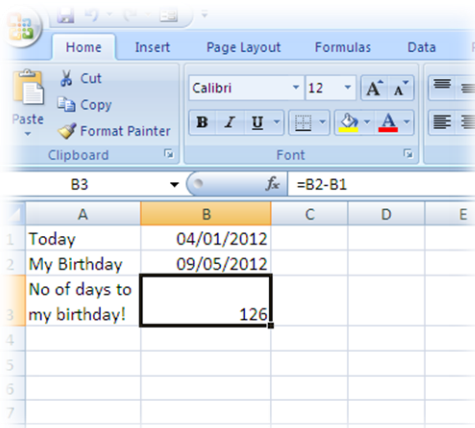
Viewing dates as numbers

To view dates as numbers:

1. Select the cell and click **Cells** on the **Format** menu.
2. Click the **Number** tab, and then click **Number** in the *Category* box.

Calculating the difference between two dates

In the following example the date in cell **B1** has been subtracted from the date in cell **B2**. The result in cell **B3** has been formatted to display a number (the number of days between two dates) with no decimal places.



NB: You will need to format the result of the formula to a number format, as it may display as a date.

If you want to know what the date is 3 weeks' time, and you have the current date in cell A1, then your formula could be:

$=A1+21$

NB Excel won't recognise a date just typed in directly into a formula: Eg $=12/1/2012+21$. You would have to use a date function to convert the date into one that Excel can understand as below:

=Date(2012,1,12)+21 The arguments being: (year,month,day)

=Today() Current date – this is a dynamic date (will change every day). You could use this in a formula to see what the date will be in 3 weeks' time from today's date: =Today()+21

=Now() Current time

Precision formatting

Care must be taken when working with formatted numbers. It is important to remember that formatted numbers, i.e. the numbers which appear on the screen, may not be the same as the value stored in the cell or the numbers used in calculations. The discrepancy can cause the results displayed to be different from the manually calculated answers.


	A	B	D
1	10	10	
2	10	10	
3	10	10	
4	10	10	
5	10	10	
6	10	10	
7	10	10	
8	10	10	
9	10	10	
10	10	10	
11	95	100	

In the example opposite, there are two columns of numbers that appear to be the same. The first column adds up to 95 but the second column adds up to 100. Take a close look at the value stored in cell A1, as displayed in the *Formula* bar. The value stored in all the cells in the first column is actually 9.5. This has been formatted to appear as a whole number (integer). The calculation is actually correct ($10 \times 9.5 = 95$), although it appears to be incorrect. The problem can be avoided by using number formats cautiously, or it can be resolved by setting the precision for the entire worksheet as explained below.

Setting the precision of number formats

To set the precision of number formats for an entire worksheet:



1. Click the Office button  , then select Excel Options button
2. Click on the **Advanced** category
3. Scroll down to **When calculating this workbook**
4. Choose the **Precision as displayed** box and click **OK**

When you choose **OK** you are warned that constant numbers throughout the workbook will be rounded permanently to match cell-formatting.

This will affect all cells in the worksheet. If you only want to round certain cells, then you can use the =ROUND function to round to a specific number of decimal places or the =INT function to convert to an integer only.

Example:

The screenshot shows the Excel formula bar with the formula `=round(C6,2)` entered. Below the formula bar, a tooltip displays the syntax: `ROUND(number, num_digits)`. The cell C6 in the spreadsheet contains the value 7.567, which is being rounded to 7.57.

The =ROUND function will round the contents of cell C6 to 2 decimal places, using mathematical rounding, and will return 7.57

The screenshot shows a spreadsheet with columns B through F. Row 6 contains the following data: Wholesale Price (43.24), VAT (7.567), Rounded (7.57), Retail Price (7.57), and Items Bought (6). The 'Rounded' and 'Retail Price' columns are highlighted in blue, indicating the result of the =ROUND function applied to the VAT column.

Statistical & mathematical functions

Some of the most commonly used statistical and mathematical functions are shown below.

Function	Example	Description
MAX	MAX(C1:C10)	Finds the largest cell value in the specified range of cells.
MIN	MIN(C1:C10)	Finds the smallest cell value in the specified range of cells.
AVERAGE	AVERAGE(C1:10)	Finds the average cell value in the specified range of cells.
MEDIAN	MEDIAN(C1:C10)	Finds the median or middle value in the specified range of cells.
STDEV	STDEV(C1:C10)	Finds the standard deviation of the values in a range of cells.
COUNT	COUNT(C1:C10)	Counts the number of cells containing numbers.
COUNTA	COUNTA(C1:C10)	Counts the number of cells containing numbers or letters (i.e. the number of non-blank cells).
COUNTBLANK	COUNTBLANK(C1:C10)	Counts the number of blank cells.
COUNTIF	COUNTIF(
INT	INT(C6)	Returns the integer value (5.35 becomes 5, 7.34 becomes 7)
ROUND	ROUND(C1, 2)	Rounds the cell value to the specified number of decimal places (2 in this example; use 0 to get a whole number).
SQRT	SQRT(C1)	Calculates the square root of a cell value.
RADIANS	RADIANS(C1)	Converts angles from degrees to radians.
SIN	SIN(C1)	Calculates the Sine of an angle (in radians – use the RADIANS function to convert degrees into radians). Other trigonometric functions include COS and TAN.

Cell references

In functions, you often need to refer to a range of cells. The way Excel displays cell references in functions depends on whether the cells you want the function to act upon are together in a block, or in several non-adjacent cells or blocks.

The table below explains how to use different operators to refer to cells:

Operator	Example	Description
Reference operator : (colon)	B5:B15	Range operator that produces one reference to all the cells between two references, including the two references.
, (comma)	SUM(B5:B15,D5:D15)	Union operator that combines multiple references into one reference.
(single space)	=B5:B15 A7:D7	Intersection operator that produces one reference to cells common to two references. In this example, cell B7 is common to both ranges; therefore the result would be the contents of cell B7.

Date Formulae and Functions

Dates are treated as numbers in Excel, therefore calculations can be performed just as with other values. Excel has a 200 year calendar and each day of the year is given a serial number, starting with 1/1/1900 which is day 1, then 2/1/1900 is day 2 and so on.

If you want to know what the date is 3 weeks' time, and you have the current date in cell A1, then your formula could be:

=A1+21

NB Excel won't recognise a date just typed in directly into a formula. Eg =12/1/2012+21. You would have to use a date function to convert the date into one that Excel can understand as below:

=Date(2012,1,12)+21 The arguments being: (year,month,day)

=Today() Current date – this is a dynamic date (will change every day)

=Now Current time

Absolute cell referencing

The ability to copy formulae from one location to another in a spreadsheet can save you a significant amount of work. Normally, if you copy a formula involving a cell reference to another location, the cell reference is adjusted relative to its starting point. So, for example, if you copy a formula which multiplies two cells to the left of it, the formula will adjust to the new location by multiplying the two cells to the left at the new position. If you start a formula in C1 and multiply A1 by B1, and you then copy the formula to C2, the formula will become A2 multiplied by B2, as these are the two cells to the left of C2. The formula has updated automatically to refer to adjacent cells. This is an example of a **relative referencing** system.

Sometimes we may need to refer to a **specific** cell location in a worksheet, and so we want that cell reference to remain unchanged, regardless of where the formula is placed. We need a method to fix our cell reference so that it does not update when we copy the formula to another location – we need an **absolute cell reference**.

Making a reference absolute

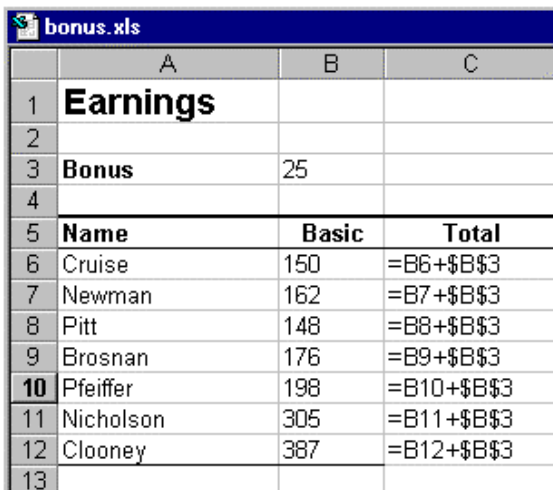
If you type a \$ sign before both the column letter and the row number of the cell reference then the relative reference A1 becomes the absolute reference \$A\$1. This absolute reference won't change if you copy the formula.

A better method is the keyboard shortcut, **F4**. This is quicker and more accurate.

- When constructing a formula and the cell which you want to make absolute is selected, press the **F4** key.

\$ signs are automatically placed in front of the column and row references.

Absolute references explained



	A	B	C
1	Earnings		
2			
3	Bonus	25	
4			
5	Name	Basic	Total
6	Cruise	150	=B6+\$B\$3
7	Newman	162	=B7+\$B\$3
8	Pitt	148	=B8+\$B\$3
9	Brosnan	176	=B9+\$B\$3
10	Pfeiffer	198	=B10+\$B\$3
11	Nicholson	305	=B11+\$B\$3
12	Clooney	387	=B12+\$B\$3
13			

The data on the left show the basic earnings for a group of staff. Their manager has decided to award them a bonus payment, and wishes to store the total pay in column C.

The formula for cell C6 is **=B6+\$B\$3**. Here the \$ is used to make the reference to cell B3 absolute. When this formula is copied into cells C7:C12, the formula updates as shown.

Cell B6 in the initial formula is relative, therefore this reference will change when copied, but B3 is absolute and will not change to another reference when copied.

Mixed references

If only the column reference or the row reference is to be absolute, prefix one or other of these with a \$ sign. For example, if the column is to be *absolute* and the row *relative* A1 becomes \$A1, if the row is to be *absolute* and the column *relative* A1 becomes A\$1.

1. Double-click in the cell as if to edit it.
2. Highlight the cell reference to be made absolute and press **F4**. Note that by pressing **F4** a number of times you cycle through different options for creating a **mixed reference**.

A1	Relative
\$A\$1	Absolute
\$A1	Mixed (Column Absolute, Row Relative)
A\$1	Mixed (Column Relative, Row