

# Section 4 Formulae and Functions

**By the end of this section you will be able to:**

- Understand the difference between functions and formulae
- Enter by typing, simple functions and formulae
- Understand and use BoDMAS
- Enter functions and formulae in using mouse, keyboard or ribbon.
- Use basic conditional functions
- Use the Fill handle to enter multiple formulae
- Understand and use Absolute and Relative cell references

## Formulae

In a spreadsheet application, at a very basic level, values often need to be added, subtracted, multiplied and divided. To allow for the fact that individual values might change, spreadsheet formulae generally refer, not to actual values, but to the cells where those values are being held. If values have been entered into A1 and A2, then A1+A2 will return an answer which will automatically recalculate if the value of A1 should change. It is this automatic recalculation which makes spreadsheets invaluable.

Excel recognises formulae because they are preceded by an equals sign (=).

When entering basic formulae, the mathematical operators defining the operation to be carried out are as follows:

Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponentiation	^

You will find all of these mathematical operators ranged across the top and down the right hand side of the numeric keypad.

### Typing Formulae

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

	A	B	C	D	E	F
1	Order Date	Customer	Product	Quantity	Price	Total
2	01/01/2001	Viking Supplies	Widget	10	5	=D2*E2
3	02/01/2001	Bloggs & Co	Ratchet	23	7	
4	03/01/2001	Jones Brothers	Gimlet	200	3	
5	04/01/2001	Viking Supplies	Gimlet	201	3	

### To Enter A Formula:

#### KEYBOARD

1. Move to the cell where you want to enter the formula.
2. Type an equals sign (=).
3. Type the formula (e.g. d2\*e2).
4. Press **ENTER** to confirm the entry.

- Excel automatically recalculates formulae. If you change one of the cells referenced in your formula, as soon as you press **ENTER** to confirm the changed value, your formula result will update.

### Entering Formulae By Pointing

It is possible to enter formulae without actually typing the equals sign (=) or the cell references. Instead, you can make use of a pointing technique to indicate which cells are to be included. As with typing formulae, it is important to start off in the cell where the answer is to be displayed.

Pointing can be quicker and more efficient than typing cell references as it reduces the chances of errors.

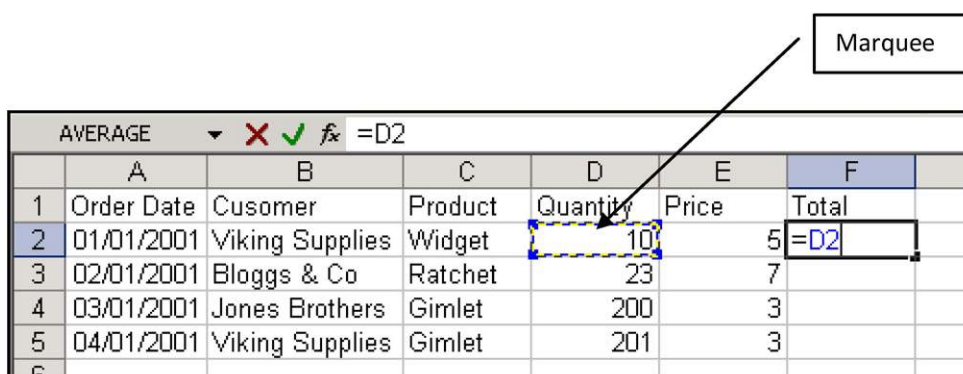
#### **To Enter A Formula Using Keyboard AND Mouse:**

##### MOUSE

- Position the cursor in the cell where you want the formula.
- Type an equals sign (=).
- Click the first cell whose reference should be included in your formula. A moving dotted line, known in Excel as a 'marquee', will appear around that cell and the cell reference will appear in the formula bar immediately after the equals sign.

##### OR

- Use an arrow key to move there. A moving dotted line, known in Excel as a 'marquee', will appear around that cell and the cell reference will appear in the formula bar immediately after the equals sign.
- Type in the mathematical symbol you want to use in your calculation, then click on (or move to) the next cell to be included in the formula.
- Continue building the formula in this way.
- Press **ENTER** to complete the formula.



## Errors In Formulae

Sometimes you may get surprising results from a formula. This is most often because you have referenced the wrong cell, but it could also be that you have multiplied where you should have added and so on. You can correct formulae using the editing techniques described earlier in this manual.

### To Edit A Formula:

#### MOUSE

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 to change to anchor the cursor there. Type any new characters or use the **BACKSPACE** and **DELETE** keys to remove characters.
3. Press **ENTER** to confirm the changes.

#### OR

1. Move to the cell containing the erroneous formula.
2. Click on the Formula bar which will show you the formula where you want to make the change.
3. Type any new characters or use the **BACKSPACE** and **DELETE** keys to remove characters.
4. Press **ENTER** to confirm the changes.

#### OR

#### KEYBOARD

1. Press **F2** to access edit mode.
2. Use the arrow keys to move the cursor to the edit position. Type any new characters or use the **BACKSPACE** and **DELETE** keys to remove characters.
3. Press **ENTER** to confirm the changes

## Filling Formulae

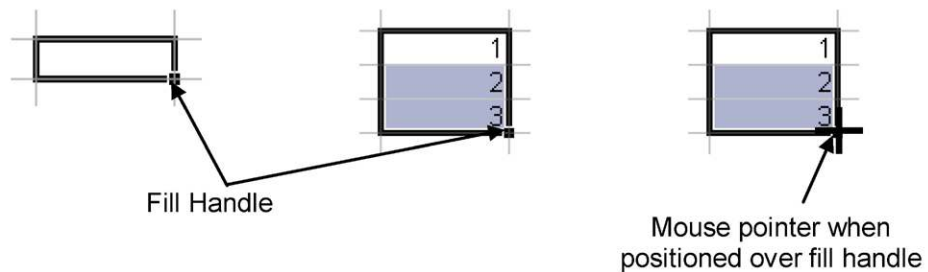
Having entered an initial formula in the first cell of a column or row, you often find that you want to generate results for the other cells in that column or row. In the example below, you would probably want your formula to work out totals for all the orders.

There are a variety of ways that you can get Excel to copy a formula so that it generates results for other cells in a column or row.

	A	B	C	D	E	F
1	Order Date	Customer	Product	Quantity	Price	Total
2	01/01/2001	Viking Supplies	Widget	10	5	50
3	02/01/2001	Bloggs & Co	Ratchet	23	7	
4	03/01/2001	Jones Brothers	Gimlet	200	3	
5	04/01/2001	Viking Supplies	Gimlet	201	3	

### The Fill Handle And Formulae

The fill handle has already been described earlier in this manual. It can be used to clear cells but has other uses as well, one of which is filling formulae.



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**To Use The Fill Handle To Copy Formulae:****MOUSE**

	Total
5	50
7	
3	
3	

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, up, left 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.
5. A Smart Tag will be produced. The options it offers are not needed at the moment.

**OR**

fx		=D4+E4					
	D	E	F	G	H	I	J
	£ 50.00	£ 60.00	£ 110.00				
	£ 75.00	£ 35.00					
	£ 80.00	£ 82.00					

**Copy Cells**

- Fill Series
- Fill Formatting Only
- Fill Without Formatting

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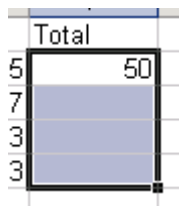
- Fill Days
- Fill Weekdays
- Fill Months
- Fill Years

---

- Linear Trend
- Growth Trend
- Series...

6. Instead of using the left mouse button to fill down, try using the right mouse button. When released after dragging a menu will appear offering numerous options as to how the data should be filled

### Fill Formulae Using Keystrokes



	Total
5	50
7	
3	
3	

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

### **To Fill Using Keystrokes:**

#### **KEYBOARD**

1. Select the cell containing the formula to fill *and* the cells where you want to copy it.
2. Press **CTRL+[D]** to fill down.

**Or**

1. Press **CTRL+[R]** to fill right.
  - *There are no keystrokes to fill up or left. Instead, repeat step1 above and then click the **fill** command from the **editing** group on the **home** ribbon and select the direction for the fill from the resulting sub-menu.*

**Bodmas With Formulae**

BoDMAS is a mathematical acronym that simply reminds us of the order of operations that mathematics uses to step through more complicated formulae. (Brackets), (Division), (Multiplication), (Addition), (Subtraction).

Excel follows these rules to a point please take note of the following table to see the order of preference that excel uses when working out calculations

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

1st	-	Negation (as in -1)
2nd	%	Percent
3rd	^	Exponentiation
4th	* and /	Multiplication and division
5th	+ and -	Addition and subtraction
6th	&	Connects two strings of text (concatenation)
7th	= <> <= >= <>	Comparison

**Using Bodmas**

**E.G.** The following formula produces 11 because Excel calculates multiplication before addition. The formula multiplies 2 by 3 and then adds 5 to the result.

**Type = 5+2\*3 press ENTER Result =11**

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.

**Type = (5+2)\*3 press ENTER result = 21**



## Functions

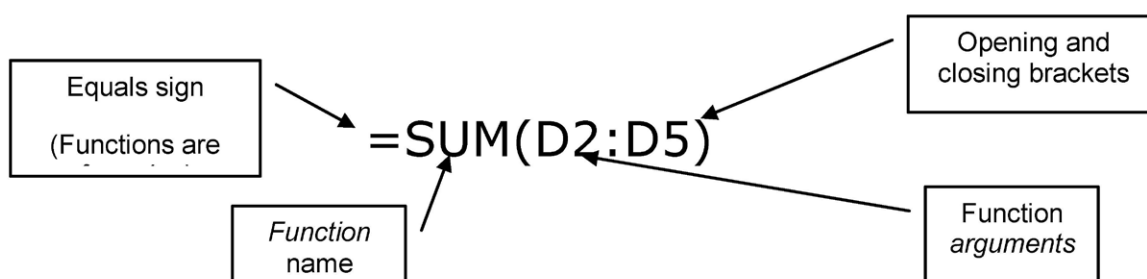
### Basic Functions

Having mastered how to set up your own custom formulae, you will be able to carry out any calculations you wish. However, some calculations are complicated or involve referring to lots of cells making entry tedious and time consuming. For example, you could construct a formula to generate a total at the bottom of a column (or the end of a row), like this:

**=D2+D3+D4+D5**

The above formula would work, but if there were 400 cells to total and not just 4, you would get bored with entering the individual cell references.

When formulae become unwieldy or complex, Excel comes to the rescue with its own built-in formulae known as *functions*.



Functions always follow the same syntax:

The name of the selected function tells Excel what you want to do and the arguments generally tell Excel where the data is that you want to calculate.

Excel has a huge number of functions, not all of them are relevant to everyone. The functions are categorised according to what they do. In this manual, we outline some of the most basic functions that can be usefully used at a general level.

### Sum Function

As discussed above on how the basic functions are made up we will create a basic function from scratch the first function being the **SUM** function this will add several figures together

**To Create Sum Function****MOUSE**

QTR4	
1000	
800	
400	
300	
=SUM(E4:E7)	
SUM(number1, [number2], ...)	

1. Enter or locate several figures you wish to find the total of.
2. In an empty cell enter the equals sign.
3. Type in the word sum and open a set of brackets.
4. Highlight the figures you wish to total so that a cell range appears after the open bracket.
5. Close the bracket and press return

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Jane, Chinese architect



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## Average Function

The next function to try is the **AVERAGE** function this will give the mean average of several figures.

### To Create Average Function

#### MOUSE

QTR3	QTR4
900	1000
800	800
500	400
500	300

=AVERAGE(D4:D7)

AVERAGE(number1, [number2], ...)

1. Enter or locate several figures you wish to find the average of.
2. In an empty cell enter the equals sign.
3. Type in the word Average and open a set of brackets.
4. Highlight the figures you wish to find the average of so that a cell range appears after the open bracket.
5. Close the bracket and press return

## Max Function

The next function to try is the **MAX** function this will give the the highest value in a range of figures

Item	QTR1	QTR2	QTR3	QTR4	
Bonnets	500	800	900	1000	=MAX(B4:E4)
Funnels	400	100	800	800	MAX(number1, [number2], ...)

### To Create Max Function

#### MOUSE

1. Enter or locate several figures you wish to find the highest value from.
2. In an empty cell enter the equals sign.
3. Type in the word Max and open a set of brackets.

4. Highlight the figures you wish to find the Highest value of so that a cell range appears after the open bracket.
5. Close the bracket and press return

**Min Function**

The next function to try is the **MIN** function this will give the the Lowest value in a range of figures

Item	QTR1	QTR2	QTR3	QTR4	
Bonnets	500	800	900	1000	1000
Funnels	400	100	800	800	=MIN(B5:E5)

**To Create Min Function**

**MOUSE**

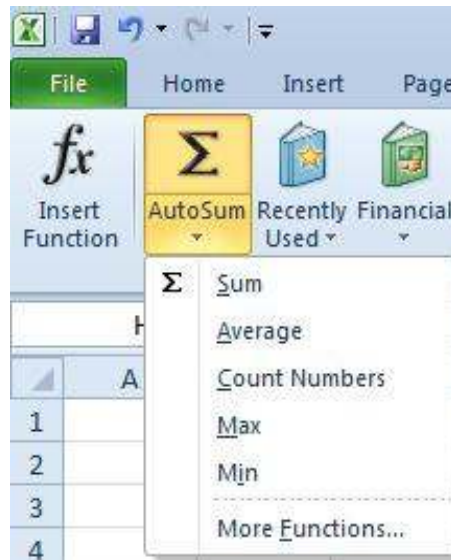
1. Enter or locate several figures you wish to find the highest value from.
2. In an empty cell enter the equals sign.
3. Type in the word Min and open a set of brackets.
4. Highlight the figures you wish to find the lowest value of so that a cell range appears after the open bracket.
5. Close the bracket and press return.



## Autosum

### Using Autosum

#### MOUSE



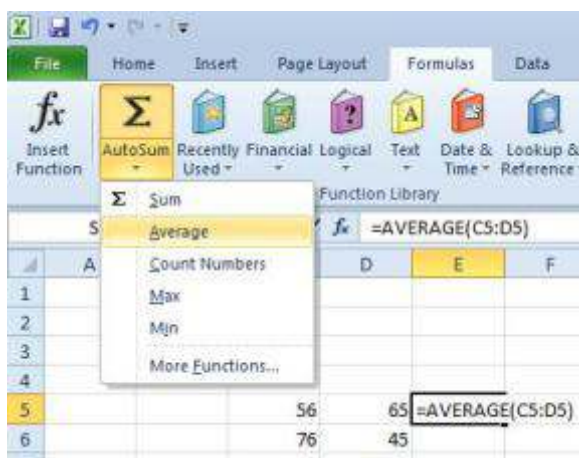
1. Move selected cell to bottom of column or end of row of figures.
2. Click on the **FORMULAS** Ribbon, then click on **AUTOSUM**. From the menu select the **SUM** function
3. A 'marquee' will appear around the suggested range to sum and a pre-built function will appear in selected cell.
4. If suggested range is correct then press **ENTER**. If not redefine range by selected the figures you wish to include in the function and press **ENTER**.

### Other Common Functions

The **Sum** function is very useful, but the AutoSum icon can also be used to for some other common functions: **Average** (of the selected figures), **Count** (the number of selected figures), **Max** (the largest selected figure) and **Min** (the smallest selected figure).

**To Use Other Common Functions:**

MOUSE



1. Select the cell immediately below a column of figures (or to the right of a row of figures) to be totalled.
2. Click on the drop-down arrow next to the AutoSum icon and select the function that you want to use from the list.
3. The selected function will automatically appear in the Formula bar and Excel will make a guess at which cells you want to use (you will see a marquee around the cells and their references will be the function arguments).
4. Press **ENTER** to accept the cells that Excel proposes.

**Function Library**

On the formulas ribbon you will find the function library which is dedicated to functions **AUTOSUM** functions are just a few of the most regularly used functions.



The functions are broken down into categories and grouped accordingly to make it easy to access the specific function you desire to use. In many places you will see the **MORE FUNCTIONS** command which allows access to the whole range of functions available to excel. This brings us to the **INSERT FUNCTION** utility.

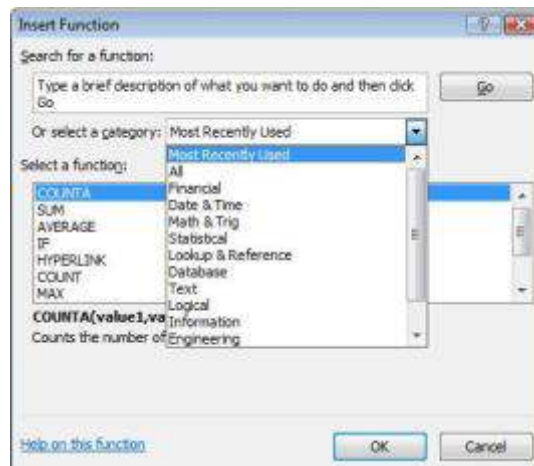
## Insert Function



If after looking through all categories you do not find, or find it difficult to locate a specific function then we can use the **INSERT FUNCTION** facility. Which contains all functions available in excel

### To Insert Function

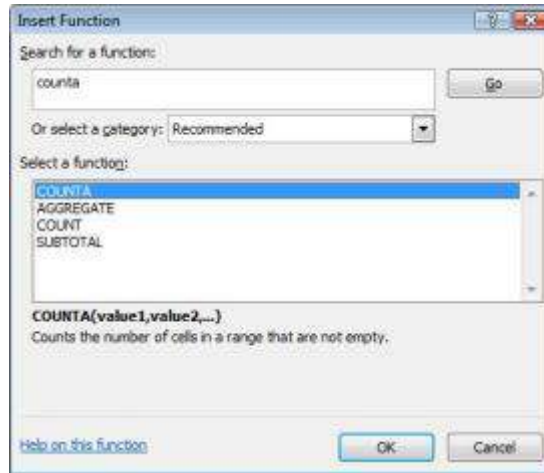
#### MOUSE



1. Click in the cell which you want a result
2. Go to the **FORMULAS** ribbon and click on the **INSERT FUNCTION** icon on the far left
3. The **INSERT FUNCTION** dialog box appears

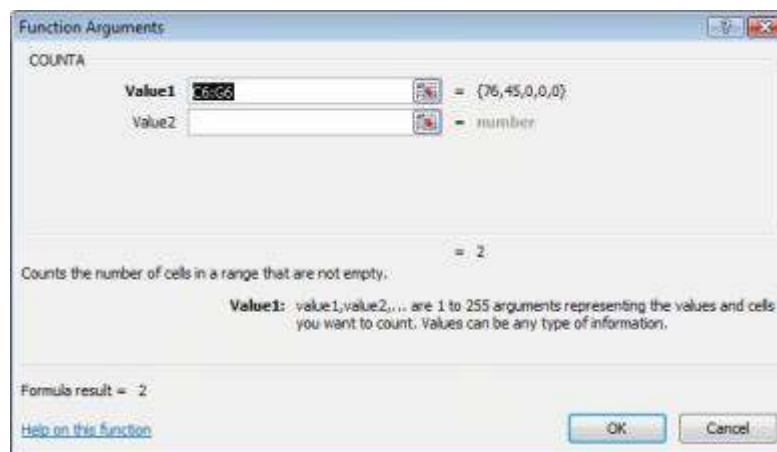
#### EITHER

1. Type a description of the function you wish to use in the topmost box and click on go OR select a category from the drop down box
2. Results will appear in the bottom box then select a specific function with a single click of the mouse



3. A description will appear underneath the white box and the syntax of how it is constructed
4. If further explanation is required on a specific function then click on the blue hyperlink in the bottom left corner to get more information.
5. When the function you want is selected (in this case **COUNTA**) click **OK**.
6. A dialog box appears (below right) with a suggested range for the function. Excel will place the function on the worksheet in the selected cell. You can see the selected function being built on the formula bar. If this is incorrect reselect the range and press **ENTER**.

**OR**



1. Click the **RANGE SELECTOR** button. This will collapse the dialog box shown above.
2. Drag across the cells to replace Excel's pre selected guess with your own cell references. Click the **RANGE SELECTOR** button again to return to the dialog.

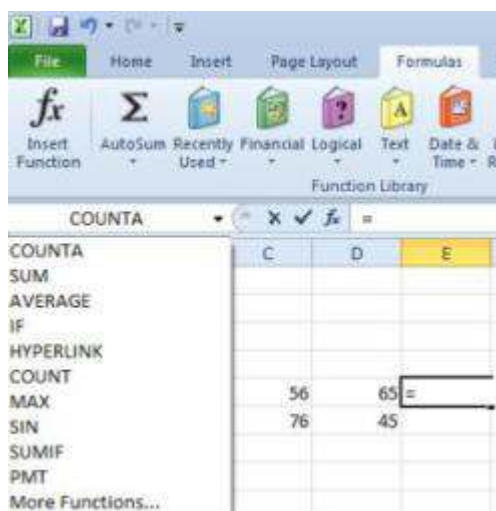


## Function Box

There are some functions that are accessed more than others and for that reason Excel gives you a slightly quicker method for entering them than the Paste function dialog. The Function box, groups the most commonly used functions for quick and easy access.

### To Enter A Function Using The Function Box:

#### MOUSE



1. Type the equals sign (=) on the formula bar (or directly into your cell). Excel displays the function box to the left of the Formula bar.
2. Click the drop-down list arrow to the right of the function box to display a list of function names.
3. Select the function you require by clicking its name from the list.

#### OR

4. If your function is not listed, click the **MORE FUNCTIONS...** option to access the Paste function dialog (*see above for instructions*).

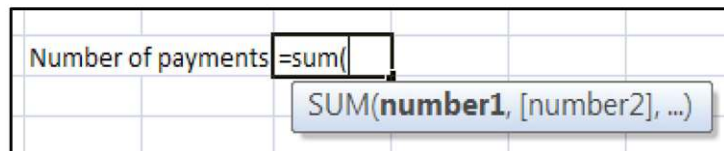
## Type Functions

When you get more familiar with functions and start to remember how they are constructed, you can type them rather than selecting them using the previously described methods.

**To Type A Function:****KEYBOARD**

1. Move to the cell where you want the function.
  2. Type an equals sign (=) followed immediately by the function name and an open bracket.
  3. A tool tip appears to indicate the arguments the function needs.
  4. Select (or type) the cells you want the function to act upon using the mouse or arrow keys.
  5. Press **ENTER** to confirm the entry.
- *As long as your formula only contains one function, you do not need to type the closing bracket. Pressing **ENTER** makes Excel close the bracket automatically.*

## Function Argument Tool Tips



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Excel 2010 displays information about function arguments as you build a new formula. The tool tips also provide a quick path to **HELP**. You click any function or argument name within the tool tip.

### 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 you can use different operators to reference cells:

Operator	Description	Example
Reference operator: (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)
(single space)	Intersection operator, which produces one reference to cells common to two references - In this example, cell B7 is common to both ranges	SUM(B5:B15 A7:D7)

### Absolute and Relative References

#### Relative References

When you fill formulae, you tell Excel to base the formulae it creates on the one you have entered by starting from the cell that contains it.

fx =D2*E2		
D	E	F
antity	Price	Total
10	5	50
23	7	
200	3	
201	3	
296	5	
371	7	
446	3	
521	3	
596	5	
671	7	

In the example shown right, the formula being copied says =D2\*E2. However, once copied, if you click on any of the copies, Excel will have updated the references to keep the row numbers current (D3\*E3, D4\*E4 and so on).

This is because Excel, by default, uses *relative referencing*. When you enter a formula, you enter specific cell references. Behind the scenes, Excel ‘translates’ those references into positions relative to the result cell. So, in our example shown left, Excel would take the formula:

=D2\*E2

Translate it as follows:

= [two cells to the left]\*[one cell to the left].

It therefore does not matter which row you copy the formula into, Excel will always use “[two cells to the left] multiplied by [one cell to the left]” to generate the result.

Most of the time, this is what you would want, but there are occasions where you need to stop Excel updating cell references when you copy formulae.

### Absolute References

The example below shows a formula being created to work out the amount of discount each order would receive. The order totals are in column F and the discount rate is in B13. The initial formula has therefore been set up as:

=F2\*B13

The formula will generate a result for the first order. However, when copied, you will get zeros against the discount amounts for the other orders. This is due to the relative referencing that Excel applies to all formulae by default.

	A	B	C	D	E	F	G	H
1	Order Date	Customer	Product	Quantity	Price	Total	Discount Amount	
2	01/01/2001	Viking Supplies	Widget	10	5	50	=F2*B13	
3	02/01/2001	Bloggs & Co	Ratchet	23	7	161		
4	03/01/2001	Jones Brothers	Gimlet	200	3	600		
5	04/01/2001	Viking Supplies	Gimlet	201	3	603		
6	05/01/2001	Viking Supplies	Widget	296	5	1480		
7	06/01/2001	Bloggs & Co	Ratchet	371	7	2597		
8	07/01/2001	Jones Brothers	Gimlet	446	3	1338		
9	08/01/2001	Viking Supplies	Gimlet	521	3	1563		
10	09/01/2001	Viking Supplies	Widget	596	5	2980		
11	10/01/2001	Bloggs & Co	Ratchet	671	7	4697		
12								
13	Discount Rate	25%						

Having copied the above formula, if you clicked on any formula in the Discount amount column below the first one, you would see that Excel has updated the references (=F3\*B14, F4\*B15). This is where the problem lies – you want Excel to change the first reference as your formula needs to refer to the different order totals, but the discount rate should remain constant. You need to make that reference *absolute*.

**To Make A Reference Absolute:****KEYBOARD**

1. Move to the cell where you have typed the formula and press **F2** to access Edit mode.
2. Move the cursor with the arrow keys so that it is next to the reference we want to fix.
3. Press [**F4**]. Dollar signs will appear against the column letter and the row number.
4. Press **ENTER** to confirm the change.
5. In our example, amending the formula to read:

**=F2\*\$B\$13**

	A	B	C	D	E	F	G	H
1	Order Date	Cusomer	Product	Quantity	Price	Total	Discount Amount	
2	01/01/2001	Viking Supplies	Widget	10	5	50	=F2*\$B\$13	
3	02/01/2001	Bloggs & Co	Ratchet	23	7	161		
4	03/01/2001	Jones Brothers	Gimlet	200	3	600		
5	04/01/2001	Viking Supplies	Gimlet	201	3	603		
6	05/01/2001	Viking Supplies	Widget	296	5	1480		
7	06/01/2001	Bloggs & Co	Ratchet	371	7	2597		
8	07/01/2001	Jones Brothers	Gimlet	446	3	1338		
9	08/01/2001	Viking Supplies	Gimlet	521	3	1563		
10	09/01/2001	Viking Supplies	Widget	596	5	2980		
11	10/01/2001	Bloggs & Co	Ratchet	671	7	4697		
12								
13	Discount Rate		25%					

6. This would prevent Excel from changing the B13 reference when the formula is copied.

**Fill Handle**

You can get the fill handle to fill formulas down to the same level as the entries in the previous column by double-clicking on it.

**Absolute References**

Pressing [**F4**] repeatedly over a reference allows you to toggle between making both the row and column absolute (**\$A\$1**), just the column absolute (**\$A1**), just the row (**A\$1**), or nothing absolute (**A1**).