



Using Microsoft Excel

Calculations in Excel

Although calculations are one of the main uses for spreadsheets, Excel can do most of the hard work for you by using a formula. When you enter a formula in to a spreadsheet cell, Excel will calculate the answer and display the answer in that cell. There are a few rules to remember when creating a spreadsheet formula.

- 1) A formula must always begin with an equal sign. As soon as you begin a cell entry with a = Excel will know that you are creating a formula.
- 2) A formula will follow the order of operations (BIMDAS). Generally if there is more than one part to a formula the calculations will work from left to right but... Any part of the formula in brackets will be calculated first. Indices will be next. Multiplication and division will be next. Addition and subtraction will be calculated last.

B	Brackets	()
I	Indices	^
M	Multiplication	*
D	Division	/
A	Addition	+
S	Subtraction	-

- 3) A formula can refer to other cells in the spreadsheet using cell references.
- 4) If any part of the formula is referring to text, the text must be enclosed in quotation marks “ ”.
- 5) The cells referred to in a formula can't include the cell the answer will be in. This will cause a **circular reference** error.

Note If you learnt something in school that was similar to **BIMDAS** (such as **BODMAS**) then it's probably the same thing using different letters to describe each part. A different way of teaching the same principle.

Exercise 1. Creating a Simple Formula

- 1) Create a blank workbook ([Ctrl] [N]).
- 2) Click in cell **A1** and enter the following.
=5+5
- 3) Press [Enter] to complete the formula. Excel will calculate the result.

Exercise 2. Using Cell Referencing

- 1) Enter the number 5 in cell **B1**.
- 2) Enter the number 10 in cell **B2**.
- 3) Enter the following formula in cell **B3**.
 $=b1+b2$
- 4) Press **[Enter]** to complete the formula. Excel will calculate the result.
- 5) Change the number in cell **B2** to 12 and press **[Enter]**. The result of the formula will be recalculated (if it doesn't recalculate on its own you can press **[F9]** to force recalculation).

	A	B
1	10	5
2		12
3		=B1+B2

Exercise 3. Using the Mouse for Cell Referencing

Creation of a formula can be made easier by using the mouse to create cell references.

- 1) Enter the number 10 in cell **C1**.
- 2) Enter the number 20 in cell **C2**.
- 3) Click in cell **C3** and type a = sign.
- 4) Click on cell **C1**. The reference for that cell will appear in the formula.
- 5) Type a + sign.
- 6) Click on cell **C2**. The reference for that cell will appear in the formula.
- 7) Check that the formula reads =C1+C2 and press **[Enter]**. Your table should look like the example below.

	A	B	C
1	10	5	10
2		12	20
3		17	30

And the same table with formulas showing instead of answers.

	A	B	C
1	=5+5	5	10
2		12	20
3		=B1+B2	=C1+C2

Tip You can make your spreadsheet show formulas instead of answers by clicking the **Formulas** tab on the ribbon and then clicking the  Show Formulas button. You can also use the **[Ctrl] [~]** keyboard shortcut (under your **Esc** key) to turn formulas display on and off.

Exercise 4. Editing a Formula

- 1) Select cell C3 and press **[F2]** to edit the formula.

	A	B	C
1	10	5	10
2		12	20
3		17	=C1+C2

Notice that the cell references in the formula have become coloured. The cells the references refer to have a border around them that is the same colour as the reference. These coloured borders can be moved as an easy way to edit a formula.

- 2) Move your mouse to the edge of the blue border around cell C1.
- 3) Drag the border to move it to cell B1. This will change the cell reference in the formula.
- 4) Press **[Esc]** to cancel the changes to in the formula.
- 5) Close the workbook without saving the changes.

	A	B	C
1	10	5	10
2		12	20
3		17	=B1+C2

Exercise 5. Use of Brackets

- 1) Open the workbook called Formulas.
- 2) Click on cell B11 and enter the current date by pressing **[Ctrl] [;]** and then pressing **[Enter]**.
- 3) Click on cell B12 and enter your date of birth.

We will create a formula in cell B13 that calculates your age by taking your date of birth away from the current date.

- 4) Click in cell B13 and enter the following formula.

=B11-B12

The result of the formula will show your age just as it should. Unfortunately, it's showing you your age in days instead of in years which probably isn't so useful. We can correct this if we divide the result by the number of days in a year.

- 5) Edit the formula so that it looks like the one below and press **[Enter]**.

=B11-B12/365

This still won't give you the correct answer because Excel will calculate division before it will calculate subtraction (remember the order of operations). We need to tell Excel to calculate the subtraction first and *then* divide the result by 365. This is where the brackets come in.

- 1) Edit the formula again to look like the one below and press **[Enter]**.

=(B11-B12)/365

That's more like it. The brackets tell Excel to calculate the age first, before dividing the result by the number of days in a year.

Functions

Functions are a special kind of formula that can simplify complex calculations. The following exercises will demonstrate the use of functions.

Exercise 6. Adding Several Numbers Together

- 1) Make sure the Formulas workbook is still open.
- 2) Click in cell **B9**.
- 3) Begin your formula with a = sign and then click on cell **B2**.
- 4) Type a + sign and click on cell **B3**.
- 5) Complete the formula so that it looks like the one below.

```
=B2+B3+B4+B5+B6+B7+B8
```

You will get the correct answer, but it's a long formula. Adding together 50 or 100 cells like this would be a tedious process.

Functions can be used to take the hard work out of many types of calculations in Excel. Functions all follow the same format. I.e. = sign, name of the function, information to be calculated in brackets.

```
=NameOfFunction(information to be calculated)
```

There are hundreds of functions built in to Excel and custom functions can be created. The most commonly used function is the **Sum** function which adds together a range of numbers.

Exercise 7. Sum Function

- 1) Click in cell **C9**.
 - 2) Type `=sum(C2:C8)` and press **[Enter]**.
- This will tell Excel to add up the sum of all the cells from **C2** to **C8**.
- 3) Click in cell **D9**.
 - 4) Type `=sum(`
 - 5) Select cells **D2** to **D8**.
 - 6) You can type the right bracket, but if you don't Excel will put it in for you. Press **[Enter]** to complete the function. It should look like the one below.

```
=SUM(D2:D8)
```

Note If you want to add together more than one group of cells, you can separate each cell range with a comma.

E.g. `=SUM(C2:C8,E2:E8,G2:G8)`

This would add cells **C2** to **C8** and **E2** to **E8** and **G2** to **G8**

Exercise 8. Using the AutoSum Tool

Since the Sum function is used so often, a special tool has been provided to make it easy to use. The icon for the Sum tool uses the Greek letter sigma Σ which is the mathematical symbol for sum.

- 1) Click in cell **E9**.
- 2) Click the **AutoSum** icon on the **Ribbon** bar (It is found on the **Home** and **Formulas** tabs). Σ AutoSum ▾

Excel will create a Sum function referring to the cells above. Excel will assume the cells above are the ones to be added together. These cells will remain selected in case you would rather select a different group of cells. If there are no numbers in the cells above, the cells to the left will be used. Otherwise the nearest group of cells will be selected.

E	F	
Σ	Σ	=Av
4	4	
6	6	
2	2	
6	6	
9	9	
7	7	
2	2	

=SUM(E2:E8)

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

- 3) Press **[Enter]** to confirm that the correct cells are selected and complete the function.

The function should look like the one below.

=SUM(E2:E8)

You can also use the AutoSum tool by selecting the cells to be added first.

- 4) Select cells **F2** to **F8**.
- 5) Click the **AutoSum** icon. Σ AutoSum ▾

A Sum function will be automatically created based on the cells you selected.

The AutoSum icon can also be used to create other common functions such as Average and Count.

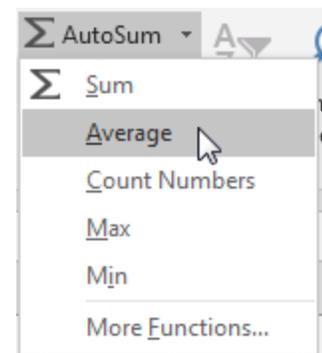
- 6) Click in cell **G9**.
- 7) Click the arrow next to the AutoSum icon.

A list of common functions will be displayed.

- 8) Click on **Average**.

An Average function will be created in the selected cell. Notice that it is written similar to a Sum function.

- 9) Check that the function reads =AVERAGE(G2:G8) and press **[Enter]** to complete the function.



- 10) Save the changes to the workbook and then close it.

Tip The result of the average function will show 5.14285714

If you don't want that many decimal places showing, click the **decrease decimal** icon $\leftarrow .00$ on the ribbon. There is also an **increase decimal** icon next to it $\rightarrow .00$.

Exercise 9. Using Functions in a Table

1) Open the *Grades* workbook. This was created in the Getting Started exercises. If you don't have a copy of the Grades workbook then open the **Grades Part 2** spreadsheet that is included in the exercise files.

16	Class Average
17	Highest Mark
18	Lowest Mark
19	Number of Students

2) Add new labels in Column A as shown to the right.

3) Click in cell F6.

4) Click the **AutoSum** icon.

5) Make sure cells B6 to E6 are selected and press **[Enter]** to complete the function.

5	Student	Term 1	Term 2	Term 3	Term 4	Year Total
6	Jean Picard	15	12	14	17	=SUM(B6:E6)
7	John Archer	18	14	17	16	SUM(number1, [number2], ...)
8	James Kirk	22	22	10	21	

6) Use the fill handle to copy the function down through to cell F16.

When a formula is copied to other cells, the cell references should change for each cell.

Term 4	Year Total
17	58
16	
21	
6	
14	
12	
19	
19	
21	
18	

7) Click in cell B16.

8) Click the arrow next to the **AutoSum** icon and click on **Average**.

9) Make sure cells B6 to B15 are selected and press **[Enter]** to complete the function.

10) Use the fill handle to copy the formula across to cell F16.

11) Click in cell B17.

12) Click the arrow next to the **AutoSum** icon and click on **Max**.

Notice that the function has selected all of the cells above including the average cell which we don't want selected.

13) While these cells are still highlighted (before you press **[Enter]**), select cells B6 to B15 and press **[Enter]**. The formula in cell B16 should be =MAX(B6:B15).

14) Use the fill handle to copy the formula across to cell F17.

15) Try completing the Lowest mark cells in row 18 yourself by using the **Min** function.

16) Use a **Count Numbers** function in row 19 to show the number of students.

The completed table should look like the example below.

13	John Smith	22	20	20	19	81
14	Michael Bur	23	21	24	21	89
15	Jack O'Neill	13	14	11	18	56
16	Class Average	17	16.8	16	16.3	66.1
17	Highest Mar	23	22	24	21	89
18	Lowest Mar	8	11	7	6	32
19	Number of :	13	13	13	13	13
20						

Exercise 10. Using an If Function

If functions can be useful if you want an excel formula to select from 2 different answers based on criteria you specify. In our grades example, we can use an If function to say a student has passed if their mark was over 50 and fail if their mark wasn't over 50. If functions have 3 sections with a comma between each section as shown below.

=If(condition to test, answer if condition is true, answer if condition is false)

- 1) Click in cell **G5** and enter the heading *Pass/Fail*.
- 2) Enter the following If function.

=If(F6>=50,"Pass","Fail")

The first part of the formula checks to see if the number in cell F6 is greater than 50 or equal to 50. The = sign is important. If it was left out then someone who scored exactly 50 wouldn't be included.

The second section says that if this test condition is true, the text *Pass* will be displayed for the answer. Note that where text is used in a formula, it must be enclosed in quotation marks. The third section specifies the answer *Fail* if the test condition is not true.

- 3) When the **If** function has been entered, use the fill handle to copy the formula down to cell **G14**. There should be 8 passes and 2 fails.

	A	B	C	D	E	F	G	
1	Joe Bloggs	Advanced Spreadsheets Class						
2	15							
3	10/04/2018							
4								
5	Student	Term 1	Term 2	Term 3	Term 4	Year Total	Pass/Fail	
6	Jean Picard	15	12	14	17	58	Pass	
7	John Archer	18	14	17	16	65	Pass	
8	James Kirk	23	22	19	21	85	Pass	
9	Chris Pike	8	11	7	6	32	Fail	
10	Jeff Sinclair	19	19	18	14	70	Pass	
11	Katheryn Ja	13	13	10	12	48	Fail	
12	Ben Cisco	16	22	20	19	77	Pass	
13	John Sherric	22	20	20	19	81	Pass	
14	Michael Bur	23	21	24	21	89	Pass	
15	Jack O'Neill	13	14	11	18	56	Pass	
16	Class Average	17	16.8	16	16.3	66.1		
17	Highest Mark	23	22	24	21	89		
18	Lowest Mark	8	11	7	6	32		
19	Number of	13	13	13	13	13		

Exercise 11. Absolute Cell Referencing

In the previous exercise, you copied formulas to different cells. As the formulas were copied, the cells referred to in each formula changed to suit the new location. This is because formulas normally use *relative* referencing.

	A	B	C
1	12	14	=A1*B1
2	13	15	=A2*B2

In the example above, the formula in **C1** multiplies **A1** by **B1**. When the formula is copied downward, it changes to multiplying **A2** by **B2**. This is because Excel is not keeping track of exact cell references. It is only seeing the cells in the formula are the two cells to the left. When the formula is copied down, it is still multiplying the two cells to the left.

Relative references are fine for most formulas but sometimes there are situations where you want a formula to refer to a specific cell even when you copy the formula to another location. In these situations, you need to use *absolute* references.

- 1) Open the *Formulas.xlsx* workbook.
- 2) Click in cell **I2** and enter 30%.
- 3) Click in cell **H2** and enter =G2*I2.

	G	H	I
4	4	=G2*I2	30%

You should get the correct answer for this cell.

- 4) Use the fill handle to copy this formula down to cell **H8**.

All of these cells will be filled with 0s. When the formula is copied down, it will still be referring to the cell to the right of the formula, and all of the cells the formula has been copied to have nothing to the right of them. We will need to edit the original formula to make sure that it keeps on referring to cell **I2**, even when the formula is copied to other locations.

- 5) Click in cell **H2** and press **F2** to edit the formula.
- 6) Click on the part of the formula that refers to **I2**.
- 7) Press **[F4]**.

	G	H	I
4	4	=G2*\$I\$2	30%

Dollar signs will appear in the cell reference (**\$I\$2**). These dollar signs mean that the formula will still refer to column **I** and row **2** even when it is copied to another location. You can type the dollar signs yourself but the **F4** shortcut will cycle between the different kinds of references.

- I2** Relative reference – row and column references will both change.
- \$I2** Mixed reference – Column reference stays constant, row reference will change.
- I\$2** Mixed reference – Row reference stays constant, column reference will change.
- \$I\$2** Absolute reference – Row and column reference will both stay constant if the formula is copied to another location.

- 8) Make sure the formula in **H2** reads =G2*\$I\$2 and press **[Enter]**.
- 9) Use the fill handle to copy the formula down to cell **H8**. Each formula should now be still correctly referring to cell **I2**. Save and close the workbook.

Lookup Functions

Lookup functions are a bit like an IF function. They allow you to create a formula that will choose from several different answers based on information in a table. We will use a vertical lookup function to create a formula which checks a student's mark and shows what their grade will be.

Exercise 12. Vertical Lookup

- 1) Open the *Grades* workbook if it is not already open.
- The first thing we will need to do is create the table that will contain the grade cut-off points.
- 2) Click in cell **K6** and enter a zero.
- 3) Complete the information in cells **K6** to **L10** as shown to the right.
- 4) Click in cell **H5** and enter the heading *Grade*.
- 5) Click in cell **H6**. This is where we want the first grade to go.

K	L
	0 F
	35 D
	50 C
	65 B
	80 A

Like an If function, a Lookup function has different parts. The sections of a lookup function are described below.

Lookup value	The cell the function is checking, in this case the student mark.
Table array	The cells the answers are coming from - our table of grade cut-offs
Column index	The column in the array that the answer will come from. In our case, the function will match the student grade with a number in the first column of the array, then it will check the second column to find the matching grade, so the second column is the column index.
Range lookup	If the function doesn't find an exact match in the table array, putting true in this section will mean that it will use the closest match instead.

- 6) Enter the following formula. =*VLOOKUP*(
- 7) Click on cell **F6** (the cell with the first student's mark).
- 8) Type a comma to end the first section and then select the grades cut-off table (which should be cells **K6** to **L10**).
- 9) Press **F4** to make sure this section uses absolute references (*\$K\$6:\$L\$10*). When we copy the function down for the other students we want to make sure it is still correctly referring to the cells with the grade cut-off marks.
- 10) Type another comma and then the number 2.
- 11) Type another comma and then type true.
- 12) Type a closing bracket and then press **[Enter]** to complete the formula. The completed formula should be =*VLOOKUP*(*F6,\$K\$6:\$L\$10,2,TRUE*).
- 13) With cell **H6** selected, move your mouse over the **Fill Handle**.

Grade
C

14) Double click on the fill handle. The contents of the cell will be copied down until a blank cell is detected to the left. This can be a quick way of using the **AutoFill** function in a table (if it goes too far, you can drag the fill handle upward to clear some extra cells).

If your lookup table goes horizontally instead of vertically then you can use a horizontal lookup function. It works exactly the same except that you type *Hlookup* instead of *Vlookup*.

15) Save the file.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Joe Bloggs	Advanced Spreadsheets Class										
2	15											
3	10/04/2018											
4												
5	Student	Term 1	Term 2	Term 3	Term 4	Year Total	Pass/Fail	Grade				
6	Jean Picard	15	12	14	17	58	Pass	C			0	F
7	John Archer	18	14	17	16	65	Pass	B			35	D
8	James Kirk	23	22	19	21	85	Pass	A			50	C
9	Chris Pike	8	11	7	6	32	Fail	F			65	B
10	Jeff Sinclair	19	19	18	14	70	Pass	B			80	A
11	Katheryn Ja	13	13	10	12	48	Fail	D				
12	Ben Cisco	16	22	20	19	77	Pass	B				
13	John Sherric	22	20	20	19	81	Pass	A				
14	Michael Bur	23	21	24	21	89	Pass	A				
15	Jack O'Neill	13	14	11	18	56	Pass	C				
16	Class Average	17	16.8	16	16.3	66.1		B				
17	Highest Mark	23	22	24	21	89		A				
18	Lowest Mark	8	11	7	6	32		F				
19	Number of :	13	13	13	13	13						

Shortcuts Covered in This Section

Home	Move to column A in a sheet
F9	Recalculate formulas
F2	Edit formulas or cell contents
F4	Change between absolute, relative or mixed references in a formula