Essential Spreadsheets

Book 1

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This material explains how to use spreadsheets, and is based around:

- Microsoft Excel 2016 on a University of York Managed PC
- Google Sheets running in an up-to-date browser

Screen-shots have been chosen to reflect the similarities and differences between these.

Every attempt has been made to ensure the accuracy of the information provided, however you may find some differences when working with other or personalised systems.

Note *This information is correct at the time of writing, but new features are added to Google Sheets on a regular basis – check periodically for new options appearing in menus.*

A collection of exercises is also available, with task documents in both Excel and Google Sheets format.

See also our support site: **https://goo.gl/OY1Wzy**

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Part 1~Spreadsheet Basics

1 ~ Introducing spreadsheets

Spreadsheets were developed to store, analyse and manipulate data. They are now commonly used for working with sets of data containing both text and numbers.

- Every spreadsheet consists of a large grid of **cells** to store data which can then be manipulated using **formulae**

- Each cell has an **address** which consists of the **column** letter and **row** number

- Many spreadsheet documents contain several individual **sheets** that can reference values in other sheets in the file

- Spreadsheets can also produce graphs and other data visualisations

1.1 - Choosing the correct tool

The University provides support for two spreadsheet tools:

Microsoft Excel, part of Microsoft Office.

Google Sheets, one of Google's cloud applications.

The two applications share many common features, and similar functionality, however Google sheets are particularly useful when working collaboratively.

When necessary, data can easily be moved between them.

This guide coves both tools, highlighting the differences and similarities so that users are able to pick the best tool for the task at hand.

1.2 - Creating and Saving

New Excel spreadsheets are created from the **File** tab of the application, and must be saved using **File > Save As...,** at which point the location of the file is also chosen. You must also remember to save changes to the spreadsheet.

When creating a new Google spreadsheet, it is recommended that in **Drive** you first locate the folder in which it is to reside before choosing **New > Google Sheets**. Google sheets are saved repeatedly and automatically without any action by the user.

1.3 - Spreadsheet workspace

Excel 2016 (PC Version)
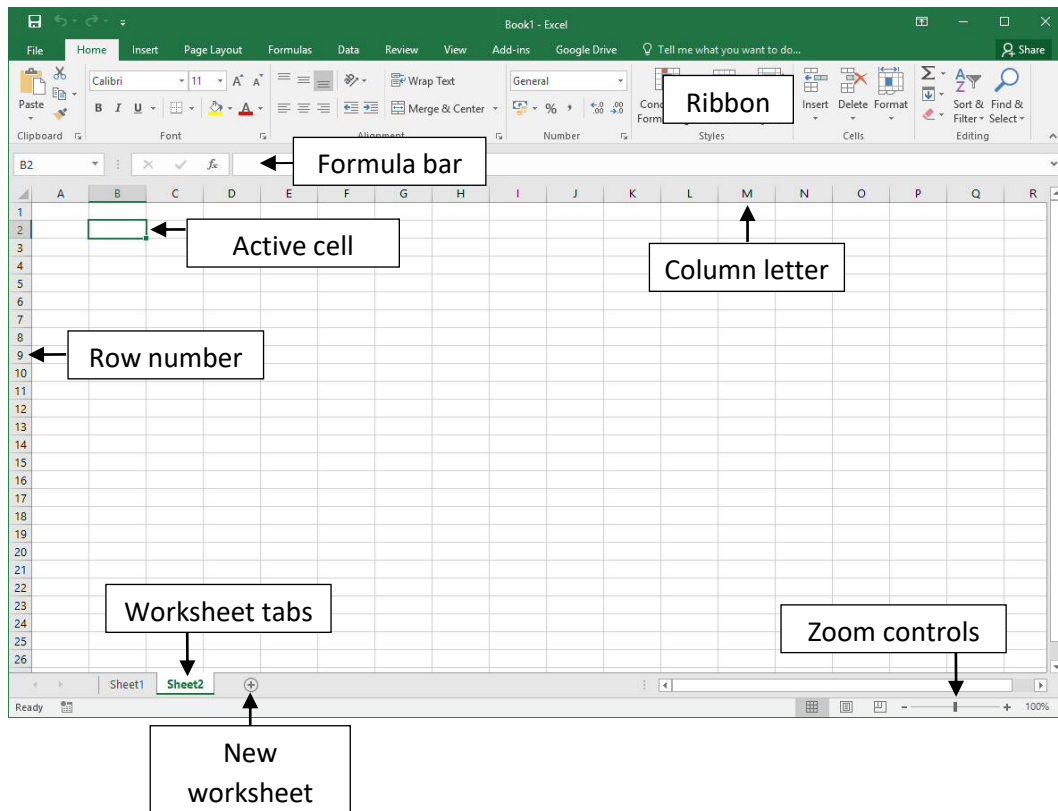
Active cell	Anything you type will be entered in the active cell. Any formatting you apply will affect only the active cell.
Row number	Rows are numbered consecutively from 1
Column letter	Columns are labelled consecutively with letters. On reaching 'Z', columns are labelled AA, AB, AC and so on.
Formula bar	This shows the content of the active cell, and can be used to edit it.
Worksheet tabs	Each workbook may consist of several worksheets, and the tabs are used to switch between them. **Right-click** or **double-click** the tab to rename or add colour markers
Zoom controls	Spreadsheets can be very large, so the Zoom controls allow you to view a larger/smaller area of worksheet
Ribbon	The ribbon includes the tabs and controls for all the essential features of the Excel spreadsheet

Google Sheets
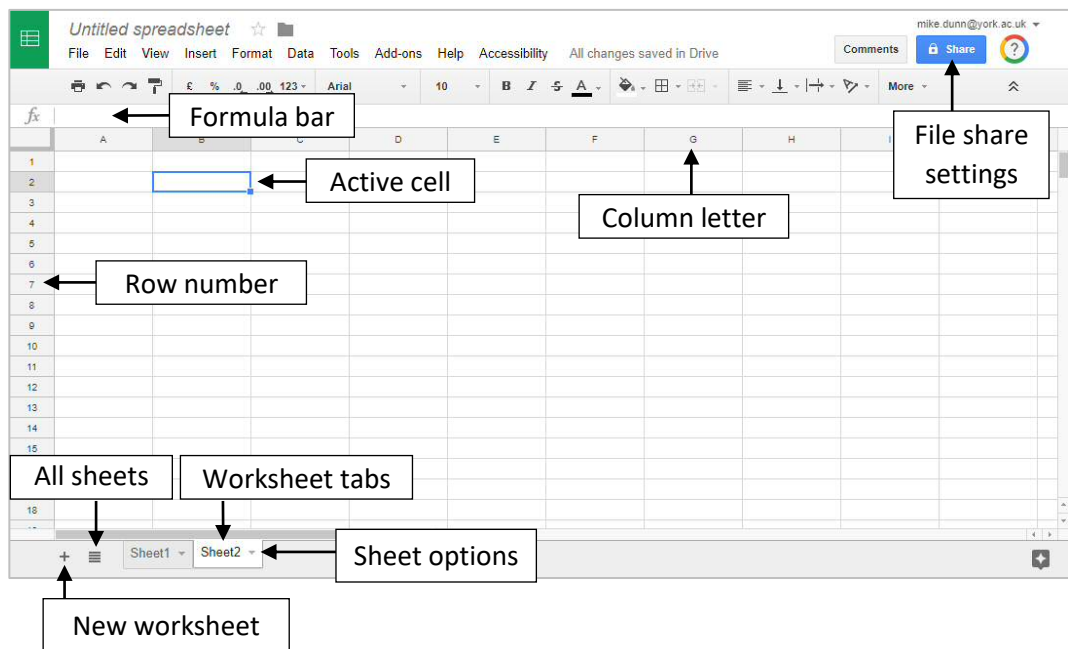
1.4 - Managing the workspace

A new spreadsheet (or new worksheet) will contain a large number of cells of a standard width and height. You will often need to make adjustments to these:

- Add, remove or rename worksheets
- Change the height of one or more rows
- Change the width of one or more columns
- Insert extra rows or columns
- Remove one or more rows or columns

Note   Although you can remove individual cells (or groups of cells), it is better always to remove entire rows/columns – otherwise a 'hole' is created that has to be filled by shifting other cells
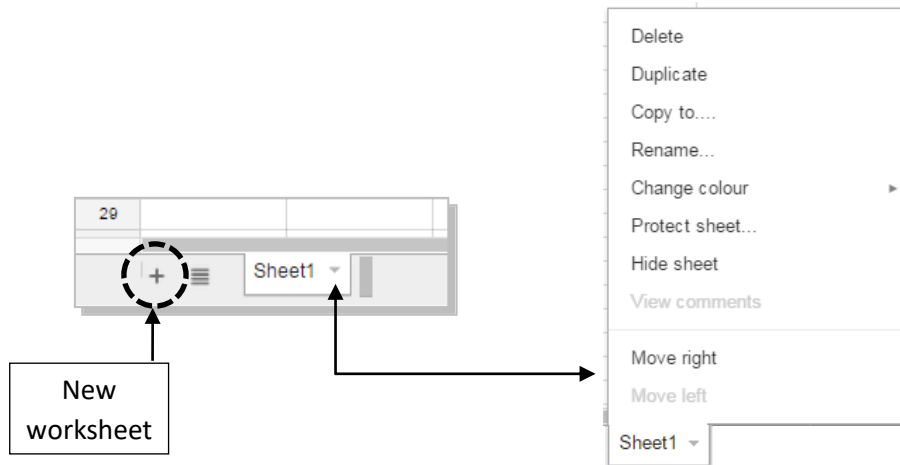
Bear in mind that **removing** (deleting) a cell is not the same thing as **clearing** the contents of a cell.

Managing worksheets

The **tab options menu** on a Google sheet lets you manage an individual worksheet. You can also drag the tab to change the order of sheets.

New worksheet

Delete	
Duplicate	
Copy to....	
Rename...	
Change colour	▶
Protect sheet...	
Hide sheet	
View comments	
Move right	
Move left	

Sheet1 ▾

In Excel, **right-click on the tab** and choose from the menu. You can also drag the tab to change the order of sheets.

Insert...	
Delete	
Rename	
Move or Copy...	
View Code	
Protect Sheet...	
Tab Color	▶
Hide	
Unhide...	
Select All Sheets	

Excel 2016

New worksheet
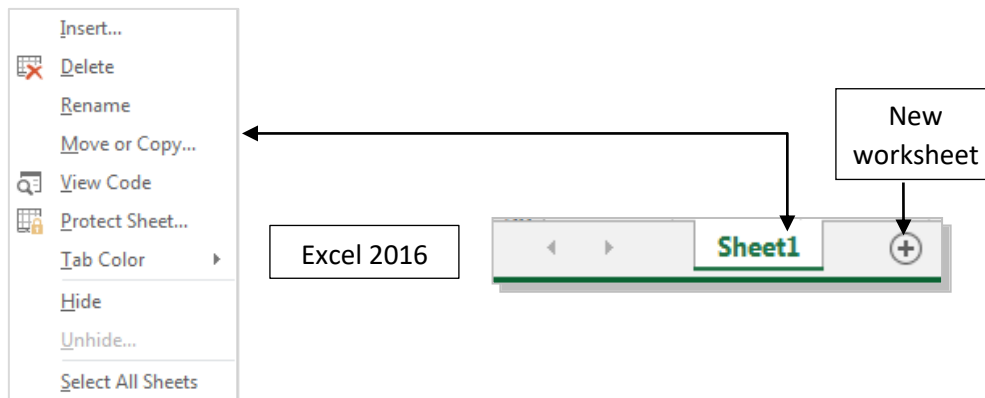
Sheet1

Copying: Both Excel and Google include a **Copy** option that allows you to put a copy of a sheet from one file into another. Excel also includes a **Move** option, which removes the sheet from the source file.

Inserting and removing rows and columns

There are menu options, but the simplest method is:

1   **Right-click** on the row or column header.

2   Choose the appropriate action from the menu.

Sheets

Excel
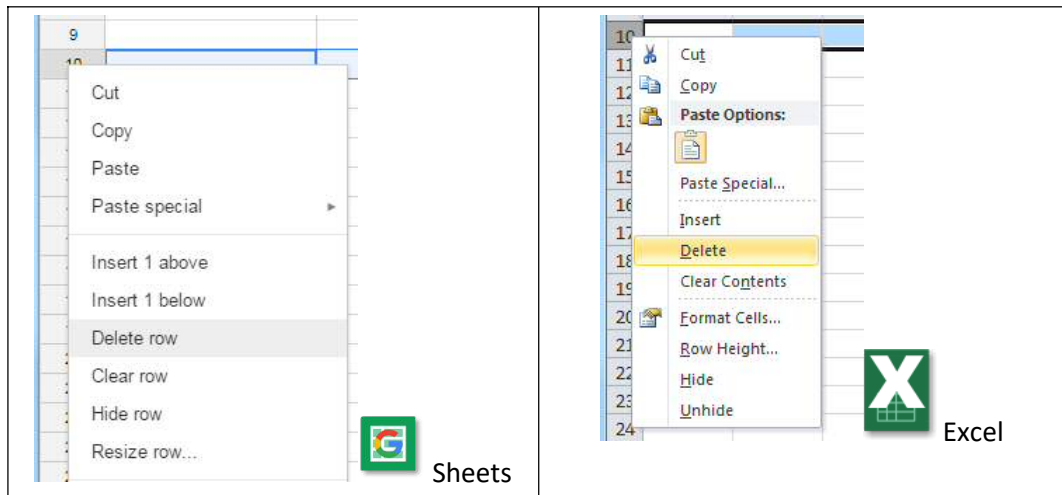
Note For multiple rows/columns, select the number you wish to insert/delete and proceed as above.

Adjusting rows height and column width

Use a right-click options as above or **drag** to adjust height/width:

Adjust column width

Adjust row height
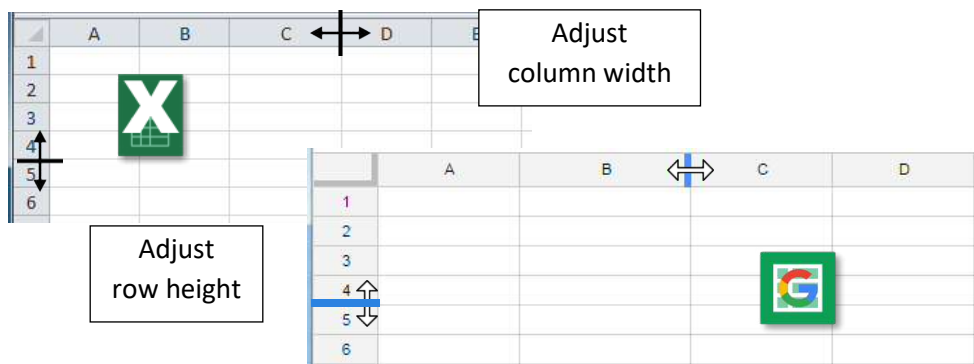
Tip If you double-click instead of dragging, the column or row will be adjusted to the minimum width/height required for the data it contains.

Text wrap

You will generally adjust column width to accommodate longer content. Sometimes you may prefer to turn on **text wrapping** and increase the height of the row.
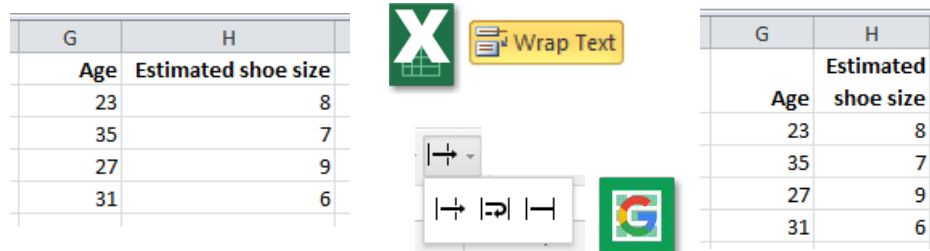
Header much wider than data

Row height increased, text-wrapping used

2 ~ Entering and editing data

A cell can contain one of three things:

- **text** data (anything not understood to be a number or formula)
- **numerical** data (including Dates, times, percentages and currency)
- a **formula**

Cells containing formulae normally display the result of the calculation.

Text data	Left-aligned by default
	Formula bar displays actual content
	Content preceded by a single quote is always regarded as text
Numeric data	Right-aligned by default
	Rounding will be applied automatically
	Leading zeros removed
Formula	Aligned according to type of result (text or numeric)
	Cell displays result of formula
	Formula bar shows formula

Both Excel and Google spreadsheets follow these conventions.

2.1 - Data entry

When constructing or editing a spreadsheet you will need to be able to navigate between cells and enter content. It's mostly intuitive, but there are some useful points to be aware of:

- Click or use the navigation (arrow) keys to move to a specific cell
- Typing in a cell overwrites existing content if it is not blank
- To edit a cell that already contains data, double-click or select it and edit the content in the **formula bar**
- Once data has been entered or edited, you *must* press **Enter** or **Tab**. At this point the spreadsheet will:
  - Check your data makes sense (and report errors)
  - Decide how numerical values should be formatted
  - Update all calculated values

  Resist the urge to click in another cell or use the cursor keys as they have a different effect when editing cell content.

- Pressing Escape (Esc) key at any point during data entry will abort the process
- Pressing Delete (Del) key will *clear* the contents, leaving the format unchanged

Note Pressing **Enter** after data entry moves to the next cell down.

Pressing **Tab** will move to the right. Holding **Shift** when pressing either **Enter** or **Tab** will move the cursor in the opposite direction.

Excel: the accept/reject edit controls can also be used to accept/reject an edit.
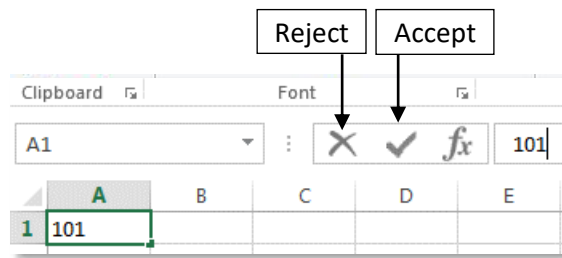
2.2 - Selecting cells

Actions that can be applied to several cells (eg formatting changes or clearing content) require you to select a **range** of cells. Use whichever method is most appropriate:

selection target	methods
Rectangular block of cells	• Drag from top left to bottom right of area to be selected • Select the first cell; hold down **Shift** and select the opposite corner • Select the first cell; hold down **Shift** and use the cursor keys to extend the selection
Several non-continuous blocks of cells	• Select the first block, then hold down **Ctrl** as you drag over another non-adjacent cell / block of cells
Whole row or column	• **Click** on the row number/column letter
Several continuous rows or column	• **Drag** over the row numbers/column letters
Several non-continuous rows and/or columns	• Select the first column or row, then hold down **Ctrl** as you select further rows/columns
Whole worksheet	• Choose the 'button' at the very top left of the worksheet (above row numbers, to the left of column letters)

Copy and paste

Cells or ranges can be moved using Cut/Copy + Paste as with other applications, but spreadsheets behave slightly differently to text applications:

- After choosing **copy** or **cut**, the range affected is surrounded by a dotted line; spreadsheets typically leave cut data in place until it is pasted elsewhere

- When **pasting** a range, select only the cell that will be the top left of the new pasted area before choosing **paste**

- In Excel, copied content only remains on the clipboard for pasting as long as the dotted line surrounds the selected area, whereas it remains until replaced when using Google Sheets

Moving

Cell or range content can also be **dragged** to a different location. Positioning the mouse cursor at the cell border will change to the move cursor (see below) at which point the cell/range can be dragged.
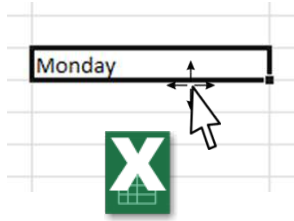
Check the cursor appearance before dragging to move one or more cells
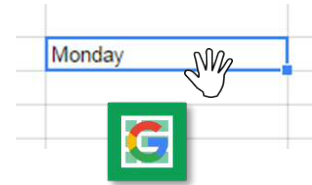
2.3 - Saving time when entering data

There are a number of features designed to help save time when entering data.

Autocomplete
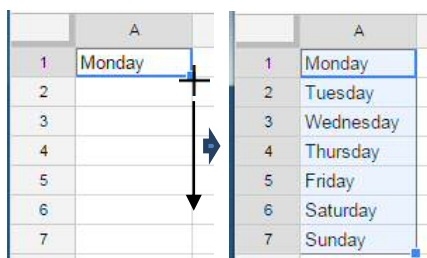
When entering text **auto-complete** may suggest using other text already present in the column. Press **Enter** to accept the suggested text, continue typing or hit **backspace** to reject it.

After typing **Ap** the auto completion is offered

Auto Fill

A series of values can usually be entered quickly using the **Autofill** feature. You must first enter the start of the sequence, select this and then drag the fill handle in the direction you wish to fill. The sequence will be continued until you release the handle.

Drag to fill

Double-click to fill to same length as neighbour

Excel also provides **Auto Fill Options**. After completing Autofill, an option menu is provided. This includes filling weekdays only, for example:
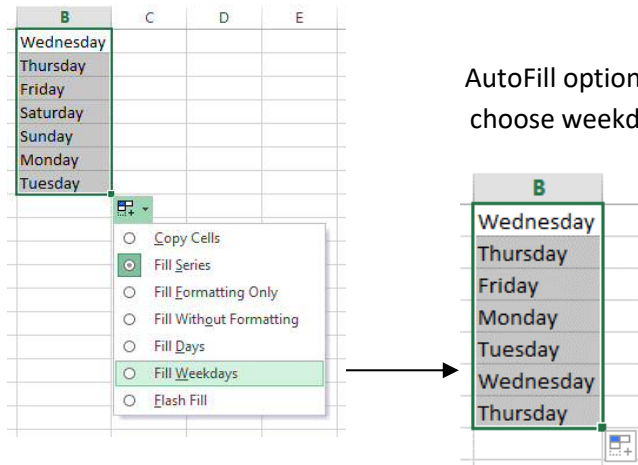
AutoFill options let you choose weekdays only

Note   Auto Fill can also be used with formulae; this is covered later.

These examples show what needs to be entered and selected to produce a range of different series:

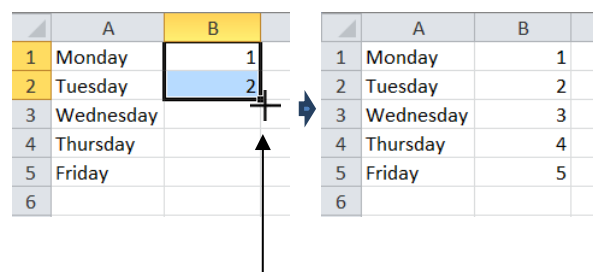| Numbers						Days / Months			Other sequences	
Repeat number or text	Count Up	Count Up in 10s	Count Down	Years	Leap Years	Days	Every Other Day	Mon, Wed, Fri	Letters	Words / The Beatles
1	1	10	50	2012	2012	Mon	Mon	Mon	A	John
1	2	20	49	2013	2016	Tue	Wed	Wed	B	Paul
1	3	30	48	2014	2020	Wed	Fri	Fri	C	George
1	4	40	47	2015	2024	Thur	Sun	Mon	D	Ringo
1	5	50	46	2016	2028	Fri	Tue	Wed	E	John
1	6	60	45	2017	2032	Sat	Thur	Fri	A	Paul
1	7	70	44	2018	2036	Sun	Sat	Mon	B	George
1	8	80	43	2019	2040	Mon	Mon	Wed	C	Ringo
1	9	90	42	2020	2044	Tue	Wed	Fri	D	John
1	10	100	41	2021	2048	Wed	Fri	Mon	E	Paul
1	11	110	40	2022	2052	Thur	Sun	Wed	A	George

Excel: Remember also to check what's available in the **AutoFill Options** list.

3 ~ Presenting a spreadsheet

Spreadsheet cells contain, in effect, two 'layers' of formatting:

- **style** (eg font, colour, border style, background colour)
- **number** format

In spreadsheets decimals, dates, percentages, and currency are all treated as numbers, and for each one there are various options. For example, currency includes a symbol; dates can be shown in different ways eg 01/01/2014 or 01-Jan-2014.

When you enter or calculate values the spreadsheet will try to detect the number format required, but you can change it if you wish.

3.1 - Number and date/time format tools

There are several buttons to control number format directly. Always select the cell or range you wish to format.

Both include:

- Currency
- Percentage
- Increase/decrease decimal places
- Other formats
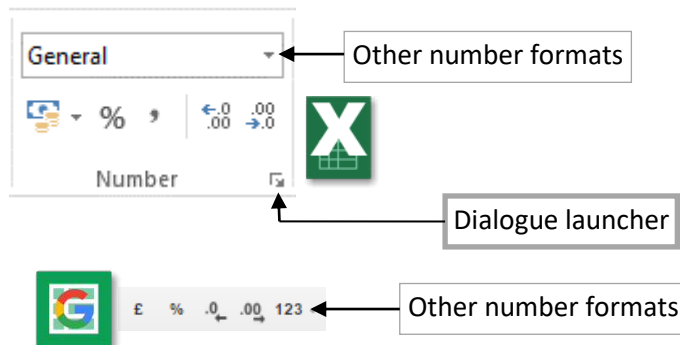
For fuller control, right-click on the selected cell(s) and choose **Format Cells**, select other number formats from the drop-down, or use the dialogue launcher.

For fuller control, choose **Format > Number**, or select from the drop-down on the formatting tools.

Note Number formats remain in a cell when clearing values. This can lead to confusion when entering data – if a cell previously contained a date, entering the number 4 will produce the result 04/01/1900.

This is easily fixed by formatting the cell(s) (choose **General** if no special format is required).

Numbers

Some useful information about numbers in spreadsheets:

Decimal places	Numbers are stored internally to 15 significant figures and the full value is used in calculations. The value *displayed*, however, will depend on the formatting chosen, when the usual rules of rounding will be applied
Leading zeros	Excel and Google will both display numbers without any leading zeros, even if entered, which can cause a problem with data such as phone numbers. Phone numbers can safely be stored as text (since they are not used in calculations)
	To force a spreadsheet to treat cell content as text, enter a single quote first, eg **'0190432000** (the quote doesn't display)
Separators	Large numbers can be easier to read if separators are used to group the thousands – eg 1,000,000 instead of 1000000
	Google sheets: Comma style is included in the standard Number format
	Excel: select the cell(s) required and choose comma style (or More number formats…)
	Note: bear in mind that in some countries the comma is used as a decimal separator – try not to confuse people
Other formats	Other options are available, including scientific notation and fractions
	Dates, times, percentages and currency are numbers with special formatting applied
######	If a number is too wide for the column it is shown as a series of hashes as truncation could be very misleading!

3.2 - Percentages

Excel and Google will recognise percentages when entered with the symbol (eg 10%). Percentages entered this way are stored in their decimal form (in this case 0.1) but *displayed* as a percentage:

	A	B	C
1	Full Price	£109.88	
2	Discount (Rate)	**10%**	*0.1*
3	Discount (Amount)	**£10.99**	*=B1*B2*
4	Price	£98.89	*=B1-B3*

Using % format, cell **B2** contains 0.1, but *displays* as 10%

Cell **B3** correctly calculates 10% of the price

Note The number of decimal places displayed for a percentage value can be controlled in the same way as decimal numbers.

You may find that some users store the percentage as a 'normal' number (ie 10 rather than 10%). While this method words, you cannot also use percentage formatting.

3.3 - Dates and Times

Dates are stored as whole numbers – the number increases by 1 every day.
Times are stored as decimal values (where '0.5' is midday).

Both are then displayed using special formatting. This means a time and date can be stored as one decimal value and you can calculate with dates and times.

For more information on calculating with Dates and Times see later.

Entering dates

Dates are formatted automatically if entered in a recognisable format.
Using 1 February 2014 as an example:

01/02/14	✓
1/2/14	✓
01-02-14	✓
01-Feb-2014	✓
01.02.14	✘ *not* recognised as a date (the 'dot' is used exclusively in decimal notation)

Note *Localisation settings* affect dates. In US locale, 01-02-14 is interpreted as 2 January 2014. *It is very important you know which date format is being used*.

Excel cannot work with dates before 1900, but Google Sheets can.

Checking the date format:

Choose **File > Spreadsheet Settings**... to check the locale for the current document. Your personal default is set in your **Google** account settings.

Enter the date 02/01 (with no year) – **Excel** will convert this to either 02-Jan (most locales, including UK) or 01-Feb (US locale). Excel uses the default locale for your Windows/Mac system, which can be found in your region settings.

Using times

Both Excel and Google Sheets will recognise times when entered in a correct format:

14:30	✓ - time only, 24 hr clock
2:30 PM	✓ - time only, 12 hr clock
14:30:15	✓ - time including seconds
14-30	✘ - not recognised
14.30	✘ - decimal number, not time
01/02/14 14:30	✓ - a date and time

Note 14:30 means half past 2 in the afternoon, *not* 14 hours and 30 minutes. Don't confuse **times** with time **duration** (see later for more detail).

3.4 - Currency

Currency can be entered in two different ways:

- Enter the sum, including the currency symbol, eg: £1.50. This will be recognised as currency and formatted appropriately
- Enter the value only and then select the currency format

Note Spreadsheets do not automatically convert currency values using number formatting - £1.50 + €1.50 will give a result of 3.00.

Excel and Google Sheets include two currency-formatting styles: **Currency** and one referred to as **Accounting** or **Financial,** which both display negative values in brackets and have other subtle differences with **Currency**.

Other currency symbols

Other currency symbols are recognised too. Users of UK keyboard with both $ and € on the 4 key can enter € by pressing Alt Gr+4 (Alt Gr is to the right of the space bar).

Entering currency symbols not on your keyboard:

1   Enter the numeric value in the cell or select the range of values

2   Choose **Format > Number > More Formats > More Currencies**... and select the currency you require
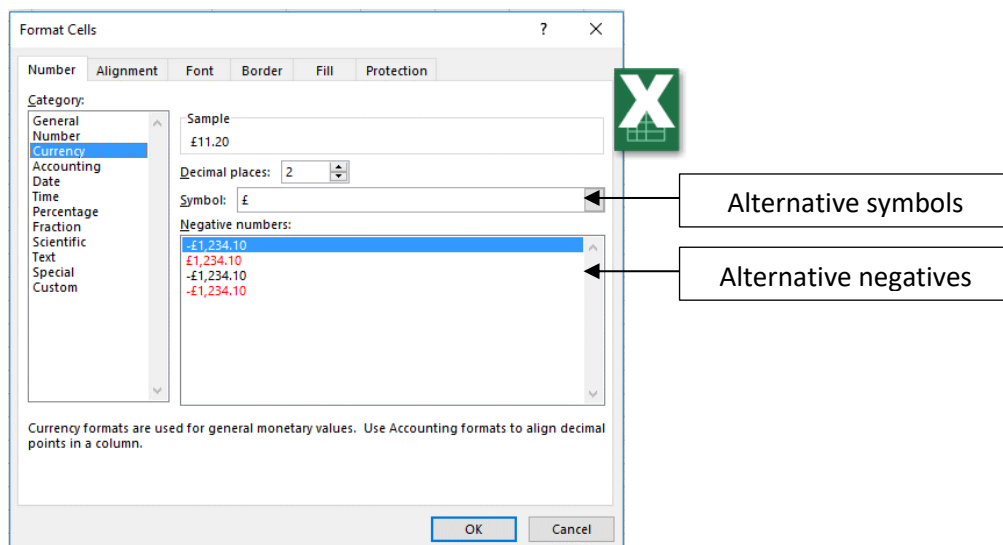
1   Enter the numeric value in the cell, or select the range of values

2   From the format drop-down select **Home > Number >More Number Formats**

3   On the Number tab select **Currency** from the **Category** list

4   Choose the **Symbol** you require.

3.5 - Text

Standard text formatting tools are available as in office applications – different fonts, colours, sizes and styles (eg bold, italic) can be used to change the appearance of cell content.

In addition, the position of content within in a cell (alignment) can be modified. Text content can also be 'wrapped' within a cell:
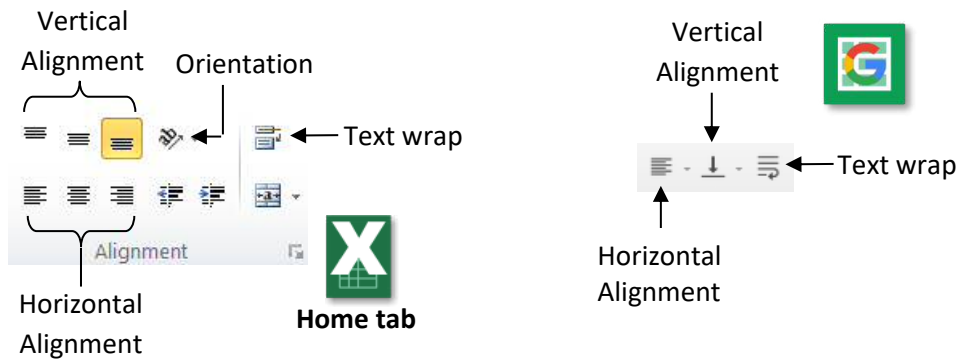
When a cell contains text that is wider than the cell:

- if the adjacent cell is empty, the text will overflow over the next cell
- if there is no adjacent space, overflowing text will not be shown but will still be stored in the cell

In either case, the text is still stored entirely in one cell.

In order to make all the content visible, do one of these:

- resize the column width (see above, p5)
- wrap text for a better fit and increase the row height
- Excel – adjust the orientation of the content

Conditional formatting

The appearance of a cell can also be made dependent on the number or text it contains. This is called **conditional formatting** and is dealt with later.

4 ~ Performing calculations

Formulae are entered directly into the cell where you want the answer to appear, and always start with an equals sign (**=**). Some important points about using formulae:

- Rather than enter numerical values in a formula, you should reference values held in spreadsheet cells wherever possible

- Never enter the 'answer' value directly in a cell, no-matter how easy the calculation is – use a formula if it can be calculated from other cell values so it will update if input values change

- As with data entry, always press **Enter** after entering a formula

4.1 - Basic arithmetic

Formulae can contain basic arithmetic. Use the following symbols for basic arithmetic:

+	Add
-	Subtract

*	Multiply
/	Divide
^	To the power of

Here is a formula that subtracts two cell values. The result is shown in cell A3, but you will also see the formula in the formula bar, = A1 − A2

fx	= A1 − A2		
	A	**B**	**C**
1	9		
2	6		
3	3		
4			

Entering cell references: When entering a formula, a cell reference can be typed directly, entered by clicking on it, or by selecting with the cursor keys.

Using brackets to control calculation order

When a formula involves more than 2 values, spreadsheets use the standard rules of operator precedence. If you are unsure in what order calculation will be performed, avoid ambiguity by using brackets. Two examples requiring different orders:

Add first – add up items sold in 2013 and 2014, then multiply by the unit cost:

	A	**B**	**C**	**D**
1	**2013**	**2014**	**Cost each**	
2	18	23	£10.00	£410.00
3				

◄—— =(A2+B2)*C2

Multiply first – calculate cost of number of items ordered, and then add P&P:

	A	**B**	**C**	**D**
1	**Items ordered**	**Cost each**	**P&P cost**	
2	18	£10.00	£5.00	£185.00
3				

◄—— =(A2*B2)+C2

Unexpected results

If the result of your formula cannot be presented, an error message may be given. Some common errors include:

Error	Error	Explanation	Solution
Pop-up: "The formula you entered contains an error"	Cell contains **#N/A**	Formula not understood	Check for missing arguments, brackets etc
Cell contains #######	*(not applicable to Google spreadsheets)*	Result calculated, but will not fit into cell	Adjust column width or format to allow the result to be viewed
Pop-up: "Circular Reference Warning"	Cell contains #REF!	Formula uses current cell in calculation	Check cell references in formula are correct
Cell contains #DIV/0!	Cell contains #DIV/0	Formula tries to divide by 0 (not allowed!) May occur if an **average** function has no values to work with	Check formula cell references are correct; check data is correct; check **average** function has values

4.2 - Using functions

Spreadsheets have hundreds of functions used to perform calculations beyond simple arithmetic. Excel and Google use the same set of core functions, though a few are specific to each tool. Some common functions:

- **SUM** (add up 2 or more cells)
- **AVERAGE** (find the mean of 2 or more cells)
- **MAX** (find the highest value in 2 or more cells)
- **MIN** (find the lowest value in 2 or more cells)

This formula illustrates the syntax:

= SUM(A2:F2)

Note that:

- All functions start with an equal =
- Each function has a particular name
- Every function must be followed by a pair of brackets
- The brackets will usually contain one or more **arguments**, extra information needed by the function, separated by commas where more than one is used

Example of a SUM function in use:

	A	B	C	D	E	F	G
1	Red	Orange	Yellow	Green	Blue	Purple	**Total**
2	6	8	9	3	11	8	**45**

Cell **G2** contains the formula = SUM(A2:F2) ⟶

Cell ranges

Many functions need to reference a **range** of cells, which can be one cell, several cells in a line, one or more columns/rows or a rectangular region. The notation used is:

single cell	B2
several cells in a line	A2:F2
one column	E:E
one row	5:5
several columns	B:F
several rows	3:8
rectangular area	B2:G9
multiple regions	A1:B7, D5:G11
Partial columns (Google only)	A2:A

Entering functions

Excel includes dialogues to help entering functions, but learning function syntax is an important part of spreadsheet use. Cell references can be typed in, but shortcut methods can save time:

- As with simple formulae, you can enter a cell reference simply by pointing and clicking on the cell.

- A range of cells can be entered by dragging over them.

- The reference for an entire column/row can be entered by clicking on the column/row label

You can also make use of controls to choose the function you require:

The list of common functions is available from **Home > Editing > Σ AutoSum** or **Formulas > Function Library > Σ AutoSum**	The list of common functions is available from **Insert > Function** or on the toolbar

There are several functions that **count** the number of values:

COUNT(range)	the number of numerical values in the range
COUNTA(range)	the number of all types of value in the range
COUNTBLANK(range)	the number of blank cells in the range
COUNTUNIQUE(range)	the number of unique values in the range (Google Sheets only)

4.3 - Replicating formulae

Often a spreadsheet formula will need to be repeated – for example to find the total of several columns of numbers. You can use **copy and paste**, or the **fill handle** (see p8).

When you do either of these, cell references in the new formulae are updated relative to the movement (they are **relative references**), following very simple rules:

- copying to the right (or left) will update the column letters
- copying down (or up) a column changes row numbers

	A	B	C
1	10	15	100
2	20	30	200
3	*=A1+A2*	*=B1+B2*	*=C1+C2*
4			

4.4 - Absolute cell addressing

In some situations you will not want all reference(s) to change, so these must be entered as **absolute references** to give the correct result.

Consider this example where the total in row 8 must always be divided by the possible maximum score (cell B1). The formulae are first entered once in cells B7 and B8:

	A	B	C	D	E
1	Max Score	205			
2					
3					
4		Sarah	James	Sam	
5	Test 1	83	76	95	
6	Test 2	67	72	63	
7	Total Score	*=B5+B6*	*=C5+C6*	*=D5+D6*	*Both references need updating*
8	Percentage	*=B7/$B$1*	*=C7/$B$1*	*=C7/$B$1*	*B1 must stay the same*

In row 7, the formula in B7 updates correctly for columns C and D when replicated, however in row 8 a relative reference to the cell B1 would change to C1, then D1, giving an incorrect result.

To prevent this, dollar signs ($) are used to define an **absolute** reference – it should not be changed when the formula is replicated.

By entering **=B7/B**1 in B8, the formula can be replicated correctly.

'Mixed' references

It is also possible to have *absolute row* or *column only* references:

	A	B	C	D	E	F
1	Name	Bonus	Jan	Jan + Bonus	Feb	Feb + Bonus
2	Alison	£125	£500	=C2 + $B2	600	=E2 + $B2
3	Bert	£75	£600		550	
4	Cathy	£100	£550		400	

In this example, the bonus in column B is added to each month's figure, so in cell D2 we could add C2 + B2. This formula would replicate down the column OK, but cannot be copied to F2 (for February) as this would give E2 +D2. We need to 'lock' the use of the B column, without affecting the ability of the row to change.

The absolute reference must be applied *only* to the column, so we place the dollar before the part of the reference we want to 'fix':

$$=C2 + \$B2$$

Tip   When entering references needing absolute or 'mixed' references, you can enter the reference as usual and then press the **F4** key to cycle through the various 'dollar' options (works with Excel and Google Sheets).

4.5 - References between worksheets

Each cell in a spreadsheet is unique by virtue of the column, row ***and*** sheet on which it resides. This means you can reference cells on one sheet from another.

There are two ways to reference between sheets.

- Combine sheet name and cell reference(s) using this syntax:

    'Sheet_name'!Cell_Refs

    Eg **'source'!B2**

- Use **named ranges** – these are normally valid between sheets (see below)

Entering cross-sheet references

You can usually employ a 'point and click' or 'drag over' method to enter references from another sheet, but you need to keep an eye on the content of the formula bar.

Two things to watch with Excel:

- If you switch sheets before you have begun entering the next item in the formula, you may find the sheet name changes again

- When you've finished a formula, but are not one the sheet on which it's being entered, resist the urge to switch sheets – instead simply **Enter** the formula and it will be OK.

Part 2~Further functions

5 ~ Named ranges

Most formulae need to reference cells or ranges. An alternative to the usual reference style (eg A1) is to assign **names** which are used in place of the cell or range address.

For example, **=A1*B1** might become =**Cost*Quantity**. They help reduce errors by:

- making spreadsheet formulae more meaningful
- avoiding the need for 'dollar' references

You can name: a **single cell**, a whole **column** or **row**, or a **rectangular range** of cells.

As names must not be ambiguous in formulae, there are some naming rules:

- They must start with a letter, but may contain numbers
- They must not contain spaces – use underscore, dashes or '**camelCase**'
- They must not be reserved words, or be a valid cell reference (eg AB123)

5.1 - Creating named ranges

The methods are different in Excel and Google Sheets, but you should always first select the cell or range to be named. If you are working with listed values and the number of rows in use may change, select entire columns rather than just the rows currently in use.

Google Sheets

1   After selection, choose **Data > Named Ranges**... or right-click on the selection and choose **Define named range**... The **Named ranges** side-panel opens, showing any existing named ranges.

2   Enter a name for the range, check the range is correct and choose **Done**.

Enter name for range ⟶ NamedRange1

Check the range is correct ⟶ IndexMatch!A:F

'Hovering' over an existing range provides an **Edit** control

Existing named ranges ⟶ MyList
A_List!A:F
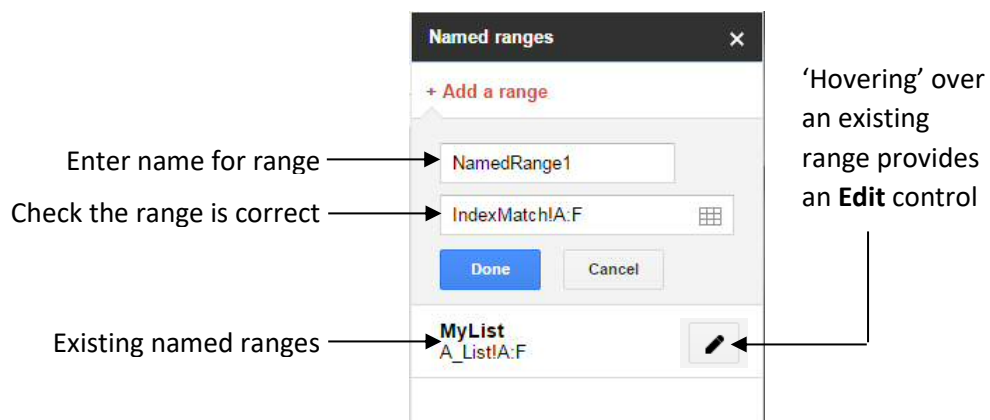
Excel

1   After selection, enter the name into the **Name Box** (to the left of the formula bar).

2   After typing the name you ***must*** press **Enter** to confirm the name.

Name box
(Excel
2013)

Whole column
selected

	Item	Price	Quantity	Cost
1	Item	Price	Quantity	Cost
2	Boxes of A4 paper (5 reams)	23.99	2	
3	Pens (Box of 10)	5.50	5	
4	Pencils (Box of 20)	3.90	10	
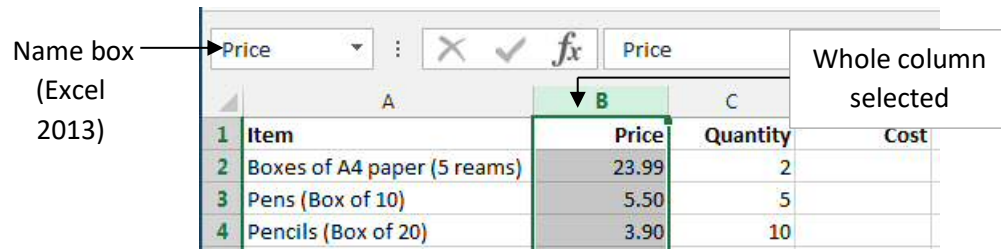
5.2 - Using named ranges

The names may now be used anywhere in a formula or function where a cell reference or range would normally be used. Below is an example using named columns and a named cell.

Cell B1 is named 'VATrate', making this an implied absolute reference (only one cell has that name). Columns B, C, D and E are named as shown:

Cell B1 is named
'VATRate'

'Price'   'Quantity'   'Cost'   'ItemVAT'

	A	B	C	D	E	F
1	VAT Rate	20%				
2						
3	Item	Price	Quantity	Cost	Item VAT	Inc Cost
4	Boxes of A4 paper (5 reams)	23.99	2	47.98	9.60	£57.58
5	Pens (Box of 10)	5.5	5	27.50	5.50	£33.00
6	Pencils (Box of 20)	3.9	10	39.00	7.80	£46.80
7	Business cards (1000)	22.5	2	45.00	9.00	£54.00
8	Board markers (pack of 8)	4.75	3	14.25	2.85	£17.10

=Price * Quantity

=Cost + ItemVAT

=Cost * VATrate

The formula entered in the **Cost** column (D) is the same in all cells, likewise for the **Item VAT** column (E) and **Inc Cost** (F).

Spreadsheets make the assumption you are referring to cells that occupy the same row as the formula.

Entering names

Simply type in the name where you would normally enter the cell or range in a formula.

In Excel, a few other options are available:

- When you start typing the name, a list of available functions and names (with a label icon) are presented – choose the name (double-click)
- Select the cell by name from the name drop-down
- If a single cell is named, 'point and click' will give the name
- If a column/row is named, 'point and click' on the column letter/row number

Note In a Google spreadsheet, clicking on a cell while entering a formula will always give the cell address, not its name.

Managing named ranges

To list all named cells/ranges in the current spreadsheet and to edit/delete them:

 Excel

1 Select **Formulas > Defined names > Name Manager**

2 Choose the **name** and **Edit**... or **Delete**... as appropriate
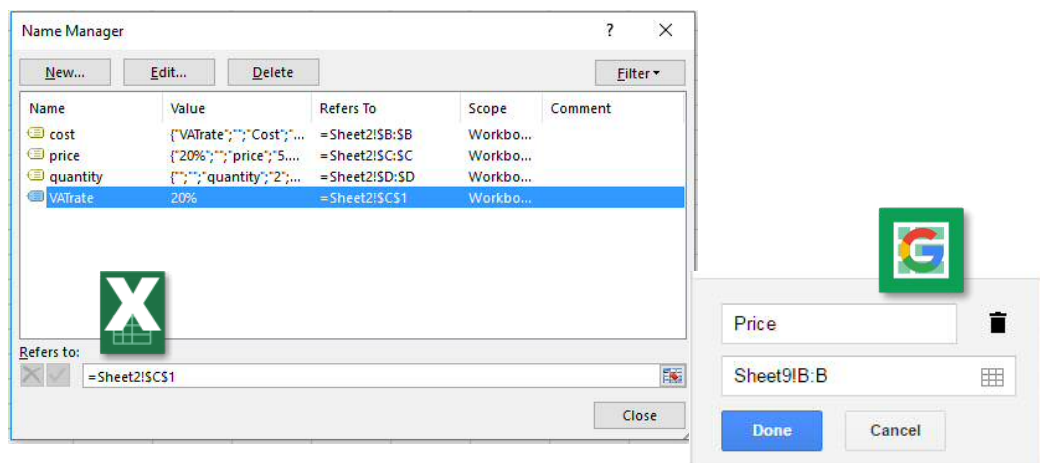
Managing names in Excel and Google sheets

 Google Sheets

1 If the **Named ranges** sidebar is not visible, select **Data > Named Ranges...**

2 Locate the named range, hover over it and choose the **Edit** button (pencil).

3 You can then change the name or cell range, or 'bin' the name.

6 ~ Finding and inserting functions

One way of entering a function is to type it directly into the cell, but this requires that you know the syntax for that particular function. Both Excel and Google Sheets try to help with this in different ways.

6.1 - Excel – Function Library

Use the **Function Library**, which organises functions by category. This opens a **Function Arguments** dialogue to help enter values/references and access help.

Categorised function library
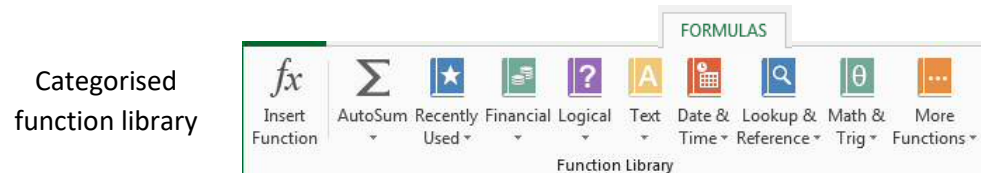
1   Choose **Formulas > Function Library >** ... and select a function from a category. Ones you use often will be in the **Recently** Used list.

2   Complete the dialogue and choose **OK** to enter the function.
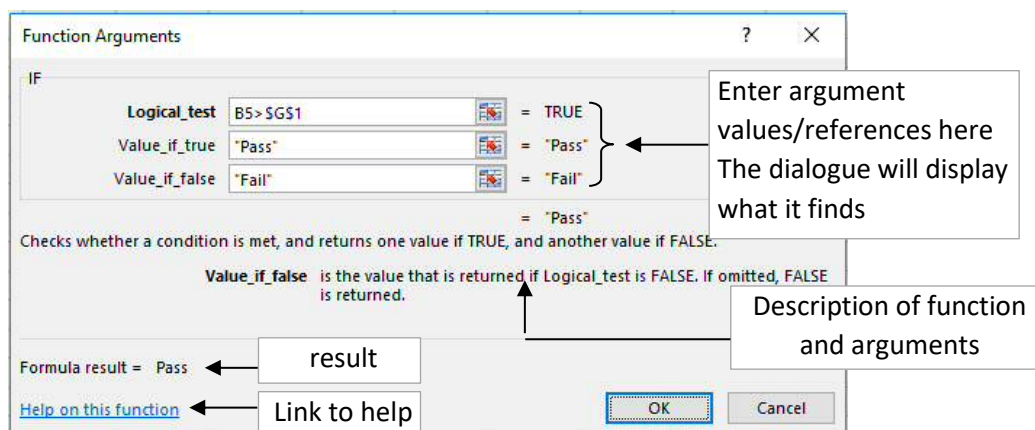
Excel – Insert Function

Excel also provides the **Insert Function** dialogue, which lists all available functions by category and is a great way to discover new functions or find out which arguments are needed. It also provides a link to further help. To use the insert function dialogue:

1   Select the cell in which you wish to enter the function (***don't*** start typing the =).

2   Choose the **Insert Function** control (f_x, to the left of the formula bar).

3   Locate the function by:

   a)   … searching

   b)   … choosing a category

   c)   … selecting from the **Most Recently Used** list (if you've used it recently)

4   Select the function – to find out more, choose the *Help on this function* link.

5   To use the function, choose **OK** – this opens the **Function arguments** dialogue

Note   The last item in each **Function Library** list also opens this dialogue.

Search →

Select a category →

Choose a function →

Find out more →
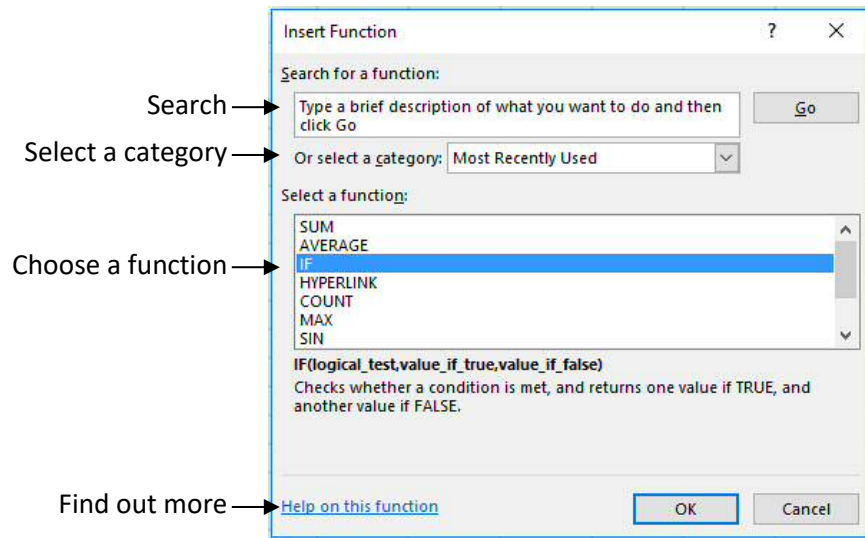
6.2 - Google Sheets

Google have an online reference of functions available, and these functions are continually being added to. To get a full list, in Google Spreadsheets choose **Insert > Function > More...**

1   Once you know which function you need, begin entering it into the cell.

2   A pop-up explains the parameters and the order they are required in.

Note   For most functions, a link provides further details and examples.

Shrink/expand

A help dialogue opens when you start entering a function

Find out more
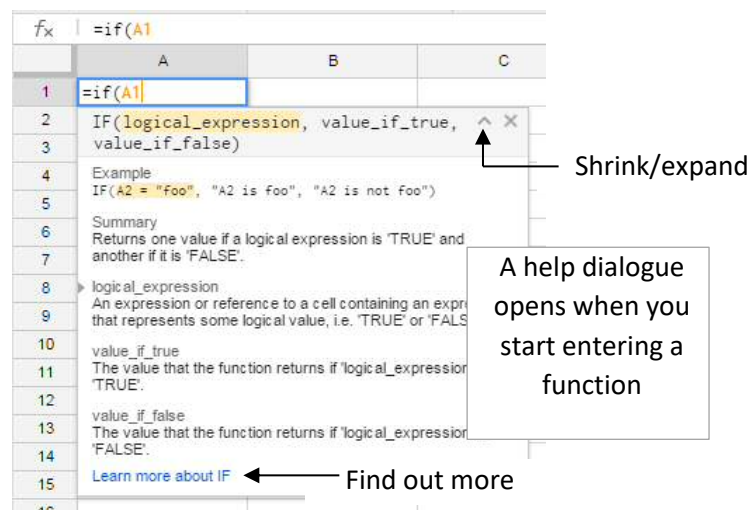
7 ~ Conditional functions

These functions test values in cells and will contain something that is either **true** or **false** on which the result will depend. Here is a (very) simple spreadsheet:

	A	B	C	D
1	10	10	20	
2	15	7	8	
3	Apple	Orange	Apple	

Below are some possible **expressions** using this data that could be true or false:

Example	Result	Works with… (Comments)
A2 > A1	True	Numbers (> greater than)
C1 < C2	False	Numbers (< less than)
A1>=B1	True	Numbers (must put = after >)
C2 <= B2	False	Numbers (must put =after <)
B1 = A1	True	Text and Numbers
A3 <> B3	True	Text and Numbers (<> means 'not equal to')

Note You can also use values (numbers or "text") in an expression, but as always it is better practice to reference a cell containing the value, otherwise you have to edit the function to change the tested value.

7.1 - IF()

This function allows you to compare values and give a different response depending on the outcome. It needs 3 parameters (or "arguments"):

=IF(an expression that is true or false, Result if true, Result if false)

The R**esult** can be:

- a **value** (number or text) that you wish to be placed in the spreadsheet as the result of the function (text is enclosed in quotes)
- a **reference to a cell** containing a value
- a **formula** to perform a calculation

Consider this example:

	A	B	C	D	E
1	**Pass Mark**	75			
2					
3	**ID**	**Family Name**	**First Name**	**Mark**	**Result**
4	10009	Smythe	Erica	89	Pass
5	10034	Walton	Sam	64	Fail
6	10072	Cheng	Violet	75	Pass

To indicate whether each student had passed, cells in column E would contain an **IF** function to test if the Mark (column D) has reached the pass mark (cell B1). In cell E4 this would be:

=IF(D4 < passMark,"Fail","Pass")

Test: Is mark in D4 < B1?
(cell B1 is named passMark)

If true: give result **Fail**

If false: give result **Pass**
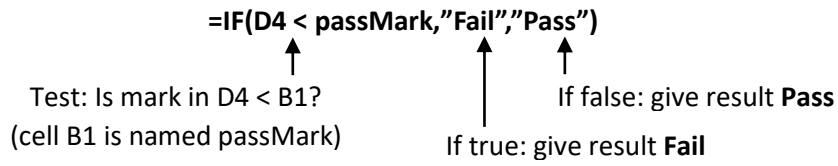
You may find it helpful to think of this in terms of a decision tree:
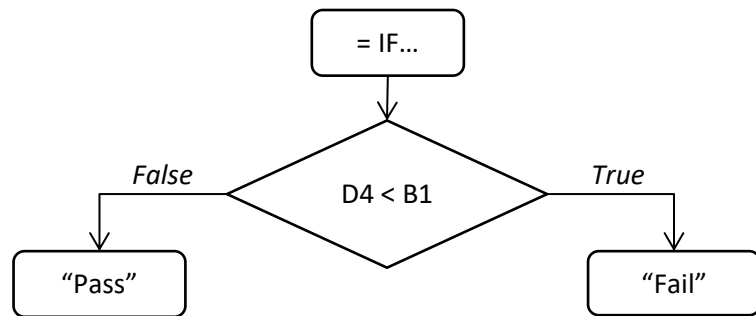
Note There is another solution to this that tests if the Mark is greater than or equal to than the pass mark. Assuming we name cell B1 as **passMark**, this becomes

=IF(D4 >= passMark,"Pass","Fail")

It doesn't matter which you use, but it helps to be consistent.

Nesting IF

Suppose there are 3 possible outcomes to an exam:

<60	Fail
60-80	Pass
>80	Distinction

Since one **IF** function only has two outcomes, it cannot give all 3 possibilities. However, combining two IF functions, one inside another, lets you test for all 3 results.

The decision flowchart now looks like this:

The first test can be done with the following function:

=IF(A1<60, "fail", "pass or distinction")
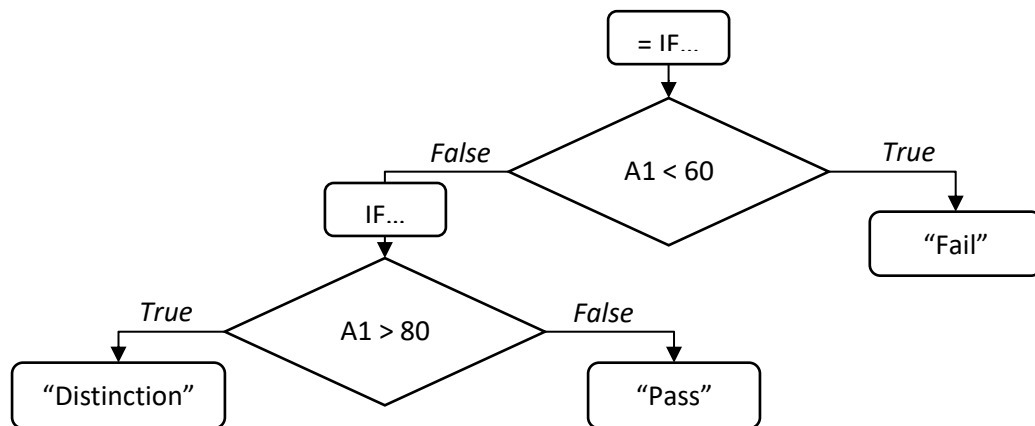
This will identify marks that are a fail, but if the result is **false**, we need now to test between a pass and a distinction. To do this we insert the second **IF**:

=IF(A1<60, "fail", **IF(A1>80, "distinction", "pass")**)

Notes The second **IF** is *not* preceded by an equal sign **=**

While this approach of nesting multiple **IF** functions could be extended further, it is not advisable for more than a few possible outcomes. Using **range lookups** is simpler in these cases (see later).

Nesting can be applied with any functions and is a very powerful technique; however the formulae involved can become confusing. Always test your formula carefully to make sure you get the expected results.

7.2 - Conditional COUNT, SUM and AVERAGE

There are several functions which combine sum(), average() and count() with the power of conditional tests. This means cell values will only be counted, totalled or averaged if they meet defined conditions.

These functions require several arguments:

- A range of cells to test against the criterion
- A value or expression to test against
- Optional – a range of cells to SUM or AVERAGE (not for COUNT)
- Multiple-criteria versions will also need additional ranges and criteria

Defining a **range**	- Start:End cell references (A2:C32) - Entire column (B:B) or row (5:5) - Several columns (C:E) or rows (5:8) - One or more columns, omitting row 1 (A2:D) (Google only) - A named range
Options for **criterion**	This can be: - A single value - A reference to a cell containing a single value - A reference to a cell containing both value and condition

Note When more than one range is used in a function, they must cover the same number or rows.

Criteria

The syntax for the criteria depends on whether the data is text or numbers, and whether or not you want to 'hard code' criteria values or reference cells containing values, the latter being the most flexible option.

Examples are shown below, referencing cells in the example data table.

You will also find 'live' examples in the accompanying files.

Text

Enter the text to be found in quotes	**"Pies"**
Include a reference to a cell containing the text to be found	**F2**

Numbers

Enter the value to be found (no quotes)	**2**
Reference a cell containing the value to be found	**F7**
Include a condition with the value, enclosed in quotes	**">=72"**
Reference a cell containing both condition and value	**F4**
Include a condition in quotes and *join* to a cell containing the value (the **&** denotes the join)	**"<"&F6**
Reference two joined cells, condition and value **Note:** if the condition entered in the cell is 'equals' you must precede this by a single quote '=	**F5&F6**

Example data:

	A	B	C	D	E	F
1	Student ID	Year	Major	Exam Mark	Awards	Criteria Values
2	001	1	Cake	81	1	**Pies**
3	002	1	Chocolate	76	2	**72**
4	003	1	Pies	61	1	**>=72**
5	004	1	Cake	58	1	**<**
6	005	1	Chocolate	92	0	**72**
7	006	2	Pies	74	0	**2**
8	007	2	Pies	72	1	
9	008	2	Pies	56	2	
10	009	2	Chocolate	81	1	

COUNTIF

COUNTIF(range,criterion)   Count the cells in the **range** that match the **criterion**

SUMIF

There are two different ways to use SUMIF, depending on whether the values you want to total are also the values you need to test. This means you can total cells in one column depending on values in another column meeting specified criteria:

=sumif(range, criterion)	Sums the cells in the range that match the criterion
=sumif(test range, criterion, total range)	Tests the values in the rest range against the criterion, and for each row that matches totals the corresponding values found in the total range

AVERAGEIF

There are two different ways to use AVERAGEIF, depending on whether the values you want to average are also the values you need to test or not. This means you can average cells in one column depending on values in another column meeting specified criteria:

=averageif(range, criterion)	Averages the cells in the range that match the criterion
=averageif(test range, criterion, total range)	Tests the values in the rest range against the criterion, and for each row that matches averages the corresponding values found in the total range

7.3 - Multiple criteria with COUNT, SUM and IF

There are also variations of conditional formulae that allow for multiple criteria. These 'plural' versions are **COUNTIFS**, **SUMIFS** and **AVERAGEIFS**.

All three functions use pairs of criterion ranges and criteria, but in the case of sum and average you must first also define the range to use for the calculation.

=countifs(range1, criterion1, range2, criterion2 etc)

Counts the number of rows that meet all the defined criteria in all the defined criteria ranges

=sumifs(total range, criterion range1, criterion1, criterion range2, criterion2 etc)

Totals the rows in total range that meet all the defined criteria in all the defined criteria ranges

=averageifs(average range, criterion range1, criterion1, criterion range2, criterion2 etc)

Totals the rows in total range that meet all the defined criteria in all the defined criteria ranges

8 ~ Time and date calculations

Spreadsheets store dates and times as formatted numbers.

Dates	Dates are stored as a single whole number. Excel starts with 1 in 1900, but Google Sheets permits negative values, allowing pre-1900 dates.
	Note The first two months of 1900 differ between Excel and Google Sheets. This is because Excel replicates an error first introduced by Lotus 123 in which 1900 is regarded as a leap year (it wasn't) and so includes 29/2/1900.
	All dates after 28 February 1900 agree.
Times	Times are stored as decimals – 0.5 is 12 noon

Using this approach means:

- A combined date and time can be stored as 1 value
- You can perform calculations with dates and times

Note *It is up to you to ensure these numbers are formatted appropriately*.

8.1 - Dates

Adding and subtracting days (format result as a date):

	A	B	C	D
1		**Start date**	**Days**	**End date**
2	Duck conference	01/01/15	8	= B2 + C2
3	Cake conference	= D3 − C3	7	21/01/15

Number of days between two dates (format result as a number):

	A	B	C	D
1		**Start date**	**End Date**	**Duration**
2	Tree conference	01/01/15	05/01/15	= C2 − B2
3	Pie conference	14/01/15	20/01/15	= C3 − C2

8.2 - Times and Duration

By default, times will be treated as a time of day, so 12:00 means mid-day. Time can also be used as duration, and used to calculate new times, even on a new day:

	A	B	C	D	
1		**Start time**	**Duration**	**New time**	
2	Tree conference	12:00	2:00	14:00	= B2 + C2
3	Pie conference	21:00	5:30	02:30	= B3 + C3

In some cases, there is no need to distinguish between time and duration. However, unexpected results may occur when totalling durations that exceed 24 hours.

In this case, the cell(s) involved **must** be formatted as duration. The method used differs between Excel and Google Sheets:

Formatting for duration – Google Sheets

- Select the cell(s) and choose **Format > Number > Duration**.
- Alternatively, set a custom format (**Format > Number > More formats**...)

Formatting for duration – Excel

1   Select the cells, choose **Home > Number > Number format** (drop-down) and select **Format Cells**... (or right-click and choose **Format cells**...)

2   Select **Custom** from the **Category** list

3   Locate and select the format **[h]:mm:ss** and **OK**

Note   The square bracket **[h]** is the important bit

8.3 - Date and Time functions

TODAY() and NOW()

Spreadsheets include some functions that are able to refer to the computer's internal calendar and clock. These functions are unusual in that they require no arguments:

= TODAY()	returns the current date (changes when spreadsheet is opened on a new day)
= NOW()	returns both the current date and time as a single value (time updates whenever a change is made to the spreadsheet)

Note   These values change with the day/time, so cannot be used as a date/time stamp.

Calculations

These functions can be used in calculations, for example to find out how many days there are until a deadline is due:

	A	B	C	D
1	Project	Deadline	Days to deadline	
2	Cake bake	31/05/18	*=B3-today()*	
3				

Other data and time functions

Several other functions allow you to deconstruct and reconstruct date or time values:

|	
=Year(*ref*), =Month(*ref*), =Day(*ref*) **=weekday(*ref, type*)**	Generate single integer values for the year, month, day of the month and day of the week ('type' determines which is considered day 1)
=Date(*ref1,ref2,ref3*)	Generates a date value from three separate values for year, month and day
=Hour(*ref*), =Minute(*ref*), **= Second(*ref*)**	Generate single integer values for the hours, minutes and seconds

8.4 - Date & Time custom formatting

As spreadsheets always store dates and times as numbers, you can achieve a wide range of display presentation by applying customised formatting codes.

Select the cell or cells to be formatted and from the Number format control (**Home > Number**) choose **More Number Formats…** On the **Number** tab, in the **Category** column select **Custom**	Select the cell or cells to be formatted and choose **Format > Number > More formats > Custom number format…**
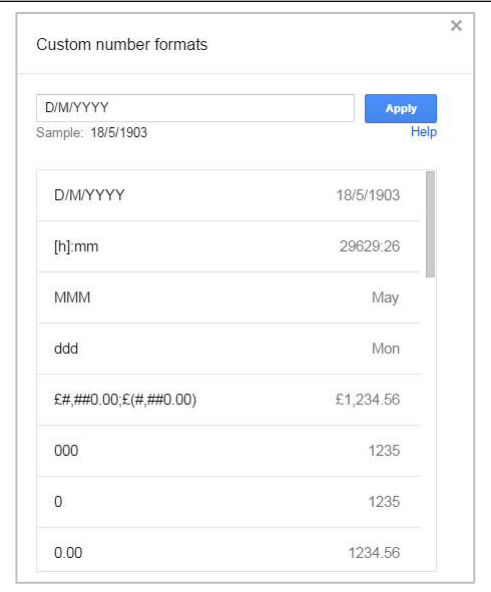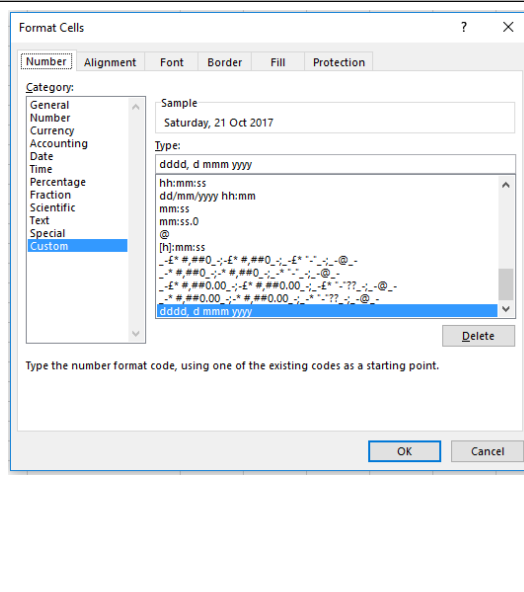
Use letters to construct the format you require, where:

d	day of the month
m	month or minute (context sensitive)
y	year
h	hour
s	seconds
AM/PM	Add this after a time to specify 12-hour clock with AM or PM

Repeating a letter code generates longer formats, and separators may be included. Below are some examples and the result they produce for 8/2/2015 at 15:20.

dd-mm-yy	08-02-15
ddd, d mmm yyyy	Fri, 8 Feb 2015
dd mmmm, h:mm	08 February, 15:20
d mmmm, h:mm AM/PM	8 February, 3:20 PM

9 ~ Other useful functions

The range of spreadsheet functions is very extensive, and if you have specific needs it's worth investigating further what's available. This section pulls together a few functions that you may find useful in several contexts.

SUBTOTAL – an alternative to SUM, AVERAGE…

The standard SUM, AVERAGE and COUNT functions have one particular weakness – they do not take notice of any filters applied to data. The SUBTOTAL function ***does***, however, and is in fact used automatically in the Excel subtotal feature.

The name is misleading, as it does a lot more than simply total values. The syntax is:

= subtotal(function code, range)

function code	the type of arithmetic to perform:
	1 - AVERAGE
	2 - COUNT
	3 - COUNTA
	4 - MAX
	5 - MIN
	9 – SUM
range	the collection of cells to be calculated

Averages

The most common average is the **mean**, found with the **AVERAGE** function. The **MEDIAN** and **MODE** functions are used to find other average measures.

	A	B	C	D	E	F
1	1	1	2	3	4	7
2	Mean	Median	Mode			
3	3	2.5	1			
4	*=average(A1:F1)*	*=median(A1:F1)*	*=mode(A1:F1)*			

Note The MODE function in spreadsheets will return only a single value for mode. This is not strictly correct – the mode of the numbers 1,1,2,2,3 is *1 and 2*. Care should be taken if you need to identify data which contains more than 1 mode.

ABS

ABS – returns the absolute value of a number, removing any negative sign from a number (eg -50 becomes 50); positive numbers are unchanged.

This can be useful when calculating the difference between two values, when the sign is not important. For example, if an essay has a word limit of 5000 it is possible to calculate if the word count is within an acceptable margin:

	A	B	C	D
1	**Word limit:**	**5000**	**Margin:**	**250**
2				
3	**Student**	**Word Count**	**Difference**	**Absolute difference**
4	Student 1	5047	47	47
5	Student 2	4903	-97	97
6	Student 3	4981	*=B6-$B$1*	*=abs(C6)*
7	Student 4	4693	*=B7-$B$1*	*=abs(C7)*

Column C contains both positive and negative values - where the word count is over or under. Column D displays the *absolute* value so only the difference from 5000 is stored, making it easier to work out of the word count is within the acceptable margin (250).

This could be entered directly in on cell, for example: **= abs(B4-$B$1)**

Rounding and arithmetic

Values are rounded for display, based on the chosen formatting, but the most precise stored value is used for any further calculations. There may, however, be times when you want to work with a rounded value, so several rounding functions are provided.

function	description
= round(value, places)	Rounds the **value** to the number of decimal **places** given, using standard rounding rules. If **places** is omitted, it rounds to a whole number.
= roundup(value, places)	Always rounds the **value** up, to the number of decimal **places** given. If **places** is omitted, it rounds up to a whole number.
= rounddown(value, places)	Always rounds the **value** down, to the number of decimal **places** given. If **places** is omitted, it rounds down to a whole number.
= ceiling(value, factor)	Rounds **value** up to the precision given by the **factor**. This means you can, for example, round up to the nearest 10 or 100, as well as to the nearest 0.1 or 0.01
= floor(value, factor)	Rounds **value** down to the precision given by the **factor**. This means you can, for example, round down to the nearest 10 or 100, as well as to the nearest 0.1 or 0.01
= trunc(value, places)	Truncates **value** to the number of **places** given with no rounding (extra digits are simply discarded)
= int(value)	Rounds **value** down to the nearest integer below.
= even(value)	Rounds **value** up to the nearest even integer.
= odd(value)	Rounds **value** up to the nearest odd integer.
= mod(value1, value2)	Gives the remainder after **value1** is divided by **value2**.

Note   **value** will usually be a cell reference.

The **INT** and **MOD** functions are useful when converting between non-decimal units, eg when converting a number of minutes into hours and minutes:

	A	B	C	D
1	**Minutes**	**Hours**	**Minutes left**	
2	250	4	10	
3		*= int(A2/60)*	*= mod(A2/60)*	

Random numbers

These two random number functions recalculate every time the spreadsheet changes. The 'randomness' of the values is probably not good enough for some specialist uses.

=rand()	Generates a random decimal number between 0 and 1
=randbetween(low, high)	Generates a random integer between **low** and **high**. Negative values can be used.

Text

Several functions allow text manipulation, which may be needed if data is not consistent, or is from another source. **Text** will usually be a cell reference

Case change	
= lower(text)	Changes **text** into lower case
= upper(text)	Changes **text** into upper case ('capitals')
= proper(text)	Changes **text** into heading case (first letter of each word capitalised)
trimming and splitting	
= len(text)	Counts the length (number of characters) in **text**, including spaces
= trim(text)	Removes any leading or trailing spaces from **text** – data exported from other systems may contain these
= split(text, "delimiter") *Google sheets only*	Splits **text** into separate cells at each occurrence of the **delimiter**. If you use more than one character as the delimiter, it uses them separately, not combined. If the delimiter is not a cell reference, it must be enclosed in quotes
= split(text, "delimiter", false) *Google sheets only*	Splits **text** into separate cells at each occurrence of the **delimiter**. If you use more than one character as the delimiter, it only splits where they are found together. If the delimiter is not a cell reference, it must be enclosed in quotes
= join("delimiter", range)	Joins together the content of cells in the **range**, using the **delimiter** between them.

Google sheets only	If the delimiter is not a cell reference, it must be enclosed in quotes – use **""** for no delimiter
= left(text, number)	Extracts a **number** of characters starting from the left-hand end of **text** (including spaces)
= right(text, number)	Extracts a **number** of characters starting from the right-hand end of **text** (including spaces)
= mid(text, start, number)	Extracts a **number** of characters from the **text**, beginning at the **start** position

There are also several other functions that allow you to search for a collection of characters (a 'string') inside another one, or look for exact matches between strings.

Splitting text

There are occasions when several items of text (or words) appear in one cell when they should be split over more than one column. This could be because you have imported values from elsewhere, or two 'fields' of data may have been put in one column (eg both forename and surname).

Excel includes a tool for splitting text, whereas Google Sheets provides a function:

Excel

1   Select the cell or cells (or column) that contains the data to be split

2   Select Data > **Data Tools > Text to Columns**

3   Follow the steps of the dialogue to tell Excel about your data

4   Choose **Finished** when you've obtained the desired result in the preview

This method places the first data after splitting into the existing column.

Google Sheets

This function can be used in Google Sheets; the split will appear in a different column, but will reflect changes in the source text, and can be 'nested' in other functions:

=split(cell to split, "delimiter")

The **delimiter** is the character that is used to separate the items, commonly a comma, space or tab, and is enclosed in quotes.

	A	B	C	D	E	F
1	Tomato, Pear, Apple, Plum		Tomato	Pear	Apple	Plum

=split(A1,",")