

QA

# Data Essentials L3

Guide to Microsoft Excel





V1.5.2

## Contents

How to use this guide.....	1
Excel versions.....	1
Preface: keyboard shortcuts .....	3
Part 1: Getting started with Excel.....	7
What is Microsoft Excel? .....	8
Excel and the Excel environment.....	9
Navigating and selecting cells in worksheets .....	19
Creating a new workbook.....	25
Saving your work.....	28
Using Help.....	29
Section review .....	31
Part 2: Modifying a worksheet .....	32
Cut, Copy and Paste commands .....	33
Undo and Redo commands .....	35
Using AutoFill.....	36
Working with rows and columns .....	38
Find and Replace .....	42
Performing a spelling check .....	44
Section review .....	46
Part 3: Introduction to functions.....	48
What is a function? .....	48
Reading syntax .....	49
Part 4: Popular Excel functions.....	54
Understanding functions .....	55
Aggregate functions.....	59
Criteria-based functions.....	63
Logical functions .....	66
Lookup and reference functions.....	70
Dynamic array functions.....	79
Section review .....	85





Part 5: Combining Functions.....	87
Advantages of nesting formulas .....	88
Examples.....	88
Tips for creating nested formulas .....	90
Part 6: Formula tools and techniques.....	91
Quick Analysis.....	92
Absolute and mixed referencing .....	93
Working with Range Names .....	95
Linking to other worksheets .....	100
Section review .....	102
Part 7: Working with data lists .....	103
Flash Fill .....	104
Applying basic sorting .....	106
Advanced sorting .....	109
Applying basic filters.....	112
Section review .....	116
Part 8: Importing data.....	117
Importing delimited text files .....	118
Using Power Query .....	120
Exporting to a delimited text file .....	126
Section review .....	127
Part 9: Mastering Excel tables.....	130
Introducing tables .....	131
Creating a table .....	132
Managing tables .....	133
Calculations and totals in tables .....	134
Formatting a table .....	136
Further table tools .....	139
Section review .....	142
Part 10: Charts.....	144
Understanding charts.....	145





V1.5.2

Creating a chart.....	149
Resizing and moving .....	150
Managing a chart.....	152
Working with chart elements.....	154
Formatting charts.....	156
Working with chart templates .....	156
Analyse data with sparklines .....	158
Section review .....	161
Part 11: Conditional formatting .....	163
Applying conditional formatting .....	164
Modifying and deleting .....	166
Creating custom conditional formats.....	169
Sorting and filtering by colour.....	171
Section review .....	173
Part 12: Transforming data using Power Query Editor.....	175
Introducing Power Query .....	176
Power Query data types.....	180
Combining data sources.....	181
Cleaning and shaping data.....	187
Creating calculated columns .....	199
Module review .....	203
Appendix 1: Text functions.....	204
The CONCATENATE function .....	204
The TEXTJOIN function .....	204
The LEFT, RIGHT, and MID functions.....	205
The TRIM function.....	206
The LEN and FIND functions.....	206
The UPPER, LOWER and PROPER functions.....	207
The REPLACE function.....	207
The SUBSTITUTE function.....	208
The TEXT function .....	209





V1.5.2

Appendix 2: Date functions .....	211
Dynamic dates and times.....	211
Regular date calculations.....	211
Calculating using working days .....	212
Appendix 3: Error messages.....	214
Appendix 4: The COUNTBLANK Function.....	216
Appendix 5: Check for Issues.....	217
Document Inspector .....	217
Accessibility Checker .....	218
Compatibility Checker.....	221





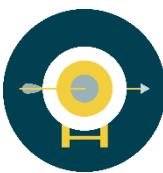
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## How to use this guide



### Activity

This icon provides details of the group/individual activity or a point for everyone to discuss.



### Key point

This icon highlights one of the major things to remember from the course



### Helpful hint

This icon guides you to tips or hints that will help you increase your effectiveness or efficiency in practising what you have learnt.



### Useful tool

This icon indicates a technique that will help you put what you have learnt into action.

## Excel versions

This manual has been written to cover all versions of Microsoft Excel from 2007 to 365 (January 2022 edition). Screenshots throughout this manual are taken from Excel 365, though below are comparisons of Excel 2016 and 365 – notice the same tools in the same places, the only difference being the icon style.

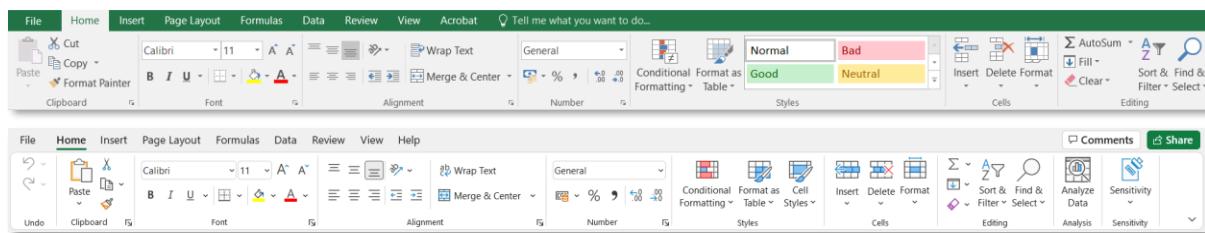


Figure 1: Excel's Home tab on the Ribbon in 2016 (top) and 365 (bottom)/Introduction to the course





V1.5.2

Microsoft Excel is a powerful piece of software that is not only capable of performing simple calculations, as explored on the Introduction course, but also of handling more complex formulas and analysis.

The goal of this course is to provide delegates with the skills and knowledge required to create more complex spreadsheets and to be able to work with and manipulate lists of data.

**“Microsoft Excel provides incredibly powerful tools for the storage, manipulation and analysis of data”**

**Richard O'Brien – Principal Technical Learning Specialist**





## Preface: keyboard shortcuts

This list of shortcut keys are relevant to the content of this training course.

### Ctrl keys

Keystroke	Action
Ctrl+A	- Select current region - When creating a formula, displays the 'Function Arguments' dialog box
Ctrl+B	Bold
Ctrl+C	Copy selection
Ctrl+D	Copy down
Ctrl+F	Displays the 'Find and Replace' dialog box (Find); Shift+F4 repeats the last Find command
Ctrl+G	Display the 'Go To' dialog box
Ctrl+H	Displays the 'Find and Replace' dialog box (Replace)
Ctrl+I	Italics
Ctrl+N	Create new workbook
Ctrl+O	Displays the 'Open' dialog box
Ctrl+P	Print
Ctrl+Q	Quick Analysis
Ctrl+R	Copy right
Ctrl+S	Save
Ctrl+U	Underline
Ctrl+V	Paste (Enter will also apply a single paste)
Ctrl+Alt+V	Display the 'Paste Special' dialog box
Ctrl+W	Close workbook
Ctrl+X	Cut selection
Ctrl+Y	Repeat last command (F4 also repeats)





Keystroke	Action
Ctrl+Z	Undo
Ctrl +	Insert cells/rows/columns (based on selection)
Ctrl -	Delete cells/rows/columns (based on selection)
Ctrl+Tab	Switch workbooks
Ctrl+1	Display 'Format Cells' dialog box
Ctrl+9	Hide rows
Ctrl+0	Hide columns
Ctrl+Shift+(	Show hidden rows
Ctrl+Shift+:	Enter current time
Ctrl+;	Enter current date

## Function keys

Keystroke	Action
F1	Display Help
Ctrl+F1	Hide/Show the Ribbon
F2	Edit cell
F3	Display list of named ranges
Ctrl+F3	Name Manager
F4	Repeat last action (when not in a formula) Absolute reference (when in formula)
Ctrl+F4	Close workbook
Alt+F4	Close Excel
F5	Go To
F7	Spelling
F8	Extend mode (selecting cells)
F9	Recalculate





Keystroke	Action
F10	Access Ribbon commands via keyboard
F11	Create a chart from your current range of data
Shift+F11	Insert a new worksheet
F12	Displays the 'Save As' dialog box

## Navigation keys

Keystroke	Action
Ctrl + →, ←, ↑ or ↓	Move to the edge of current dataset
Home	Move to column A on the current row
Ctrl+Home	Move to cell A1
Alt+PageUp/Down	Move one screen right/left
Ctrl+PageUp/Down	Move to previous/next worksheet
Ctrl+Tab	Switch workbooks

## Selecting cells

Keystroke	Action
Shift+ →, ←, ↑ or ↓	Select cells in the corresponding direction
Ctrl+Shift + →, ←, ↑ or ↓	Select from your current cell to the next blank cell in the appropriate direction
Shift+Home	Select from current location to column A on the current row
Ctrl+Shift+Home	Select from current cell to cell A1
Ctrl+A	Select the current region of data (outside the region selects all worksheet cells)
Ctrl+Space	Select entire column/s
Shift+Space	Select entire row/s
F8, followed by →, ←, ↑ or ↓	Extend selection in the direction of the arrow keys. Press F8 to subsequently turn off





## Editing cells

Keystroke	Action
Tab or Shift+Tab	Move to cell on the right/left (most useful when entering data, combined with Enter)
Alt+Enter	New line in the same cell
Ctrl+Enter	Copy current text to selected range
Ctrl+Shift+U	Expand/contract the Formula Bar

## Number formatting

Keystroke	Action
Ctrl+Shift ~	General Format
Ctrl+Shift \$	Currency Format
Ctrl #	Date Format
Ctrl+Shift @	Time Format
Ctrl+Shift %	Percentage Format
Ctrl+Shift !	Number Format

## Filters

Keystroke	Action
Ctrl+Shift+L	Add/remove filter buttons
Ctrl+Alt+L	Reapply last used filter

## Other

Keystroke	Action
Alt	Display Ribbon shortcut keys
Alt+↓	Show cells Pick List of previously entered text values in the same column of the current region





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## Part 1: Getting started with Excel

This section will introduce you to Microsoft Excel, explain its purpose. We will discover how to use the interface to interact with the application, create, save, open and close workbooks, and explore the built-in Help system.

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

- Understand the purpose and advantages of using Excel
- Identify and use the main elements of the Excel interface
- Navigate and select cells within worksheets
- Customise the appearance of Excel
- Create a new, basic worksheet





# What is Microsoft Excel?

Excel is a *spreadsheet application* that allows you to calculate, analyse and publish data.

A file in Excel is a *workbook* and is made up of many *worksheets*.

A worksheet can be used to keep accounts, calculate payments or sales data, or present data in a different format, such as a chart.

Unlike a raw text file, a worksheet provides you with many tools and features that give you more options for using the data.

Some of these features include:

## Structure

A worksheet is divided into 16,384 *columns* (identified by letters A to XFD) and *rows* (identified by a number 1 to 1,048,576). Data is entered in *cells* (the intersection between columns and rows). Each cell can be identified by its column letter and row number (the *cell reference*, for example, A1 and THX1138).

## Data types

A worksheet can identify the type of data you enter in a cell. The type of data determines what sort of *calculations* you can make using the data. Data types include text, numbers, and dates/times.

## Formulas

As well as storing data, you can use a worksheet to perform calculations on the data. A calculation can be made up of mathematical operators (such as add or multiply), special *functions* (to perform more advanced operations on data), and references to data in cells in the worksheet. The advantage of using references to cells is that if the value of a cell is changed, the result of the formula is automatically changed too.

## Presentation

A worksheet includes tools for formatting the data in cells. You can do many of the things that you can in Microsoft Word, such as change the formatting of text, set the page size, and add headers and footers.

This course is designed to help you to obtain the necessary skills required to create and use a worksheet using Microsoft Excel, and you will learn how to enter and edit data, create formulas, format, and print the worksheet.



# Excel and the Excel environment

## The Excel Start Screen

When you start Excel, the first screen that is displayed is the Excel Start Screen (colour-coded in green), this may display an online library of tutorials, a link to create a Blank Workbook and a list of files you have recently opened.

The Excel Start Screen automatically starts when Excel opens; however, you can switch it off by following the steps below.

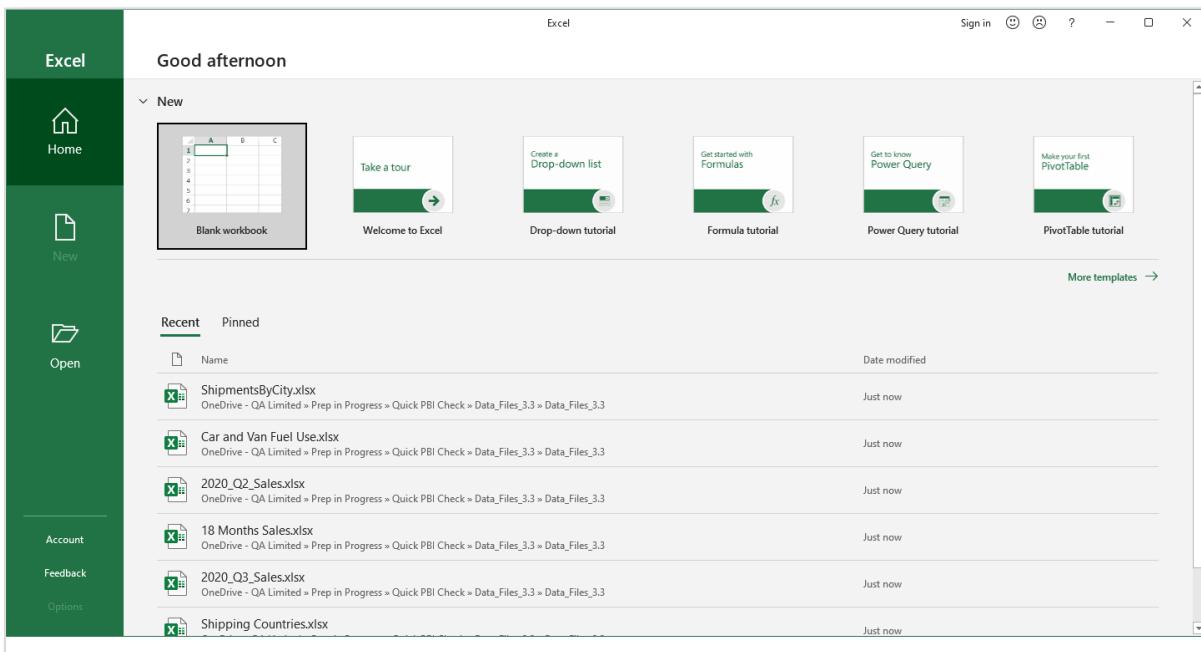


Figure 2: The Excel screen

To switch off the Start Screen:

1. Click **File > Options > General > Start Up Options**
2. Untick **Show the Start Screen when this application starts**, and click **OK**.

Next time Excel starts, it will display a blank workbook.

Within the blank workbook, two windows are displayed, one within the other. The outer window is the main Excel workbook application window that usually fills the entire screen; the inner window is the workbook window where you will work with data.



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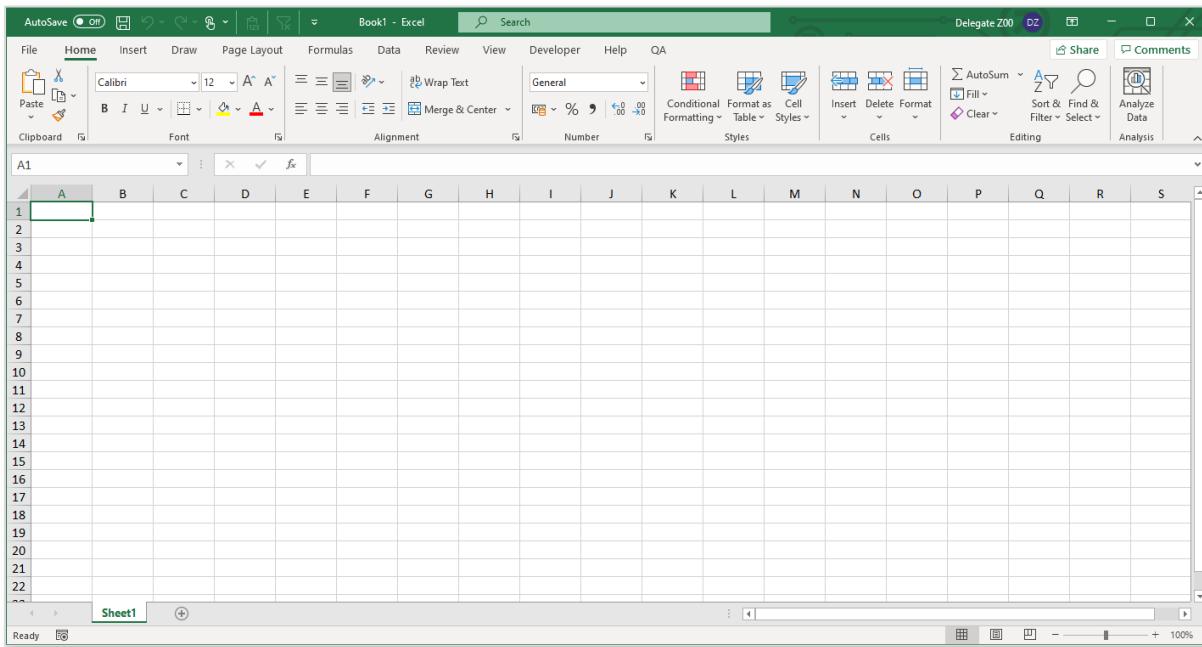


Figure 3: A blank workbook

The Excel screen comprises several distinct parts:

Feature	Description
Ribbon	Interactive area at the top of the screen, containing commands relevant to the selected Ribbon
Tabs	Divides the Ribbon into Core areas, i.e., Home, Insert, Page Layout
Groups	Tabs are divided into Groups, i.e., Font, Alignment
Commands	Commands are the buttons in each Group, i.e., Bold, Italics
Quick Access Toolbar	Frequently used commands are displayed on the Quick Access Toolbar, showing at the top left of the Ribbon
Formula bar	Displays the value, formula, or text in the active cell
Columns	Vertical groups of cells referenced by letters. There are 16,384 columns per worksheet
Rows	Horizontal groups of cells referenced by numbers. There are 1,048,576 rows per worksheet
Active cell	The cell that will be affected by the next action you perform will have a border around it





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## The Ribbon

The Office suite has a control centre running across the top of the window, known as the Ribbon, instead of having numerous toolbars and commands hidden away in menus.

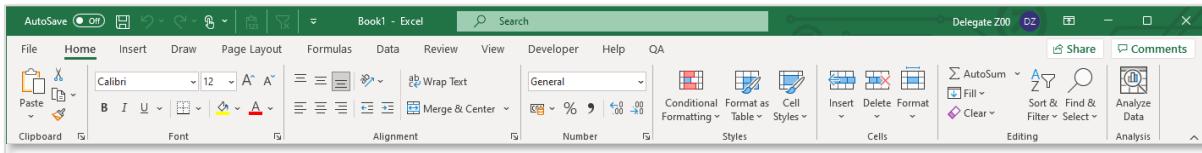


Figure 4: Excel's Home Ribbon

### Tabs, Groups and Commands

The Ribbon is divided up into the core tasks for each application. These are known as *tabs*, and the Home tab is where you will find the most used features.

Feature	Description
File	Known also as Backstage View it contains commands to Print, Save, Share, Export and Publish workbooks (Publish is not available to Excel 2013)
Home	All formatting commands are here to edit and format cells
Insert	Insert text, tables, charts, symbols, and images.
Page Layout	Change page settings, i.e., margins, orientation and other options associated with printing workbooks
Formulas	Create formulas from the vast array in the Functions Library, all neatly categorised by type making it easier to use
Data	Connect to external data sources and import data into the workbook
Review	Provides commands such as spell checker, thesaurus, and translator
View	Control the display of the worksheet or workbook window



Feature	Description
Developer	Not showing as default, this tab can be added using <b>File &gt; Options &gt; Customize Ribbon</b> , and gives access to Macro and Visual Basic Commands

Tabs are divided up into *groups*, such as Clipboard, Font and Insert as shown above.

Groups contain *commands*: icons, dropdown menus, galleries, etc.

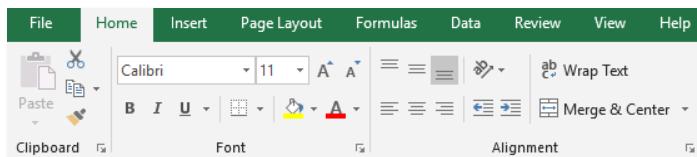


Figure 5: The Clipboard, Font, and Alignment groups on the Home Ribbon

### Dialog Box Launcher

To access additional dialog boxes for a command group, click the *Dialog Box Launcher arrow*, found at the bottom right of some groups.



Figure 6: The Dialog Box Launcher

### Ribbon display options

If the Ribbon takes up too much space on your screen, use the Collapse the Ribbon arrow at the top right-hand side of the screen to Hide or Show the Ribbon (image below right, as seen from the Home tab). Alternatively, you can double-click the active tab to hide it, click once on any tab for the Ribbon to fully appear. Further to this, use the Ribbon Display Options button for additional show and hide commands.

If you press **Ctrl+F1** in any Microsoft Office application, you toggle to show/hide the Ribbon.



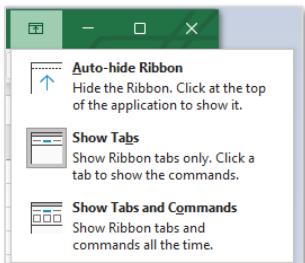


Figure 7: Ribbon Display Options

## Customising the Ribbon

Office allows you to create custom tabs, rearrange and add commands to personalise the application.

To customise the Ribbon:

1. Click **File > Options** (or right-click anywhere on the Ribbon)
2. In the 'Excel Options' dialog box, click **Customize Ribbon**
3. Click **New Tab** button at bottom (shown below)
4. Select **New Tab (Custom) > Rename**, if necessary
5. Select **New Group (Custom) > Rename**, if necessary
6. Select the new tab, select the commands you want to add from the left pane by using the **Add** button in the middle  
(Click **Remove** to remove the command from the group)
7. Use the arrows on the right to change group or commands position
8. Click **OK** to close the Excel Options dialog box

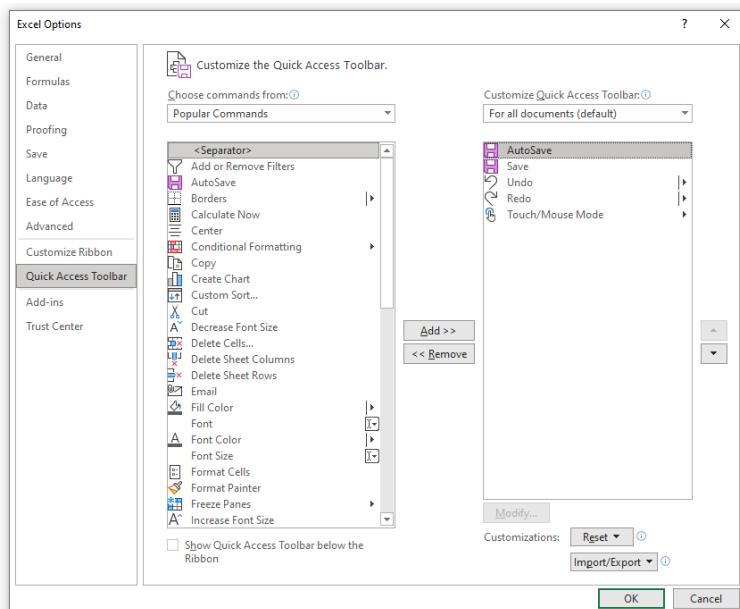


Figure 8: Customise the Ribbon





## Keyboard shortcuts

Shortcut keys can be accessed by pressing the **Alt** key (to the left of your spacebar). You can then navigate around the Ribbon area using the keyboard.

Many other shortcut keys exist within Excel, such as **Ctrl+S** to save a file. This manual will show the shortcut keys when relevant; a list of handy shortcut keys can be located on page 3.

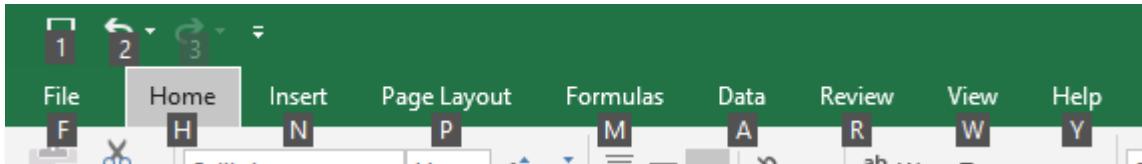


Figure 9: Tooltips show which keys can be pressed to access commands on the Ribbon

## Quick Access Toolbar



Figure 10: the Quick Access Toolbar

This is displayed at the top left of the screen above the Ribbon and gives you quick access to common commands. By default, the Save, Undo and Redo commands are visible. More commands can be added and how to customise this toolbar further is shown in the next section.

### Customise the Quick Access Toolbar

There are two methods for adding commands to the Quick Access Toolbar.

For commands on the Ribbon:

- **Right-click** a button on the Ribbon > **Add to the Quick Access Toolbar**

A more comprehensive method is available:

1. Click the **arrow** at the end of the Quick Access Toolbar – several popular commands will appear and can be added if you wish



### Helpful hint

A full list of commands is available if you select the **More Commands** option.

2. Choose the commands from the left side, using the **Add** button to add to the Quick Access Toolbar on the right



3. Use the **Move Up** or **Move Down** to rearrange the list, and the **Separator** command to section the commands into groups



### Useful tool

Any group or command can be added to the Quick Access Toolbar by **right-clicking** it > **Add to Quick Access Toolbar**.



### Helpful hint

Click the arrow at the end of the Quick Access Toolbar to position it below the Ribbon.

## The Status Bar

A horizontal bar that appears at the bottom of the Excel window and keeps you informed of Excel's current mode.

Also, you can use the Status bar to change the worksheet view and to zoom in and out on the worksheet.

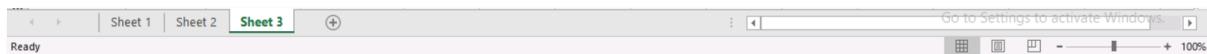


Figure 11: The Status Bar

To customise the Status Bar, right-click to add or remove options.

## Formula Bar

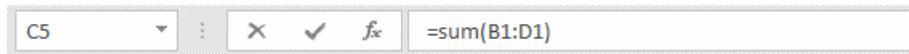


Figure 12: The Name Box and the Formula Bar

The Formula bar displays a cell entry as it is typed or edited on the worksheet. It also displays the contents of the active cell in precisely the way it was entered into the spreadsheet.

When entering or editing text, a tick and a cross will appear on the Formula bar; these can be used to confirm or cancel the entry.

## Views and zooming

Views can be found in the bottom right corner of the screen in the Status Bar, next to the zoom controls. It is now easier to change the viewing size by dragging the slider.



Figure 13: The Zoom Bar and View icons





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## View Buttons:

Feature	Description
Normal View	Working view of Excel
Page Layout View	Add Headers and Footers and see how it will look printed
Page Break View	Check out where pages begin and end

Click the percentage number to the right to bring up a dialog box of more zoom options.

All View and Zoom commands can also be accessed from the View tab.

## File (Office Backstage™)

The File tab is a way of accessing the background (or Backstage View) of Excel, giving quick access to operations such as Save, Open, Print and Options with just a few clicks.

To return to the workbook, click the back arrow at the top left of the screen, or press **Esc** on your keyboard.

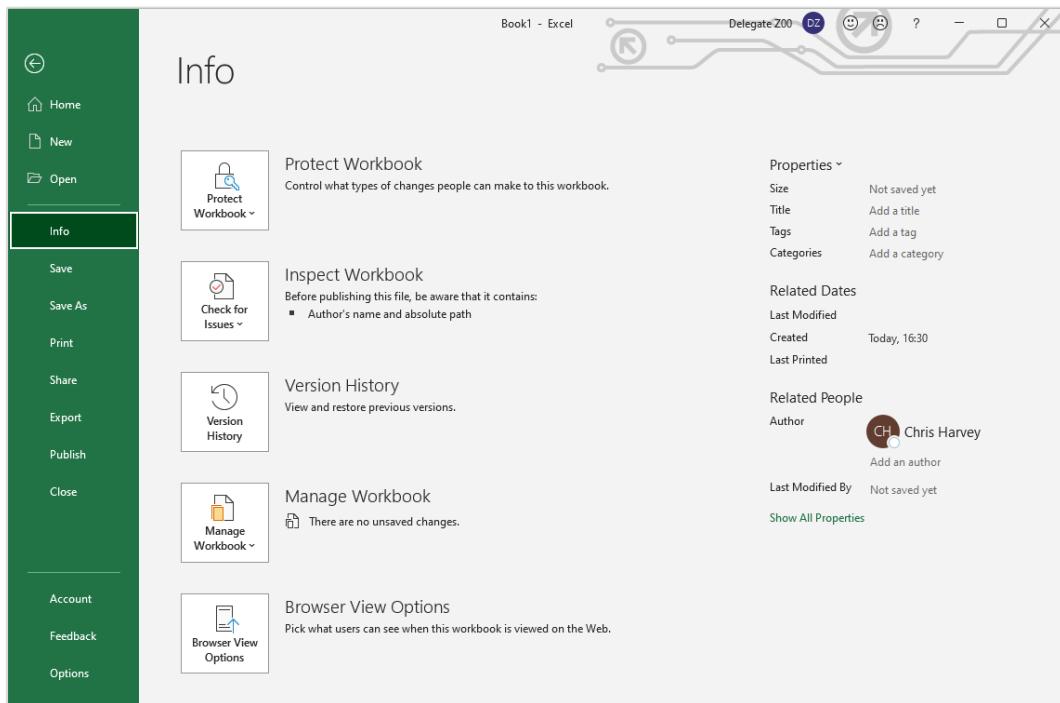


Figure 14: Backstage view





## File tab commands:

Features	Description
File	Known as <i>Backstage View</i> , it contains commands to Print, Save, Share and Export workbooks
New	Displays options to create a blank workbook and links to templates to create customised workbooks
Open	Open existing workbooks has Recent Workbooks links for quick access to frequently used workbooks which can also be pinned to this area
Info	Displays options to protect and inspect workbooks, manage versions and access to workbook properties
Save	Save to various Computer locations including OneDrive
Save As	As Above – creating a copy of the workbook, leaving the original workbook in the original saved location
History	Provides the file's version history (if stored in the cloud) (Excel 2019)
Print	Options to preview and print workbooks and Page Setup options
Share	Share your workbook via email or on the Cloud
Export	Export your workbook to PDF/XPS
Publish	In Excel 2019 and 2021, you can publish your workbook to Power BI, letting you create Power BI reports and dashboards based on your workbook data. You can share Power BI reports/dashboards with work colleagues
Close	Close the workbook, and options will appear for Save and Save As
Account	Shows current signed-in user, locations to save to and select options such as Office colour schemes
Feedback	Send feedback to Microsoft (Excel 2019 and 2021)
Options	Displays the Excel Options dialog box, which allows you to customise the Excel interface, and many settings





V1.5.2

## Contextual tabs

These tabs appear after selecting objects in Excel and will be visible at the end of the Ribbon (after the last default tab). For Excel 2013 and 2016 users, the heading above the tab(s) is usually coloured more brightly, such as pink, green, blue, or yellow. In more recent versions contextual tabs can be identified by green text.

Contextual tabs contain tools for editing specific objects that have been selected, and when that object is deselected, they will disappear.

For example, inserting a chart (example below) will display the Chart Design and Format Contextual tabs at the end of the Ribbon.

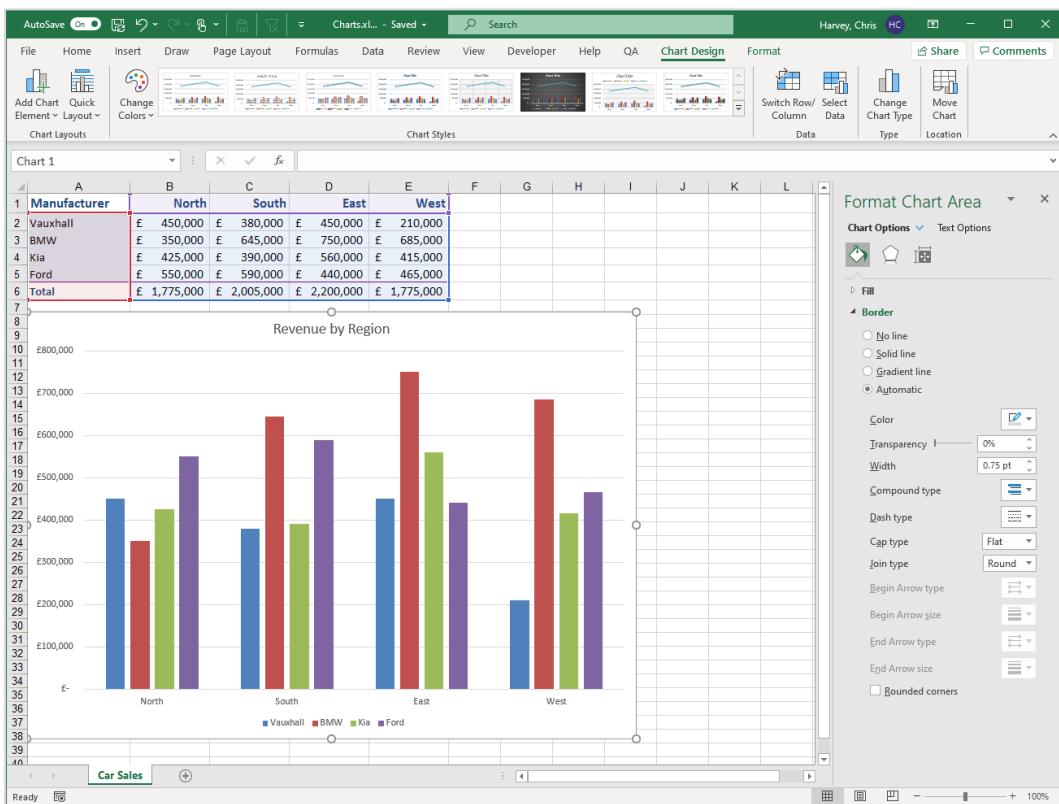


Figure 15: Contextual Tabs, here showing chart commands



### Guided activity: Excel and the environment

In this activity, we will explore the Excel environment and see icons/commands that may become daily routines you follow.

1. If necessary, start the Excel application and open the Excel file named **GETTING STARTED.XLSX**



2. Explore the Ribbon, tabs, groups, commands, and Dialog Box Launcher features
3. Hide the Ribbon, by **double-clicking** on your current Ribbon tab
4. Show the Ribbon again using the keyboard shortcut **Ctrl + F1**
5. Click **Home > and right-click the Bold icon > Add to Quick Access Toolbar**
6. **Customise** the Quick Access Toolbar to add the **Print** command
7. Zoom into the spreadsheet, by way of the controls in the bottom right-hand corner of the Excel application
8. Keep the file open for the next activity

## Navigating and selecting cells in worksheets

Navigating around the worksheet or workbook can be done using the mouse or keyboard, a selection of keyboard actions are shown below:

Press	To Move
← ↑ → ↓ (Arrow Keys)	To the next cell in the direction of the arrow
Enter	To the next cell down
Shift+Enter	To the next cell up
Tab	To the next cell right
Shift+Tab	To the next cell left
Home	To column A on the current row
Ctrl+Home	To cell A1
Ctrl+End	To the last column containing data
Ctrl+Backspace	Scrolls to the active cell
Page Up	Up one screen
Page Down	Down one screen
Alt+Page Up	Left one screen
Alt+Page Down or Tab	Right one screen
Ctrl+← ↑ → ↓ Keys	To the end of a block of non-blank cells



Press	To Move
Ctrl+Page Up	To the next sheet
Ctrl+Page Down	To the previous sheet
Ctrl+G	To display the Go To dialog box

## Scroll around a Worksheet

The scroll bars are for quickly moving around the sheet and are located at the right and bottom edges of the screen.

The vertical scroll bar moves up or down the sheet, and the horizontal scroll bar moves left or right across the sheet.

Click this button	To Move
	Click the up and down scroll arrows on the vertical scroll bar. Holding the mouse button down will repeat the scroll very quickly
	Point to the scroll button on the vertical scroll bar and drag it up or down. As it moves the row number that will be positioned at the top of the screen is indicated
	Click the grey area above or below the scroll button on the scroll bar
	Click the right or left arrows on the horizontal scroll bars. Holding the mouse button down will repeat the scroll very quickly
	Point to the scroll button on the horizontal scroll bar and drag it left or right. As it moves the column letter that will be positioned at the left of the screen is indicated





### Helpful hint

Scrolling does not move the active cell; its current location is displayed in the Name box in the top left corner of the sheet.

## Select cells with the mouse

Selecting cells (highlighting) is one of the most critical actions in Excel. You need to select cells before you do something with them, for example, enter data, copy, delete, or apply enhancements.

To select a single cell using the mouse:

- Point to the cell then click once to select it
- The cell appears transparent with a green border around it. The fill handle (square) is in the bottom right corner of the border
- This cell is named the *Active Cell*

To select a group of adjacent cells using the mouse:

- Click in the centre of the first cell to be selected, and holding the mouse button down, drag to the last cell to be selected; or
- Click the first cell to be selected, then **Shift+click** the last cell to be selected

	A	B	C	D	E
1					
2					
3					
4					
5					
6					
7					
8					

Figure 16: Highlighting a group of adjacent cells, with the Active Cell appearing transparent

The active cell is the first cell selected. A black border appears around all the selected cells. The Fill Handle is in the bottom right corner of the border.



### Helpful hint

To move the active cell from its start position to each successive corner of the selected range, press **Ctrl+.** (full stop)



To select a group of non-adjacent cells using the mouse:

	A	B	C	D	E
1					
2					
3					
4					
5					

Figure 17: A selection of non-adjacent cells

9. Select the first cell(s)
10. Hold the **Ctrl** key and select the next cell(s)
11. Repeat for all cells to be selected

The active cell is the first cell of the last group selected. A faint border appears around each group of cells. There is no Fill Handle on any of the selected cells.



#### Helpful hint

In the newer versions of Excel, users can deselect cells by holding **Ctrl** and clicking on the cells to be removed from the selection.

To select a whole column or row, use any of the following methods:

- Click the column or row heading to select it
- Click and drag across multiple headings to select adjacent columns or rows
- Click the first heading, then hold the **Ctrl** key and click other headings to select non-adjacent columns or rows
- Press **Ctrl+Space** to select an entire column, or **Shift+Space** to select your current row. Use Shift+ the relevant arrow keys to extend your selection

To select the entire worksheet, use any of the following methods:

- Click the **Select All** button above row 1
- From outside a range of cells press **Ctrl+A** on the keyboard
- Press **Ctrl + A** twice (or possibly three times) from inside a range/table

Every cell on the sheet is selected.





### Key point

If you were inside a range of cells or a table and you intend to use copy and paste or formatting commands, do not select all 17.1 billion cells.

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						

Figure 18: Every cell on the worksheet is selected

To clear the highlighted selection, either:

- Click any cell with the mouse; or
- Press an arrow key on the keyboard



### Helpful hint

It is a good idea to clear the selection before you save or close the workbook, or the range will still be selected when you reopen the file.

## Select cells with the keyboard

Selecting cells with the keyboard can save considerable time and effort. The keyboard can also be used to extend or reduce a selection already highlighted using the mouse.

To select a group of adjacent cells using the keyboard:

12. Move to the first cell to be selected
13. Hold the **Shift** key down and use the **arrow keys** to move to the last cell to be selected

The active cell is the first cell selected. A border appears around all the selected cells. The fill handle is in the bottom-right corner of the border.

To select a group of non-adjacent cells using the keyboard:

14. Select the first block of cells, then press **Shift+F8**
15. Move to the start of the next block of cells to select then use **Shift+arrow keys** to select the range
16. Press **Shift+F8** again to select another block of cells, if necessary



## Keyboard shortcuts for selecting cells

Pressing the **Shift** key in conjunction with the keys mentioned in the section Navigating and selecting cells in worksheets on page 19 will select in the appropriate direction.

The essential shortcut keys for selecting cells are:

Press	To select
Shift+ ← ↑ → ↓ (Arrow Keys)	The next cell in the direction of the arrow This can also be used to extend/reduce selections
Shift+Home	From the active cell to column A on the current row
Ctrl+Shift+Home	From your active cell to cell A1
Ctrl+Shift+End	From your active cell to the last cell containing data within your current region
Ctrl+Shift ← ↑ → ↓	To the end of a block of non-blank cells
Ctrl+A or Ctrl * (* on number keypad) or Ctrl+Shift * (above 8)	To select all the current region of cells
Ctrl+Space	To select an entire column
Shift+Space	To select an entire row



### Guided activity: Navigating and selecting cells

In this activity, we will experiment with navigating around cells

1. Ensure you are in the **GETTING STARTED.XLSX** file.
2. Click into cell C10.
3. Press **Ctrl+Home** to move to cell A1.
4. Press **Ctrl+↓** to move to the bottom of the list (cell A50).
5. Press **Tab** to move to cell B50.



6. Use **Alt + ↓** and select **Howard** (from the existing entries) to change the Customer name.
7. **Tab** again and change the Product name.
8. Press **F5**, and type cell reference **F1**, and click **OK** – Excel will navigate to cell F1
9. Press **Ctrl+Shift+↓** to move to cell F50
10. Press **Ctrl+Home** to move to cell A1
11. Press **Ctrl+A** to select the entire table
12. Press **Ctrl+Page Down** to move to the empty Sheet1
13. Close the workbook without saving changes

## Creating a new workbook

### File formats

Excel has a file format based on Microsoft's Open XML (Extensible Mark-up Language). These files have increased security, reduced file sizes and reduced chance of corruption.

### Convert to a different file format

You can open older versions of Excel files. When opened the filename will have (Compatibility Mode) showing in the title bar.



Figure 19: File created in an earlier version

These files can be converted into the format you are using with the following steps:

1. Click **File > Info > Convert**
2. Resave the document with filename and location, click **OK** to convert the file to the latest file format.

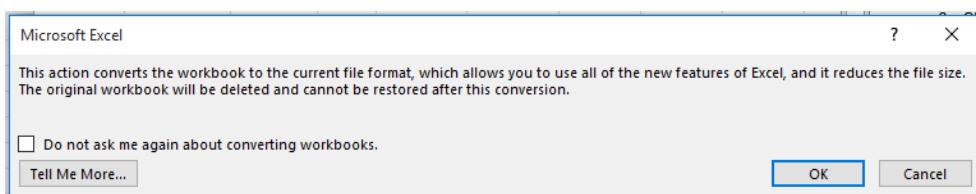


Figure 20: Update workbook message to the current format

### Managing file versions

Microsoft Office products can manage versions of a document. Office can now store versions of your documents automatically.





Even if you close a document without saving the changes to it, Office will allow that version to be reopened and then saved. Use the Info link on the File tab to display and recover the versions.

### File types

Excel now supports various new file formats based upon Open XML. This format is more secure and allows for separate, safer storage of macros and codes. Therefore, when you save a spreadsheet, you will have various options, including:

- **.xlsx** for spreadsheets with no macros or VBA
- **.xlsm** for macro or VBA enabled spreadsheets
- **.xltx** for Excel templates with no macros or VBA
- **.xltm** for macro or VBA enabled templates
- **.xlsb** for huge Excel files. These will open faster, and no XML is stored

### Recover unsaved workbooks

1. Click **File > Info** (or **File > Open**) to open the Backstage view
2. Click **Manage Versions > Recover Unsaved Workbooks**
3. In the 'Open' dialog box, select the unsaved workbook and click **Open**

### Create a new workbook

1. Select **File > New**
2. Select **Blank workbook > Create**



#### Helpful hint

Press **Ctrl+N** to create a new workbook



#### Helpful hint

Every time you start Excel, the first workbook you create is named Book1. The second is named Book2, etc. You can change the name by saving the workbook.

### Entering data

At some stage, you will need to enter information into your worksheet. This can be easily achieved.

1. Move to the cell where you want the data to appear
2. Type the information



3. Press the **Enter** key. Note the active cell will move to the cell below your current location. If you wish to keep the active cell in the same position, you can press **Ctrl+Enter** instead

If you are typing information in a list, you may benefit from a series of shortcut keys.

1. As above, move to the first cell where you want the data to appear
2. Type the information
3. Press the **Tab** key (located above **Caps Lock** and may look like ↩). This will move to the cell on the right.
4. Repeat these steps, as necessary. Note if you need to go back to a cell on the left, press **Shift+Tab**, rather than the left arrow.
5. When you reach the end of your line of data and need to start a new line, press the **Enter** key – this will move the cursor below the cell where you started pressing the Tab key



#### Helpful hint

Press **Ctrl ;** (semi-colon) to enter the current date or **Ctrl+Shift ;** (semi-colon) to enter the current time.

Note these will not update as time progresses.

## Edit information

Typing on a cell which currently holds data will replace its current contents – there is no need to press the **Delete** key.

To edit the current cell's contents:

- Position the cursor in the Formula Bar at the top of the screen and make any changes, as necessary. Press the **Enter** key when you are finished; or
- Press the **F2** key, and make changes as necessary; or
- **Double-click** the cell and make changes as necessary

To delete information, press the **Delete** key.



#### Key point

When editing a cell's contents, the **Delete** key deletes information to the right of your cursor; the **Backspace** key deletes information to the left





## Saving your work

### Saving a workbook

Once you create a new workbook or amend an existing one, you can save it. To save a workbook, you must give it a file name. Excel provides two methods for saving workbooks – *Save* and *Save As*.

- *Save* allows you to save changes under the existing file name. To access this command, you can:
- *Save As* allows you to save the changed workbook under a new name or in a different folder while keeping the previous, unchanged copy under the original filename

To use the Save command:

- Click **File > Save**; or
- Use the **Save** command on the Quick Access Toolbar; or
- Press **Ctrl+S**

To use the Save As command; or

- Click **File > Save As**; or
- Press F12

### Closing a workbook

You may want to close a workbook after you finish. When you close a workbook, Excel closes the workbook window. You can use any of the following methods to close a workbook:

- Click **File > Close**; or
- Use either the **Ctrl+W** or **Ctrl+F4** keyboard shortcut



#### Guided activity: Creating and saving a new workbook

1. Create a new, blank Excel workbook
2. Type the following data into the new workbook

	A	B	C
1	Product	Quantity	Unit Price
2	Keyboard	7	29
3	Monitor	2	129
4	Mouse	20	19



3. Save the workbook as **EXAMPLE 1.xlsx** in your training files folder
4. Use the Formula Bar to edit the price in cell **C3** to **125**
5. **Double-click** to edit the quantity in cell **B2** to **10**
6. Save and close the workbook

## Using Help

### Tell me

Help can be accessed via a feature called *Tell me* available to Excel 2016 onwards. You will find the phrase 'Tell me what you want to do' located alongside the Ribbon tabs.

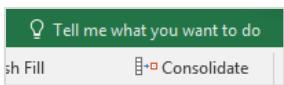


Figure 21: Tell me what to do feature

You just type in what you want help with, and it will show you Help options.

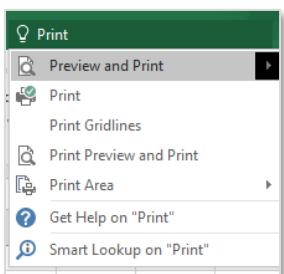


Figure 22: Example using Tell me what to do

An alternative method for obtaining help is to use the Help tab on the Ribbon (Excel 2019 and 2021).

Excel Help enables you to search online for answers to your question. There are also popular search and skills training links.

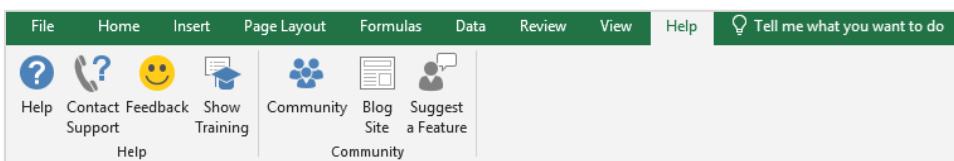


Figure 23: Excel 2019 Help tab



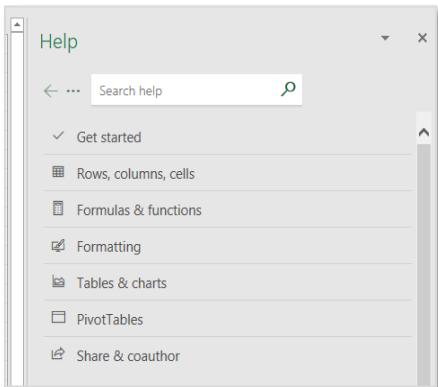


Figure 24: The Help pane

Buttons at the top will allow you to print, go back and forward and clicking home will bring you back to the first screen.



### Key point

For Excel 2013 users a help button, displayed as a question mark, is conveniently located in the top right-hand corner of your Excel window.



Clicking on this icon will take you to a contents page in Microsoft Help system. You can browse through the listed topics or use the search bar at the top to display topics related to your search term.

You can also press the **F1** key to gain access to the Help system, and many of Excel's dialog boxes have a question mark in their top right-hand corner.



### Guided activity: Using the Help system

In this activity, we will experiment using the Help system.

1. Create a new excel workbook
2. Click in the **Tell Me** box or press **F1**
3. Type in “**saving a workbook**” in the search bar
4. Select “**save your workbook**”
5. Use the **Back** Button to clear the selection

Only if available:

6. Click **Help > Help**
7. Select **Formulas and Functions > SUM** function
8. Look at the information displayed



9. Close the **Help** window
10. Close the workbook without saving changes

## Section review

In this section, you were introduced to Excel and the Excel environment:

- Introduction to Excel
- Excel and the Excel environment
- Navigating and selecting cells
- Creating a new workbook
- Open, save and close a Workbook
- Use Microsoft Help

### Review questions:

1. How do you add a command to the Quick Access Toolbar?
2. What command can I use to Auto-Hide the Ribbon?
3. What tab can I use to Zoom to 100%?
4. What keyboard command will Select All cells in a workbook?
5. Where can I find Help?



#### Independent activity: Getting started with Excel

1. Start Excel and create a blank workbook.
2. Add the following data into the relevant cells.

	A	B	C	D
1		January	February	March
2	Team A	25	22	12
3	Team B	34	17	33
4	Team C	19	30	26

3. Save the workbook as **MY SALES SHEET.XLSB** in the training files folder.
4. Close the workbook.





V1.5.2

## Part 2: Modifying a worksheet

In this section, you will learn how to use features that will allow you to modify worksheets:

- Cut, Copy and Paste commands
- Undo and Redo
- AutoFill Options
- Insert and Delete Options
- Column Width and Row Height
- Hide and Unhide Options
- Find and Replace
- Spelling





## Cut, Copy and Paste commands

These commands allow you to move data from the current location to another location with your worksheet.

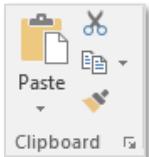


Figure 25: The Cut, Copy and Paste commands

- The **Cut** command will move your selected data and formatting to a new location – the keyboard shortcut key is **Ctrl+X**
- The **Copy** command will duplicate your selected data and formatting to a new location – the keyboard shortcut is **Ctrl+C**
- The **Paste** command is used to confirm the new location for your data and formatting – the keyboard shortcut is **Ctrl+V** (alternatively, press **Enter** to paste once only)

The Paste command has more options available with a Live Preview. It shows how they will appear when you paste them, i.e., Paste Values, Paste Formulas, Paste Link, Paste as picture, all available from the dropdown buttons or the Paste Special link at the bottom of the menu.



Figure 26: Paste options

1. Select the cells or range of cells containing the data to be moved or copied
2. Click **Home > Copy** or **Home > Cut** as required
3. Navigate to the cell where the data needs to be pasted, and click **Home > Paste**



## Using drag-and-drop

1. Select a cell or cell range.
2. Position the mouse pointer on one edge of the extended cell range (the green border that surrounds the cell/s, not the Fill Handle).
3. The cursor will change to a white arrow attached to a smaller, four-headed black arrow.
4. Drag your selection to its destination (drag by holding down the mouse button while moving the mouse) this moves the cell/s.
5. Release the mouse button.



### Key point

Unlike most other applications, Excel only remembers what you have copied or cut until you complete the next command. For best results, use Paste as soon as you have copied (or cut) the necessary cells.



### Helpful hint

Holding the **Ctrl** key while you drag a cell range will copy the selected cell/s instead of moving them.

## Transpose data

To transpose data:

1. Select the data you want to transpose
2. **Cut** or **Copy** the data as normal
3. Select the destination cell for the transposed data
4. Click **Home > Paste > Transpose**

As shown below, the column and row heading are now changed around:

A	B	C	D	E	F
1	1st Quarter Sales				
2		January	February	March	Total
3	Inkjet Printer	£ 33,033	£ 35,558	£ 36,663	£105,254
4	LaserJet Printer	£ 65,663	£ 83,181	£ 66,373	£215,217
5	Laptop	£ 88,088	£ 85,558	£ 86,668	£260,314
6	Netbook	£ 42,850	£ 21,086	£ 56,800	£120,736
7	Total	£ 229,634	£ 225,383	£246,504	£701,521
8					
9					
10					
11	Inkjet Printer	LaserJet Printer	Laptop	Netbook	Total
12	January	£ 33,033	£ 65,663	£ 88,088	£ 42,850 £229,634
13	February	£ 35,558	£ 83,181	£ 85,558	£ 21,086 £225,383
14	March	£ 36,663	£ 66,373	£ 86,668	£ 56,800 £246,504
15	Total	£ 105,254	£ 215,217	£260,314	£120,736 £701,521
16					

Figure 27: An example of transposed data





### Guided activity: Cut, Copy and Paste

In this activity, you will practise moving and copying data from one worksheet to another.

1. Open the file **COPY PASTE.XSLX** workbook
2. Select cell **B1** and use the drag-and-drop method to move (or Cut) the heading to cell **A1**
3. Copy the heading in cell **A1** and Paste it into cell **A1** in **Sheet 2**
4. Likewise, copy cells **A3:E8** from **Sheet 1** to cell **B1** in **Sheet 2** worksheet and paste using the **Transpose** option
5. Save and close the file

## Undo and Redo commands

The **Undo** command allows you to undo recent actions in a worksheet. You will find the Undo command on the Quick Access Toolbar (or use **Ctrl+Z**). You can use this command to step back quickly and easily and reverse your recent actions (e.g., typing, deleting, and formatting). Some commands cannot be reversed; usually, these are commands from the File Tab/Backstage area, or commands that warn you before the action is completed.



### Helpful hint

Typically, you can undo up to **100** actions.

The **Redo** feature will redo the last step from the Undo command (**Ctrl+Y**); therefore, you can undo if you change your mind. The two work together, allowing you Undo and Redo quickly without having to delete actions and re-type.

Both commands have a dropdown list of actions that were performed in the worksheet and will allow you to undo/redo more than one action at a time, however, you cannot just choose to undo/redo Action 3 without going through Actions 1 and 2 first.

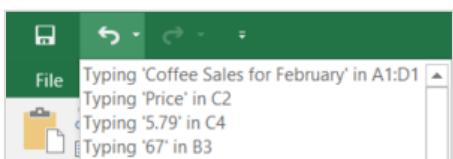


Figure 28: You can undo multiple actions from the dropdown list





### Guided activity: Using Undo and Redo

In this activity, you will undo various changes made.

1. Open the file **EDITING.XLSX**
2. In Cell **B2** change the Quantity to **10**
3. In Cell **C4** change the Unit Price to **£20.00**
4. **Undo** the last action, then **Redo** the last action
5. Save and close the file

## Using AutoFill

The *AutoFill* feature allows you to fill cells with a series of data, by using the fill handle at the bottom right corner of the selected cell or cell range.

Excel has many built-in lists, including dates, days, months and quarters or you can create your own from a data list and use the Fill Handle to extend the series.

When extending data, a *SmartTag* will appear to give you more AutoFill options. The list below shows how to start the data series and how it extends when you use the Fill Handle to drag across columns or down rows. In some cases, you will need to select both cells before dragging, i.e., select 5 and 10 drag the Fill Handle to produce the extended series.

Data type	Example Selection	Extended Series
Day of week	Monday	Tuesday, Wednesday, etc.
Abbreviated day of week	Mon	Tue, Wed, etc.
Month	April	May, June, etc.
Abbreviated Month	Apr	May, Jun, Jul, etc.
Dates	17/2/2020	18/2/2020, 19/2/2020, etc.
Quarters	Quarter 1 Qtr 1 Q1	Quarter 2, Quarter 3, etc. Qtr 2, Qtr 3, etc. Q2, Q3, etc.
Numbers	1, 2 also	3, 4, etc.



Data type	Example Selection	Extended Series
	10, 20	30, 40, etc.
Text with Numbers	Room 1 Year 1	Room 2, Room 3, etc. Year 2, Year 3, etc.



### Useful tool

Enter data into two (or more) cells, select them and use AutoFill to create a custom sequence. For example, entering and selecting two dates seven days apart would let you AutoFill weeks commencing dates.



### Guided activity: Using AutoFill

In this activity, you will test various AutoFill features (AutoFill will also be used later when formulas are looked at).

1. Create a new blank workbook
2. In cell, **A1** type the current day of the week, and **drag** the **Fill Handle** down to **row 14** – Excel will enter the days of the week twice
3. In cell **B1**, type the first three letters of the current month, and **drag** the Fill Handle down to **B12** – Excel will enter the abbreviation for each month into the blank cells
4. **Delete** the information you have entered

Having tested how Excel deals with days of the week, you will now experiment with using AutoFill with values and dates:

5. In cell **A1** type the number **1**, and in cell and **A2** type the number **2**
6. Select both cells together and drag the Fill Handle down to cell **A20** – Excel will continue the sequence in the blank cells
7. In cell **B1**, press **Ctrl ;** (semi-colon), to quickly enter the current date
8. Drag the Fill Handle down to cell **B20**, and Excel will enter the dates in sequence
9. Keep the date list selected and click the SmartTag icon in the bottom right corner of the last date cell
10. Select **Fill Weekdays** then change to **Fill Months** and finally **Fill Years** – observe the impact these options have on the date range.
11. Delete the information you have entered



12. Finally, in cell **C1** enter **next Monday's** date, and drag the Fill Handle down to cell **C20**
13. Keep the date range highlighted and select **Home > Editing > Fill > Series**
14. Ensure that **Day** is selected and enter **7** into the **Step Value** box.
15. Click **OK** to replace the individual dates with dates for consecutive Mondays
16. Close the workbook without saving changes

## Working with rows and columns

### Inserting and deleting

At times you may need to create additional space or to delete from within your data set. You can easily insert additional blank rows or columns; likewise, you can delete rows or columns. Where the insertion falls within a SUM function range, the new cells are included in the total.

Columns are inserted to the left of the selection; rows are inserted above the selection.

To perform these actions, you can use one of the following:

- **Home > Cells > Insert** or **Delete** shown below:

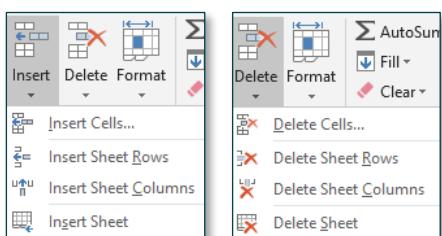


Figure 29: Options for inserting and deleting

- Right-click to access the shortcut menu
- Use the shortcut keys **Ctrl +**(plus) to insert, or **Ctrl -** (minus) to delete



#### Helpful hint

Highlight the area you want to insert or delete before using the relevant commands.

To insert a collection of cells:

1. Select the cell or cell range
2. Click **Home > Insert > Cells...**
3. Choose to **Shift cells right** or **Shift cells down**



In the example below, selecting the 'Shift Cells Down' option will allow us to type February in the correct location:

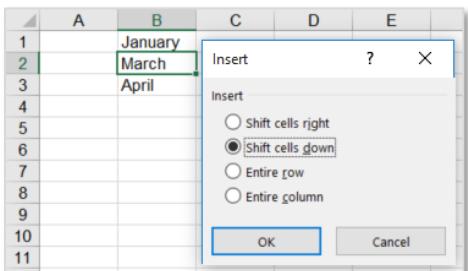


Figure 30: The Insert Cells dialog box



### Guided activity: Inserting and deleting

1. Open the file **INSERT DELETE.XLSX**
2. Delete column A and delete row 4
3. Delete cells A5:B6 and **Shift Cells Up**
4. Insert a column between columns E and F
5. Name this new column – **'Date of Travel'**.
6. Save and close the file

## Column width and row height

There are times when you may have more information within a cell than will fit into the width of the cell. In these situations, you can change the column width, or increase the row height.

To change the column width:

- Place the mouse pointer in between the column headings to the right of a column heading, (mouse pointer will change to a black cross) and drag to the right or left; or
- Select the column heading, and click **Home > Format > Column Width...**

To have Excel automatically set the column width:

- Place the mouse pointer in between the column headings to the right of a column heading and double-click the mouse button. Excel will set the column width to accommodate the widest piece of text in the column



To change the row height:

- Place the mouse pointer in between the row headings and drag up or down
- Place the mouse pointer in between the row headings and double-click the mouse button. Excel calculates the row height to accommodate the highest entry in the column
- Select the column heading, and click **Home > Format > Row Height...**



#### Helpful hint

To change the column width of multiple columns (or rows), select the columns you need to alter and change the column width in one of the methods described above.



#### Guided activity:

#### Changing column width and row height

In this activity, you will tidy up your sheet adjusting row height and column widths.

1. Open the file **COLUMNS & ROWS.XLSX**.
2. Adjust the column widths using different methods:
  - Double-click to auto-adjust column A and B
  - Select and drag to manually adjust column C
  - Use **Home > Format > AutoFit Column Width** for column D
3. Select Row 1 and insert a row above it
4. Add the heading **Sales Information by Product**
5. Increase the row height to exactly **30** using **Home > Format > Row Height...**
6. Insert a column to the left of column A and move the contents of cells **B11:B15** into the cell range **A3:A7**
7. Change the column width by any of the techniques used previously
8. Save the changes to the file and close it

### Hide and unhide options

You can hide a row or column by using the Visibility commands, or by changing the row height or column width to 0 (zero). You can display them again by using the Unhide command.





## Hide rows or columns:

1. Select the rows or columns that you want to hide.
2. Click **Home > Format > Hide & Unhide** > select the required hide option

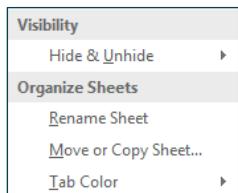


Figure 31: Visibility options from within the Format command

## Display rows or columns

To display hidden rows or columns:

- Select the rows or columns on both sides of the hidden range
- Click **Home > Format > Hide & Unhide** > and select the relevant unhide option



### Helpful hint

If column A or row 1 are hidden, use the 'Go To' dialog box (shortcut keys **F5** or **Ctrl+G**). In the Reference box, type **A1**, and then click **OK**.

You can also position the mouse to the left of column letter B or above row 2 and **right-click** > (a green line appears) **Unhide**. This can be used between any two columns or rows.



### Guided activity: Hiding and showing data

In this activity, you will tidy up your sheet, adjusting hiding or showing various rows and columns.

1. Open the **HIDING & SHOWING DATA.XLSX** workbook
2. Hide all rows for the **South Region** using the mouse and right-click option
3. Display all rows again
4. Hide column **A**

You will now unhide the previously hidden data:

5. Click **Home > Find & Select > Go To...**, or press **F5**
6. In the 'Go To' dialog box, type **A1** and click **OK**



7. Click **Home > Format > Hide & Unhide > Unhide Columns**
8. Save and close the file

## Find and Replace

When you have a worksheet with a large volume of data, it can be challenging to locate specific values quickly.

Using the *Find* command, you can effortlessly search for the information you require, for example, someone's name, or a product, or an invoice number.

The *Replace* command allows you to replace one piece of data with another efficiently. For example, if a colleague leaves, you can easily replace their name with the name of their replacement. You can change the data cell by cell or use the Replace All feature to allow Excel to make the changes globally.

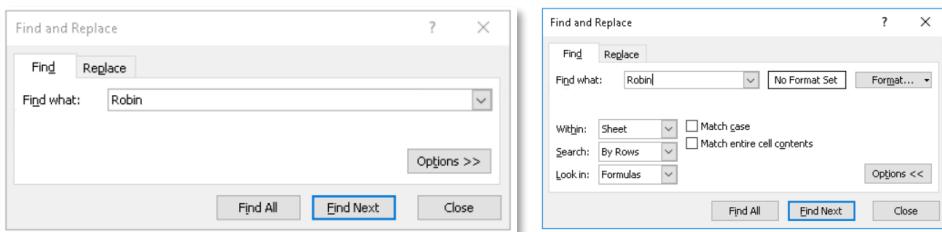


Figure 32: The 'Find' dialog box, with and without options displayed

### Find and Replace options

There are several options which control how both the Find and Replace commands behave. To access these, click the **Options** button in the dialog box.

Command	Description
Format	Excel will only find data with matching formatting options
Within	Allows you to specify whether Excel searches just your current worksheet (default action), or the entire workbook
Search	The direction in which Excel performs the search
Look in	Specifies where Excel should look for the date: <ul style="list-style-type: none"> <li>• With the <i>Formulas</i> option, Excel will find the data where it has been typed directly into a cell and if it appears within a formula</li> </ul>



Command	Description
	<ul style="list-style-type: none"> <li>If you select the <b>Values</b> option, Excel will find the data where it has been typed directly into a cell and where the value is the result of a formula</li> <li>Select <b>Comments</b> if you only want Excel to find the search term within a comment (i.e., not cells)</li> </ul>
Match Case	Specify this if you want Excel only to find the data if it matches the capitalisation that you use in the Find/Replace dialog box
Match entire cell contents	Prevents Excel from returning partial matches

Additionally, Excel offers multiple buttons to complete the action:

Button	Description
Find Next	Excel will move to the next instance of the search term. Note: continuously pressing this will cause Excel to perform the search repeatedly, i.e., Excel does not stop searching, even if it has found every search term
Find All	Excel produces a list of locations containing the search term; Note the cell addresses in the list will act as a hyperlink if you click them
Replace	Excel will replace the search term in the current cell with your replacement text and take you to the next instance. This gives you control over if the search term is replaced. If you wish to ignore this instance, click Find Next to move to the next location
Replace All	Excel will automatically replace every instance of your search term with your replacement text

To find data:

1. Click **Home > Find & Select > Find...**, or press **Ctrl+F**
2. Enter your search term in the **Find What** text box
3. If necessary, click the **Options** button to customise the behaviour
4. Either click the **Find Next** or **Find All** button



To replace data:

1. Click **Home > Find & Select > Replace...**, or press **Ctrl+H**
2. Enter your search term in the *Find What* text box
3. Enter the replacement term in the *Replace With* text box
4. If necessary, click the **Options** button to customise the behaviour
5. Click the **Find Next** and **Replace** buttons to control when the replacement is made; alternatively, click **Replace All** to make global changes without being prompted



### Guided activity: Find and Replace

In this activity, rather than retying the same value numerous times, you will use the Replace command to update email addresses.

1. Open the file **FIND & REPLACE.XLSX**
2. Use Find and Replace to correct the surname **Johnson** to **Johnstone**
3. Use Find and Replace to replace all email addresses with **.com** with **.co.uk**
4. Use **Replace** for the first few, then **Replace All** (24 in total)
5. Save and close the file

## Performing a spelling check

Excel has *spelling checking* capabilities, although it does not highlight potential issues in the worksheet in the same way that Word, Outlook, and PowerPoint will.

The Spelling command is located on the Review tab of the Ribbon, (the shortcut key **F7** also works in all Microsoft Office applications). You can also easily add it to the Quick Access Toolbar by right clicking on the command.

A dialog box will appear to help check the spelling within your worksheet, see example below:



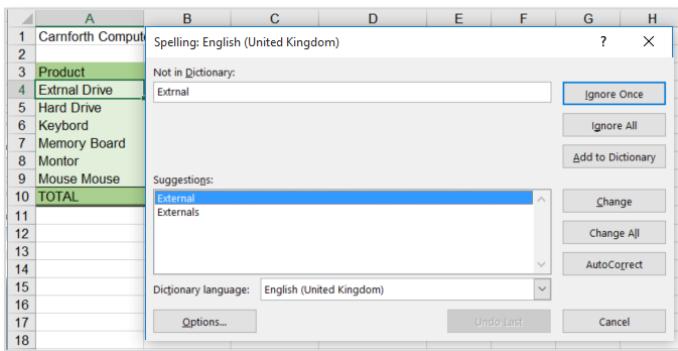


Figure 33 – Spell Check dialog box

Many options are available to control the actions performed by Excel.

Command	Description
Ignore Once/ Ignore All	If you are satisfied that the highlighted word is spelt correctly, you can use Ignore Once to move to the next flagged word or Ignore All to prevent you from being prompted every time Excel encounters this word in the current spell check
Add to Dictionary	Add to Dictionary To prevent you from being prompted about a correctly spelt word which Excel does not recognise, you can add the term to your Custom Dictionary. This will also prevent the text from being flagged in all other Microsoft applications that you use. This could be useful to prevent Excel from flagging up names of companies, products, people, locations etc.
Change	Click to replace the highlighted word with a word from the Suggestions list box
Change All	Click this button to automatically change all occurrences of a word with a word from the Suggestions list box
AutoCorrect	Click this button to have Excel automatically correct this spelling error with the suggestion displayed in the Suggestions list box (by adding the misspelling and suggestion to the AutoCorrect dialog box)
Dictionary Language	Allows you to select the language to perform the spell check



Command	Description
Options	Takes you to the Proofing area in the Excel Options where you can modify the current spell check settings, edit the Custom Dictionary and setup how Excel deals with different Spelling corrections



### Helpful hint

If the spell check does not commence from the top of the sheet the following box will appear once the check has been completed in a downward direction to continue from the top.

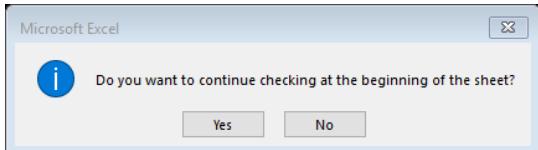


Figure 34: Spellcheck complete dialog box



### Guided activity: Performing a spelling check

1. Open the file **SPELLING.XLSX**
2. Click **Review > Spelling** to start the spelling check
3. Add the word “Barnforth” into the dictionary
4. Continue with the check, changing information as required
5. Remove the repeated word **Mouse** when asked
6. Save and close the file



### Useful tool

If you see an option AutoCorrect, it is worth considering using it. In future, the mistakes can then automatically correct themselves as you type.

## Section review

In this section, you have covered how to use features that will allow you to modify worksheets and workbooks:

- Cut, Copy and Paste Commands
- Undo and Redo Commands
- AutoFill





- Inserting and Deleting
- Column Width and Row Height
- Hide and Unhide Options
- Find and Replace
- Performing a Spell Check

### Review questions:

1. What shape is the mouse pointer when you use drag and drop editing?
2. How do I start a spelling check?
3. What is the keyboard action for Undo?
4. Where will I find the Visibility option to hide and unhide rows or columns?
5. How could you change the width of multiple columns?



#### Independent activity: Modifying a workbook

1. Open a file named **LAB MODIFYING.XLSX**
2. From **Sheet 2**, copy cells **A1:A14** into **Sheet 1** to cells **B7:B20**
3. Adjust columns' widths to view the data
4. Move the date in cell **B2** to cell **A2**
5. Edit the text in cell **B5** from Product Nos. to **Product Code**
6. Delete row **4**
7. Move the cell range **B4:F19** to **A4:E19**
8. Delete row **6**
9. Adjust the height of row **1** so that the text is visible
10. Save and close the file





## Part 3: Introduction to functions

We will start with a recap of the basic concepts of using functions within Excel. There are techniques which are important to learn and work through in order to maximise your use of Excel functions.

In this lesson by doing a review of functions that may have been covered on previous courses, or by simply going over functions that you may already know we can go over how to write functions, how to use help and how to use keyboard shortcuts when writing functions.

We will also explore how to understand the function syntax, namely the information and instructions about a given function.

### What is a function?

Let's start by considering this: **What is a Function?**

A function is a pre-programmed calculation in Excel, which will perform the steps necessary to compute an outcome. Whilst you could perform these steps yourself, using a function is significantly easier and quicker for you.

Consider a scenario where we need to calculate the average sales of ten products. We could create a formula to calculate the average as follows:

= $(A2+A3+A4+A5+A6+A7+A8+A9+A10+A11)/10$

Now imagine how tedious it would be if we had to calculate the average for 100 products!

Thankfully, Excel has a built-in function to simplify the process, Microsoft have created the AVERAGE function, which understands the steps it takes to calculate the average (arithmetic mean). We simply need to specify the function to use and provide the cells containing the values, meaning we can simply type the following into a cell:

=AVERAGE(A2:A11)



#### Key point

Formula means any calculation within Excel (e.g., =B100-A100)

Function is a built-in calculation (e.g. =SUM(A2:A13))



## Reading syntax

An important logic that must be learnt when writing functions is the ability to read the 'syntax' of a function. The syntax describes the information we need to provide Excel in order for it to perform the calculation.

For instance, some functions require what are called 'arguments' for them to work, some functions have no arguments, and others have mixtures of mandatory and optional arguments. Being able to decipher this information will make it much easier to use functions.

Information about the syntax can be gained from a number of places within Excel:

- Typing a function directly in a cell
- Using the Function Wizard
- From Excel's help (which typically includes several examples)

### Typing a function directly in a cell

In Excel all formulas and functions start with an equal's sign (=), which is then followed by the name of the function. Next, contained within brackets come any relevant arguments for the function; multiple arguments need to be separated by comma symbols.

When writing functions in Excel a drop-down list will appear as you type the name of your functions. To auto complete the function you are writing either press Tab, or double-click on the function name in the list.

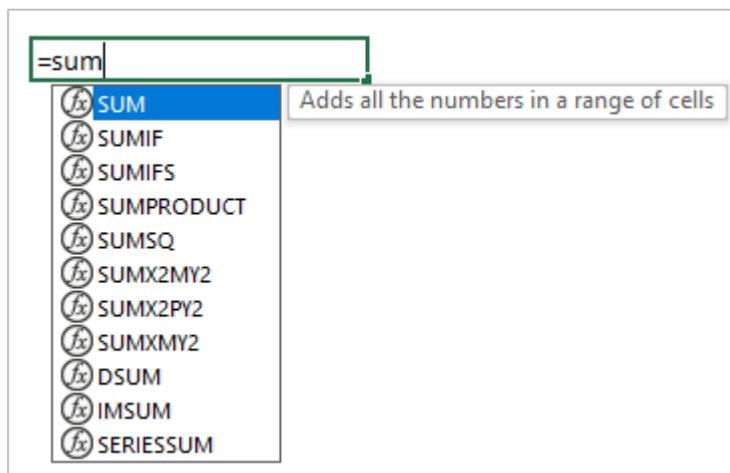


Figure 35: A picklist appears when you type = followed by the (partial) name of a function

You don't get much assistance from Excel using this technique; all you'll see is a small screen tip below the function you are typing and a list of arguments for the function. The screen tip will display optional arguments



inside square brackets ([ ]); arguments outside of square brackets are mandatory.



### Key point

The current argument (i.e. the one where your cursor is positioned) is displayed in bold. This is updated as you move your cursor throughout the arguments.



### Helpful hint

Clicking on the name of an argument in the screen tip will result in that argument being selected, which can prove extremely useful.

Figure 36: Samples of screen tips showing the syntax of several Excel functions

Let's examine the examples shown in Figure 36 above:

For the TODAY function, there are no arguments required and therefore there is nothing to provide within the brackets (if you include any information, you will receive an error).

For the SUM function, there is one required argument, and an optional second and further set of numbers, symbolised with the ellipsis...

The IF function shows the logical test argument is required, while the results for the true and false arguments are optional. As with the SUM function, these are symbolised as being optional by the use of square brackets [ ]. Notice here that the value\_if\_false argument appears in bold as this matches the cursor position.

## Using the Function Wizard

The Function Wizard is a dialog box designed to help Excel users create functions. It provides an interface where users can quickly get help on the function being created and with the information needed by any



arguments, easily interact with their spreadsheets and it also allows access to the full Excel Help for the function being written.

There are various methods you can use to access the Function Wizard:

- Click on the Insert Function icon, on the Formulas Tab of the ribbon
- Click on the fx icon on the Formula Bar
- Click on the function name from the appropriate function category on the Formulas Tab
- Start writing the function and press CTRL+A when you have entered the name of the function being written
- Press SHIFT+F3 to either start the Function Wizard (then select the relevant function), or to edit an existing function

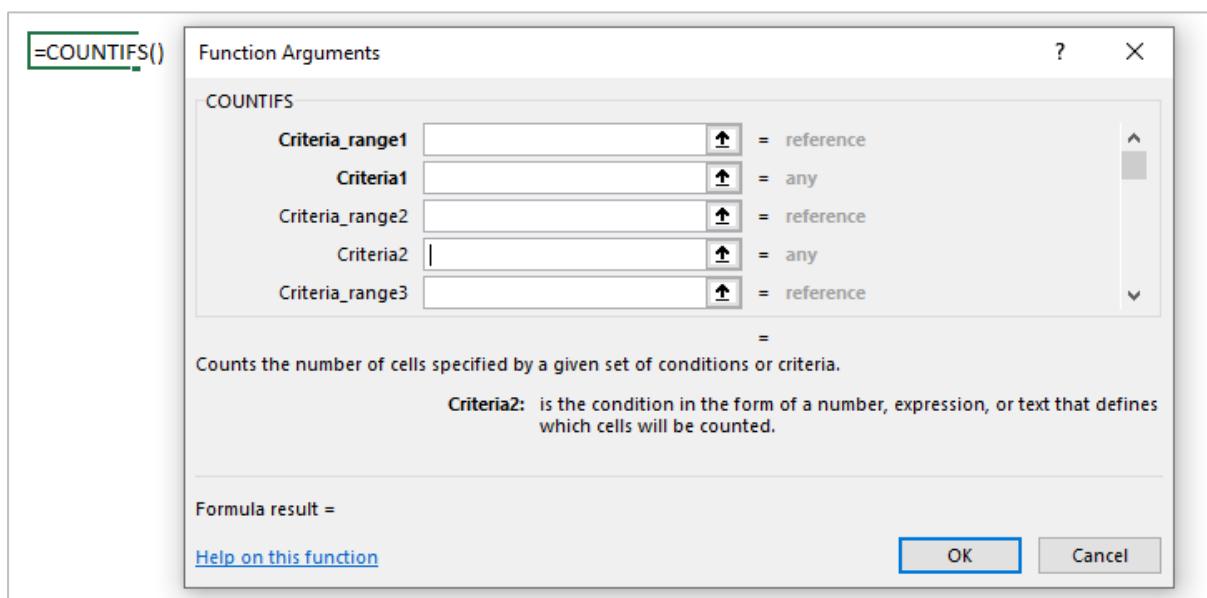


Figure 37: The Function Wizard



### Useful tool

The Function Wizard displays mandatory arguments in bold, optional arguments as non-bold and repetitive arguments as numbered.

You can use the scrollbar on the right to view additional arguments if relevant.



59	Revenue over £2,000 earns 5% commission		
60			
61	Product	Revenue	Commission
62	RYG-1383	£ 2,784	<code>commission,B62*5%</code>
63	UXU-2682	£ 3,121	£ 156.05
64	BYZ-1302	£ 1,892	No commission
65	XQY-1951	£ 2,615	£ 130.75
66	YIJ-1447	£ 1,388	No commission
67	UEL-1692	£ 2,384	£ 119.20
68	GVQ-1872	£ 2,040	£ 102.00
69	TVK-1217	£ 2,685	£ 134.25
70	VRO-2259	£ 2,551	£ 127.55
71			
72			
73			
74			
75			

Function Arguments

IF

Logical_test	B62<2000	= FALSE
Value_if_true	*No commission	= Invalid
Value_if_false	B62*5%	= 139.2

Checks whether a condition is met, and returns one value if TRUE, and another value if FALSE.

Value\_if\_false is the value that is returned if Logical\_test is FALSE. If omitted, FALSE is returned.

Formula result =

[Help on this function](#)

**OK**   **Cancel**

Figure 38: Editing a function with the Function Wizard

There are several useful features in the dialog box.

- To the right of each completed argument, the Function Wizard will display either the contents of the cell/s referenced, or the outcome of a formula (see the first and last arguments in Figure 38 above)
- Certain syntax issues will be flagged to the right of the relevant argument, after your cursor has left the textbox. In Figure 38 above we have omitted the closing speech marks, which is an error
- An overview of the purpose of the function is displayed below the text boxes
- Next, a short description of the information you need to provide in each function appears, with the relevant function name in bold
- Commas are required to separate the various arguments (apart from the last argument). The Function Wizard will add these automatically
- If your argument is entirely text-based, speech marks will be added by the Function Wizard. You can, of course, do this manually
- The result of the entire function can typically be viewed in the bottom-left corner of the dialog box (not shown in Figure 38 above)
- A hyperlink to Excel's help system appears in the bottom-left corner of the dialog box

## Reading the Help Screen syntax

Excel's Help system gives you a wealth of information regarding its functions, displayed in a consistent format regardless of the function's capabilities.

To access function Help you can do one of the following:



- Press F1 and locate the function from the Search area; either type the name of the function or enter some text that might help you find the function ("How can I calculate a loan payment plan")
- When writing the function, click on the name of the function from the screen-tip that appears below the text you are typing
- Within the Function Wizard, click on the Help hyperlink

Help is broken down into various sections.

- Description provides an overview of the purpose of the function and any extra notes to help you understand how the function works.
- Syntax describes the function must be written. Descriptions of required and optional arguments are explained.
- Examples are provided, which you can copy and paste into a worksheet to see how the function works. There are instructions on what to do within the Example area. All examples if copied should be pasted into A1 on a blank worksheet. Once pasted a smart tag appears below the pasted data and an option called Match Destination Formatting should be selected.
- Best Practice tips may also be provided



### Helpful hint

Keyboard Shortcuts for working with or editing functions

- **F4** - Switch between Absolute (\$) and Relative cell references
- **CTRL+A** – Display the Function Wizard. Press the keys after opening the bracket of the relevant function
- **CTRL+`** (grave symbol, top left of keyboard) Reveal Formulas/Functions (toggle)
- **TAB** – Press to AutoComplete the name of a function or Range Name from a list
- **SHIFT+F3** – Display the Insert Function dialog box
- **F9** - Recalculate entire workbook
- **SHIFT+F9** - Recalculate current worksheet





V1.5.2

## Part 4: Popular Excel functions

In this section you will explore some of Excel's popular functions. You will examine the Function Library, and create common calculations using criteria, logical and lookups. You will also explore a simple example of the new 'spill' functions.

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

- Understand Functions
- Use Insert Function to assist with formula writing
- Work with criteria-based functions
- Using logical functions
- Working with lookup functions
- Understand what a dynamic array function is



## Understanding functions

A function is a calculation built directly into Excel. They save you from having to create each formula manually. Can you imagine how tedious it would be to add 1,000 cells together, or to calculate their average? Instead, we could use the built-in functions to save time and reduce mistakes.

When examining a function, the function name is displayed immediately after the equal sign. Following this, enclosed within brackets, are the function's arguments; this is the information required to perform the necessary calculation. If required, the arguments are separated by commas.

The arguments used by functions can typically include text (enclosed in speech marks), numbers, cell addresses or expressions.

For example, the formula =SUM(A1:A10,C10:C20,D20:D30) has three arguments – the three sets of cell references.



### Key point

Functions generally have two components:

- The *function name* (e.g., SUM or AVERAGE)
- The *arguments*, which are entered inside brackets (e.g., A2:A13)

As your experience and knowledge of Excel expands, you are likely to need to create more and more formulas. It can be difficult to remember how each different function works and the information you need to provide. We will now examine two features of Excel which can help us to discover and use the built-in functions.

### The Function Library

It is useful to think of functions as living within 'families' of functions. For instance, there are functions in Excel called MIN and MAX that relate closely to SMALL and LARGE.

The Function Library lists all of Excel's functions, arranged by their families.

Category	Purpose
Financial	Common accounting and financial calculations. The calculations are primarily based on depreciation of assets, investments, and loans.
Logical	Perform checks to see if a condition is true or false



Text	Manipulate text in a worksheet, e.g., change the case of text, or extract characters from within a text string
Date & Time	Perform date-related calculations on data. The data must generally be stored as a value for these to work.
Lookup & Reference	Used for finding values in a corresponding table or list and incorporating the data into the calculation. One of the most frequently used Excel functions is VLOOKUP.
Math & Trig	Used to perform common mathematical and trigonometric calculations such as SUM, rounding, sine and cosine values, logarithms, and exponents
Statistical	Statistical analysis on a range of data in a worksheet or in a chart, for example to calculate an average
Engineering	Engineering conversions and tests
Cube	Analyse OLAP data cubes
Information	Analyse ranges of data to determine the type of data or formatting present in a cell
Compatibility	Functions originally created in earlier versions of Excel that have since been upgraded to correct errors, or improve functionality
Web	A small number of functions which interact with web services

## Function syntax

The **syntax** of a function – or how it is written – is important to understand. Essentially, when writing a function, it is being written in Excel's 'language', and like all languages there are structures that should be followed.

All functions comprise an equal sign, their name, and a pair of round brackets (parentheses), e.g., **=SUM(...)**. Inside these will be any **arguments** – the pieces of information and/or cell references the function requires.

Because it is almost impossible to remember which arguments each function requires, when writing a function Excel will display a short ScreenTip to remind the user. More detailed information is provided when creating a function using the Function Wizard.



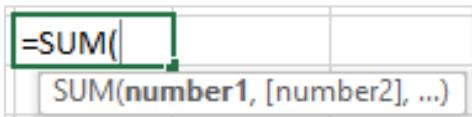


Figure 39: An example function and its ScreenTip

In the above screenshot notice that the two arguments are displayed differently – one is in bold, the other in square brackets (brackets).

Argument style	Description
Bold	The argument currently being worked on
Not bold	Other arguments
In square brackets	Optional arguments (note that if ignored, Excel may make 'assumptions')



### Key point

The Function Wizard displays mandatory arguments appear in bold, optional arguments do not

## Using Insert Function and the Function Wizard

The '*Insert Function*' dialog box (also known as the *Function Arguments* dialog box) allows you to create a formula using any of Excel's built-in functions and keeps typing to a minimum. It also provides descriptions of the purpose of the function and gives you an overview of the information you need to specify each argument.

Essentially, it means that you do not have to remember the intricacies of every function you use. The Function Wizard will also automatically add any commas and brackets that are needed for the function to work.

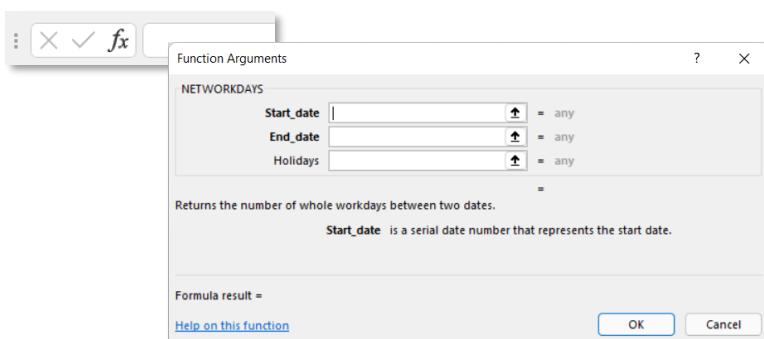


Figure 40: The '*Insert Function*' button and its dialog box



To use the 'Insert Function' dialog box:

1. Select the cell where the new formula is to be placed
2. Click the **Insert Function** icon in the Formula Bar
3. Select or search for the required function, and click OK – Excel will display the 'Function Arguments' dialog box for the selected function



#### Useful tool

The 'Insert Function' dialog can also be displayed by clicking **Formulas > Insert Function** icon.

The 'Function Arguments' dialog box provides you with several pieces of information that can be beneficial when creating a formula, especially if it is one you rarely use, or something complex.

At the top of the dialog:

- The name of the selected function and a list of its *arguments*
- Any arguments displayed in bold are mandatory; those which are not are optional (the same as arguments displayed in square brackets on the popup ScreenTip when writing a formula)

At the bottom of the dialog:

- An explanation of the function
- A short description of the currently selected argument
- The current formula result, given the data so far provided to the function
- A link to Excel's Help system, which can provide further information on the function and its arguments, typically with examples



#### Helpful hint

Some functions have many arguments, so Excel will not display them all immediately. It will add them to the dialog box as the previous one is completed.

We will explore using the Function Wizard throughout the rest of this section.





## Aggregate functions

### SUM

Function Category	Version / Availability
Math & Trig	All versions

#### Definition

The **SUM** function provides the total of all numbers listed within the arguments.

Each individual argument can be a number, a cell or range of cells, an array of cells, a name, or any combination of these.

#### Syntax

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

- **Number1 (required)** this related to a series of numbers, or cells containing numbers
- **Number2 (optional)** A total of 255 arguments can be provided

#### Examples

=SUM(10,100,500)

=SUM(A1:A10)

=SUM(January)

=SUM(10, A1:A10, January)



#### Helpful hint

The AutoSum command ( $\Sigma$ ) is available on both the Home and Formulas tab and will help you create SUM functions.

This also has a keyboard command **ALT+=**

	A	B	C
1	Sales	Income	
2	Jan	£ 18,000	
3	Feb	£ 19,000	
4	Mar	£ 26,000	
5	Quarter 1 Total	£ 63,000	=SUM(B2:B4)

Figure 41: Sample SUM function

In the example shown in Figure 41, the SUM function will total the values from B2 through to B4 inclusive; the result is £63,000.





## AVERAGE

Function Category	Version / Availability
Statistical	All versions

### Definition

The **AVERAGE** function will calculate the average of the values given within the arguments. The arithmetic mean type of average is used.

Each individual argument can be a number, a cell or range of cells, an array of cells, a name, or any combination of these.

### Syntax

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

- **Number1 (required)** this related to a series of numbers, or cells containing numbers
- **Number2 (optional)** A total of 255 arguments can be provided

### Examples

=AVERAGE(A1:A10)

=AVERAGE(DataTable)

=AVERAGE(10, A1:A10, DataTable)



#### Helpful hint

You can easily create an AVERAGE function by using the AutoSum command ( $\Sigma$ ). Click on the drop-down arrow to the right of the icon and select Average.

	A	B	C
1	Sales	Income	
2	Jan	£ 18,000	
3	Feb	£ 19,000	
4	Mar	£ 26,000	
5	Quarter 1 Average	£ 21,000	=AVERAGE(B2:B4)

Figure 42: The AVERAGE function

In the example shown in Figure 41, the AVERAGE function will total the values from B2 through to B4 inclusive; the result is £21,000.



#### Key point

Empty cells are ignored from the result, but cells containing a zero are included.



## MIN/MAX

Function Category	Version / Availability
Statistical	All versions

### Definition

The **MIN** or **MAX** functions will calculate the minimum or maximum value from the numbers within the given arguments.

Each individual argument can be a number, a cell or range of cells, an array of cells, a name, or any combination of these.

### Syntax

=MAX(number1, [number2], ...)

- **Number1 (required)** this related to a series of numbers, or cells containing numbers
- **Number2 (optional)** A total of 255 arguments can be provided

### Examples

=MIN(A1:A10)

=MAX(DataTable)



#### Helpful hint

You can easily create either a MAX or MIN function by using the AutoSum command ( $\Sigma$ ). Click on the drop-down arrow to the right of the icon and selecting the appropriate function.

	A	B	C
1	Student Name	Height	
2	Shirley	147	
3	Rupika	153	
4	Carl		
5	Lee	141	
6	Jason	155	
7	MIN	141	=MIN(B2:B6)
8	MAX	155	=MAX(B2:B6)

Figure 43: Sample MIN and MAX functions

In the example shown in Figure 43, the MIN function produces a result of 141 and the MAX result is 155.





## COUNT, COUNTA, COUNTBLANK

Function Category	Version / Availability
Statistical	All versions

### Definition

The **COUNT** function will count the quantity of numbers from the given arguments.

The **COUNTA** function will count the quantity of populated cells, including cells containing numbers, text, date/time, and formulas.

The **COUNTBLANK** function will count the quantity of blank cells within the listed range/es.

Each individual argument can be a number, a cell or range of cells, an array of cells, a name, or any combination of these.

### Syntax

```
=COUNT(number1, [number2], ...)  
=COUNTA(value1, [value2], ...)  
=COUNTBLANK(value1, [value2], ...)
```

- **Number1/Value1 (required)** this related to a series of numbers, or cells containing numbers
- **Number2/Value2 (optional)** A total of 255 arguments can be provided

### Examples

```
=COUNT(A1:A10)  
=COUNT(DataTable)  
=COUNTA(10, A1:A10, DataTable)  
=COUNTBLANK(Payments[Status])
```



#### Helpful hint

You can easily create a COUNT function by using the AutoSum command ( $\Sigma$ ). Click on the drop-down arrow to the right of the icon and selecting the appropriate function.



	A	B	C
1	Student Name	Height (cm)	Height (feet/inches)
2	Shirley	147	4.8
3	Rupika	153	5.0
4	Carl	Unknown	
5	Lee	141	4.6
6	Jason	156	5.1
7		5	4
8	=COUNTA(A2:A6)	=COUNT(B2:B6)	=COUNTBLANK(C2:C6)

Figure 44: The COUNT, COUNTA and COUNTBLANK functions

In the example shown in Figure 44, the COUNTA function produces a result of 5, the COUNT result is 4 and COUNTBLANK is 1. Note however, if the COUNT function was used in cell A7, the result would be 0.

## Criteria-based functions

Excel provides several functions to perform *criteria-based* calculations – traditional functions that only deal with specific data. For example, the SUM function might be used to calculate the total salary, but its equivalent criteria-based function of SUMIFS would be used to total the salary for a specific department.



### Key point

MAXIFS and MINIFS are also available in Excel 365 and 2019 onwards.



### Key point

The legacy functions COUNTIF, SUMIF and AVERAGEIF functions perform their respective calculations based on a single criterion, e.g., counting the number of managers. These are not covered here as they have been superseded.

The three most popular criteria-based functions in Excel are:

Function	Category
=COUNTIFS(criteria range1, criterial...)	Statistical
=AVERAGEIFS(average range, criteria range1, criterial...)	Statistical
=SUMIFS(sum range, criteria range1, criterial...)	Math & Trig



**Key point**

SUMIFS and AVERAGEIFS have the sum/average range as the first argument.

All three functions have their criteria specified in pairs – the *criteria range*, and the *criteria* for that range. Excel denotes these as *criteria\_range1*, *criterial*, etc.

**Key point**

Up to 127 pairs of range/criteria can be specified.

	A	B	C	D	E	F
1	Last Name	First Name	Position	Region	Hours	
2	Somerset	David	Sales	South	21.5	
3	Boothroyd	Geoffrey	Director	North	38.0	
4	Bray	Hilary	Director	West	32.0	
5	Hergesheimer	Klaus	Sales	South	42.0	
6	Mansfield	Olivia	CEO	West	38.0	
7	Sterling	Robert	Director	North	39.0	
8	di Vincenzo	Teresa	Director	South	31.5	
9						
10	Directors	2	=COUNTIFS(C2:C8,"Director",D2:D8,"North")			
11	Sales Hours	77	=SUMIFS(E2:E8,C2:C8,"Director",D2:D8,"North")			
12		38.5	=AVERAGEIFS(E2:E8,C2:C8,"Director",D2:D8,"North")			

Figure 45: Criteria-based functions with multiple criteria

In the above screenshot, criteria-based functions with multiple criteria have been used to:

- Count the number of directors in the north
- Total the hours for those directors
- Average the number of hours for the northern directors

**Guided activity:****Working with criteria-based functions**

The manager of the HR department has provided you with a list of employees for your organisation. She needs to you calculate several statistics from this list.

First, several employees are approaching retirement age – the company are considering offering the services of an external expert to these staff. Your manager needs to know how many staff are aged 62 or older.

Secondly, the HR manager would like to know the average salary of the employees with a company car.





The spreadsheet has several named ranges that can be used to make the process easier.

1. Open the file called **STATISTICAL FUNCTIONS.XLSX**
2. In cell D1, click **Formulas > More Functions > Statistical > COUNTIFS**
3. Populate the 'Function Wizard' dialog box as follows, and click **OK**:
  - o Criteria\_range1: **Age** – this is an existing named range for cells G7:G158
  - o Criteria1: "**>=62**" (including the speech marks)

The formula should read =COUNTIFS(Age , ">=62"). You will now calculate the average salary of company car owners:

4. In cell D2, click **Formulas > More Functions > Statistical > AVERAGEIFS**
5. Complete the 'Function Wizard' dialog box as follows, and click **OK**:
  - o Average\_range: **Salary**
  - o Criteria\_Range1: **Car**
  - o Criteria1: **Yes**

The completed formula should read =AVERAGEIFS(Salary,Car,"Yes").

6. Save the file and keep it open for use in the next activity



#### Guided activity:

#### Using criteria-based functions with multiple criteria

Further to the statistics you produced in the previous activity, the HR manager would now like to know how many staff work in the IT Department in Sheffield, and the total salary for those employees.

1. Ensure that the **STATISTICAL FUNCTIONS.XLSX** workbook is open from the previous activity
2. In cell D3, click **Formulas > More Functions > Statistical > COUNTIFS**
3. In the 'Function Wizard' dialog box, enter the following arguments before clicking **OK**:
  - o Criteria range1: **Department** – this is an existing named range for cells D7:D158
  - o Criteria1: **IT** – the Function Wizard will add a 'Criteria\_range2' section



- Criteria range2: **Location** – a named range for cells E7:E158
- Criteria2: **Sheffield**

The formula reads =COUNTIFS(Department, "IT", Location, "sheffield"). You will now calculate the total salary for the same data:

4. In cell D3, click **Formulas > More Functions > Statistical > SUMIFS**
5. Enter the following arguments in the dialog box, and click **OK**:
  - Sum range: **Salary** – a named range for cells H7:H158
  - Criteria range1: **Department**
  - Criteria1: **IT**
  - Criteria range2: **Location** – a named range for cells E7:E158
  - Criteria2: **Sheffield**

The formula reads =SUMIFS(Salary, Department, "IT", Location, "Sheffield").

6. Make sure to save the file as it will be used again later, and close it

## Logical functions

Excel provides several *logical functions* – functions that perform a ‘logical test’, or ‘true/false’ test. In simple terms, they act as a ‘yes/no’ question of the data, and then respond accordingly.

### The IF function

The IF function allows Excel to display one of two differing values depending upon the outcome of a logical test - one value if the condition is met (i.e., True), but a different value if the test is not met (i.e., False).

For example, IF the value in cell A1 is greater than 100, then increase salary otherwise do not.

A typical IF function comprises three arguments:

- *Logical test*: the comparison being tested
- *Value if true*: the action Excel should take if the result of the logical test is true
- *Value if false*: the action to be taken if the result of the logical test is false



#### Key point

The ‘value if true’ and ‘value if false’ arguments can be numbers, text (enclosed in speech marks), cell addresses or another calculation.



The logical test depends on the use of a mathematical operator to compare two values, as shown in the following table:

Operator	Action	Example	
=	Equal to	10=10	True
>	Greater than	10>5	True
<	Less than	10<5	False
>=	Greater than or equal to	10>=10	True
<=	Less than or equal to	5<=5	True
<>	Not equal to	10<>10	False

	A	B	C	D
1	Score	Passmark	Result	Formula
2	66	65	Pass	=IF(A2>=B2,"Pass","Fail")
3	69	70	Fail	=IF(A3>=B3,"Pass","Fail")
4	98	70	Pass	=IF(A4>=B4,"Pass","Fail")
5	84	60	Pass	=IF(A5>=B5,"Pass","Fail")
6	53	55	Fail	=IF(A6>=B6,"Pass","Fail")

Figure 46: Examples of the IF function



### Guided activity: Using the IF function

You have been passed a list of vehicles in stock at your second-hand car dealership. Your manager would like you to reduce the price of vehicles which have been in stock for 45 days or more, by 5%.

1. Open the **IF FUNCTIONS.XLSX** workbook, and select cell L1
2. Enter a heading of “**Sale Price**”
3. Click **Formulas > Logical > IF**, and enter the following:
  - o Logical test: **I2>=45**
  - o Value if true: **J2\*95%** - this will reduce the price by 5%
  - o Value if false: **J2** – replicates the existing price (if the vehicle has been in stock for less than 45 days)
4. Click **OK** to close the Function Wizard – the formula should read  
**=IF(I2>=45,J2\*95%,J2)**
5. Copy the calculation to cells L3:L21



6. Use **Format Painter** to copy the formatting from column J to column L
7. Save the file and keep it open for use in the next activity

## The IFS function

The IFS function allows Excel to test for multiple different possibilities, rather than the single test/two outputs of the regular IF function. Historically the user would need to create multiple IF functions in a single cell – known as *nested IFs* – which the IFS function replaces.



### Key point

The IFS function is only available in Excel 2019, 2021 and 365, and as such your instructor may decide not to cover it.



### Key point

Nesting formulas is covered on the QA Excel Advanced course. See [www.qa.com/qaexadv](http://www.qa.com/qaexadv) for details.

	A	E	F	G	K	L	M	N	O	P	Q	R
1	Make	Year of Reg	Age	Mileage	Miles/Year	=IFS(K2>=20000,"High mileage",K2>=10000,"Average mileage",TRUE,"Low mileage")						
2	Peugeot	2017	5	24,726	4945.2	Low mileage						
3	Ford	2020	2	23,765	11882.5	Average mileage						
4	Peugeot	2020	2	21,873	10936.5	Average mileage						
5	Ford	2021	1	10,956	10956.0	Average mileage						
6	Renault	2020	2	55,475	27737.5	High mileage						
7	Skoda	2021	1	8,636	8636.0	Low mileage						
8	Ford	2020	2	22,694	11347.0	Average mileage						
9	Vauxhall	2021	1	9,254	9254.0	Low mileage						
10	Honda	2020	2	16,883	8441.5	Low mileage						
11	Audi	2017	5	62,389	12477.8	Average mileage						
12	Renault	2019	3	39,320	13106.7	Average mileage						
13	Audi	2017	5	66,285	13257.0	Average mileage						
14	Audi	2017	5	48,237	9647.4	Low mileage						
15	Citroen	2018	4	46,749	11687.3	Average mileage						
16	Audi	2019	3	26,904	8968.0	Low mileage						
17	Ford	2020	2	21,732	10866.0	Average mileage						
18	VW	2020	2	23,842	11921.0	Average mileage						
19	Renault	2021	1	13,247	13247.0	Average mileage						
20	Vauxhall	2021	1	10,081	10081.0	Average mileage						
21	Peugeot	2018	4	34,148	8537.0	Low mileage						

Figure 47: The IFS function producing different results

A typical IFS function comprises four arguments:

- *Logical test 1*: the first comparison being tested
- *Value if true 1*: the action Excel should take if the result of the first test is true
- *Logical test 2*: the second comparison being tested



- **Value if true 2:** the action to be taken if the result of the second test is true



### Key point

The IFS function must have a logical test that will generate a TRUE result, so the last-used test will often simply state 'TRUE'.



### Guided activity:

#### Using the IFS function

Continuing your work on the second-hand car dealership workbook, you have been asked to ascertain whether vehicles are high, average, or low mileage and you have decided to use the IFS function for this.

1. Ensure that the **IF FUNCTIONS.XSLX** workbook is still open from the previous activity
2. Enter a heading of "**Status**" in cell M1
3. Click **Formulas > Logical > IFS** and enter the following:
  - **Logical test 1: K2>=20000**
  - **Value if true 1: High** – Excel will place it in speech marks
  - **Logical test 2: K2>=10000**
  - **Value if true 2: Average**
  - **Logical test 3: TRUE** – because this is not performing a comparison in the same way as the others, Excel will not display a 'Value if true 3' box
4. In the Formula Bar, click after the word TRUE and type **, "Low"** (ensure you include the comma)
5. Click **OK** to close the Function Wizard – the formula should read =  
=IFS(K2>=20000, "High", K2>=10000, "Average", TRUE, "Low")
6. Copy the formula down to M3:M21
7. Save and close the file

## The IFERROR function

Sometimes a formula may result in an error message being returned, rather than the anticipated answer. For example, multiplying a number by a word will result in the #VALUE! error in the cell.



The IFERROR function can be used to detect if the formula will return an error and provide an alternative value in its place. It is typically used to hide an Excel error and provide a friendlier or more informative message.



### Key point

A complete list of error messages can be found in Appendix 3: Error messages on page 214.

The IFERROR function has two arguments:

- *Value*: the formula or cell containing the formula, which is being checked for an error – this formula will be calculated if no error results
- *Value if error*: the output if an error should be returned

	A	B
1	Without IFERROR	With IFERROR
2	#NAME?	Name not defined
3	=AVERAGE(Sep_Sales)	=IFERROR(AVERAGE(Sep_Sales),"Name not defined")

Figure 48: Examples of the IFERROR function

## Lookup and reference functions

For many years the INDEX and MATCH functions could be combined by users to overcome some of the restrictions of the VLOOKUP function. In 2019, Microsoft introduced the XLOOKUP function which has been designed to replace INDEX, MATCH and VLOOKUP.

For the benefit of anyone using a version of Excel other than 2021/365, we will examine the older functions here, but whenever possible the new XLOOKUP Function should be used as it is easier, calculates faster and is arguably more efficient.

### The VLOOKUP function

One of the most popular functions in Excel is the powerful VLOOKUP – *vertical lookup* – function.

VLOOKUP searches the first column of a table (list) and returns an entry from a specified column in the same row as the lookup value. Columns are counted from left to right, with the first column in the table counted as number one.

The VLOOKUP function has four arguments:

- *Lookup value*: the value being searched for



- **Table array:** the list of data that contains all information to be searched for
- **Column index number:** the column number (counting from the left) that contains the value to be returned
- **Range lookup:** optional – specifies whether the lookup is searching a range of values (default), or for an exact match



### Key point

An error value (#N/A!) is returned if the value being searched for is smaller than any value in the table, or if the formula fails to find an exact match.



### Helpful hint

Using a range name (see page 96) for the table array can significantly improve the legibility of the formula.

## Searching for approximate matches

VLOOKUP was originally conceived as a way of retrieving information from a table of approximate matches.

The following figure shows the information Excel would retrieve whilst searching for an approximate match.

	A	B	C
1	House Price	Stamp Duty	Formula
2	100,000	0%	=VLOOKUP(A2,Stamp_Duty,2)
3	250,000	3%	=VLOOKUP(A3,Stamp_Duty,2)
4	490,000	3%	=VLOOKUP(A4,Stamp_Duty,2)
5	7,500,000	7%	=VLOOKUP(A5,Stamp_Duty,2)
6			
7			
8	Stamp_Duty table		
9	Price	Rate	
10	0	0%	
11	125,000	1%	
12	250,000	3%	
13	500,000	4%	
14	1,000,000	5%	
15	2,000,000	7%	
16			

Figure 49: The VLOOKUP function – approximate match

The worksheet shown above is using the VLOOKUP function to determine the stamp duty to be paid on the sale of various properties.

The house price recorded in cell A4 is used as the *lookup\_value* within the VLOOKUP in cell B2. Excel looks for this value within the Stamp\_Duty table (shown in cells A10:B15) and finds it in cell A12. The VLOOKUP function is



using a `col_index_num` of 2, so Excel returns the value of 3% - the second column on the row of 250,000.



### Key point

When using VLOOKUP to search for an approximate match, the first column of the lookup table must be sorted in ascending order.

### Searching for exact matches

VLOOKUP is also able to search for an exact match of specified the lookup value. This is done using the keyword FALSE in the range lookup argument of the formula.

If an exact match cannot be found, Excel generates a #N/A error.



### Helpful hint

Lookup functions are often combined with the IFERROR function (see page 69) to prevent #N/A! errors from being returned.

	A	B	C	D	E
1	<b>ISBN</b>	<b>Book Title</b>	<b>Function</b>		
2	978-030-747-4278	The Da Vinci Code	=VLOOKUP(A2,Stock,2,FALSE)		
3	978-030-794-9493	The Girl with the Dragon Tattoo	=VLOOKUP(A3,Stock,2,FALSE)		
4	978-010-000-0000	#N/A	=VLOOKUP(A4,Stock,2,FALSE)		
5					
6					
7	<b>Stock table</b>				
8	<b>ISBN</b>	<b>Title</b>	<b>Author</b>	<b>Stock Level</b>	
9	978-045-116-7712	The Godfather	Mario Puzo	87	
10	978-054-792-8227	The Hobbit	JRR Tolkien	98	
11	978-030-747-4278	The Da Vinci Code	Dan Brown	185	
12	978-030-794-9493	The Girl with the Dragon Tattoo	Steig Larsson	207	
13	978-009-175-1920	Fly Fishing	JR Hartley	1	
14					

Figure 50: The VLOOKUP function – exact matches

The worksheet shown above is using the VLOOKUP function to retrieve a book's title based on the ISBN number.

The ISBN number recorded in cell A2 is the `lookup_value` of the VLOOKUP function in cell B2. Excel looks for this value within the first column of the Stock table (cells A10:D14) and returns the value from the second column, i.e. 'The Da Vinci Code'.





### Helpful hint

Excel also includes the HLOOKUP – horizontal lookup – function. This is written in the same way as VLOOKUP, but the table being searched is entered horizontally – the options across the top (rather than down the first column) row.



### Guided activity:

#### Working with lookup functions

You have a worksheet recording the telephone orders placed with your company. You would like to automate part of the telephone process to enable you to quickly inform the customer of the discount they are entitled to, and to calculate the postage charge, which is based on the number of units ordered.

You will use two VLOOKUP functions – the first, to return the postage charge will be an approximate match:

1. Open **VLOOKUP FUNCTION.XLSX** workbook
2. Navigate to the 'Tables' worksheet, and select cells B3:C7

Examine this table – note that the postage charge is stored in the second column of the table – it is useful to note this information before creating the VLOOKUP.

3. Click into the Name Box, enter a name of **Postage**, and press **Enter**
4. Move to the 'Orders' sheet and select cell E5 – this is where the lookup formula will be written
5. Click **Formulas > Lookup & Reference > VLOOKUP**
  - o *Lookup value:* **C5** (the quantity ordered)
  - o *Table array:* **Postage** (the newly created range name)
  - o *Column index number:* **2** (the second column needs to be returned)
  - o *Range lookup:* leave blank – by leaving it blank, Excel will perform an approximate (TRUE) match
6. Click **OK** to complete the formula and return to the workbook – the formula should read =VLOOKUP(C5, Postage, 2)
7. Copy the formula into cells B6:B12

Now that the postage has been calculated, you will use a second VLOOKUP function to determine the discount:



8. Navigate to the 'Tables' worksheet, and select cells E3:G13

Examine this table – note that the customer's discount is recorded in the third column of the table.

9. Click into the Name Box, enter a name of **Customers**, and press **Enter**
10. On the 'Orders' worksheet, select cell G5 – this is where the new lookup formula will be created
11. Open the VLOOKUP Function Wizard, and populate it as follows:
  - *Lookup value:* **B5** (the customer's name)
  - *Table array:* **Discount** (the new range name)
  - *Column index number:* **3** (the third column needs to be returned)
  - *Range lookup:* **FALSE** (an exact match is required)
12. Click **OK** to complete the formula and return to the workbook – the completed formula should be =VLOOKUP(B5, Customers, 3, FALSE)
13. Copy the formula into cells G6:G12

Notice the #N/A error message. This has been caused by a typo in the customer's name.

14. Correct the typo in cell B9, and ensure the #N/A error has been replaced with a value
15. Save the file and close it

## The MATCH Function

### Definition

The MATCH function allows you to look through a list of values to see if a value exists. MATCH is great for checking if values exist when comparing data in two separate lists for data consistency.

It returns the numerical position of a value within a list, e.g., if you were looking for E in the letters of the alphabet MATCH would return 5.

### Syntax

=MATCH(lookup\_value, lookup\_array, [match\_type])

- *lookup\_value* is required and is the value to be searched for
- *lookup\_array* is required and is the range to be searched in
- *match\_type* optional – tells MATCH to either use the exact value or the closest match that is either greater or less than the value you are looking for



## Example

```
=MATCH(A2, B2:B100,0)  
=MATCH(A2, Data, 1)
```



### Useful tool

The MATCH function nests well with the INDEX function to complete the row/column arguments of that function (see page 75).

	A	B	C
1	Find:	10252	=MATCH(B1,A4:A12,0)
2			
3	Order ID	Customer ID	Customer Name
4	10248	VINET	Vins et alcools Chevalier
5	10249	TOMSP	Toms Spezialitäten
6	10250	HANAR	Hanari Carnes
7	10251	VICTE	Victuailles en stock
8	10252	SUPRD	Suprêmes délices
9	10253	HANAR	Hanari Carnes

Figure 51 - Sample MATCH function

In the sample above, the result would be **5** as B2 is five rows down in the range A4:A12.

## The INDEX Function

### Definition

The INDEX function works well in a data table when you are trying to extract a value both horizontally and vertically. There are two variations of INDEX, these notes show the first (and simpler version).



### Key point

Whereas the previously covered MATCH function returns the *position* of a piece of data, INDEX returns the *data* in the specified location.

## Syntax

```
INDEX(array, row_num, [column_num])
```

- *array* is required and represents a range of cells in a data table
- *row\_num* is required and is the row number within the table to extract from
- *column\_num* is optional (although normally it is populated and not left blank). This is a column number within the table to be extracted from



## Example

```
=INDEX(A1:H500, 5, 8)  
=INDEX(DataTable, 1000, 2)
```

In these examples the values returned are five rows down, eight columns across or 1000 rows down and two columns across.



### Useful tool

The INDEX function nests well with the MATCH function to calculate how far down or across for the relevant arguments (see page 74).

	A	B	C	D	E
1	Order ID	Date	Customer Name		
2	1	01/06/2011	Sara Kling		=INDEX(A1:C11,5,3)
3	2	02/06/2011	Sean Willis		
4	3	03/06/2011	Colleen Abel		
5	4	04/06/2011	Teri Binga		
6	5	05/06/2011	Frank Culbert		
7	6	06/06/2011	Kristen Devey		

Figure 52 - Sample basic INDEX function

The result of the function above is **Teri Binga** – starting in cell A1 and working down five rows and three columns across.

## The XLOOKUP function

Introduced into Excel 365 in 2019, XLOOKUP is an alternative lookup function to VLOOKUP or HLOOKUP. Microsoft are even encouraging users to move to XLOOKUP, though support for the earlier functions will remain.

Whilst the existing lookup functions have three required arguments and one optional, XLOOKUP has three required and three optional:

- *Lookup value*: the value being searched for
- *Lookup array*: the range of cells to search in
- *Return array*: the range of cells containing the results to be returned
- *If not found*: optional; value to return if no match is found
- *Match mode*: whether to search for an exact match or not
- *Search mode*: the type and direction of the search



	A	B	C	D	E	F
1			Itinerary	6		
2			Title	Scenic French Riviera	=XLOOKUP(D1,Itinerary_No.,Title,"")	
3			Date	30/05/2012	=XLOOKUP(D1,Itinerary_No.,Date,"")	
4						
5			Title	Pisa		
6			Date	31/05/2012	=XLOOKUP(D5,Title,Date,"")	
7						
8						
9	Itinerary No.	City	Country	Date	Title	Difficulty
10	1	Barcelona	Spain	29/05/2012	Embark Transfer to Ship via Barcelona City Tour	Moderate
11	2	Monte Carlo	Monaco	30/05/2012	Grasse & St Paul-de-Vence	Moderate
12	3	Monte Carlo	Monaco	30/05/2012	Nice & The French Riviera	Moderate
13	4	Monte Carlo	Monaco	30/05/2012	Cannes Walking Tour	Strenuous
14	5	Monte Carlo	Monaco	30/05/2012	Monaco & Monte Carlo	Strenuous
15	6	Monte Carlo	Monaco	30/05/2012	Scenic French Riviera	Mild
16	7	Monte Carlo	Monaco	30/05/2012	Villages of Provence: Fayence & Seillans	Strenuous
17	8	Florence/Pisa	Italy	31/05/2012	Historical Florence & Academia Museum	Strenuous
18	9	Florence/Pisa	Italy	31/05/2012	Tuscan Countryside: San Gimignano & Volterra	Moderate
19	10	Florence/Pisa	Italy	31/05/2012	Pisa	Mild

Figure 53: Examples of the XLOOKUP function

In the screenshot above, the data in each column has been assigned a range name (see page 95) using its heading.

XLOOKUP solves several issues associated with traditional lookup functions including, but not necessarily limited to:

- One function can be used for either vertical or horizontal searches
- Existing lookup functions default to an approximate match, which is not usually what is required; XLOOKUP defaults to an exact match
- The ‘return array’ argument can be positioned either to the left or right of the ‘lookup array’, meaning XLOOKUP can search in either direction, whereas VLOOKUP can only return from the right
- Because the ‘return array’ is either a range name or cell references, XLOOKUP is much more resilient to changes in the worksheet caused by columns or rows being inserted or deleted
- The ‘if not found’ argument allows XLOOKUP to return a value rather than a #N/A! error (VLOOKUP or HLOOKUP then must be nested inside another function to solve this)
- Traditional lookup functions can only return the next smaller item when used with TRUE in the last argument, whereas XLOOKUP can return the next larger item
- Existing lookup functions reference a larger area than is usually necessary as the ‘lookup table’ must include all cells from the lookup column to the results column – this can result in unnecessary calculations and impact the performance of the workbook





### Guided activity: Using XLOOKUP (if supported)

In this activity, you will create two VLOOKUP and two XLOOKUP formulas so that you can compare them.

1. Open the **XLOOKUP FUNCTION.XLSX** workbook
2. Using the Name Box, notice that there are several range names already created:
  - *AllStockData*: all the data in the list
  - *Code*: A12:A88
  - *Description*: B12:B88
  - *Cost*: C12:C88
  - One range name for each of the remaining columns of data
3. Select cell B3 – this is where the lookup formula will be written
4. Click **Formulas > Lookup & Reference > VLOOKUP**
  - *Lookup value*: **B2** (the product's code cell)
  - *Table array*: **AllStockData** (the list of all product details)
  - *Column index number*: **2** (the second column – the Description – needs to be returned)
  - *Range lookup*: FALSE –Excel will perform an exact match
5. Click **OK** to complete the formula and return to the workbook – the formula should read `=VLOOKUP(B2,AllStockData,2,FALSE)`
6. Repeat the process in cell B4 and create a second formula, this time to return the cost of the product – the formula should read `=VLOOKUP(B2,AllStockData,3,FALSE)`

With the existing VLOOKUP functions working, you now wish to compare them to the modern lookup function, XLOOKUP:

7. In cell B8, click **Formulas > Lookup & Reference > XLOOKUP**
  - *Lookup value*: **B2** (the product's code cell)
  - *Lookup array*: **Code** (the range name for all codes in column A)
  - *Return array*: **Description** (the range name for all descriptions in column B)
8. Click **OK** to complete the formula and return to the workbook – the completed formula should read `=XLOOKUP(B2,Code,Description)`



9. Repeat the process in cell B8 and create a second formula to return the cost of the product – the formula should read  
`=XLOOKUP(B2,Code,Cost)`

Comparing the two sets of formulas you should be able to see that XLOOKUP is (usually) shorter and is much easier to read, understand and edit than a traditional VLOOKUP formula.

10. Save the workbook, and close it

## Dynamic array functions

Introduced in early 2019, Excel's *dynamic array* functions – often referred to as *spill* functions – elevate function writing to a new level.

There are several dynamic array functions in Excel, with more being added on a reasonably regular basis. In this section you will explore one to gain an understanding of them.



### Key point

Dynamic arrays are currently only available in Excel 365 and Excel 2021. As such, your instructor may elect not to cover them during the course.



### Key point

Dynamic array functions are covered in more depth on the Excel Advanced course, if applicable.

## What are dynamic array formulas?

A dynamic array function allows you to create a single formula that can generate multiple results that are placed into multiple cells, thus *spilling* out into as many cells as are needed.

For example, you have a worksheet listing staff and training courses they have attended, and you wish to create a list of training courses but do not need to list a course multiple times if it has been attended by multiple people. A dynamic array would solve this problem nicely.



	A	B	C	D	E	F
1	Employee	Course		Courses		
2	C Bernard	First Aid in the Workplace		First Aid in the Workplace	=UNIQUE(B2:B11)	
3	W Albert	Excel Intermediate		Excel Intermediate		
4	I McDermott	Presentation Skills		Presentation Skills		
5	E Mawar	Excel Essentials		Excel Essentials		
6	I Li	Presentation Skills				
7	C Kwame	First Aid in the Workplace				
8	W Smyth	Excel Essentials				
9	D Holland	Presentation Skills				
10	F Johns	First Aid in the Workplace				
11	N Pope	Excel Intermediate				

Figure 54: The UNIQUE dynamic array function



### Key point

If a dynamic array formula cannot spill to the required cells, for example if one of them already contains data, a #SPILL! error will be returned.

## Popular dynamic array functions

Excel 365 has many dynamic array functions, with more being added regularly, which makes it impossible for the course to cover every function! However, some popular ones are discussed here.

### UNIQUE

The UNIQUE function extracts unique values from a set of data, a formula equivalent to using Excel's 'Remove Duplicates' command.

Syntax: =UNIQUE(array, [by\_col], [exactly\_once])

- *Array*: the range to extract the unique values from
- *By Col*: comparing rows to ascertain unique values (FALSE or omitted), or comparing columns (TRUE)
- *Exactly Once*: only return unique values that appear once only



F	G	H	I
Moderate	=UNIQUE(Difficulty)		
Strenuous			
Mild			
Difficulty	Dress Code	Shopping	Meal Included
Moderate			
Moderate		Yes	
Moderate		Yes	
Strenuous		Yes	
Strenuous	Yes	Yes	
Mild	Yes	Yes	
Strenuous		Yes	

Figure 55: The UNIQUE function extracting data

In the screenshot above, the formula =UNIQUE(Difficulty) is extracting all unique values from the 'Difficulty' range of data in column F.



### Guided activity: Using the UNIQUE function

In this activity you will use the UNIQUE function to extract items from a list, ensuring that any duplicate items are not extracted multiple times.

1. Open the file called **DYNAMIC ARRAYS.XLSX** – notice that there are multiple items for the same course
2. If necessary, navigate to cell D2
3. Enter the formula =UNIQUE(B2:B11) and press **Enter** – notice the formula ‘spills’ out into cells below D2 as it produces more than one result
4. Click into the cells below D2 – notice that the formula is displayed in pale text in the Formula Bar, as they are cells it has spilled to (the formula only resides in cell D2)

## SORT

The SORT function sorts the specified range based on a single column. It is often used in conjunction with other dynamic array functions, such as UNIQUE.

Syntax: =SORT(array, [sort\_index], [sort\_order], [by\_col])

- **Array:** the range of data to be sorted
- **Sort Index:** a numeric value to indicate which column to sort by, e.g., 1 for the first column, 2 for the second
- **Sort Order:** 1 (or omitted) to sort in ascending order, -1 for descending



- *By Col:* sort data by row (FALSE or omitted), TRUE to sort by column

F	G	H	I
Mild	=SORT(UNIQUE(Difficulty))		
Moderate			
Strenuous			
Difficulty	Dress Code	Shopping	Meal Included
Moderate			
Moderate		Yes	
Moderate		Yes	
Strenuous		Yes	
Strenuous	Yes	Yes	
Mild	Yes	Yes	
Strenuous		Yes	

Figure 56: Using the SORT and UNIQUE functions together

In the screenshot above, the formula =SORT(UNIQUE(Difficulty)) is extracting all unique values from the ‘Difficulty’ range of data in column F, and then sorting them into ascending order.

## SORTBY

An enhanced version of the SORT function, SORTBY allows you to perform multiple sorts at once.

Syntax: =SORTBY(array,by\_array1,[sort\_order1],[by\_array2],...)

- *Array:* the range of data to be sorted
- *By Array 1:* the column of data to be sorted by
- *Sort Order1:* 1 (or omitted) to sort in ascending order, -1 for descending
- *By Array 2:* the second column of data to be sorted by
- *Sort Order 2:* 1 (or omitted) to sort in ascending order, -1 for descending

Further sorts can be added as necessary.



	A	B	C	D	E	F	G	H
1	Person	Month	Sales	=SORTBY(A2:C11,A2:A11,1,C2:C11,-1)				
2	Fred	May	883	Barney	Jun	680		
3	Barney	Jun	488	Barney	Feb	586		
4	Wilma	Mar	184	Barney	Jun	488		
5	Betty	Apr	732	Betty	Apr	732		
6	Fred	Apr	321	Betty	Jan	138		
7	Barney	Feb	586	Fred	Jun	918		
8	Wilma	Apr	641	Fred	May	883		
9	Betty	Jan	138	Fred	Apr	321		
10	Fred	Jun	918	Wilma	Apr	641		
11	Barney	Jun	680	Wilma	Mar	184		

Figure 57: The SORTBY function

In the screenshot above, the formula =SORTBY(A2:C11,A2:A11,1,C2:C11,-1) is sorting all the data in A2:C11, firstly by the person's name in ascending order (A2:A11, 1), and then by sales in descending order (C2:C11, -1).

## FILTER

The FILTER function allows you to dynamically extract values from an array which matches a criteria.

Syntax: =FILTER(array, include, [IF\_EMPTY], [by\_array2], ...)

- *Array*: the original list of values
- *Include*: your criteria
- *If\_Empty*: the action to take when there are no matching results. This is an optional argument, if omitted, the #CALC! error message will be displayed in the cell

	A	B	C	D	E	F	G	H	I
1					=FILTER(A3:C17,C3:C17="IT","No matching records")				
2	Staff No	Name	Department		Staff No	Name	Department		
3	1114	Shaw, Billy	Administration		1118	Hawkins, Hannah	IT		
4	1116	Carr, Lisa	Procurement		1146	Scott, Oscar	IT		
5	1118	Hawkins, Hannah	IT						
6	1121	Walton, John	Sales						
7	1123	Phillips, Billy	Manufacturing		=FILTER(A3:C17,C3:C17="Human Resources","No data")				
8	1127	Mead, Nancy	Marketing		Staff No	Name	Department		
9	1129	Fry, Trevor	Administration		No data				
10	1130	Barlow, Billy	Administration						
11	1132	Binsley, Danielle	Manufacturing						
12	1136	Springer, Nathan	Procurement						
13	1146	Scott, Oscar	IT						
14	1147	Curnow, Debbie	Manufacturing						
15	1150	Woodward, Paul	Finance						
16	1164	Tyler, Billy	Manufacturing						
17	1166	Smart, Lacey	Marketing						

Figure 58: The FILTER dynamic array function





### Key point

Whilst not immediately obvious, you can use the FILTER function with multiple criteria. Unlike some other functions there is only a single instance of the Include argument, so to provide multiple criteria you must place each criterion inside brackets, and separate each with an asterisk as shown here.

```
=FILTER(A2:D153, (A2:A153="IT")*(B2:B153="Sheffield"))
```

### Combining functions

Of course, the dynamic array functions examined here can be nested within each other to provide greater functionality.

In the screenshot below (Figure 59), the SORT function is being used to place the unique values in alphabetical order

	A	B	C	D	E	F
1						=SORT(UNIQUE(C3:C17))
2	Staff No	Name	Department		Unique Departments	
3	1114	Shaw, Billy	Administration		Administration	
4	1116	Carr, Lisa	Procurement		Finance	
5	1118	Hawkins, Hannah	IT		IT	
6	1121	Walton, John	Sales		Manufacturing	
7	1123	Phillips, Billy	Manufacturing		Marketing	
8	1127	Mead, Nancy	Marketing		Procurement	
9	1129	Fry, Trevor	Administration		Sales	
10	1130	Barlow, Billy	Administration			
11	1132	Binsley, Danielle	Manufacturing			
12	1136	Springer, Nathan	Procurement			
13	1146	Scott, Oscar	IT			
14	1147	Curnow, Debbie	Manufacturing			
15	1150	Woodward, Paul	Finance			
16	1164	Tyler, Billy	Manufacturing			
17	1166	Smart, Lacey	Marketing			

Figure 59: The SORT and UNIQUE functions combined



### Guided activity: Working with dynamic array functions

Earlier you created various functions to report key details to the HR manager. You now realise that you can improve the information you provided with the use of dynamic array functions

Specifically, you can now provide an auto-updating list of staff who are approaching retirement age and thus eligible for the services of an external expert. Likewise for a list of IT staff who are based in Sheffield.

1. Open the file called **STATISTICAL FUNCTIONS.XLSX**
2. Move to cell A2 on the Retirement worksheet



3. Create the following formula to display all staff aged at least 62  
`=FILTER('Staff List'!A7:J158, Age>=62)`
4. Now to sort the employees based on their surname, modify the formula as follows:  
`=SORT(FILTER('Staff List'!A7:J158, Age>=62), 2)`
5. Move to the Sheffield IT worksheet and use the following formula to list all relevant staff members:  
`=FILTER('Staff List'!A7:J158, (Location="Sheffield")*(Department="IT"))`
6. Save and close the file

## Section review

This section was about:

- Understanding functions
- Use Insert Function to assist with formula writing
- Work with criteria-based functions
- Using logical functions
- Working with lookup functions
- Understand what a dynamic array function is

## Review questions

1. How do you access the list of function categories?
2. Name two of the criteria-based functions, and which category they are found in
3. What are the three arguments of the IF function?
4. What does FALSE mean at the end of a VLOOKUP formula?
5. Which functions are you likely to use most, and why?



### Independent activity: Working with functions

You have been tasked with working out the potential price increases on products; only products in two categories will have an increase. You also need to keep track of the average price of products per category and calculate the monthly payments of customers paying via finance agreements.

1. Open the **IA WORKING WITH FUNCTIONS.XLSX** workbook



2. On the 'Stock List' worksheet, create a named range called **AllStock** for cells A2:G78
3. On the Invoice Details worksheet, in cells A11:A13, enter Codes **14, 42** and **67**
11. Use a suitable lookup formula to populate the Description and Cost columns with the names and prices of the three products
4. Enter suitable values in the Quantity column
5. Multiply the Cost and Quantity columns to calculate the Totals in column E and in cell E25, calculate the overall total
6. Multiply the total by the current VAT rate in cell E26
7. In E27, calculate the Discount – a discount of 10% is applied if the price before VAT exceeds £250
8. Calculate the Net Total – the Total plus the VAT, minus the Discount
9. Save the file and close it





V1.5.2

## Part 5: Combining Functions

One hugely powerful aspect of Excel lies in its ability to accept a formula in the place of an argument for another function. We call this feature *nesting formulas*.

There are hundreds of functions available in Excel, and they can all be nested inside others.



## Advantages of nesting formulas

There are two main advantages of nesting formulas:

- **Perform calculations in a more concise manner.** A nested formula may require just a single cell; if we perform the same calculation without nesting, it will need two or more cells to display the result
- **Improved spreadsheet structure.** Without nested formulas you may end up hiding large portions of data, to prevent the spreadsheet showing the results of your non-nested formulas

## Examples

### Example 1: TODAY and MONTH functions

Let's study a simple example. Imagine that we need to determine the month number for the current date. Two functions can help us determine this: TODAY to calculate the current date, and MONTH which determines the month number for a given date.

	A	B
1	10	31/10/2022
2	=MONTH(B1)	=TODAY()

Figure 60: Using the MONTH and TODAY functions to determine the month number of today's date

While the example in Figure 60 works perfectly well, it's a little inefficient as it requires two cells to produce the result.

If we combine these two formulas into a single, nested formula, we'll greatly improve our efficiency, as seen in Figure 61.

	A
1	10
2	=MONTH(TODAY())

Figure 61: A nested formula

In Figure 61, the TODAY function is being used as the argument for the MONTH function.

Notice also that there are two closing brackets at the end of the formula. When nesting formula you need to close every bracket which has been opened within the calculation. It's important that the closing bracket is in the correct position, as per the function's syntax, otherwise it may produce errors.



## Example 2: AVERAGE and ROUND functions

Often, when we perform an average calculation, we are presented with numerous decimal places, which can make it difficult to read. Excel has several built-in functions which perform rounding – we can easily nest an AVERAGE function inside a ROUND function to make the result easier to read.

	A	B	C	D
1	Name	Exam Mark		Overall Average Mark
2	Billy Shaw	71		65.41666667
3	Lisa Carr	76	=AVERAGE(B2:B157)	
4	Hannah Hawkins	62		
5	John Walton	57	Rounded Average Mark	
6	Nancy Williams	46		65.4
7	Joanne Stedman	73	=ROUND(D2,1)	
8	Claire Mitchell	92		
9	Stephen Harvey	54		
10	Billy Phillips	57		
11	Nancy Mead	90		
12	Trevor Fry	49		
13	Billy Barlow	58		

Figure 62: The AVERAGE and ROUND functions are calculating the average exam mark

In Figure 62, we are first calculating the average exam mark (cell D2), and then rounding it to a single decimal place (cell D6).

It would be much quite simple to perform the average and round calculations at the same time, as seen in Figure 63.

	A	B	C	D
1	Name	Exam Mark		Overall Average Mark
2	Billy Shaw	71		65.4
3	Lisa Carr	76	=ROUND(AVERAGE(B2:B157),1)	
4	Hannah Hawkins	62		
5	John Walton	57		
6	Nancy Williams	46		
7	Joanne Stedman	73		
8	Claire Mitchell	92		
9	Stephen Harvey	54		
10	Billy Phillips	57		
11	Nancy Mead	90		
12	Trevor Fry	49		
13	Billy Barlow	58		

Figure 63: The AVERAGE function is nested inside the parent ROUND functions

## Example 3: UNIQUE and SORT functions

In this scenario, we need to extract the unique values from a list and place them into alphabetical order. This is simple enough with the UNIQUE and SORT functions, as seen Figure 64.



	A	B	C	D	E
1			=UNIQUE(A3:A12, FALSE, FALSE)		=SORT(C3#)
2	Customer Location		Unique Locations		Sorted List
3	Rochdale		Rochdale		Blackpool
4	Manchester		Manchester		Chorley
5	Stockport		Stockport		Manchester
6	Preston		Preston		Oldham
7	Stockport		Blackpool		Preston
8	Blackpool		Chorley		Rochdale
9	Chorley		Warrington		Stockport
10	Warrington		Oldham		Warrington
11	Preston				
12	Oldham				

Figure 64: The UNIQUE and SORT functions used independently of each other

However, using these functions separately is inefficient. It also makes spreadsheet management difficult – we currently have three versions of this simple list.

	A	B	C
1			=SORT(UNIQUE(A3:A12, FALSE, FALSE))
2	Customer Location		Unique Locations
3	Rochdale		Blackpool
4	Manchester		Chorley
5	Stockport		Manchester
6	Preston		Oldham
7	Stockport		Preston
8	Blackpool		Rochdale
9	Chorley		Stockport
10	Warrington		Warrington
11	Preston		
12	Oldham		

Figure 65: A nested version of the UNIQUE and SORT functions

## Tips for creating nested formulas

- Until you become familiar with the process, start by placing each formula in a separate cell. This will help you to ensure that the individual components are working correctly.
- As you have seen elsewhere, the function Wizard can be useful when using functions of any kind. However, accessing it when creating nested formulas is very difficult. Often you will type the formula without the assistance of the Function Wizard as a result
- When creating nested functions, you do not need to use the equal's sign in front of every function, only the first one.
- You can nest a maximum of 64 levels





V1.5.2

## Part 6: Formula tools and techniques

This section covers several different tools and techniques that can be used when creating formulas.

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

- Use Quick Analysis
- Incorporate absolute and mixed cell referencing
- Use Range Names to simplify formulas



## Quick Analysis

It is common to need to perform similar tasks to worksheets of data, for example to add totals, or to visualise the data using charts. Added in Excel 2013, the *Quick Analysis* tool can be used to swiftly add calculations, charts, and other options to enhance the data.

The Quick Analysis SmartTag will appear when a range of cells is selected, or can be activated by pressing **Ctrl+Q**.

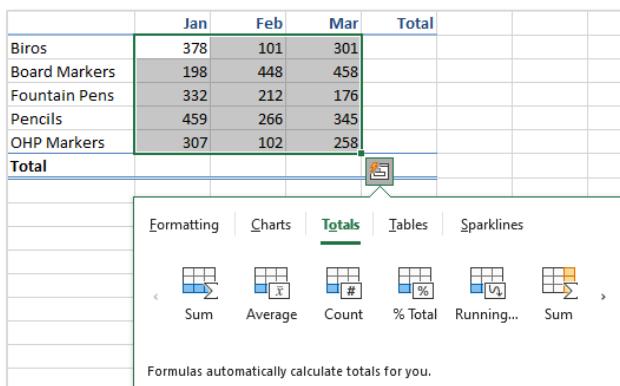


Figure 66: The Quick Analysis tools

The Quick Analysis pop-up is split into five sections:

- Formatting: common conditional formatting options
- Charts: suggested charts based on the selected data
- Totals: vertical (blue) and horizontal (yellow) totals
- Tables: converts selected data into a table or PivotTable
- Sparklines: produce sparklines for the selection



### Helpful hint

The 'Formatting', 'Charts', 'Tables' and 'Sparklines' options will be covered in more detail later in the course.

To use Quick Analysis:

1. Select the data to be used
2. Click the **Quick Analysis SmartTag**, or press **Ctrl+Q**
3. Select the required type of analysis (Formatting, Charts, etc.)
4. Click the desired option – Excel will add the selected analysis to the worksheet





### Guided activity: Using Quick Analysis

In this activity you will use Quick Analysis to add some further information to a worksheet.

1. Open the **QUICK ANALYSIS.XLSX** workbook, and navigate to the 'Quarter 1' worksheet
2. Select the cells **B4:D8**
3. Click the **Quick Analysis SmartTag**
4. Click **Totals > Sum (blue)** – Excel will add totals beneath the selected data
5. Select all the numbers on the worksheet (B4:D9)
6. Click **Quick Analysis > Totals > Sum (yellow)** to add totals on the right of the data
7. Select cells E4:E8
8. Click **Quick Analysis > Totals > % Total (yellow)**
9. Save the workbook and close it

## Absolute and mixed referencing

When creating a formula in Excel, a cell reference can be specified in three different ways:

- Relative
- Absolute
- Mixed

All three terms relate to how a formula will behave when it is copied.



#### Key point

Relative and absolute referencing are covered on the Introduction course but are repeated here for clarity.



#### Helpful hint

When writing a formula, cycle through relative, absolute and both mixed referencing options by pressing **F4**



## Relative referencing

*Relative referencing* is the default setting in Excel and means that formulas will be adjusted to be relative to their new location when copied. For example, if a formula in column A that references cells in the same column is copied to column B, the formula will be updated to reference column B.

## Absolute referencing

An *absolute reference* is a cell reference in a formula that does not change when the formula is copied.

Absolute cell references are always indicated by two dollar signs – one in front of the column letter, and one in front of the row number.

## Mixed referencing

At times, it may be necessary to prevent the column reference from changing whilst allowing the row reference to change, or vice versa. This can be done using a *mixed reference*.

Excel has two forms of mixed reference – fixed row, relative column; and fixed column, relative row.

The table below shows a cell reference with each available reference type:

Cell reference	Description
F22	Relative reference
\$F\$22	Absolute reference
F\$22	Mixed (fixed row) reference
\$F22	Mixed (fixed column) reference

	A	B	C	D	E	F
1		Projected Revenue	90%	95%	105%	110%
2	Reading	£ 222,000	= \$B2 * C\$1	£ 210,900	£ 233,100	£ 244,200
3	Bristol	£ 130,000	£ 117,000	£ 123,500	£ 136,500	£ 143,000
4	Birmingham	£ 150,000	£ 135,000	£ 142,500	£ 157,500	£ 165,000
5	Stockport	£ 100,000	£ 90,000	£ 95,000	£ 105,000	£ 110,000
6	Edinburgh	£ 180,000	£ 162,000	£ 171,000	£ 189,000	£ 198,000

Figure 67: A formula with mixed references





### Guided activity: Using mixed referencing

You have plotted your forecasted projections for the forthcoming financial year. However, your manager has asked you to calculate a margin of error for each figure; plus, or minus 10% in 5% increments.

Without mixed references, you would have to manually perform the calculation 20 times (five projections and four percentages).

1. Open the **MIXED REFERENCES.XLSX** workbook, and navigate to cell **C2**

We need to perform a simple calculation – the Projected Revenue figure in column B needs to be multiplied by the percentage in row 1.

Note that the Projected Revenue figure is always in column B, and the percentage is always in row 1, thus a mixed reference within the formula is required.

2. Create a formula to multiply the Projected Revenue by the Percentage  
**=\\$B2\*C\$1**
3. Copy the formula down to row 6, and across to column F – notice the resulting formulas
4. Save the workbook and close it

## Working with Range Names

A *range name* is a descriptive label assigned to one or more cells and can be used within formulas and other features of Excel. There are numerous benefits of doing so, particularly making calculations easier to read and understand. For example, a calculation of **=sales-cost** is much easier to read and understand than **=B1000-U800**.

Names move with the cell contents, so using a name instead of the cell reference(s) would still locate the data in its new position.

### Guidelines

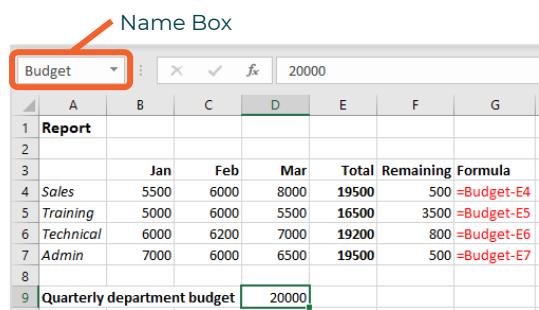
Follow these guidelines when creating range names:

- Names can be created from text entries (labels) on the sheet, or as separate entities up to 255 characters long
- A range name must start with a letter or underscore (\_), and can include numbers, full stops (.) or underscores
- They cannot contain spaces or other punctuation



- Names cannot be the same as a cell address, e.g., 'May2022' would be invalid, as there is a column 'MAY' and a row number of '2022'
- Using an underscore to separate words within a range name is advisable, e.g., May\_2022
- Capitalisation can make long names more legible, e.g., 'Sales\_North'

Each cell can be part of more than one named range. For example, cell E4 could be named 'Total' and be part of a named range 'Sales\_Figures' referring to the range B4:E4. In the following example, cell B11 is named 'Budget'. This represents the equivalent of \$B\$11.



The screenshot shows a Microsoft Excel spreadsheet. The Name Box at the top left contains the text "Budget". A red arrow points from the text "Name Box" in the caption below to the "Budget" entry in the Name Box. The spreadsheet has a header row "Report" and data rows for Sales, Training, Technical, Admin, and a summary row "Quarterly department budget". The formula in cell D9 is =B11, which refers to the named range "Budget".

	A	B	C	D	E	F	G
1	Report						
2							
3		Jan	Feb	Mar	Total	Remaining	Formula
4	Sales	5500	6000	8000	19500	500	=Budget-E4
5	Training	5000	6000	5500	16500	3500	=Budget-E5
6	Technical	6000	6200	7000	19200	800	=Budget-E6
7	Admin	7000	6000	6500	19500	500	=Budget-E7
8							
9	Quarterly department budget			20000			

Figure 68: A range name in use, with the Name Box highlighted



### Helpful hint

Named ranges can be used within many of Excel's dialog boxes, making these features easier to follow and set up. For example, the Insert Function dialog box will allow you to enter a range name.

Pressing **F3** will give you a list of available Range Names.

## Creating range names

A range name can refer to a single cell, or a group of cells, and can be created in several different ways.

### Using the Name Box

To create a range name using the Name Box:

11. Select a cell(s) to be named
12. Click in the Name Box
13. Type the desired name and press **Enter**





## Using the 'Define Name' dialog box

Whilst the Name Box provides a quick method of naming areas, it does not allow comments, set a scope, or make modifications to an existing range name.

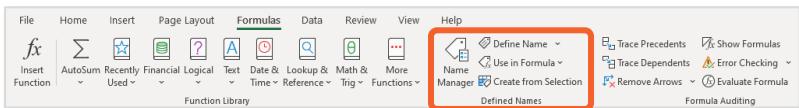


Figure 69: The 'Defined Names' section of the Ribbon

Range names are usually 'visible' from anywhere in the workbook – the *scope* of the name. However, it is possible to create a named range that is only applicable to a particular worksheet – this could allow you to use the same name for different ranges on different worksheets, making it easier to copy a single calculation across multiple worksheets.

Additionally, being able to add comments to Names can be useful as a point of reference.

To create a range name using the dialog box:

14. Select the cell(s) to be named
15. Click **Formulas > Define Name >**
16. Enter the name and specify any desired options
17. Click **OK**

## Using labels

If the area to be named contains descriptive labels in its immediate proximity, these can be used to quickly name the area. Labels can be positioned around any edge of the range of values to name.

1. Select the cell(s) to be named, including the descriptive text labels (the labels themselves will not be included within the named area)
2. Click **Formulas > Create from Selection**
3. In the 'Create Names from Selection' dialog box, tick the relevant options to indicate where the labels are in relation to the cells to be named
4. Click **OK**



### Key point

Any disallowed characters in the label are converted automatically (for example, spaces become underscores).



## Navigation

Once a range name has been created, it can be navigated to quickly and easily. Depending on the scope of the named area (see above), the range can be navigated to even if it is on a different worksheet.

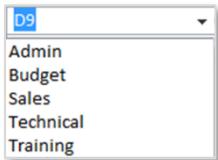


Figure 70: The Name Box displaying named areas

To navigate to a named area:

1. Click the dropdown button in the Name Box
2. Select the desired name – Excel will navigate to the named area and select the cells

## Managing named ranges

Once range names have been created, you can use the 'Name Manager' dialog box allows them to be deleted or edited – renamed, a change of scope, or comments worked with.

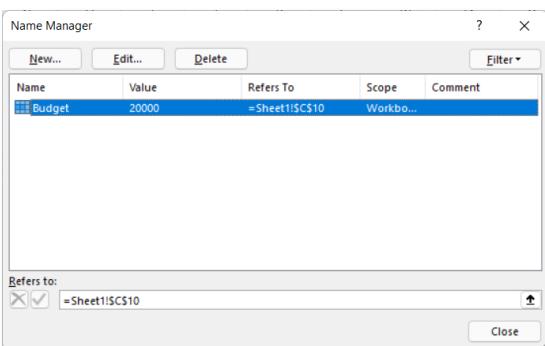


Figure 71: The 'Name Manager' dialog box

To work with the Name Manager:

1. Click **Formulas > Name Manager**
2. If necessary, use the **Filter>** button to control which named ranges are displayed in the dialog box
3. Select the name to be amended, and click **Edit...**
4. Adjust any relevant settings, and click **OK**
5. Click **Close** to exit the dialog box and return to the workbook

If the range name is no longer required, the 'Delete' option in the 'Name Manager' dialog box can be used.





### Useful tool

If the workbook already contains formulas containing cell references, use **Formulas > Define Name > Apply Names...** to update the formulas to use names.

## Range names in formulas

Range names can be used in place of cell references within a formula. For example, =SUM(Revenue)-SUM(Costs), rather than the usual =SUM(C20:C90)-SUM(F20:F40). This can make a formula easier to read and understand.

A formula can be created in the normal manner, but using range names instead of cell references:

- Type the required range name into the formula; or
- Click **Formulas > Use in Formula >**; or
- Press **F3** to select the name from the ‘Paste Name’ dialog box



### Guided activity:

#### Working with range names

In this activity you will create and edit range names within an existing Excel workbook.

1. Open the **RANGE NAMES.XLSX** workbook
2. Select the cell range B5:E5
3. Click in the Name Box and enter the name **Birmingham**, and press **Enter**

Whilst we could continue with this method of naming cells, we can utilise the text labels in column A to easily create the necessary names:

4. Highlight the range A6:E8
5. Click **Formulas > Create from Selection**
6. In the ‘Create Names from Selection’ dialog box, ensure the Left Column check box is ticked, to indicate where the labels are in relation to the cells to be named, and click **OK**
7. Click the dropdown button in the Name Box to confirm the names have been created. Notice that Excel has used an underscore in the name ‘Milton\_Keynes’, as the original label included a disallowed character (the space)



Now that we have created the names, we will use them in formula to calculate the total regional sales:

8. Navigate to cell G5
9. To create a formula which averages the Birmingham values, type **=AVERAGE(**
10. Highlight cells B5:E5 – note that Excel enters the name for these cells (Birmingham) rather than the cell references
11. Type **)** and press **Enter**

As names use absolute references, the Birmingham calculation cannot be copied:

12. In cell G6, enter **=AVERAGE(**
13. Press **F3** to display the ‘Paste Name’ dialog box
14. Select **Milton\_Keynes** and click the **OK** button
15. Repeat the above actions for the Sunderland and Leeds regions

The existing totals in column F were produced using cell references. We will now update these to use the Names we have just created.

16. Highlight the cell range F5:F8
17. Click **Formulas > Define Name > Apply Names...**
18. Ensure that Birmingham, Milton Keynes, Sunderland, and Leeds are highlighted, and click **OK**
19. Save and close the workbook

## Linking to other worksheets

It is possible to share the data on different worksheets by *linking* them. This can be particularly useful when it is not practical to work with large worksheets, or to save you from duplicating data. Using linked data also makes it easy to protect confidential or sensitive data – you could ensure that people looking at a spreadsheet only see the linked cells and not the underlying data.

Linked worksheets are commonly used to link cells in different worksheets to create summary sheets.

### Write a formula to link to worksheets

Using the equals sign with a formula reference allows the transfer of data from one cell to another. References can be created that point to cells on different worksheets. This could enable displaying data from monthly



worksheets on an annual summary sheet or to carry forward a balance from one sheet to another for example.

The link instruction within a formula will appear as `SheetName!CellAddress`. For example, `=SUM(Sales!A1:A10)`.

The name of the worksheet is followed by an exclamation mark (!), which separates it from the range of cells. If the sheet names contain spaces, the reference to the sheets is enclosed by single quotes.

To write a formula that 'pulls' data from another worksheet:

1. Type **=** to start a formula, as normal. You can use a function if desired
2. Move to relevant worksheet and cell where the source data is located – the Formula Bar displays the sheet name and cell reference separated by an exclamation mark, e.g., `=Sheet3!A1`
3. Press **Enter** to finish the formula – the value is carried forward and is updated automatically whenever changes to the source data occur

## Using Paste Special

When pasting values or formulas there are various ways the results can be created. A feature of Paste Special is to *Paste Link*.

When data in the original cells change, the linked copies are automatically updated. Paste Link creates a formula for each copied cell, for example `=Sheet1!A1`, making it much more efficient than creating links manually.



Figure 72: The 'Paste Link' option

To create a link using the Paste Link command:

1. Select the cell(s) containing the source data, and copy them using your normal method
2. Select the cell(s) where the linked formulas are required





V1.5.2

3. Click **Home > Paste > Paste Link**

## Section review

This section was about:

- Using Quick Analysis
- Incorporating absolute and mixed cell referencing
- Using Range Names to simplify formulas

## Review questions

1. Name a benefit of using range names
2. Which dialog box would you use to modify an existing range name?
3. Name the different features you can create when using Quick Analysis



## Part 7: Working with data lists

This section covers the most efficient ways to store, sort and subtotal lists of data in Excel.

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

- Use Flash Fill to manipulate data
- Perform a sort on multiple columns
- Understand the options when sorting



## Flash Fill

Introduced in Excel 2013, *Flash Fill* is an easy way to reformat and rearrange data without resorting to formulas, macros, or other sometimes convoluted features.

In some way, Flash Fill is like the traditional AutoFill feature you will have used many times, but there are some important differences:

	<b>AutoFill</b>	<b>Flash Fill</b>
<b>Starting data</b>	1 cell	Several cells
<b>Purpose</b>	Fills sequences or copies data	Reconfigures data
<b>Fills based on</b>	Pre-programmed lists	Learns from your data
<b>Activates by</b>	Fill Handle	Typing; Fill Handle; Ribbon commands

Email Address	First Name
Janet.Poole@example.com	Janet
Christopher.Robinson@example.com	Christopher
Brian.Allison@example.com	Brian
Barry.Robson@example.com	Barry
Charles.McKnight@example.com	Charles
Peter.James@example.com	Peter
Marjorie.Frost@example.com	Marjorie
John.Hooper@example.com	John
Gordon.West@example.com	Gordon
John.Luke@example.com	John
Basil.Curry@example.com	Basil
Paul.Wales@example.com	Paul

Figure 73: Flash Fill in action

In the above screenshot, you can see that Flash Fill is learning how to create peoples' first names based on their email address.

To use Flash Fill:

1. Ensure you are in a cell adjacent to the data
2. Type the required data, as normal
3. In the next cell down, start to type the required data for the second entry – if Excel can determine a pattern, it will display a ‘faded’ version of the data
4. Based on Excel’s proposed entries:
  - If the suggestions are correct, press **Enter** to fill the remaining cells



- If Excel is not correct, continue typing entries until it learns



### Helpful hint

If a pattern is not detected, type two or three entries, then use either **Data > Flash Fill**, or press **Ctrl+E**.

When Flash Fill completes data, the *Flash Fill indicator* on the Status Bar will detail the number of cells changed. Whilst this message is visible, Excel is still learning – correct any further cells that need changing, and Excel will update the filled data accordingly.



Figure 74: The Flash Fill status indicator at the bottom of the screen



### Guided activity: Using Flash Fill

You have received a list of names of new starters at your organisation, and need to extract their surname, office location and extension number, and create their email address, using the format initial.surname@example.com

1. Open the **DATA LISTS.XLSX** workbook
2. Select cell B2 and type **Poole**
3. In B3 start typing **Robinson** – you only need to type one or two letters, do not type the whole name
4. When the transparent view appears, press **Enter** to extract the remaining data for the other names
5. Create the email addresses by moving to cell C2 and typing **J.Poole@example.com**
6. In cell C3 type **C.Robinson@example.com**
7. When Excel shows the completed list, press **Enter**
8. Repeat the process to extract the information for the ‘Location and ‘Extension’ columns
9. Save the file, and keep it open for use in the next activity



## Applying basic sorting

Sorting enables a list to easily be reordered to help organise and find the data that is needed.

For convenience, the Sort commands appear in several locations:

- On the right-hand side of the Home tab on the Ribbon
- In the middle of the Data tab on the Ribbon
- If the Filter command has been used, sorting commands appear in the dropdown lists
- By right-clicking within the list of data

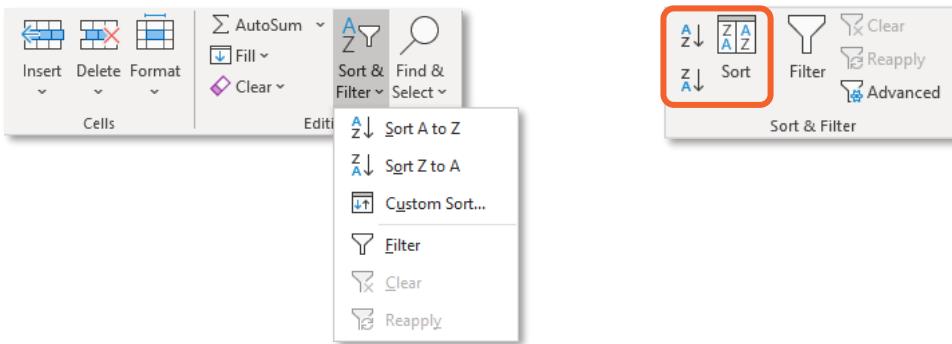


Figure 75: The sorting tools in Excel – Home (left), Data (right)

### Sort order

When a list is sorted in ascending order, Excel sorts the list using the following rules. Blank cells always appear at the bottom of the list.



Data type	Ascending sort order
Numeric	Smallest negative number to largest positive number
Date/time	Earliest date/time to latest date/time
Text	<p>Sorted left to right, character by character using the following order of precedence:</p> <p>0 1 2 3 4 5 6 7 8 9 (space) ! " # \$ % &amp; ( ) * , . / : ; ? @ [ \ ] ^ _ ` {   } ~ + &lt; = &gt;</p> <p>A B C D E F G H I J K L M N O P Q R S T U V W X Y Z</p> <p>If a case-sensitive sort has been specified, then lowercase appears before uppercase.</p> <p>Apostrophes and hyphens are ignored unless two cells are identical except for the presence of an apostrophe or hyphen. For example, 'co-ordinator' follows 'coordinator.'</p>
Boolean	FALSE then TRUE

The sort orders listed above are reversed in a descending sort. However, blank cells still appear at the bottom of the list, even in a descending sort.

If the range contains mixed data types, it will be sorted in the order shown above (that is, numeric values appear at the top, followed by dates, then text, and finally Boolean values). If the list contains numbers that should be sorted as text, format the cells as Text.

### Sort using a single column

Once the data list has been created (considering the guidelines on page **Error! Bookmark not defined.**), then it is ready for sorting.

To sort a list using a single column:

1. Select any single cell in the relevant column
2. Either:
  - Click **Home > Sort & Filter >** select the desired sort order; or
  - Click **Data >** select the desired sort order



#### Helpful hint

You only need to select one cell in the relevant column to sort data.





### Key point

Selecting multiple cells in the same column will cause Excel to ask if the range should be expanded to include the whole list. Selecting cells in multiple columns will cause Excel to sort only the currently selected area.



### Helpful hint

Unlike Microsoft Access, Excel does not have a 'Remove Sort' command. You may want to consider adding a column of sequential numbers to the list before sorting – this can then be used to re-sort the data later.

## Reapplying a sort

If data is added to a sorted list, the sort will need to be performed again. If the list contains the Filter buttons, the last sort can be quickly reapplied using the relevant icon.

To reapply the last-used sort:

1. Select any cell in the relevant column of the data list
2. Click **Data > Reapply**



### Guided activity:

#### Sorting data in a list

You have a worksheet which does not appear to be sorted in any way. You would like to view the data in several different orders and will use basic sorting to achieve this.

1. Open the **DATA LISTS.XLSX** workbook
2. Select any single cell in the 'Department' column (column D)
3. Click **Home > Sort & Filter > Sort A to Z**
4. Select any cell in the 'Date of Birth' column
5. Click **Data > Sort Oldest to Newest** (the 'AZ' icon)
6. Sort the data into **ascending** order using the **Staff No** column
7. Save the file, and keep it open for use in the next activity



## Advanced sorting

We examined the basic sorting commands on the Essentials course. However, there may be instances where more control is needed, and Excel's more advanced sorting commands can be used to accomplish this.

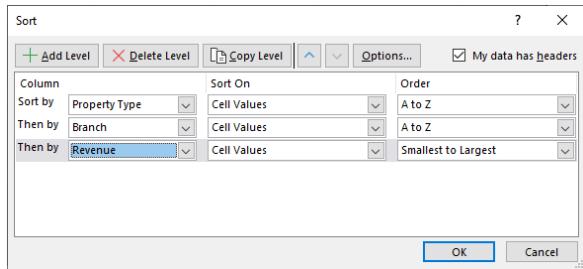


Figure 76: The 'Custom Sort' dialog box

### Sort using multiple columns

It may be desirable to sort on several columns at the same time. Excel can sort by up to 64 columns at once. In this example, the data is sorted by Date then by Company.

Invoice	Date	Number	Company	Amount	VAT	Total
11560	11/04/2013	TC/001	Ability	£3,472.00	£607.60	£4,079.60
11562	14/04/2013	TC/024	Adept Computer Technology	£ 690.00	£ 120.75	£ 810.75
11561	14/04/2013	TC/004	Lectern Systems	£ 782.00	£ 136.85	£ 918.85
11563	16/04/2013	TC/004	Lectern Systems	£ 499.00	£ 87.33	£ 586.33
11564	18/04/2013	TC/001	Ability	£2,890.00	£505.75	£3,395.75
11568	19/04/2013	TC/001	Ability	£ 1,575.00	£ 275.63	£ 1,850.63
11567	19/04/2013	TC/024	Adept Computer Technology	£ 804.00	£ 140.70	£ 944.70
11565	19/04/2013	TC/004	Lectern Systems	£1,809.00	£316.58	£2,125.58
11566	19/04/2013	TC/010	Northwind Systems	£3,635.00	£636.13	£4,271.13

Figure 77: Data sorted by multiple columns

To sort a data list using multiple columns:

1. Select any cell within the data list
2. Click **Home > Sort & Filter > Custom Sort...** or **Data > Sort** to display the 'Custom Sort' dialog box
3. Specify the desired **Sort by** options:
  - o Select the first column to sort by
  - o Ensure that 'Sort On' is set to **Values**
  - o Select the desired 'Order'
4. To add another column to sort by, click **Add Level** and specify the sorting, as above
5. Once all sorting levels have been added, click **OK** to close the dialog box and perform the sort





### Helpful hint

When adding sorting levels, it may be necessary to rearrange the order in which the sort will be performed – the dialog box has two ‘arrowed’ icons to help with this.

## Sorting options

Excel provides two sorting options that can be used to change the behaviour of sorting – these are found in the ‘Custom Sort’ dialog box.

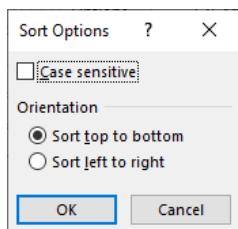


Figure 78: The ‘Sort Options’ dialog box

Option	Description
Case sensitive	Lowercase letters will appear before uppercase
Sort top to bottom	The default setting – sorts vertically based on the columns selected
Sort left to right	Sorts horizontally, based on the rows selected

## Using a custom list

Excel’s *custom lists* have multiple uses, but the one covered here is to allow a list to be sorted into a logical order, rather than ascending or descending.

For example, if there are four regions – North, South, East, and West – this is probably the desired order, but a regular sort would list ‘East’ first.



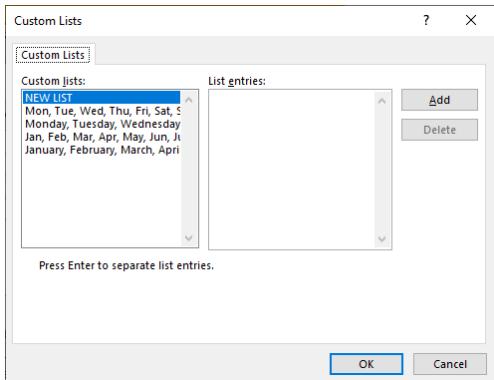


Figure 79: The 'Custom Lists' dialog box

To create and sort using a custom list:

1. Click into the data list to be sorted, as normal
2. Open the 'Sort' dialog box using any of the previously covered methods
3. In the 'Order' option, select **Custom List...** – Excel will display the 'Custom Lists' dialog box
4. In the 'List Entries' section on the right, type the desired list options, pressing **Enter** as required so that each entry is on its own line
5. Click **OK** to return to the 'Sort' dialog box
6. Specify any remaining sort settings and click **OK** to close the dialog box and perform the sort



#### Useful tool

Custom lists can also be created using **File > Options > Advanced > Edit Custom Lists...** - this provides the ability to import existing data from a range of cells to create the list.



#### Guided activity:

#### Sorting using multiple columns

You have a worksheet which does not appear to be sorted in any way. You would like to display the different types of building as the first level of a sort – where there are several rows of the same building type, you would like a second level of Branch, and a third level of Revenue – with the highest revenue at the top of the list.

1. Ensure that the **DATA LISTS.XLSX** workbook is open



2. If necessary, navigate to the 'Advanced' worksheet, and select any cell within the list
3. Click **Home > Sort & Filter > Custom Sort...**
4. Set the following sort options:
  - o *Sort by: Property Type*
  - o *Sort on: Cell Values*
  - o *Order: A to Z*
5. Click the **Add Level** button to add a secondary sort, and define it as follows:
  - o *Sort by: Branch* – leave all other options as they are
6. Click the **Add Level** button to add a third sort:
  - o *Sort by: Revenue*
  - o *Order: Largest to Smallest*
7. Click **OK** to close the dialog box and perform the sort
8. Save the file, and keep it open for use in the next activity

## Applying basic filters

When working on a list with many rows, it can be difficult to view and analyse the data. Filtering is a quick way to find and work with a subset of the list. Filters allow make it possible to view just the records needed and hide any data that is not relevant to the search. For example, you might want to find the records for a specific department, or salary figures within a specific range or above an amount.

Unlike sorting, filtering does not rearrange your data; it simply hides the rows you do not want to view. You may then edit, format, chart and print filtered data as required.

Once you have filtered the list, a number of on-screen changes will occur:

- Only rows meeting the criteria are visible
- The row numbers for the filtered rows are shown in blue
- The dropdown arrow in any filtered column has changed to a filter (funnel) symbol, with a small arrow
- The Status Bar will display the number of records left



A	B	C	D	E	F
Branch	Property	Property Type	Agent	Selling Price	Revenue
33 Emersons Green	98 Cadbury Heath Road, Warmley	Detached	Judy Mansfield	202,817	1,299
102 Emersons Green	Rock House Farm, Mangotsfield	Detached	Judy Mansfield	192,600	1,288
162 Emersons Green	2 Lewis Close, Emersons Green	Detached	Judy Mansfield	217,700	1,895
182					

Single Column   Advanced   Subtotals   (+)

3 of 180 records found

Figure 80: An example of a filtered list

To enable filtering of a list:

1. Click inside the data list to be filtered
2. Click **Home > Sort & Filter > Filter**, or click **Data > Filter** – Excel will display the filter dropdown buttons at the top of each column in the list



### Helpful hint

Quickly add or remove the filter buttons by pressing **Ctrl+Shift+L**.

## Filtering with checkboxes

Once filtering has been enabled, Excel provides a variety of different filtering techniques that can be used. The most popular is to use the provided checkboxes.

When a column of data contains either text or numerical values, the filter button will display checkboxes next to each unique value. However, if the values within the column are exclusively dates, the filter button will group the dates into years, months, and days – a small plus or minus symbol will appear next to the checkbox, allowing you to drill into, or out of, the options provided.

Figure 81: Filter options for text (left), values (middle) and dates (right)





### Helpful hint

The filter dropdown can display a maximum of 10,000 unique entries. If the dataset has more, only the first 10,000 unique values will be listed.

To filter a list:

1. Ensure that the filter buttons are displayed at the top of each column of the list
2. Click the appropriate filter button for the desired search
3. Untick **Select All**
4. Tick all the desired options – if the column contains dates, it may be necessary to need to drill into the required year/month using the +/- icons – and click **OK**

### Using the search option

If the filter list is particularly lengthy list, it may be easier to use the Search box. This allows part of the result being searched for to be entered, and then add it to the filter.



### Useful tool

As soon as the search box is used, Excel will display a checkbox 'Add current selection to filter.' Tick this to keep the current filter in use; unticking it will clear any existing filter.

### Clearing filters

Once filters have been applied and the necessary work completed, it will usually be necessary to clear the search. Indeed, it is considered good practice to do so, especially if others are using the same workbook to help prevent misunderstandings around which data is currently available.

To clear the filters from one column only:

- Click the relevant filter button and tick **Select All**; or
- Click the relevant filter button and choose **Clear filter from...**

To clear all active filters:

- Click **Home > Sort & Filter > Clear**; or
- Click **Data > Clear**





### Guided activity: Filtering a data list

You have been passed a list of selected employees of your organisation and have been asked to perform several filters to obtain information from the list.

1. Ensure that the **DATA LISTS.XLSX** workbook is still open from the previous activity
2. Click anywhere inside the data list, and click **Home > Sort & Filter > Filter** – this will switch the filter buttons on

You have been asked to display all members of the HR department in Milton Keynes who are part-time (i.e., under 35 hours per week):

3. Using the 'Department' column click the filter button, untick **Select All**, tick **HR**, and click **OK**
4. Use the 'Location' column and ensure that only Milton Keynes is displayed
5. Click the filter button in 'Hours per week' and ensure that only values less than 35 are selected
6. Click **Data > Clear** to clear the current set of filters



### Independent activity: Sorting and filtering data

You have been tasked with organising and checking a list of customers to make it easier to interpret.

1. Open the **LAB FILTERING.XLSX** workbook
2. Sort the list into order by age – how old are the youngest and oldest customers?
3. Sort the list so homeowners are displayed at the top of the list
4. Filter the list to display only customers who are self-employed – how many are there?
5. Clear the current filter, and filter the list to show only those who are homeowners – how many are there?
6. Leaving the current filter active, now filter the list to show those customers in the northeast – how many are there?
7. Clear all filters, save, and close the workbook





V1.5.2

## Section review

This section was about:

- Using Flash Fill to manipulate data
- Performing a sort on multiple columns
- Understanding the options when sorting
- Using Excel's standard filtering command

### Review questions

1. How do you show or hide the filter buttons?
2. Can you perform a chronological sort?
3. How do you remove a filter applied to a column of data?
4. What is the process to filter a column for two items at once?
5. What might you use a custom sort for?
6. How would you modify the sort order priority?





V1.5.2

## Part 8: Importing data

In this section you will explore some of Excel's tools that allow you to easily import data into an Excel workbook.

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

- Importing a delimited text file
- Using Power Query to connect and import data
- Exporting delimited text files



## Importing delimited text files

Many systems output data in *delimited text files* – commonly **.TXT** or **.CSV** (Comma Separated Values) files – and it can be beneficial to import these into Excel.



### Key point

A *delimiter* is a symbol which appears between each field or cell of information. Common delimiters include comma, semi-colon and tab.

*Fixed-width* files have a set size for each field or cell of information, which may vary from one field to another

Import - Orders.txt								
File Origin		Delimiter		Data Type Detection				
1252: Western European (Windows)		Comma		Based on first 200 rows				
anoOrderID	txtCustomerID	IngEmployeeID	dtmOrderDate	dtmRequiredDate	dtmShippedDate	IngShipVia	curFreight	
10248	VINET	5	04/08/1994 00:00:00	01/09/1994 00:00:00	16/08/1994 00:00:00	3	32.38	Vins
10249	TOMSP	6	05/08/1994 00:00:00	16/09/1994 00:00:00	10/08/1994 00:00:00	1	11.61	Ton
10250	HANAR	2	08/08/1994 00:00:00	05/09/1994 00:00:00	12/08/1994 00:00:00	2	65.83	Han
10251	VICTE	3	08/08/1994 00:00:00	05/09/1994 00:00:00	15/08/1994 00:00:00	1	41.34	Vict
10252	SUPRD	4	09/08/1994 00:00:00	06/09/1994 00:00:00	11/08/1994 00:00:00	2	51.30	Sup
10253	HANAR	3	10/08/1994 00:00:00	24/08/1994 00:00:00	16/08/1994 00:00:00	2	58.17	Han
10254	CHOPS	5	11/08/1994 00:00:00	08/09/1994 00:00:00	23/08/1994 00:00:00	2	22.98	Cho
10255	FISSA	9	12/08/1994 00:00:00	09/09/1994 00:00:00	15/08/1994 00:00:00	3	148.33	Ric
10256	WELLI	3	15/08/1994 00:00:00	12/09/1994 00:00:00	17/08/1994 00:00:00	2	13.97	Wel
10257	HILAA	4	16/08/1994 00:00:00	13/09/1994 00:00:00	22/08/1994 00:00:00	3	81.91	Hil
10258	ERNSH	1	17/08/1994 00:00:00	14/09/1994 00:00:00	23/08/1994 00:00:00	1	140.51	Erm
10259	fissa	4	18/08/1994 00:00:00	15/09/1994 00:00:00	25/08/1994 00:00:00	3	3.25	Cen
10260	OTTIK	4	19/08/1994 00:00:00	16/09/1994 00:00:00	29/08/1994 00:00:00	1	55.09	Otti
10261	QUEDO	4	19/08/1994 00:00:00	16/09/1994 00:00:00	30/08/1994 00:00:00	2	3.05	Qu
10262	RATTIC	8	22/08/1994 00:00:00	19/09/1994 00:00:00	25/08/1994 00:00:00	3	48.29	Ratt
10263	fissa	9	23/08/1994 00:00:00	20/09/1994 00:00:00	31/08/1994 00:00:00	3	146.06	Erm
10264	FOLKO	6	24/08/1994 00:00:00	21/09/1994 00:00:00	23/09/1994 00:00:00	3	3.67	Folk
10265	BLONP	2	25/08/1994 00:00:00	22/09/1994 00:00:00	12/09/1994 00:00:00	1	55.28	Blor
10266	WARTH	3	26/08/1994 00:00:00	07/10/1994 00:00:00	31/08/1994 00:00:00	3	25.73	War
10267	FRANK	4	29/08/1994 00:00:00	26/09/1994 00:00:00	06/09/1994 00:00:00	1	208.58	Fran

Figure 82: Connecting to a delimited file

## Excel 2013 & 2016



### Useful tool

In Excel 2013, the ‘Text Import Wizard’ will activate to walk through the process of configuring the import’s results.

1. Select the first cell to hold your imported data
2. Click **Data > From Text**
3. Navigate to the file you want to import and choose **Import**
4. Ensure the *Delimited* option is selected, and if your data includes the names of the columns or fields, ensure *My data has headers* is ticked



5. After clicking **Next**, select the delimiter for the file and click **Next**
6. The final part of the Wizard allows you to set the data format of the columns – click **Finish**
7. A new dialog box will appear, allowing you to specify where to locate the imported data – click **OK**

## Excel 2019, 2021 & 365

1. Select the first cell to hold your imported data
2. Click **Data > From Text/CSV**
3. Navigate to the file you want to import and choose **Import**
4. From the preview screen, if necessary, modify the delimiter for the file
5. Click **Load** to return the data to a new table in the workbook



### Guided activity 2013 & 2016: Importing data from a text delimited file

In this activity you will import product data from a Text file into an Excel workbook.

1. Create a new blank workbook, and save it as **PRODUCTS\_DATA.XLSX**
2. Click **Data > From Text**
3. Select the **IMPORT – PRODUCTS.TXT** file and click by **Import**
4. Ensure the delimited option is selected, tick 'My data has headers', followed by **Next**
5. Remove the tick from **Tab**, and tick the **Comma** option, followed by **Next**
6. Click **Finish**, followed by **OK**
7. How many rows of data have been imported?
8. Save the changes and close the file



### Guided activity 2019, 2021 & 365: Importing data from a text delimited file

In this activity you will import product data from a Text file into an Excel workbook.

1. Create a new blank workbook, and save it as **PRODUCTS\_DATA.XLSX**



2. Click **Data > From Text/CSV**
3. Select the **IMPORT – PRODUCTS.TXT** file and click by **Import**
4. Ensure **Comma** is specified as the *Delimiter*
5. **Load** the data into the workbook – this will create a new sheet with a formatted table containing the data
6. How many rows of data have been imported?
7. Save the changes and close the file

## Using Power Query

Power Query is a tool used by Microsoft Excel in versions 2019 and later, to enhance the import process. It allows the user a greater degree of control over the imported data, its formatting and appearance.

It is also possible to *connect* to the imported file so that any changes to it can be easily incorporated into the Excel workbook. For example, the file may get updated on a weekly basis.

Power Query has many commands which can aid when importing data, some of which we will examine in this section.



### Helpful hint

Power Query is used in other Microsoft products, including Power BI and Power Automate.



### Key point

Anything done in Power Query does not affect the original, underlying data source.

## Accessing Power Query

The Power Query interface can easily be accessed when importing data

1. Click **Data > From Text/CSV**
2. Select the file to import and choose **Import**
3. Click **Transform Data**

If Power Query has already been used and it is necessary to return to it, perhaps to modify the Applied Steps, click **Data > Get Data > Launch Power Query Editor...**



## Filtering records to import

If you have a large dataset, you may not wish to import every record into Excel. Power Query allows you to filter the data before it reaches Excel so only required records are imported.

Importing an unnecessarily large dataset may cause Excel to run slowly and unresponsive.

To filter data in Power Query:

1. Click the appropriate filter button for the relevant column
2. Untick **Select All**
3. Tick all the desired options and click **OK**
4. Alternatively, from the dropdown, select an option from within either Text, Number or Date Filters

## Selecting the columns to Import

In addition to selecting the rows of data you wish to import; you can also use Power Query to choose the columns to import.

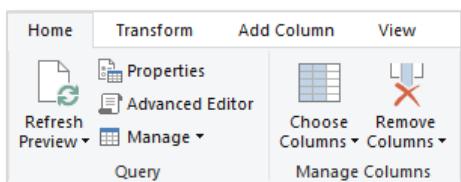


Figure 83: Choose Columns allows you to select which columns of data to import

To remove unwanted columns in Power Query:

1. Click **Home > Choose Columns**
2. Remove the ticks from the columns you do not need to import

Alternatively, you can select the column/s you wish to remove, and press the **Delete** key on your keyboard

## Data types

When you import data, Power Query will examine the first 200 values of each field or column to determine the type of data contained within.

Typically, data will be either text, numerical or date/time, although other data types exist.

At times it may be necessary to change the data type of a column.

- Click **Home > Data Type** and select the relevant option; or
- Alternatively, click the small symbol to the left of the column name.



A <sup>B</sup> <sub>C</sub> Location	I <sup>B</sup> <sub>C</sub> Staff No	Date Joined
Worcester	1.2 Decimal Number	26/02/1995
Hull	\$ Currency	27/04/1989
Plymouth	1 <sup>2</sup> 3 Whole Number	27/01/2002
Nottingham	% Percentage	07/05/1996
Stoke	Date/Time	01/10/1980
Cardiff	Date	01/03/2004
Northampton	Time	23/09/2002
Manchester	Date/Time/Timezone	08/09/1977
Manchester	Duration	04/04/1977
Portsmouth	A <sup>B</sup> <sub>C</sub> Text	24/10/2005
Plymouth	X <sup>B</sup> <sub>C</sub> True/False	29/07/1981
Colchester	Binary	19/06/1989
Leicester	Using Locale...	01/01/1999
Kings Lynn		23/07/1971
Cardiff		20/06/2007

Figure 84: You can change the data type from the symbol to the left of the column name

## Setting column names

If your imported data holds the names of the columns, Power Query will typically detect the titles and assign them to the relevant columns. However, this may not always happen, such as when your imported data only contains text values.

You can force Power Query to use the first row of data as the column titles if necessary. Alternatively, you may want to manually set the names of the columns

	A <sup>B</sup> <sub>C</sub> Column1	A <sup>B</sup> <sub>C</sub> Column2	A <sup>B</sup> <sub>C</sub> Column3	A <sup>B</sup> <sub>C</sub> Column4
1	Name	Department	Manager	Location
2	Scott, Gemma	Manufacturing	Harvey, Pete	Worcester
3	Binsley, Joanne	Manufacturing	James, Rachel	Hull
4	Shaw, Pete	Administration	Winter, Kathryn	Plymouth

Figure 85: Power Query has failed to detect the column titles exist in the first row of data

To use the first row of data as column headings:

- Click **Home > Use First Row as Headers**

To set column names manually:

- Double click the current column name and enter the desired title

## Splitting a column

At times, a column of your imported data may contain multiple values, which you would like to split into multiple columns. For example, if you have a value of “Mitchell, Pete”, you may wish to split the name into Surname and First Name columns. Whilst multiple methods exist within Excel for achieving this, it can be beneficial to split the data within Power Query.

There are several methods within Power Query to split your data, we will examine the popular Delimiter option.



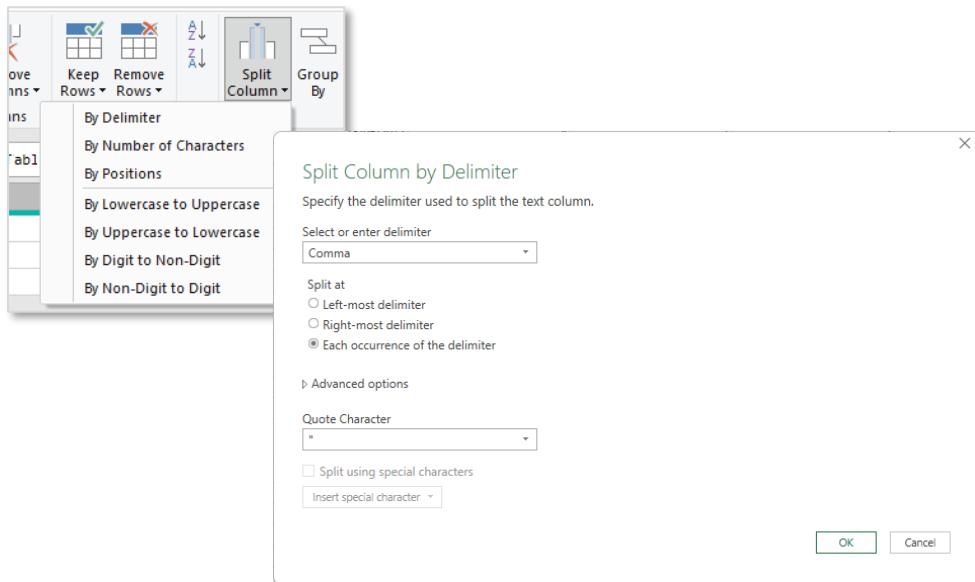


Figure 86: The Split Column command has several useful options

To split the current column:

1. Click **Home > Split Column >**
2. Select **By Delimiter** and specify the delimiter for your data – note that you can split at either the first, last or at each occurrence of the delimiter
3. Click **OK**

## Using Applied Steps

If you regularly import data in Excel, perhaps as part of a weekly or monthly reporting process, you will know that it can be a tedious affair. Indeed, many users will create a macro to ease the process.

Power Query, however, can perform all your transformation steps against your imported data, any time there is an update to the data; for example, when the underlying .csv file is modified, without any need to create a macro.

The Applied Steps area of Power Query shows you the actions performed on your data. In many cases these steps can be modified or removed. For example you may have removed some columns of data; at a later point in time, you can restore these columns.





### Key point

Some steps will have been performed automatically by Power Query.

When the underlying data is updated, Power Query will execute each Applied Step against the modified data, saving you the trouble of performing the actions again.

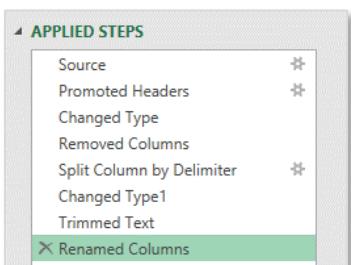


Figure 87: The Applied Steps lists all the actions you have performed against your data

To modify an Applied Step:

1. Click the **cog** symbol to the right of the step name
2. Make the necessary adjustments and click **OK**

To delete an Applied Step

- Click the **cross** symbol to the left of the step name



### Key point

Care should be taken when deleting (or inserting) steps as this may cause a problem with a later Step.

## Sending the data to Excel

Once you have performed the necessary steps with your data, you will want to send the data to Excel, where you can calculate and analyse accordingly.

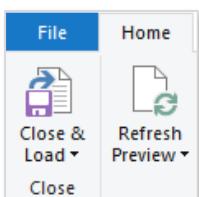


Figure 88: The Close & Load command will send your data to Excel

To load the modified data into the current Excel workbook, click **Home > Close & Load**.





### Helpful hint

You can return to the Power Query interface after importing data, by clicking on the **Edit** button from the **Query** tab.

## Updating the imported data

One of the advantages of connecting to data sources using the above methods is that they can be *refreshed* – updated so that the most recent or current data is available in the workbook.

By having semi-live data that can easily be refreshed, should the source data change, it is only a couple of minutes work to update the workbook (and any formulas etc. update) rather than a time-consuming, repetitive process.

To refresh the current workbook or data source:

- Click **Data > Refresh**; or
- **Query > Refresh**



### Helpful hint

Remember, when refreshing your data, all applied steps will be executed again, eliminating the need for you to repeat the actions manually.

## Closing the connection to the source data

Once you have imported the data, Power Query will maintain a connection, which allows it to update the data should there be any changes to the data.

However, you may not want or need this feature. Perhaps the source file will be deleted or moved, and this may cause issues later.

You can easily remove the connection with the **Delete** command; this will simply delete the connection, and not the imported data.

3. Click into the table holding your imported data
4. From the **Query** tab, click the **Delete** command



### Useful tool

The **Refresh** command will refresh the current data source and everything that relies on it. Use the **Refresh All** command to update all sources, though this may take longer.





### Guided activity: Importing data with Power Query

In this activity you will import a staff list from a .csv file.

1. Create a new file and save it with the name **STAFF LIST.XLSX**
2. Click **Data > From Text/CSV**
3. Select the file called **IMPORT – STAFF.TXT** and click **Import**
4. Click **Transform Data**
5. Click the header of the **Manager** column and press **Delete**
6. From the filter for the **Department** column, remove the tick from **Select All** and then tick **Marketing**
7. Select the **Name** column, and click **Home > Split Column** then **By Delimiter**
8. As there is both a comma and a space separating the names, select **Custom** as the delimiter
9. In the text box below, press comma followed by a space and click **OK**
10. Double click the Name.1 column header and change the name to **Surname** and press **Enter**
11. Likewise, change the Name.2 column to **First Name**
12. Click **Home > Close & Load**

## Exporting to a delimited text file

Data held in Excel can easily be saved in other formats, most notably text files, allowing you to share information with other systems.

Note, it is not possible to save multiple worksheets of Excel data to a single text file; you must use several text files if you have this situation. Additionally, the text file cannot store information regarding Excel calculations; the text file will simply store the result of said calculations.

1. Click **File > Save As**
2. Select a location to save the file to
3. From the **Save as type** box, choose the text file format for the worksheet, for example “CSV (comma delimited) (\*.csv)”
4. A dialog box will appear warning you that only the current worksheet will be saved
5. Click **Yes**



6. If a second dialog box appears warning you that you are working with content features not compatible with text file formats, click **OK**

## Section review

This section was about:

- Importing a delimited text file
- Using Power Query to connect and import data
- Exporting delimited text files

### Review questions

1. How do you export Excel data?
2. How do you rename a column in Power Query?
3. What reasons would you have to export Excel data?
4. What reasons would you have to import a text file?



#### Independent activity: Importing a text/CSV file

In this activity you will import data from a text file that you have been supplied with.

1. Create a new, blank workbook
2. Import the text file called **IMPORT - ORDERS.TXT**, ensuring that the data is separated at each comma
3. Review the imported data and save the file as **IMPORTED ORDERS.XLSX**



#### Independent activity: Importing data using Power Query

In this activity you will use Power Query to import a CSV file and transform it, before returning the results to an Excel workbook. You will then modify the source file and refresh the workbook with the changes.

1. Create a new workbook and import the **IMPORT - HOLIDAYS.CSV** file, ensuring that the imported file is available in Power Query
2. Filter the data using the **Booking Source** column so that only Contact Centre bookings are kept



3. Remove the following columns:
  - Adults
  - Children
  - BookingSource
  - InsuranceTaken
4. Split the **CustomerName** and **LoginName** columns into initial/last name and last name/first name, respectively
5. Ensure the **NetRevenue** column is stored as currency
6. Rename the columns as follows:

Column name	New name
BookingID	Booking Ref
CustomerID	Customer ID
CustomerName.1	Customer Initial
CustomerName.2	Customer Last Name
Employee.1	Employee Last Name
Employee.2	Employee First Name
BookingDate	Booking Date
ArrivalDate	Arrival Date
PartySize	No. of Guests
NetRevenue	Booking Total
HolidayType	Holiday Category

7. Import the completed data to the Excel workbook

Now the data has been imported, you will test Power Query's applied steps by adding a new row of data to the source file.

8. Open the **IMPORT - HOLIDAYS.CSV** file
9. At the bottom of the data, add a new row as follows:

Column	New data
BookingID	10760
CustomerID	99



Column	New data
CustomerName	Yourself
BookingDate	Today's date
ArrivalDate	Next Monday
Nights	7
Adults	2
Children	2
PartySize	4
NetRevenue	1000
Park	Rauros Falls
HolidayType	Monday Week
BookingSource	Contact Centre
InsuranceTaken	No

10. Return to the imported data and refresh the Power Query results and check that the newly added data is there
11. Save the workbook as **IMPORTED BOOKING.XLSX**, and close it





V1.5.2

## Part 9: Mastering Excel tables

This section will provide an understanding of Excel's tables feature, its benefits and its capabilities.

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

- Convert data to and from an Excel table
- Modify and resize a table
- Add calculations and totals to a table
- Manage a table



## Introducing tables

Excel is often used as a tool to store and analyse lists of data. Introduced in Excel 2007, **tables** are an invaluable tool to aid list handling.

The main benefit of using tables, however, is that the list will automatically expand should data be added to either the rows or columns immediately below or to the right of the existing data. Consequently, any calculations or features which point to the table can automatically expand the range they refer to, to include the new data. For example, if a chart is based on a table, as soon as data is added below the table, the chart would automatically include the new data.

	A	B	C	D	E	F	G		
1	Invoice No.	Invoice Date	Client	Region	Amount	Due Date	Date Paid		
2	800	19/06/2007	Alyce Grayson	North	£ 1,896.00	19/07/2007	23/07/2007		
3	801	30/10/2007	Bloggs Training Company	North	£ 1,722.00	29/11/2007	11/12/2007		
4	802	01/10/2007	Acme Copying	South	£ 881.00	31/10/2007	31/10/2007		
5	803	05/10/2008	Bloggs Training Company	West	£ 1,564.00	04/11/2008	20/11/2008		
6	804			D	E	F	G		
7	805	1	Invoice No.	Invoice Date	Client	Region	Amount	Due Date	Date Paid
8	2	800	19/06/2007	Alyce Grayson	North	£ 1,896.00	19/07/2007	23/07/2007	
9	3	801	30/10/2007	Bloggs Training Company	North	£ 1,722.00	29/11/2007	11/12/2007	
10	4	802	01/10/2007	Acme Copying	South	£ 881.00	31/10/2007	31/10/2007	
	5	803	05/10/2008	Bloggs Training Company	West	£ 1,564.00	04/11/2008	20/11/2008	
	6	804	01/07/2010	Acme Copying	North	£ 1,188.00	31/07/2010	26/08/2010	
	7	805	27/02/2009	Bloggs Training Company	West	£ 836.00	29/03/2009	24/05/2009	
	8	806	05/12/2010	Ferguson & Bardell	West	£ 1,488.00	04/01/2011	11/01/2011	
	9	807	11/03/2009	Acme Copying	East	£ 1,888.00	10/04/2009	04/05/2009	
	10	808	06/02/2007	Bloggs Training Company	North	£ 1,074.00	08/03/2007		

Figure 89: A list before (top) and after (bottom) being converted into a table

Tables provide many benefits when compared to regular lists. The most popular are detailed here:

Benefit	Description
Header row	The header row of a table holds the column headings, and is kept visible if the cell pointer stays within the table (similar to the Freeze Pane command)
Filtering	Filter buttons are automatically added to the column headings to allow quick access to Excel's sorting and filtering commands
Formatting	Tables have 60 pre-set colour schemes allowing the table to be quickly formatted. New data automatically has any existing formatting applied to it.
Insertions and deletions	Any rows/columns that are inserted or deleted are only done across the span of the table, rather than the entire worksheet. The <b>Tab</b> key can be used in the last cell of the data to insert a new row.



Benefit	Description
Expanding ranges	Tables automatically expand to include new data typed below or to the side of existing information. Any formula or feature based on the table range will be instantly increased to include the new information.
Range names	All tables are provided with a default (and changeable) range name to help simplify formulas
Calculated columns	Formulas typed into a table are automatically applied to the entire column, and are also copied down to any new rows added to the table
Total row	If added to a table, the total row displays the results of the chosen calculations, without the need to write a formula. If filters are used, the total row will display the totals for the current filter, not for all records.
Slicers	A new method of filtering data that is much more graphical, user- and touchscreen-friendly than traditional filtering commands

## Creating a table

Any existing list of data can be converted into a table, if so required. Because tables are based on lists, though considerably more powerful, when planning a table, the same care should be taken as when planning a list.



### Key point

Tables are not compatible with Excel's Subtotals command (see page **Error! Bookmark not defined.**).



### Helpful hint

Convert the current data list into a table by pressing **Ctrl+T**.

To convert a list of data into a table:

1. Click anywhere inside the list of data
2. Click **Home > Format as Table**, or **Insert > Table** – if using the 'Format as Table' button, a collection of pre-set styles will be displayed



3. In the 'Create Table' dialog box:
  - o Confirm the data range to be converted
  - o If necessary, specify whether the table has headers
4. Click **OK** once all the desired options have been set

When the cell pointer is positioned inside a table, Excel will display the 'Table Design' tab at the top of the screen on the Ribbon. This tab provides a wealth of commands to control and manage a table.

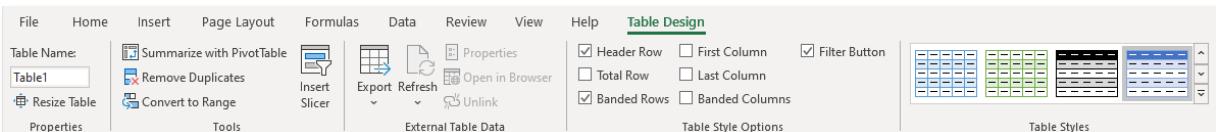


Figure 90: The 'Table Design' contextual tab on the Ribbon

## Managing tables

### Resizing a table

There are several different methods of adjusting the size of a table: inserting rows and pasting data, amongst others.

#### The Resize Table command

Tables can be resized using the 'Resize Table' command on the Table Tools Design tab on the Ribbon. To resize a table:

1. Click any cell inside the table
2. Click **Table Design > Resize Table**
3. Specify the new table range, and click **OK**



#### Helpful hint

Tables can be resized by dragging the 'notch' in the bottom-right corner of a table.

### Inserting new rows or columns

When working within a table, you may well encounter two extra commands – 'Insert Table Rows' (or Columns) and 'Delete Table Rows' (or Columns).

These only affect the table range – essentially Excel will insert new cells within the span of the table, rather than a new row or column across the entire worksheet's width or height.

To resize a table using insert or delete commands:

1. Right-click inside the table



2. Select **Insert > Table Columns to the Left**, or **Table Rows Above**, as appropriate
3. Select **Delete > Table Rows**, or **Table Columns**, as appropriate

### Adding data

Whenever new data is added to a row or column directly beneath the table or to its right, respectively, Excel will automatically resize the table accordingly.

In the same way as Microsoft Word, pressing **Tab** when in the last cell of a table will insert a new row.

### Pasting data into a table

If data that already exists elsewhere needs to be added to a table, the data can be copied and pasted:

1. Copy the source data
2. Click in the first available cell below the table
3. Paste the data in the normal manner – Excel will automatically expand the table range

### Naming a table

When a list is converted into a table, Excel automatically applies a default range name to it, e.g., Table1, Table2, etc. Whilst this name doesn't have to be used, it provides all the same benefits as using named ranges (see page 96), with the added advantage of adjusting the named area as data is added or removed.

To modify the name of a table:

1. Click anywhere inside the table
2. Click **Table Design > Table Name**
3. Type a new name, and press **Enter**



#### Key point

Table names are subject to the same rules as named ranges (see page 95)

## Calculations and totals in tables

Tables are usually named as a precursor to writing calculations within a table, as Excel also creates names for each column of data, based on its column heading.



## Creating calculations from table data

Once a table and its columns have names, formulas can be created that reference and use the data. The basic syntax is `TableName[ColumnName]`.

If the formula is within the table, the table's name does not need to be specified.

When writing a formula that references part of a table, clicking or selecting the data will cause Excel to use the appropriate name rather than cell reference:

- Selecting the column of data (not the worksheet column) will display `TableName[ColumnName]`
- Clicking a cell on the current row will display `[@ColumnName]` – the @ symbol indicates 'this row'
- Clicking a cell in a table's totals row (see below) will display `TableName[[#Totals], [ColumnName]]`

To create a calculation within a table:

1. Create the formula using your usual techniques – Excel will translate cell references into names automatically
2. Press **Enter** to complete the formula (as normal) – Excel will automatically copy the formula to each row of the table



### Useful tool

Calculated columns in table are automatically copied down as new rows are added to the table.

When calculated columns are created or modified, Excel will automatically copy the new calculation to all cells in the column. If this is not needed – perhaps just one row needs a different formula – use the *AutoCorrect Options* button to manage the situation.

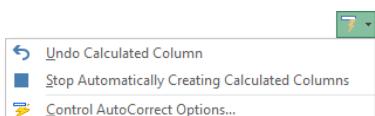


Figure 91: The calculated column 'AutoCorrect Options' button in a table

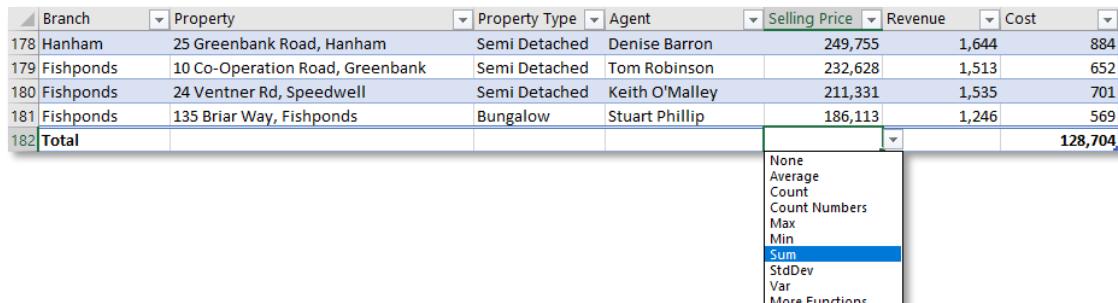
## Adding a total row

Many everyday lists will have a set of totals (or other statistics) at the bottom of the list – a *total row*.

When a total row is added to the list, Excel will automatically perform a suitable calculation on the last column of the table – if the data is



numerical then a traditional total will be generated, if not then the data will be counted. The defaults can easily be overridden if necessary – each cell in a total row is a dropdown list of calculations to choose from.



Branch	Property	Property Type	Agent	Selling Price	Revenue	Cost
178 Hanham	25 Greenbank Road, Hanham	Semi Detached	Denise Barron	249,755	1,644	884
179 Fishponds	10 Co-Operation Road, Greenbank	Semi Detached	Tom Robinson	232,628	1,513	652
180 Fishponds	24 Ventner Rd, Speedwell	Semi Detached	Keith O'Malley	211,331	1,535	701
181 Fishponds	135 Briar Way, Fishponds	Bungalow	Stuart Phillip	186,113	1,246	569
<b>Total</b>					<b>128,704</b>	

Figure 92: A table with a total row

To add a total row to a table:

1. Select any cell inside the table
2. On the Ribbon, click **Table Design > Total Row** – Excel will add the default totals
3. If necessary, modify the total row to display the required information



### Helpful hint

A total row uses Excel's SUBTOTAL function. This is different from the regular SUM, COUNT, and other functions, in that it only includes visible cells within its calculation.

## Formatting a table

Excel provides numerous predefined *table styles* that can be used to quickly format a table.

A table style can then be further customised using options for specific table elements, such as header and total rows, first and last columns, and banded rows and columns.

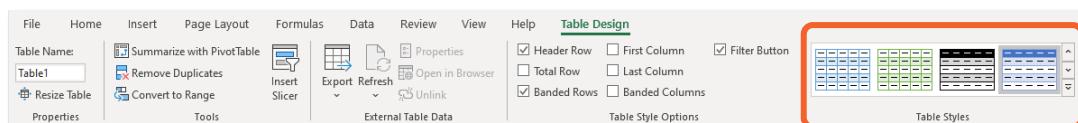


Figure 93: Table styles on the 'Table Design' tab of the Ribbon

To modify the current table style:

1. Select any cell within the table
2. Click the **Table Design** tab on the Ribbon



3. Select a new table style if needed
4. Modify the 'Table Style Options' using the checkboxes next to the table styles

**Guided activity:****Create and modify an Excel table**

You work in a busy 148-room hotel, and need to log the number of rooms occupied, unoccupied and those which are receiving refurbishment work (and therefore unavailable for bookings). You want to turn the existing list into a table to take advantage of its benefits.

1. Open the **TABLES.XLSX** workbook and ensure that the 'Occupancy' worksheet is displayed
2. Select any cell in the list of data and click **Home > Format as Table**
3. Select a table style of your choice – Excel will display the 'Format As Table' dialog box

The 'Format As Table' dialog will indicate which cells in the worksheet will be converted to a table – notice that although only a single cell was selected, Excel has detected the entire list.

4. Ensure that the correct range is shown, that **My table has headers** is ticked, and click **OK**

As the original data did not record the number of rooms being refurbished, this will now be added to the table. Note that the heading 'Average Occupancy Rate' is currently recorded in cell D1.

5. **Right-click** any cell in column D, within the table > **Insert > Table Columns to the Left** – Excel will add the new column, and note that the data in cell D1 has not been affected
6. Change the new column's heading to **Rooms Refurbished**, and enter the values **10, 6, 5, 5, 10, 10** in the new column
7. Save the file and keep it open for use in the next activity

**Guided activity:****Working with formulas and totals in a table**

You have noticed that the 'Occupancy Rate' cells are not formulas and so have decided to replace the static values with a calculation to speed up and automate the process of working with the list:



1. Delete the data in cells E5:E10
2. In cell E5, press **=** to start a formula, and click cell B5 – notice that Excel displays `=[@[Rooms Occupied]]` as it is using the column name from the table
3. Continuing the formula, type **/SUM(**
4. Select cells B5:C5 – Excel will display `/SUM(Table1[@[Rooms Occupied]:[Rooms Vacant]])`
5. Close the (round) bracket and press **Enter** to finish the formula – Excel will automatically copy the formula to each cell in the table column

The final formula reads:

`=[@[Rooms Occupied]]/SUM(Table1[@[Rooms Occupied]:[Rooms Vacant]])`

Whilst this method of writing and displaying formulas may make them longer than using traditional cell references, it can be much easier to understand.

Now that the occupancy rate has been calculated, the ‘Average Occupancy Rate’ can be worked out:

6. In cell E1, create an AVERAGE function, highlighting cells E5:E10 – the formula should read `=AVERAGE(Table2[Occupancy Rate])`

With the average occupancy rate calculated, you have decided that having other summary data available in the table would be useful, and that using the table’s total row would be the quickest way to achieve this:

7. Ensure that the cell pointer is positioned anywhere inside the table
8. Click **Table Design > Total Row**
9. Using the dropdown buttons in the total row, set the following totals:
  - o *Rooms Occupied*: Average
  - o *Rooms Vacant*: Average
  - o *Rooms Refurbished*: Sum
  - o *Occupancy Rate*: Average
10. Format the totals to have 2 decimal places
11. Navigate to the last cell containing data (cell E10) and press **Tab** – Excel will insert a new table row, copy any formulas into the new row, and move the total row down



12. Add two new rows of data:

Date	Occupied	Vacant	Refurbished
07/2/22	81	57	10
08/02/22	137	11	0

13. Save the file and keep it open for use in the next activity



### Guided activity: Adding data to a table

You have been on holiday for two weeks and need to update the data from this period.

1. Navigate to the 'Import' worksheet
2. Copy all the data (but not the headings)
3. Paste it onto the 'Occupancy' worksheet, in cell A13 – Excel will add the data to the table and update any formulas as needed

## Further table tools

### Slicers

A *slicer* is a graphical object that can be used to perform filters. These can be used to provide an interface that allows people to filter a table quickly and easily.

### Creating and modifying slicers

Slicers can be used as well as, or instead of, the usual filtering controls.

Branch	
Brislington	Emersons Green
Fishponds	Hanham
Kingswood	St George

Property Type	
Bungalow	
Detached	
Flat	
Semi Detached	
Terraced	

Figure 94: The 'Insert Slicer' button on the Ribbon, and a pair of slicers





To create a slicer for the current table:

1. Click **Table Design > Insert Slicer**
2. Tick each field that requires a slicer, and click **OK**

Once a slicer has been created, it can be modified using the 'Slicer' tab on the Ribbon at the top of the screen.

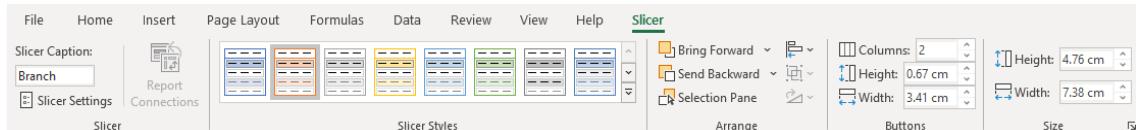


Figure 95: The 'Slicer' tab on the Ribbon

### Filtering with a slicer

Slicers can be used to filter a table simply by clicking the item or 'button' on the slicer. However, a slicer provides a few techniques that can be used to make filtering more powerful:

- *Select multiple consecutive items:* click the first required item, hold **Shift** and click the last
- *Select multiple non-consecutive items:*
  - Click the first required item, hold **Ctrl** and click each other item; or
  - Click the first, click the **Multi-Select** ('tick') icon at the top of the slicer, click each required item
- *Clear the filter:* click the **Clear Filter** ('funnel/cross') icon at the top of the slicer



#### Useful tool

If a table has multiple slicers, they work sequentially – the first-used slicer governs the options in the next. Any options that do not apply will appear at the bottom of the slicer and will appear faded.

### Removing duplicates

If several people have entered data into a table, or perhaps if information has been copied from several sources, it is possible that a table may end up containing duplicated information. Excel makes it extremely easy to remove any duplicates from the data.

Excel will allow the user to specify which columns are being checked for duplicates, or the entire row.



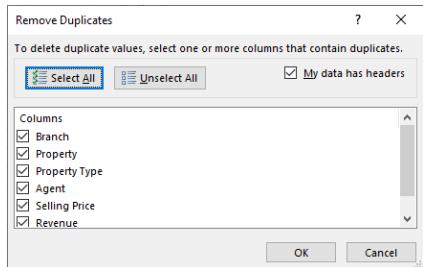


Figure 96: The 'Remove Duplicates' dialog box

To remove duplicates from within a table:

1. Select any cell within the table
2. Click **Table Design > Remove Duplicates**
3. Ensure that the required fields to be compared are ticked, and click **OK** – Excel will display a dialog box detailing the number of duplicates that have been removed

## Converting to a list

Not every Excel feature is compatible with tables. For example, both workbook sharing and subtotals cannot be used within a table. In such cases, it may be necessary to convert the table back to a regular range.



### Key point

When converting the table, all the table's features will be removed (header rows, named areas etc.), but colours retained.

To convert a table to a regular list:

1. Select any cell within the table
2. Click **Table Design > Convert to Range**
3. In the dialog box, click **Yes** to confirm the conversion



### Guided activity:

#### Using Slicers and removing duplicate entries

You often find yourself filtering a list of staff and you have decided that adding Slicers could save you some time. You have also been advised that the staff in the Manufacturing department of Aberdeen may have been entered twice.

1. Move to cell A11 on the 'Staff List' worksheet
2. Create a filter by clicking **Table Design > Insert Slicer**



3. From the dialog box tick **Department** and **Location** and click OK
4. Resize and move the two Slicers so they sit in the area above the list
5. Select **Manufacturing** from the Department slicer, and **Aberdeen** from the Location slicer

You will be able to see that the staff in the list appear twice.

1. Clear the filters by clicking **Data > Clear**
2. Click **Table Design > Remove Duplicates** and click OK

## Section review

This section was about:

- Converting data to and from an Excel table
- Modifying and resizing a table
- Adding calculations and totals to a table
- Managing a table

### Review questions

1. How do you create table from worksheet data?
2. Name a method of calculating the data in an Excel table
3. What benefits do tables provide, compared to regular lists?
4. Which features are not compatible with Excel tables?
5. How do you revert the Excel table back to an ordinary range of cells?



### Independent activity: Working with tables

You manage a spreadsheet containing details of telephone orders received during the day and have decided to convert the existing list into an Excel table.

1. Open the **IA MASTERING EXCEL TABLES.XLSX** workbook
2. Convert the data in cells B4:I12 into a table
3. Create a formula in cell H5 to determine the discount amount the customer will receive  
 $=[@Subtotal]*[@[Discount %]]$
4. Add a formula in cell I5 which shows the amount to invoice the customers  
 $=[@Subtotal]-[@[Discount Amount]]$





V1.5.2

5. Add a total row displaying the total of the Invoiced Amount column and the average of Quantity Ordered column
6. Save and close the file





V1.5.2

## Part 10: Charts

This section covers how to create, modify, and format charts in Microsoft Excel. You will learn how to generate a chart, how to work with chart elements, and how to format a chart.

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

- Create different types of charts
- Work with chart elements
- Format a chart
- Save a custom chart as a template
- Analyse data with sparklines



## Understanding charts

A chart is a graphical representation of data that can transform worksheet data to show comparisons, patterns, and trends in a visual and easy to understand way.

Charts are linked to the underlying worksheet data, so amending the values on the worksheet will adjust the chart automatically.

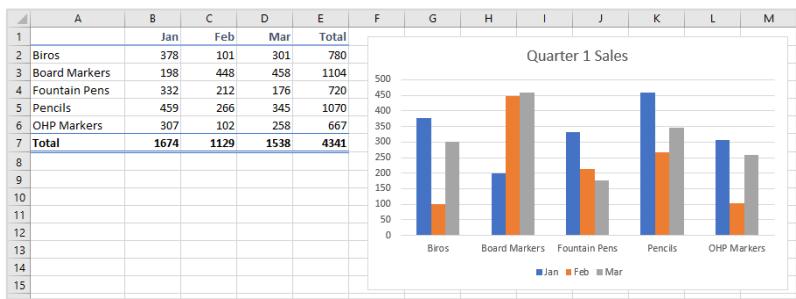


Figure 97: An example of a chart and its data

### Plotting a chart

Data for a chart generally needs to be laid out in a block of data with column and row headings, though not all data has to be selected (in the above example, the totals were not included in the chart).

Bar, column, and line charts comprise the *data series* (the values that are plotted), the *value axis* (displaying the range of values in the data series), and the *category axis* (displaying the range of items providing the values).

In Figure 97, the series legend comes from the column headings (Jan, Feb, and Mar), the categories are North, South, East and West, and the values to plot range from B2:D5.

Alternatively, separate areas of the data could be selected using the **Ctrl** key, perhaps to show the totals for each region as a percentage of the overall sales – and appropriate chart to display this data would be a pie chart.

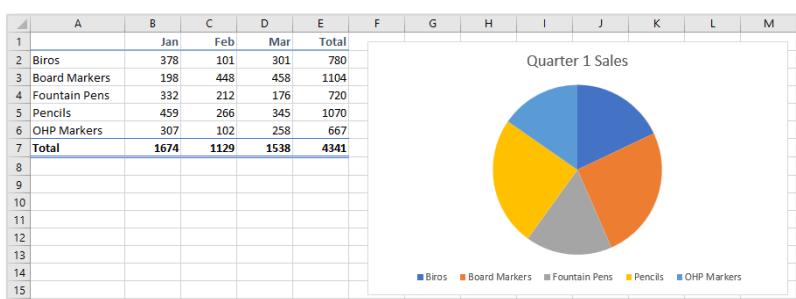


Figure 98: A sample pie chart



## Chart types

There are a variety of chart formats (or *types*), such as Line, Bar, and Pie charts. Chart elements can be customised for colour, font, size, and scale, amongst others.

One of the most important decisions to make is to choose an appropriate chart type to effectively describe the data. Some of the more commonly used types are:

Chart type	Description
Bar/Column	These display coloured bars or columns to represent each value. This type of chart makes it easy to compare values, because extremely high or low values stand out. Bar charts are better suited to displaying many different items (i.e., series) than column charts - the emphasis is more on the values than the items themselves. Bars on a chart can be displayed in a variety of shapes including blocks, columns, cones, and pyramids.
Line	A line chart plots each value with a small marker and add a line to join the markers up. Line charts emphasise changes in data over a regular time-period, particularly where there are highs and lows. Line charts should not be used with too many series, as they can become too confusing to read. However, they are useful when a category contains many values.
Area	Area charts plot each series of values as a line without markers. The area under the line is shaded. Area charts emphasise the rate of change rather changes in discrete values. Stacked area charts (where the lines are plotted on top of one another) make it easy to see how much an item contributes to the total amount of values plotted.
Pie	Pie charts display each value as a slice of a circle, which represents the total of all values plotted. This shows how much one element contributes to the overall amount in comparison to the other elements. Pie charts can only display a single data series. A doughnut chart can be used if there is more than one data series – they will each be plotted as a series of decreasing rings



Starting with Excel 2016, Microsoft has added new chart types to each subsequent version of Excel, and these are detailed below:

### Treemap charts

Designed to show statistics in categories and sub-categories, i.e., where there is a hierarchy within the data, treemap charts make it easy to quickly identify patterns. They are ideal for comparing the relative sizes of groups. The data will need to have a category in the first column, a sub-category in the second column, and numerical data in the third column.

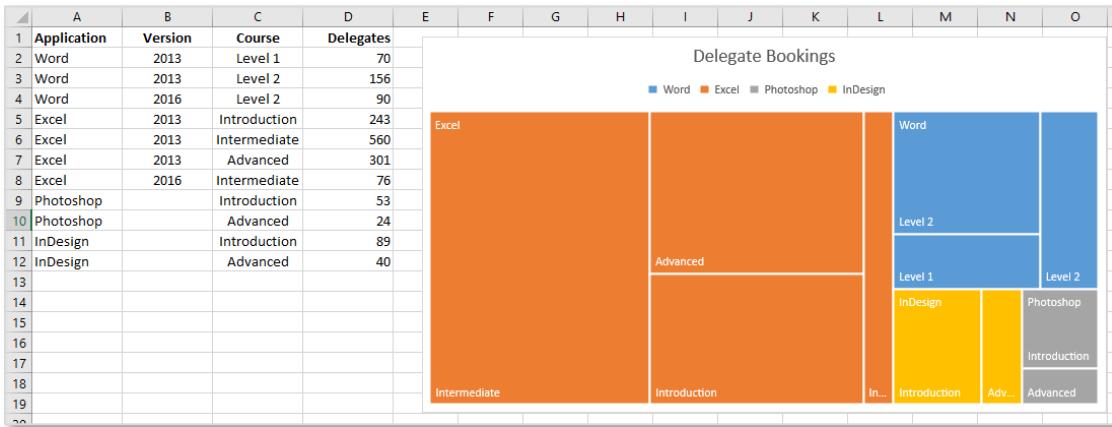


Figure 99: A sample treemap chart

### Sunburst charts

Like treemap charts, a *sunburst chart* can also be used to display hierarchical data, but it is able to display multiple columns of data. The chart will display graphical rings of information, much like a doughnut chart, but each ring will represent one level of the hierarchy. The Sunburst chart allows you to see how one ring is broken into its contributing categories.

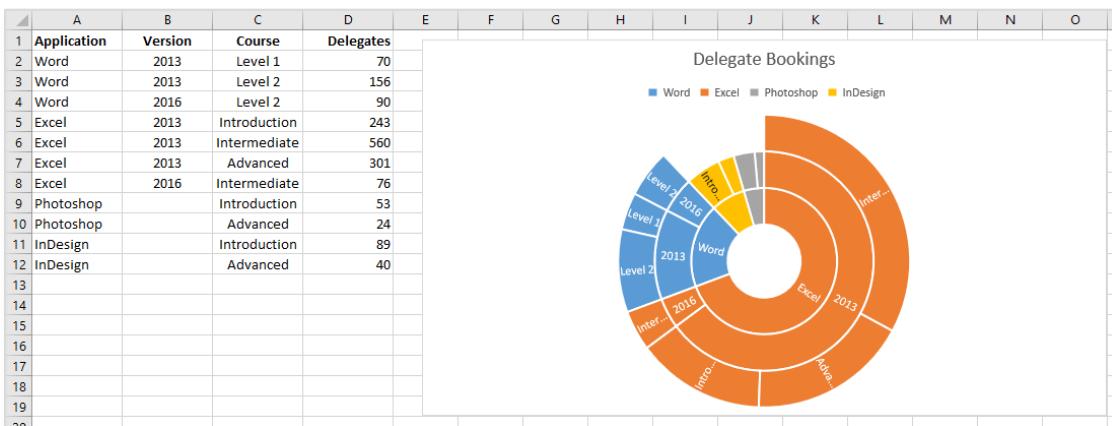


Figure 100: A sample sunburst chart



## Waterfall charts

These have gained considerable popularity over recent years, and at last, these can easily be created within Excel without the need for third-party add-ons. A *waterfall chart* shows an initial value, broken down into subsequent entries (values). For example, if you are a project manager, it can show you your income, broken down into different 'streams', and likewise for your expenditure.

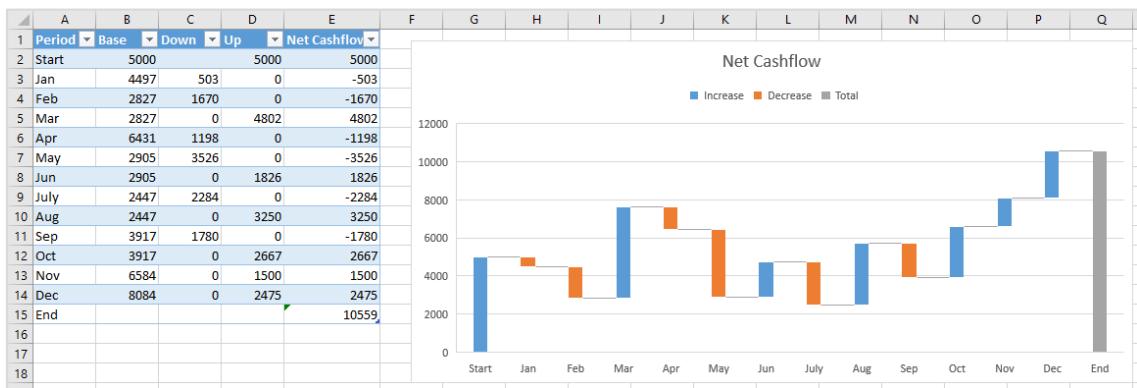


Figure 101: A sample waterfall chart

## Histograms

*Histogram charts* are widely used within statistical analysis, but to date they have been difficult to create in Excel. Now Microsoft have added a Histogram to address this issue. A histogram displays the frequencies within a distribution of values.

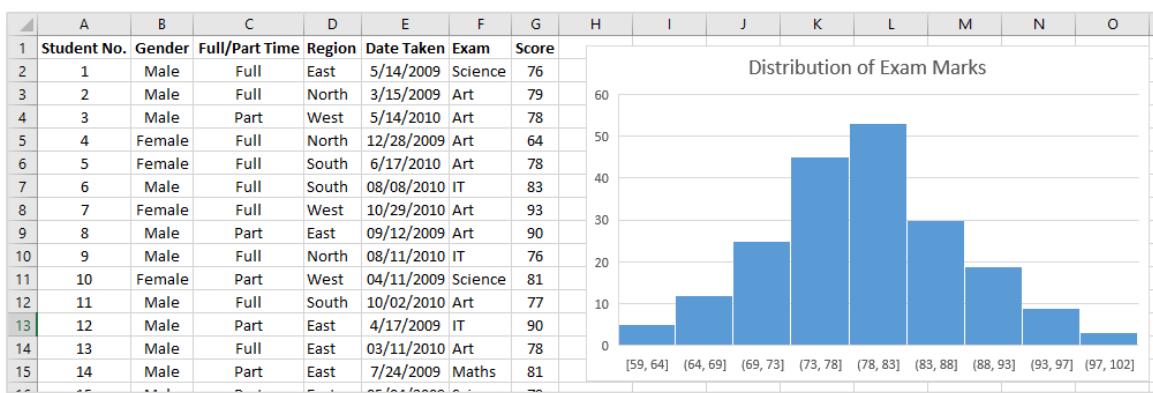


Figure 102: A sample histogram chart

## Pareto charts

These are like histogram charts, but a *Pareto chart* displays the categories in descending order of the values and include a line representing the cumulative total percentage.



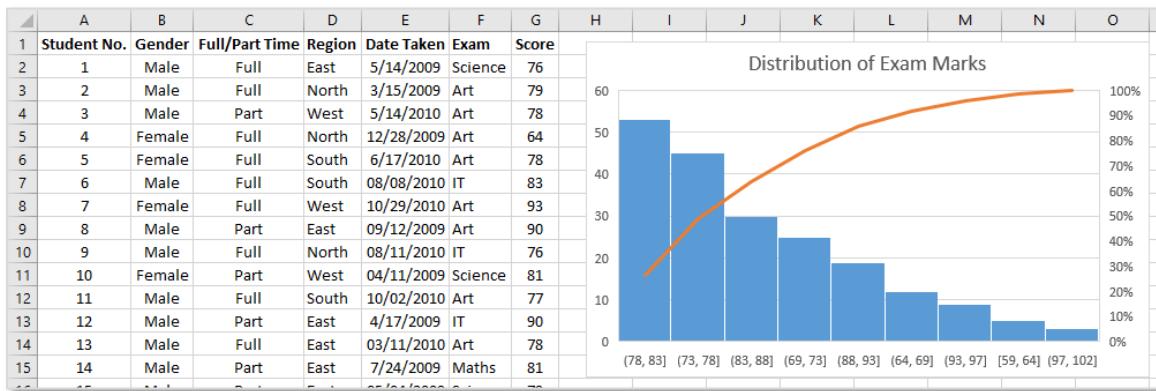


Figure 103: A sample Pareto chart

## Box and Whisker

A **box and whisker** chart is useful for statistical analysis, as a single chart which shows several statistics – the range, quartiles, mean and outliers.

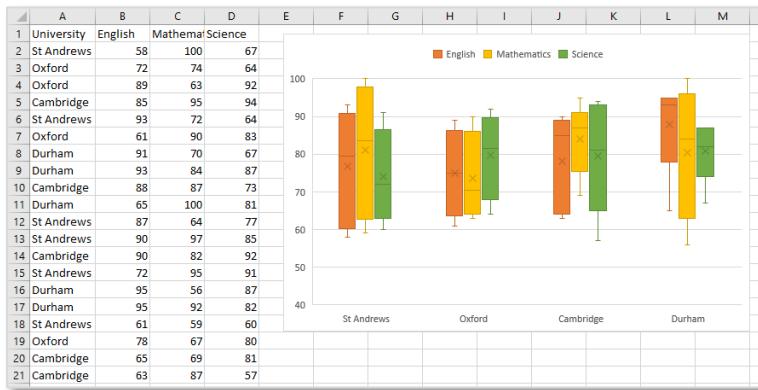


Figure 104: A sample box and whisker chart

## Creating a chart

Excel provides several different methods that can be used to create a chart – this course covers the most popular methods.



Figure 105: The chart creation tools on the Ribbon

To create a chart:

1. Select the data to be charted
2. Click the **Insert** tab on the Ribbon > select the desired chart type, and select required ‘subtype’, for example, **Insert > Column or Bar Chart > 2-D Clustered Column**





### Key point

Charts created using this technique are created as an object, meaning that they are placed on a worksheet, typically near the data they represent.



### Helpful hint

Create a chart quickly by pressing **F11** (to create on its own sheet), or **Alt+F1** (as an object). When selecting the data to be charted, hold **Ctrl** to select non-adjacent cells.



### Useful tool

Introduced in Excel 2013, 'Recommended Charts' can be used to have Excel suggest the most suitable chart types based on the currently selected data.

Charts can also be created using Excel's 'Quick Analysis' tool.

As with other features of Excel, including tables, clicking onto a chart will display a set of contextual tabs on the Ribbon:

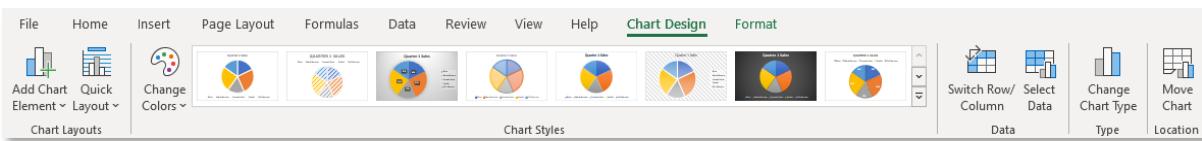


Figure 106: Excel's chart tools tabs on the Ribbon

As with all Ribbon tabs, the two extra Ribbon tabs are listed from left to right in the order in which they are most likely to be needed.

## Resizing and moving

Once a chart has been created, it is highly likely that it will need to be resized or moved elsewhere in the workbook.

### Resizing a chart

Resizing a chart is no different to resizing any graphical object in the Microsoft suite – click-and-drag the handles on the edges of the chart. Hold **Shift** when resizing to keep the chart in proportion.

### Moving a chart

If a chart has been placed on a worksheet as an object, then it can be moved around the worksheet by clicking-and-dragging it.





### Helpful hint

When dragging to resize or move a chart, hold **Alt** to 'snap' the chart to the worksheet grid.

However, in many cases it will be necessary to move the chart to another part of the workbook – either a different worksheet (as an object), or to place it on its own *chart sheet*.

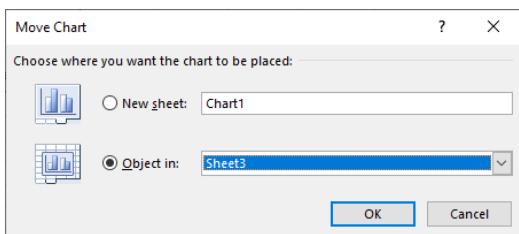


Figure 107: The 'Move Chart' dialog box

To move a chart to another part of the workbook:

1. Ensure that the chart is selected
2. Click **Chart Design > Move Chart**
3. Select the desired location, and click **OK**



### Guided activity: Creating a chart

In this activity you will create two simple charts – a clustered column chart and a pie chart. You will then move the pie chart to its own chart sheet.

1. Open the **CHARTS.XLSX** workbook
2. Select the range A1:E5
3. Click **Insert > Column or Bar Chart > 2-D Clustered Column** (the first one listed) – the chart will be placed on the same worksheet as the data
4. If necessary, click-and-drag the chart so it is below the data and resize as appropriate
5. Select the ranges A1:A5 and F1:F5 (hold **Ctrl** whilst highlighting the second range)
6. Click **Insert > Pie > 2-D Pie** (the first listed) – the chart will be placed on the same worksheet as the data



7. Ensure that the pie chart is still selected, and click **Chart Design > Move Chart**
8. In the 'Move Chart' dialog box:
  - Select **New sheet**
  - Enter a name of **Sales Comparison**
  - Click **OK**
9. Save the file, and keep it open for use in the next activity

## Managing a chart

Each chart item can be formatted to appear exactly as needed to meet any requirements. In addition, the style and the layout of the chart can be changed to better represent the data. There are many styles and layouts to choose from to help format a chart to represent the data in the best way.

### Managing the data series

A chart reflects any changes to the values in its data range automatically, but sometimes the range must be extended, reduced, or reselected because of changes in the worksheet.

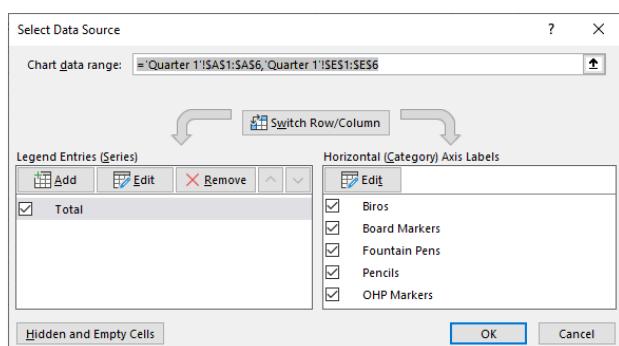


Figure 108: The 'Select Data Source' dialog box

### Adding or removing series

As time progresses it is likely that further data series will need to be added to an existing chart. For instance, you may have a chart displaying two series – 2017/18/18 and 2018/19. Once the 2019/20 figures have been confirmed, you are probably going to want to add them onto the chart.

To add or remove a data series:

1. Ensure that the chart is selected
2. Click **Chart Design > Select Data**



3. If adding data:

- Type a name for the series, or click a cell containing the data for the name
- Ensure that the 'Series Value' box is blank, and select the cells containing the series data

4. If series need to be deleted, click the **Remove** button

5. Once all modifications have been made, click **OK** to close the dialog box



#### Helpful hint

If a chart is stored on the same worksheet as its data, once the chart is selected, adjust the boxes that indicate which data is being used.

### Transposing chart data

By default, when a chart is plotted by rows, the series labels derive from the first value in each row. When plotted by columns, the series labels come from the values in the first cells of each column.

If more rows than columns were selected, Excel will plot the chart by columns, and vice versa. Naturally, this can be changed, if required – selecting the 'Switch Row/Column' icon will move the items in the category axis to the legend, and items in the legend will move to the category axis.

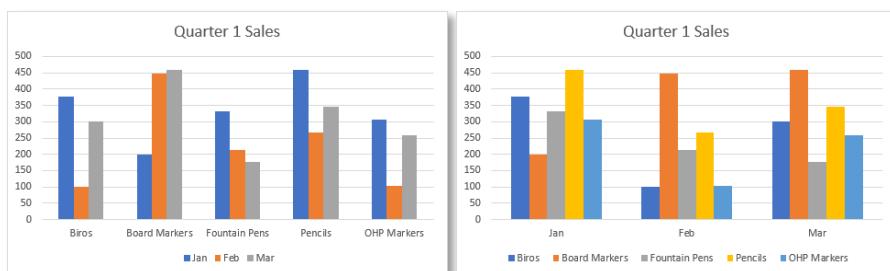


Figure 109: Chart with original orientation (left), and after being transposed (right)

To transpose chart data:

1. Ensure that the chart is selected
2. Click **Chart Design > Switch Row/Column**



#### Helpful hint

Chart data can also be transposed in the 'Select Data' dialog box.



## Changing the chart type

As work on a chart progresses, it may become apparent that the wrong kind of chart was originally selected – the ‘Change Chart Type’ dialog box can be used as required.

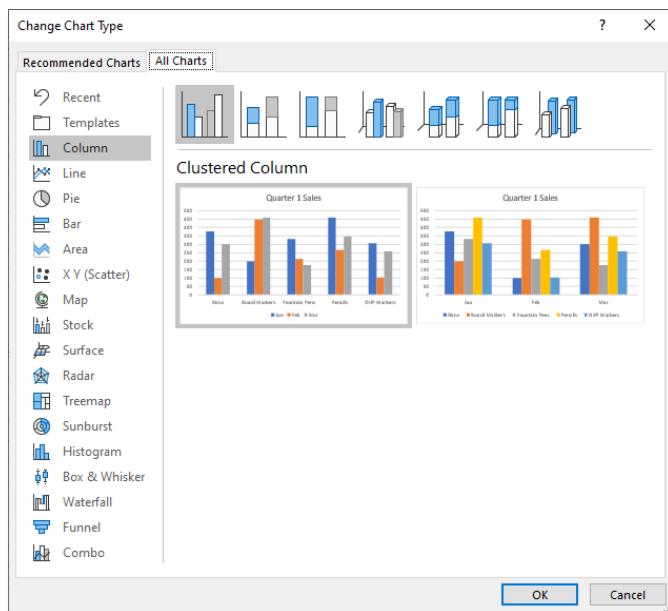


Figure 110: The ‘Change Chart Type’ dialog box

To change the type of chart being used:

1. Ensure that the chart is selected
2. Click **Chart Design > Change Chart Type**
3. Select the desired chart type, and click **OK**



### Helpful hint

Use the ‘Combo’ chart type to combine different kinds of chart, e.g., column and line charts.

## Working with chart elements

The layout of a chart defines which *chart elements* – components of a chart, such as the title, legend, data labels, etc. – are displayed.

Excel provides two methods of managing chart elements:

- The ‘Chart Layouts’ section of the Chart Design tab
- The ‘Chart Elements’ button attached to a chart (the ‘plus sign’ icon)





Figure 111: Buttons for modifying the selected chart

## Pre-set layouts

Excel provides a selection of pre-set chart layouts, available on the Chart Design tab of the Ribbon. The provided layouts vary depending on the chart type.

To use a pre-set chart layout:

1. Ensure that the chart is selected
2. Click the **Chart Design** tab on the Ribbon, and if necessary, expand the list of **Quick Layouts**
3. Click the desired layout

## Adding and removing elements

In some cases, it may be preferable to manage the chart elements manually. Whilst this may take longer, it provides the user with more control than using a pre-set, or it may be desirable to use a pre-set and then customise it afterwards.

To add or remove chart elements for the current chart, either:

- Click **Chart Design > Add Chart Element >** and select the desired element and its options; or
- Click the **Chart Elements** icon (the 'plus sign') attached to the chart and select the required element and its options



## Formatting charts

Once a chart has been created and all its required elements are displayed, it may be desirable to format the chart, perhaps changing its colours, fonts, etc.

As with chart elements, Excel provides two methods of formatting a chart – some pre-set colour schemes, and/or formatting manually.

The pre-set colour schemes are available in the 'Chart Styles' section of the Chart Design tab of the Ribbon.

To format individual elements:

1. Select the element to be formatted by clicking it in the chart
2. Click the **Chart Format** tab on the Ribbon
3. Select the desired fill, outline, and effect options



### Helpful hint

Chart elements can be formatted in the regular, non-chart manner. For example, changing the colour of an element could be done using the regular 'Fill Color' button on the Home tab of the Ribbon.

If more control over the appearance of a chart element is needed, a formatting pane can be used:

1. **Right-click** the element to be modified
2. Select the **Format...** option – the wording will vary depending on the element selected
3. Modify the options as desired

For example, if the scale on a column chart needed adjusting:

1. **Right-click** the axis containing the scale
2. Select **Format Axis...** from the shortcut menu
3. In the dialog box, adjust the **Minimum, Maximum, Major** and **Minor Unit** values as desired
4. Click **Close** once all the required settings have been changed

## Working with chart templates

You may find yourself regularly creating charts with the same formatting and chart elements. For example, you may often create charts with data



labels, the legend above the chart and formatted to match the organisation's colour scheme.

In this situation, it would be beneficial to save the chart as a *chart template*. Any future charts subsequently created can be based on this template, eliminating the need to repeatedly tailor settings.

## Creating a chart template

Any chart can be used as the basis for a chart template, and all templates are available from the 'Change Chart Type' dialog box.

To create a new chart template:

1. Modify a chart as required by the template – this can include the chart type, chart elements, formatting etc.
2. **Right-click** the chart > **Save as Template**
3. Enter a name for the template, and click **Save**

## Using chart templates

Once chart templates have been created, they can be applied to any chart as required.

To apply an existing template to a chart:

1. Ensure that the chart to be changed is selected
2. Click **Chart Design** > **Change Chart Type**
3. In the dialog box, click **Templates** (at the top of the list)
4. Select the desired template, and click **OK**



### Guided activity: Modifying and formatting charts

In this activity you will modify the charts created earlier.

1. Ensure that the **CHARTS.XLSX** workbook is still open from the previous activity, and that the 'Sales Comparison' tab is active
2. Click the **Chart Design** tab on the Ribbon:
3. From the list of **Quick Layouts**, select the sixth option, **Layout 6**
4. Using the **Chart Styles** gallery, select **Style 12**
5. Ensure that the chart is still selected and click the **Home** tab on the Ribbon
6. Adjust the font size to 16pt – the whole chart should change text size



With the pie chart modified, you will now modify the clustered column chart:

7. Navigate to the 'Car Sales' worksheet, and select the column chart
8. Click into the existing chart title and change it to **Regional Sales**
9. Click **Chart Design > Switch Row/Column** – the manufacturers should now be on the axis, and the regions in the legend
10. On the worksheet, insert a new row above the total:

Manufacturer	North	South	East	West
Peugeot	542,000	560,000	566,000	714,000

11. In cell F6 use AutoSum to total the Peugeot sales

As the new data is not automatically included in the chart, the column chart will need updating to include it:

12. Select the chart and drag the handle at the bottom of cell E5 – to include the new data
13. Click **Chart Design > Change Chart Type > Stacked Column**

Now that the column chart has been updated, the changes need to be reflected in the pie chart:

14. Navigate to the sheet containing the pie chart
15. Click **Chart Design > Select Data**
16. Delete the contents of the 'Chart data range' box at the top of the dialog
17. Select the ranges A1:A6 and F1:F6 (if necessary, hold **Ctrl** to select the second range), and click **OK**

Finally, one of the slices of the pie chart will be exploded – moved out from the centre of the chart – to make it more obvious:

18. Click the BMW segment of the pie chart
19. Click-and-drag it out from the centre of the chart
20. Save the file and close it

## Analyse data with sparklines

Introduced in Excel 2010, *sparklines* provide a way of showing trends in data, Sparklines are mini charts placed inside single cells which visually represent trends in the data.



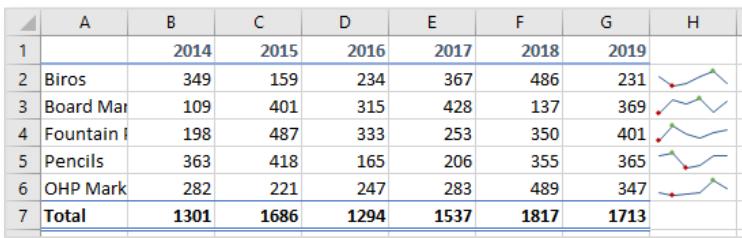


Figure 112: Sparklines alongside their data

## Creating sparklines

Excel provides two methods of creating sparklines, and three different types of sparkline:

- The ‘Insert’ tab on the Ribbon
- Excel’s ‘Quick Analysis’ tool

Sparkline	Description
Line	Data trends are displayed in the form of a straight or zigzag line. Markers are used to highlight a point where the orientation of the trendline changes. Markers can be applied only to line sparklines.
Column	Data trends are displayed in the form of columns. Each data value is represented by a column whose size is proportional to the data value.
Win/Loss	Data trends are displayed through the high points, the median point, and the low points.

To create a sparkline:

1. Select the cells to be plotted as a sparkline
2. Click **Insert** > select the desired type of sparkline (**Line**, **Column** or **Win/Loss**) – Excel will display the ‘Create Sparklines’ dialog box
3. Specify the location where the sparkline needs to be placed, and click **OK**



### Helpful hint

To ensure that sparklines can be clearly viewed, consider increasing column width or row height. Alternatively, cells can be merged once the sparklines have been created.

Sparklines can be deleted in the same way as deleting data, slicers, charts, and other graphical objects.



## Modifying sparklines

As with most tools in Excel, once a sparkline has been created then it can be modified using its dedicated tab on the Ribbon.



Figure 113: The 'Sparkline' tab on the Ribbon

The Sparkline tab can be used to modify which data is plotted by the sparkline, its type and its formatting.

## Sparkline grouping

If multiple sparklines are created in adjacent cells, they are automatically grouped so that they can be managed as a single item – any changes made to one of the sparklines will be replicated to the others in the group.

However, it may be necessary to treat individual sparklines differently.

1. Select the group of sparklines
2. Click **Sparklines > Ungroup** (or **Sparklines > Group**) as required

## Sparkline axes

Each sparkline is plotted on its own axis, meaning that if the values vary by a large margin, they may be marked against different axis, which in turn may skew your interpretation.

	A	B	C	D	E	F	G	H
1		2013	2014	2015	2016	2017	2018	
2	North	15,886	15,516	15,899	18,000	14,004	16,312	
3	South	11,793	9,867	6,380	11,152	8,217	10,895	
4	East	12,729	11,325	5,528	9,073	7,485	9,140	
5	West	10,306	13,468	10,847	10,721	15,017	9,928	
6	Overseas	7,363	7,567	5,952	7,687	7,724	9,913	

	A	B	C	D	E	F	G	H
1		2013	2014	2015	2016	2017	2018	
2	North	15,886	15,516	15,899	18,000	14,004	16,312	
3	South	11,793	9,867	6,380	11,152	8,217	10,895	
4	East	12,729	11,325	5,528	9,073	7,485	9,140	
5	West	10,306	13,468	10,847	10,721	15,017	9,928	
6	Overseas	7,363	7,567	5,952	7,687	7,724	9,913	

Figure 114: Sparklines on individual axes (top) and same axis (bottom)

In the above screenshot, the second sparkline (in cell H2) appears to suggest a poor start to the reporting period. However, on examining the figures, cell B2 is the highest figure in column B by quite some margin.



To improve the accuracy of the sparkline, it may be desirable to plot each sparkline against the same axis (shown in the bottom screenshot), where it can clearly be seen that the second sparkline represents the highest values in the range.

To change the axis settings for sparklines:

1. Select one of the sparklines in the group
2. Click **Sparkline > Axis >**
3. For both the 'Vertical Axis Minimum Value Options' and the 'Maximum', click **Same for All Sparklines**



#### Guided activity: Creating sparklines

In this activity you will add sparklines to an existing workbook.

1. Ensure that the **CHARTS.XLSX** workbook is still open from the previous activity, and that the 'Car Sales' worksheet tab is active
2. Select cell B2
3. Click **Insert > Line Sparkline** and set the following options, and then click **OK**:
  - *Data Range*: B2:E2
  - *Location Range*: G2:G6
4. Select one of the line sparklines and click **Sparkline > High Point**
5. Change from a Line Sparkline to a Column Sparkline by clicking **Sparkline > Column**
6. With the column sparklines selected:
  - Click **Sparkline > Vertical Axis Minimum Value Options > Same for All Sparklines**
  - Repeat this for the 'Vertical Axis Maximum Value Options'
7. Save and close the workbook

## Section review

This section was about:

- Creating different types of charts
- Working with chart elements
- Formatting charts



- Saving custom charts as a template
- Analysing data with sparklines

## Review questions

1. Which Ribbon tab would you use to create a chart?
2. Which command would you use to move a chart onto its own sheet?
3. Which function keys could you use to create a new, default chart?
4. How do you add a new data series to a chart?
5. Name two tools to help identify trends



### Independent activity: Creating and modifying charts

You have been tasked with setting up the necessary charts to aid the sales manager in tracking their staff sales.

1. Open the **IA CHARTS.XLSX** workbook
2. Create a 2-D clustered column chart using the data in cell A3:D8
3. Modify the chart as follows:
  - Add a title of **Quarter 1 Analysis**
  - Display a legend above the chart
  - Increase the font size to make the text more legible
  - Move the chart to its own chart sheet
4. Using cells A3:A8 and E3:E8 on the worksheet, create a 2-D pie chart
5. Format it as desired, and ensure that the slices are exploded
6. Save the file and close it





V1.5.2

## Part 11: Conditional formatting

This section covers how to work with conditional formatting in Excel, and covers how to apply, modify, and control it. It will also cover how to create powerful conditional formatting using formulas, and how to use conditional formatting to assist with sorting and filtering of data.

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

- Apply basic conditional formatting
- Modify existing conditional formatting settings
- Create user-defined conditional formatting rules and formulas
- Use conditional formatting with sorting and filtering



## Applying conditional formatting

*Conditional formatting* allows enables Excel to control the formatting of data based on a series of rules.

There are several pre-set colour options available typically based around a red/amber/green – RAG – scheme, or if desired custom formatting can be created.

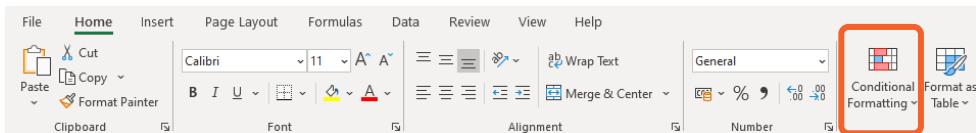


Figure 115: Conditional Formatting on the Home tab of the Ribbon

There are five categories of pre-set conditional formatting:

Category	Description
Highlight Cells Rules	Common conditional formats that are activated when a cell is greater than, less than, or between specified values. Rules based on text contents, date values and highlight duplicated entries can also be applied.
Top/Bottom Rules	Apply formatting based on the cell's value in relation to the other selected cells. Do not have to be '10' as their names imply.
Data Bars	Cells are formatted based on their relative contents. A horizontal bar will appear in the cells – the longer the bar, the bigger the value in relation to the other cells.
Color Scales	Used to visually represent data distribution and variation. A graduation of colour shades is used to represent the high, mid, and low values.
Icon Sets	Icons are displayed to represent the relative value of cell contents. Excel automatically distributes data into thirds, quarters or fifths depending on the number of icons in the selected set.



Highlight	Top (3)	Data Bars	Color Scales	Icon Sets
Pass	10	45	34	✓ 76
Pass	9	-61	3	! 41
Fail	3	-34	73	✗ 20
Pass	2	56	68	✗ 19
Fail	7	-73	29	✗ 10
Fail	9	22	79	✓ 93
Pass	1	-10	80	! 41
Pass	4	-81	27	! 46
Fail	2	76	72	✓ 97
Pass	5	-60	17	! 58

Figure 116: Examples of the conditional formatting pre-sets

Conditional Formats are dynamic – if the contents of a cell changes and consequently meets (or no longer meets) a rule, the formatting will change accordingly.

This allows conditional formatting to be created before a colleague enters information. For example, a conditional format could be set to show where a value has been entered outside realistic expected values on an expenses form.

## Basic conditional formatting

The simplest forms of conditional formatting are Excel's *Highlight Cells Rules* and *Top/Bottom Rules* – the user sets a reason (a condition) for the format to be applied.



Figure 117: Applying a basic conditional format

To apply basic conditional formatting:

1. Select the cell(s) that require the conditional format
2. Click **Home > Conditional Formatting >**
3. Select either **Highlight Cells Rules >** or **Top/Bottom Rules** as required
4. Select the desired rule from the list
5. Enter any required values – the condition – and specify the desired formatting
6. Click **OK** to apply the formatting





### Useful tool

When prompted for a value in the dialog box, either a value can be set, or a cell reference provided.

## Comparison conditional formatting

The three other categories of conditional formatting – Data Bars, Color Scales, and Icon Sets – all format cells by comparing them to others in the same-formatted range.

At the outset, these formats can be applied without requiring any entries or dialog box settings.

To apply a comparison conditional format:

1. Select the cell(s) that require the conditional format
2. Click **Home > Conditional Formatting >**
3. Select the desired category and specific setting, e.g., Icon Sets > 3 Symbols (Uncircled)



### Helpful hint

Three-colour scales and data bars will split the data based on the possible options, so the colour scale would have a low, mid, and high value; data bars would split the data into top, middle and bottom third, quarters or fifths accordingly. This can be modified as desired (see below).

## Modifying and deleting

Once conditional formatting has been applied it can be modified or deleted as required.

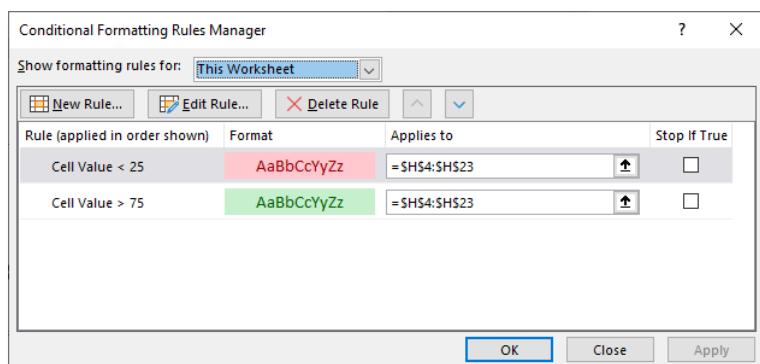


Figure 118: The 'Conditional Formatting Rules Manager' dialog box



## Modifying existing rules

It is often necessary to modify rules once they have been applied as the requirements of the worksheet change, or perhaps if one of the pre-sets has been used as a starting point.

To modify existing conditional formatting:

1. Click **Home > Conditional Formatting > Manage Rules...**
2. At the top of the dialog box, ensure that **Show formatting rules for** is displaying the correct rules
3. Select the rule to work with, and click **Edit Rule...**
4. In the 'Edit Formatting Rule' dialog box, modify the rule as desired and click **OK**
5. Click **OK** in the 'Conditional Formatting Rules Manager' dialog box to return to the worksheet

## Deleting conditional formatting rules

If rules are no longer required, then they should be deleted to prevent them from being applied to data.

To delete a specific conditional formatting rule:

1. Click **Home > Conditional Formatting > Manage Rules...**
2. At the top of the dialog box, ensure that **Show formatting rules for** is displaying the correct rules
3. Select the rule to be deleted, and click **Delete Rule**
4. Click **OK** in the 'Conditional Formatting Rules Manager' dialog box to return to the worksheet

It is also possible to remove all rules that are currently active:

1. Click **Home > Conditional Formatting > Clear Rules >**
2. Select the desired rules location to have the rules cleared from



### Guided activity: Working with conditional formatting

In this activity you will work with an existing workbook containing billable projects, and you need to highlight various cells, as follows:

- Where a project resulted in a loss
- The cell containing 'Total Actual Cost' needs to appear in green if it is less than the 'Total Invoiced Amount', and in red if it exceeds it



- A specific project code

You will start by applying highlight rules where needed:

1. Open the **CONDITIONAL FORMATS.XLSX** workbook and ensure that the 'Projects' worksheet is active
2. Navigate to E26 and click **Conditional Formatting > Highlight Cells Rules > Less Than** and configure it as required:
  - *Format cells that are less than:* **D26**
  - *With:* **Green Fill with Dark Green Text**
3. Remaining in cell E26 create a **Greater Than** Conditional Formatting rule as follows:
  - *Format cells that are greater than:* **D26**
  - *With:* **Light Red Fill with Dark Red Text**
4. Click **OK** to return to the worksheet

You will now test the rule has been created and works as desired:

5. Delete the contents of cells D24:D25 – the Total Actual Cost now indicates we made a loss and cell should be formatted red
6. Undo the action to restore the value and redisplay the formatting

We will now add icons to highlight the relative worth of each cell in the 'Profit' column. Additionally, conditional formatting will be used to highlight the project code typed into cell H2.

7. Select the cells reporting the profit/loss of each project – **F2:F25**
8. Click **Conditional Formatting > Icon Sets > 3 Traffic Lights (Unrimmed)**

Note that cell F14 has a red icon against it, despite making a small profit. The rule will be modified so that only items which made a loss have a red icon. At the same time, rule for the green icon will be changed so that any item over £2500 is assigned a green icon.

1. Ensure that cell F14 is selected
2. Click **Conditional Formatting > Manage Rules... > Edit Rule...**
3. Modify the rule as below and click OK twice to return to the worksheet:
  - *Type (first):* **Number**
  - *Value:* **2500**
  - *Type (second):* **Number**
  - *Value:* **0**



4. In cell H1, enter the phrase **Project Code** and in H2, **13-376**
5. Select cells A2:A25
6. Click **Conditional Formatting > Highlight Cells Rules > Equal To...**
7. Configure the formatting options as below, and click **OK** twice to return to the worksheet:
  - o *Format cells that are equal to:* **H2**
  - o *With:* **Custom Format...**
  - o *Font color:* **White**
  - o *Font style:* **Bold**
  - o *Fill:* **Red**
8. Save the workbook and keep it open for use in the next activity

## Creating custom conditional formats

Using the above techniques is an easy and convenient way of using conditional formatting. However, in some situations, the automatic method that Excel uses may not provide the options required.

For example, it may be necessary to highlight an entire row where a condition is met or to highlight cells starting with certain characters, or to highlight cells producing an error.

In these situations, custom conditional formatting rules can be created and applied.

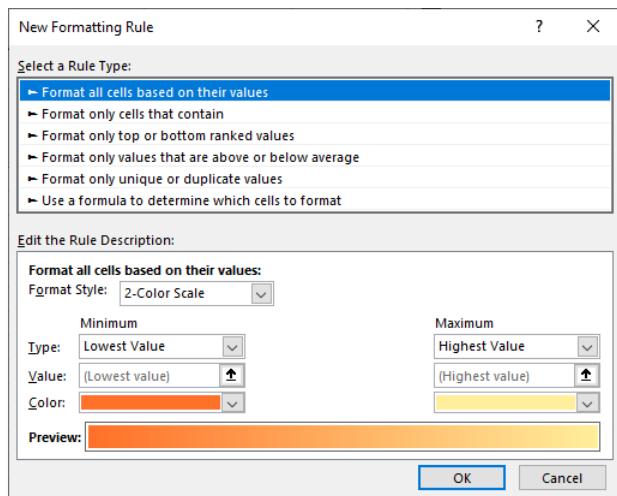


Figure 119: The 'New Formatting Rule' dialog box

To create a custom conditional format:

1. Select the cells to be formatted



2. Click **Home > Conditional Formatting > New Rule...**
3. In the 'New Formatting Rule' dialog box, select the desired 'Rule Type'
4. Specify the desired settings to format the cells based on their values, and click **OK**

## Formula-based conditional formatting

If the options provided by Excel do not match the requirements, it may be possible to create a logical formula to determine whether to apply the formatting.

For example, a formula of `=A1>500` could be used to highlight the selected cell when the contents of cell A1 exceeds 500. The use of Excel's functions is permitted within a formula-based conditional format, so it would also be possible to `=A1=TODAY()-1` to highlight the selected cell if cell A1 matches yesterday's date.



### Key point

The rules of using relative and absolute cell addresses are just as applicable within conditional formatting as they are in the worksheet (see page 93 for more information).



### Helpful hint

Because of the way that Excel copies a conditional formatting formula, it is generally better to select the cell range from the top-left cell down to the bottom-right one.



### Helpful hint

It may be preferable to build the formula in the worksheet first as it is typically easier to create and modify formulas on the worksheet than within a small dialog box.

To create a formula-based conditional format:

1. Select the cells to be formatted
2. Click **Home > Conditional Formatting > New Rule...**
3. In the 'New Formatting Rule' dialog box, select **Use a formula to determine which cells to format**
4. Enter the formula in the 'Format values where this formula is true'



5. Click **Format...** to specify the desired formatting, and click **OK** twice to return to the worksheet



### Guided activity: Custom conditional formatting

In this activity you will continue working with an existing workbook and will customise one of the rules so that a project's row is highlighted rather than individual cells.

1. Ensure that the **CONDITIONAL FORMATS.XLSX** workbook is still open from the previous activity
2. Select cells A2:A25
3. Click **Home > Conditional Formatting > Clear Rules > Clear Rules from Selected Cells**
4. Select cells A2:F25 and click **Conditional Formatting > New Rule...**
5. In the 'New Formatting Rule' dialog box, configure the formatting as follows and click **OK** to return to the worksheet:
  - o **Use a formula to determine which cells to format**
  - o **Formula:** `=$A2=$H$2`
  - o **Format:** **light purple fill**
6. To test the formula, change the data in cell H2 to read **30-224**
7. Save the workbook and keep it open for use in the next activity

## Sorting and filtering by colour

In many instances, data will have been formatted as a method of indicating something about the data. The formatting may have been applied using the traditional methods, or by using conditional formatting. Excel allows the user to sort or filter the data using its formatting.

### Sorting by colour

Excel's existing sorting commands can be used to sort a list (or table) of data by its appearance, rather than by what the data says.



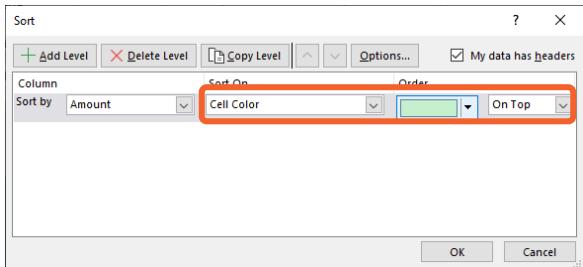


Figure 120: Sorting data by its formatting

To sort a list by the formatting of the data:

1. Click **Home > Sort & Filter > Custom Sort...**, or **Data > Sort**
2. In the 'Sort' dialog box:
3. Select the appropriate 'Sort On' option
4. Specify the colour or icon to be sorted by
5. Add any further levels, as normal, and click **OK**

## Filtering by colour

Not only might it be necessary to sort data by its appearance, but sometimes to filter it, for example to only show those invoices that are in red as they are overdue.

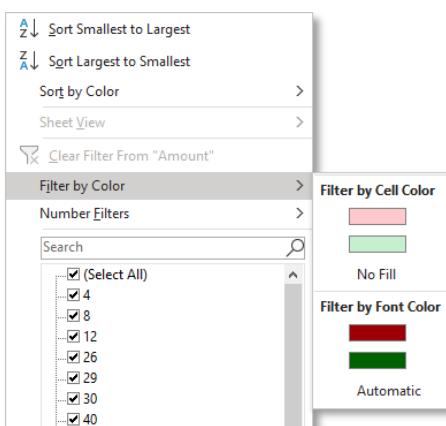


Figure 121: Filtering a list by appearance

To filter a list by the appearance of the data:

1. If necessary, click **Home > Sort & Filter > Filter**, or **Data > Filter** to activate the filter buttons
2. Click the desired filter button > **Filter by Color >**
3. Select the desired colour or icon to filter for





### Guided activity: Sorting using conditional formatting

In this activity you will sort an existing list by the appearance of the data so that certain office locations are displayed together.

1. Ensure that the **CONDITIONAL FORMATS.XLSX** workbook is still open from the previous activity, and navigate to the 'Colours' worksheet
2. Click into the data on the worksheet, and click **Data > Sort**
3. In the dialog box, configure the sorting as follows:
  - *Sort by:* Branch
  - *Sort on:* Cell Color
  - *Order:* select the green colour
4. Click **Copy Level** four times and configure the new levels as follows:
  - Second level: **Lilac**
  - Third: **Blue**
  - Fourth: **Red**
  - Final: **Tan**
5. Click **OK** to apply the sort
6. Save and close the workbook

## Section review

This section was about:

- Applying basic conditional formatting
- Modifying existing conditional formatting settings
- Creating user-defined conditional formatting rules and formulas
- Using conditional formatting with sorting and filtering

## Review questions

1. Which Ribbon tab would you use to apply conditional formatting?
2. How do you format the duplicate values in a field?
3. How do you format the above average values in a field?
4. How do you clear conditional formatting from the entire sheet?
5. How do you modify conditional formatting?





### Independent activity: Using conditional formatting

You have been given a list of properties currently being handled by your organisation. You would like to colour code various columns to make identification easier.

1. Open the **IA CONDITIONAL FORMATTING.XLSX** workbook
2. Apply background formatting to the 'Stage' data as follows:
  - New: Purple
  - For sale: Green
  - Under offer: Orange
  - Sold: Red
  - Completed: Blue
3. Sort the data into the same order as specified above
4. Apply red data bars to the 'Selling Price' column of data
5. Add the **3 flags** icon set to the 'Est/Act Revenue' data
6. Modify the rule so that only the top 10% of values display a green flag
7. Save and close the workbook





V1.5.2

## Part 12: Transforming data using Power Query Editor

In this module you will explore some of the tools and capabilities of the Power Query Editor. You will see how it can be used to clean and prepare data for analysis.

By the end of this module, you will be able to:

- Explain the purpose of Power Query and how to access it
- Create Merge and Append queries
- Understand the difference between 'transforms' and 'creates'
- Use Power Query to apply common data transformations
- Split columns and extract data
- Use Power Query to create calculated and conditional columns



## Introducing Power Query

Originally available as a free add-in for Excel 2013, and built-in from 2016 onwards, *Power Query* – sometimes referred to as *Power Query Editor* or even *Query Editor* – is used to enhance the import process.

When data is imported into Excel using the ‘Get Data’ process, it always passes through Power Query before being made available to the user, even if this is not immediately obvious.

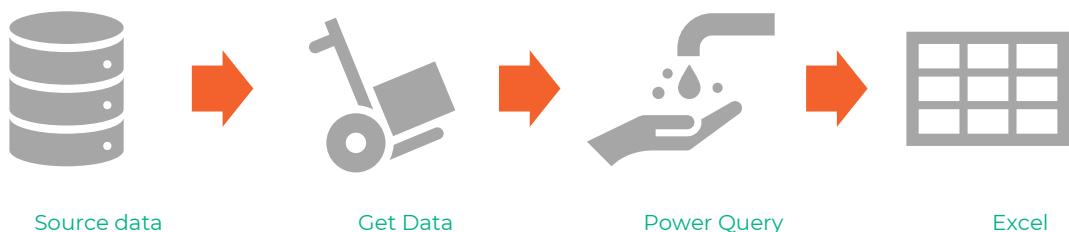


Figure 122: How Power Query fits in

The Query Editor’s job within Excel is to clean your data – prepare it, shape it, or *transform* it.



### Helpful hint

Power Query is used in other Microsoft products, including Power BI and Power Automate.



### Key point

Any tasks performed in Power Query do not affect the original, underlying data source.

Many Excel users regularly spend hours copying and pasting data into Excel, and then go on to complete a lengthy sequence of repetitive tasks to clean and shape that data using data tools, formulae, and macros – this is where Power Query comes in!

It can potentially save hours of work by making it easy to extract data from many different data sources, filter that data, aggregate it, clean it, and perform calculations on it, finally loading that data into either your worksheet or directly into the Excel Data Model.





### Key point

Once data has been brought into Power Query it can be worked on in the same ways, regardless of its actual source.

The Power Query Editor window can be accessed using two main methods:

- When getting data, click the **Transform Data** button whilst previewing the data; or
- Click **Data > Get Data > Launch Power Query Editor...**



### Helpful hint

Depending on your specific version of Excel, you may be able to use the keyboard shortcut **Alt+F12** to open Power Query Editor.



### Key point

The Power Query Editor window must be closed to be able to return to Excel.

The screenshot shows the Microsoft Power Query Editor interface. The ribbon at the top includes File, Home, Transform, Add Column, and View tabs. The Home tab is selected. The main area displays a table with columns: OrderNo, CustomerID, EmployeeName, OrderDate, RequiredDate, ShipDate, and Order Total. The table contains approximately 27 rows of data. On the left, a sidebar lists queries: Employees, Products, Customers, Categories, Order Details, Shippers, Suppliers, and 2018 (which is selected). On the right, there are sections for Query Settings (Properties and Applied Steps) and a preview pane.

Figure 123: The Power Query Editor window

The Power Query window is split into three sections:

- Left: a list of all the queries (imports and connections) in the workbook





V1.5.2

- Centre: a preview of the currently selected query and its data
- Right: *Query Settings* that show the name of the query and its *Applied Steps*
- Bottom: *the number of columns and rows (will display '999+' if there are 1,000 or more rows)*

## The Query Editor Ribbon

The Power Query Ribbon has four tabs:

### Home

On the *Home* tab, you will find the commonest query tasks, from starting a new query and editing the query data's columns or rows, to shaping (transforming) data types.

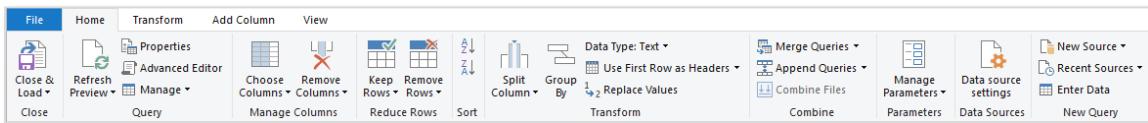


Figure 124: The Home tab in Query Editor

The Home tab can be used to manage existing data sources, add new data, apply filters, and select rows or columns to include or exclude and perform common transformation tasks.

### Transform

The *Transform* tab provides common data transformation tasks such as adding or removing columns, changing data types, pivoting a data source, or applying aggregate functions.



#### Key point

In Power Query parlance, 'transform' means that existing fields or data will be changed.

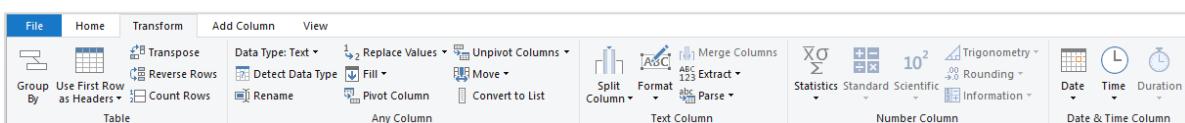


Figure 125: The Transform tab in Query Editor

In conjunction with the Home tab, this tab is most often used for working with the fields and data. Commands will only be available if the selected field matches the command's capabilities.



## Add Column

The *Add Column* tab provides additional tasks associated with adding custom and calculated columns to the selected query's dataset. You can apply formatting and functions as well as creating logical or conditional columns.



Figure 126: The Add Column tab in Query Editor

## Applied Steps

Each query will comprise a series of *Applied Steps* – the work that has been done by you in the query. Any changes made using the commands in Query Editor are held as pending in the Editor itself – they are not applied to any data until you close the window.



### Key point

Power Query will apply some steps at the point of importing the data – not all steps will be added by the user.

All queries will begin with at least one step, often the 'Source' step that tells Power Query where the data came from. As you perform tasks to clean and transform your imported data, Power Query will add further steps to the list.

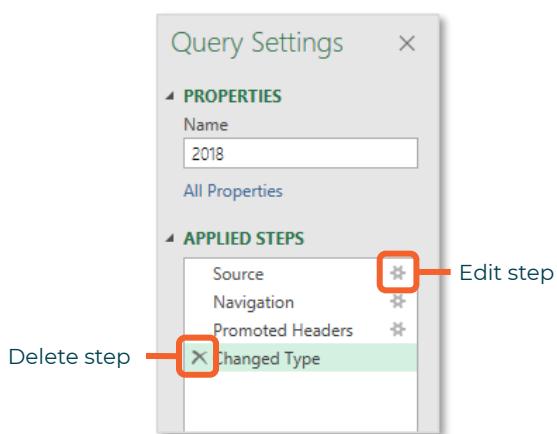


Figure 127: The Applied Steps list

There are several useful things to be aware of when working with the Applied Steps list:

- Any step with a 'gear' icon can be edited



- New steps are always added after the currently selected step
- Unwanted steps can be deleted
- Steps can be renamed by **right-clicking** them



### Key point

Inserting steps or deleting steps within the list could cause subsequent query steps to fail. Be careful, as there is no 'undo' capability in Power Query!

## Power Query data types

In Excel we traditionally think there are very few different data types, and depending on who you talk to you will get different information!

Some people say there are two – constants (data that only changes if the user changes it) and volatile (data that changes automatically, such as formulas).

Others would say there are three – text, values (numbers, dates, times), and formulas.

Yet others would say there are four – text, numbers, logical (TRUE and FALSE), and errors.

No matter how you look at it, there are very few. Power Query, however, has around a dozen, most of which are available using the **Home > Data Type >** command, or the data type icon dropdown at the top of a column.

Data type	Icon	Description
Decimal Number	1.2	Stores numbers the same way as Excel; decimal point can be anywhere in the number
Currency	\$	Decimal point always has four digits to the right
Whole Number	1 <sup>2</sup> 3	An integer, thus no decimal places
Percentage	%	As with Excel, increases the field by a factor of 100 and applies a percent symbol
Date/Time	date/time icon	Date and time value
Date	date icon	Date only (no time)



Data type	Icon	Description
Time		Time only (no date)
Date/Time/Timezone		Represents a UTC date/time with a time zone offset
Duration		Length of time, displayed in decimal
Text		Text strings, numbers, dates, etc. represented as text
True/False		A Boolean value of true or false; may be seen when imported 'checkbox' data
Binary		Represents any other data with a binary format
Any		Assigned to any column whose data type has not been specified; should be avoided



### Useful tool

The data type icon dropdown provides an extra option – *Using Locale* – which can be used to convert international data such as US dates or currency. Select the desired data type and the locale of origin.

## Combining data sources

We often have a requirement to use multiple sets of data that need to be analysed and reported on together. However, this data may be held in different files, different file formats, or even in separate systems.

Traditionally this process of combining various sources has been very time consuming or required the use of macros. This is where Power Query can most definitely help!

Query Editor has two main methods of combining data sources:

- Append
- Merge

### Append queries

*Append queries* enable multiple queries that contain the same column headings to be combined. For example, you have a year's worth of sales



data with each quarter of data stored separately (this could be individual files or different worksheets in the same Excel workbook), and they need to be combined and treated as a single data source.

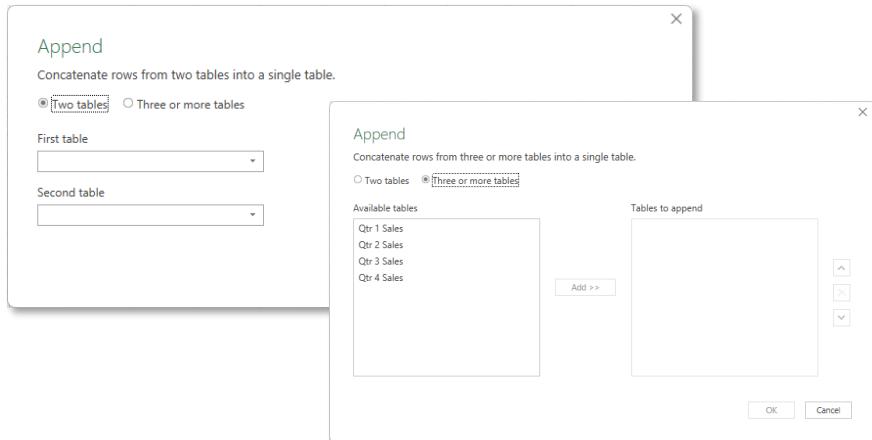


Figure 128: The two versions of the 'Append' dialog box



### Helpful hint

An append query is often likened to copying and pasting multiple lists of data together to create a single, large list!

To append multiple queries:

1. Import or connect to the required sources as normal
2. Either:
  - o In Query Editor, click **Home > Append Queries**; or
  - o In Excel, click **Data > Get Data > Combine Queries > Append**
3. If more than two tables are to be combined, click **Three or more tables**
4. Select the tables:
  - o **Two tables**: specify the first and second tables
  - o **Three or more tables**: select the tables, click **Add** and if necessary, use the 'arrow' buttons on the right to put them in the desired order
5. Click **OK** – the Query Editor window will show the appended results





### Key point

Appending queries using Excel's **Get Data > Combine Queries** method is the same as using Query Editor's **Home > Append Queries > Append Queries as New** method – a separate query holding the appended results is generated.



### Helpful hint

Before appending queries, make a note of the number of columns and rows. Comparing the values once the append process has finished to check that the number of rows has increased and that the columns have not.

The process involves very few steps; however, there are two things to be aware of:

- If a column in one of the tables does not exist others, the Query Editor will create the 'new' column and write a 'null' data value for all existing rows
- A different data type present in a column in an appended table will not overwrite the same column's data type in the main table. The append step will still succeed, however this may cause issues later when you perform your analysis.



### Useful tool

An append query will have either a 'Source' step (if you used 'Append As New') or 'Appended Queries' step (if not) that can be edited to manage the merge afterwards – click the **gear** icon to edit the step.

## Merge queries

Whereas an append query relies on the layout of the data and common column titles to work, a *merge query* relies on there being common column data rather than common column titles.

Continuing the append query's example, if we have appended sales data for each of our four quarters, we might now want to combine that with customer data. Obviously, this data will not be presented in the same way as the sales data, but there will be data in common – usually some sort of customer identifier – that can be used to action the merge query.



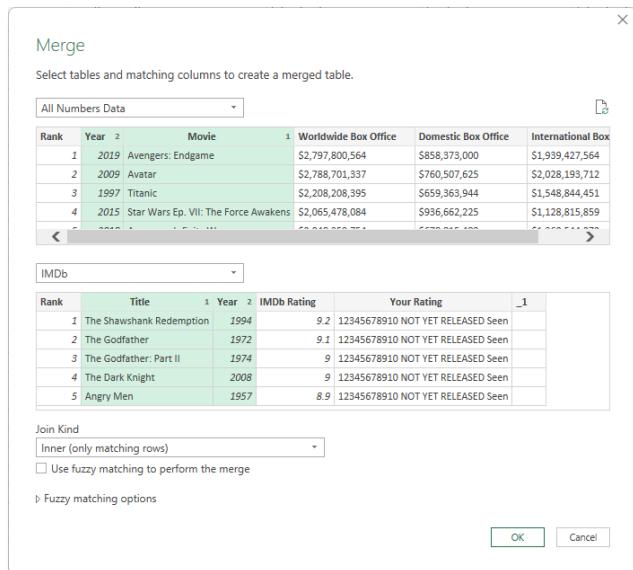


Figure 129: The ‘Merge’ dialog box



### Key point

You can only merge two queries at a time.



### Helpful hint

A merge query is often compared to the results of using two lists with lookups to ‘pull through’ required data!

To initiate a merge query:

1. Import or connect to the required sources as normal
2. Either:
  - In Query Editor, click **Home > Merge Queries**; or
  - In Excel, click **Data > Get Data > Combine Queries > Merge**
3. In the top half of the dialog box, select the first query (sometimes referred to as a the ‘main’ query) – this is the query that data will be merged *into*
4. In the bottom half, select the second query – this is the query that data will be merged *from*
5. In both parts of the dialog box, select the field(s) the two queries have in common
6. Select a *join kind* (see below), and click **OK**





### Useful tool

When selecting the fields, the two queries have in common, hold **Ctrl** to select more than if needed – the order the fields are selected is important!

## Join kinds

A merge query has six different *join kinds* – six ways to control which records are returned.

Consider the example of merging customer and order data. Theoretically a customer will have placed an order, in which case the customer exists in the customers data and in the orders data. However, it is also possible that a customer would create their online account, but never go through with their purchase so exist in the customers data, but not in the orders data.

Different join kinds could return these results in different ways. You might ask Query Editor to return all customers with or without orders, or you may just want those who have made a purchase.

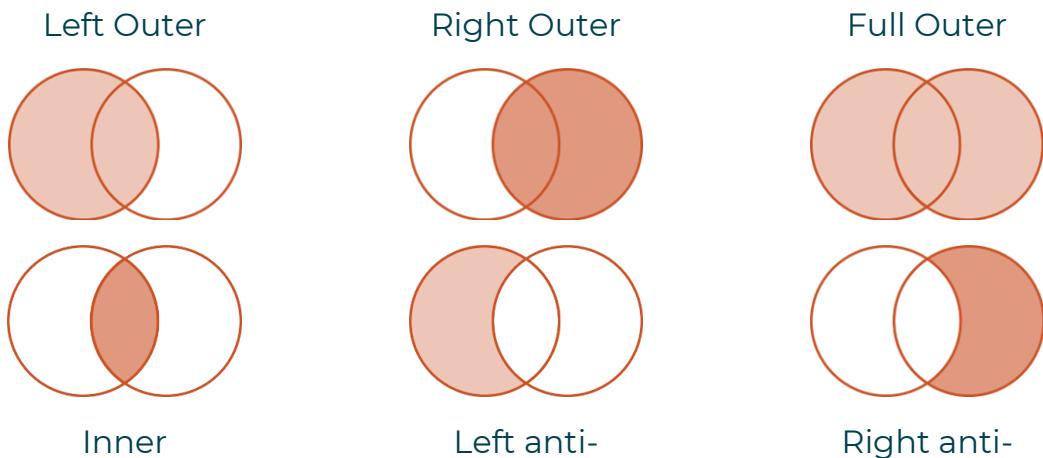


Figure 130: Diagrams to the possible results from different join kinds

The join kind you select controls which records are returned. As examples:

- A *left outer join* would return all records in the main table and the matching records in the second
- An *inner join* would only return the records that match in both tables
- A *right anti join* would return those records found only in the second table

Continuing our customers and orders example, if the customers data is the left (main) table and orders is the right, using a left outer join would return



all customers with or without orders, but an inner join would only return those who had placed an order.



### Useful tool

Microsoft have provided [this useful tool](#) to help understand the results of different join types



### Useful tool

A merge query will have either a 'Source' step (if you used 'Merge As New') or 'Merged Queries' step (if not) that can be edited to manage the merge afterwards – click the **gear** icon to edit the step.

## Expanding merged queries

When merging queries, you can select which columns should be returned from the second query, similar to the *return\_array* or *col\_index\_num* argument in a lookup – Power Query Editor calls this *expanding*.

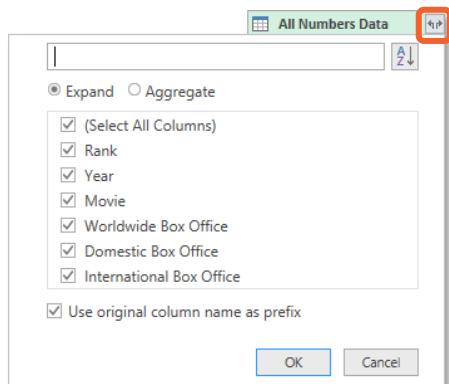


Figure 131: The 'Expand' icon at the top of a merged query column

To expand a merged query:

1. Click the **Expand** icon at the top of the new column
2. Select the fields to be included from the merge query and click **OK**



### Helpful hint

By default, the names of expanded columns will be prefixed with the name of the source query. Untick **Use original column name as prefix** when expanding if this is not needed.





### Helpful hint

If needed, the **gear** icon on a merged query's 'Expanded...' step can be used to edit it and change which columns are returned.



### Useful tool

If you have multiple files of the same file type and layout, the **Data > Get Data > From File > From Folder** command can be used to combine in much the same way as an Append Query does.

## Cleaning and shaping data

The Power Query Editor provides a wealth of tools to help you clean, shape, prepare and transform your data. In this part of the course, we will explore some of the tools that you would be likely to use on many queries.



### Key point

Remember, all steps in Query Editor are automatically repeated each time the data is refreshed.

## Common tools

In this section of the course, you will explore the most popular tools that people use when preparing data in Power Query. Some of these may happen automatically when you import your data, depending on where it comes from and how the data is structured.



### Helpful hint

The most used tools are available by **right-clicking** the column header in the data preview.

## Promoting headers

When data is imported, Power Query will try to identify column headings. Depending on the data source and how it was configured, Power Query might detect them automatically and present the resulting data accordingly – you may well see a 'Promoted Headers' Applied Step. In some cases, it may not be able to do so, resulting in the first row of 'data' containing the column headings.



The commonest cause (but not the only one) is that all the data is text – because the column headings would typically also be text, Power Query may not be able to separate the headings from the data.

	A <sup>B</sup> <sub>C</sub> Column1	A <sup>B</sup> <sub>C</sub> Column2	A <sup>B</sup> <sub>C</sub> Column3	A <sup>B</sup> <sub>C</sub> Column4	A <sup>B</sup> <sub>C</sub> Column5
1	Customer ID	Company Name	Contact Name	Contact Title	Address
2	ALFKI	Alfreds Futterki	Maria Anders	Sales Represen	Obere Str. 57
3	ANATR	Ana Trujillo Em	Ana Trujillo	Owner	Avda. de la Con
4	ANTON	Antonio Moren	Antonio Moren	Owner	Mataderos 23
5	AROUT	Around the Hor	Thomas Hardy	Sales Represen	120 Hanover S
6	BERGS	Berglunds snab	Christina Bergl	Order Administ	Berguvsvägen
7	BLAUS	Blauer See Deli	Hanna Moos	Sales Represen	Forsterstr. 57
8	BLONP	Blondel père et	Frédérique Cite	Marketing Man	24, place Klébe
9	BOLID	Bólido Comidas	Martin Somme	Owner	C/ Araquil, 67

Figure 132: An example of data whose column headings have not been identified

In the above screenshot, notice that the column headings have not been automatically identified by Power Query and are shown as the first row of data, but also that all the data is text data.



### Key point

Query Editor can only promote the first row of data. If headings are split across multiple rows this may cause issues, and if there are excess rows above the 'headings' then these will have to be removed.

To promote the first row of data and convert it to column headings:

- Click **Home > Use First Row as Headers**; or
- Click **Transform > Use First Row as Headers**



### Useful tool

Query Editor provides the 'reverse' option to **Use Headers as First Row**. This is nested with the 'First Row as Headers' option.

## Working with rows and columns

As well as filtering data, Power Query provides several ways to work with rows and columns. For example, you may wish to remove blank or duplicated rows. Not only would these be removed before the data gets as far as your worksheet, thus reducing Excel's workload and minimising the size of worksheets, but as with all things in Query Editor, they are removed each time the query is refreshed.



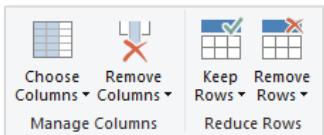


Figure 133: Working with rows and columns



### Helpful hint

When removing columns, **Choose Columns** may be a better option than the more obvious 'Remove Columns' as its step can be edited, whereas the 'Remove Columns' step cannot.

Query Editor's 'Keep Rows' and 'Remove Rows' tools each provide several options to help manage the rows in a query:

Keep Rows	Remove Rows
Keep Top Rows Keep Bottom Rows Keep Range of Rows	Remove Top Rows Remove Bottom Rows Remove Alternate Rows
Keep Duplicates Keep Errors	Remove Duplicate Rows Remove Blank Rows Remove Errors



### Key point

When removing duplicates, Power Query will compare all the currently selected columns to determine if a row is a duplicate or not.

## Changing data types

Power Query usually does a decent job of successfully detecting and setting data types – seeing 'Changed Type' in the Applied Steps list without asking for it is quite common.

In some instances, it will not be able to detect the correct or most appropriate data type. For example, in Excel we typically think of data being text, numerical, or date/time and anything beyond that, such as currency or percentages is dealt with by applying formatting. In Query Editor, these are classed as different data types.



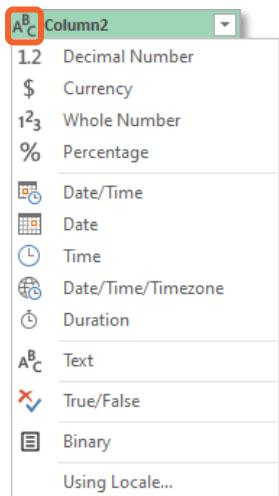


Figure 134: Changing data types in Query Editor

To change the data type of a field in Query Editor, either:

- Click **Home > Data Type >** or
- Click **Transform > Data Type >** or
- Click the data type indicator at the top of the column (shown above)

Query Editor also provides a separate option to assist with converting international data, most commonly US-style dates or imported currency data where the source currency symbol comes into Power Query as a text character. Query Editor calls this feature *Change Type with Locale*.

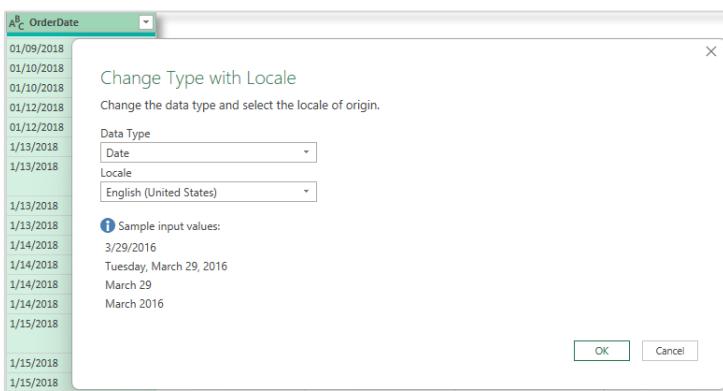


Figure 135: Changing the data type 'with Locale'

To change the data type of a field 'with Locale':

3. Click the data type indicator at the top of the column
4. Select **Change Type with Locale...**
5. Specify the desired data type and the locale of origin, and click **OK**





### Key point

You must select the locale of origin, not the desired locale. For example, if you were converting US dates to UK, you would set the 'Locale' to 'English (United States)'.

## Sorting

You will by now be quite familiar with sorting (and filtering) data in Excel, but Power Query provides its own tools. Whilst like those in Excel there are some subtle differences that make them worth mentioning in this course.

A <sup>B</sup> <sub>C</sub> ShipCountry	A <sup>B</sup> <sub>C</sub> ShipCity	A <sup>B</sup> <sub>C</sub> ShipName
Sort Ascending	Buenos Aires	Cactus Comidas para llevar
Sort Descending	Buenos Aires	Cactus Comidas para llevar
Clear Sort	Buenos Aires	Cactus Comidas para llevar
Clear Filter	Buenos Aires	Cactus Comidas para llevar
Remove Empty	Buenos Aires	Cactus Comidas para llevar
Text Filters	Buenos Aires	Océano Atlántico Ltda.

Figure 136: Sorting and filtering in Query Editor

As you would expect, sorting can be done using the dropdown button at the top of a column, just as you would in Excel.

There are, however, two changes to sorting that are worthy of note:

- The option to **Clear Sort** and return the data to its original order
- Sorting by multiple columns at once will display a number at the top of the column to indicate the sequence of the sort (as shown in the screenshot)

## Filtering

Again, filtering is applied in much the same way as it would be in Excel – click the dropdown button at the top of the column and select or search as needed. However, it is worth being aware that the options provided in the data type specific options – Text Filters, Number Filters, and Date/Time Filters – may be different to what you would expect to see.

Data Type	Excel	Query Editor
Text	Equals... Does Not Equal... Begins With... Ends With... Contains...	Equals... Does Not Equal... Begins With... Does Not Begin With... Ends With... Does Not End With...





Data Type	Excel	Query Editor
	Does Not Contain... Custom Filter...	Contains... Does Not Contain...
Number	Equals... Does Not Equal... Greater Than... Greater Than or Equal To... Less Than... Less Than or Equal To... Between... Top 10... Above Average Below Average Custom Filter...	Equals... Does Not Equal... Greater Than... Greater Than or Equal To... Less Than... Less Than or Equal To... Between...
Date and Time	Equals... Before... After... Between... Tomorrow Today Yesterday next Week This Week Last Week Next Month This Month Last Month Next Quarter This Quarter Last Quarter Next Year This Year Last Year Year to Date All Dates in the Period Custom Filter	Equals... Before... After... Between... In the Next... In the Previous... Is Earliest Is Latest Is Not Earliest Is Not Latest Year > Quarter > Month > Week > Day > Hour > Minute > Second > Custom Filter...





### Helpful hint

The Query Editor date and time filter options with an arrow each provide a minimum of 'Next...', 'This...', and 'Last...'

## Splitting, extracting, merging, and replacing data

It is common for data to have to be manipulated and made more usable, often by splitting a column into multiple columns, extracting data from within columns, combining columns and even using good old 'Find & Replace.'

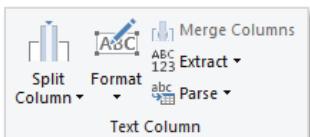


Figure 137: The 'Text Column' tools on the Ribbon

### Splitting columns

Power Query's *Split Column* tool feels like Excel's 'Text to Columns' tool, and indeed it is. However, it is also much more powerful, and of course anything done in Power Query is refreshable, unlike 'Text to Columns.'

The Query Editor provides several different techniques for splitting a column of data:

Option	Description
By Delimiter	Splits at a designated character or series of characters
By Number of Characters	Splits into fragments of the specified length of characters
By Positions	Splits the data at the nominated character positions; must be entered as a list of ascending values
By Lowercase to Uppercase; By Uppercase to Lowercase	Splits based on case-changes in the data
By Digit to Non-Digit; By Non-Digit to Digit	Splits where the data changes between digits and non-digits

The first three options will display a dialog box prompting for further information.



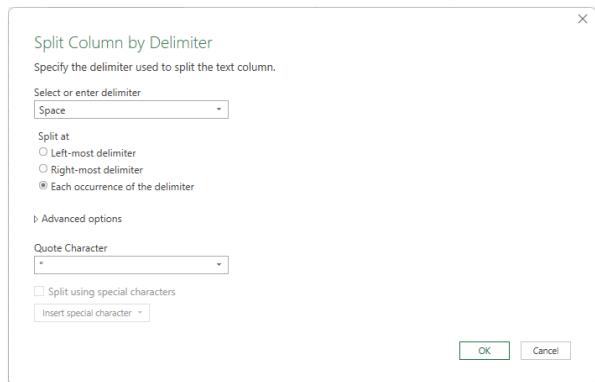


Figure 138: Splitting data using a delimiter

To split the current column of data using a delimiter:

1. Click **Home > Split Column > By Delimiter** (you can also use the **Transform** tab)
2. Select or enter the appropriate delimiter – use **Custom** to either enter a custom delimiter, or to use a special character (at the bottom of the dialog box)
3. Specify when to split – the first time only (*left-most*), last time only (*right-most*) or each time
4. Click **OK** to split the column into the relevant number of separate columns

### Extracting data from a column

As useful as splitting a column is, sometimes you do not need to separate data into multiple columns, but there may be a requirement to extract part of the data. In Excel this would commonly be managed by Flash Fill, or formulas such as =LEFT(...), =RIGHT(...), =MID(...) and the newer =TEXTBEFORE(...) and =TEXTAFTER(...) functions.

Query Editor provides several ways of extracting data from within a piece of data:

Option	Description	Excel equivalent
Length	Calculates the length of the data in the column	=LEN(...)
First Characters	Extract first x number of characters	=LEFT(...)



Option	Description	Excel equivalent
Last Characters	Extracts last x number of characters	=RIGHT(...)
Range	Extracts x number of characters from a specified index	=MID(...)
Text Before Delimiter Text After Delimiter Text Between Delimiters	Extracts text before, after or between specified delimiters	=TEXTBEFORE(...) =TEXTAFTER(...)

To extract characters from within the currently selected column:

1. Click **Transform > Extract** (it is also available on the **Add Column** tab) and select the required option
2. If needed, specify the number of characters and any delimiters, and click **OK**

### Merging columns

You have very possibly used formulas in Excel to combine columns, the most popular one being =CONCATENATE(...), though the newer =CONCAT(...) and =TEXTJOIN(...) functions are certainly gaining in popularity.

Power Query's *Merge Columns* command performs a similar function.

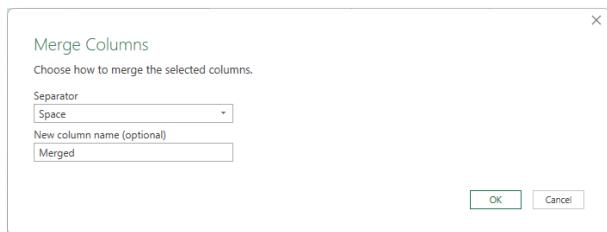


Figure 139: The 'Merge Columns' dialog box

To merge the currently selected columns:

1. Click **Transform > Merge Columns** (it is also available on the **Add Column** tab)
2. Select or specify what separator should be used, and the name of the new column if required
3. Click **OK**





### Key point

The order the columns are selected will affect the results. For example, selecting columns A and B would produce 'AB', but selecting them the other way around would produce 'BA'.

## Replacing data

One of the most underused commands in Excel is the traditional 'Find & Replace' tool. Often forgotten about or ignored because it must be reused if the data changes – hence the =SUBSTITUTE(...) function often coming into play – Power Query does of course have its own version.

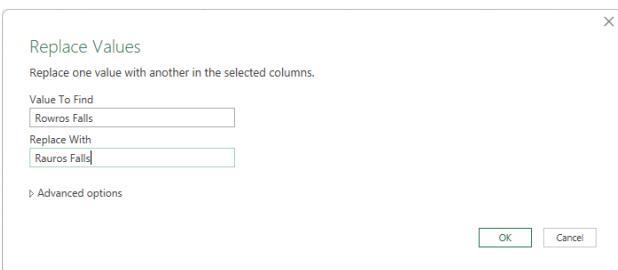


Figure 140: Using Query Editor's 'Replace Values' dialog box

To find and replace data, either:

- Click **Home > Replace Values**; or
- Click **Transform > Replace Values**



### Helpful hint

The 'Advanced options' are only available for text columns.

## Using Power Query's 'Format' tool

Data often needs to be prepared for use by ensuring that it reads correctly and is presented consistently – Power Query provides its *Format* tool for just these situations.

### Changing capitalisation

It is common to need to change the capitalisation of data. Whilst this often does not present an issue in terms of analysis (most of Excel's functions are not case-sensitive by default), it can be an issue when it comes to presenting data.

Traditionally Excel's functions =UPPER(...), =LOWER(...) and =PROPER(...) might be used.



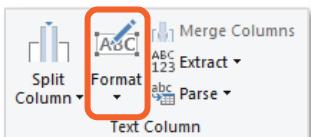


Figure 141: The 'Format' tool on the Ribbon

To change the capitalisation of data in the currently selected column(s):

- Click **Transform > Format >** or **Add Column > Format >** and select the desired capitalisation option

### Removing unwanted characters

Data containing excess or unwanted characters is a frequent problem – how many times have you had extra spaces on the end of data that are nigh on impossible to detect until they cause a problem? Or non-printing characters such as line breaks?

In some cases, unwanted characters can be removed using Power Query's 'Replace' command (and just replace with nothing at all), but it is not always the best choice. Consider if you were to use it to remove unwanted spaces – it would remove all the spaces from the data, meaning that multiple words would now run together!

Query Editor provides two tools to assist in these situations – *Trim* to remove all excess spaces, and *Clean* to remove non-printable characters.

To remove unwanted characters from the currently selected column(s):

- Click **Transform > Format >** or **Add Column > Format >** and select the desired cleaning option

### Adding prefixes or suffixes

Whilst we can easily merge multiple columns together, there may well be a requirement to add data to the beginning or end of a piece of data.

Again, this would usually be the remit of one of the various concatenation formulas, but Power Query has two dedicated tools – *Add Prefix* and *Add Suffix*.

To add a prefix or suffix to the currently selected column:

1. Click **Transform > Format >** or **Add Column > Format >** and select the desired option
2. Enter the prefix or suffix that is needed, and click **OK**

### Summarising data and unpivoting

Depending on your requirements it may sometimes be necessary to either group data (think how a PivotTable might look) – *Group By* – or to do the



opposite and take data that looks like a PivotTable and turn it into a normal list of data – *Unpivot*.

### Summarising data

Many data analysis tasks require the use of summary information. In Excel this is commonly achieved using formulas or PivotTables, but using Power Query's *Group By* command allows you to summarise data as it is imported – useful for when data will be reused but always summarised in the same way.

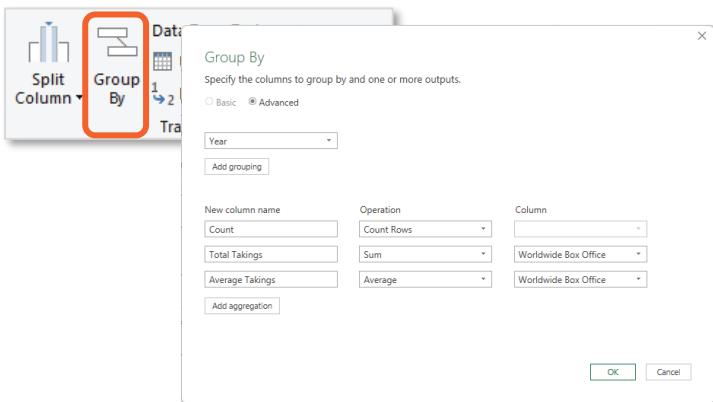


Figure 142: The 'Group By' dialog box

To summarise data, you need to provide two options:

- The field to be *grouped by*. This will usually be a field whose data is repeated, for example with customer orders you may wish to group by customer to enable you to calculate summaries per customer
- The *aggregation* or summary to take place

The results of a Group By query are not dissimilar to a PivotTable, with the added advantage that the data is already summarised before Excel 'sees' it, making it especially easy if it needs to be reused.

To group and summarise data in the current query:

1. Click **Home > Group By**, or **Transform > Group By**
2. At the top of the dialog box, select the field to be grouped by
3. Specify the desired settings and click **OK**:
  - *Name*: the name of the new (summary) column
  - *Operation*: the summary calculation
  - *Column*: for the summary – this can only be specified if any of the first five operations are selected – not the 'Rows' operations





### Helpful hint

A 'Basic' group by only permits a single summary; 'Advanced' allows multiple groups and aggregations to be performed.

## Unpivoting columns

In some instances, data will be imported in summary-like form as though it has come from a PivotTable. However, a PivotTable is usually a desired end-result rather than how data should be structured, and this is where Power Query's *Unpivot* command can be used.

	A	B	C	D	E	F
1	Customer ID	2018	2019	2020	2021	2022
2	ALFKI	5,060.62	5,746.40	11,277.71	9,397.14	9,138.04
3	ANATR	10,776.61	10,230.29	9,414.79	8,489.42	6,226.70
4	ANTON	6,484.89	6,602.62	9,514.92	10,824.30	5,
5	AROUT	6,773.35	8,897.37	9,993.46	5,914.94	7,
6	BERGS	8,711.00	8,720.66	9,131.06	9,302.05	5,604.38
7	BLAUS	13,079.43	8,803.66	6,273.54	12,322.01	5,580.51
8	BLONP	10,231.75	6,562.34	8,425.16	7,168.38	8,892.73
9	BOLID	9,80				
10	BONAP	8,88				

	Customer ID	Attribute	Value
1	ALFKI	2018	
2	ALFKI	2019	
3	ALFKI	2020	11277.71
4	ALFKI	2021	9397.14
5	ALFKI	2022	9138.04
6	ANATR	2018	10776.61
7	ANATR	2019	10230.29
8	ANATR	2020	9414.79
9	ANATR	2021	8489.42
10	ANATR	2022	6226.7

Figure 143: An example of pivoted data being unpivoted

To unpivot data:

4. Select the columns to be unpivoted – in the above example the five columns containing yearly data would be selected
5. Click **Transform > Unpivot Columns**

## Creating calculated columns

Whilst it is possible to write calculations in Query Editor, most users would default to using formulas they know and love in Excel! That said, Power Query does provide tools to enable you to quickly produce calculations without having to write any formulas at all, some of which are covered in this section.

### Calculated columns

A *calculated column* in Query Editor is what it sounds like – a column of data that is added to the dataset by using a calculation, just like creating a formula in Excel and 'copying it down.'

Query Editor, however, simplifies the creation of calculated columns by providing a series of buttons that can create the calculations for you.





### Key point

Query Editor will only make a calculated column button available if the data is of the relevant data type. For example, to use the Date calculated column tool, a date column must be selected in the query.



### Key point

When selecting columns to use for calculated columns, the order the columns are highlighted can affect the outcome.

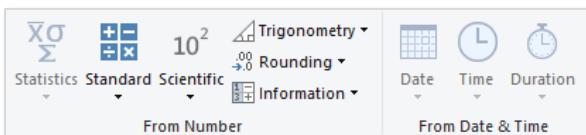


Figure 144: The calculated column tools in Power Query Editor

To create a calculated column using the Query Editor tools:

1. Select the column(s) containing the data the calculation will use
2. Using either the **Transform** or **Add Column** tab, select the desired category, e.g., Standard, or Date, and calculation



### Key point

Remember, tools on the 'Transform' tab will modify the current column(s); tools on the 'Add Column' tab will create a new column on the righthand side of the dataset.

## Conditional columns

One of the most popular functions in Excel is the =IF(...) function or its newer alternative, =IFS(...). Whilst many people are happy creating a basic =IF(...), we commonly hear of users struggling when it comes to creating multiple – or *nested* – formulas.

For either of these situations, Power Query's *Conditional Column* tool may well suffice. It is much simpler when multiple IF(...) formulas would traditionally be used, though does have some limitations (though these certainly do not affect everyone) around multiple criteria conditions.



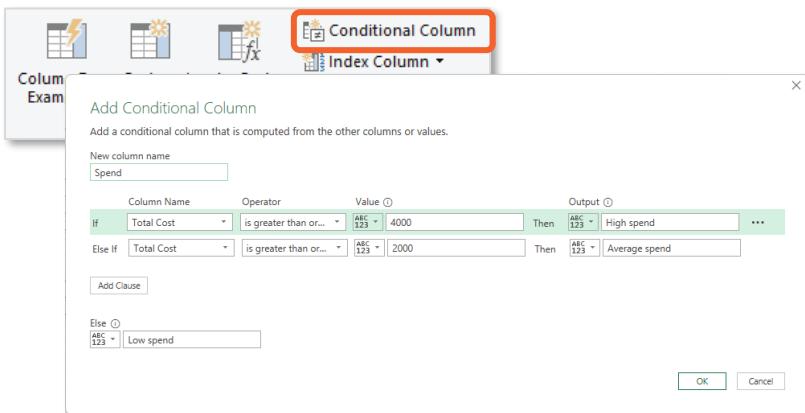


Figure 145: Adding conditional columns to a query



### Helpful hint

The **ABC123** buttons can be used to either enter a value, or select another column in the query

To add a conditional column:

1. Click **Add Column > Conditional Column**
2. Populate the options as necessary
3. If more options are needed, click the **Add Clause** button
4. For more control, click the **ellipsis** (three dots) button to the right of each clause to delete or reorder clauses
5. Click **OK** – Query Editor will add the new column to the righthand side of the data

## Columns from examples

Back in Excel 2013, Microsoft introduced the particularly useful *Flash Fill* feature that learns what you are wanting to do with data in a list based on what you type. This is particularly useful when doing simple tasks like splitting columns and extracting data.

However, it cannot be refreshed and so if you need to perform the task regularly, we either must repeatedly use Flash Fill or resort to formulas.

This is where *Column From Examples* comes into play. You can type into Query Editor what the resulting data should look like, and Power Query will work out how it is done! This is perfect for those situations where you are not sure how to do something, or what order to do things in.





### Key point

'Column From Examples' compares what you type and tries to identify a pattern – the more values you enter, the more accurate the pattern should be.

Microsoft are now starting to add this capability into Excel For Web with their 'Formula by Example' feature, but Power Query has had this for several years!

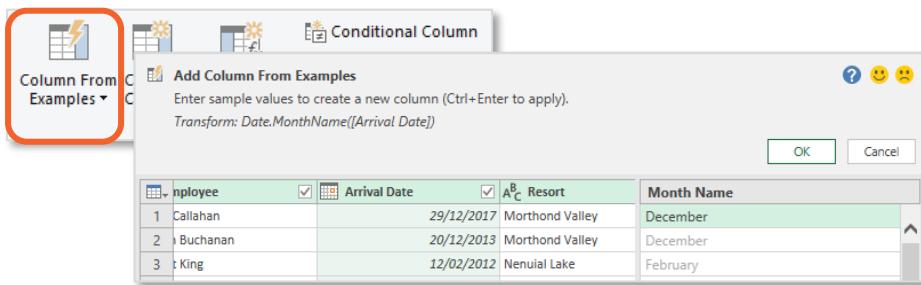


Figure 146: Using 'Column From Examples'

To use the 'Column from Examples' feature:

1. Select the column(s) that contain the data to function as the source(s) for the new column
2. Click **Add Column > Column From Examples > From Selection** – Query Editor will add a new 'temporary' column
3. In the new column, enter the desired result and press **Return** – you may need to enter multiple values in the column before it 'learns' the pattern
4. When the column has been populated as needed, click **OK**



## Module review

This module was about:

- Explaining the purpose of Power Query and how to access it
- Creating Merge and Append queries
- Understanding the difference between 'transforms' and 'creates'
- Using Power Query to apply common data transformations
- Splitting columns and extracting data
- Using Power Query to create calculated and conditional columns

### Review questions

1. Name two methods of combining data sources in Power Query Editor
2. How might you remove unwanted columns in Query Editor?
3. Which Power Query command enables you to produce a 'summary' of data in a query?
4. Which tools could you use to remove unwanted characters from a column of data?
5. What are the three commonest ways of adding calculated columns to a query?



## Appendix 1: Text functions

Excel has many functions for manipulating text. They can be used to combine text with other text or numbers, extracting selected parts of a text entry, or for converting numbers and dates to text. Text can be changed from lower to upper case, and vice versa; searches can also be performed to locate specific characters within an entry, and the length of text entries can be checked.

### The CONCATENATE function

Excel's CONCATENATE function allows entries from multiple cells to be joined – *concatenated* – and may or may not include extra text.

The CONCATENATE function has a minimum of two arguments:

- *Text1*: the first piece of text or cell reference to be used
- *Text2*: the second item of text or cell reference



#### Key point

To include spaces or other text between the joins, include the space(s) or text within speech marks (" " ).

	A	B	C	D	E	F	G
1	Text1	Text2	Result				
2	Mr	Taylor	MrTaylor	=CONCATENATE(A2,B2)			
3			Mr Taylor	=CONCATENATE(A2," ",B2)			
4	Total		1956 Total = 1956	=CONCATENATE(A4," =",B4)			
5	red		The colour is red	=CONCATENATE("The colour is ",A5)			

Figure 147: Using the CONCATENATE function



#### Key point

In Excel 2019, 2021 and Excel 365, the CONCATENATE function has been replaced by the CONCAT function.

### The TEXTJOIN function

Introduced in Excel 2019 and 365, the TEXTJOIN function is an enhanced version of the CONCATENATE function covered previously.

The TEXTJOIN function has three required arguments:

- *Delimiter*: a text string or cell reference that will be used to separate each item of text



- *Ignore empty*: specifies whether to ignore empty cells
- *Text1*: text item to be joined; can be a single cell or range of cells

	A	B	C	D	E	F	G
1	First Name	Middle Name	Last Name	Full Name			
2	David	James	Somerset	David James Somerset	=TEXTJOIN(" ",TRUE,A2:C2)		
3	Geoffrey		Boothroyd	Geoffrey Boothroyd	=TEXTJOIN(" ",TRUE,A3:C3)		

Figure 148: The TEXTJOIN function

## The LEFT, RIGHT, and MID functions

These three functions are used to split long text entries into separate shorter entries, or to extract characters from within a text string.

- =LEFT(text, [num chars])
- =RIGHT(text, [num chars])
- =MID(text, start at num, num chars)



### Key point

All three functions share the 'text' and 'num chars' arguments, though in the case of MID the argument is required.

The LEFT and RIGHT functions have two arguments:

- *Text*: the text string to search
- *Num chars*: optional; the number of characters to be extracted (if not specified, the function will return the first character)

The MID function has a third argument – *start at num*:

- *Text*: the text string to search
- *Start at num*: the character number (from the left) the start extracting from
- *Num chars*: the number of characters to be extracted (if not specified, the function will return the first character)

	A	B	C
1	Text	Result	Function
2	jo.bloggs@qa.com	jo	=LEFT(A2,2)
3		qa.com	=RIGHT(A2,6)
4		bloggs	=MID(A2,4,6)

Figure 149: The LEFT, RIGHT and MID functions





### Helpful hint

In many cases, these functions have been superseded by Excel's 'Flash Fill' feature, introduced in Excel 2013.

## The TRIM function

The TRIM function is used to remove all spaces from text except for single spaces between words. It is especially useful for text that has been imported into Excel from another application that may have irregular spacing.

- `=TRIM(text)`

	A	B	C
1	Text	Result	Function
2	First Quarter Report	First Quarter Report	<code>=TRIM(A2)</code>

Figure 150: The TRIM function

## The LEN and FIND functions

The LEN function returns the number of characters in a cell. This is particularly useful when using find and replace functions and performing string extraction. It is rarely used by itself, commonly being used with the FIND function.

The FIND function returns the position of a character, or number of characters within a cell.

- `=LEN(text)`
- `=FIND(find text, within text, [start num])`

	A	B	C
1	Text	Result	Function
2	jo.bloggs@qa.com	16	<code>=LEN(A2)</code>
3		10	<code>=FIND("@",A2)</code>
4		jo.bloggs	<code>=LEFT(A2,FIND("@",A2)-1)</code>
5		qa.com	<code>=RIGHT(A2,LEN(A2)-FIND("@",A2))</code>

Figure 151: Using the LEN and FIND functions

In the above screenshot the first two functions return the length of the text string (16 characters) and the position of the @ sign, respectively. The last two return all the characters to the left of the symbol, and to the right.



## The UPPER, LOWER and PROPER functions

It is often desirable to change the capitalisation of a piece of data, or of multiple pieces. Excel's UPPER, LOWER and PROPER functions can be used to achieve this.

- =UPPER(text)
- =LOWER(text)
- =PROPER(text)



### Helpful hint

The result is displayed in a different cell to the original entry but can be copied over the original using the **Paste Special > Values** command to replace it.

	A	B	C
1	Text	Result	Function
2	hg2 7ld	HG2 7LD	=UPPER(A2)
3	Jo.Bloggs@qa.com	jo.bloggs@qa.com	=LOWER(A3)
4	jo bloggs	Jo Bloggs	=PROPER(A4)

Figure 152: The UPPER, LOWER and PROPER functions

## The REPLACE function

### Definition

The **REPLACE** function will swap one portion of text at a specified position, with another text string. For example, you could replace any email address ending in .com with .co.uk.

### Syntax

=REPLACE(old\_text,start\_num,num\_chars,new\_text)

- **Old\_Text (required)** is the text from which you want to replace some characters
- **Start\_Num (required)** is the location of the text that you want to replace
- **Num\_Chars (required)** you must specify how many characters in the old\_text argument you need replacing
- **New\_Text (required)** The replacement text to use

### Examples

=REPLACE("C:\ALPHA\DOCUMENTS\" ,1,3,"F:\")



```
=REPLACE("01-12-2019 report.docx",7,4,"2022")  
=REPLACE(A1,6,2,"uk")
```

A	B	C
1 Old Telephone Number	New Telephone Number	
2 0117-9779546	0272-779546	=REPLACE(A2,2,5,"272-")
3		

Figure 153: The REPLACE function

The REPLACE function in Figure 153 is replacing an old telephone area code with a new one. The first argument is pointing to the location of the old text, A2; the second argument of 2 is specifying the position to start the replacement; the third argument (5), is stipulating the number of characters to replace; the final argument is detailing the replacement text.

## Comments

- The REPLACE function is a dynamic version of the Find and Replace command in Excel.
- Use the REPLACE function when the location of the text to be replaced is known or can be easily calculated.  
The SUBSTITUTE function may be preferred when the location of the old text is difficult to determine.
- Combine with the FIND function if the starting position of the text to replace is variable
- To remove the old text, use a new\_text argument of ""

# The SUBSTITUTE function

## Definition

The **SUBSTITUTE** function will swap one portion of text with another.

Unlike the REPLACE function, SUBSTITUTE can determine the location of the text to replace dynamically.

## Syntax

```
=SUBSTITUTE(text, old_text, new_text, [instance])
```

- **Text (required)** is the original text
- **Old\_text (required)** is the text to search for, and to replace
- **New\_text (required)** is the replacement text to use
- **Instance (optional)** allows you to limit the replacement to a particular instance. If this is blank, every instance will be replaced



## Examples

```
=SUBSTITUTE("South Shields"," ","_")
=SUBSTITUTE("Whitchurch Lane, whitchurch","whit","white",1)
=SUBSTITUTE("Joe Bloggs","Joe","Jo")
```

	A	B	C
1	Old Filename	New Filename	
2	Ellie.Cook@hsh.com	Ellie.Cook@HSH.com	=SUBSTITUTE(A2,"hsh","HSH")
3	Martin.Freedman@hsh-gb.com	Martin.Freedman@HSH-gb.com	
4	Dennis.Windows@hsh.co.uk	Dennis.Windows@HSH.co.uk	
5	Heather.King@hsh.org	Heather.King@HSH.org	

Figure 154: The SUBSTITUTE function, being used to validate the size of ISBN numbers

The **SUBSTITUTE** function in Figure 154 is being used to replace each instance of 'hsh' with 'HSH' in capitals

## Comments

- SUBSTITUTE is case-sensitive and does not support wildcards.
- The SUBSTITUTE function is generally seen as being more flexible and user friendly compared with REPLACE

## The TEXT function

### Definition

The **TEXT** function converts a numerical value into a text value.

This is useful if you want to use 'format cells' codes in your answer like displaying a number with a £, \$ or € or maybe formatting a date in your own dd/mm/yyyy code.

The opposite effect of converting text to a number is calculated by using the VALUE function, see above.

### Syntax

```
=TEXT(value, format_text)
```

- **Value (required)** is the numerical value to convert into text
- **Format\_text (required)** is the number format to use  
The list of codes you can use is comprehensive. Some examples are provided here. For full details, visit support.microsoft.com and search for "Excel number format codes"

Some of the more common number format codes include the following:



Code	Output	Notes
0.00	1.23	Display a number with 2 decimal places
000	007	A number with leading zeros
#,###	1,000	Display a comma as a thousand separator
£#,##0.00	£1,000.00	Currency format with 2 decimal places, and a comma as a thousand separator
dd/mm/yyyy	01/12/2022	Display a date in short format
0%	5%	Display a decimal value as a percentage
0 "kg"	15 kg	Specific text, such as units of measurements, can be placed before or after the value

## Examples

```
=TEXT(123,"£#,##0.00")
=TEXT(44896,"dd/mm/yyyy")
=TEXT(0.5,"0%")
```

	A	B	C
1	ISBN Number	Formatted	
2	9.78026E+12	978-026-220-3283	=TEXT(A2,"000-000-000-0000")
3			

Figure 155: The TEXT function, being used to format the raw ISBN number in cell A2

The TEXT function (cell B2) in Figure 155 is being used to format the number in cell A2.

## Comments

- When possible, copying the relevant number format code directly from the Format Cells dialog box is recommended. Select a cell with the relevant format, press CTRL + 1, go to Number, and select Custom. Copy the format and paste it inside speech marks in the TEXT function



## Appendix 2: Date functions

Dates and times are stored in Excel as values, meaning that calculations could be performed on them. The date '1 January 1900' is counted as day 1 (that is, if you format a cell containing the value 1 as a Date, the cell will display 01/01/1900). Excel recognises 1 Jan 1900 through to 31 Dec 9999 as valid dates.

Times are stored as fractions of a day (12 noon is 0.5 and 6AM is 0.25). Both dates and times can be entered in a fixed format that will not update, or in dynamic format that works from the system date and time held by the computer.

### Dynamic dates and times

Excel provides many date and time functions, all available using **Formulas > Date & Time >**. However, two of the most popular are used to enter a dynamic date or time using the system's date or date and time, respectively:

- =TODAY()
- =NOW()

### Regular date calculations

Because Excel stores dates as values (assuming that they have been entered correctly), calculating with dates does not need to be any different to calculating with non-date values.

For example, it may be necessary to calculate an end date based on a starting date, such as an invoice due date. Inversely, it may be necessary to calculate how much time elapsed between two dates. In both situations, standard maths can be used.



#### Key point

When calculating with dates, Excel will return the number of calendar days unless specialised functions are used.

	A	B	C	D
1	Start Date	End Date	Result	Formula
2	16/10/2019		15/11/2019	=A2+30
3	16/10/2019	14/04/2020	181	=B3-A3

Figure 156: Basic calculations with dates



## Calculating using working days

As has already been covered, Excel always calculates using calendar days rather than working days. However, it does come with several functions that can be used to deal with working days. The most popular of these are:

- =NETWORKDAYS(start date, end date, [holidays])
- =WORKDAY(start date, days, [holidays])

For both functions, it is assumed that Saturday and Sunday are non-working days. The 'holidays' argument is optional and can be used if other non-working dates are needed, for example public holidays or perhaps for regular part-time data.

### The NETWORKDAYS function

Excel's NETWORKDAYS function is used to calculate the number of working days between two dates. It is written with two mandatory arguments, and one optional:

- *Start date*: the date to start calculating from
- *End date*: the date to calculate to
- *Holidays*: optional; the range of cells that holds a list of other non-working dates

	A	B	C	D	E	F
1	Start Date	End Date			Bank Holidays	
2	01/01/2020	30/05/2020			New Year's Day	01/01/2020
3					Good Friday	10/04/2020
4	Calendar Days		150 =B2-A2		Easter Monday	13/04/2020
5	Working Days		108 =NETWORKDAYS(A2,B2)		VE Day	08/05/2020
6	inc. Bank Holidays		103 =NETWORKDAYS(A2,B2,F2:F9)		Spring bank holiday	25/05/2020
7					Summery bank holiday	31/08/2020
8					Christmas Day	25/12/2020
9					Boxing Day (substitute)	28/12/2020

Figure 157: Calculating calendar and working days

The above screenshot shows three calculations – one calculating the number of calendar days between A2 and B2; the other two calculate working days.

The first calculates the number of working days by discounting Saturdays and Sundays, the second the number of working days by discounting Saturdays, Sundays, and all the dates in F2:F9 that fall between the starting and ending dates.



## The WORKDAY function

The WORKDAY function is used to add working days to a starting date and has the same arguments as NETWORKDAYS. For example, if an invoice's settlement terms were 30 (calendar) days then the due date could be calculated with simple addition. However, if the terms were 30 working days, then the WORKDAY function would be used.

	A	B	C	D	E	F
1	Invoice Date	Terms (days)			Bank Holidays	
2	01/04/2020	30			New Year's Day	01/01/2020
3					Good Friday	10/04/2020
4	Calendar Days	01/05/2020	=A2+B2		Easter Monday	13/04/2020
5	Working Days	13/05/2020	=WORKDAY(A2,B2)		VE Day	08/05/2020
6	inc. Bank Holidays	18/05/2020	=WORKDAY(A2,B2,F2:F9)		Spring bank holiday	25/05/2020
7					Summery bank holiday	31/08/2020
8					Christmas Day	25/12/2020
9					Boxing Day (substitute)	28/12/2020

Figure 158: Calculating a due date with the WORKDAY function

In this example, three different due dates are calculated by adding:

- 30 (calendar) days
- 30 working days
- 30 working days, and considering bank holidays



### Useful tool

Excel provides an international version of both functions – NETWORKDAYS.INTL and WORKDAY.INTL – that can be used to accommodate different weekend days.



## Appendix 3: Error messages

The following table provides a list of all error messages you may find within a cell and provides tips for resolving the appropriate issue.

Error	Description	Solution
#DIV/0!	Excel is trying to divide a number by a value of zero, or an empty cell	Look for cells used within the calculation which contain either zeros or are empty
#N/A!	The formula cannot find a referenced value. Typically produced as the result of a lookup function.	Check the value being looking up exists, and that the table being searched is the correct size, and sorted by the first column of the specified range
#NAME?	The named range, or other text within the formula is not recognised	Check that named areas are correct. Also check the spelling and cell references within the formula
#NULL!	An unusual error within Excel. A calculation was expecting an intersection between two ranges,	You may have entered a space instead of a colon or comma. Otherwise, check the specified ranges intersect correctly
#NUM!	A number is outside of the Excel's capabilities (i.e., too large or too small), or you are performing an impossible calculation (e.g. performing a square root against a negative number)	Check any numbers provided aren't too extreme, and that the calculation is sensible



Error	Description	Solution
#REF!	One or more cell references is invalid	This error often appears after deleting a range of cells. Alternatively, your Lookup function may be pointing to a column index number outside of the specified table array.
#VALUE!	The wrong type of argument has been used	Check the data types for the arguments are correct, e.g., text, date, numbers etc.
#####	The column is not wide enough to display the value contained within. Also occurs if a negative date or time is contained within a cell.	Widen the column. Negative dates and times are not permitted, correct the formula as necessary.

With the addition of dynamic arrays in Excel 2021 and 365, two more error messages have been introduced.

Error	Description	Solution
#SPILL	Excel is trying to spill into cells, but existing data within the range is preventing it	Clear the spill range of data
#CALC	In this case, there is an unspecified error in the dynamic array.	Double-check the text within the formula is possible



## Appendix 4: The COUNTBLANK Function

Excel has numerous COUNT functions, some of which have been examined on this course. Another instance is COUNTBLANK, which as the name suggests, will report how many blank cells exist within a range.

The COUNTBLANK function has one argument:

- *Range*: the range of cells to be assessed

For example, =COUNTBLANK(A1:A100) will show many blank cells exist within the range A1:A100.

In the following screenshot, the spreadsheet is recording payments made within a period. Cell E2 contains the function =COUNTBLANK(A3:C8), which in turn reports a value of 6 blank cells.

	A	B	C	D	E
1	Payments made				
2	January	February	March	Number of outstanding payments for this quarter	
3	£ 53	£ 27	£ 81		6
4		£ 93		=COUNTBLANK(A3:C8)	
5	£ 78		£ 47		
6	£ 19	£ 26	£ 66		
7		£ 40			
8	£ 84		£ 48		

Figure 159: The COUNTBLANK function



## Appendix 5: Check for Issues

All products in the Office suite of apps provide three tools to enable you to check a document, workbook, or presentation for any potential issues, prior to sharing with colleagues or other users:

- Inspect document
- Check accessibility
- Check compatibility

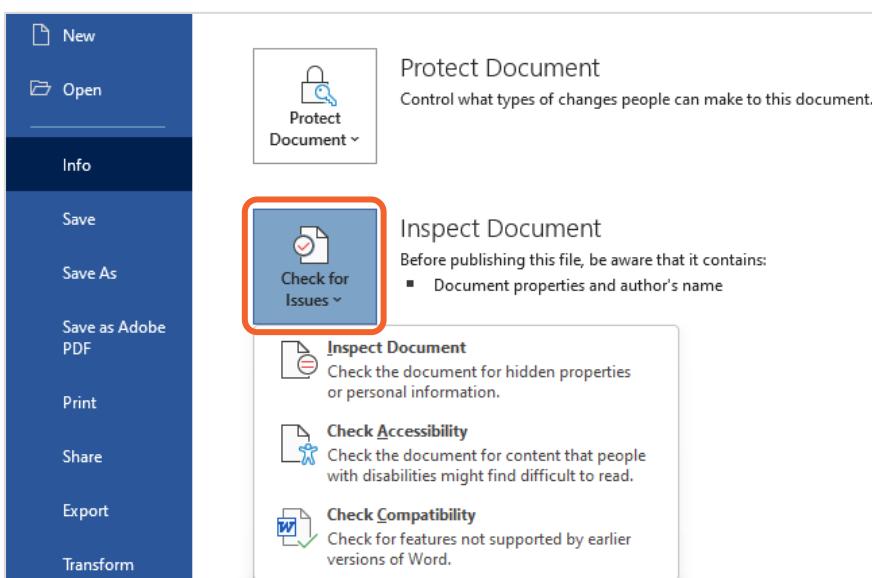


Figure 160: 'Check for Issues' in an Office application



### Key point

Although the above screenshot is from Word, the tools work the same way in all Office applications.

## Document Inspector

The *Inspect Document* tool checks the file to see if it contains information and data, which may not always be immediately visible, that you perhaps do not wish to share with other users.

For example, in a document there may be hidden text, in a workbook there might be hidden worksheets or a data model, in a presentation there might be hidden slides or speaker notes. In most files you create in Microsoft Office, as a minimum the file will contain the name of the author and co-authors, file creation date and so forth.





### Key point

Each of the Office applications has its own list of items that it will check for, anything from approximately a dozen different types of content, through to around 20.



### Helpful hint

It is advisable to save the file before inspecting it – any data that is removed cannot be retrieved if you change your mind later!

To inspect the current file:

1. Click **File > Info > Check for Issues > Inspect Document** – you may be prompted to save the file
2. Select the items you wish to check for, and click **Inspect**
3. In the Inspector's results dialog box, perform any required actions – you may wish to **Reinspect** once any issues have been actioned
4. When all required actions have been dealt with, **Close** the 'Document Inspector' dialog box

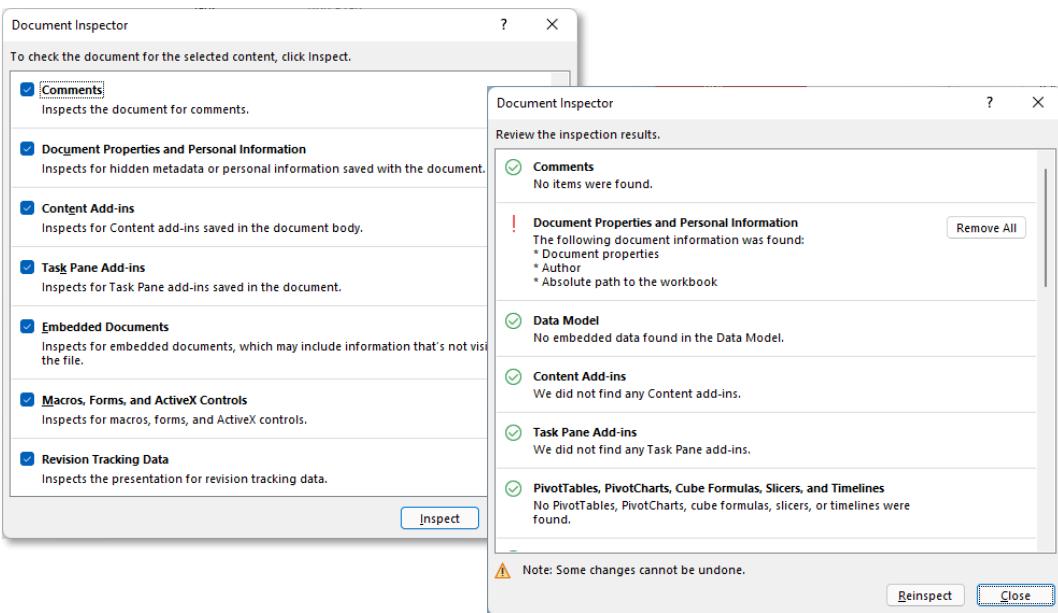


Figure 161: The 'Document Inspector' dialog box before (left) and after (right) checking the file

## Accessibility Checker

Microsoft Office's **Accessibility Checker** will check the file to ensure it is easy to read for people with disabilities. This will include, but is not limited



to, checking for accessible use of colours, the reading order for tables, and alt text for charts, diagrams, and other graphics.



Figure 162: A file's accessibility status, displayed on the Status Bar

To check a file for any potential accessibility issues:

- Click **File > Info > Check for Issues > Check Accessibility** – a list of issues will be presented in the Accessibility pane on the right-hand side of the screen



#### Helpful hint

Later versions of Microsoft Office can also check accessibility using **Review > Check Accessibility**.



#### Useful tool

The latest versions of Office can check for accessibility automatically as the file is being created. The Accessibility status will be displayed on the Status Bar at the bottom of the screen – click this to open the Accessibility pane.

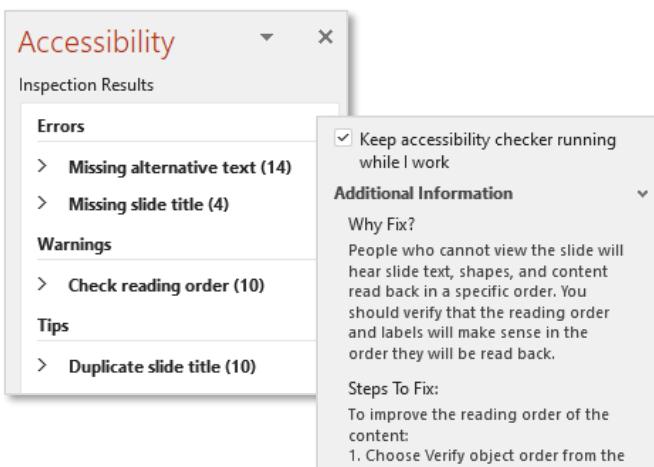


Figure 163: The Accessibility pane showing the Checker's results and suggestions

The Accessibility pane lists any issues that should be investigated. Each issue can be clicked to navigate to that part of the file to help you to make any required changes. The pane also provides additional information as to why the fix should be made, and steps to take to make the changes.



## Alt Text

Any graphical object in the file, whether a photograph, a PivotTable, chart, or diagram should have *alt text* added to it.

Alt text is descriptive text for users who are visually impaired – they may use screen reading software that describes anything on the screen, and for graphical content the software will read out any alt text.



### Key point

The exact method of adding alt text varies depending on the application version and the content that it is being added to.

## Adding and editing alt text

To add alt text to graphical content:

1. **Right-click** the item > **Edit Alt Text...**; or
2. **Right-click** the item > **Format... > Alt Text**

## Adding alt text automatically

Office 365 applications can generate alt text for some content automatically, and this feature is usually enabled by default.

To check if the feature is active:

- Click **File > Options > Accessibility >**



Figure 164: Office 365's automatic alt text generation feature

Once a picture is inserted into the file, the application will attempt to generate some alt text.

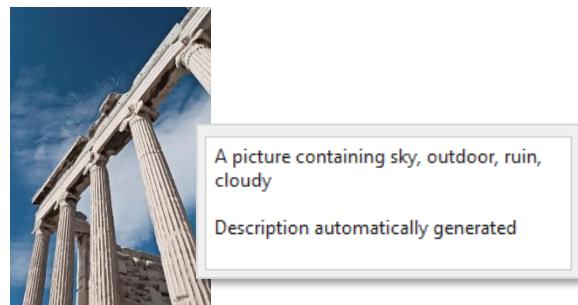


Figure 165: An image and its automatically generated alt text



## Mark as decorative

In some instances, graphical objects will be used in a file to add visual interest but are not informative, such as the arrow in the bottom right of this page. These sorts of content should be *marked as decorative* so that the reader knows the content is decorative and that they are not missing any important information.

## Compatibility Checker

The *Compatibility Checker* tool allows you to check for any potential issues when sharing a file with users who may be using an earlier version of the software.

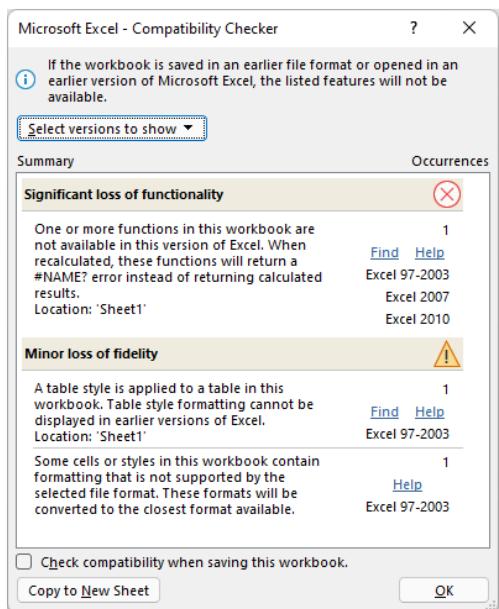


Figure 166: The 'Compatibility Checker' dialog box in Excel

To check the compatibility of the file with earlier versions:

1. Click **File > Info > Check for Issues > Check Compatibility** – the application will display a list of possible issues
2. Click **Select versions to show** and tick/untick the versions the file needs to be compared with for a more precise list

Compatibility results may be split into two different categories:

- *Significant loss of functionality*: the feature will not function in the specified versions, such as a new formula in Excel, or a brand-new feature
- *Minor loss of fidelity*: the appearance and formatting may change when viewed in the selected versions, such as a colour



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