Essential Spreadsheets

Book 2
This material explains how to use spreadsheets, and is based around:

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

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

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

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

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

See also our support site: [https://goo.gl/OY1Wzy](https://goo.gl/OY1Wzy)

Last Updated: September 2017
Part 3: Working with lists and data

10 ~ Data validation
11 ~ List structure
   11.1 - Working with larger lists
12 ~ Sorting and Filtering
   12.1 - Sorting data in Excel
   12.2 - Filtering data in Excel
   12.3 - Subtotals in Excel
   12.4 - Working with data in Google Sheets
   12.5 - Sorting/filtering data in Google Sheets
   12.6 - Collaborative data tools
13 ~ Lookup functions
   13.1 - LOOKUP
   13.2 - VLOOKUP
   13.3 - Range lookups
   13.4 - MATCH and INDEX
14 ~ Introducing Pivot Tables
   14.1 - Data you can’t pivot
   14.2 - Data structure rules
   14.3 - Pivot table anatomy
   14.4 - Some example pivot tables
   14.5 - Creating pivot tables

Part 4: Presenting data visually

15 ~ Conditional Formatting
   15.1 - Conditional formatting in Excel
   15.2 - Conditional formatting in Google Sheets
16 ~ From Spreadsheet to Chart
   16.1 - Effective charts
   16.2 - Creating Charts
   16.3 - Using Charts in other applications
Part 3~ Working with lists and data

Although originally designed for numeric data, spreadsheets are a powerful tool for working with sets of data that include text values, enabling calculation and manipulation of data, including sorting and filtering.

Google Sheets are also used as a repository for tables of data generated from Google forms and manipulated with Google’s scripting language, Apps Script.

If you are using a spreadsheet to store and process complex data, you should be aware of the advantages of using a Relational Database Management System (RDBMS) such as Microsoft Access. If your data includes several related sets or a lot of repeated data you should investigate using a RDBMS. The data can easily be exported to a spreadsheet for further numeric analysis if needed.

If access control and collaboration are key requirements, or you need to integrate with Google forms, email, or calendar, Google Sheets may be the preferred option.

10 ~ Data validation

The outcome of data processing will always depend in part on the quality of the source data, and although you can never ensure 100% accuracy of the data entered in spreadsheet, you can take steps to minimise the likelihood of errors and improve consistency.

Validation is about making sure the data entered is reasonable, at the point it is entered by the user. This can be achieved by:

- Checking the type of data entered in a cell
- Testing data to see if it lies within a sensible range
- Providing lists of values for a user to pick from

For example you might:

- Ensure cells that should contain valid dates can’t include plain text (eg ‘Next Tuesday’)
- Check that an entered date of birth isn’t in the future
- Decide on a maximum price and prevent very large values being entered
- Provide options such as ‘Pending review’, ‘Approved’, ‘Rejected’ as a drop-down list – this is particularly useful if you will later sort or filter when spelling mistakes could introduce errors
Validation with Excel

1. Select the cells to which you wish to apply a particular validation rule, and choose Data > Data Tools > Data Validation – a dialogue box opens.

2. On the Settings tab, choose the validation criteria as appropriate. After choosing the data type in the Allow option, the other settings will change to match. Configure these as necessary.

3. The Input Message tab lets you prepare a prompt to appear when the cell is chosen. Over-use of this can be annoying!

4. The Error Alert tab is more important, as you can select how to respond when invalid data is encountered. The options are:
   - **Stop** – Prevent the data being entered
   - **Warning** – Advise the user that the value is not valid, but give them the option to continue or cancel entry
   - **Information** – Let the user know the data is invalid, but let them carry on or cancel (this is essentially the same as Warning, but Warning looks more scary)

Picking from a list

If you select the List option for allowed data, you are asked to provide a source for this list, either as a cell range or named range. Points to note:

- The sources list can be on another sheet in the file
- Choosing this List option provides a drop-down control on the cell when selected
- If the Error Alert tab is set to Stop, only values in the drop-down can be used, but Warning and Information allow the user to enter a value not on the list
- List-based validation improves consistency as it forces users to choose from a limited set of possibilities, and so can make sorting/filtering more reliable.
Validation with Google Sheets

1. Select the cells to which you want to apply validation and choose **Data > Validation...** - a dialogue box opens.
2. Configure the criteria as necessary.
3. Choose whether simply to show a warning or reject the input.
4. If **Show validation help text** is ticked, the message in the line below appears when you hover over the cell.

---

**Picking from a list**

There are two pick from list options:

- **List from a range** – you will need to define a cell range or named range (usually on another worksheet)
- **List of items** – the list is entered directly in the dialogue box

Try to use the first option to avoid having to edit the validation dialogue

**Tip** If you create the list at the top of an otherwise empty column on another sheet, select the whole column for the list range. This means any new items added to this column will automatically appear in the list.

**Generating a validation list from existing data values**

If you use a column from an existing data set as the range for the list values, a list is automatically generated containing one of each of the unique values in the column, not a list of the whole column.

It is also possible to generate a list of unique values from a range using the **unique** function.
11 ~ List structure

In order to make best use of available features when working with structured sets of data, some simple rules should be observed:

- Lists should be entered down the page, each new item occupying a new row
- Each column should contain one type of information (eg text, number, date)
- Each cell should contain just one value
- Enter column headings in one row at the top of the list – never use more, and never merge cells for labels
- Do not leave whole rows or columns empty (but blank cells where the information is not applicable/unknown are OK)
- Stick to one list per tab of your spreadsheet file

A Good list:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Month</td>
<td>Fruit</td>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Jan</td>
<td>Apple</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Jan</td>
<td>Orange</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Feb</td>
<td>Apple</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Feb</td>
<td>Orange</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

Preventing some common mistakes:

- A full name in one column makes it impossible to sort/filter by family name, so split titles and names into multiple columns
- Stick to one data type in a column
- Store one attribute per column – don’t combine values
- Use proper dates in a Date column. ‘Next Tuesday’ is not a date; neither is ‘Sometime in May?’ nor ‘Jan-Feb’.

11.1 - Working with larger lists

If you are working with a list that is longer/wider than your screen, labels keep disappearing when you scroll, or you wish to compare data from cells that are a way apart, try one of these:

<table>
<thead>
<tr>
<th>Zoom</th>
<th>Changing the zoom level can help if the list is only slightly bigger than the current screen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Use the zoom control (bottom right) or View &gt; Zoom</td>
</tr>
<tr>
<td></td>
<td>As Google Sheets are browser-based, use the browser built-in zoom controls</td>
</tr>
<tr>
<td></td>
<td>(PC: Ctrl and +, -, and 0)</td>
</tr>
<tr>
<td></td>
<td>(Mac: Cmnd and +, -, and 0)</td>
</tr>
</tbody>
</table>
### Freeze panes

This feature 'locks' rows and/or columns in position so they remain on screen as you scroll

- Select the cell immediately **below** and to the **right** of the rows/columns you want to freeze. Choose **View > Window > Freeze panes > Freeze Panes**.
- Use the same control to unfreeze.

If you want to freeze more than 2 rows or columns, first select the cell that is in the last row/column you want frozen. Choose **View > Freeze** and select as appropriate (rows and columns are treated separately). Use the same menu to unfreeze.

### Split view

Excel also includes a split view, which creates up to 4 semi-independently scrollable areas on the sheet.

- First select the cell where you want the split.
- Then choose **View > Window > Split**.
- You can drag the position of the split once it’s there.

There is no equivalent in Google Sheets, but it is possible to open two separate instances of the same file in two separate browser windows/tabs, allowing you to view and work with two different views of the same document.

### Tip

**Finding the edges of a list**

Some keyboard shortcuts are useful for finding the extreme right/bottom of a long or wide list:

- Jump to the last occupied cell in a column: **Ctrl + ↓**
- Jump to the last occupied cell in a row: **Ctrl + →**
- Excel only - Jump to the last occupied cell in a range: **Ctrl + End**

And yes, using **up, left and Home** keys with **Ctrl** also works as you would expect.
12 ~ Sorting and Filtering

If a list has been created using the above principles, sorting and filtering can easily be applied to organize and locate information.

**Sorting** a list will re-arrange the rows in a specific order – for example you could sort by price to find the most expensive item in a list.

**Filtering** will display only rows containing values matching specified criteria, temporarily hiding all other rows – for example, you could filter to show just students in year 1.

**Note**  Google Sheets includes tools designed for a collaborative environment, so although the methods used for sorting and filtering have a lot in common, the two applications are explained separately.

While both Excel and Google Sheets will sort by full dates, at the time of writing only Excel can correctly sort cells containing the names of days or months in day/year order.

Google sheets will sort these alphabetically whereas Excel will order them chronologically. A simple work-around for this if you wish to use Google Sheets is to enter days of week or months as dates.

12.1 - Sorting data in Excel

The following data types can be sorted:

- Numbers – ascending or descending
- Text – alphabetical, ascending/descending
- Dates – ascending/descending
- Days – can be sorted in weekday order
- Month names – can be sorted in year order

The controls for sorting can be found on the Data tab:

**Single field sort**

1. Select any one cell in the column by which you wish to sort
2. From Data > Sort & Filter select either **Ascending** or **Descending**

**Note**  If your data contains entire blank rows/columns this method will not work correctly, and you may corrupt data by ‘shuffling’ it.
Advanced sorting

A custom sort, using a dialogue, will allow you to:

- Fix incorrect detection of header rows
- Sort in weekday or month order
- Sort by multiple fields

Method:
1. Select any one cell in the data you wish to sort
2. Choose Data > Sort & Filter > Sort
3. Configure the sort as necessary and then select OK

Note Options: case-sensitive sort, or lists that run horizontally.

12.2 - Filtering data in Excel

Data lists are filtered by enabling a series of drop-down controls in the header row:

Method:
1. Select any one cell in the range to be filtered.
2. Select Data > Sort & Filter > Filter. The filter button will remain highlighted and drop-down controls will be applied to the column header row.
3. Use the drop-down controls to configure the filter for one or more columns.
4. Filtered columns show a filter icon on the drop-down; filtered row numbers are coloured; and the application status bar will display the number of records.
The filter options available will depend on the type of data – text or number:

**Text data**

Select the value(s) you want to be displayed...

**Numerical data**

This list of values will be less useful with numbers...

...but these options let you configure ranges of values to display

**Note** If you enter new records immediately below the current data, the filter range will be automatically expanded. Then choose Data > Sort & Filter > Reapply to re-filter the changed data.

To clear filters:

| Clear a single filter | From the drop-down control, choose Clear Filter From...
|-----------------------|------------------------------------------------------
| Clear all filters     | From Data > Sort & Filter, choose Clear              |
| Clear and remove controls | From Data > Sort & Filter, choose Filter            |
12.3 - Subtotals in Excel

This feature is available in Excel, but not Google Sheets as it acts directly on the source data and so is not appropriate in a collaborative context.

It is used when a list includes values that fall into categories and subtotalling is required. The name is misleading as it can perform other calculations, including averages.

Creating subtotals

1. First ensure there are no filters applied to the list and sort the data so records are grouped by a specific category.
2. Ensure the active cell is within the list, and select Data > Outline > Subtotal
3. In the dialogue select:
   - The field by which you wish to group
   - The function required
   - The field(s) requiring the subtotal
4. Choose OK to insert the subtotals.

   Extra rows are inserted containing the subtotals and a grand total. Additional controls appear on the left to collapse and expand sections of the worksheet, showing or hiding sub and grand totals

Editing or removing subtotals

One advantage of using the subtotals feature is that it is very easy to change or remove:

1. Ensure the list is fully expanded, and the active cell is within the list region.
2. Select Data > Outline > Subtotal to open the dialogue box, and then:
   - For editing: change the dialogue box as appropriate, and ensure Replace current subtotals is ticked. Click OK to apply these new options
   - To remove subtotals: choose Remove All
12.4 - Working with data in Google Sheets
When working collaboratively, the disadvantage of the ‘standard’ sort/filter tools is that the data is changed for all users. Google Sheets therefore has features designed specifically with collaboration in mind.

12.5 - Sorting/filtering data in Google Sheets
There are two approaches, both using the same sort and filter tools:

- Directly on the data set – every collaborator sees the result of this
- Indirectly using a Filter View – this leaves the underlying data untouched and is the best option when working collaboratively

Single field sort or filter
There are sort options in the Data menu, but if your list has a header row either ‘freeze’ the header row (View > Freeze…) or use the following method for both sorting and filtering:

1. Select any one cell in the data range you wish to sort or filter.
2. Enable the filter controls (even if you only want to apply a sort) by choosing Data > Filter (also available as a button on the toolbar).

   a) Sort: In the header of the column on which you wish to sort, select the filter control drop-down, and choose Sort A → Z or Sort Z → A.
      At the time of writing, you can sort by:
      - Numbers – ascending or descending
      - Text – alphabetical, ascending/descending
      - Dates – ascending/descending

   b) Filter: To apply a single field filter, choose one or more values from the drop-down list, or choose an option from Filter by condition…

Filter by condition includes criteria for text…
...and for numbers
Multi-column sorting and filtering

You must first select the whole data range or you risk corrupting your data by shuffling it when you sort. The quickest way to do this is either to enable the Filter, which automatically selects the whole data range, or alternatively select the range using keyboard methods. Then:

1. Select Data > Sort Range... - the sort dialogue opens.
2. Configure this as appropriate and then choose OK.

12.6 - Collaborative data tools

The sort and filter limitations reflect the fact that these are essentially destructive processes; they change the view of the data, which is not helpful in collaborative use.

Google Sheets therefore include features that leave the underlying source data untouched: filter views and data functions.

Filter Views

These allow you to create a particular set of filter/sort criteria; the two advantages are:

- The filter view effectively sits on top of the source data so does not affect the view for other users, who can create their own filter views too.
- It can be named and saved for future use by you and other collaborators.
Create a new filter view as follows:

1. Select any cell in the data range and choose **Data > Filter Views... > Create new filter view**. The first thing you will notice is a change to the colouring of the page – this is to ensure you know you are in a filter view.

2. Configure any sorting and filtering as required (same methods as above).

3. For future use, name the filter suitably, and when you’ve finished, close filter view.

4. To re-visit a filter view, select **Data > Filter Views** and choose it from the list.

**Data functions**

An effective, non-destructive way to work with a data set is to generate a sub-data set on another worksheet using data functions. As the output is generated by functions, it will automatically reflect any changes made to the underlying data.

\[
\begin{align*}
&=\text{Sort}(\text{dataSet}, n, \text{true}, m, \text{false}...) \\
&=\text{Filter}(\text{dataSet}, \text{criterion}_1, \text{criterion}_2...) \\
&=\text{Unique}(\text{dataSet!A:E}) \\
&=\text{Query}(\text{source data}, "query criteria")
\end{align*}
\]

Of these, the **Query** function is the most powerful, as it includes an expression that defines the columns to be used, sort orders, criteria and even grouping or calculated values. The expression is based on Structured Query Language (SQL), used by database systems, but is not difficult for straightforward sorting and filtering.

Some examples, where **dataList** is a named range (see Book 1):

\[
\begin{align*}
&=\text{query(dataList, "select A,F,B")} & \text{simple select of three columns} \\
&=\text{query(dataList, "select A,F,B order by B desc"}) & \text{select and sort by one column} \\
&=\text{query(dataList,"select A,F,B where F=3")} & \text{select rows where the data in F = 3}
\end{align*}
\]

You’ll find a fuller description of these functions in the on-line support resources.
ImportRange

As Google Sheets is a web application, it is not possible directly to reference cells in worksheets from another file within a formula (this can be done in Excel).

To enable data from one file to be used in another, the importrange function is provided. Although the name would suggest a one-off data import, it does in fact create a link to the source data.

To use this function you need to know:

- Either the URL or unique ID (“Key”) of the source file (both should work)
- The range you want to import

Syntax

=importrange(“URL or Key”, “range”)

The range can be:

- Sheet name and range
  Sheet1!A1:G50
- Sheet name and column range
  Sheet1!A:G
- A named range
  demoData

Examples

Here is an example using the full URL and a range:

=importrange("https://docs.google.com/spreadsheets/d/1vbNC338Lbj7ayP6sECJ6K1gv935eW9hpT4INNF1","Sheet1!A:G")

This example uses the spreadsheet key and a named range (‘demoData’):

=importrange("1vbNC338Lbj7ayP6sECJ6K1gv935eW9hpT4INNF1","demoData")

Note that...

- Both the URL or Key and the range must each be enclosed in quotes
- When you first insert the function, the #REF! error will display because you need to allow the sheets to connect – hover over the cell to see the button

After inserting the importrange function you must allow access before data is visible

Using ImportRange in other functions

The ImportRange function can be used as the data source in other functions such as the Query function. In this case the Select expression must refer to columns as Col1, Col2 etc rather than A, B etc.
13 ~ Lookup functions

Lookup functions provide a means to reference data stored as a table elsewhere in a spreadsheet, and so extract values from it for use elsewhere.

There are three lookup functions:

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOOKUP</td>
<td>Locates a supplied value in one column and returns a value from the same row in another column</td>
</tr>
<tr>
<td>VLOOKUP</td>
<td>Locates a supplied value (or its position in ranges of values) in the first column of a range of data and returns the value from the same row in any other specified column</td>
</tr>
<tr>
<td>HLOOKUP</td>
<td>Works the same as VLOOKUP but with data that is arranged in rows rather than columns – not used very often</td>
</tr>
</tbody>
</table>

Two other functions, MATCH and INDEX, can provide similar functionality (see below).

13.1 - LOOKUP

=lookup(lookup value, range to look in, range to find in)

Example:

Using LOOKUP, a supplied value (‘Muffins’) is looked up in one column (B) and the value in the same row of another column (D) is returned.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ID</td>
<td>Item</td>
<td>Portion (g)</td>
<td>Calories</td>
</tr>
<tr>
<td>2</td>
<td>1001</td>
<td>Chocolate Cake</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>1002</td>
<td>Apple Pie</td>
<td>200</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>1003</td>
<td>Lemon drizzle cake</td>
<td>170</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>1004</td>
<td>Muffins</td>
<td>90</td>
<td>120</td>
</tr>
<tr>
<td>6</td>
<td>1005</td>
<td>Flapjack</td>
<td>160</td>
<td>210</td>
</tr>
<tr>
<td>7</td>
<td>1006</td>
<td>Sausage rolls</td>
<td>85</td>
<td>130</td>
</tr>
</tbody>
</table>

Assume this is cell G2

Corresponding value returned from column D
13.2 - VLOOKUP

=VLOOKUP(lookup value, table array, index number, range lookup)

<table>
<thead>
<tr>
<th>lookup_value</th>
<th>a reference to the value to find in the first column of the table (the value you are looking for)</th>
</tr>
</thead>
<tbody>
<tr>
<td>table_array</td>
<td>the range of cells to lookup in (it is easier if this is a named range)</td>
</tr>
<tr>
<td>index_num</td>
<td>from which column of the table_array to return a value (this is a number, not a column letter)</td>
</tr>
<tr>
<td>range_lookup (Excel)</td>
<td>whether to perform a range lookup or not – set to false or 0 to get exact matches only (range lookups are explained in the next section)</td>
</tr>
<tr>
<td>is_sorted (Google Sheets)</td>
<td></td>
</tr>
</tbody>
</table>

Example:

The first table contains anonymised exam results, showing only the student ID. Using VLOOKUP, we can locate the corresponding names in another table.

This example uses a named range as the data source (`students`).

Value from **A2** (1001) located in first column
Value from column **3** returned (Lister)

Cells A1:C6 are a named range (`students`)
13.3 - Range lookups

In the example above, the 4th argument was set to `false`. This means a student surname will only be returned if their StudentID has an exact match in the lookup table.

A range lookup is generally used with numerical data and does not expect an exact match, but instead uses a sorted list to find out where the value falls in a range. The 4th argument is then `true`.

For example, some exams could have the following grade boundaries, and we need to work out the grade for some results. The range lookup will match the closest range value below the supplied value:

```
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StudentID</td>
<td>Exam</td>
<td>Result</td>
<td>Forename</td>
</tr>
<tr>
<td>2</td>
<td>1001</td>
<td>1</td>
<td>68</td>
<td>Lister</td>
</tr>
<tr>
<td>3</td>
<td>1001</td>
<td>2</td>
<td>72</td>
<td>Lister</td>
</tr>
<tr>
<td>4</td>
<td>1002</td>
<td>1</td>
<td>56</td>
<td>Jones</td>
</tr>
<tr>
<td>5</td>
<td>1002</td>
<td>2</td>
<td>63</td>
<td>Jones</td>
</tr>
<tr>
<td>6</td>
<td>1003</td>
<td>1</td>
<td>81</td>
<td>Hoskins</td>
</tr>
</tbody>
</table>
```

When you use a range lookup, the values in the first column must be sorted in ascending order.

You must include the lowest possible value – in this case a zero is needed otherwise values below 40 would generate an error.
13.4 - MATCH and INDEX

These functions are often used together, when they provide LOOKUP functionality.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>=match(search value, range, type)</td>
<td>identifies a value in a column (range), returning the row number</td>
</tr>
<tr>
<td>=index(range, row number)</td>
<td>uses the row number to return a value from a column (range)</td>
</tr>
</tbody>
</table>

**Note** When using MATCH, the type is set to 0 for an exact match or 1 for a ‘nearest match below’ in a sorted column of values (the equivalent of true in VLOOKUP)

Consider this data set as an example. The student ID is not in the first column, so VLOOKUP cannot be used. The **Surname** for a particular **StudentID** is required.

**Data set:**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Forename</td>
<td>Surname</td>
<td>StudentID</td>
<td>Shoe size</td>
</tr>
<tr>
<td>2</td>
<td>Kate</td>
<td>Lister</td>
<td>1001</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Angela</td>
<td>Jones</td>
<td>1002</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>David</td>
<td>Hoskins</td>
<td>1003</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Lee</td>
<td>Hodges</td>
<td>1004</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Homer</td>
<td>Gumble</td>
<td>1005</td>
<td>7</td>
</tr>
</tbody>
</table>

MATCH is used first, to identify the row, and then this row number is used with INDEX to find the Surname:

<table>
<thead>
<tr>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Student ID</td>
<td>MATCH</td>
<td>INDEX</td>
</tr>
<tr>
<td>3</td>
<td>1002</td>
<td>3</td>
<td>Jones</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note** To use just one cell for the result, MATCH can be nested inside INDEX. In the example above this would become:

=INDEX(B:B,H3)

The returned value would still be Jones
Introducing Pivot Tables

Using Pivot Tables allows you to rearrange a data set so as to view it from different perspectives. In order to do this, the data must be organised; you cannot create a pivot table from poorly-organised data. An example may make this clearer.

The scenario – Students have volunteered to take part in activities to raise funds for charity, and we want to analyse the proceeds to see which activities were most successful, which colleges raised the most, and so on.

In order to facilitate pivoting, the structure should be:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student name</td>
<td>Year</td>
<td>College</td>
<td>Activity</td>
<td>Amount</td>
</tr>
<tr>
<td>2</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>Bean bath</td>
<td>60.00</td>
</tr>
<tr>
<td>3</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>10k run</td>
<td>75.50</td>
</tr>
<tr>
<td>4</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>Tandem jousting</td>
<td>55.00</td>
</tr>
<tr>
<td>5</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>Bean bath</td>
<td>70.00</td>
</tr>
<tr>
<td>6</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>Parachute jump</td>
<td>45.00</td>
</tr>
<tr>
<td>7</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>Tandem jousting</td>
<td>85.00</td>
</tr>
<tr>
<td>8</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>10k run</td>
<td>65.50</td>
</tr>
<tr>
<td>9</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>Parachute jump</td>
<td>95.50</td>
</tr>
<tr>
<td>10</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>Tandem jousting</td>
<td>35.00</td>
</tr>
</tbody>
</table>

This may look odd, particularly the repetition, but it means each row is a collection of separate data items including all relevant information for each instance of a student doing an activity.

Many users are more likely to create a structure that makes for easy data entry and display, but which makes it impossible to use pivot tables.

14.1 - Data you can’t pivot

Example 1: The data has been recorded like this:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student name</td>
<td>Year</td>
<td>College</td>
<td>Bean bath</td>
<td>10k run</td>
<td>Parachute jump</td>
<td>Tandem jousting</td>
</tr>
<tr>
<td>2</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>60.00</td>
<td>75.50</td>
<td>55.00</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>70.00</td>
<td>85.00</td>
<td>45.50</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>65.50</td>
<td>95.50</td>
<td>35.00</td>
<td></td>
</tr>
</tbody>
</table>

This cannot be pivoted!

It seems a perfectly reasonable way to record the data; you can easily total the amounts for each activity and student. It would, however, take a lot of rearrangement, conditional functions (in Excel perhaps the Subtotal feature) to total the amounts for each college or year, because the data is already recorded in a ‘pivoted’ format.
Example 2: The data has been recorded like this:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student name</td>
<td>Year</td>
<td>College</td>
<td>Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>Bean bath, 60.00</td>
<td>10k run, 75.50</td>
<td>Tandem jousting, 55.00</td>
</tr>
<tr>
<td>3</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>Bean bath, 70.00</td>
<td>Parachute jump, 85.00</td>
<td>Tandem jousting, 45.50</td>
</tr>
<tr>
<td>4</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>10k run, 65.50</td>
<td>Parachute jump, 95.50</td>
<td>Tandem jousting, 35.00</td>
</tr>
</tbody>
</table>

**This cannot be pivoted!**

This is even worse. Cells in columns D-F contain both text and numbers, which means the numbers cannot be used in any calculations at all, and the data is still in multiple columns. The use of one heading for 3 columns is also an issue, as you need to be able to identify each column individually. No functions could easily rescue this!

Example 3: The data has been recorded like this:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student name</td>
<td>Year</td>
<td>College</td>
<td>Activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>David Jones</td>
<td>2</td>
<td>Derwith</td>
<td>Bean bath, 10k run, Tandem jousting</td>
<td>190.50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Kate Thomson</td>
<td>1</td>
<td>Alcricke</td>
<td>Bean bath, Parachute jump, Tandem jousting</td>
<td>200.50</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>John Smith</td>
<td>2</td>
<td>Langburgh</td>
<td>10k run, Parachute jump, Tandem jousting</td>
<td>196.00</td>
<td></td>
</tr>
</tbody>
</table>

**This cannot be pivoted!**

The total amount has been entered in column E. With some extra work you could find sub-totals for colleges and years, but the amounts for individual activities cannot be calculated, and you couldn’t find out if particular activities were more popular with particular years groups.

Example 4: Using a different data set, monitoring spending:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Item</td>
<td>Dept</td>
<td>Jan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Paper</td>
<td>Admin</td>
<td>25.00</td>
<td></td>
<td>60.00</td>
<td>75.50</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Printing</td>
<td>Admin</td>
<td></td>
<td>15.00</td>
<td>35.00</td>
<td></td>
<td>85.00</td>
</tr>
</tbody>
</table>

**This cannot be pivoted!**

This is a very common way to record monthly data, but it cannot be pivoted because it has in effect already been ‘pivoted’ to show items versus months.
**14.2 - Data structure rules**

The rules for data structure are more or less the same as for lists:

- Data should be entered down the page, each item occupying a new row, so that each row contains one instance of the value to be used in calculation.
- Each column should contain just one type of information (e.g., text, number, date), and each cell should contain just one value.
- Enter column headings in one row at the top of the list – never use more, and never merge cells for labels.
- Do not repeat attributes across several columns (e.g., month names).
- Do not leave whole rows or columns empty (some blank cells are OK).
- Stick to one data set per tab of a spreadsheet file.

**Planning the ideal data structure**

Here’s one approach that may help you plan or check your data structure. We’ll continue to use the student fund-raising example.

First, identify the data that provides the individual values (i.e., not totals or sub-totals) – in this case, it’s the *amount* raised at a specific activity undertaken by a specific student:

```
amount
```

Next, surround this with the collection of related attributes:

```
student --+-- amount --+-- activity
\        |       |         |
\        v       v         |
college   year
```

Also include ‘attributes of attributes’ if you are likely to make use of them. For example, College and Year are technically attributes of the *student*, but since we are storing all the data in one table, these must also be regarded as attributes of the *amount*, and included with each value.

These attributes should then be the additional columns used in the data set, so each *amount* has a corresponding *activity*, *student*, *college* and *year*. 
14.3 - Pivot table anatomy

In order to construct a pivot table, you need to choose:

- A field that contains the **values** to be used in calculation
- A field to be used as labels on the left (**row labels**)
- A field to be used as labels across the top (**column labels**)
- Optional – a field to be used for **filtering**

Ask yourself what two attributes you want to compare – one of these will become the **row labels**, the other the **column labels**.

The **filter** allows you to limit the rows, columns and values by another field. You could, for example, compare totals for students against activity, but use the filter to use only the values for first years, or just certain selected colleges.

Based on the activity example above:

14.4 - Some example pivot tables

Q1: Which **activities** generated the most money in each **year** group?
Q2: Which **activities** were most successful in each **college**?

<table>
<thead>
<tr>
<th></th>
<th>Altricke</th>
<th>Derwith</th>
<th>Hallworth</th>
<th>Lamburgh</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10k run</td>
<td>220</td>
<td>215</td>
<td>215</td>
<td>215</td>
</tr>
<tr>
<td>2</td>
<td>Bike race</td>
<td>220</td>
<td>275</td>
<td>165</td>
<td>140</td>
</tr>
<tr>
<td>3</td>
<td>Hair-wax</td>
<td>150</td>
<td>300</td>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Jump</td>
<td>100</td>
<td>100</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>5</td>
<td>Tandem-jousting</td>
<td>235</td>
<td>265</td>
<td>415</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>Grand Total</td>
<td>925</td>
<td>1355</td>
<td>1020</td>
<td>940</td>
</tr>
</tbody>
</table>

Q3: How well did **students** in year 1 do at raising funds – which **activities** raised most?

<table>
<thead>
<tr>
<th></th>
<th>10k run</th>
<th>Baked-bean bath</th>
<th>Fancy-dress raft race</th>
<th>Full-body hair-wax</th>
<th>Parachute jump</th>
<th>Tandem-jousting</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>David</td>
<td>25</td>
<td>25</td>
<td>70</td>
<td>70</td>
<td>125</td>
<td>135</td>
</tr>
<tr>
<td>2</td>
<td>Andrew</td>
<td>20</td>
<td>30</td>
<td>70</td>
<td>75</td>
<td>125</td>
<td>135</td>
</tr>
<tr>
<td>3</td>
<td>Smith</td>
<td>75</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>David</td>
<td>90</td>
<td>125</td>
<td>50</td>
<td>50</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>5</td>
<td>Smith</td>
<td>300</td>
<td>225</td>
<td>325</td>
<td>325</td>
<td>1350</td>
<td>1350</td>
</tr>
<tr>
<td>6</td>
<td>Phillips</td>
<td>305</td>
<td>225</td>
<td>325</td>
<td>325</td>
<td>1350</td>
<td>1350</td>
</tr>
</tbody>
</table>

**Note** In this particular example, three row fields are used: students are identified by an ID number, and first name & surname are added too.

Q4: Which activities by year 2 students raised the most?

<table>
<thead>
<tr>
<th></th>
<th>Parachute jump</th>
<th>10k run</th>
<th>Baked-bean bath</th>
<th>Fancy-dress raft race</th>
<th>Full-body hair-wax</th>
<th>Parachute jump</th>
<th>Tandem-jousting</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Grand Total</td>
<td>15</td>
<td>15</td>
<td>18</td>
<td>15</td>
<td>15</td>
<td>63</td>
<td>63</td>
</tr>
</tbody>
</table>

Q5: How many activities did each college undertake?

<table>
<thead>
<tr>
<th></th>
<th>Altricke</th>
<th>Derwith</th>
<th>Hallworth</th>
<th>Lamburgh</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10k run</td>
<td>220</td>
<td>215</td>
<td>215</td>
<td>215</td>
</tr>
<tr>
<td>2</td>
<td>Bike race</td>
<td>220</td>
<td>275</td>
<td>165</td>
<td>140</td>
</tr>
<tr>
<td>3</td>
<td>Hair-wax</td>
<td>150</td>
<td>300</td>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Jump</td>
<td>100</td>
<td>100</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>5</td>
<td>Tandem-jousting</td>
<td>235</td>
<td>265</td>
<td>415</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>Grand Total</td>
<td>925</td>
<td>1355</td>
<td>1020</td>
<td>940</td>
</tr>
</tbody>
</table>
14.5 - Creating pivot tables

Whether you’re using Excel or Google Sheets, you first need to ensure your data is suitable for pivoting. You also then need to be very clear about what questions you want to ask of your data, and which field contains the numerical values.

**Excel**

1. In your data set, select any cell and choose *Insert > Tables > PivotTable* – the data range is indicated and a dialogue opens with the range already entered.

**Note** Excel 2016 has a *Recommended Pivot Tables* option gives you an idea of what’s possible with your data.

2. You will probably want your pivot table on a new sheet, but you can opt to put it on an existing sheet – in which case you must define the position of the top left cell of the area to be used.

**Tip** If you use this option, rather than a new sheet, always start on row 3 as the filter need two rows above the pivot table.

3. Choose OK and the framework for the pivot is created.

4. Using the panel that appears on the right, drag fields from the list into the appropriate areas below. As you do this, the used fields will be ticked.

   Alternatively you can tick the required fields and Excel will decide which area to put them in. This may not be what you want, but you can drag to rearrange.

5. The field you choose for the *Values* will usually (but not always) be numeric. For numeric data you can choose to display a *Sum, Average* etc by choosing the drop-down and selecting *Value Field Settings*...
You may also need to choose the **Value Field Settings** from here and change the calculation – the default is **COUNT**

As you drag fields, the pivot table will be built

The resulting pivot table

Filter
Google Sheets

1. In your data set, select any cell and choose **Data > Pivot table report...** – the framework for the pivot table is created (a pivot table is always created on a new sheet).

2. Using the **Report Editor** pane on the right, add fields to the **Rows**, **Columns** and **Values** using the **Add field** link. Choose a field for the filter if you need this too.

As you choose fields, the pivot table will be built:
Part 4~Presenting data visually

Data in a spreadsheet can be quickly turned into charts, providing visual representation of data. Several types of graph are supported, with options to control the appearance.

15 ~ Conditional Formatting

Conditional formatting modifies the visual appearance of cells based on the value it contains and is useful for identifying values that need your attention – very high, very low, outliers etc.

The methods used in Excel and Google Sheets are different, but conversion between Excel and Google Sheets (via upload and download) preserves conditional formatting that is common to both applications.

15.1 - Conditional formatting in Excel

1. Select the range of cells to be formatted.
2. Choose Home > Styles > Conditional Formatting. You are presented with a range of rule options (see below).
3. Select the appropriate rule and specify the condition for formatting the chosen cell or range of cells. Try to use cell references rather than values in the condition.
4. When done, choose OK.

Rule options

<table>
<thead>
<tr>
<th>Highlight Cells Rules</th>
<th>Identifies cells that are greater than, less than, between, etc specified criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top/Bottom Rules</td>
<td>Identifies cells that are the top ten, bottom ten, etc in a range of cells</td>
</tr>
<tr>
<td>Data Bars, Colour Bars, Icon Sets (not available in Google Sheets)</td>
<td>Identifies with bars, colours or icons how the value of a cell or range of cells compares with other cells</td>
</tr>
</tbody>
</table>
Managing multiple conditional formats - Excel

1. Select the cells and choose Home > Styles > Conditional Formatting > Manage Rules… to open the Rules Manager dialogue box.

2. If no rules are shown, check the setting for Show formatting rules for

From here you can add, edit and delete rules and the order in which they are applied.

15.2 - Conditional formatting in Google Sheets

1. Select the range of cells to be formatted and choose Format > Conditional formatting… to open the side panel.

2. Configure the rule and format in the side panel.

3. Select Done when complete.
Managing multiple rules in Google Sheets

The rules side panel is used to add, remove or edit conditional formatting rules.

1. First select the cells containing the rules you want to change.
2. Choose a rule to edit it, or add/delete rules using the appropriate controls.

Note: The rules are applied in the order they appear in the side panel, from bottom to top. This means a rule higher on the list can override one lower down.
16 ~ From Spreadsheet to Chart

In the chart below, a single series shows the number of apples consumed in the months January-March. Values and labels can both be used in the graph.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Jan</td>
<td>26</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Feb</td>
<td>31</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>Mar</td>
<td>28</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Apr</td>
<td>19</td>
<td>14</td>
</tr>
</tbody>
</table>

Before inserting a chart, ensure your data is laid out appropriately:

- Do not leave empty rows/columns in your data if avoidable
- Include axis labels, but enter them in just one cell for each row/column

Well laid out for charting:

16.1 - Effective charts

You need to choose the right sort of chart for your data – the final arbiter is not how pretty it looks, but how effectively it presents your data. In part this will depend on whether your data are categorised or purely numeric.

In particular, you need to be clear about the types of data you are working with. Some graphs plot numerical values for categorised data, whereas some plot two sets of related numerical data.

Categorised data is often plotted using bar, column or pie charts, but related numerical data usually requires a scatter graph.

Below are some examples:
**Categorised data**: the *number of fruit items eaten* per month:

![Eating fruit chart](image)

**Numeric data**: the *mass* of a dog and the *number of biscuits it eats*.

![Relationship between dog mass and biscuits eaten](image)

**Implied numeric values**

Some data may appear to be categorised, but is better understood as a special case of numeric data. The most common case of this is when a value is plotted over *time*, either *months*, *days of the week* or *years*. In this case, the *time/week days/months* may need to be recorded in a format that provides a numeric value (spreadsheets store *dates* and *times* numerically) so as to achieve a linear scale.

In this example, if the days are used as categories, a non-linear scale for the week is generated (left), but treating the days as dates includes the missing days and provides a linear scale for the horizontal axis.

<table>
<thead>
<tr>
<th>Day</th>
<th>Spent (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>45</td>
</tr>
<tr>
<td>Tue</td>
<td>67</td>
</tr>
<tr>
<td>Thu</td>
<td>34</td>
</tr>
<tr>
<td>Fri</td>
<td>78</td>
</tr>
<tr>
<td>Sun</td>
<td>38</td>
</tr>
</tbody>
</table>
16.2 - Creating Charts

In many cases, simply selecting data and choosing the kind of chart you require will give a good initial graph, which can then be modified to your requirements.

Google charts from Sheets

1. Select the range of cells you wish to create a chart from, including any labels that are required.

2. Choose Insert > Chart, or select the Insert Chart button on the toolbar. A ‘provisional’ Chart will appear, with an editing panel on the right.

3. Use the controls on the panel to configure the chart as required – the DATA tab lets you choose how to use the data, and the CUSTOMISE tab controls the appearance.

The chart will initially appear within the current spreadsheet; you can reposition and resize it, and the chart can be moved into its own tab (see below).

Customising Google Charts

Selecting an existing chart twice (or double-clicking) re-enables the Chart Editor.

When a chart is selected, there is also a short menu to allow other common actions, including moving to its own sheet:

Additional visualisation options

Google sheets includes some more unusual chart types, including maps, trees, gauges, organisational charts and animated ‘motion’ graphs. Most of these are also designed to be embedded on web pages and include a measure of interaction.
Creating charts from Excel

1. Select the range of cells you wish to create a chart from, including any labels that are required.

2. On the ribbon, select the Insert tab. Excel versions categorise charts differently, but the choices are essentially the same.

3. Choose the type of chart you require. Excel will create a basic chart from your data. You can then use the controls provided with the chart or the Ribbon tools to adapt the chart’s appearance.

The chart will initially appear within the current spreadsheet; you can move and resize it, or the chart can be moved into its own tab from the ribbon controls.

Customising Excel Charts

There are several tools for modifying the behaviour and appearance of a chart:

<table>
<thead>
<tr>
<th>The controls for elements, styles and filters that appear when a chart is selected</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="chart_elements.png" alt="Add/remove chart elements" /></td>
</tr>
<tr>
<td><img src="chart_styles.png" alt="Chart styles" /></td>
</tr>
<tr>
<td><img src="chart_filters.png" alt="Chart filters" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The ribbon controls (two extra tabs) which are enabled when a chart is selected</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="ribbon_controls.png" alt="Ribbon controls" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A side panel which appears when you double-click a chart or choose further options from the ribbon controls</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="side_panel.png" alt="Side panel" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right-click on a chart and choose options as appropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="right_click.png" alt="Right-click options" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Various dialogue boxes or the side panel will appear</th>
</tr>
</thead>
</table>
16.3 - Using Charts in other applications

**Excel**
Charts constructed in Excel can be placed in other Office applications including Word and PowerPoint. All you have to do is copy and paste the chart, however there are essentially three different options, and you need to understand the implications.

<table>
<thead>
<tr>
<th>Method</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Embed</strong></td>
<td>A copy of the entire Excel file is inserted into the document</td>
</tr>
<tr>
<td></td>
<td>Separate Excel file no longer needed</td>
</tr>
<tr>
<td></td>
<td>Chart and data editable from within Word/PowerPoint</td>
</tr>
<tr>
<td></td>
<td>Makes your document file larger</td>
</tr>
<tr>
<td></td>
<td>Sharing the Word/PowerPoint file shares your whole spreadsheet</td>
</tr>
<tr>
<td><strong>Link</strong></td>
<td>The chart that appears in the document is dynamically tied to the separate Excel file</td>
</tr>
<tr>
<td></td>
<td>Changes made in Excel are reflected in the document automatically</td>
</tr>
<tr>
<td></td>
<td>Minimal effect on file size</td>
</tr>
<tr>
<td></td>
<td>Complicates document management – must keep document and Excel files together for updating to take place</td>
</tr>
<tr>
<td><strong>Static image</strong></td>
<td>An image</td>
</tr>
<tr>
<td></td>
<td>Chart/data cannot be edited in document (updates must be made in Excel and pasted back again)</td>
</tr>
<tr>
<td></td>
<td>Chart only included in document – no access to data</td>
</tr>
</tbody>
</table>

**Pasting a Chart**
To place a chart in a Word/PowerPoint document:

1. Select the chart in Excel and choose Edit > Copy (or CTRL + C)
2. Switch to the document/presentation and Paste into the target document
3. Choose the appropriate paste option:
Editing a linked or embedded chart

If you are using Linked charts, any edits to the linked Excel file will automatically reflected in the document, but a linked or embedded chart can also be edited from within Word/PowerPoint:

1. Select the chart, **right-click** and choose **Edit data**...

2. **Choose** either to Edit Data using a mini-window (See below) in the document or to Edit Data in Excel

3. After making changes to embedded charts, simply close the Excel window; with linked charts you can continue to work with both open.

![Editing a linked or embedded chart](image)

Excel charts in other applications

For many other non-office applications (including online tools), inserting the chart as an image is generally the only option, and is what usually happens you paste a copied chart into an application.

High Quality Charts

If you need professional quality images for publication, one option is to transfer the chart into a vector drawing application such as Corel Draw. This allows you to work to a high resolution (publishers usually need 300dpi) or use CMYK colours, usually required for commercial colour printing.

To make sure you can edit the charts as a vector drawing object in Corel Draw, try one of the following methods:

1. **Copy the chart and paste using Edit > Paste Special**, choosing
   a) Windows metafile
   b) Or Windows enhanced metafile

2. Put the chart on its own Excel sheet and save as a pdf – import this into Corel Draw
Google sheets

A chart can be inserted into a Document or Slides presentation as a static or linked image. When linked, the chart can be updated. There are two methods:

1. Select and copy the chart, switch applications and paste – you will be presented with the option to link. When pasting a copied chart linking is the default option, but you can change this if you want a ‘snapshot’ of data.

2. In the ‘other’ application (Docs or Slides) choose Insert > Chart > From Sheets...; select the file and chart, and choose whether or not to link. Linking is again the default option.

Updating: A linked chart will show an UPDATE button when selected, if the chart has changed. Also included are controls to un-link and open the source file.

Static Charts

If you do not want a chart to update in a document or slide, deselect the link option when you insert it.

If you need the chart in another context and do not want it to update, you could also save it as an image from the short menu. The image will be in PNG format and will be saved on your Windows/Mac filing system.
Google New Sites
Charts in sheets can be embedded on Google Sites pages, allowing this to be published to a wider audience.

The New Sites make it very simple to insert an existing chart on a page and the chart is always linked to the source spreadsheet data:

1. On a New Sites page, from the INSERT tab choose Charts
2. Locate the Sheets file that contains the chart, select it and choose INSERT
3. In the dialogue select the chart (a Sheets file could contain several) and choose ADD

Note: Use the Preview to check the chart is updating, as this may not be apparent in Design mode.