SumProduct

Excel 2019

NEWSLETTER #73 - December 2018

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So as we bid "adieu" to 2018 we say "hello" to 2019 – that's Excel 2019. We mentioned it was Commercially Available last time out: this time we take a look at it in detail.

But of course, that's not all. We look at Excel operators as we still reveal the latest update news, plus continue our regular series on Power Query, VBA, Keyboard Shortcuts and the ever-continuing A to Z of Excel Functions.

Season's greetings to you all.

Liam Bastick, Managing Director, SumProduct

What's New in Excel 2019

Last month we mentioned Office 2019 was now Commercially Available. We thought we'd better do some digging and see what was new (compared to Excel 2016, rather than Office 365). There really wasn't any room in last month's newsletter, so please forgive our tardiness. However, we aim to put it right now!

New Functions

Yes, we know we've done this before but for completeness, there are six new functions in Excel 2019 (compared to Excel 2016). These comprise:

- **IFS**
- **SWITCH**
- **CONCAT**
- **TEXTJOIN**
- **MAXIFS**
- **MINIFS.**

Let's go through them.

IFS

As model developers and reviewers, we must confess we remain unconvinced about this one. If you have ever used a formula with nested **IF** statements, *e.g.*

=IF(IF(IF…

then maybe this function is for you – however, if you have ever written Excel formulae like this, then maybe Excel isn't for you! There are usually better ways of writing the formula using CHOOSE or INDEX(MATCH) (see www.sumproduct.com/thought/index-match.html for more) for example.

The syntax is as follows:

IFS(logical_test1, value_if_true1, [logical_test2, value_if_true2], [logical_test3, value_if_true3],…)

where:

- **logical_test1** is a logical condition that evaluates to TRUE or FALSE;
- **value_if_true1** is the result to be returned if **logical_test1** evaluates to TRUE. This may be empty
- **logical_test2** (and onwards) are further conditions that evaluate to TRUE or FALSE also
- **value_if_true2** (and onwards) are the respective results to be returned if the corresponding logical_test evaluates to TRUE. Any or all may be empty.

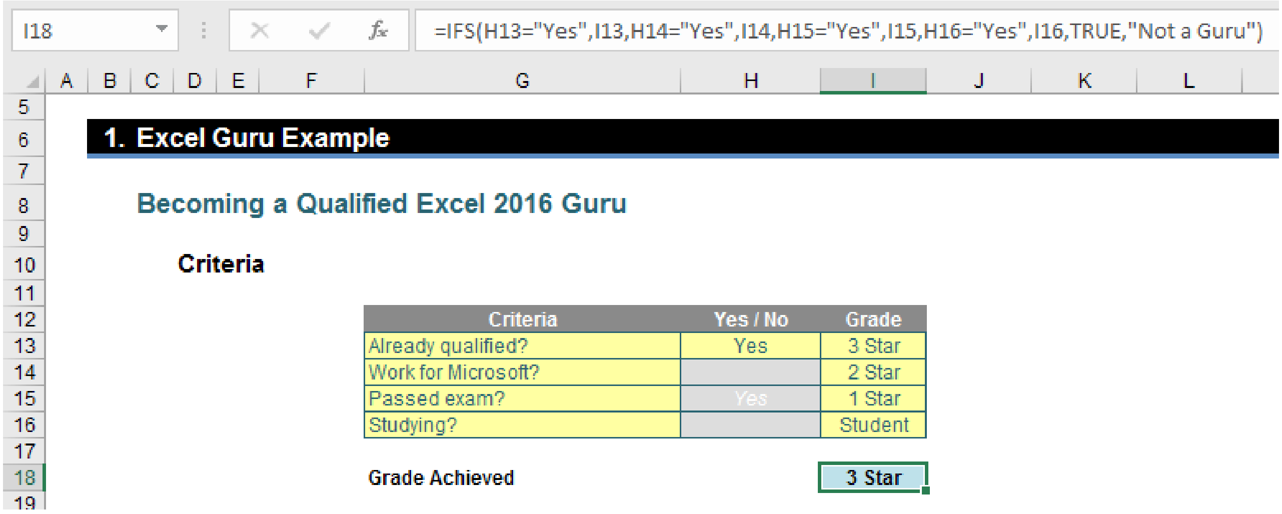
Since functions are limited to 254 arguments (sometimes known as parameters), the new **IFS** function can contain 127 pairs of conditions and results.

One thing to note is that **IFS** is not quite the same as **IF**. With the **IF** statement, the third argument corresponds to what do if the **logical_test** is not TRUE (*i.e.* it is an ELSE condition). **IFS** does not have an inherent ELSE condition, but it can be easily generated. All you have to do is make the final **logical_test** equal to a condition which is always true such as TRUE or 1=1 *(say)*.

Other issues to consider:

- Whilst the **value_if_true** may be empty, it must not be omitted. Having an odd number of arguments in an **IFS** statement would give rise to the "You've entered too few arguments for this function" error message.
- If a **logical_test** is not actually a logical test (*e.g.* it evaluates to something other than TRUE or FALSE, the function returns an *#VALUE!* error. Numbers still appear to work though: any number than zero evaluates as TRUE and zero is considered to be FALSE.
- If no TRUE conditions are found, this function returns the *#N/A!* error.

To show how it works, consider the following example.



I18

=IFS(H13="Yes",I13,H14="Yes",I14,H15="Yes",I15,H16="Yes",I16,TRUE,"Not a Guru")

1. Excel Guru Example

Becoming a Qualified Excel 2016 Guru

Criteria

Criteria	Yes / No	Grade
Already qualified?	Yes	3 Star
Work for Microsoft?		2 Star
Passed exam?	Yes	1 Star
Studying?		Student

Grade Achieved 3 Star

Here, would-be gurus are graded based on evaluation criteria in the table, applied in a particular order:

=IFS(H13="Yes",I13,H14="Yes",I14,H15="Yes",I15,H16="Yes",I16,TRUE,"Not a Guru")

I think it's safe that although it is reasonably straightforward to follow, it is entirely reasonable to say it's not the prettiest, most elegant formula ever put to Excel paper. In particular, do pay heed to the final **logical_test:** TRUE. This ensures we have an ELSE condition as discussed above.

To be fair, one similar solution using legacy Excel functions isn't any better:

=IF(H13="Yes",I13,IF(H14="Yes",I14,IF(H15="Yes",I15,IF(H16="Yes",I16,"Not a Guru"))))

Lovely.

SWITCH

SWITCH is already available in many alternative programming languages and can simplify potentially horrible formulae. This function evaluates an expression against a list of values and returns the result corresponding to the first matching value. If there is no match, an optional default value may be returned. The syntax is as follows:

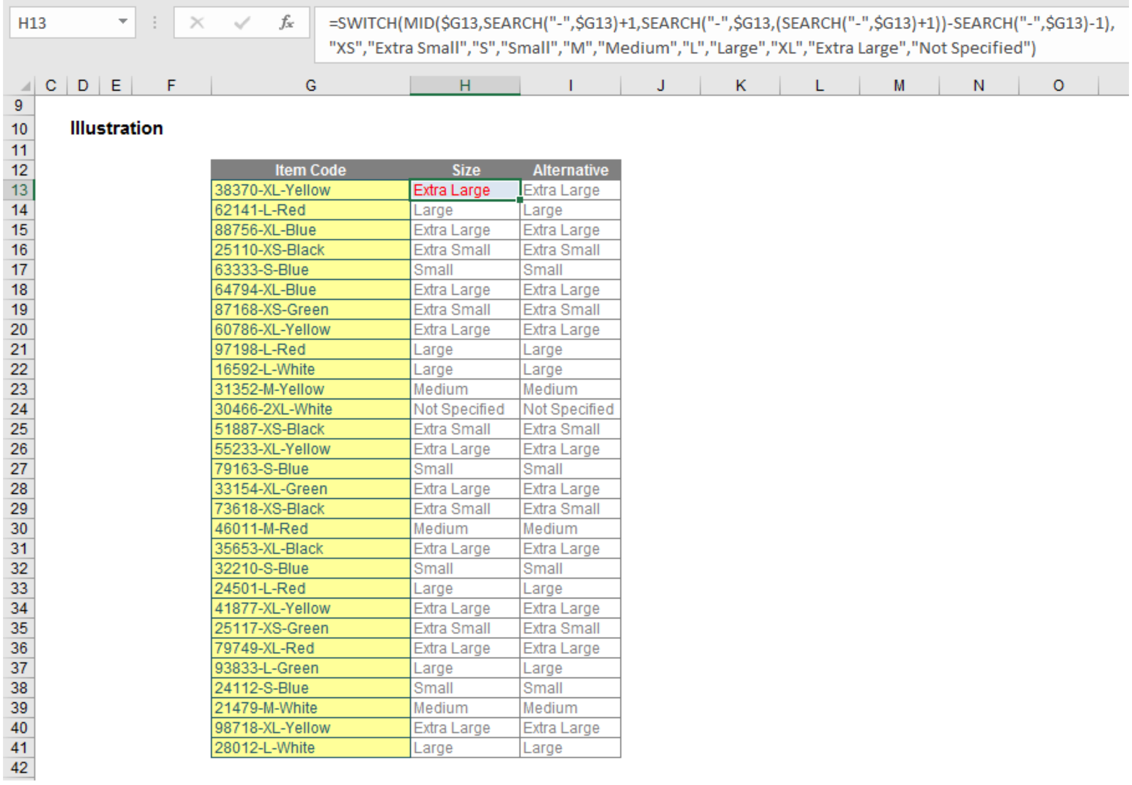
SWITCH(expression, value1, result1, [default or value2, result2],…[default or valueN, resultN])

where:

- **expression** is the value that will be compared against the values *(value1 to valueN)* cited
- **value1** to **valueN** are the values that will be compared against the **expression**
- **result1** to **result** are the values, references or formulae results to be returned when the corresponding **valueN** argument matches the **expression**. The result must be supplied for each corresponding **valueN** argument
- **default** is an optional value to return in case no matches are found in the **valueN** expressions. The **default** argument is identified by having no corresponding result expression, *i.e.* it must be the final argument in the function where the function contains an odd, rather than an even, number of arguments. If no **default** argument is supplied and no match is found this function returns the *#N/A!* error.

To illustrate, consider the following painful formula:

=SWITCH(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1),"XS","Extra Small","S","Small","M","Medium","L","Large","XL","Extra Large","Not Specified")



H13

```
=SWITCH(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1),
"XS","Extra Small","S","Small","M","Medium","L","Large","XL","Extra Large","Not Specified")
```

Illustration

Item Code	Size	Alternative
38370-XL-Yellow	Extra Large	Extra Large
62141-L-Red	Large	Large
88756-XL-Blue	Extra Large	Extra Large
25110-XS-Black	Extra Small	Extra Small
63333-S-Blue	Small	Small
64794-XL-Blue	Extra Large	Extra Large
87168-XS-Green	Extra Small	Extra Small
60786-XL-Yellow	Extra Large	Extra Large
97198-L-Red	Large	Large
16592-L-White	Large	Large
31352-M-Yellow	Medium	Medium
30466-2XL-White	Not Specified	Not Specified
51887-XS-Black	Extra Small	Extra Small
55233-XL-Yellow	Extra Large	Extra Large
79163-S-Blue	Small	Small
33154-XL-Green	Extra Large	Extra Large
73618-XS-Black	Extra Small	Extra Small
46011-M-Red	Medium	Medium
35653-XL-Black	Extra Large	Extra Large
32210-S-Blue	Small	Small
24501-L-Red	Large	Large
41877-XL-Yellow	Extra Large	Extra Large
25117-XS-Green	Extra Small	Extra Small
79749-XL-Red	Extra Large	Extra Large
93833-L-Green	Large	Large
24112-S-Blue	Small	Small
21479-M-White	Medium	Medium
98718-XL-Yellow	Extra Large	Extra Large
28012-L-White	Large	Large

The **expression** here is

MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)

which is determining what is contained between the two hyphens (for more on text string functions, please see www.sumproduct.com/thought/text-messages.html). It is horrible, and that's the point. The formula then considers what the values may be ("XL","M") and what value should be returned as a consequence ("Extra Large", "Medium").

The corresponding Excel formula before **SWITCH** would have been a nightmare:

**=IF(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)="XS","Extra Small",
IF(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)="S","Small",
IF(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)="M","Medium",
IF(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)="L","Large",
IF(MID($G13,SEARCH("-",$G13)+1,SEARCH("-",$G13,(SEARCH("-",$G13)+1))-SEARCH("-",$G13)-1)="XL","Extra Large","Not Specified")))))**

CONCAT

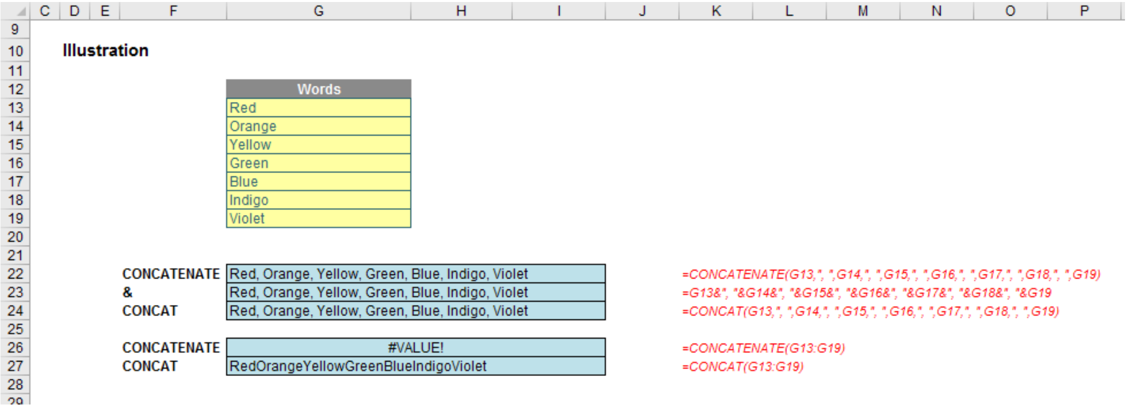
This function replaces the **CONCATENATE** function (see www.sumproduct.com/thought/concatenation.html). The **CONCAT** function combines the text from multiple ranges and / or text strings:

CONCAT(text1, [text2],…)

where:

- **text1** is the text item to be joined
- **text2** (onwards) are the additional items to be joined.

For example, consider the following illustration:



Illustration

Words
Red
Orange
Yellow
Green
Blue
Indigo
Violet

CONCATENATE	Red, Orange, Yellow, Green, Blue, Indigo, Violet	=CONCATENATE(G13,", ",G14,", ",G15,", ",G16,", ",G17,", ",G18,", ",G19)
&	Red, Orange, Yellow, Green, Blue, Indigo, Violet	=G13&", "&G14&", "&G15&", "&G16&", "&G17&", "&G18&", "&G19
CONCAT	Red, Orange, Yellow, Green, Blue, Indigo, Violet	=CONCAT(G13,", ",G14,", ",G15,", ",G16,", ",G17,", ",G18,", ",G19)
CONCATENATE	#VALUE!	=CONCATENATE(G13:G19)
CONCAT	RedOrangeYellowGreenBlueIndigoViolet	=CONCAT(G13:G19)

Upon first glance, **CONCAT** does the same thing as the legacy **CONCATENATE** function or **&** (ampersand) operator, but is just easier to spell. However, it is a little more than that: **CONCATENATE** will not cope with highlighting a contiguous range (it will just return the *#VALUE!* error); **CONCAT** will concatenate them all.

TEXTJOIN

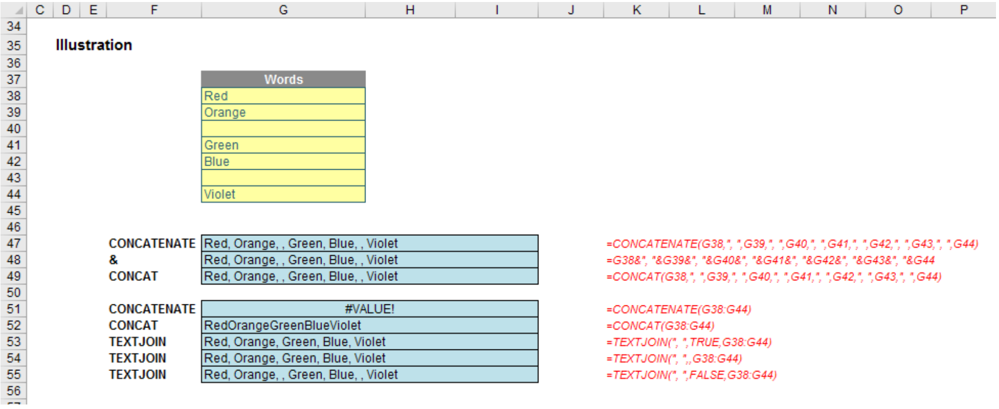
The **TEXTJOIN** function combines the text from multiple ranges and / or text strings and includes a delimiter to be specified between each text value to be combined. If the delimiter is an empty text string, this function will effectively concatenate the ranges similarly to the **CONCAT** function. Its syntax is

TEXTJOIN(delimiter, ignore_empty, text1, [text2], …)

where:

- **delimiter** is a text string (which may be empty) with characters contained within inverted commas (double quotes). If a number is supplied, it will be treated as text
- **ignore_empty** ignores empty cells if TRUE or the argument is unspecified (*i.e.* is blank)
- **text1** is a text item to be joined
- **text2** (onwards) are additional items to be joined up to a maximum of 252 arguments. If the resulting string contains more than 32,767 characters **TEXTJOIN** returns the *#VALUE!* error.

TEXTJOIN is more powerful than CONCAT. To highlight this, consider the following examples:



Illustration

Words
Red
Orange
Green
Blue
Violet

CONCATENATE	Red, Orange, , Green, Blue, , Violet	=CONCATENATE(G38,", ",G39,", ",G40,", ",G41,", ",G42,", ",G43,", ",G44)
&	Red, Orange, , Green, Blue, , Violet	=G38&", "&G39&", "&G40&", "&G41&", "&G42&", "&G43&", "&G44
CONCAT	Red, Orange, , Green, Blue, , Violet	=CONCAT(G38,", ",G39,", ",G40,", ",G41,", ",G42,", ",G43,", ",G44)
CONCATENATE	#VALUE!	=CONCATENATE(G38:G44)
CONCAT	RedOrangeGreenBlueViolet	=CONCAT(G38:G44)
TEXTJOIN	Red, Orange, Green, Blue, Violet	=TEXTJOIN(", ",TRUE,G38:G44)
TEXTJOIN	Red, Orange, Green, Blue, Violet	=TEXTJOIN(", ",,G38:G44)
TEXTJOIN	Red, Orange, , Green, Blue, , Violet	=TEXTJOIN(", ",FALSE,G38:G44)

Here, in the formulae on rows 53 and 54, empty cells in a contiguous range may be ignored and delimiters only need to be specified once. When you compare to **CONCAT**, you do begin to wonder why you need it – perhaps to soften the demise of **CONCATENATE..**?

MAXIFS and MINIFS

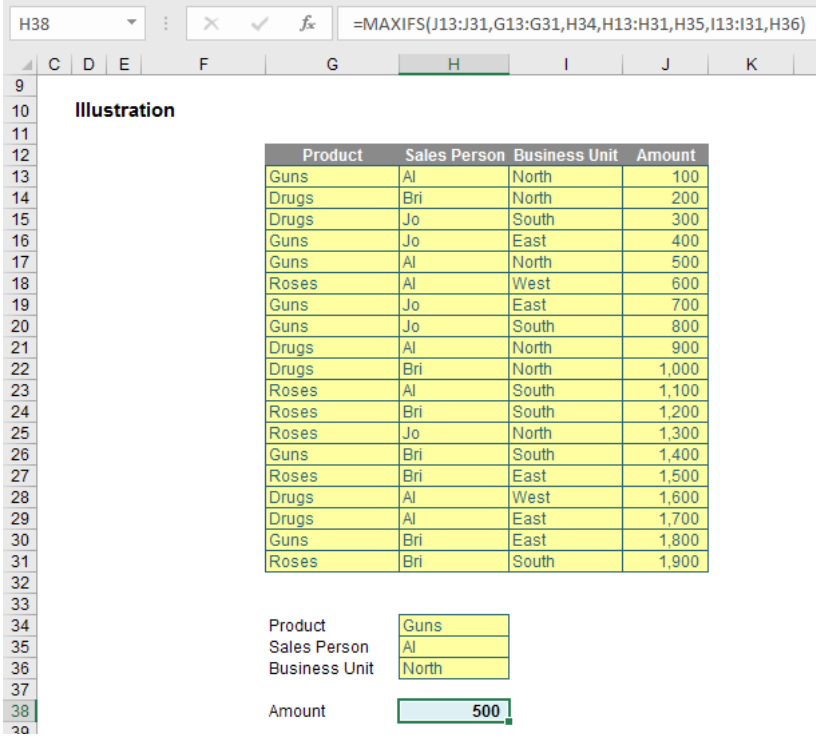
The last two new functions I am going to combine – and not with **TEXTJOIN!**

MAXIFS(max_range, criterion_range1, criterion1, [criterion_range2, criterion2], ...)

returns the maximum value among cells specified by a given set of conditions or criteria, where:

- **max_range** is the actual range of cells in which the maximum is to be determined
- **criterion_range1** is the set of cells to evaluate with the criterion specified
- **criterion1** is the criterion in the form of a number, expression or text that defines which cells will be evaluated as a maximum
- **criterion_range2** (onwards) and **criterion2** (onwards) are the additional ranges and their associated criteria. 126 range / criterion pairs may be specified. All ranges must have the same dimensions otherwise the function returns an *#VALUE!* error.

MINIFS behaves similarly but returns the minimum rather than the maximum value among cells specified by a given set of conditions or criteria.



H38 =MAXIFS(J13:J31,G13:G31,H34,H13:H31,H35,I13:I31,H36)

Illustration

Product	Sales Person	Business Unit	Amount
Guns	Al	North	100
Drugs	Bri	North	200
Drugs	Jo	South	300
Guns	Jo	East	400
Guns	Al	North	500
Roses	Al	West	600
Guns	Jo	East	700
Guns	Jo	South	800
Drugs	Al	North	900
Drugs	Bri	North	1,000
Roses	Al	South	1,100
Roses	Bri	South	1,200
Roses	Jo	North	1,300
Guns	Bri	South	1,400
Roses	Bri	East	1,500
Drugs	Al	West	1,600
Drugs	Al	East	1,700
Guns	Bri	East	1,800
Roses	Bri	South	1,900

Product	Guns
Sales Person	Al
Business Unit	North
Amount	500

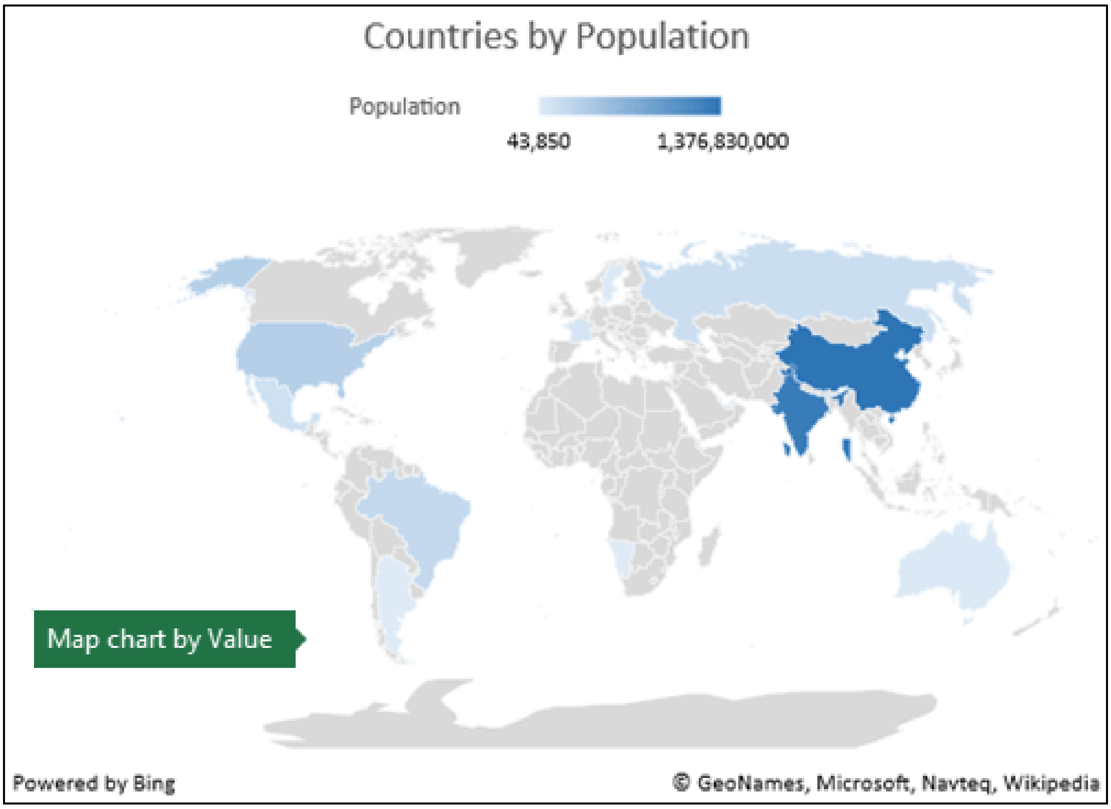
This example is preferable to its standard Excel counterpart:

{=MAX(IF(G13:G31=H34,IF(H13:H31=H35,IF(I13:I31=H36,J13:J31))))}

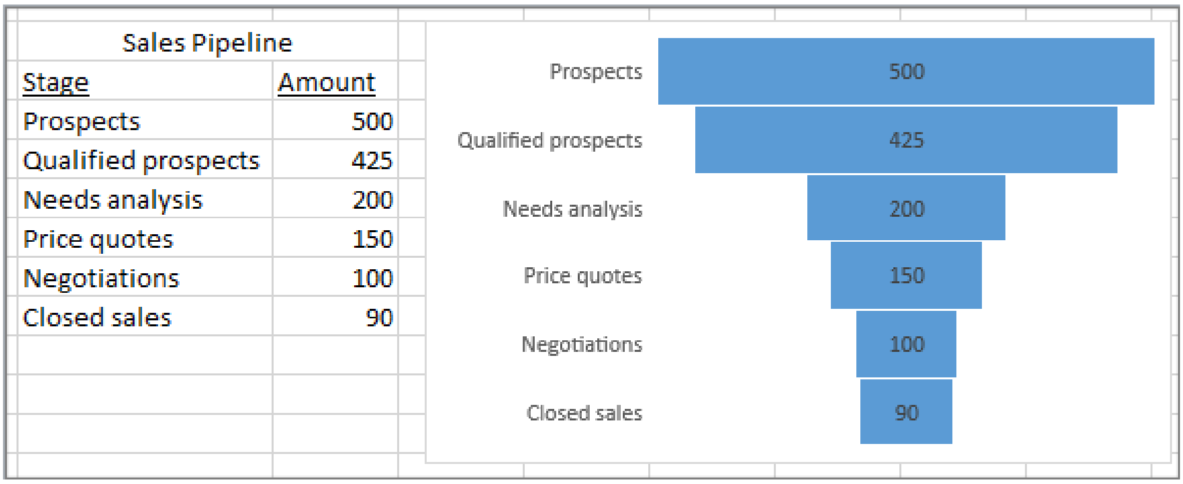
Array formulae (see www.sumproduct.com/thought/array-of-light.html for more information) are cumbersome and not readily understood.

New Charts

You can create a **map chart** to compare values and show categories across geographical regions. This may be used when you have geographical regions in your data, like countries / regions, states, counties or postal codes.



Funnel charts show values across multiple stages in a process. For example, you could use a funnel chart to show the number of sales prospects at each stage in a sales pipeline. Typically, the values decrease gradually, allowing the bars to resemble a funnel.



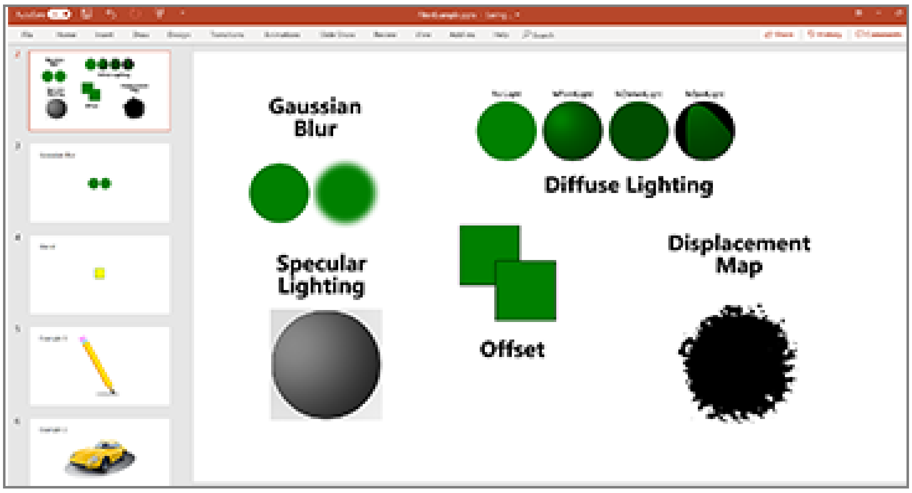
Sales Pipeline

Stage	Amount
Prospects	500
Qualified prospects	425
Needs analysis	200
Price quotes	150
Negotiations	100
Closed sales	90

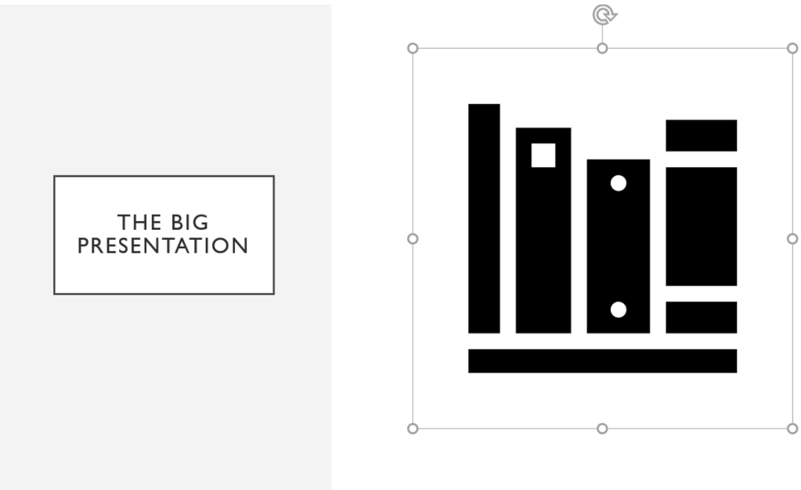
Enhanced Visuals

You can now insert what are known as **Scalable Vector Graphics (SVG)** files into not just Excel but any of your Microsoft Office documents, workbooks, emails and presentations. Once they're in place, they are easy to rotate, colour, filter and resize with no loss of image quality. To insert:

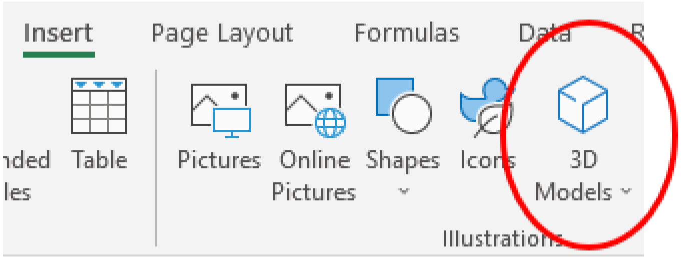
- **Insert an SVG file in Office for Windows:** simply drag and drop the file from Windows File Explorer into your document
- **Insert an SVG file in Office for Mac:** Go to **Insert > Pictures > Picture from file** to insert your SVG images.



Further, you may **transform all SVG pictures** and icons into Office shapes so you can change their colour, size or texture:



You can insert **3D models** into your Excel files much the same way as other images. On the ‘Insert’ tab of the Ribbon, select 3D ‘Models’ and then ‘From a File’:

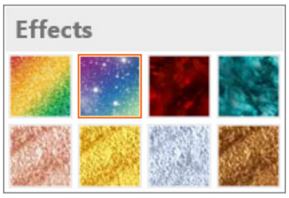


You can use 3D to increase the visual and creative impact of your, so that images may be rotated through 360 degrees.

Ink Improvements

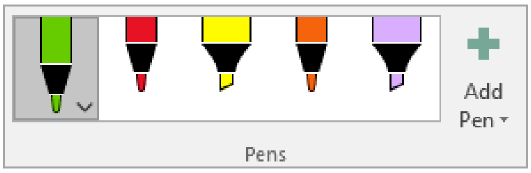
We can’t say we use these features much in financial modelling, but some of you out there may. Inking features were initially introduced in Office 2016, but there have been improvements made in the 2019 counterpart:

- **New ink effects:** you can now express your ideas using metallic pens and ink effects like rainbow, galaxy, lava, ocean, gold, silver and more

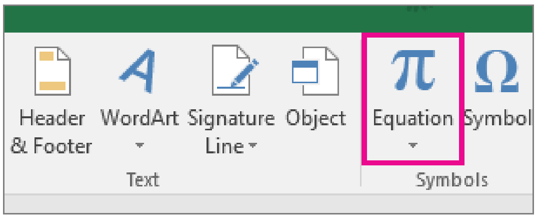


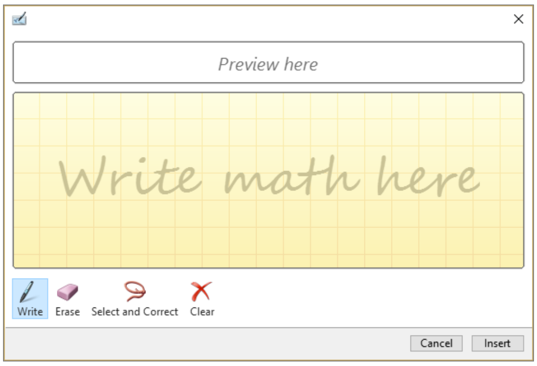
- **Digital Pencil:** you may write or sketch out ideas with the new pencil texture

- **Customisable, portable pen set:** It’s now possible to create a personal set of pens to suit your needs. Office remembers your pen set in Word, Excel and PowerPoint across all of your Windows devices



- **Ink equations:** including mathematical equations is now easier – simply go to **Insert > Equation > Ink Equation**, any time you want to include a complex maths equation in your workbook. If you have a touch device, you can use your finger or a touch stylus to write math equations by hand and Excel will convert it to text. (If you don't have a touch device, you can use a mouse to write, too.) You may also erase, select and correct what you've written as you go



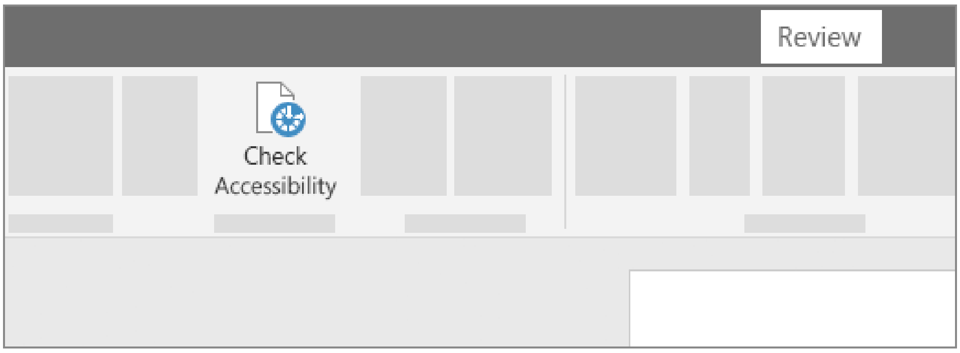


Note to Microsoft: it’s “Maths”…

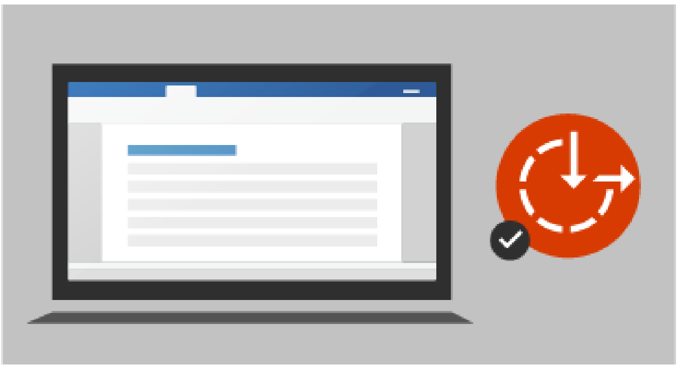
- **New Ink Replay button:** if you are using ink in your spreadsheets, you can now replay or rewind your ink to better understand the flow of it. This offers an alternative to GIF images to provide get step-by-step instructions. You'll find ‘Ink Replay’ on the ‘Draw’ tab
- **Lasso Select at your fingertips:** Excel now has **Lasso Select** , a free-form tool for selecting ink. Drag with the tool to select a particular area of an ink drawing, and then you can manipulate that object as you wish
- **Convert ink drawing to shapes:** the ‘Draw’ tab lets you select inking styles and start making ink annotations on your touch-enabled device. You may also convert those ink annotations to shapes. Just select them and then select ‘Convert to Shapes’. That way, you get the freedom of freeform drawing with the uniformity and standardisation of Office graphic shapes
- **Use your Surface pen to select and change objects:** Well that assumes you have a Surface! In Excel, with a Surface pen, you can select an area without even tapping the selection tool on the Ribbon. Just press the barrel button on the pen and draw with the pen to make a selection. Then you can use the pen to move, resize or rotate the ink object.

Better Accessibility Features

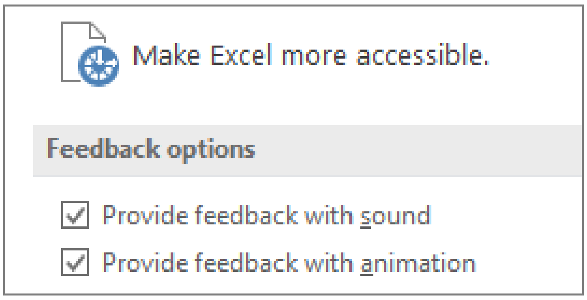
Before sharing your spreadsheet, in Excel 2019 you can run the 'Accessibility Checker' to ensure your content is easy for people of all abilities to read and edit. On the Ribbon, click the 'Review' tab and then click 'Check Accessibility':



This will provide review results. You may see a list of errors, warning, and tips with how-to-fix recommendations for each. Excel 2019 now offers one-click fixes and is better than ever with updated support for international standards and handy recommendations to make your documents more accessible for all users.



Helpful sounds improve accessibility, but be careful: when you make changes to settings, the option affects all Microsoft Office programs that support this. Having said that, you can turn on audio cues to guide you as you work.



Make Excel more accessible.

Feedback options

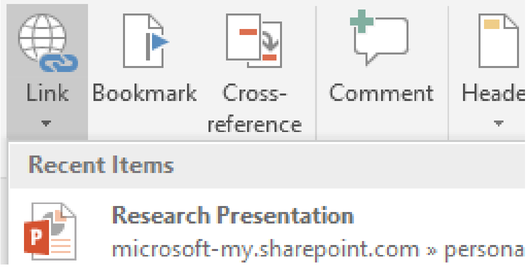
☑ Provide feedback with sound

☑ Provide feedback with animation

In the 'File' menu, select 'Options' (**ALT + T + O**). On the 'Ease of Access' tab, under 'Feedback Options', select or clear the 'Provide feedback with sound checkbox'. If you wish, you can use the original Office sound effects by selecting the 'Classic theme' from the 'Sound Theme' drop-down.

Sharing and Saving

You can now attach hyperlinks to recent cloud-based files or websites and create meaningful display names for people using screen readers. To add a link to a recently used file, on the 'Insert' tab, choose 'Link' and select any file from the displayed list.

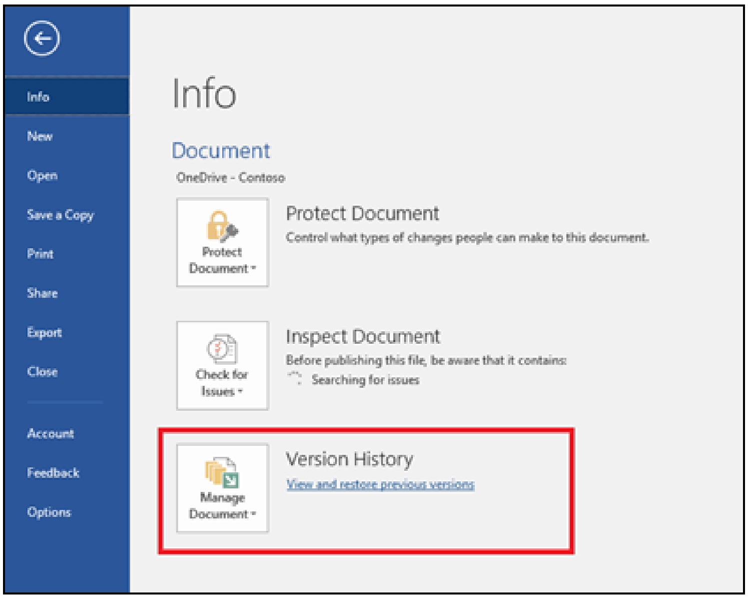


That’s not all. You may also view and restore changes in workbooks that are shared. You can now quickly view who has made changes in workbooks that are shared, and easily restore earlier versions.

Microsoft Office automatically saves versions of your SharePoint, OneDrive and OneDrive for Business files while you’re working on them (we have covered this before and not necessarily favourably!). These versions allow you to look back and understand how your files evolved over time and allow you to restore older versions in case you have made a mistake.

Version history in Office only works for files stored in OneDrive or SharePoint Online. If you don't see this option it's possible your file is stored in a different service or on a local device. To view historical versions:

1. Open the file you were working on
2. Click the **File > Info** and select ‘View and restore previous versions’



Info

Document

OneDrive - Contoso

Protect Document

Control what types of changes people can make to this document.

Inspect Document

Before publishing this file, be aware that it contains:

Searching for issues

Version History

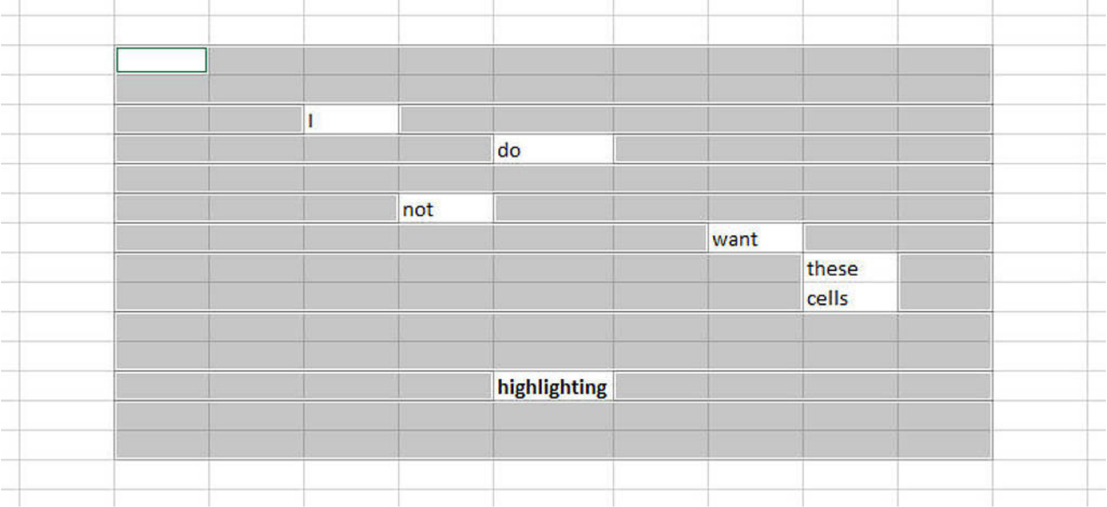
View and restore previous versions

3. The ‘Version history’ tab will open. Click a version to open and view it in a separate window.

With the version you want to restore open in your application, click ‘Restore’ in the message bar at the top of the opened version. Restore will save your current file as a new version and then replace your current file with the contents of the version you chose to restore.

You can quickly save to recent folders too. Go to **File > Save As > Recent**, and you’ll see a list of recently accessed folders that you can save to.

Selecting Only What You Want



I

do

not

want

these

cells

highlighting

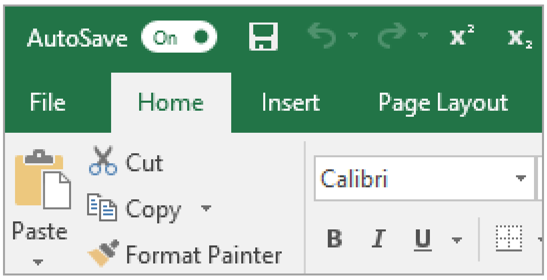
Excel will now let you deselect cells or a range of cells from your current selection. Microsoft has just rolled this out for PC and Mac subscription users of Office 365.

To "unselect" (it's a new word, look it up!) a selected cell, hold down the **CTRL** button (or **Command** on a Mac) key and click on the cells you want to deselect. To unselect a range of selected cells, hold down the **CTRL** (or again, the **Command** for Mac) key and drag the range you want to deselect, starting from within the selected range.

Don’t get confused with the cell in the top left-hand corner of the range selected remaining white! You can have fun experimenting what that looks like when it is de-selected...

Quick Access to Superscript and Subscript

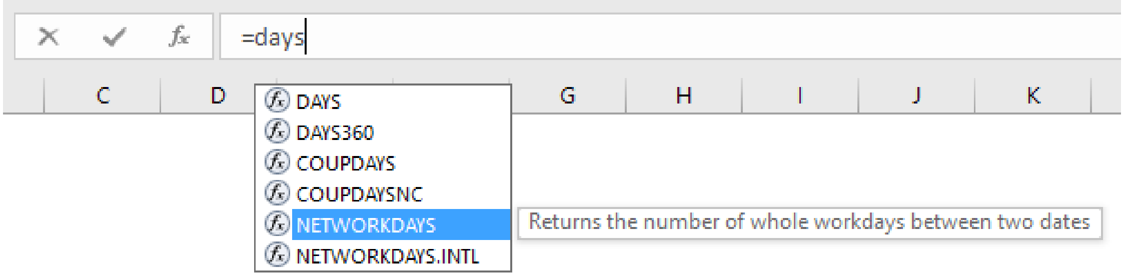
Now this one made me laugh. This is apparently a new feature, but we swear you have been able to do this since the Quick Access Toolbar came out! You can now add these features to the Quick Access Toolbar. Wow.



There you go. If ever there was a business case to go out and buy Excel 2019, that certainly wasn't it…

Improved AutoComplete

Microsoft has improved the AutoComplete functionality in that you no longer need to be so precise to find what you are looking for, *e.g.*


=days

Returns the number of whole workdays between two dates

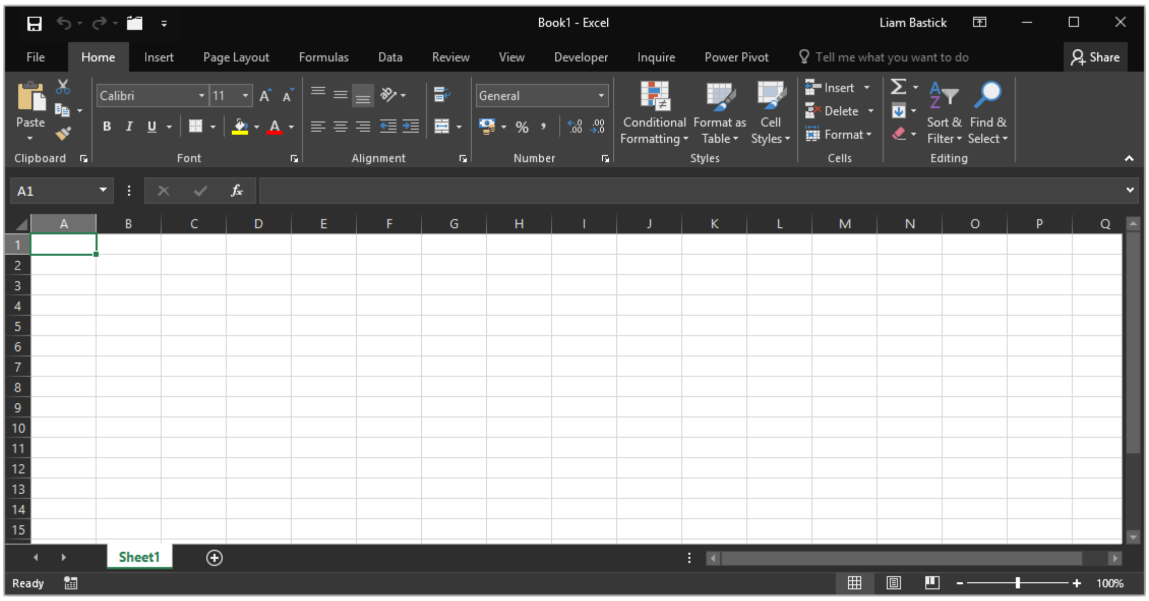
Excel will now look for functions or range names that contain the phrase sought. This will help immensely when you cannot quite remember what it was you are looking for. This one *is* cool.

New Themes

There are now three Office Themes that you can apply: Colorful *(sic)*, Dark Gray and White. To access these themes, go to **File >Options > General**, and then click the drop-down menu next to 'Office Theme'.

Black Theme

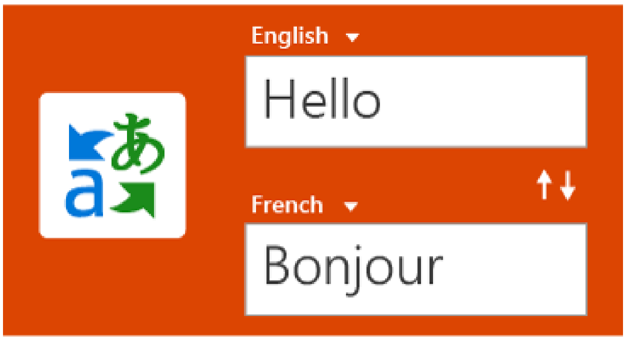
The highest-contrast Office theme yet has arrived. To change your Office theme, go to **File > Account**, and then click the drop-down menu next to Office Theme. The theme you choose will be applied across all your Office apps.



Perfect for hangovers and for reflecting your mood when you have to work late, we originally claimed we weren't quite sure this was going to catch on, but we have seen many clients adopt this. I suppose once you go black you never go back…

Translator

Translate words, phrase, or sentences to another language with Microsoft Translator. You can do this from the 'Review' tab in the Ribbon:



CSV Improvements

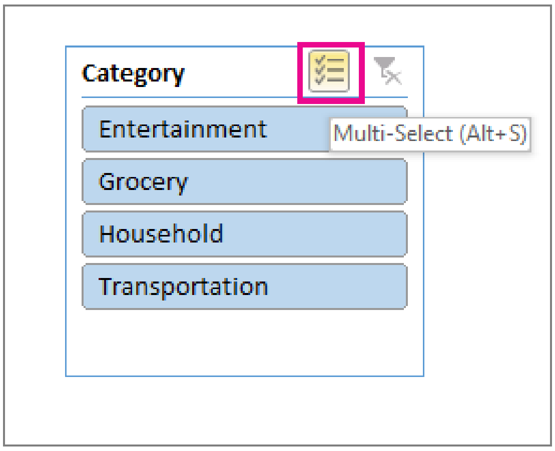
Remember this warning: "This file may contain features that are not compatible with CSV..."? Well, apparently no one wanted it. So Microsoft has got rid of it when you save a CSV file.

Furthermore, you can now open and save CSV files that use UTF-8 character encoding. Go to **File > Save As > Browse**. Then click the 'Save as type' menu, and you'll find the new option for 'CSV UTF-8 (Comma delimited)'. CSV UTF-8 is a commonly used file format that supports more characters than Excel's existing CSV option (ANSI). What does this mean in English? Better support for working with non-English data, and ease of moving data to other applications.

PivotTable Enhancements

PivotTables were enhanced beyond recognition with the advent of Excel 2010 and Excel 2013, and the introduction of Power Pivot and the Data Model, bringing the ability to easily build sophisticated models across your data, augment them with measures and KPIs and then calculate over millions of rows with high speed. But it's not stopped there:

- **Personalise the default PivotTable layout:** you may now set up a PivotTable the way you like. You can choose how you want to display subtotals, grand totals and the report layout, then save it as your default. This means that the next time you create a PivotTable, you will start with that layout
- **Automatic relationship detection:** this feature discovers and creates relationships among the tables used for your workbook's data model, so you don't have to. Excel knows when your analysis requires two or more tables to be linked together and notifies you. With one click, it does the work to build the relationships, so you can take advantage of them immediately
- **Creating, editing, and deleting custom measures:** this may now be done directly from the PivotTable fields list, saving you a lot of time when you need to add additional calculations for your analysis
- **Automatic time grouping:** this helps you to use time-related fields (year, quarter, month) in your PivotTable more powerfully, by auto-detecting and grouping them on your behalf. Once grouped together, simply drag the group to your PivotTable in one action and immediately begin your analysis across the different levels of time with drill-down capabilities
- **PivotChart drill-down buttons:** this allows you to zoom in and out across groupings of time, and other hierarchical structures within your data
- **Search in the PivotTable:** the 'Field list' helps you get to the fields that are important to you across your entire data set
- **Smart renaming:** this gives you the ability to rename tables and columns in your workbook's data model. With each change, Excel automatically updates any related tables, and calculations across your workbook, including all worksheets and DAX formulae. This is quite a welcome improvement as this caused many problems in previous versions of Excel
- **Multi-select Slicer:** you may now select multiple items in an Excel Slicer on a touch device. This is a change from prior versions of Excel, where only one item in a Slicer could be selected at a time using touch input. You can enter Slicer multi-select mode by using the new button located in the Slicer's label

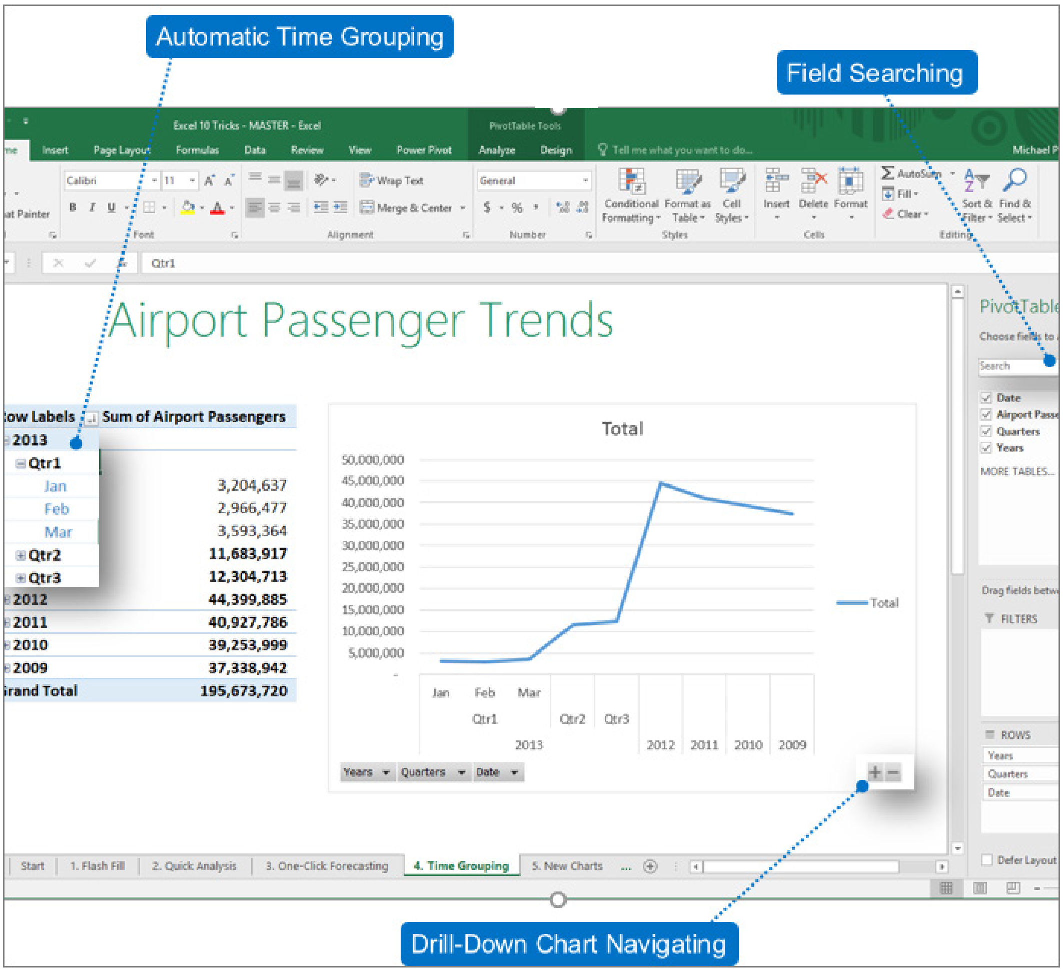


- **Faster OLAP PivotTables:** if you work with connections to online analytical processing (OLAP) servers, your PivotTables are now faster. Excel 2019 contains query and cache improvements in this powerful feature's performance. You could benefit from this work, whether you use PivotTables to answer one-off questions, or build complicated workbooks with dozens of PivotTables. It doesn't matter if your PivotTables are connected to a tabular or multi-dimensional model. Any PivotTable connected to Microsoft SQL Server Analysis Services, third party OLAP providers or the Power Pivot Data Model will likely give you fresh data, faster. Additionally, now if you disable Subtotals and Grand Totals, PivotTables can be much faster when refreshing, expanding, collapsing, and drilling into your data. The bigger the PivotTable, the bigger the potential improvement. Specifically, Excel 2019 offers improvements in three major areas while querying OLAP servers:
    - **Improved query efficiency:** Excel will now query for Subtotals and Grand Totals only if they're required to render the PivotTable results. This means you wait less for the OLAP server to finish processing the query and you wait less while waiting for the results to transfer over your network connection. You simply 'disable Subtotals and Grand Totals' from the 'PivotTable Design' tab just like you would normally
    - **Reduced the number of queries:** Excel is smarter when refreshing your data. Queries will now only refresh when they've actually changed and need to be refreshed
    - **Smarter caches:** when the PivotTable schema is retrieved, it is now shared across all of the PivotTables on that connection, further reducing the number of queries.

Power Pivot Updates

Power Pivot gets a dusting down in Excel 2019 too:

- **Save relationship diagram view as picture:** you may now save the data model diagram view as a high resolution image file that can then be used for sharing, printing or analysing the data model. To create the image file, in the 'Power Pivot' pane, click **File > Save View as Picture**
- **Multiple usability improvements:** these have also been made. For example, delayed updating allows you to perform multiple changes in Power Pivot without the need to wait until each is propagated across the workbook. The changes will be propagated at one time, once the Power Pivot window is closed.


Automatic Time Grouping

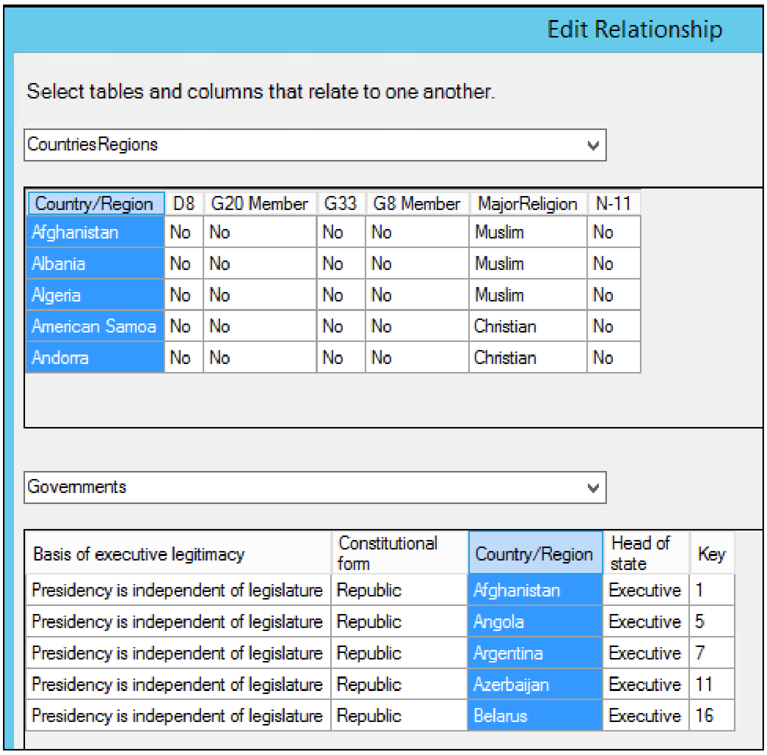
Field Searching

Drill-Down Chart Navigating

Airport Passenger Trends

ow Labels	Sum of Airport Passengers
2013	
Qtr1	
Jan	3,204,637
Feb	2,966,477
Mar	3,593,364
Qtr2	11,683,917
Qtr3	12,304,713
2012	44,399,885
2011	40,927,786
2010	39,253,999
2009	37,338,942
rand Total	195,673,720

- **Enhanced 'Edit Relationship' dialog creates faster and more accurate data relationships:** Power Pivot users can manually add or edit a table relationship while exploring a sample of the data—up to five rows of data in a selected table. This helps create faster and more accurate relationships, without the need to go back and forth to the data view every time you wish to create or edit a table relationship



Edit Relationship

Select tables and columns that relate to one another.

CountriesRegions

Country/Region	D8	G20 Member	G33	G8 Member	MajorReligion	N-11
Afghanistan	No	No	No	No	Muslim	No
Albania	No	No	No	No	Muslim	No
Algeria	No	No	No	No	Muslim	No
American Samoa	No	No	No	No	Christian	No
Andorra	No	No	No	No	Christian	No

Governments

Basis of executive legitimacy	Constitutional form	Country/Region	Head of state	Key
Presidency is independent of legislature	Republic	Afghanistan	Executive	1
Presidency is independent of legislature	Republic	Angola	Executive	5
Presidency is independent of legislature	Republic	Argentina	Executive	7
Presidency is independent of legislature	Republic	Azerbaijan	Executive	11
Presidency is independent of legislature	Republic	Belarus	Executive	16

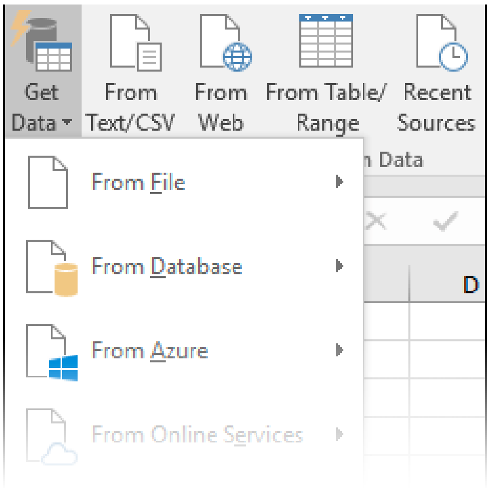
- **Table selection using keyboard navigation:** in the 'Edit Relationship' dialog, type the first letter of a table name to move the first column name starting with the selected letter
- **Column selection using column navigation:** in the 'Edit Relationship' dialog, type the first letter of a column name to move the first column starting with the selected letter. Retype the same letter moves to the next column starting with the selected letter
- **Auto column suggestion for same column name in both tables:** after selecting the first table and column, on the selection of the second table, if a column with the same name exists, it is auto-selected (works both ways)
- **Fixes that improve your overall modelling user experience:**

  1. The Power Pivot data model is no longer lost when working with hidden workbooks
  2. You can now upgrade an earlier workbook with a data model to Excel 2016 and later
  3. You can add a calculated column in Power Pivot, unless it contains a formula.

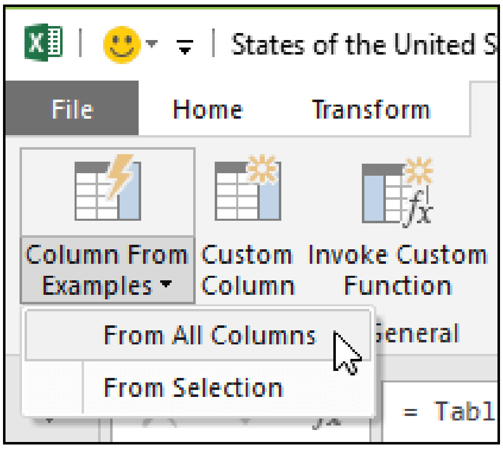
Get & Transform (Power Query)

Improvements have also been made to Get & Transform (also known as Power Query):

- **New and improved connectors:** there are now new connectors in Excel 2019. For example, there's the new SAP HANA connector. Excel 2019 has also improved many of the existing connectors so that you can import data from a variety of sources with efficiency and ease



- **Improved transformations:** in Excel 2019, Microsoft has significantly improved many of the data transformation features in the Power Query Editor. For example, splitting columns, inserting custom columns, adding columns from an example, merge and append operations, and filtering transforms have been improved / enhanced



- **General improvements:** Excel 2019 also has some general improvements across the Get & Transform area in Excel 2019. One notable improvement is the new 'Queries & Connections' side pane, which lets you manage queries and connections easily. There are also many improvements to the Power Query Editor as well, including "select-as-you-type" drop-down menus, date picker support for date filters and conditional columns, the ability to reorder query steps via drag-and-drop and the ability to keep the layout in Excel when refreshing.

Publish to Power BI

If you have a Power BI subscription, you can now publish files that are stored locally to Power BI. To get started, first save your file to your computer. Then click **File > Publish > Publish to Power BI**. After you upload, you can click the 'Go To Power BI button' to see the file in your web browser.

Finally, one thing to stress. Excel 2019 is what is known as a "perpetual licence". Microsoft will update for security features and so forth but new features – described here in past newsletters – such as Dynamic Array functions will <u>**not**</u> be included down the road. It's likely you will have to wait until Office 2022 (assuming such a thing will exist) as Microsoft tries to convert everyone to the annual subscription model.

Operators: Horsing Around with the CART

Operators specify the type of calculation that you want to perform on the elements of a formula. They are essentially the smallest building blocks of a calculation – even most functions are based upon these humble specifiers.

There are four types of operator altogether: Comparison, Arithmetic, Reference and Text – think **CART**. In this newsletter, we take a look at these four types. Think you know everything you need to know? Let's see…

Comparison Operators

These operators are used to compare one expression with another, as long as these expressions evaluate to values. When two values are compared by these operators, the result is a logical value, *i.e.* either TRUE or FALSE.

Comparison Operator	Meaning	Example	Comments
= (equals sign)	Equal to	A1=B1	Whilst all formulae begin with an equals sign, the actual '=' here is seeking value equivalency. The two values must be precisely equal
> (greater than sign)	Greater than	A1>B1	This is what mathematics calls a <u>strict</u> inequality. The two values must not equal each other
< (less than sign)	Less than	A1<B1	Another strict inequality
>= (greater than or equals sign)	Greater than or equal to	A1>=B1	This is what mathematics refers to as an inequality (*i.e.* values must not be equal).
<= (less than or equals sign)	Less than or equal to	A1<=B1	Another inequality
<> (not equal to sign)	Not equal to	A1<>B1	Many modellers appear unaware of this notation and use the function NOT(A1=B1) instead. This syntax is less efficient

As mentioned in the table above, the equals operator is used to denote a formula in Excel. It essentially communicates to Excel what the value of the cell should equal.

There are two common mistakes made by less experienced Excel users:

1. Some modellers write 'greater than or equal to' as '=>' rather than '>=' (and similarly with 'less than or equal to'). Be sure Excel will advise you of such an error with the 'We found a typo' dialog box or similar.
2. The opposite of '>' (greater than) is not '<' (less than). It is in fact '<=' (less than or equal to). Be careful any logic you employ in a model allows for the two values to be identical.

Arithmetic Operators

I once saw a brilliant typo on a website describing these type of operators as 'arthritic operators'. AutoCorrect is such a wonderful tool. It's a good job my spelling is sew grate or I may have create similar errors. Whilst it is true these operators probably represent the oldest and most readily recognisable operators, they don't need pensioning off just yet!

Arithmetic Operator	Meaning	Example	Comments
+ (plus sign)	Add	A1+B1	Whilst all formulae begin with an equals sign, the actual '=' here is seeking value equivalency. The two values must be precisely equal
- (minus sign)	Subtract Negate	A1-B1 -A1	This is what mathematics calls a strict inequality. The two values must not equal each other
*** (asterisk sign)**	Multiply	A1*B1	Another strict inequality
/ (forward slash)	Divide	A1/B1	This is what mathematics refers to as an inequality (*i.e.* values must not be equal).
% (per cent symbol)	Percent	30%	Another inequality
^ (caret symbol)	Raises to a power, often referred to as exponentiation	2^4 is 2*2*2*2	Many modellers appear unaware of this notation and use the function NOT(A1=B1) instead. This syntax is less efficient

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Arithmetic Operator	Meaning	Example	Comments
+ (plus sign)	Add	A1+B1	Some modellers begin formulae with a + symbol. This only adds an additional unnecessary character as Excel will automatically include the equals sign
- (minus sign)	Subtract Negate	A1-B1 -A1	This operator serves two purposes, either subtracting one value from another, or else converting positive values to negative ones and *vice versa*

*** (asterisk sign)**	Multiply	A1*B1	This is not Asterix. That’s a cartoon character
/ (forward slash)	Divide	A1/B1	Be careful to use the forward slash rather than the backslash
% (per cent symbol)	Percent	30%	This effectively divides numbers (rather than references) by 100
^ (caret symbol)	Raises to a power, often referred to as exponentiation	2^4 is 2*2*2*2	Care should be taken if the number raised to a power is not positive

These are the operators everyone considers to be operators. However, familiarity may breed contempt and there are potential pitfalls / tips to watch out for:

1. It has been proved by greater minds than mine that using a double minus (*e.g.* **=--A1**) is the quickest way to convert a number stored as text into a number. This beats multiplying by 1 or using the **VALUE** function apparently.
2. Some modellers add a zero before negating a value or cell reference. For example, they may use the formula **=0-A1** rather than **=-A1** as they argue it is easier to see that the value has been negated (tired eyes may easily miss the minus sign).
3. Take care with the forward slash (‘/’) for dividing. Some users accidentally use backslashes. Not only may this result in an attempted murder, the backslash (‘\’) is used to refer to file locations or even act as the **ALT** button in certain versions of Excel depending upon user settings.
4. I recommend avoiding the per cent sign (‘%’) altogether and simply divide by 100 instead. Whilst having hard coded values in a formula should be avoided, there are greater perils risked here. The ‘%’ symbol can cause problems in certain formulae and DAX (Power Pivot) expressions when shared on the internet or SharePoint as % is often used to refer to a space in a URL for example.
5. Raising a number to a power needs to be undertaken carefully. Not only can numbers get large very quickly (Excel seems to cope with the number 10^308 if typed in but the number 1.7976931348623158 x 10^308 if calculated!), but some powers may not be evaluated as real numbers. For example, -1^0.5 attempts to evaluate the square root of -1 which is an imaginary number in mathematics (Excel does not know that *i* or *j*, depending upon notation, is the square root of -1).

Reference Operators

These operators are used to combine values and / or ranges for calculations in Excel.

Reference Operator	Meaning	Example	Comments
: (colon symbol)	Range operator, which produces one reference to all of the cells between two references, including the two references themselves	A1:B10	Ranges do not have to be just for one row or column
, (comma)	Union operator, combining multiple references into one reference	SUM(A1,B2,C3)	For touch typists: don’t add spaces after a comma (see below)
‘ ’ (space)	Intersect operator, which produces a reference to cells common to the two references	A1:C3 B3:B8	B3 is common to both ranges here

Most users are unaware of the space operator. Space may be the final frontier, but hitting the spacebar may inadvertently cause Excel to try and intersect ranges. Be careful as many Microsoft Help examples are blighted by the proliferation of these pesky spaces in formulae.

Text Operator

Like Highlander, there can be only one.

Text Operator	Meaning	Example	Comments
& (ampersand symbol)	Connects, or concatenates, two values to produce one continuous text value	=”The value in cell A1 is “&A1	Be careful to include spaces in text so that values do not ‘crash’ into each other

Similar to the **CONCATENATE** function, ‘&’ is useful for connecting segments together. Each segment must make sense on its own: an open bracket must be followed by a close bracket, open quotation marks require closed quotation marks later and so on.

Order of Operations

But it's not as simple as just picking out an operator. Sometimes we need to combine them – and unfortunately, they do not mix in the order we might think.

At school, many of us are taught a variant of **BoDMAS**, which stipulates the order of calculations in a mathematical expression. The order is:

1. **Brackets:** items in brackets are calculated first
2. **Powers:** values are raised exponentially second
3. **Division:** values are divided third
4. **Multiplication:** values are multiplied fourth
5. **Addition:** values are added fifth
6. **Subtraction:** values are deducted from each other last.

Therefore, an expression such as

=3+8^2x5+(4/7+8)-5+9

evaluates to 335.57, when several other values may be calculated otherwise without this rule. The problem is, this may be the way we have been brought up to calculate, but Excel was taught a subtly different order which sometimes leads to formulaic errors as a consequence.

Finding the correct order of operations in Excel is tricky but I reproduce the order here:

Order	Type of Operator	Example(s)
1	Brackets or parentheses *Not strictly operators, but they force the order of operations*	([open bracket symbol] and) [closed bracket symbol]
2	Reference operators	: (colon symbol) ' ' (single space) , (comma)
3	Negation (not subtraction), *i.e.* effectively multiplying by -1	- (minus sign)
4	Per cent	% (per cent symbol)
5	Exponentiation (raising to a power)	^ (caret symbol)
6	Multiplication and division (reading from left to right, not that this matters as these operations are mathematically associative)	* (asterisk sign) and / (forward slash)
7	Addition and subtraction (again, associative)	+ (plus sign) and - (minus sign)
8	Text operator	& (ampersand symbol)
9	Comparison operators	= (equals sign) <> (not equal to sign) *etc.*

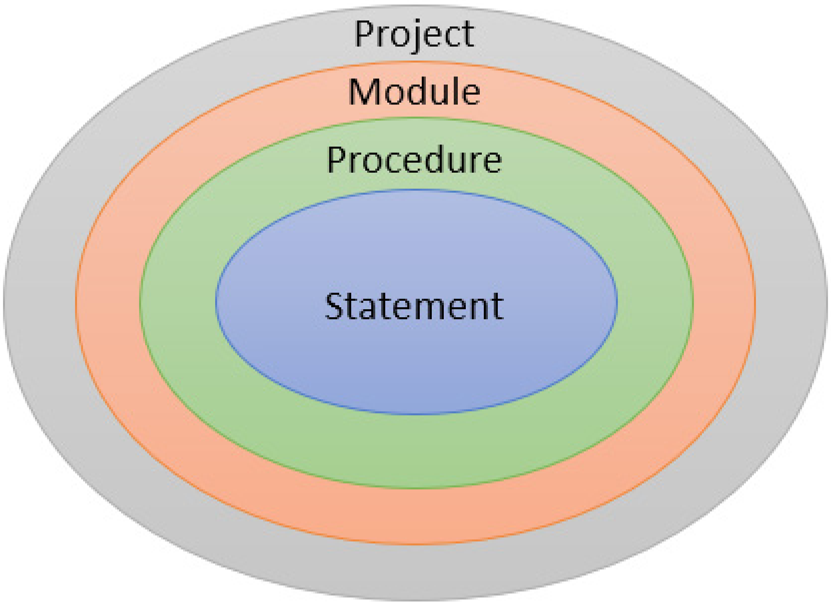
Do you see the slight differences? Negating in general (essentially multiplying by -1) and dividing by 100 (per cent) will both be computed ahead of exponentiation. This may not be what you expect.

I strongly recommend that you take a look at some of your more complex formulae. Stepping out calculations not only makes logic easier to follow but also ensures that computations are executed in the desired order. If all else fails, inserting brackets, like Star Wars, will "use the Force".

Visual Basics

It's not all about the Power Tools, you know. We thought we'd run a new elementary series going through the rudiments of Visual Basic for Applications (VBA) as a springboard for newer users. This month, we actually at the basic principles of VBA.

Macros are organised and stored in the following way in VBA. The following common items are the principal components we need to know.



- **A statement** is a single command or action in a macro – that is, it's a line of code. For example, **Range("B3").Select** is a statement. If we think of VBA as a language, think of a statement as a sentence
- A **procedure** is, essentially, another way of referring to a macro, although there are other types of procedures as well, such as **functions**. A function is a procedure that returns a result
- A **module** is a collection of code. Think of a module as a code document. A module can contain several procedures. Like documents, modules can be saved as files, copied and shared

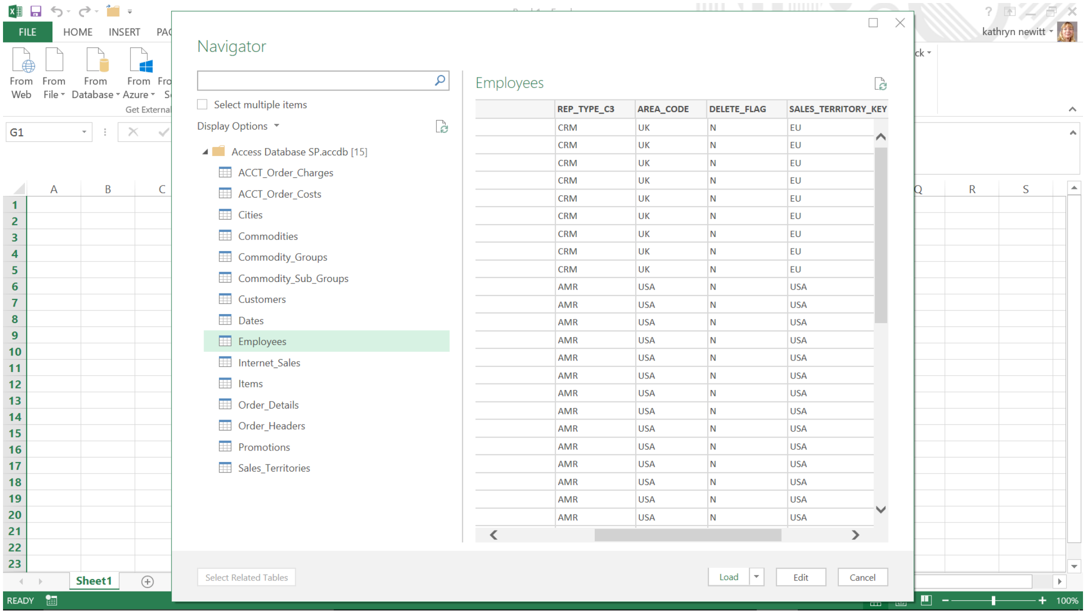
A **project** is the collection of all modules and related VBA objects in our document, template or add-in. A project might have one or several modules, as well as other elements such as UserForms (dialog boxes).

More next month.

Power Query Pointers

Each month we'll reproduce one of our articles on Power Query (Excel 2010 and 2013) / Get & Transform (Excel 2016) from www.sumproduct.com/blog. If you wish to read more in the meantime, simply check out our Blog section each Wednesday. This month, we look at simple manipulation of table data.

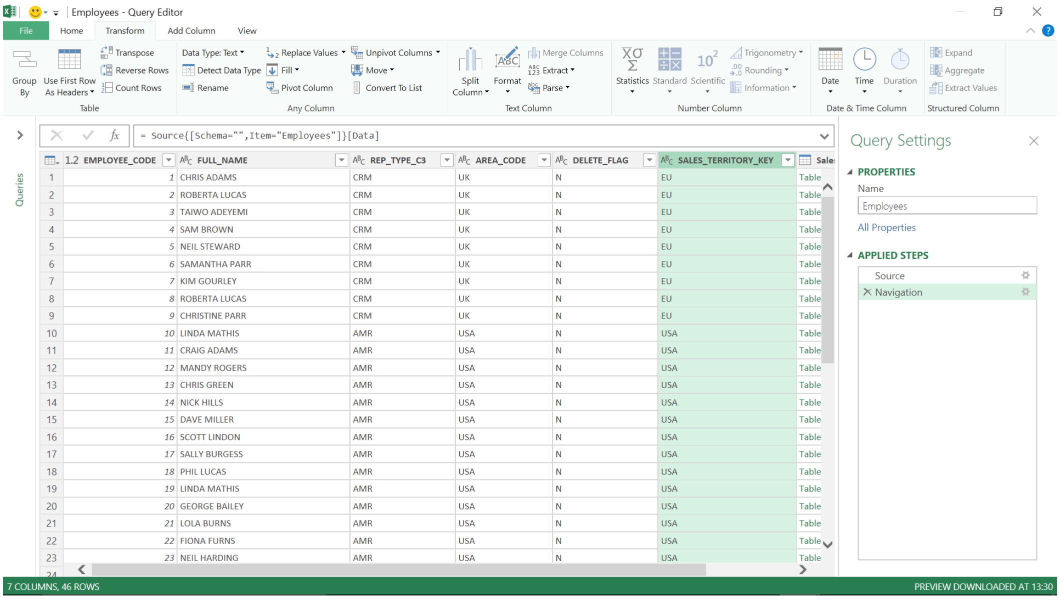
Whilst creating data to use for training and blogs, the team has spent significant time manipulating data in a Microsoft Access database. It is however possible to do much of this transforming in Power Query and this month we take a look at a simple example. We have a table 'Employees' which sits in our database, and we will extract it to Power Query in order to make some changes:



Employees

	REP_TYPE_C3	AREA_CODE	DELETE_FLAG	SALES_TERRITORY_KEY
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	CRM	UK	N	EU
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA
	AMR	USA	N	USA

We have a list of employees, and they are each allocated an area and a sales territory. However, thinking ahead here, and thanks to 52% of voting UK citizens, the UK will soon no longer be in the European Union. We need to change the data to show UK instead of EU in the sales territory. Let's begin by editing the query.



```
= Source{[Schema="",Item="Employees"]}[Data]
```

	EMPLOYEE_CODE	FULL_NAME	REP_TYPE_C3	AREA_CODE	DELETE_FLAG	SALES_TERRITORY_KEY	Sale
1	1	CHRIS ADAMS	CRM	UK	N	EU	Table
2	2	ROBERTA LUCAS	CRM	UK	N	EU	Table
3	3	TAIWO ADEYEMI	CRM	UK	N	EU	Table
4	4	SAM BROWN	CRM	UK	N	EU	Table
5	5	NEIL STEWARD	CRM	UK	N	EU	Table
6	6	SAMANTHA PARR	CRM	UK	N	EU	Table
7	7	KIM GOURLEY	CRM	UK	N	EU	Table
8	8	ROBERTA LUCAS	CRM	UK	N	EU	Table
9	9	CHRISTINE PARR	CRM	UK	N	EU	Table
10	10	LINDA MATHIS	AMR	USA	N	USA	Table
11	11	CRAIG ADAMS	AMR	USA	N	USA	Table
12	12	MANDY ROGERS	AMR	USA	N	USA	Table
13	13	CHRIS GREEN	AMR	USA	N	USA	Table
14	14	NICK HILLS	AMR	USA	N	USA	Table
15	15	DAVE MILLER	AMR	USA	N	USA	Table
16	16	SCOTT LINDON	AMR	USA	N	USA	Table
17	17	SALLY BURGESS	AMR	USA	N	USA	Table
18	18	PHIL LUCAS	AMR	USA	N	USA	Table
19	19	LINDA MATHIS	AMR	USA	N	USA	Table
20	20	GEORGE BAILEY	AMR	USA	N	USA	Table
21	21	LOLA BURNS	AMR	USA	N	USA	Table
22	22	FIONA FURNS	AMR	USA	N	USA	Table
23	23	NEIL HARDING	AMR	USA	N	USA	Table

Query Settings

PROPERTIES

Name: Employees

All Properties

APPLIED STEPS

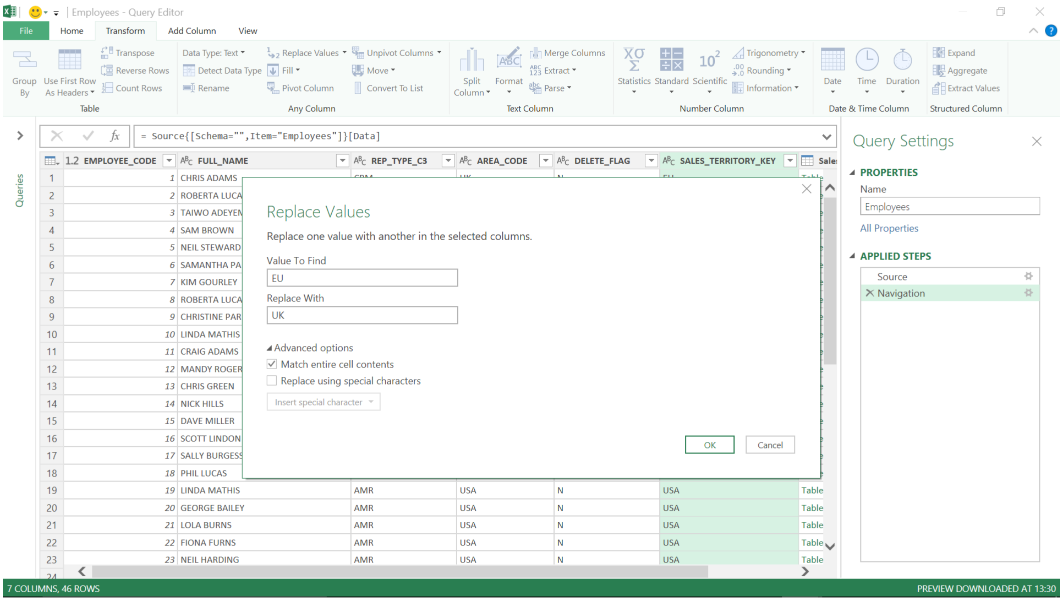
Source

Navigation

7 COLUMNS, 46 ROWS

PREVIEW DOWNLOADED AT 13:30

With the ***SALES_TERRITORY_KEY*** column highlighted, go to the 'Transform' Menu and choose to 'Replace Values':



```
= Source{[Schema="",Item="Employees"]}[Data]
```

	EMPLOYEE_CODE	FULL_NAME	REP_TYPE_C3	AREA_CODE	DELETE_FLAG	SALES_TERRITORY_KEY	Sale
1	1	CHRIS ADAMS					
2	2	ROBERTA LUCA					
3	3	TAIWO ADEYEN					
4	4	SAM BROWN					
5	5	NEIL STEWARD					
6	6	SAMANTHA PA					
7	7	KIM GOURLEY					
8	8	ROBERTA LUCA					
9	9	CHRISTINE PAR					
10	10	LINDA MATHIS					
11	11	CRAIG ADAMS					
12	12	MANDY ROGER					
13	13	CHRIS GREEN					
14	14	NICK HILLS					
15	15	DAVE MILLER					
16	16	SCOTT LINDON					
17	17	SALLY BURGESS					
18	18	PHIL LUCAS					
19	19	LINDA MATHIS	AMR	USA	N	USA	Table
20	20	GEORGE BAILEY	AMR	USA	N	USA	Table
21	21	LOLA BURNS	AMR	USA	N	USA	Table
22	22	FIONA FURNS	AMR	USA	N	USA	Table
23	23	NEIL HARDING	AMR	USA	N	USA	Table

Replace Values

Replace one value with another in the selected columns.

Value To Find: EU

Replace With: UK

Advanced options

☑ Match entire cell contents

□ Replace using special characters

Insert special character

OK | Cancel

Query Settings

PROPERTIES

Name: Employees

All Properties

APPLIED STEPS

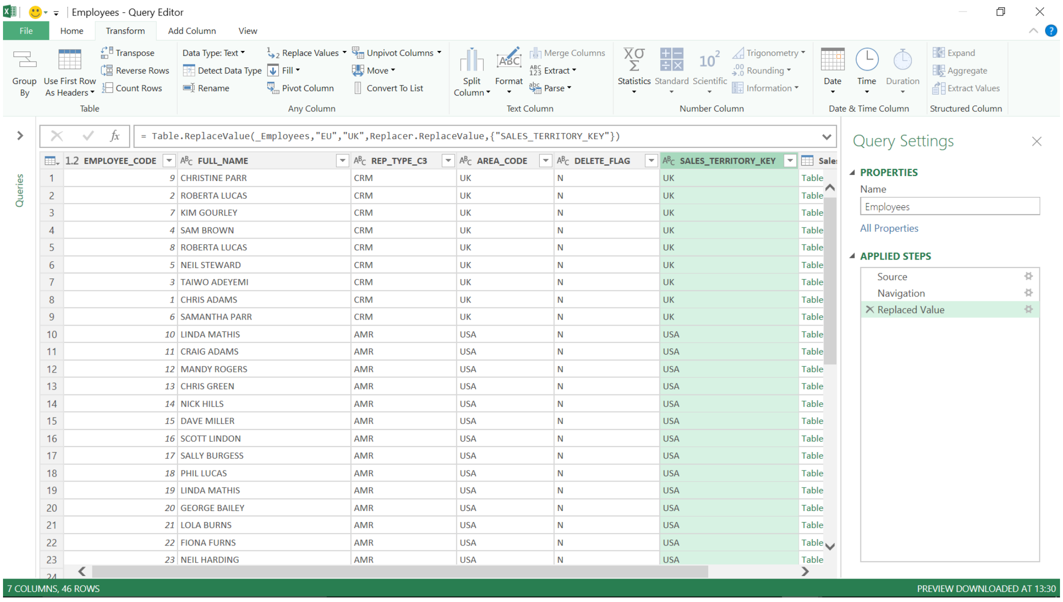
Source

Navigation

7 COLUMNS, 46 ROWS

PREVIEW DOWNLOADED AT 13:30

We will enter values such that 'EU' may be replaced with the new value 'UK'. Let's use the 'Advanced Options' to match the entire cell to make sure we don't inadvertently pick up some other region with an 'EU' in it. It might be best to have some conditional logic in this box in future updates of Power Query but for now, it's an absolute replacement of all values. Press 'OK' and…



```
= Table.ReplaceValue(_Employees,"EU","UK",Replacer.ReplaceValue,{"SALES_TERRITORY_KEY"})
```

	EMPLOYEE_CODE	FULL_NAME	REP_TYPE_C3	AREA_CODE	DELETE_FLAG	SALES_TERRITORY_KEY	Sale
1	9	CHRISTINE PARR	CRM	UK	N	UK	Table
2	2	ROBERTA LUCAS	CRM	UK	N	UK	Table
3	7	KIM GOURLEY	CRM	UK	N	UK	Table
4	4	SAM BROWN	CRM	UK	N	UK	Table
5	8	ROBERTA LUCAS	CRM	UK	N	UK	Table
6	5	NEIL STEWARD	CRM	UK	N	UK	Table
7	3	TAIWO ADEYEMI	CRM	UK	N	UK	Table
8	1	CHRIS ADAMS	CRM	UK	N	UK	Table
9	6	SAMANTHA PARR	CRM	UK	N	UK	Table
10	10	LINDA MATHIS	AMR	USA	N	USA	Table
11	11	CRAIG ADAMS	AMR	USA	N	USA	Table
12	12	MANDY ROGERS	AMR	USA	N	USA	Table
13	13	CHRIS GREEN	AMR	USA	N	USA	Table
14	14	NICK HILLS	AMR	USA	N	USA	Table
15	15	DAVE MILLER	AMR	USA	N	USA	Table
16	16	SCOTT LINDON	AMR	USA	N	USA	Table
17	17	SALLY BURGESS	AMR	USA	N	USA	Table
18	18	PHIL LUCAS	AMR	USA	N	USA	Table
19	19	LINDA MATHIS	AMR	USA	N	USA	Table
20	20	GEORGE BAILEY	AMR	USA	N	USA	Table
21	21	LOLA BURNS	AMR	USA	N	USA	Table
22	22	FIONA FURNS	AMR	USA	N	USA	Table
23	23	NEIL HARDING	AMR	USA	N	USA	Table

Query Settings

PROPERTIES

Name: Employees

All Properties

APPLIED STEPS

Source

Navigation

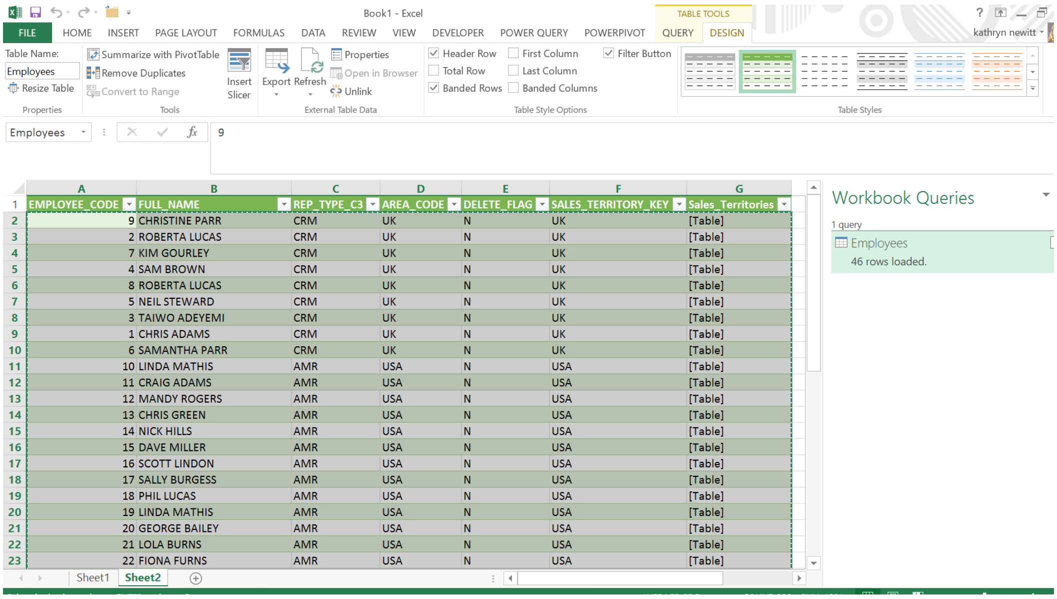
Replaced Value

7 COLUMNS, 46 ROWS

PREVIEW DOWNLOADED AT 13:30

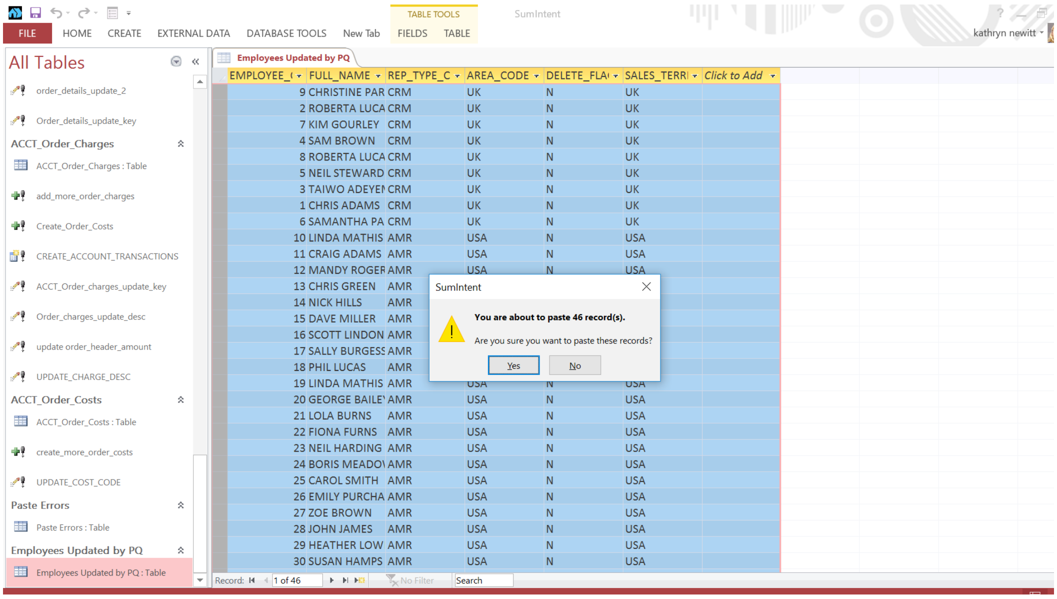
Instantaneously, the UK is out of the EU (it's a shame it won't be this simple outside of Power Query!).

Next, close and load the query:



	A	B	C	D	E	F	G
1	EMPLOYEE_CODE	FULL_NAME	REP_TYPE_C3	AREA_CODE	DELETE_FLAG	SALES_TERRITORY_KEY	Sales_Territories
2	9	CHRISTINE PARR	CRM	UK	N	UK	[Table]
3	2	ROBERTA LUCAS	CRM	UK	N	UK	[Table]
4	7	KIM GOURLEY	CRM	UK	N	UK	[Table]
5	4	SAM BROWN	CRM	UK	N	UK	[Table]
6	8	ROBERTA LUCAS	CRM	UK	N	UK	[Table]
7	5	NEIL STEWARD	CRM	UK	N	UK	[Table]
8	3	TAIWO ADEYEMI	CRM	UK	N	UK	[Table]
9	1	CHRIS ADAMS	CRM	UK	N	UK	[Table]
10	6	SAMANTHA PARR	CRM	UK	N	UK	[Table]
11	10	LINDA MATHIS	AMR	USA	N	USA	[Table]
12	11	CRAIG ADAMS	AMR	USA	N	USA	[Table]
13	12	MANDY ROGERS	AMR	USA	N	USA	[Table]
14	13	CHRIS GREEN	AMR	USA	N	USA	[Table]
15	14	NICK HILLS	AMR	USA	N	USA	[Table]
16	15	DAVE MILLER	AMR	USA	N	USA	[Table]
17	16	SCOTT LINDON	AMR	USA	N	USA	[Table]
18	17	SALLY BURGESS	AMR	USA	N	USA	[Table]
19	18	PHIL LUCAS	AMR	USA	N	USA	[Table]
20	19	LINDA MATHIS	AMR	USA	N	USA	[Table]
21	20	GEORGE BAILEY	AMR	USA	N	USA	[Table]
22	21	LOLA BURNS	AMR	USA	N	USA	[Table]
23	22	FIONA FURNS	AMR	USA	N	USA	[Table]

We may put our updated employee data into the Access database if we so choose. We can create a new empty copy of the 'Employees' table called 'Employees Updated by PQ' and paste our data in.



You are about to paste 46 record(s).

Are you sure you want to paste these records?

EMPLOYEE_(	FULL_NAME	REP_TYPE_C	AREA_CODE	DELETE_FLA(	SALES_TERRI	Click to Add
9	CHRISTINE PAR	CRM	UK	N	UK	
2	ROBERTA LUCA	CRM	UK	N	UK	
7	KIM GOURLEY	CRM	UK	N	UK	
4	SAM BROWN	CRM	UK	N	UK	
8	ROBERTA LUCA	CRM	UK	N	UK	
5	NEIL STEWARD	CRM	UK	N	UK	
3	TAIWO ADEYEI	CRM	UK	N	UK	
1	CHRIS ADAMS	CRM	UK	N	UK	
6	SAMANTHA PA	CRM	UK	N	UK	
10	LINDA MATHIS	AMR	USA	N	USA	
11	CRAIG ADAMS	AMR	USA	N	USA	
12	MANDY ROGER	AMR	USA	N	USA	
13	CHRIS GREEN	AMR				
14	NICK HILLS	AMR				
15	DAVE MILLER	AMR				
16	SCOTT LINDON	AMR				
17	SALLY BURGESS	AMR				
18	PHIL LUCAS	AMR				
19	LINDA MATHIS	AMR	USA	N	USA	
20	GEORGE BAILE'	AMR	USA	N	USA	
21	LOLA BURNS	AMR	USA	N	USA	
22	FIONA FURNS	AMR	USA	N	USA	
23	NEIL HARDING	AMR	USA	N	USA	
24	BORIS MEADO\	AMR	USA	N	USA	
25	CAROL SMITH	AMR	USA	N	USA	
26	EMILY PURCHA	AMR	USA	N	USA	
27	ZOE BROWN	AMR	USA	N	USA	
28	JOHN JAMES	AMR	USA	N	USA	
29	HEATHER LOW	AMR	USA	N	USA	
30	SUSAN HAMPS	AMR	USA	N	USA	

The data is now updated and ready to use.

More next month!

November Updates for Power BI Desktop

Perhaps a few less updates than in recent months, but that's to be expected and there's still enough to keep you on your toes! Here's the full run down of the November updates:

Reporting

- Expand and collapse matrix row headers
- Copy and paste between Power BI Desktop files
- Updated filtering experience (Preview)
- Report accessibility improvements

Analytics

- Colour saturation on visuals upgraded to use conditional formatting
- Follow-up questions in the Q&A explorer

Modelling

- New modelling view (Preview)
- Composite models now Generally Available
- Modeling accessibility improvements
- New DAX functions

Custom Visuals

- Calendar by MAQ Software
- Ratings by MAQ Software
- Hourglass Chart by MAQ Software
- Forecast Using Multiple Models by MAQ Software
- Pie Charts Tree

Data Connectivity

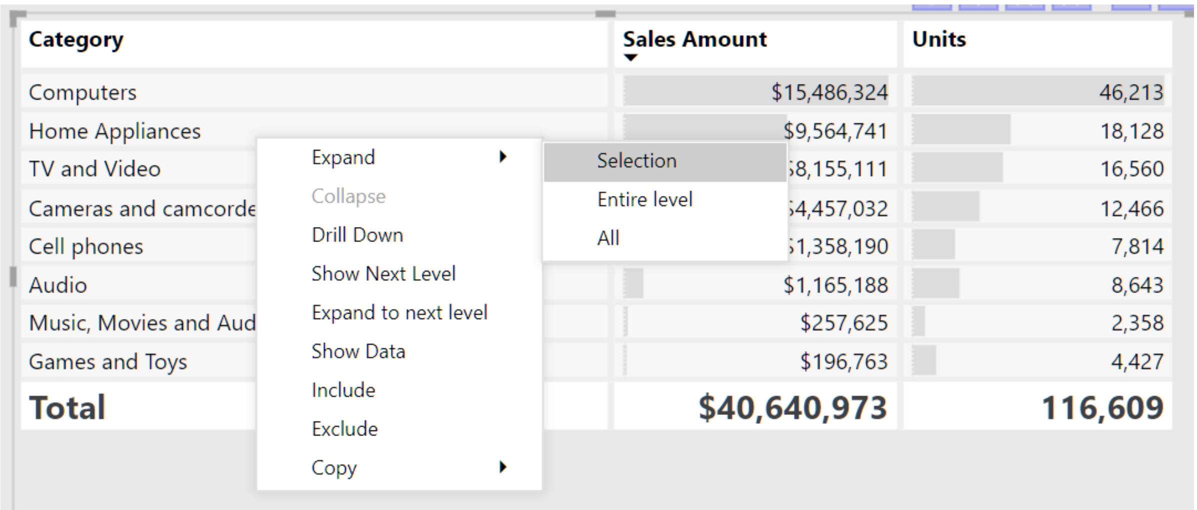
- Azure DevOps Server connector
- PDF Connector support for Start Page and End Page parameters
- Improved Azure Consumption Insights connector.

Let's go through each new feature in turn.

Expand and collapse matrix row headers

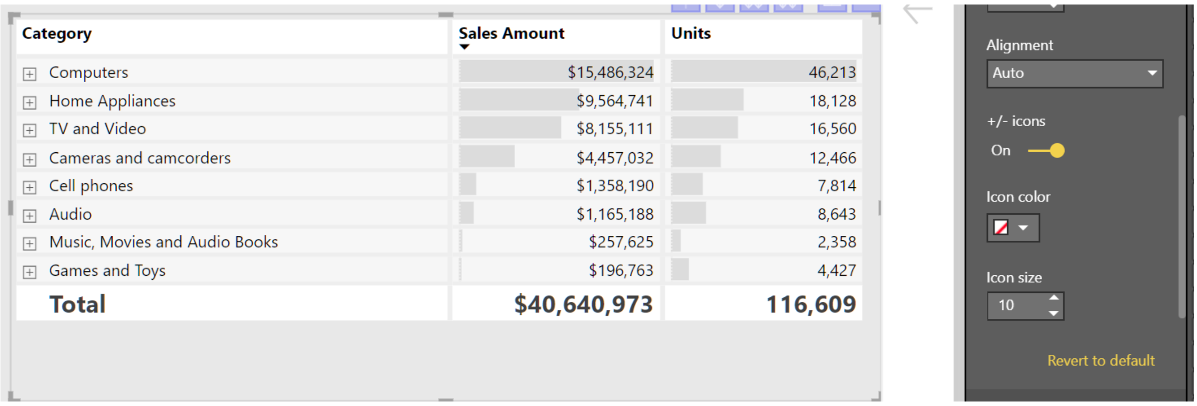
This update provides you with the ability to expand and collapse individual row headers. There are two ways you can expand row headers.

The first method is through the right-click menu. You'll see options to expand the specific row header you clicked on, the entire level or everything down to the very last level of the hierarchy. You have similar options for collapsing row headers as well.



Category	Sales Amount	Units
Computers	$15,486,324	46,213
Home Appliances	$9,564,741	18,128
TV and Video	8,155,111	16,560
Cameras and camcorde	4,457,032	12,466
Cell phones	1,358,190	7,814
Audio	$1,165,188	8,643
Music, Movies and Aud	$257,625	2,358
Games and Toys	$196,763	4,427
Total	$40,640,973	116,609

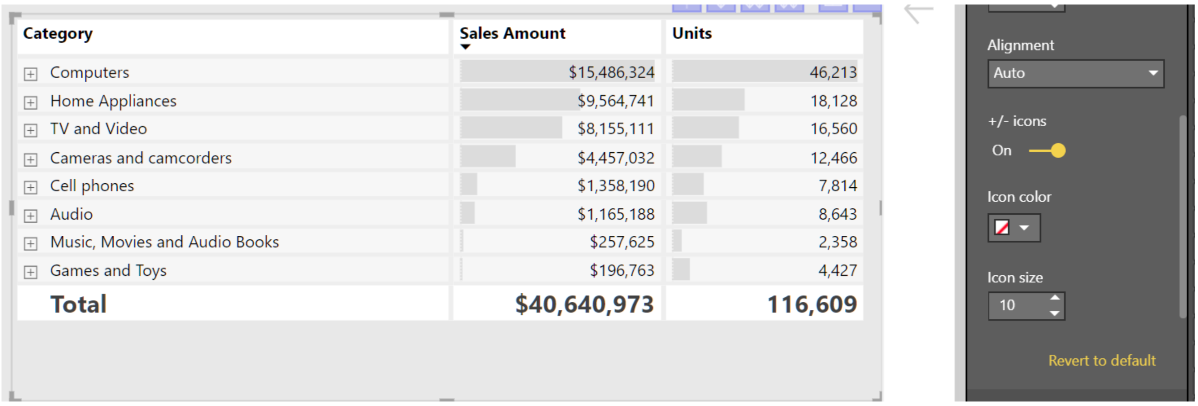
The second method is to add + / - buttons to the row headers through the 'Formatting' pane under the 'Row Headers' card. By default, the icons will match the formatting of the row header, but you may customise the icons' colours and sizes separately should you wish.



Category	Sales Amount	Units
⊞ Computers	$15,486,324	46,213
⊞ Home Appliances	$9,564,741	18,128
⊞ TV and Video	$8,155,111	16,560
⊞ Cameras and camcorders	$4,457,032	12,466
⊞ Cell phones	$1,358,190	7,814
⊞ Audio	$1,165,188	8,643
⊞ Music, Movies and Audio Books	$257,625	2,358
⊞ Games and Toys	$196,763	4,427
Total	$40,640,973	116,609

Alignment: Auto
+/- icons: On
Icon color
Icon size: 10

Once the icons are turned on, they work similarly to the icons from PivotTables in Excel.



Category	Sales Amount	Units
⊞ Computers	$15,486,324	46,213
⊞ Home Appliances	$9,564,741	18,128
⊞ TV and Video	$8,155,111	16,560
⊞ Cameras and camcorders	$4,457,032	12,466
⊞ Cell phones	$1,358,190	7,814
⊞ Audio	$1,165,188	8,643
⊞ Music, Movies and Audio Books	$257,625	2,358
⊞ Games and Toys	$196,763	4,427
Total	$40,640,973	116,609

Alignment: Auto

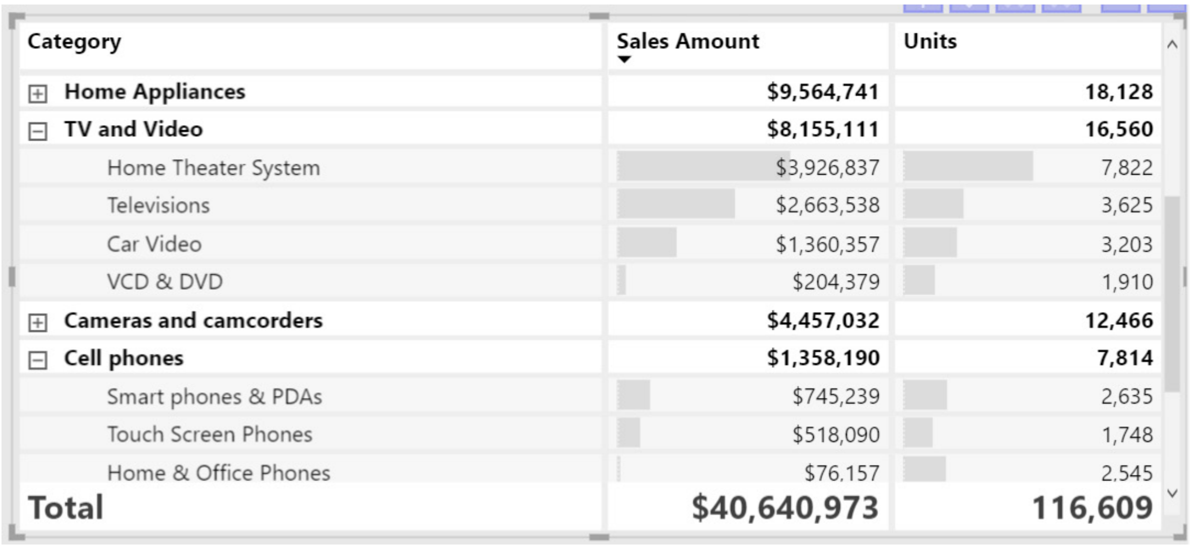
+/- icons: On

Icon color

Icon size: 10

Revert to default

Once the icons are turned on, they work similarly to the icons from PivotTables in Excel.

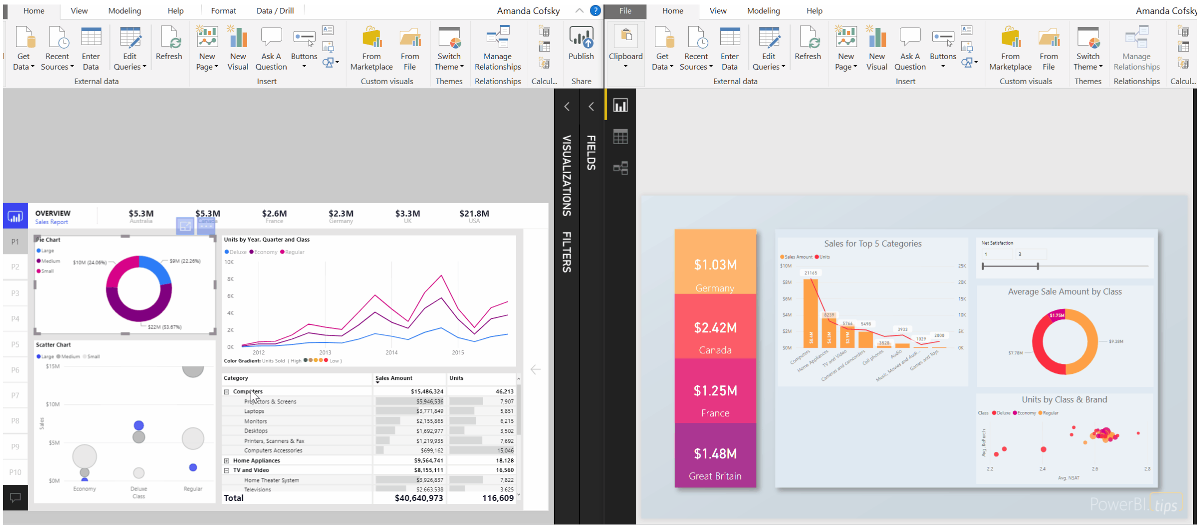


Category	Sales Amount	Units
⊞ Home Appliances	$9,564,741	18,128
⊟ TV and Video	$8,155,111	16,560
Home Theater System	$3,926,837	7,822
Televisions	$2,663,538	3,625
Car Video	$1,360,357	3,203
VCD & DVD	$204,379	1,910
⊞ Cameras and camcorders	$4,457,032	12,466
⊟ Cell phones	$1,358,190	7,814
Smart phones & PDAs	$745,239	2,635
Touch Screen Phones	$518,090	1,748
Home & Office Phones	$76,157	2,545
Total	$40,640,973	116,609

The expansion state of the matrix will save with your report. It can be pinned to dashboards as well, but consumers will need to open up the report to change the state. It should be noted though that conditional formatting will only apply to the inner most visible level of the hierarchy.

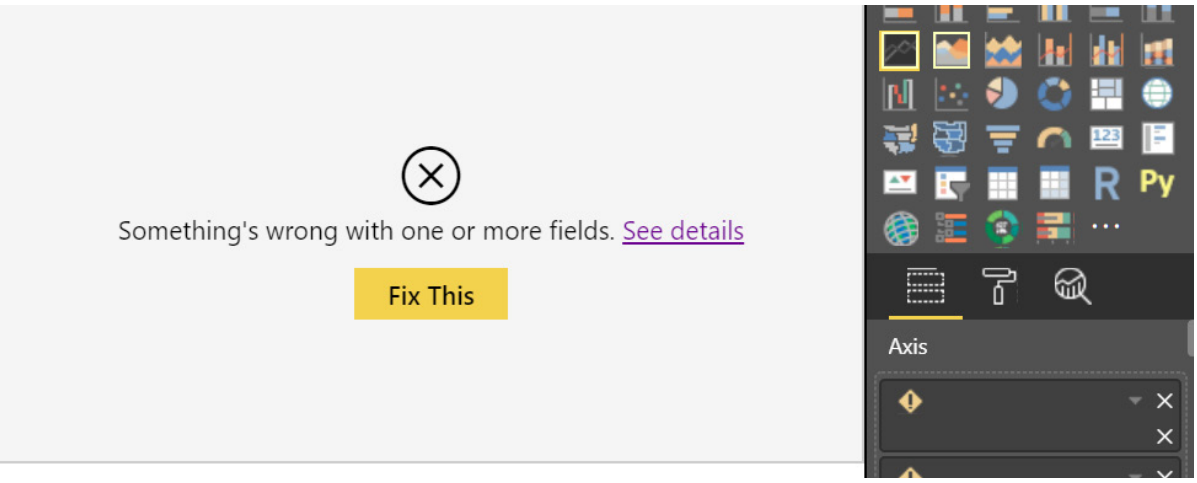
Copy and paste between Power BI Desktop files

These latest updates also allow you to copy visuals between .pbix files. This means you may now copy a visual either through the visual's context menu or through the standard **CTRL + C** keyboard shortcut and paste it into another report through **CTRL + V**.



This is very useful if you build and update multiple reports frequently. When copying between files, formatting that has been explicitly set in the formatting pane will carry forward, and anything that is relying on a theme or the default settings will update to match the theme of the destination report.

If the fields in your model are different, you'll see an error on the visual and a warning on the fields that don't exist, similar to what you would see if you were to delete a field in the model that a visual is using. All you'll need to do is replace the broken fields with the ones you want to use from the new model. If you are using a custom visual, you'll also need to import it to the destination file as well.


Something's wrong with one or more fields. See details

If only you could get a 'Fix This' button for life in general, eh?

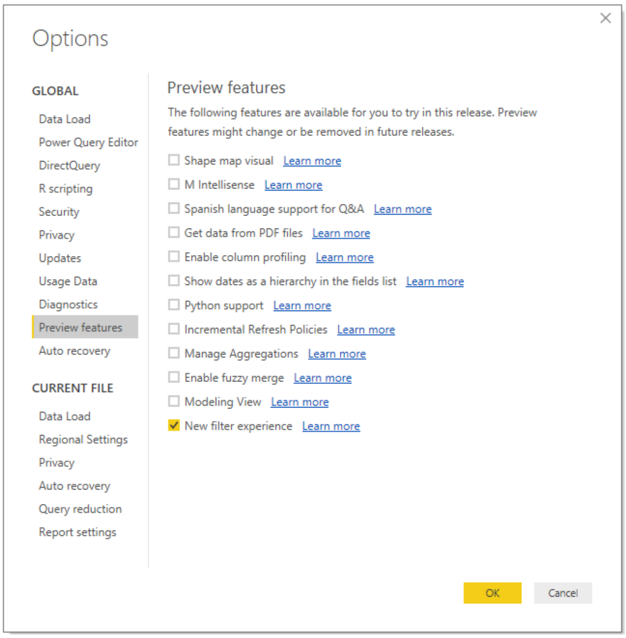
Updated filtering experience (Preview)

The 'Filter' pane is a very important part of any report, and Microsoft claims they have been listening to the feedback provided by a multitude of end users. One such concern was that consumers do not understand which filters are affecting a visual. Not only does the filter pane showing up as collapsed at the corner of the report making it difficult to notice, it also didn't have enough configuration and customisation options to meet all users' needs when building reports. Based on all of this feedback, Microsoft has created a Preview of a fully revamped filtering experience.

This new filter pane has many new features such as:

- Hide individual filters or the entire filter pane from report consumers
- Lock filters as read-only for report consumers
- Formatting options for the filter pane to make it feel like part of the report
- Flexibility of defining default expand / collapsed filter pane at report load time for consumers
- Read only view of filters affecting a visual directly on visuals.

To start using this new 'Filter' pane, you will first need to enable it through the 'Preview features' section of the 'Options' dialog. After this, it will be enabled for all new reports:

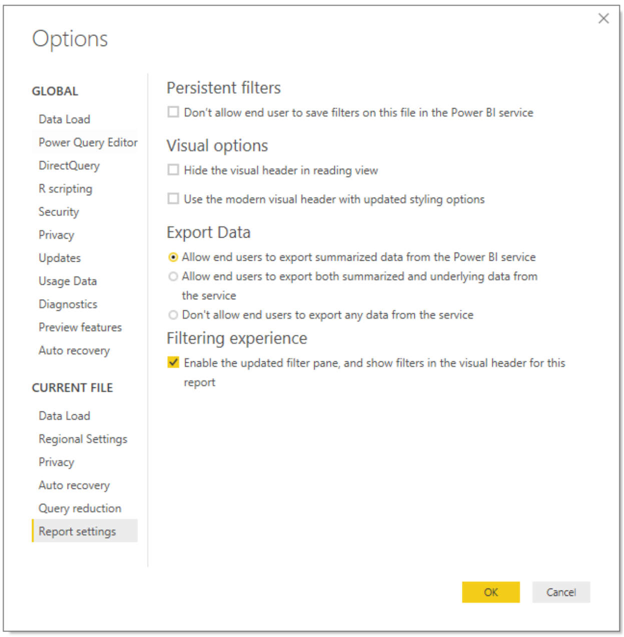


Preview features

The following features are available for you to try in this release. Preview features might change or be removed in future releases.

☐ Shape map visual Learn more
☐ M Intellisense Learn more
☐ Spanish language support for Q&A Learn more
☐ Get data from PDF files Learn more
☐ Enable column profiling Learn more
☐ Show dates as a hierarchy in the fields list Learn more
☐ Python support Learn more
☐ Incremental Refresh Policies Learn more
☐ Manage Aggregations Learn more
☐ Enable fuzzy merge Learn more
☐ Modeling View Learn more
☑ New filter experience Learn more

For existing reports, you'll additionally need to check the option under 'Report settings' in the 'Options' dialog, *viz.*



Options

GLOBAL

- Data Load
- Power Query Editor
- DirectQuery
- R scripting
- Security
- Privacy
- Updates
- Usage Data
- Diagnostics
- Preview features
- Auto recovery

CURRENT FILE

- Data Load
- Regional Settings
- Privacy
- Auto recovery
- Query reduction
- Report settings

Persistent filters

☐ Don't allow end user to save filters on this file in the Power BI service

Visual options

☐ Hide the visual header in reading view

☐ Use the modern visual header with updated styling options

Export Data

● Allow end users to export summarized data from the Power BI service

○ Allow end users to export both summarized and underlying data from the service

○ Don't allow end users to export any data from the service

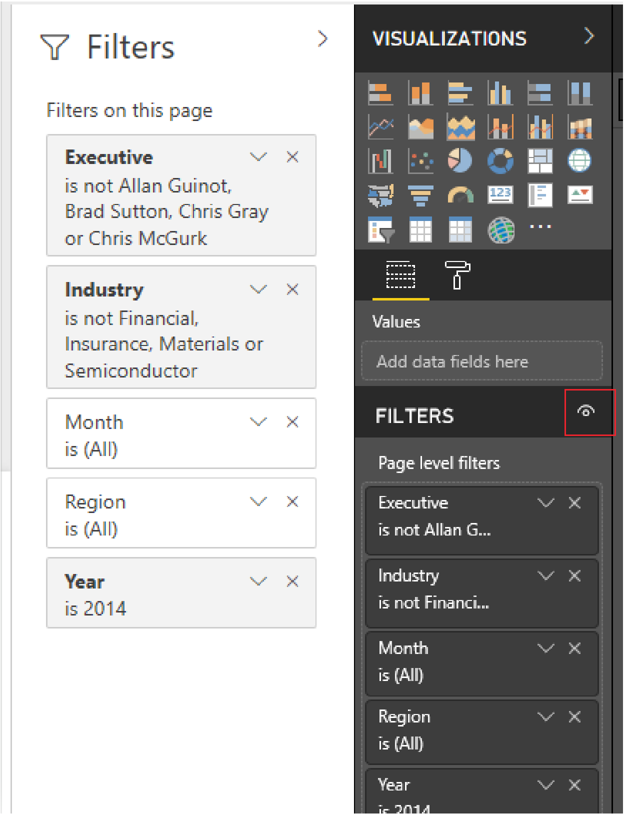
Filtering experience

☑ Enable the updated filter pane, and show filters in the visual header for this report

Once the new ‘Filter’ pane is enabled, you’ll see it attached to the report page. It will be formatted by default based on your current report settings. This new ‘Filter’ pane is what your report consumers will see when you publish your report, and the older filter pane now acts as a filter editing pane. This means you can update existing filters through the new pane, but you’ll use the older filter pane to configure which filters to include.

In case you are wondering why there are two ‘Filter’ panes, Microsoft has stated that the new ‘Filter’ pane provides you with a taste of what end users will see without publishing the report (same as any other visual in your report). However, in a few months, Microsoft plans to remove the old ‘Filter’ pane so that the new pane will be used to add new filters as well.

To show and hide the new filter pane, you can use the eye icon next to ‘FILTERS’ title of the ‘Filter’ editing pane. This saves with the report, so you’ll be able to completely hide the ‘Filter’ pane from your report consumers if you want.



Filters

Filters on this page

Executive
is not Allan Guinot, Brad Sutton, Chris Gray or Chris McGurk

Industry
is not Financial, Insurance, Materials or Semiconductor

Month
is (All)

Region
is (All)

Year
is 2014

VISUALIZATIONS

Values

Add data fields here

FILTERS

Page level filters

Executive
is not Allan G...

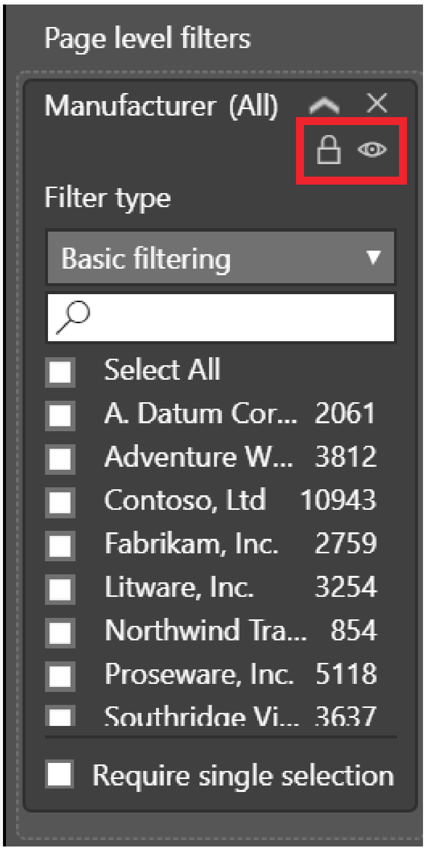
Industry
is not Financi...

Month
is (All)

Region
is (All)

Year
is 2014

You can also use the ‘Filter’ editing pane to lock or hide individual filter cards. As you toggle these settings in the editor, you’ll see the changes reflected in the new ‘Filter’ pane:



Page level filters

Manufacturer (All)

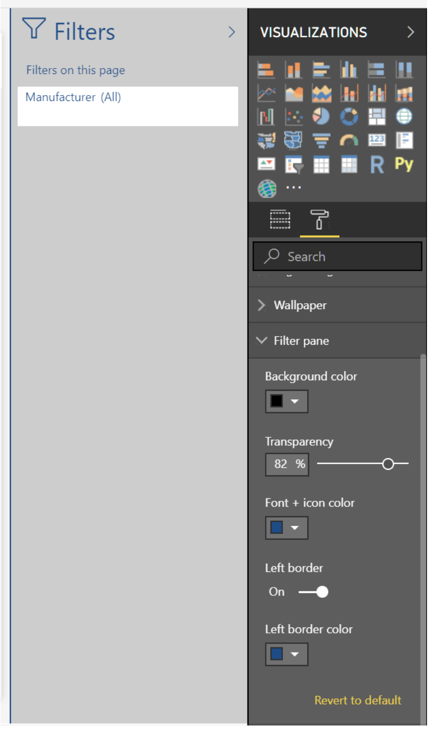
Filter type

Basic filtering ▼

□	Select All	
□	A. Datum Cor...	2061
□	Adventure W...	3812
□	Contoso, Ltd	10943
□	Fabrikam, Inc.	2759
□	Litware, Inc.	3254
□	Northwind Tra...	854
□	Proseware, Inc.	5118
□	Southridge Vi...	3637

□ Require single selection

Through the ‘Formatting’ pane you can format both the new ‘Filter’ pane, and the individual filter cards. For the ‘Filter’ pane, you can format the background colour and transparency, the font and icon colours, and the colour and visibility of the left border of the pane.



Filters

Filters on this page

Manufacturer (All)

VISUALIZATIONS

Search

Wallpaper

Filter pane

Background color

Transparency 82 %

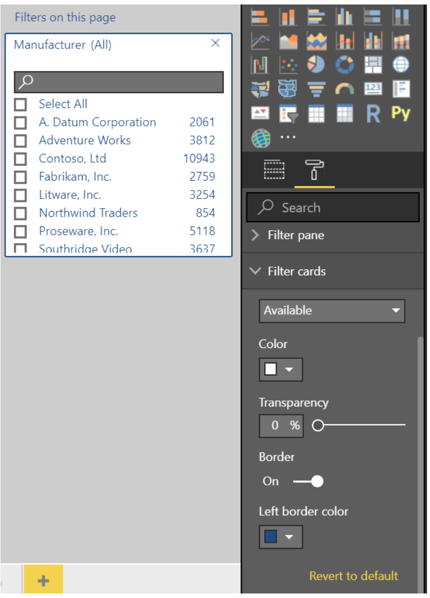
Font + icon color

Left border On

Left border color

Revert to default

You can format the ‘Filter’ card’s background colour and transparency and border colour and visibility. Users are able to format these properties for both the state when the filter is cleared (Available) and the state when the filter is set to something (Applied).

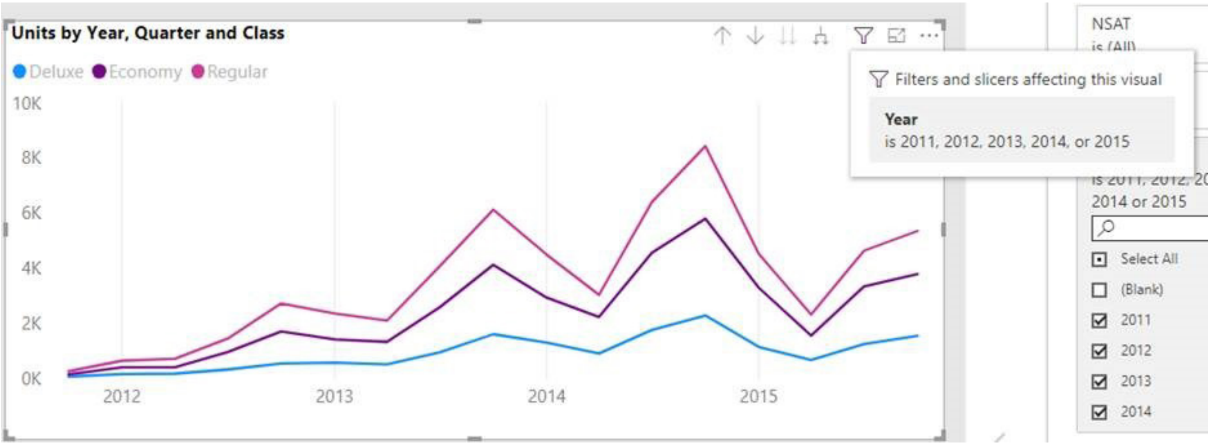


Filters on this page

Manufacturer (All)

□ Select All	
□ A. Datum Corporation	2061
□ Adventure Works	3812
□ Contoso, Ltd	10943
□ Fabrikam, Inc.	2759
□ Litware, Inc.	3254
□ Northwind Traders	854
□ Proseware, Inc.	5118
□ Southridge Video	3637

Another benefit of this new experience is that you can now see a read-only view of filters that are affecting each visual. You can hover over a filter icon in the visual's header to see filters, slicers and cross-highlighting state that is affecting what data is showing in the visual. This new icon is on by default (provided your Preview switch is checked as called out above), but of course you can turn it off for your report consumers through the visual header card in the 'Formatting' pane.



Units by Year, Quarter and Class

Filters and slicers affecting this visual

Year
is 2011, 2012, 2013, 2014, or 2015

NSAT
is (All)

is 2011, 2012, 20
2014 or 2015

☑ Select All
□ (Blank)
☑ 2011
☑ 2012
☑ 2013
☑ 2014

Report accessibility improvements

There are plenty of accessibility improvements this month in the reporting space.

It should be noted that the selection pane is now fully accessible. This includes keyboard navigation, screen reader support and high contrast support. When using the selection pane with a keyboard, once you open the selection pane from the Ribbon, your focus will move directly to the pane. From there you can tab through all the buttons on pane. When your focus is on the list, you can press **F6** to "activate" the list and use up / down arrows to cycle through the list of visuals. While your focus is on an individual object in the 'Selection' pane list, you can use the following hotkeys:

- Select / deselect an object: **ENTER** or **SPACEBAR**
- Multi-select: **CTRL + SPACE**
- Move an object up in the layering: **CTRL + SHIFT + F**
- Move an object down in the layering: **CTRL + SHIFT + B**
- Hide / show (toggle) an object: **CTRL + SHIFT + S.**

Press **TAB** to exit the activated list and return to the top of the pane.

The following experiences also fully support keyboard navigation, screen readers, and high contrast settings:

- 'Q&A explorer' dialog
- 'Getting started' dialog
- 'File Menu' and 'About' dialogs
- Warning bar
- 'File Restore' dialog
- 'Frowns' dialog.

Furthermore, you may quickly navigate to different areas of Power BI Desktop through **CTRL + F6**. Instead of just jumping between visuals on a page and the page tab switcher, you can also quickly jump to whatever panes are currently visible, the view switcher on the left and the account options on the top right. You can still reach the Ribbon through pressing the **ALT** key.

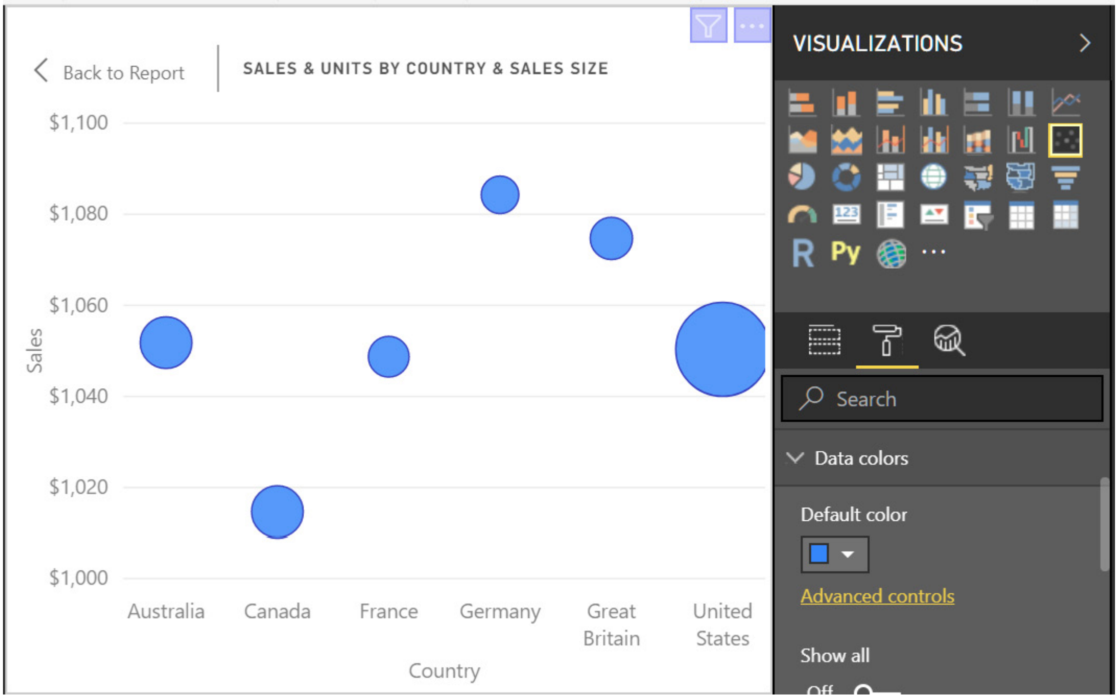
Colour saturation on visuals upgraded to use conditional formatting

For quite a while now, there have been two different ways to dynamically colour a visual's data points depending on the visual type. Charts had a colour saturation option in the field well that gave you basic controls, and the table and matrix visuals had conditional formatting. Recent updates have added functionality to the conditional formatting experience for table and matrix over the last year, but the colour saturation feature for cartesian charts hasn't received much attention.

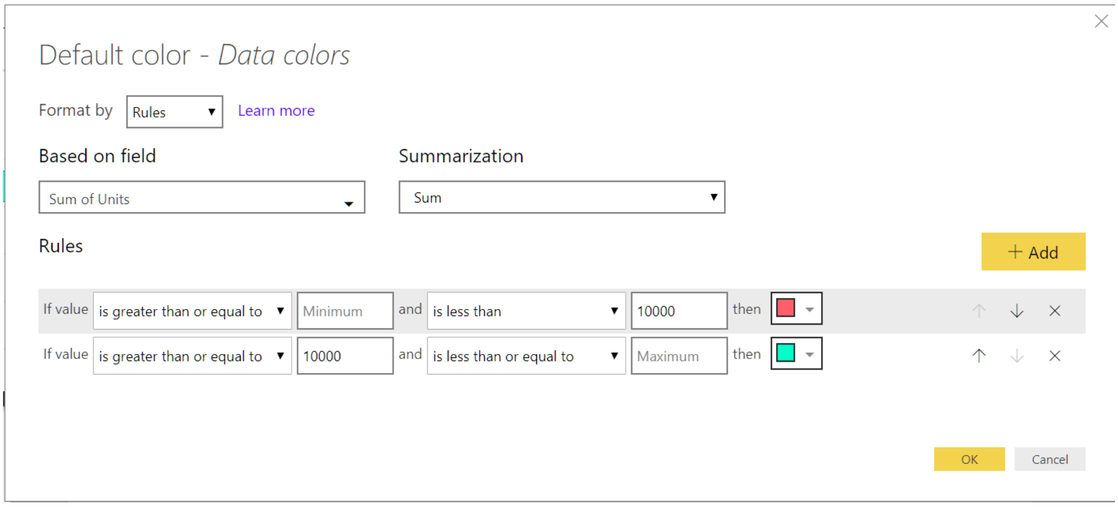
That has finally changed in this update. Microsoft has now upgraded all of the visuals that previously used colour saturation to have the same conditional formatting experience as table and matrix currently has. This means you'll have access to all three types of formatting currently available: Color by color scales, Color by rules, and Color by field. As mentioned, this change impacts all visuals which previously had color saturation which includes:

- All variants of column and bar charts
- Funnel chart
- Bubble and filled maps
- Shape map (Preview)
- Treemap
- Scatter chart.

With this upgrade, you'll notice the colour saturation bucket is no longer in the field well. Instead to format, you'll go to the 'Data colors' card in the 'Formatting' pane. Here you can format with the colour pickers as normal or select the 'Advanced' controls option to launch the conditional formatting dialog.



Once there, you can use any of the three conditional formatting options and select 'OK' to apply the formatting.


Default color - *Data colors*

Format by Rules ▾ Learn more

Based on field: Sum of Units

Summarization: Sum

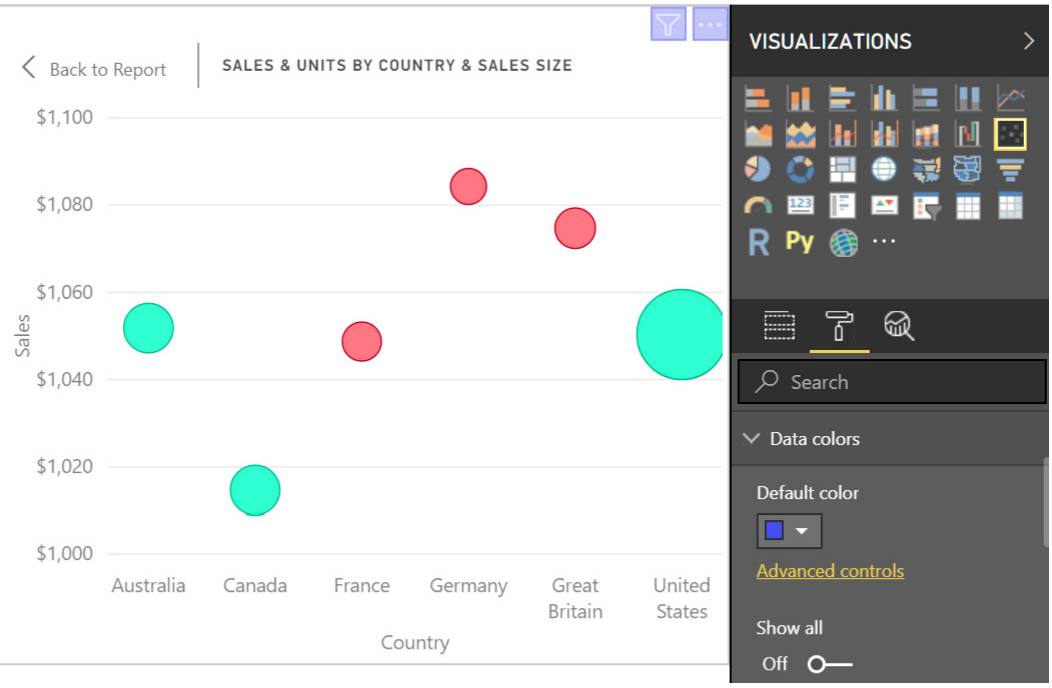
Rules + Add

If value is greater than or equal to ▾ Minimum and is less than ▾ 10000 then 🟥

If value is greater than or equal to ▾ 10000 and is less than or equal to ▾ Maximum then 🟩

OK Cancel

And that's it! The conditional formatting colours will apply on top of whatever formatting you already have through theming and manually picking through the colour pickers.



Data colors

Default color

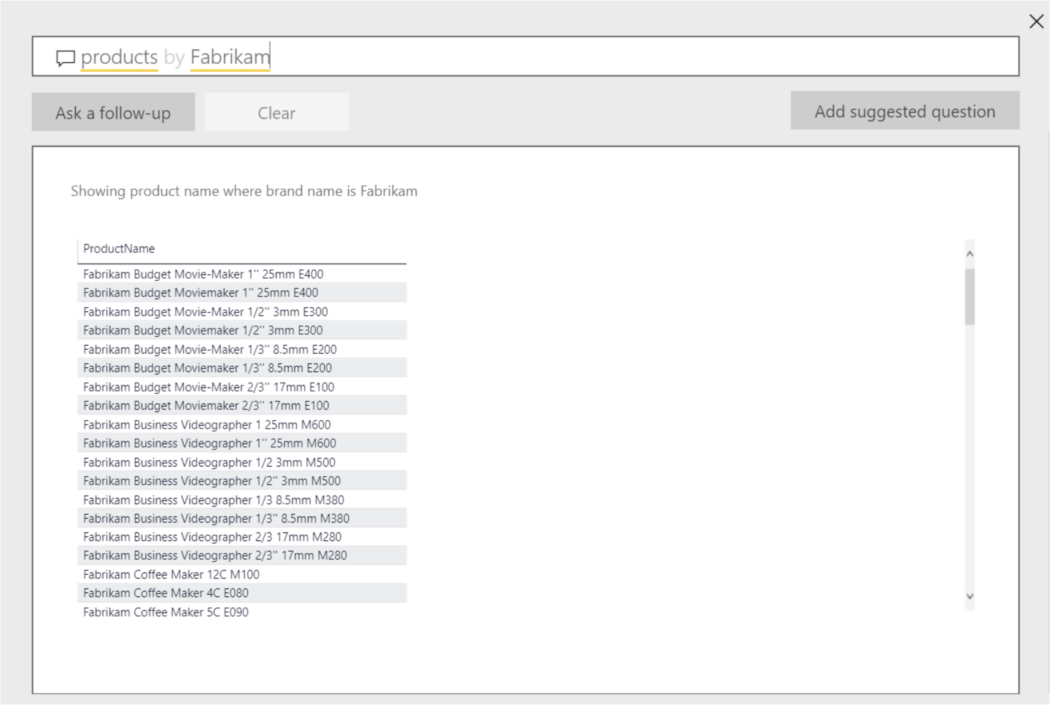
Advanced controls

Show all

Off

Follow-up questions in the Q&A explorer

You can now ask follow-up questions in the 'Q&A explorer' dialog, which means that the answers to your questions can take into account the previous question's context. For example, you can start by asking for the products sold by Fabrikam:

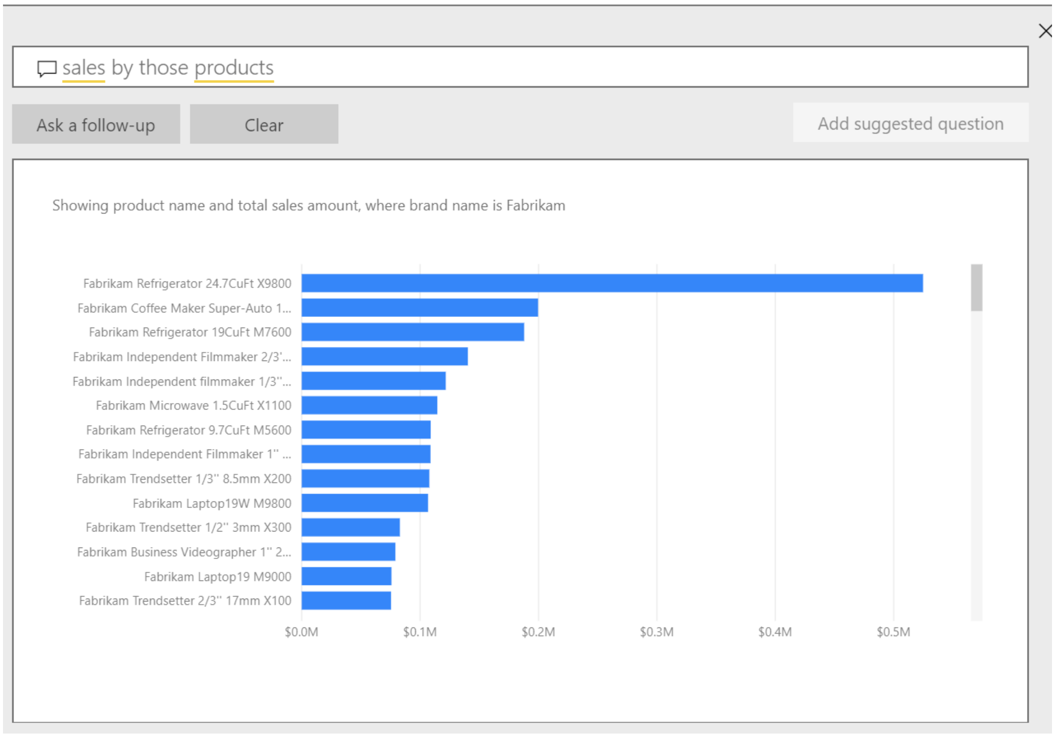


products by Fabrikam

Showing product name where brand name is Fabrikam

ProductName
Fabrikam Budget Movie-Maker 1'' 25mm E400
Fabrikam Budget Moviemaker 1'' 25mm E400
Fabrikam Budget Movie-Maker 1/2'' 3mm E300
Fabrikam Budget Moviemaker 1/2'' 3mm E300
Fabrikam Budget Movie-Maker 1/3'' 8.5mm E200
Fabrikam Budget Moviemaker 1/3'' 8.5mm E200
Fabrikam Budget Movie-Maker 2/3'' 17mm E100
Fabrikam Budget Moviemaker 2/3'' 17mm E100
Fabrikam Business Videographer 1 25mm M600
Fabrikam Business Videographer 1'' 25mm M600
Fabrikam Business Videographer 1/2 3mm M500
Fabrikam Business Videographer 1/2'' 3mm M500
Fabrikam Business Videographer 1/3 8.5mm M380
Fabrikam Business Videographer 1/3'' 8.5mm M380
Fabrikam Business Videographer 2/3 17mm M280
Fabrikam Business Videographer 2/3'' 17mm M280
Fabrikam Coffee Maker 12C M100
Fabrikam Coffee Maker 4C E080
Fabrikam Coffee Maker 5C E090

Then you can click the 'Ask a follow-up' button and ask the follow-up question for the sales for each of those products.



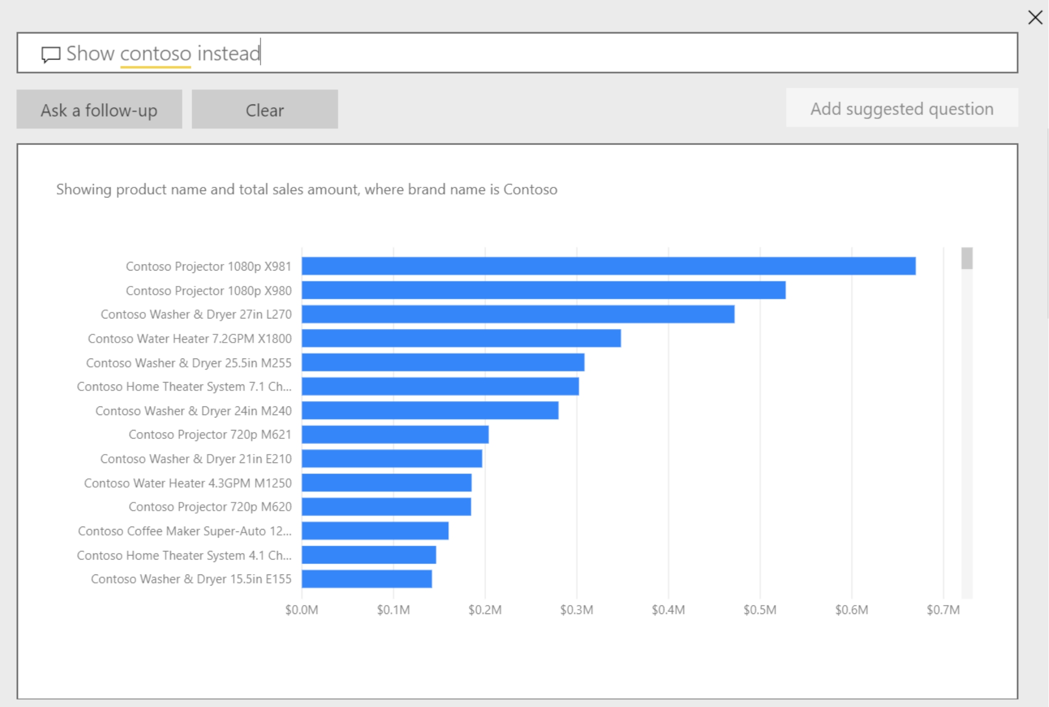
sales by those products

Ask a follow-up
Clear
Add suggested question

Showing product name and total sales amount, where brand name is Fabrikam

Fabrikam Refrigerator 24.7CuFt X9800
Fabrikam Coffee Maker Super-Auto 1...
Fabrikam Refrigerator 19CuFt M7600
Fabrikam Independent Filmmaker 2/3''...
Fabrikam Independent filmmaker 1/3''...
Fabrikam Microwave 1.5CuFt X1100
Fabrikam Refrigerator 9.7CuFt M5600
Fabrikam Independent Filmmaker 1'' ...
Fabrikam Trendsetter 1/3'' 8.5mm X200
Fabrikam Laptop19W M9800
Fabrikam Trendsetter 1/2'' 3mm X300
Fabrikam Business Videographer 1'' 2...
Fabrikam Laptop19 M9000
Fabrikam Trendsetter 2/3'' 17mm X100
$0.0M
$0.1M
$0.2M
$0.3M
$0.4M
$0.5M

You can continue to ask follow-up questions and can even change filter context, *e.g*. by asking to show Contoso products instead:



Show contoso instead

Ask a follow-up
Clear
Add suggested question

Showing product name and total sales amount, where brand name is Contoso

Contoso Projector 1080p X981
Contoso Projector 1080p X980
Contoso Washer & Dryer 27in L270
Contoso Water Heater 7.2GPM X1800
Contoso Washer & Dryer 25.5in M255
Contoso Home Theater System 7.1 Ch...
Contoso Washer & Dryer 24in M240
Contoso Projector 720p M621
Contoso Washer & Dryer 21in E210
Contoso Water Heater 4.3GPM M1250
Contoso Projector 720p M620
Contoso Coffee Maker Super-Auto 12...
Contoso Home Theater System 4.1 Ch...
Contoso Washer & Dryer 15.5in E155
$0.0M
$0.1M
$0.2M
$0.3M
$0.4M
$0.5M
$0.6M
$0.7M

Here are some types of follow-up questions you can ask and the phrasing to use:

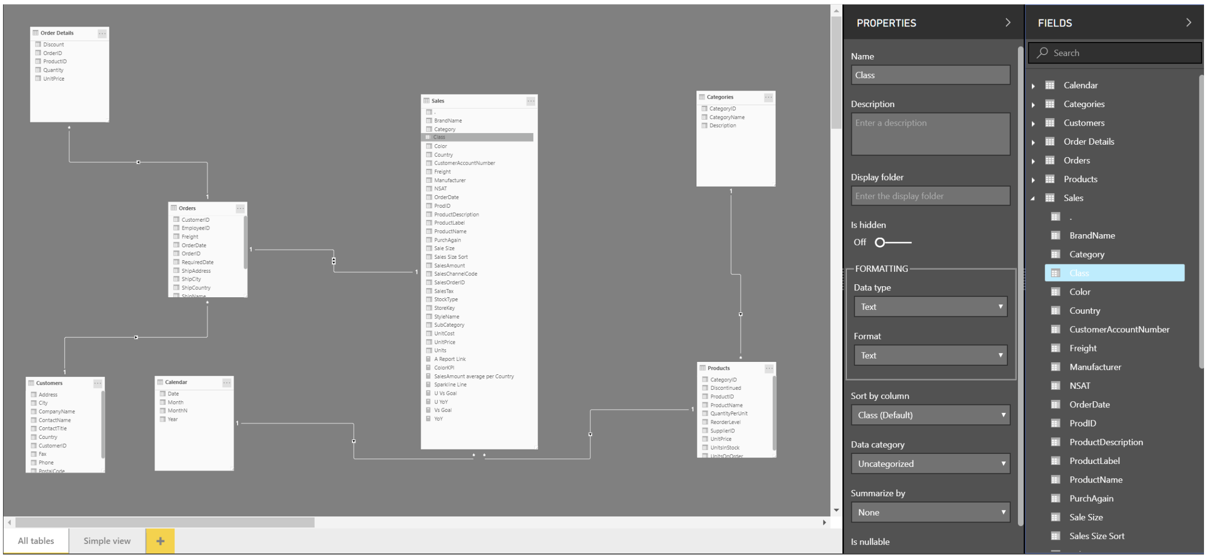
- Add another field: "Include brand name"
- Extend filter: "For Contoso as well"
- Add a filter: "what about 2015?"
- Replace filters: "Show Contoso instead" or "What about for Contoso?".

We think this is going to be very popular…

New modelling view (Preview)

Another major improvement this time out is the Preview of the new 'Modelling' view. Microsoft has been working on this new view for a while now. This new version has many new features including:

- Faster performance on large models with many tables
- Customise and save diagram view layouts
- Multiple diagram layouts
- Modelling options through the 'Field properties' pane and field list
- Display folder creation
- Apply common settings to multiple fields at once.



Name: Class

Description: Enter a description

Display folder: Enter the display folder

Is hidden: Off

FORMATTING

Data type: Text

Format: Text

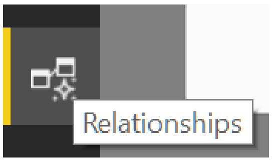
Sort by column: Class (Default)

Data category: Uncategorized

Summarize by: None

Is nullable

Once you turn on the Preview in the 'Options' dialog, you'll see two relationships views. You'll be able to recognise the new {review one through a little star on the bottom right corner of the icon:



Composite models now Generally Available

The recent composite models feature is now Generally Available. It does differ slightly from its Preview predecessor. Microsoft now allows relationships that are between different sources to have a cardinality of 'Many to 1' to reflect the actual cardinality of the data. While the relationships still have the same "weak" behaviour as relationships that have a cardinality of 'Many-to-Many', allowing the true cardinality to be defined, permits additional optimisations and clearer models.

Modeling accessibility improvements

The 'Modelling' experience has accessibility improvements with this update. Keyboard navigation, screen reader support and high contrast setting support have been added to the following:

- 'Manage relationships' dialog
- 'Edit relationships' dialog
- 'Manage roles' dialog for Row Level Security (RLS).

New DAX functions

Finally, there's three new DAX updates. In support of the new expand / collapse feature for the matrix visual, there's now an additional optional **DrilldownFilter** argument for the **RollupAddIsSubtotal** function and a new **NonVisual** function.

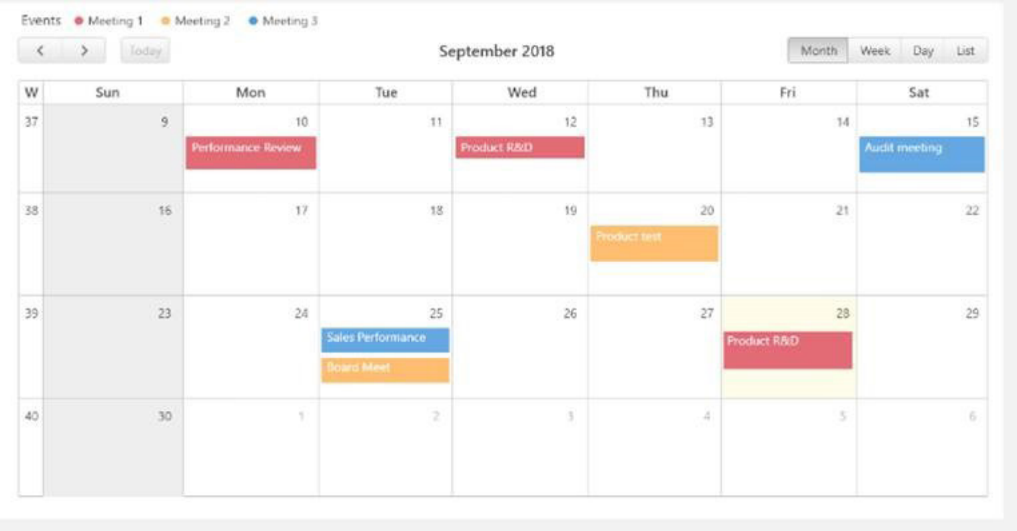
Additionally, Microsoft has also added the **IsInScope** function, which is a better way to detect hierarchy level in a measure expression. Some popular tasks you might need this for include:

- Calculating child percentage of parent subtotal
- Calculating ranks of children under different parents.

Calendar by MAQ Software

The Calendar by MAQ Software custom visual is a method to track events within your Power BI report. Some key features include:

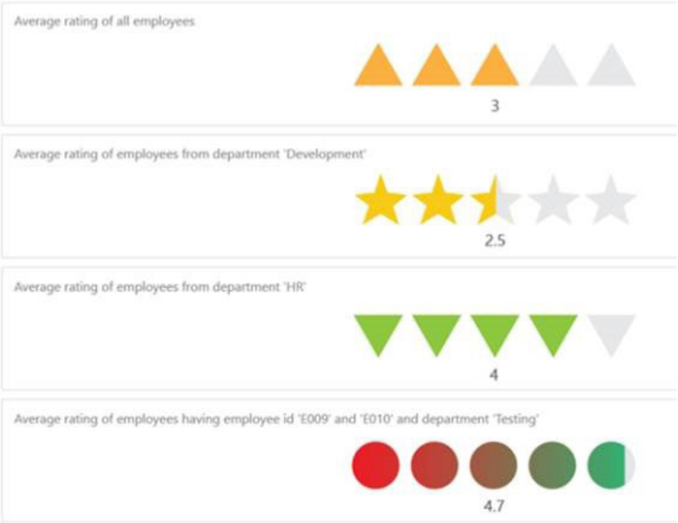
- Grouping events based on category
- Month, week, day and list views
- Navigate to event details with a single click
- Set workdays and hours.



W	Sun	Mon	Tue	Wed	Thu	Fri	Sat
37	9	10 Performance Review	11	12 Product R&D	13	14	15 Audit meeting
38	16	17	18	19	20 Product test	21	22
39	23	24	25 Sales Performance Board Meet	26	27	28 Product R&D	29
40	30	1	2	3	4	5	6

Ratings by MAQ Software

The Ratings by MAQ Software custom visual allows you to add ratings or scores to your reports. You can show either the average ratings or break it down over a specific category. You're able to choose between four different shapes and between a solid and gradient fill.

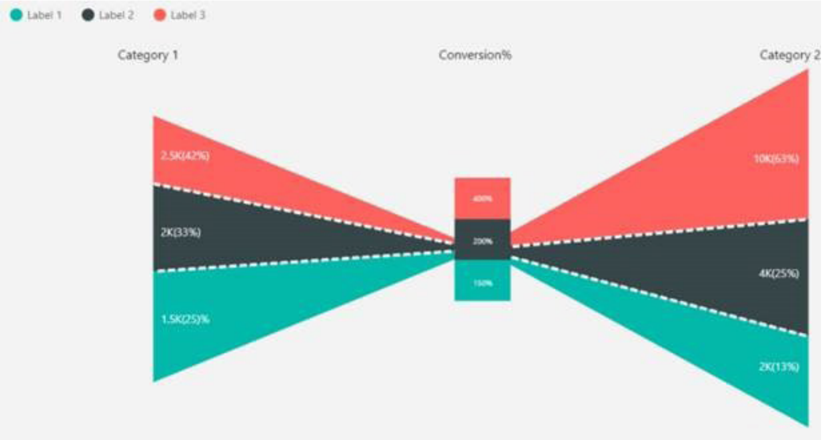

Average rating of all employees
3
Average rating of employees from department 'Development'
2.5
Average rating of employees from department 'HR'
4
Average rating of employees having employee id 'E009' and 'E010' and department 'Testing'
4.7

Hourglass Chart by MAQ Software

The Hourglass Chart by MAQ Software custom visual lets you compare category values between two scenarios, which can be useful when showing conversion rates.

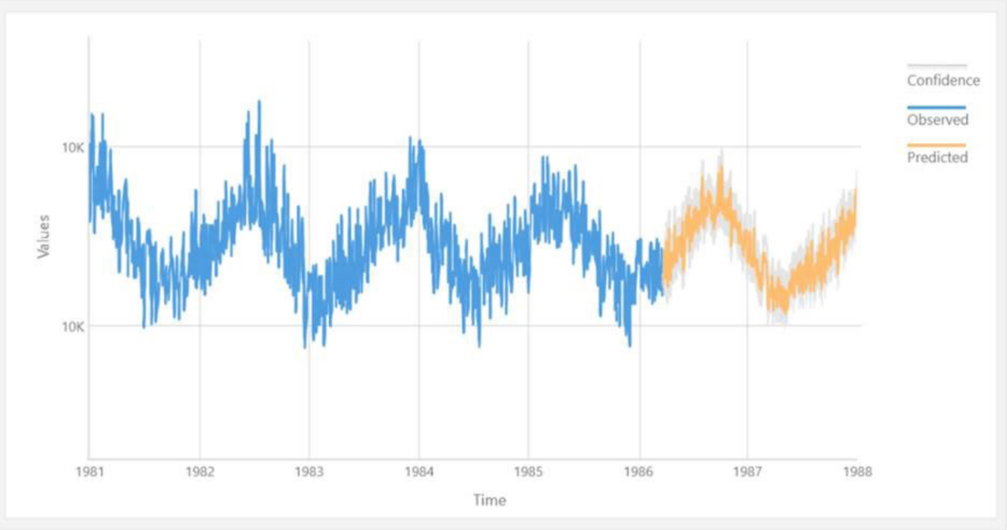
With this visual you can:

- Cross-highlight individual categories
- Display it either horizontally or vertically
- Animate individual categories on hover
- Add and remove the conversion box.



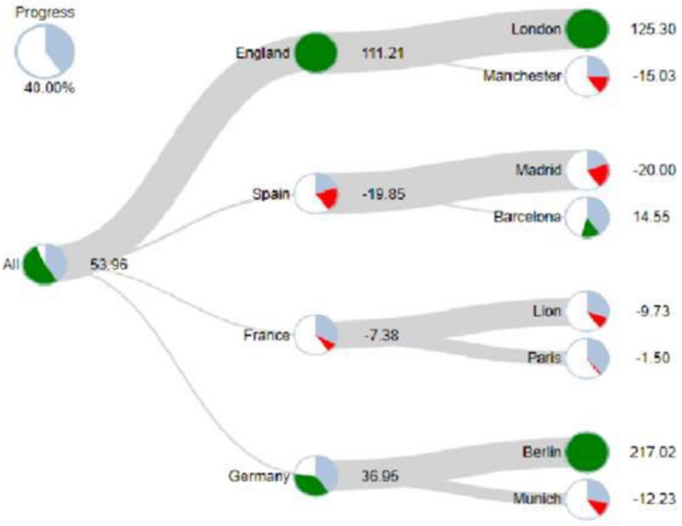
Forecast Using Multiple Models by MAQ Software

The Forecast Using Multiple Models by MAQ Software R custom visual lets you forecast future values based on historical data using four different forecasting models. The models include Linear Regression, ARIMA, Exponential Smoothing and Neural Network. You can manually adjust the parameters of the learning model, show the confidence intervals and decide upon the split point.



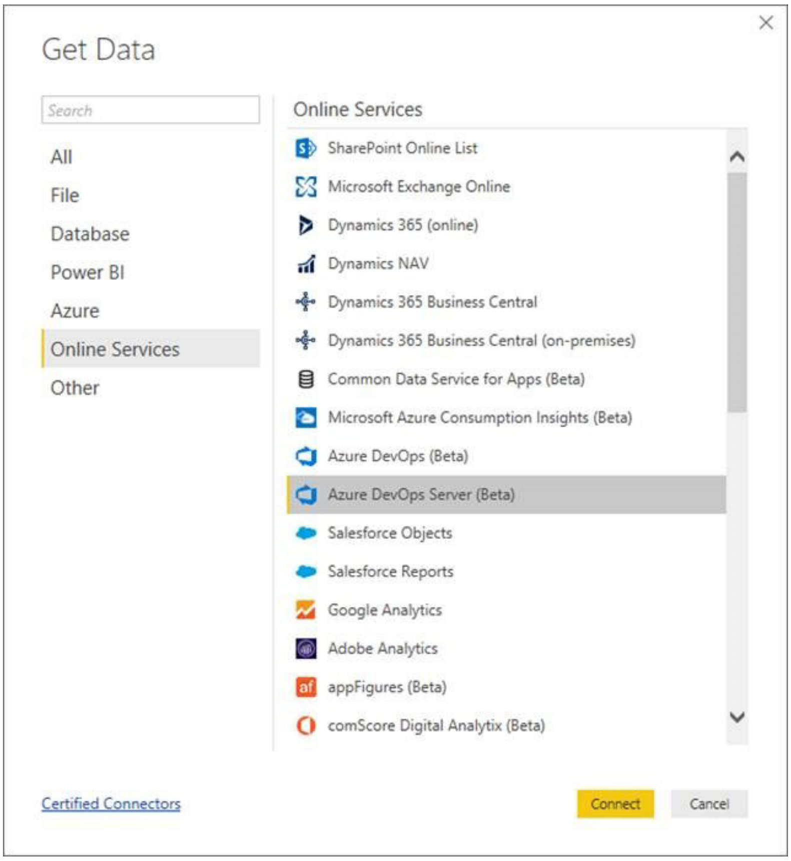
Pie Charts Tree

The Pie Charts Tree custom visual by Aritz Fancoy lets you display a tree visual with pie charts as the nodes. To create a plain tree structure all you need to do is add multiple fields to the 'Categories' bucket in the 'Fields' list. From there you can add data labels with the 'Values' bucket, percent of target pie charts with the 'Target' bucket, and progress percentage with the Progress field.



Azure DevOps Server connector

This update also sees the release of a new connector for Azure DevOps Server, allowing you to import and transform data from Azure DevOps Server in order to build Power BI reports. The new Azure DevOps Server Connector can be found under the Online Services category within the Get Data dialog.



PDF Connector support for Start Page and End Page parameters

The PDF Files connector has been enhanced in this release to allow you to specify **Start Page** and **End Page** optional parameters, which restricts Power Query to only explore a given range of pages for discovering tables.

These parameters can be specified in the **M** formula generated after connecting to a **PDF file: Pdf.Tables(File.Contents("c:\sample.pdf"), [StartPage=10, EndPage=11])**

Improved Azure Consumption Insights connector

Finally, Microsoft has also enhanced the Azure Consumption Insights connector to add ‘Budget’ and ‘Reserved Instances’ data.

More next month we’re sure!

New Artificial Intelligence (AI) Capabilities for Power BI

If you have read the above, you can’t help but notice the direction Power BI is going in. We often get asked the difference between Qlik, Tableau et al and whilst we try to remain [reasonably] neutral, you would have to be blind not to recognise Power BI makes it possible for everyone to have access to better data and dashboards.

But that’s just one aspect.

With the massive volumes of data generated today about every aspect of a business, finding insights from the data can be challenging. This is where Artificial Intelligence (AI) can help and doesn’t replace the analyst but *supports* them. AI can aid in data exploration, comb through the data to automatically find patterns, help users understand what the data means and predict future outcomes to help business drive results.

Power BI has been applying AI through capabilities such as natural language, which enables users to get answers by asking questions in plain English, or Quick Insights, which automatically finds patterns in data. There’s more though: here’s some features presently reviewed in more detail that are in Preview:

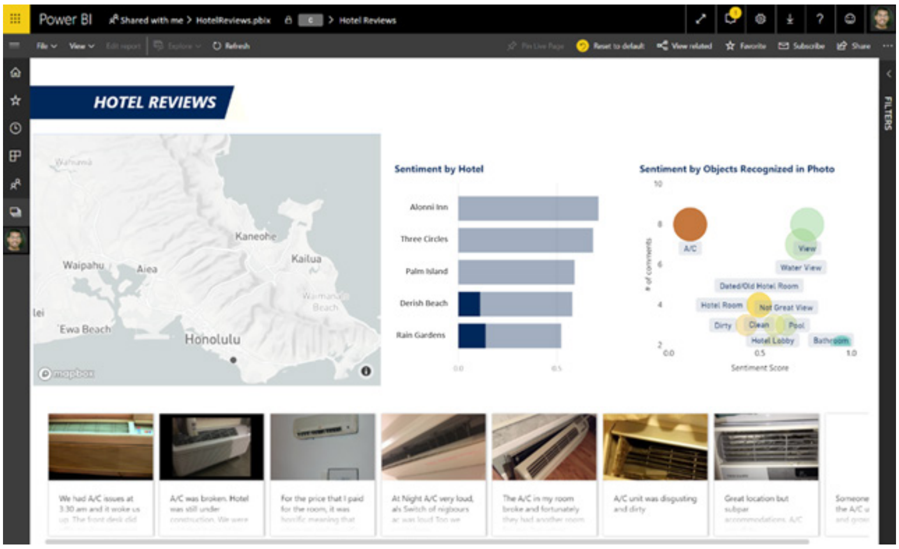
- users can now get capabilities such as image recognition and text analytics directly in Power BI
- Key driver analysis helps users understand what influences key business metrics
- users can create machine learning models directly in Power BI using automated machine learning
- users now have seamless integration of Azure Machine Learning within Power BI.

All these new AI capabilities—pioneered in Azure and now available in Power BI—require no code. That’s great for the average user. This enables all Power BI users to discover hidden, actionable insights in their data and drive better business outcomes with easy-to-use AI and not be a “geek freak”.

Azure Cognitive Services Capabilities in Power BI

Azure Cognitive Services are sophisticated pre-trained machine learning models that can extract insights from data. Microsoft is bringing Azure Cognitive Service capabilities into Power BI to provide powerful ways to extract information from a variety sources like documents, images and social media feeds. These algorithms can identify named entities such as organizations, people and locations. They can recognise objects in images, detect language, identify key phrases and determine positive or negative sentiment.

For example, imagine you're a business analyst for a hotel chain and want to evaluate what guests are saying in their online reviews. With Azure Cognitive Services in Power BI, you could analyse thousands of online reviews, understand what your guests are happy or unhappy about, and pinpoint areas of improvement. In the example below, the user can understand that a specific hotel has issues with air conditioning, causing customer dissatisfaction and negative reviews. Azure Cognitive Services capabilities in Power BI can surface this insight automatically, so the hotel can take action.



We had A/C issues at 3:30 am and it woke us up. The front desk did

A/C was broken. Hotel was still under construction. We were

For the price that I paid for the room, it was horrific meaning that

At Night A/C very loud, als Switch of nigbours ac was loud Too we

The A/C in my room broke and fortunately they had another room

A/C unit was disgusting and dirty

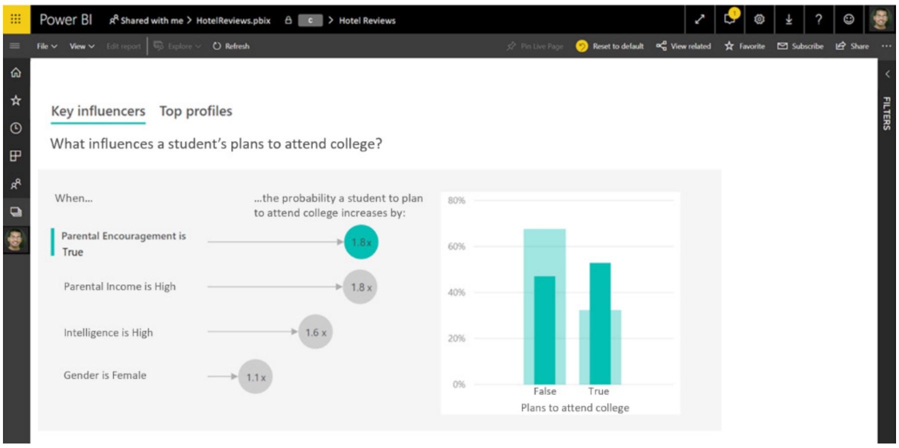
Great location but subpar accommodations. A/C

Someone the A/C u and grow

New Key Driver Analysis Feature in Power BI

Every organisation has metrics or key performance indicators (KPIs) that measure business success. How do businesses determine what impacts those KPIs? What causes these KPIs to go up, down or stay the same? The most obvious business drivers are typically easy to spot, but it doesn't take long before things get complex. What drives business outcomes is often subtle and depends on any combination of circumstances.

Key driver analysis helps you understand what drives an outcome. It reasons over your data, ranks those things that matter and surfaces those key drivers. For example, consider a student's plans to attend college as a KPI. There are different factors that impact whether kids plan to enrol in college. Key driver analysis automatically surfaces those things that matter the most. Below, you see that parental encouragement has significant positive impact on a student's plans.



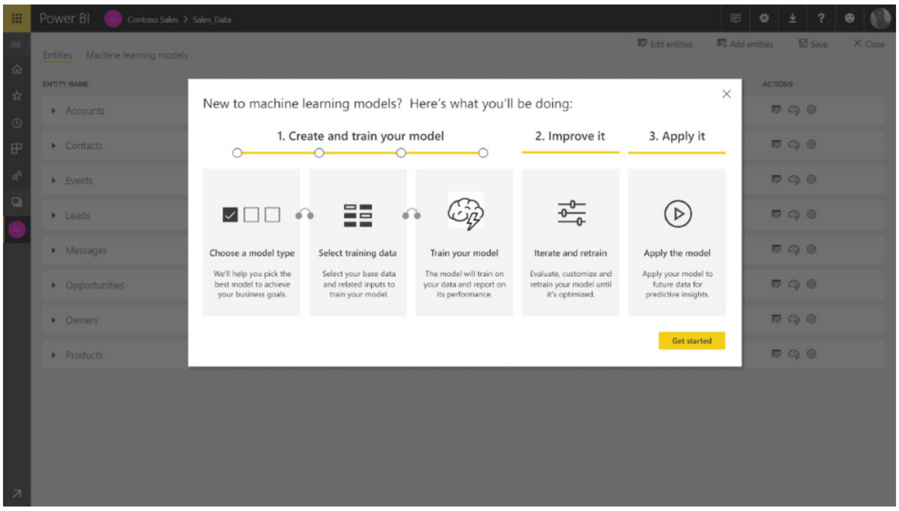
What influences a student's plans to attend college?

...the probability a student to plan to attend college increases by:

Build Your Own Machine Learning Models in Power BI

In Power BI, business analysts will now be able to build their own machine learning models without writing a single line of code. Microsoft is using the automated machine learning feature in Azure Machine Learning, but instead of targeting developers or data scientists, they have made it broadly accessible for common use cases. This means that when an analyst builds a machine learning model in Power BI, it does all the heavy lifting by selecting the best algorithm and features with just a few clicks.

As an example, a business analyst could leverage the automated machine learning technology to quickly and easily build a model to predict how likely an open sales opportunity is to be won. This could help a sales manager prioritise which high value opportunities to focus on and how likely they are to meet their target.



New to machine learning models? Here's what you'll be doing:

1. Create and train your model

Choose a model type
We'll help you pick the best model to achieve your business goals.

Select training data
Select your base data and related inputs to train your model.

Train your model
The model will train on your data and report on its performance.

2. Improve it

Iterate and retrain
Evaluate, customize and retrain your model until it's optimized.

3. Apply it

Apply the model
Apply your model to future data for predictive insights.

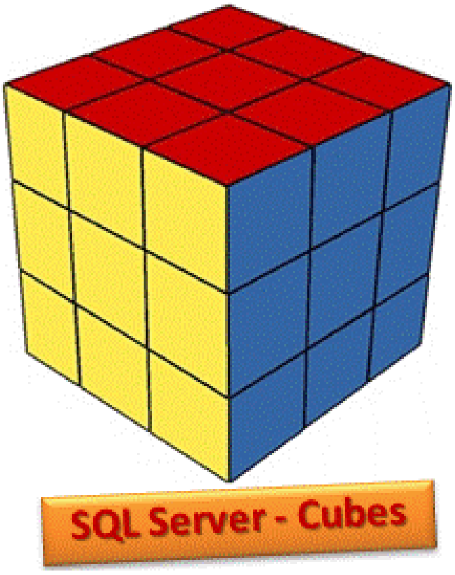
Integrate Azure Machine Learning Models with Power BI

Advanced Machine Learning requires specialised data science tools. This is a platform where data scientists develop machine learning models to take on complex business challenges. These models built by data scientists can now be easily shared with business analysts. Power BI works behind the scenes to discover the models to which each user has access and automatically creates a point and click user interface to invoke them. This makes collaboration among business analysts and data scientists easier and faster than ever before.

Power BI is building on years of work in Microsoft Research and Azure, and bringing these capabilities to any business user, regardless of their coding skill. Complex tasks that typically require technical know-how — key phrase extraction, sentiment analysis, understanding drivers, creating machine learning models—will now be possible with just a few clicks and without code. This will empower everyone in an organisation to harness the power of AI to make better decisions. Roll on the Preview.

The A to Z of Excel Functions: CUBEKPIMEMBER

When an Excel workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source, this function returns a key performance indicator (KPI) property and displays the KPI name in the cell. A KPI is a quantifiable measurement, such as monthly gross profit or quarterly employee turnover, that is used to monitor an organisation's performance.

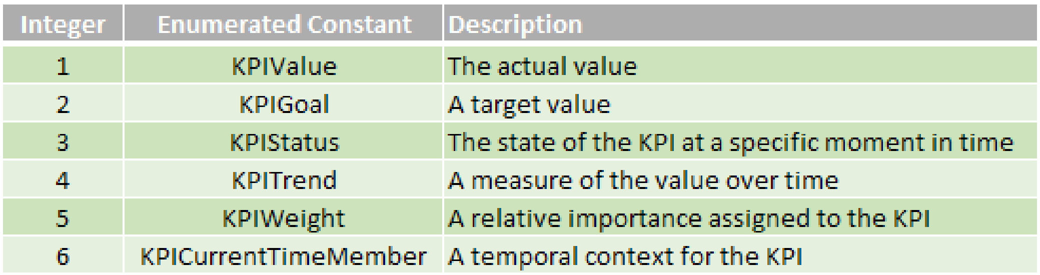


The **CUBEKPIMEMBER** function employs the following syntax to operate:

CUBEKPIMEMBER(connection, kpi_name, kpi_property, [caption])

The **CUBEKPIMEMBER** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **kpi_name:** this is also required. This is a text string of the name of the KPI in the cube
- **kpi_property:** again, this is required. This is the KPI component returned and can be one of the following:



Integer	Enumerated Constant	Description
1	KPIValue	The actual value
2	KPIGoal	A target value
3	KPIStatus	The state of the KPI at a specific moment in time
4	KPITrend	A measure of the value over time
5	KPIWeight	A relative importance assigned to the KPI
6	KPICurrentTimeMember	A temporal context for the KPI

- **caption:** this is optional. This represents an alternative text string that is displayed in the cell instead of **kpi_name** and **kpi_property**.

It should be further noted that:

- the **CUBEKPIMEMBER** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBEKPIMEMBER** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- to use the KPI in a calculation, specify the **CUBEKPIMEMBER** function as a member_expression argument in the **CUBEVALUE** function
- if the connection name is not a valid workbook connection that is stored in the workbook, **CUBEKPIMEMBER** returns an *#NAME?* error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, **CUBEKPIMEMBER** returns a *#NAME?* error value
- **CUBEKPIMEMBER** returns an *#N/A* error value when **kpi_name or kpi_property** is invalid
- if you specify **KPIValue** for **kpi_property**, only **kpi_name** is displayed in the cell
- **CUBEKPIMEMBER** may return an *#N/A* error value if you reference a session-based object, such as a calculated member or named set, in a PivotTable when sharing a connection, and that PivotTable is deleted or you convert the PivotTable to formulae (on the ‘Options’ tab in the Ribbon, in the ‘Tools’ group, click ‘OLAP Tools’, and then click ‘Convert to Formulas’).

Please see our examples below:

=CUBEKPIMEMBER("Sales","MySalesKPI",1)

=CUBEKPIMEMBER("Sales","MySalesKPI", KPIGoal,"Sales KPI Goal").

The A to Z of Excel Functions: CUBEMEMBER

Again, when a workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source, this function returns a member or tuple from the cube. This is used to validate that the member or tuple exists in the cube.

The **CUBEMEMBER** function employs the following syntax to operate:

CUBEMEMBER(connection, member_expression, [caption])

The **CUBEMEMBER** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **member_expression:** this is also required. This is a text string of a multi-dimensional expression (**MDX**) that evaluates to a unique member in the cube. Alternatively, member_expression can be a tuple, specified as a cell range or an array constant
- **caption:** this is optional. This represents a text string displayed in the cell instead of the caption, if one is defined, from the cube. When a tuple is returned, the caption used is the one for the last member in the tuple.

It should be further noted that:

- the **CUBEKPIMEMBER** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBEMEMBER** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- when you use **CUBEMEMBER** as an argument to another **CUBE** function, the **MDX** expression that identifies the member or tuple is used by that **CUBE** function, not the displayed value in the cell of the **CUBEMEMBER** function
- if the connection name is not a valid workbook connection stored in the workbook, **CUBEMEMBER** returns a *#NAME?* error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, **CUBEMEMBER** returns a *#NAME?* error value
- if at least one element within the tuple is invalid, **CUBEMEMBER** returns an *#VALUE!* error value
- if **member_expression** is longer than 255 characters, which is the limit for an argument to a function, **CUBEMEMBER** returns a *#VALUE!* error value. To use text strings longer than 255 characters, enter the text string in a cell (for which the limit is 32,767 characters), and then use a cell reference as the argument instead

- **CUBEMEMBER** returns an *#N/A* error value when:
  - the **member_expression** syntax is incorrect
  - the member specified by the **MDX** text string doesn't exist in the cube
  - the tuple is invalid because there is no intersection for the specified values (this can occur with multiple elements from the same hierarchy)
  - the set contains at least one member with a different dimension than the other members
- **CUBEMEMBER** may return an *#N/A* error value if you reference a session-based object, such as a calculated member or named set, in a PivotTable when sharing a connection, and that PivotTable is deleted or you convert the PivotTable to formulae (on the 'Options' tab in the Ribbon, in the 'Tools' group, click 'OLAP Tools', and then click 'Convert to Formulas').

Please see our examples below:

=CUBEMEMBER("Sales","[Time].[Fiscal].[2020]")

=CUBEMEMBER(A1,D$12)

=CUBEMEMBER("Sales",(B4, C6, D5),"SalesFor2020")

=CUBEMEMBER("xlextdat8 FoodMart 2020 Sales","([Product].[Food],[Time].[2019])")

=CUBEMEMBER(A1,C$12:D$12).

The A to Z of Excel Functions: CUBEMEMBERPROPERTY

Continuing the theme of connecting to a Microsoft SQL Server 2005 Analysis Services or later data source, the **CUBEMEMBERPROPERTY** function, one of the Cube functions in Excel, returns the value of a member property from a cube. You may use it to validate that a member name exists within the cube, and to return the specified property for this member.

The **CUBEMEMBERPROPERTY** function employs the following syntax to operate:

CUBEMEMBERPROPERTY(connection, member_expression, property)

The **CUBEMEMBERPROPERTY** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **member_expression:** this is also required. This is a text string of a multi-dimensional expression (**MDX**) of a member within the cube
- **property:** again, this is required and represents a text string of the name of the property returned or a reference to a cell that contains the name of the property.

It should be further noted that:

- the **CUBEMEMBERPROPERTY** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBEMEMBERPROPERTY** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- if the connection name is not a valid workbook connection stored in the workbook, **CUBEMEMBERPROPERTY** returns an *#NAME?* error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, **CUBEMEMBERPROPERTY** returns an *#NAME?* error value
- if the **member_expression** syntax is incorrect or if the member specified by member_expression doesn't exist in the cube, **CUBEMEMBERPROPERTY** returns an *#N/A* error value
- **CUBEMEMBERPROPERTY** may return an *#N/A* error value if you reference a session-based object, such as a calculated member or named set, in a PivotTable when sharing a connection, and that PivotTable is deleted or you convert the PivotTable to formulae (on the 'Options' tab in the Ribbon, in the 'Tools' group, click 'OLAP Tools', and then click 'Convert to Formulas')
- **CUBEMEMBERPROPERTY** will not work against Excel Data Models that are edited in Power Pivot, since they are not multi-dimensional cubes.

Please see more examples below:

=CUBEMEMBERPROPERTY("Sales","[Time].[Fiscal].[2020]",A3)

=CUBEMEMBERPROPERTY("Sales","[Store].[MyFavoriteStore]","[Store].[Store Name].[Store Sqft]").

The A to Z of Excel Functions: CUBERANKEDMEMBER

Using Microsoft SQL Server 2005 Analysis Services or later as a data source, this function returns the nth, or ranked, member in a set. Use this to return one or more elements in a set, such as the top sales performer or the top 10 students.

The **CUBERANKEDMEMBER** function employs the following syntax to operate:

CUBERANKEDMEMBER(connection, set_expression, rank, [caption])

The **CUBERANKEDMEMBER** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **set_expression:** this is also required. This is a text string of a set expression, such as **"{[Item1].children}"**

- **set_expression** can also be the **CUBESET** function or a reference to a cell that contains the **CUBESET** function
- **rank:** again, this is required. This is an integer value specifying the top value to return. If **rank** is a value of 1, it returns the top value, if **rank** is a value of 2, it returns the second most top value, and so on. To return the top 5 values, use **CUBERANKEDMEMBER** five times, specifying a different **rank**, 1 through 5, each time
- **caption:** this argument is optional. This is a text string displayed in the cell instead of the caption, if one is defined, from the cube.

It should be further noted that:

- the **CUBERANKEDMEMBER** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBERANKEDMEMBER** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- if the connection name is not a valid workbook connection stored in the workbook, **CUBERANKEDMEMBER** returns an #NAME? error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, **CUBERANKEDMEMBER** returns an *#NAME?* error value
- **CUBERANKEDMEMBER** returns an *#N/A* error value when the syntax of set_expression is incorrect or when the set contains at least one member with a different dimension than the other members
- to return the bottom n values instead, use the **sort_order** and **sort_by** arguments of the **CUBESET** function to reverse the order of the set so that the top values in the sorted set are the bottom values. For example, CUBERANKEDMEMBER (**"Sales",D4,1**) returns the last member, **CUBERANKEDMEMBER** (**"Sales",D4,2**) returns the next to last member, and so on.

Please see our examples below:

=CUBERANKEDMEMBER("Sales",D4,1,"Top Month")

=CUBERANKEDMEMBER("Sales",CUBESET("Sales","Summer","[2020].[June]","[2020].[July]","[2020].[August]"),3,"Top Month").

The A to Z of Excel Functions: CUBESET

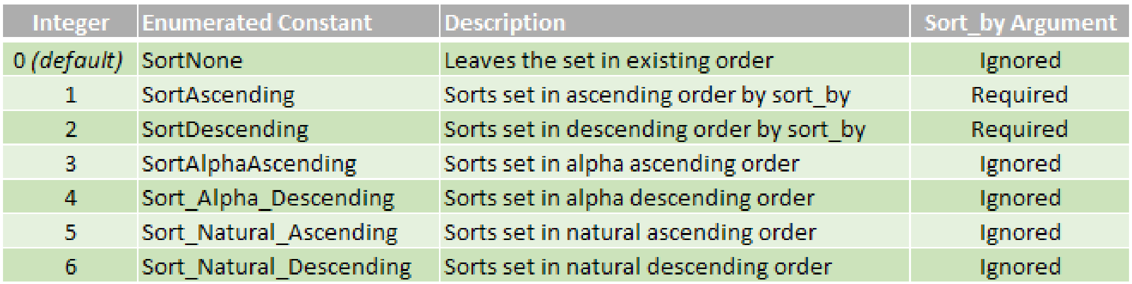
Just for a change, if you connect to a Microsoft SQL Server 2005 Analysis Services or later data source, this function defines a calculated set of members or tuples by sending a set expression to the cube on the server, which creates the set, and then returns that set to Microsoft Excel.

The **CUBESET** function employs the following syntax to operate:

CUBESET(connection, set_expression, [caption], [sort_order], [sort_by])

The **CUBESET** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **set_expression:** this is also required. This is a text string of a set expression that results in a set of members or tuples
- **set_expression** can also be a cell reference to an Excel range that contains one or more members, tuples or sets included in the set
- **caption:** this is optional. This is a text string that is displayed in the cell instead of the caption, if one is defined, from the cube
- **sort_order:** this is also optional. This is the type of sort, if any, to perform and can be one of the following:



Integer	Enumerated Constant	Description	Sort_by Argument
0 *(default)*	SortNone	Leaves the set in existing order	Ignored
1	SortAscending	Sorts set in ascending order by sort_by	Required
2	SortDescending	Sorts set in descending order by sort_by	Required
3	SortAlphaAscending	Sorts set in alpha ascending order	Ignored
4	Sort_Alpha_Descending	Sorts set in alpha descending order	Ignored
5	Sort_Natural_Ascending	Sorts set in natural ascending order	Ignored
6	Sort_Natural_Descending	Sorts set in natural descending order	Ignored

- **sort_by:** this is optional and represents a text string of the value by which to sort. For example, to get the city with the highest sales, **set_expression** would be a set of cities and **sort_by** would be the sales measure. Alternatively, to get the city with the highest population, **set_expression** would be a set of cities, and **sort_by** would be the population measure. If **sort_order** requires **sort_by** and **sort_by** is omitted, **CUBESET** returns the *#VALUE!* error message.

It should be further noted that:

- the **CUBESET** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBESET** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- if the connection name is not a valid workbook connection stored in the workbook, **CUBESET** returns an *#NAME?* error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, **CUBESET** returns an *#NAME?* error value
- if the **set_expression** syntax is incorrect or the set contains at least one member with a different dimension than the other members, **CUBESET** returns an *#N/A* error value

- If **set_expression** is longer than 255 characters, which is the limit for an argument to a function, **CUBESET** returns an *#VALUE!* error value. To use text strings longer than 255 characters, enter the text string in a cell (for which the limit is 32,767 characters), and then use a cell reference as the argument
- **CUBESET** may return an *#N/A* error value if you reference a session-based object, such as a calculated member or named set, in a PivotTable when sharing a connection, and that PivotTable is deleted or you convert the PivotTable to formulae (on the 'Options' tab in the Ribbon, in the 'Tools' group, click 'OLAP Tools', and then click 'Convert to Formulas').

Please see examples below:

=CUBESET("Finance","Order([Product].[Product].[Product Category].Members,[Measures].[Unit Sales],ASC)","Products")

=CUBESET("Sales","[Product].[All Products].Children","Products",1,"[Measures].[Sales Amount]").

The A to Z of Excel Functions: CUBESETCOUNT

When the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source, this function returns the number of items in a set.

The **CUBESETCOUNT** function employs the following syntax to operate:

CUBESETCOUNT(set)

The **CUBESETCOUNT** function has the following arguments:

- set: this is required and represents a text string of a Microsoft Excel expression that evaluates to a set defined by the **CUBESET** function
- set can also be the **CUBESET** function, or a reference to a cell that contains the **CUBESET** function.

It should be further noted that:

- the **CUBESETCOUNT** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBESETCOUNT** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved.

Please see the examples below:

=CUBESETCOUNT(A3)

=CUBESETCOUNT(CUBESET("Sales","[Product].[All Products].Children","Products",1,"[Measures].[Sales Amount]")).

The A to Z of Excel Functions: CUBEVALUE

Finally, let's shake it up for our last function this month and, er, link an Excel workbook to a Microsoft SQL Server 2005 Analysis Services or later data source. Then, this function returns an aggregated value from the cube.

The **CUBEVALUE** function employs the following syntax to operate:

CUBEVALUE(connection, [member_expression1], [member_expression2], …)

The **CUBEVALUE** function has the following arguments:

- **connection:** this is required and represents a text string of the name of the connection to the cube
- **member_expression:** these arguments are optional. Each is a text string of a multi-dimensional expression (**MDX**) that evaluates to a member or tuple within the cube. Alternatively, **member_expression** can be a set defined with the **CUBESET** function. Use member_expression as a slicer to define the portion of the cube for which the aggregated value is returned. If no measure is specified in **member_expression**, the default measure for that cube is used.

It should be further noted that:

- the **CUBEVALUE** function is supported only when the workbook is connected to a Microsoft SQL Server 2005 Analysis Services or later data source
- when the **CUBEVALUE** function evaluates, it temporarily displays a "*#GETTING_DATA…*" message in the cell before all of the data is retrieved
- if a cell reference is used for member_expression and that cell reference contains a **CUBE** function, then **member_expression** uses the **MDX** expression for the item in the referenced cell, and not the value displayed in that referenced cell
- if the connection name is not a valid workbook connection stored in the workbook, CUBEVALUE returns an #NAME? error value. If the Online Analytical Processing (OLAP) server is not running, not available or returns an error message, CUBEVALUE returns an #NAME? error value
- if at least one element within the tuple is invalid, **CUBEVALUE** returns an *#VALUE!* error value
- **CUBEVALUE** returns an *#N/A* error value when:
  - the **member_expression** syntax is incorrect
  - the member specified by **member_expression** doesn't exist in the cube
  - the tuple is invalid because there is no intersection for the specified values (this can occur with multiple elements from the same hierarchy)
  - the set contains at least one member with a different dimension than the other members

- **CUBEVALUE** may return an *#N/A* error value if you reference a session-based object, such as a calculated member or named set, in a PivotTable when sharing a connection, and that PivotTable is deleted or you convert the PivotTable to formulae (on the 'Options' tab in the Ribbon, in the 'Tools' group, click 'OLAP Tools', and then click 'Convert to Formulas').

Known issue: null values are converted to zero-length strings

In Excel, if a cell has no data because you never changed it or you deleted the contents, the cell contains an empty value. In many database systems, an empty value is called a null value. An empty or null value literally means "no value". However, a formula can never return an empty string or null value. A formula always returns one of three values: a number value; a text value (which may be a zero-length string) or an error value, such as *#NUM!* or *#VALUE!*

If a formula contains a **CUBEVALUE** function connected to an Online Analytical Processing (OLAP) database and a query to this database results in a null value, Excel converts this null value to a zero-length string, even if the formula would otherwise return a number value. This can lead to a situation where a range of cells contain a combination of numeric and zero-length string values, and this situation can affect the results of other formulae that reference that range of cells. For example, if **A1** and **A3** contain numbers, and **A2** contains a formula with a **CUBEVALUE** function that returns a zero-length string, the following formula would return an *#VALUE!* error:

=A1+A2+A3

To prevent this, you can test for a zero-length string by using the **ISTEXT** function and by using the **IF** function to replace the zero-length with a 0 (zero) as the following example shows:

=IF(ISTEXT(A1),0,A1)+IF(ISTEXT(A2),0,A2)+IF(ISTEXT(A3),0,A3)

Alternatively, you can nest the **CUBEVALUE** function in an **IF** condition that returns a zero value if the **CUBEVALUE** function evaluates to a zero-length string as the following example shows:

=IF(CUBEVALUE("Sales","[Measures].[Profit]","[Time].[2020]","[All Product].[Beverages]")="",0, CUBEVALUE("Sales","[Measures].[Profit]","[Time].[2020]","[All Product].[Beverages]"))

Note that the **SUM** function does not require this test for a zero-length string because it automatically ignores zero-length strings when calculating its return value.

Please see our final examples below:

=CUBEVALUE("Sales","[Measures].[Profit]","[Time].[2020]","[All Product].[Beverages]")

=CUBEVALUE(A1,"[Measures].[Profit]",D$12,$A23)

=CUBEVALUE("Sales",B7,D$12,$A23).

More Excel Functions next year…

Upcoming SumProduct Training Courses

Location	Course	Date	Duration
Sydney	Excel Tips & Tricks	10 Dec 2018	1 Day
Sydney	Financial Modelling	11 - 12 Dec 2018	2 Days
Sydney	Power Pivot, Power Query and Power BI	17 - 19 Dec 2018	3 Days
Sydney	Power Pivot, Power Query and Power BI	21 - 23 Jan 2019	3 Days
Melbourne	Power Pivot, Power Query and Power BI	29 - 31 Jan 2019	3 Days
Sydney	Excel Tips & Tricks	4 Feb 2019	1 Day
Sydney	Financial Modelling	5 - 6 Feb 2019	2 Days
Brisbane	Excel Tips & Tricks	11 Feb 2019	1 Day
Brisbane	Financial Modelling	12 - 13 Feb 2019	2 Days
Melbourne	Excel Tips & Tricks	19 Feb 2019	1 Day
Melbourne	Financial Modelling	20 - 21 Feb 2019	2 Days
Perth	Excel Tips & Tricks	25 Feb 2019	1 Day
Perth	Financial Modelling	26 - 27 Feb 2019	2 Days
Melbourne	Power Pivot, Power Query and Power BI	11 - 13 Mar 2019	3 Days

Key Strokes

Each newsletter, we'd like to introduce you to useful keystrokes you may or may not be aware of. This month, it's time we took **CTRL** of the function keys

Keystroke	What it does
CTRL + F1	Show / hide Ribbon
CTRL + F2	Print
CTRL + F3	Open Name Manager
CTRL + F4	Close Window
CTRL + F5	Restore Window
CTRL + F6	Next Window / Workbook
CTRL + F7	Move Window
CTRL + F8	Size Window
CTRL + F9	Minimise Window
CTRL + F10	Toggle Maximised / Restored
CTRL + F11	Insert New Macro Sheet
CTRL + F12	Open

There are over 540 keyboard shortcuts in Excel. For a comprehensive list, please download our Excel file a www.sumproduct.com/thought/keyboard-shortcuts. Also, check out our new daily **Excel Tip of the Day** feature on the www.sumproduct.com homepage.

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Link to Others

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