It's another bumper edition with all sorts of Excel, Power BI and financial modelling articles to read. I can't keep up – and I edit them!

This month, we look at how you can get at Excel's syntax easily, plus new Excel features such as Save As Picture and auto-detecting Data Types. There is important news about Power BI Desktop and Windows 7, plus there is a free Microsoft download to play with if you fancy your chances with the stock markets (definitely interesting given the current world economy!).

We also have our monthly regulars Beat the Boredom, Visual Basics, Power Pivot Principles, Power Query Pointers, Power BI updates for Desktop, Service and Mobile, plus we face the **FACT** that the A to Z of Excel Functions is continuing and even there are the usual Keyboard Shortcuts too (we show you how to keep **CTRL** of your functions...).

Happy reading and remember: stay safe, stay happy, stay healthy.

Until next month.

*Liam Bastick,* Managing Director, SumProduct

A is for Assistance

Now we know we have an entire section of the newsletter dedicated to keyboard shortcuts, but every now and then we get a tip we hadn't come across before that we think is worth highlighting – and this is such a case.

For example, imagine you wanted to get acquainted with a little-known and infrequently used function such as, *say*, **VLOOKUP**. If you were to start typing the formula into a cell, you would see
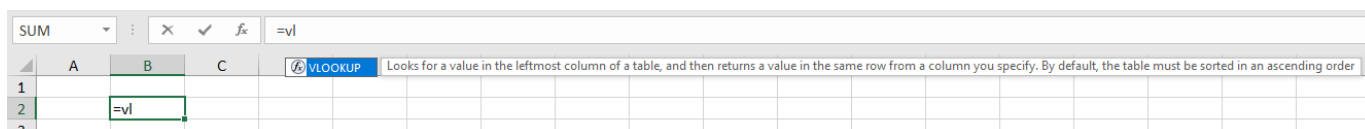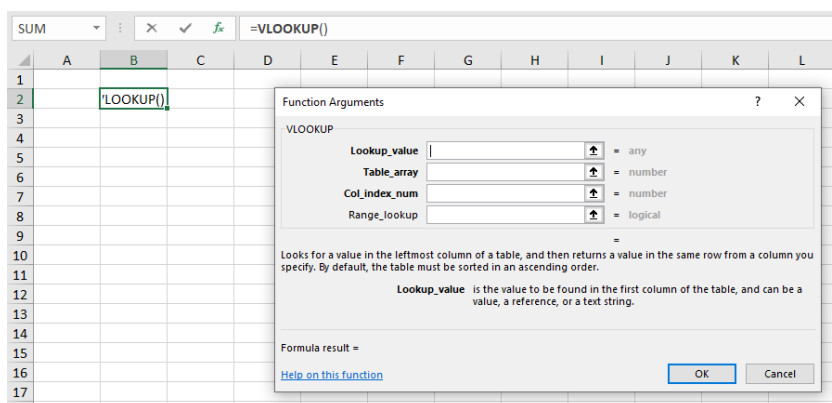

Tiny image, we know, but Microsoft never thought to wrap text in its screen tips!

If at this stage, I were to press **TAB**,
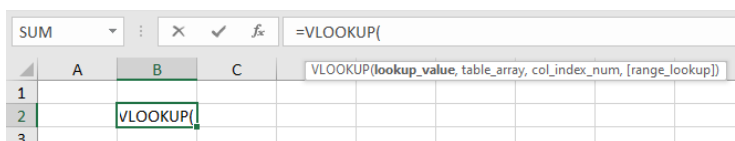
the function name would autocomplete, together with the opening parenthesis (that's the posh word for bracket). At this stage, whilst still in Edit mode, if I were to press **CTRL + A**,

I would get the 'Function Arguments' dialog which could help me complete my formula. OK, you may or may not have known this (we did), but there is an alternative that fellow Excel MVP **Nabil Mourad** filled us in on. Instead of using the keyboard shortcut **CTRL + A**, look what happens if I were to execute **CTRL + SHIFT + A** instead:
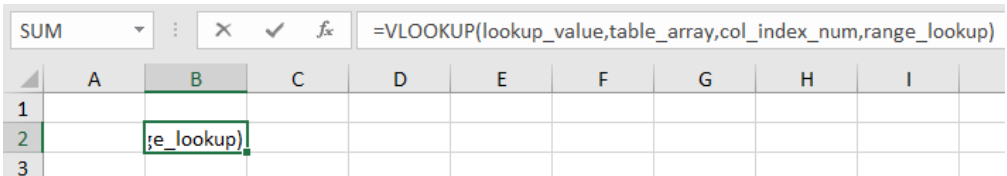

The function syntax is now **displayed in the cell**. We think that's quite a clever trick, which could be useful when attempting to explain a function to a colleague.

It should be noted that these tricks don't work with all functions (*e.g.* the usual suspects such as **DATEDIF** and **EVALUATE** are immune) and may require an interim step where alternative syntax is available (*e.g.* **AGGREGATE** or **INDEX**) – but hey, a cool trick is still a cool trick!
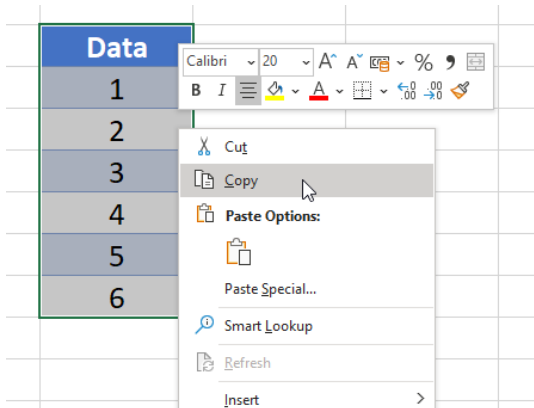
Save As Picture

Now this one is a bit of an interesting curiosity. Indeed, I have been saving images from Word and PowerPoint as pictures for years, but you have not been able to do the same thing in Excel. Granted, it was possible by simply copying an pasting into a graphics editor (*e.g.* Paint) and choosing a graphics file format (please see https://support.microsoft.com/en-us/office/save-a-chart-as-a-picture-254bbf9a-1ce1-459f-914a-4902e8ca9217 for more details).

However, unannounced by Microsoft, Microsoft 365 Beta / Insider / whatever it's called this week has a new option in Excel for charts, shapes and SmartArt – **Save as Picture**. Simply right-click on the item in Excel and select the option from the shortcut menu, *viz*.
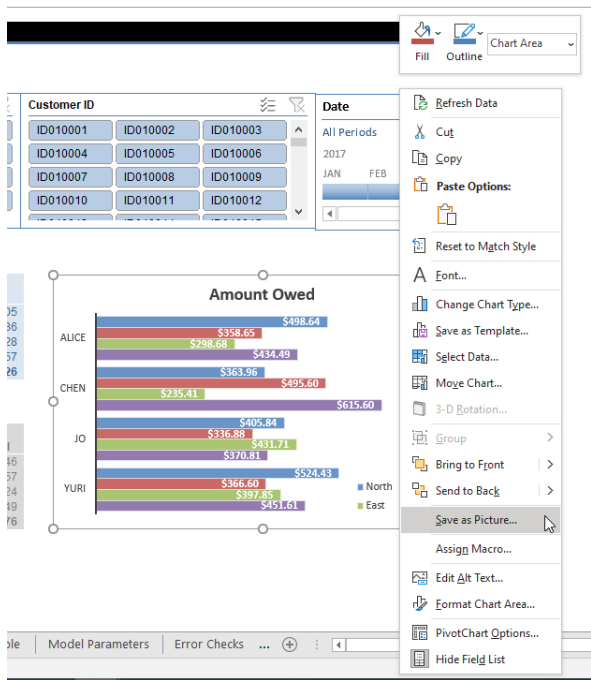

The default option is to save as a **.png** file, but other standard formats are available too. It's worth noting that the chart export is based upon the zoom level. Therefore, it's worthwhile temporarily setting the zoom to maximum (400%) before saving, so you get a higher resolution.
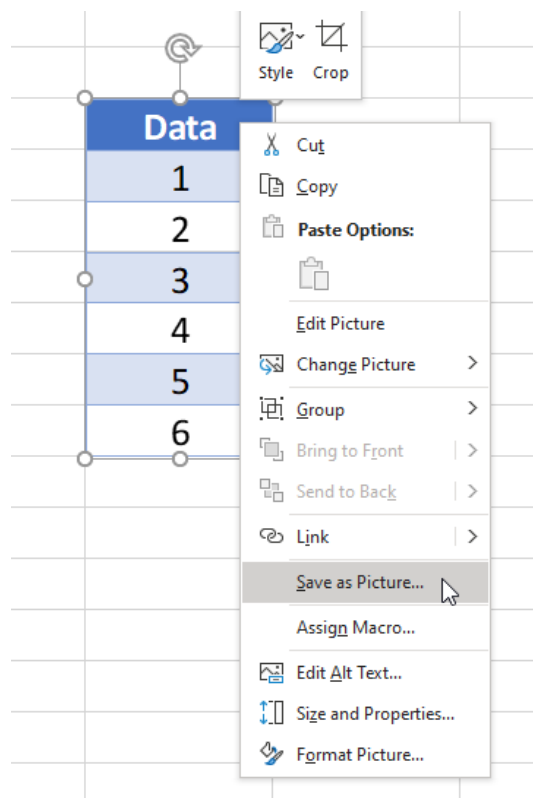
The one thing missing is copying *data* as a picture! You can use Excel's camera tool, but there is another alternative. First, copy your data in the usual way:

Then, go to 'Paste Special...' and paste as a picture (**ALT + H + V + U + ENTER**):
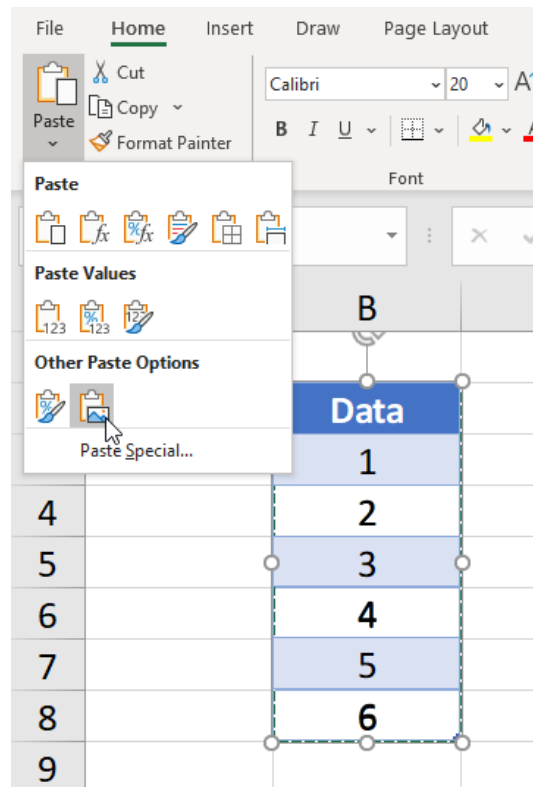
Once you have it pasted, you may right-click this image and **Save as Picture**, as before.

Simple trick!

Auto-detecting Data Types

Here's a new one. As regular readers will know, Data Types such as Stocks and Geography have been available for a while, but many users simply aren't aware of their existence. That's about to change. Excel is going to get more bolshy and let users know when they have data in their workbook that could be enhanced by Data Types which will help users pull in external data to enhance the data they're analysing.
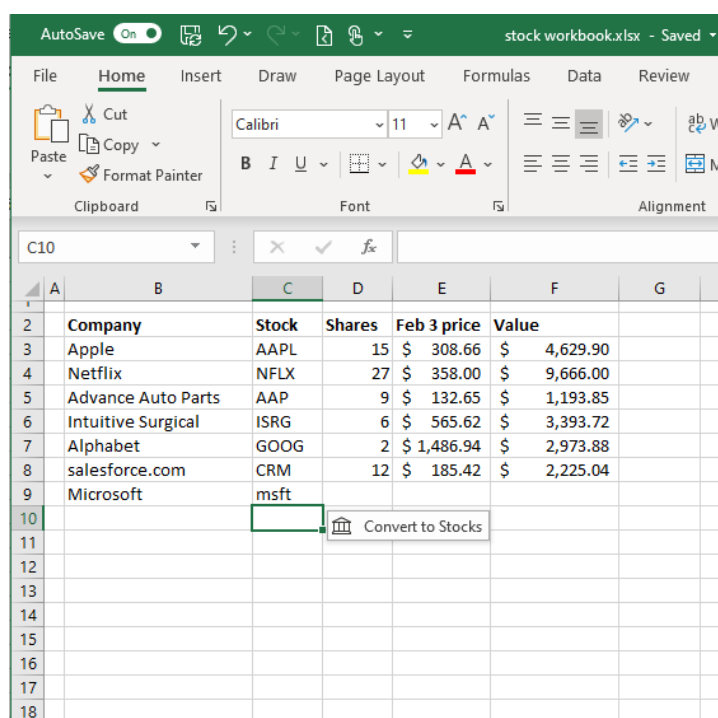
To see it in action, imagine you typed in several geographic locations or stock ticker symbols and put them in a columnar format (*i.e.* listed them in a column). For example, "Sydney", "Tokyo", "London" or "MSFT", "ADBE", "GOOG".

A ScreenTip will appear (either Convert to Geography or Convert to Stocks, depending upon what you typed). All you have to do is click on that ScreenTip as it appears to the right of the selected cell.

It should be noted that for the moment, auto detecting in Excel is only available when an English input language is installed, and even then you have to have the right version of Excel. Currently, this feature is available to Current Channel (Preview) users who are running Version 1911 Build 11326.10000 or later.

New investment tracking template using Data Types and the STOCKHISTORY function

Microsoft has just released a new investment tracking template out into the wild. You can use it for automatically fetching and tracking investment data such as stock prices and history and it may be downloaded from here: https://go.microsoft.com/fwlink/?linkid=2141359&clcid=0x409. It uses both the Stocks Data Type and the **STOCKHISTORY** function.

Once you have downloaded and opened the spreadsheet, you land on the 'Welcome' worksheet.

Here, you may change the Theme settings: if you prefer a darker look, you can set it to Dark theme. The entire template will transition be as black as my mood.

This sheet also explains how you can add or replace stocks, which may be identified using tickers or company names.

The 'Portfolio' sheet is the main sheet, where you enter your investments and shares to see their current values. You can quickly see the price and current day results.

A sparkline shows you the history in the row, and you can adjust the day's value to see more. For example: change it to 180 to see around six months of history.

As you scroll the sheet, you'll see additional information such as previous close and industry. You can also see a 52–week high and low and a visual that shows you how close each stock is to its high and low.

The 'Dashboard' sheet shows some of the aggregations from the Portfolio sheet, as well as a breakdown of the overall investments and categories.
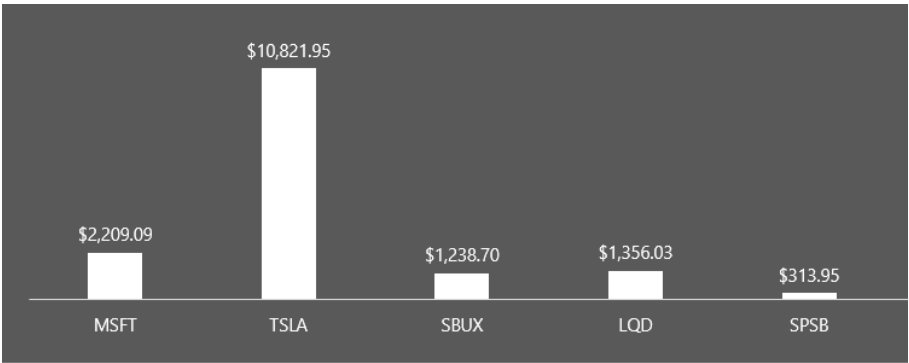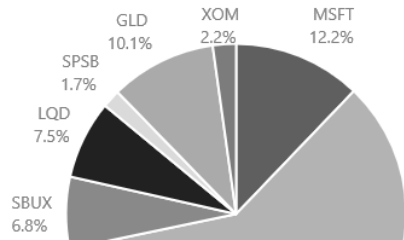
The 'Watch' sheet provides information about the company and what it does, as well as flag if a stock is within a set percentage of its 52 week high or low.

The final sheet, 'Compare', displays all the details for a stock and put it side by side with another stock to compare price, price history, trend, volume, market cap, *etc*.

Compare Stocks
Type in a couple of stocks to see their details side by side.

1st stock:

🏛 ACTIVISION BLIZZARD, INC. (XNAS:ATVI)

3100 Ocean Park Blvd, Santa Monica, Ca, 90405-3032 Us

	ACTIVISION BLIZZARD, INC.		ELECTRONIC AR
		Industry	Software & IT S
		Offical Name	
	9,200	Employees	9,800
	2000	Year Inc	1991
	$84.58	Price	$143.03
	$0.96	Change	$0.82
	1.15%	%	0.58%
		3 Month Trend	
	$47.53	52 Week Low	$85.69

Software & IT Services

Activision Blizzard, Inc. is a developer and publisher of interactive entertainment content and services. The Company develops and distributes content and services

If you don't have these features available yet, please note the following requirements:

- Data Types require a Microsoft 365 subscription
- The new Data Types are only available to the Consumer audience in English-speaking markets
- The feature is rolling out to Insiders between now and the end of October, and will be available to users running:
   o Windows: Version 2007 Build 13029.20006
   o Mac: Version 16.40 Build 20062901.

Newsflash: Office Next

The Microsoft Exchange Team has just announced that Microsoft Office will also see a new perpetual release for both Windows and Mac, in the second half of 2021. Details are scant, but check out

https://techcommunity.microsoft.com/t5/exchange-team-blog/exchange-news-and-announcements-microsoft-ignite-2020-edition/ba-p/1662224 to confirm we aren't lying to you…

Beat the Boredom Challenge

With many of us currently "working from home" / quarantined, there are only so Zoom / Teams calls you can make before you reach your data limit. Perhaps they should measure data allowance in mugs of coffee. To try and keep our readers engaged, we will continue to reproduce some

*of our popular **Final Friday Fix** challenges from yesteryear in this and upcoming newsletters. One suggested solution may be found later in this newsletter. Here's this month's…*

Not everything revolves around **LET** functions, dynamic arrays, **XLOOKUP**, VBA, Power BI, *et al*. Sometimes problems are more rudimentary and occasionally, in this series, we will highlight such challenges to encourage you to think outside the box or remember your studies from yesteryear.

This one is such an example.

In a recent financial model build, we needed to work out how much of a certain product was sold, which reduced each period, based on two multiplicative factors. Over the life of the project, the proportion that needed to be considered was:

$$\frac{1}{2 \times 5} + \frac{1}{5 \times 8} + \frac{1}{8 \times 11} + \dots + \frac{1}{998 \times 1{,}001}$$

In Excel, I just needed to sum this as *efficiently as possible* – returning the total as a fraction in its simplest form.

This month's challenge is to create an Excel spreadsheet that can calculate the result and be sufficiently flexible to allow for alternative, similar sequences of varying length. No dynamic arrays, no VBA, no megaformulae. In fact, for those readers with children, you might find they do better at this than you do…

Sound easy? Try it. One solution may be found later in this newsletter – but no reading ahead!

Visual Basics

We thought we'd run an elementary series going through the rudiments of Visual Basic for Applications (VBA) as a springboard for newer users. This month, we consider just how well you can hide...

If something is hidden, it's hard to see. Therefore, if something is very hidden, it must be very hard to see, right? That's the overall principle behind hiding sheets using VBA. Let's go over the basics.

In normal Excel, a sheet is either Visible or it's Hidden. If you can see it at the bottom of the page, it's Visible, and you can right click on the sheet name, click Hide, and this will classify the sheet as a Hidden sheet. If you want, you can then unhide the sheet by right clicking on any sheet, click on Unhide, and this will pull up a list of the Hidden sheets and you can choose which sheet to make Visible again.

Hence, if I ask you, how many sheets are there in the file in this screenshot below, you'll be forgiven for saying that there are four sheets – three that are Visible, and one that is Hidden.
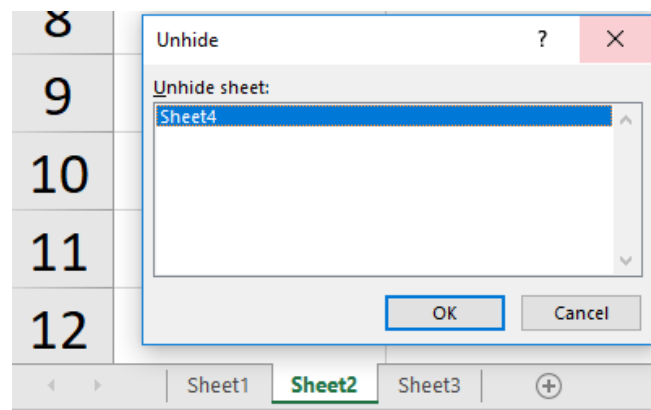
However, there's a third state of sheets that's not actually accessible via the standard Excel User Interface (UI). This state is known as Very Hidden. When a sheet is Very Hidden, not only is it an affront to the English language and not visible in your list of sheets, it's also not shown in the list of sheets when you click on 'Unhide'. Very hidden indeed!

The only way to access a Very Hidden sheet is to go into the VBA Editor (**ALT + F11**). On the top left-hand side of the screen, you'll see the Project Explorer. In here, you'll see different files and add-ins that you have open, along with the relevant objects that they're made up of. Here you'll see the answer to my earlier question – this file has 11 sheets! Click on one of the sheets in any file you have open.
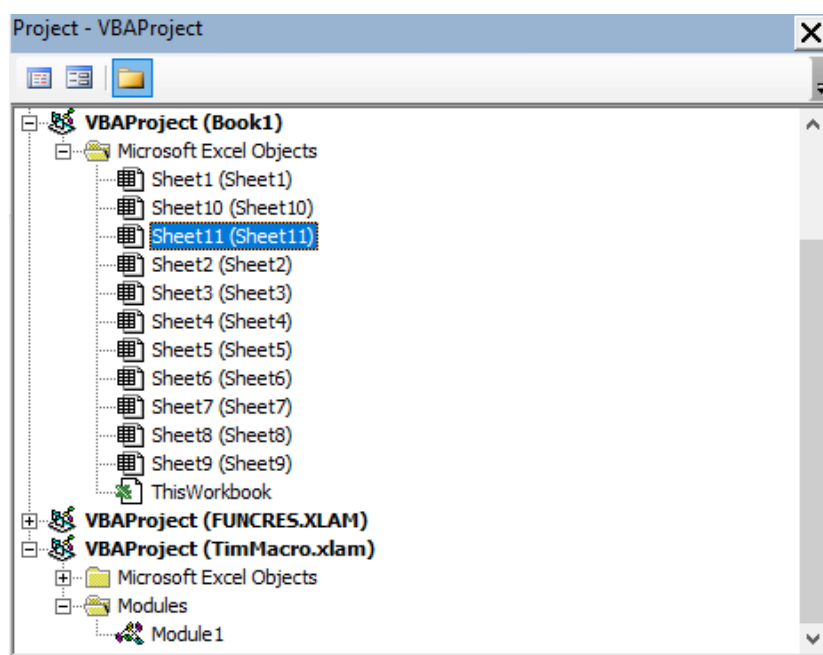
Just below the Project Explorer, you'll see the Properties window. This contains a number of key settings about the sheet, including the name, whether page breaks are visible, if calculations are on, and so on. The property we're most concerned about in this instance is the very bottom one – the Visible property.
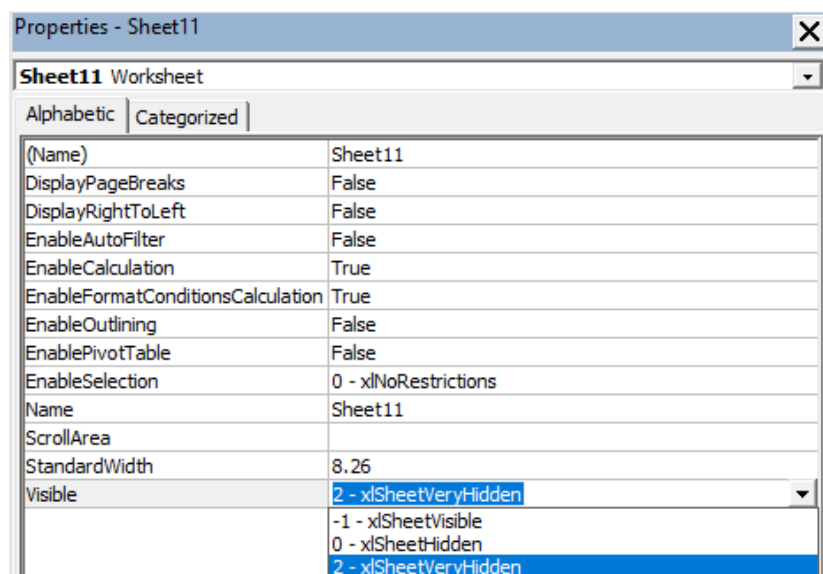
You can see in the screenshot that my sheet is currently selected to **xlSheetVisible** – the technical name for the Visible state. You'll see that there are two others though – **xlSheetHidden** and **xlSheetVeryHidden**. These are the two states that I described earlier – either Hidden and can be unhidden using the UI, or Very Hidden and only accessible via VBA. You can change the state of the sheet here in the Properties window, and that will immediately hide the sheet accordingly in Excel.

Therefore, if you ever want to hide a sheet in a slightly more secure way (people can always come into the VBA editor and check for themselves), then the Very Hidden sheet state is what you're looking for.

If we want to actually code this up, we'd use the following:

```
Sheets("Sheet1").Visible = xlSheetVisible
Sheets("Sheet2").Visible = xlSheetHidden
Sheets("Sheet3").Visible = xlSheetVeryHidden
```

If you couldn't guess, this will set Sheet1 to be Visible, Sheet2 to be Hidden (and able to be unhidden using the UI), and Sheet3 to be Very Hidden, requiring users to get to it via VBA.

More next time.

Power Pivot Principles

We continue our series on the Excel COM add-in, Power Pivot. This month, we look at multiple tables.

In our previous articles, we have created PivotTables that filter information for us. However, in those PivotTables we only used information from a single table. This time, we are going to build a PivotTable from multiple tables.

In Excel it would be very difficult to code a PivotTable to draw data from more than one table; Power Pivot, on the other hand, can do this with ease.

First things first, let's ensure that our dataset has multiple tables. From the 'Home' tab in the Power Pivot window we can navigate to the 'Diagram View':
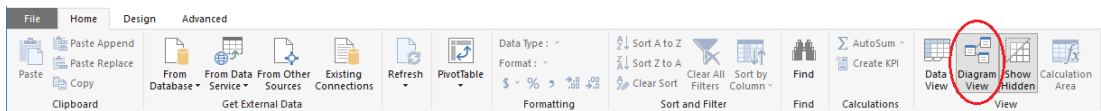
We should then see a collection of tables:
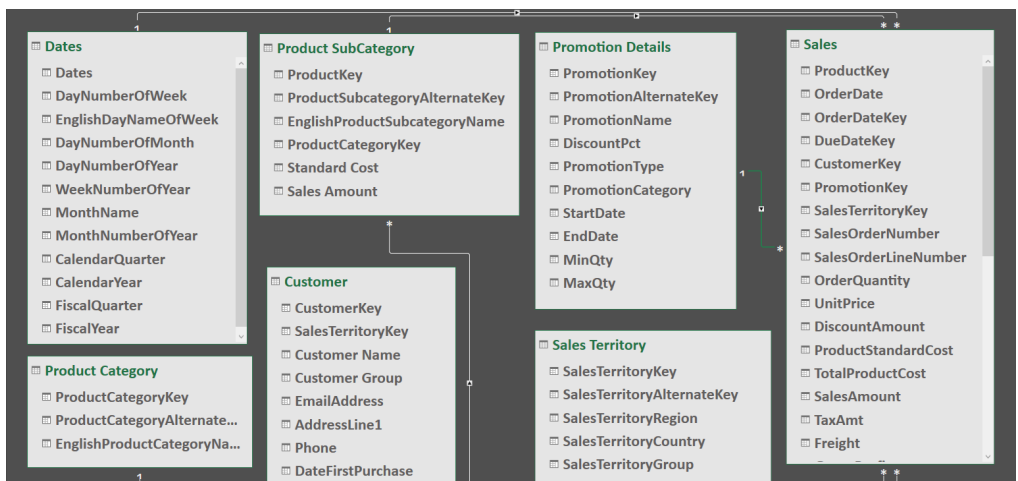
Ensure that the tables have appropriate relationships established, by dragging and dropping the fields, as required. Next, let's head back to our Excel window and look at the 'PivotTable Fields' section:
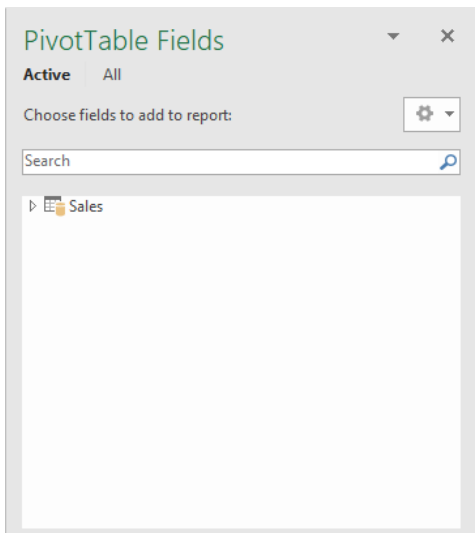
There appears to be only one table here, even though we've linked all of the tables together. Why don't they appear? This is a common query and an indictment on the user interface. We have to select the 'All' option (it is annoying that Excel always defaults to 'Active', but it is trying to be "helpful").
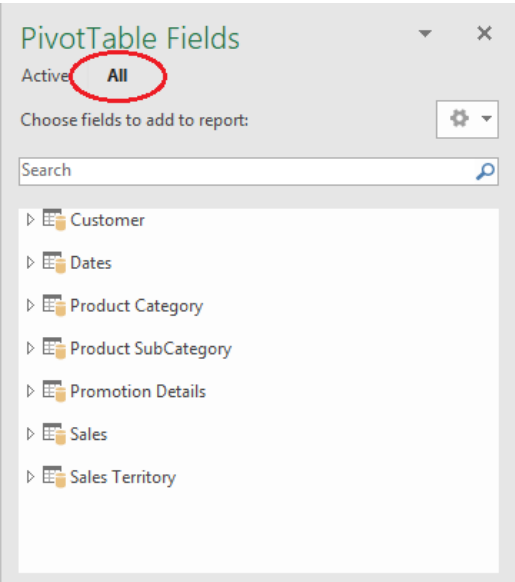
We can create a PivotTable with data from all of the tables in the list here. Let's start with the Sales from the 'Sales' table, and the **EnglishProductCategoryName** from the 'Product Category' table.

Row Labels	Sales
Accessories	$89,364.90
Cosmetics	$600,252.55
Skin Care	$653,603.95
Tanning Products	$477,377.15
Grand Total	**$1,820,598.55**

We can also add in the **Dates** from the 'Dates' table.

Sales	Column Labels				
Row Labels	Accessories	Cosmetics	Skin Care	Tanning Products	Grand Total
⊞2014	$1,291.40	$9,656.75	$11,716.25	$6,838.05	$29,502.45
⊞2015	$4,369.55	$26,037.95	$29,555.10	$20,739.05	$80,701.65
⊞2016	$35,854.25	$239,874.50	$264,768.95	$193,540.85	$734,038.55
⊞2017	$47,849.70	$324,683.35	$347,563.65	$256,259.20	$976,355.90
Grand Total	$89,364.90	$600,252.55	$653,603.95	$477,377.15	$1,820,598.55

As an added bonus, we can expand on the dates to view the breakdown based upon quarters and months:

| Sales	Column Labels				
Row Labels	Accessories	Cosmetics	Skin Care	Tanning Products	Grand Total
⊟2014					
⊟Qtr3					
⊞Jul	$131.40	$1,359.75	$1,741.95	$895.00	$4,128.10
⊞Aug	$184.45	$1,203.45	$1,690.65	$1,160.55	$4,239.10
⊞Sep	$164.95	$1,558.05	$1,774.65	$800.60	$4,298.25
⊞Qtr4	$810.60	$5,535.50	$6,509.00	$3,981.90	$16,837.00
⊞2015	$4,369.55	$26,037.95	$29,555.10	$20,739.05	$80,701.65
⊞2016	$35,854.25	$239,874.50	$264,768.95	$193,540.85	$734,038.55
⊞2017	$47,849.70	$324,683.35	$347,563.65	$256,259.20	$976,355.90
Grand Total	$89,364.90	$600,252.55	$653,603.95	$477,377.15	$1,820,598.55

More *Power Pivot Principles* next month.

Power Query Pointers

Each month we'll reproduce one of our articles on Power Query (Excel 2010 and 2013) / Get & Transform (Office 365, Excel 2016 and 2019) 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 lists.

This time out, let's start with a nice simple example. In a new query, we will create a list of consecutive numbers.
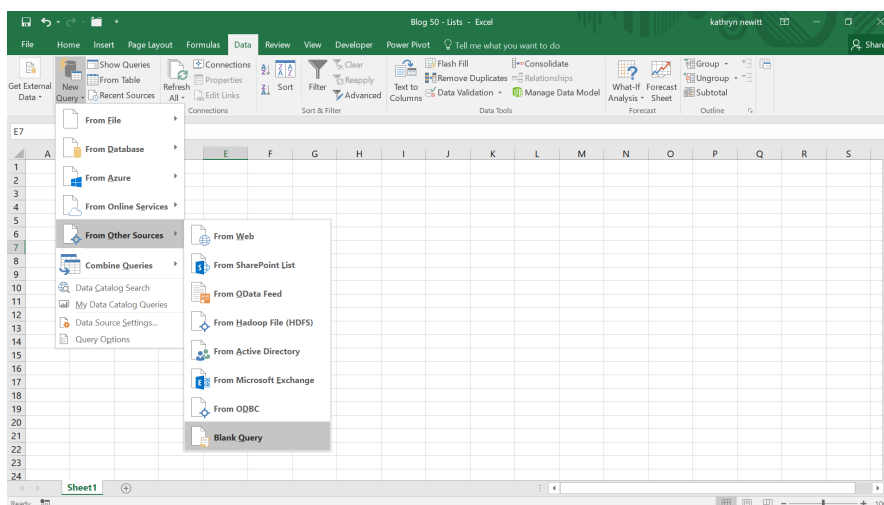
Curly brackets (or braces) **{ }** indicate that a list is enclosed. For whole numbers, we can define a range by giving my start and end points and separate them by an ellipsis of two dots (**..**) to indicate that the intervening numbers should be included. Therefore, we may specify a list from 1 to 10 by entering

    = {1..10}

in the formula bar.
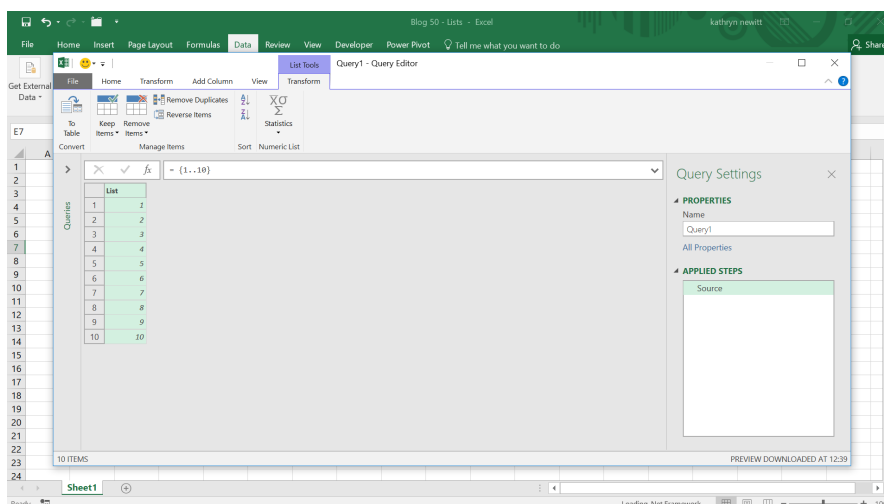
Numbers are not the only list we may create with this format; we can create a list of consecutive letters. Since letters are text, they must be surrounded by speech marks **" "**.
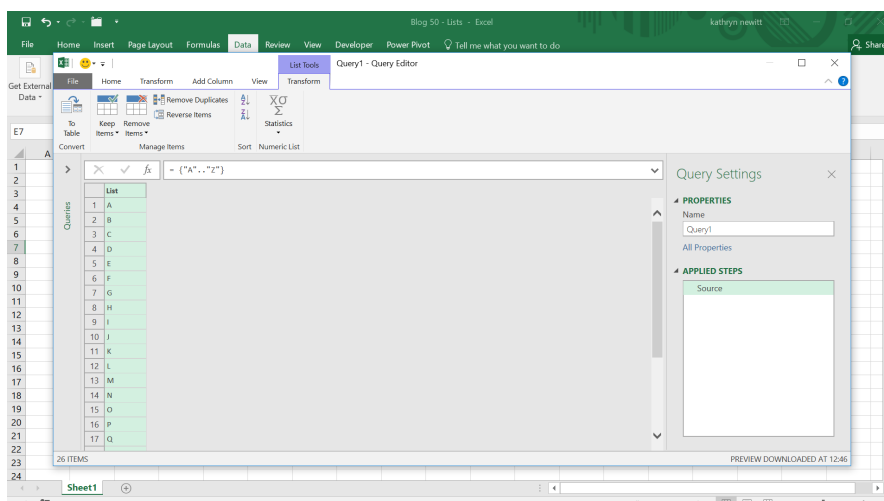
Using ellipses with characters is limited to single characters though, so although we can create this list,

= {"0".."9"}
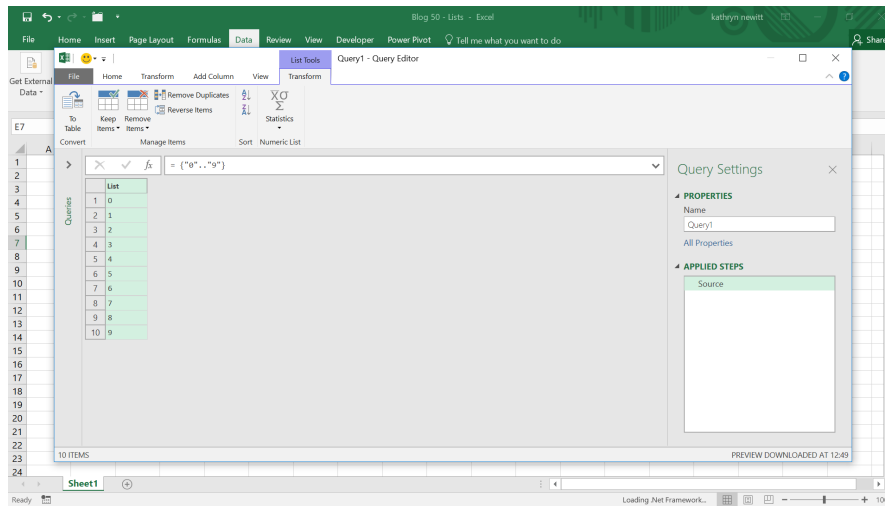
We are not allowed to create this:

= {"0".."10"}
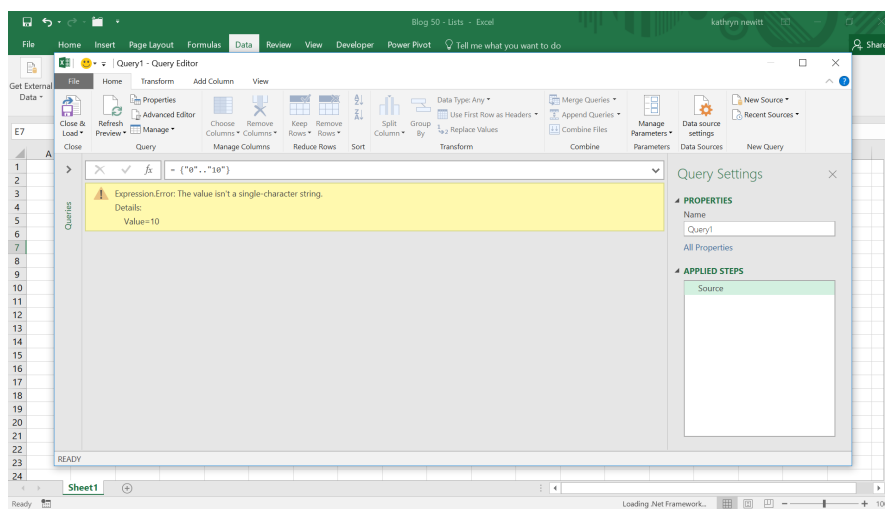
We have to specify the whole list instead:

= {"0","1", "2", "3", "4", "5", "6", "7", "8", "9", "10"}
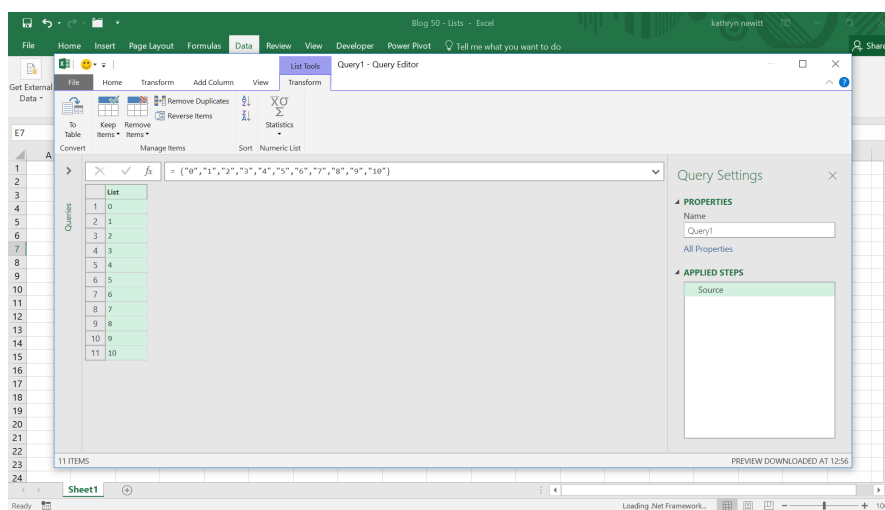
Therefore, lists with ellipses are more useful for numbers. What if you want to create a list of dates without typing them out? In this case, you can't just type the number for the date as 15/11/17 or even 151117, as this is not how Power Query will recognise it. However, we may use the serial number of the date. In order to get a date in serial number format, we can use the **Number.From** function:

Number.From(value as any, optional culture as nullable text) as nullable number

The value is **#date** and we need to give the date as a year, month and day separated by commas. Therefore, one such example would be:

= Number.From(#date(2017,11,15))

We may create a list of the dates (in serial number format) until the end of November, *viz*.
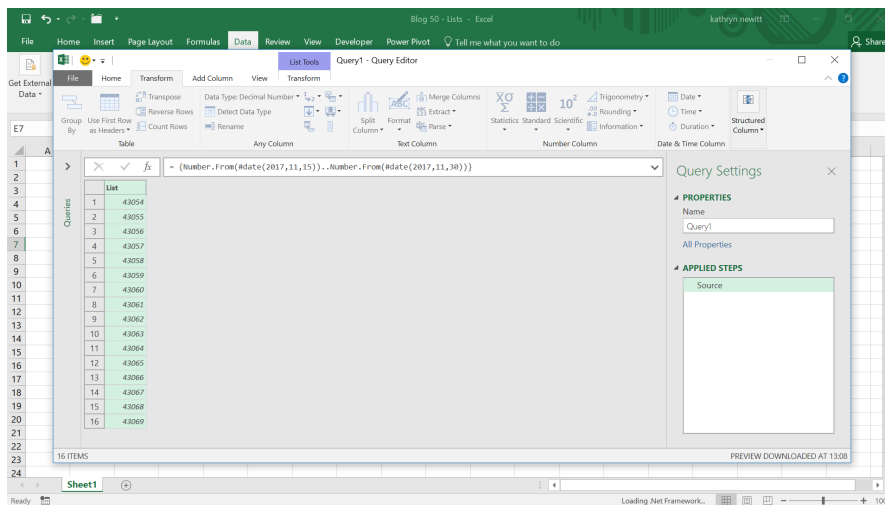
If we want the dates to look like dates, then we need more formatting options open to us. Having created our list, if we want to transform data or merge with other tables, then we need to convert our list to a table, which is easy to do, as the options for lists are automatically displayed when we create the list.
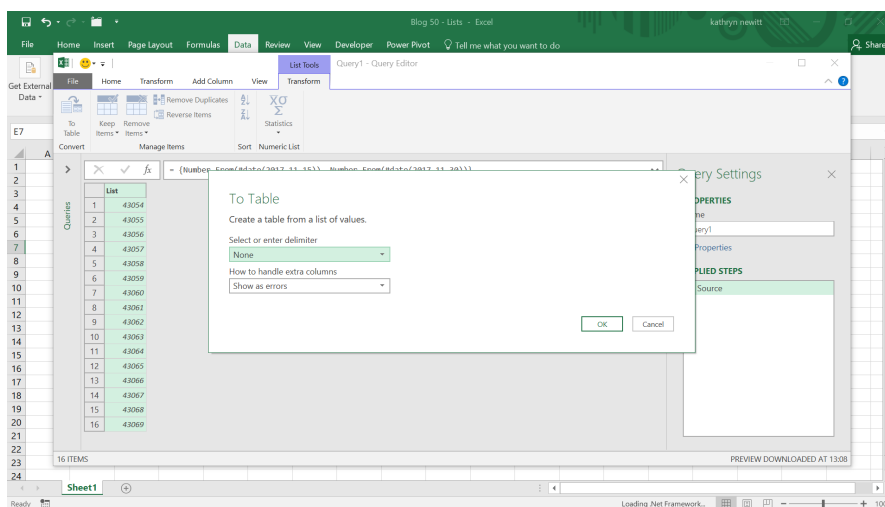
As we have created a very simple list, we may take the defaults and create a table. In the 'Transform' tab, we can choose to convert the 'Data Type' to 'Date' (we could also do this from the 'Home' tab).
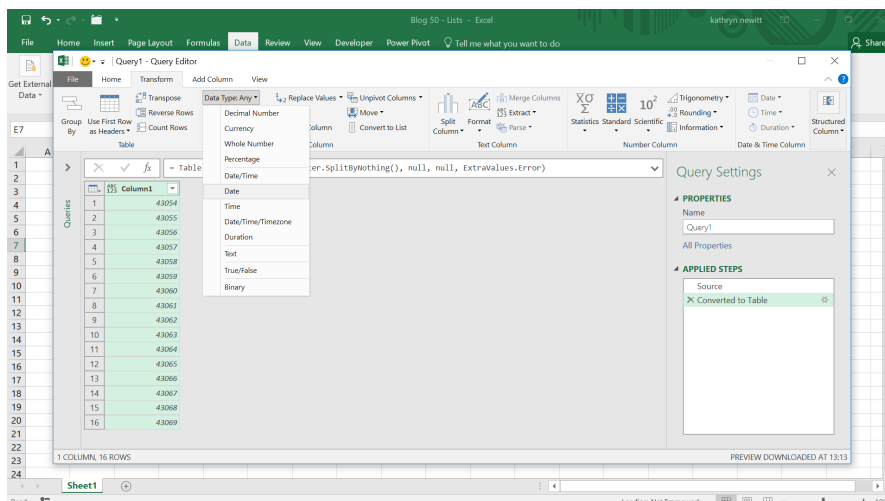
Thus, we have a list of dates in a recognisable format.
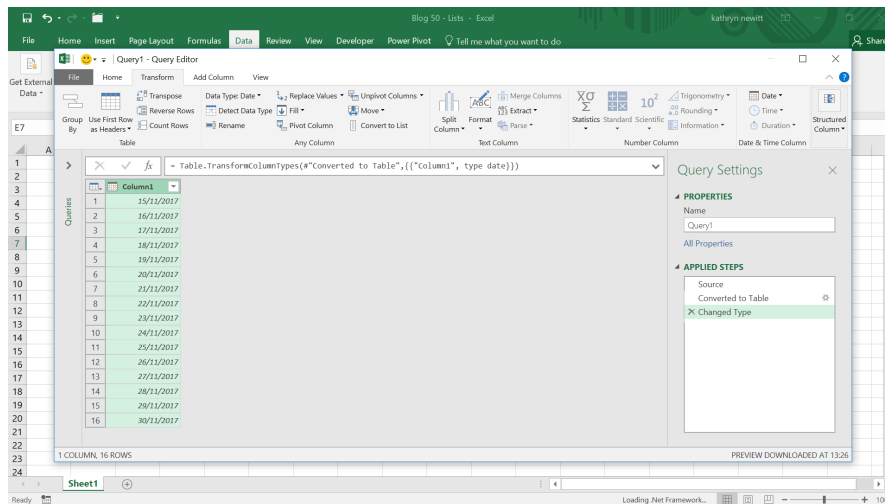
There are other ways to get a list of dates (without using the ellipsis). The **List.Dates** function allows more flexibility:

List.Dates(start as date, **count** as number, **step** as duration**) as list**

We are going to create the list again from a blank query, using this function.

=List.Dates(#date(2017,11,15), 16, #duration(1,0,0,0))

Now, since this function is more flexible, it looks more complicated. We have specified the start date as before, then we need to specify how many list entries we want and finally, what the difference is between each entry. Since we may also use this function for 'datetimes' the duration may be hours, minutes, *etc*. Let's choose to increment by one day at a time.

That sounds complicated: if only there were some way to remind us what to enter for the **List.Dates** function…
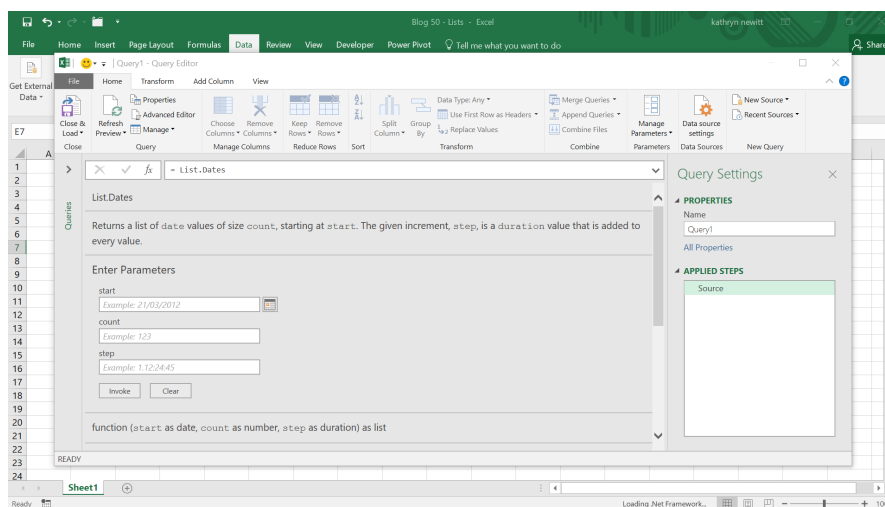
Now this is useful. Power Query has recognised what we are trying to do when we enter **List.Dates**, and we may enter the parameters one at a time.
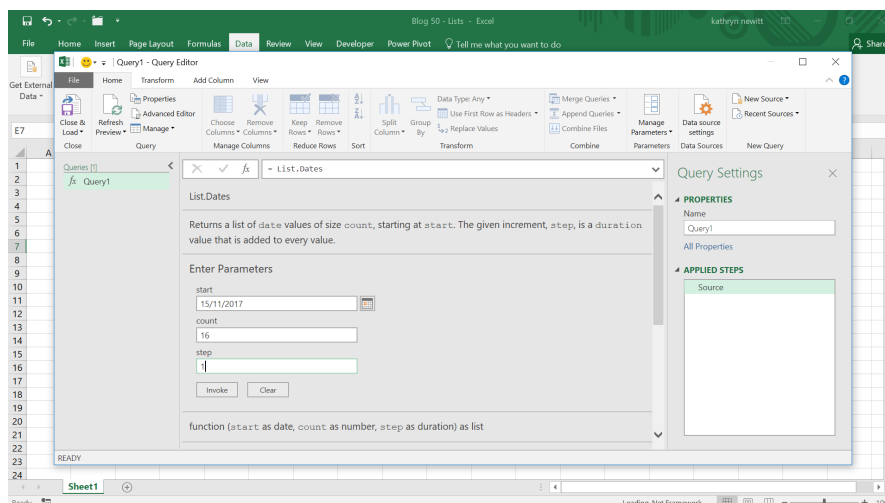
Let's enter the parameters (enter one [1] as the step or increment as we'll assume one day is the default).
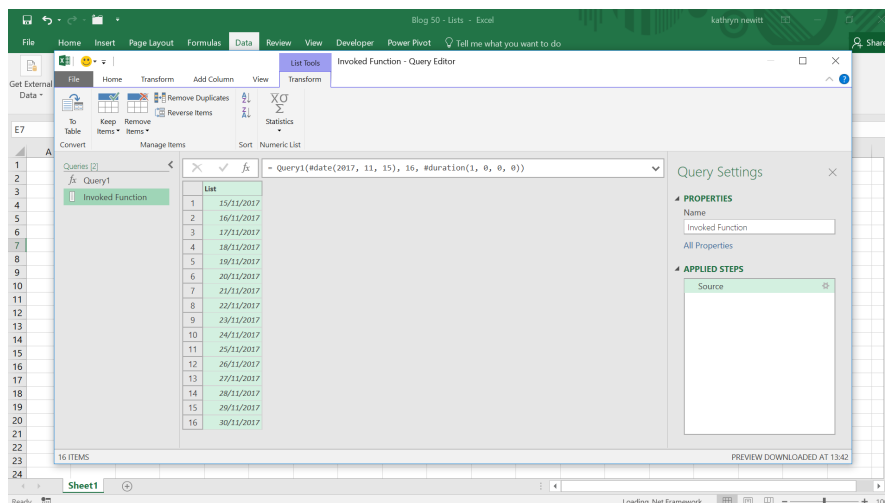
The advantage this way, is that the dates are created in a recognisable format so we can see they are all there.

There are some other interesting uses of the **List** functionality too. We can list numbers, without using an ellipsis, and by specifying the interval:

List.Numbers(start as number, **count** as number, **optional increment** as nullable number**) as { Number }**

This function is very flexible too, although it looks complicated. Let's create a list with the following formula:

= List.Numbers(3, 16, 3)

Therefore, we are expecting our list to start at three (3), have 16 entries and have an interval or increment of three (3). As before, we don't have to remember how to use the parameters; we can just enter **List.Numbers**:
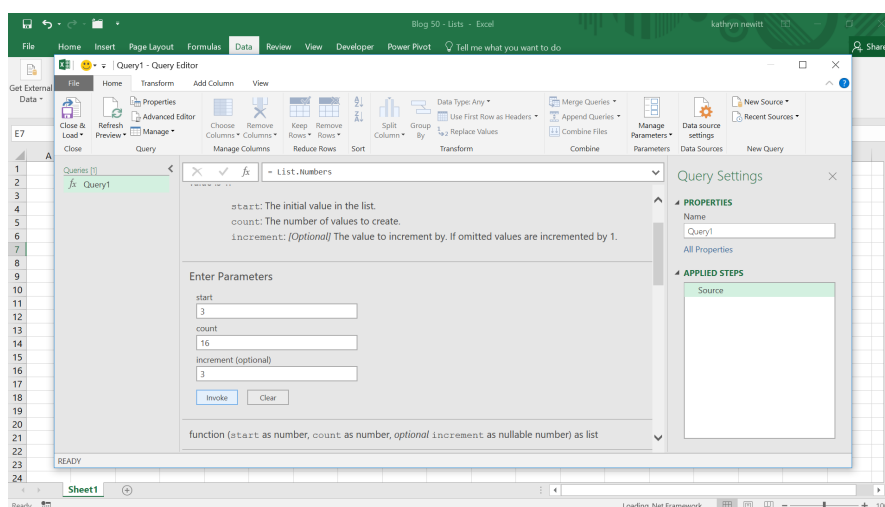
We are now expecting to see our three times table:
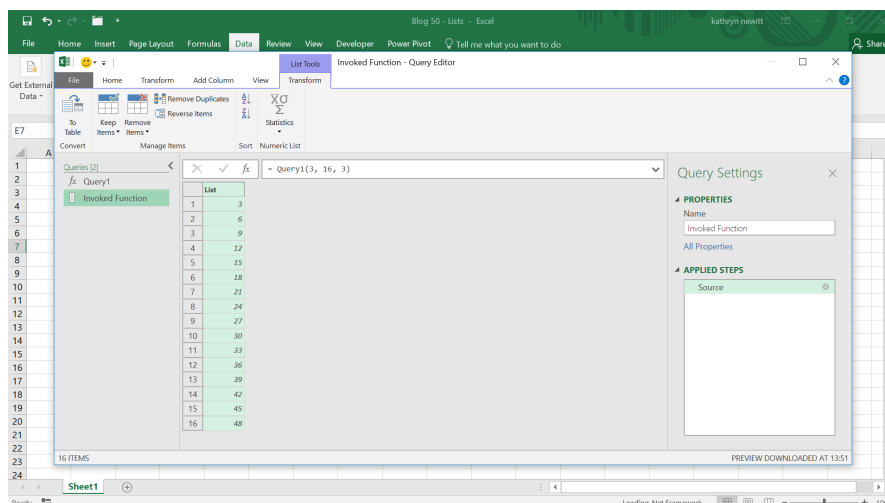
We don't have to stick to whole numbers; if we choose different parameters we can have a list of decimals:
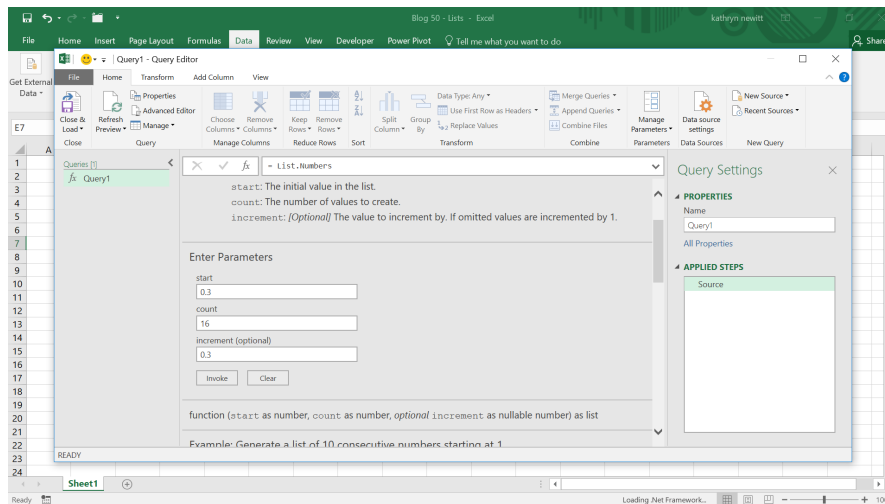
This time we should expect to see our 0.3 times table!
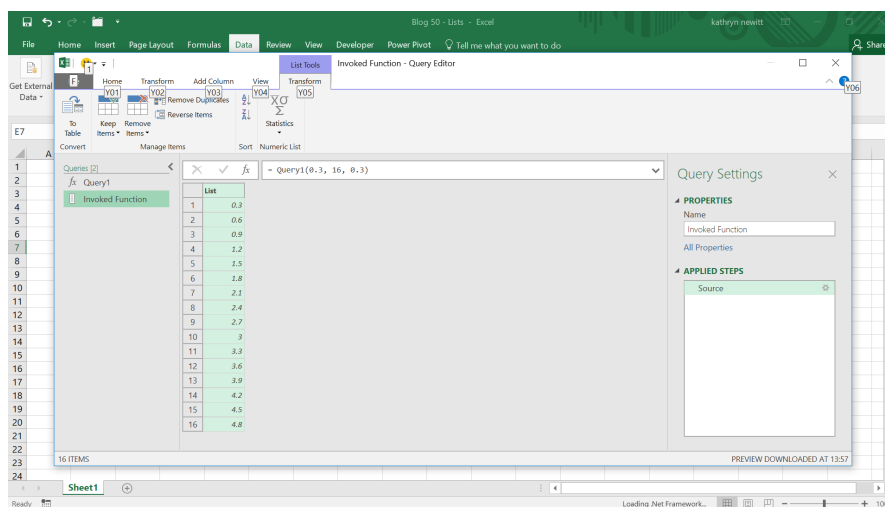
If for some reason we want to see our list in reverse, this can be achieved as follows:

List.Reverse(list as list**) as list**

The **list** can be created using any of the methods used so far, so we can create

= List.Reverse({1..15})
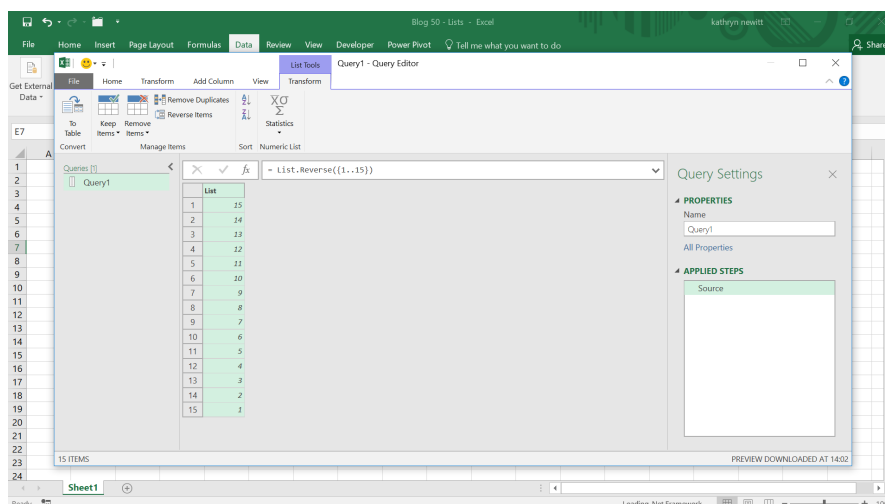
We can reverse our three times table:
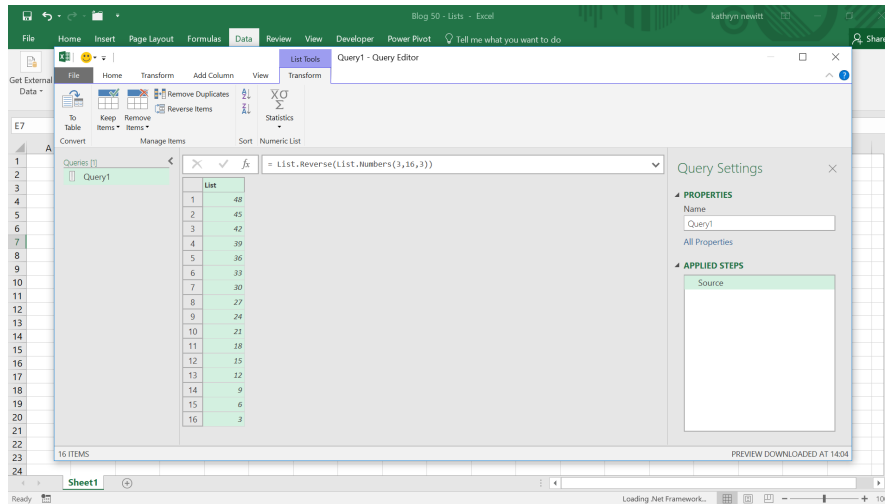
Finally (for this month), we may create a repeating list of numbers, with **List.Repeat**:

List.Repeat(list as list**, count** as number**)** as list

This repeats any list as many times as we want. Therefore, we can repeat the first three entries of our three times table.

= List.Repeat(List.Numbers(3,3,3),3)
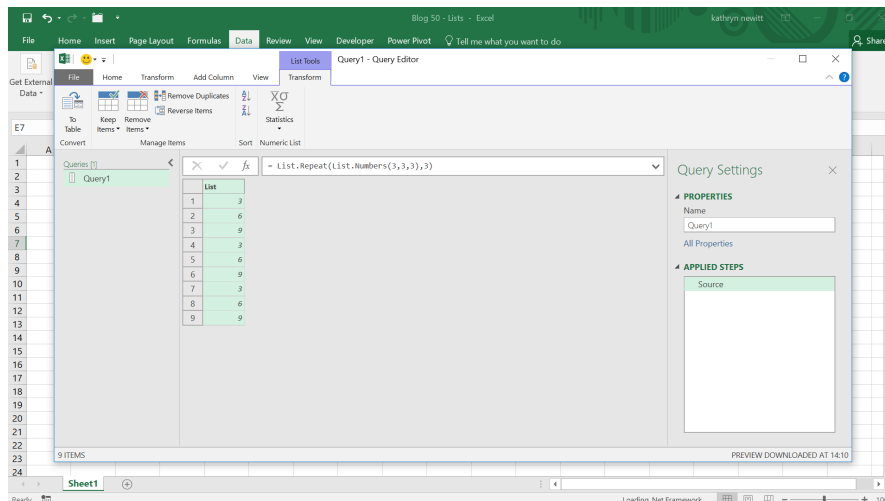
More next month!

Power BI, Windows 7 and .NET Announcements

It's been almost nine months since support for Windows 7 ended (back on 14 January 2020). To be fair, Windows 7 has been around for more than 10 years, so perhaps it is time for us all to *let it go* and move on…

This means that Power BI Desktop will support on **31 January 2021**. After that, Power BI Desktop will only be supported on Windows 8 and newer. Further, the January 2021 release of Power BI Desktop Optimized *(sic)* for Report Server will be supported as per the Modern Lifecycle Policy, *i.e.* supported until the next release (currently scheduled for May 2021), after which it will only receive security updates until **January 2022**, after which support will also stop.

Microsoft is also making a change to the version of .NET that is required to run Power BI Desktop. Starting from the October release users will need to have **.NET 4.6.2** or greater installed. This is installed by default with Windows 10. For older versions of Windows, the Power BI Desktop installer will launch the .NET installer for you.

Power BI Updates

We noticed that the usual Power BI Desktop updates announcement was later than usual (much to the consternation of our desktop publisher and printers!) and put it down to the upcoming *Microsoft Ignite* conference. But it turned out that wasn't the case. No, Microsoft has decided it's time to consolidate all Power BI update announcements – and, well, that takes *time*.

Amalgamated highlights this month include a Preview of the Smart narratives visual which helps you quickly summarise visuals and reports by providing relevant out-of-the-box insights which is customisable.

Analytics

- Smart narratives (Preview)
- Q&A now supports arithmetic operations

Reporting

- Data point rectangle select for additional charts
- Added general visual option to maintain layer order
- Search for a workspace during Publish
- Total labels for stacked visuals
- Mobile authoring enhancements:
    - Bookmark pane is now available in the Mobile layout view
    - New options: turn off gridlines and snap to grid

Mobile

- Improved navigation tree (iOS and Android)
- Share from Power BI using your favourite apps (iOS and Android)
- Pinch and zoom is now available in all report views – on both phones and tablets (iOS and Android)
- Auto play a slideshow on start-up (Windows)

Service

- New capabilities in Lineage view:
    - Search within lineage view
    - Data source impact analysis
- Excel inherits the Power BI dataset's sensitivity label when using a PivotTable connection
- Analyze in Excel provides Excel file instead of .ODC
- Deployment pipelines is now Generally Available
- New simplified action bar
- Page navigation settings

On the reporting side, several things are added, including the introduction of controls for the z-order of visuals, and searching for a workspace during publish. For modelling, the enhanced dataset metadata that was previously in Preview is now Generally Available. In Power BI Service, new capabilities have been introduced in the lineage view, updates to Analyze in Excel have been made and deployment pipelines are now Generally Available.

Check out the full update list (deep breath!):

- Minimise global navigation and collapse left page navigation
- Tenant early opt-in and release plan
- 'Other' improvements

Modelling

- Enhanced Dataset Metadata is now Generally Available
- Performance improvements to aggregation expressions involving columns of currency data type

Data connectivity

- CDS connector (Preview)
- Azure Databricks
- MariaDB
- Hexagon PPM Smart API
- Other data connectivity updates

Community

- Spanish language community forum is now available
- Data Stories Gallery theme for October

Visualisations

- Collage by CloudScope
- Advanced Trellis / Small Multiples Chart by xViz
- Waterfall Chart by xViz

Template Apps

- Multichannel Attribution Dashboard
- Workspace Analytics Dashboard.

Let's take a look at each in turn.

Smart narratives (Preview)

Frequently, users will use PowerPoint, text boxes, interactive headers or custom visuals to add narrative to their data. All these options either lack interactive data, interactive and customisable text or useful automatic insights. This Preview of Smart narrative visual can help users

with this. The Smart narrative visualisation helps you quickly summarise visuals and reports by providing relevant out-of-the-box insights in a customisable fashion.
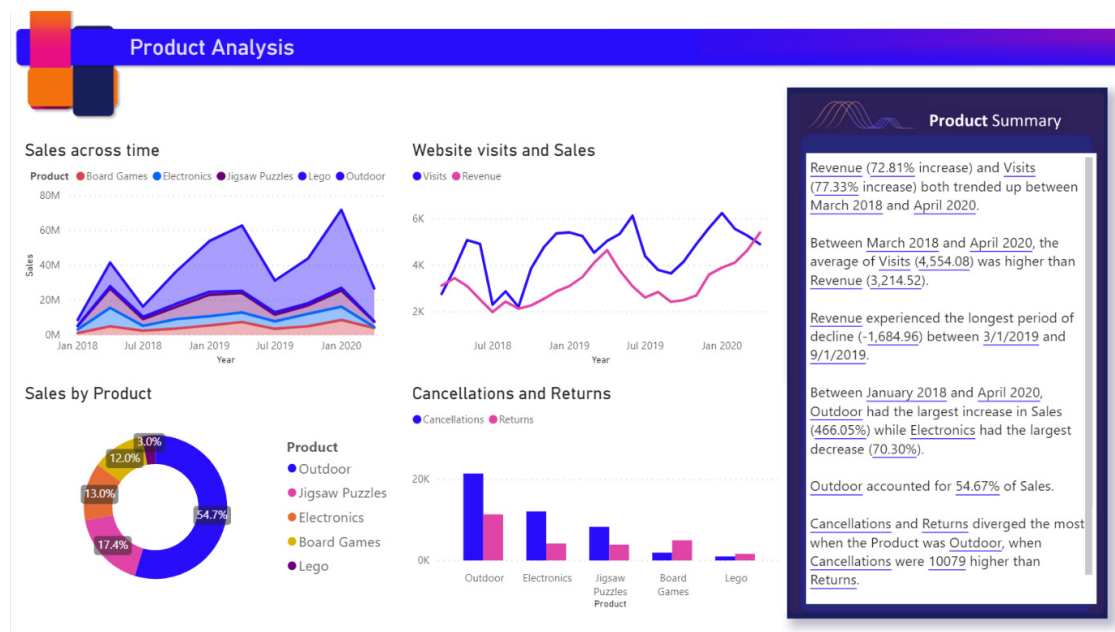
Using this feature creators can add narratives to their report to address key takeaways, point out trends, and edit the language and format it to fit a specific audience. Instead of pasting a screenshot of their report in PowerPoint with key takeaways added, you may now add narratives to the report that are updated with every refresh. End-users may use the narratives to understand their data, get to the key points faster and explain the data to others.

Since this feature is in Preview, you will need to first turn on the feature switch by going to **File -> Options and Settings -> Options -> Preview feature** and make sure 'Smart narrative visual' is turned on:

Clicking on the new smart narratives icon in the Visualization pane creates narrative based upon all the visuals on the page.
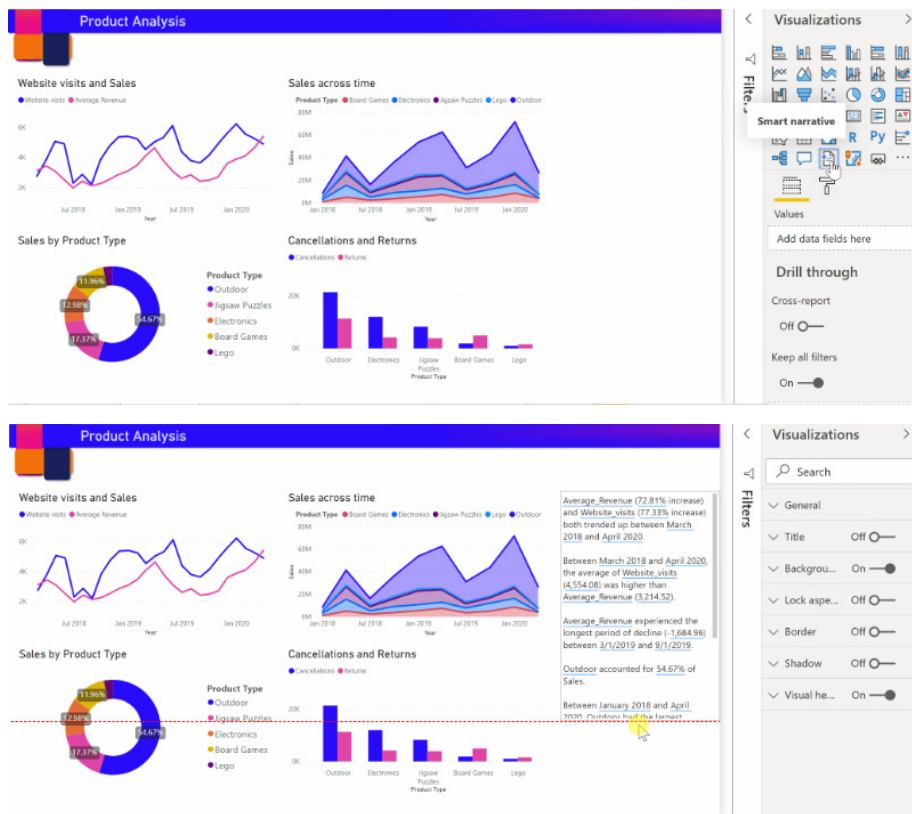
You can also right click a visual and select 'summarize'. This will generate an automatic summary of that visualisation. For example, Power BI analyses the scatter chart visual showing the various transactions and shows which city / region has the highest revenue per transaction and highest number of transactions:
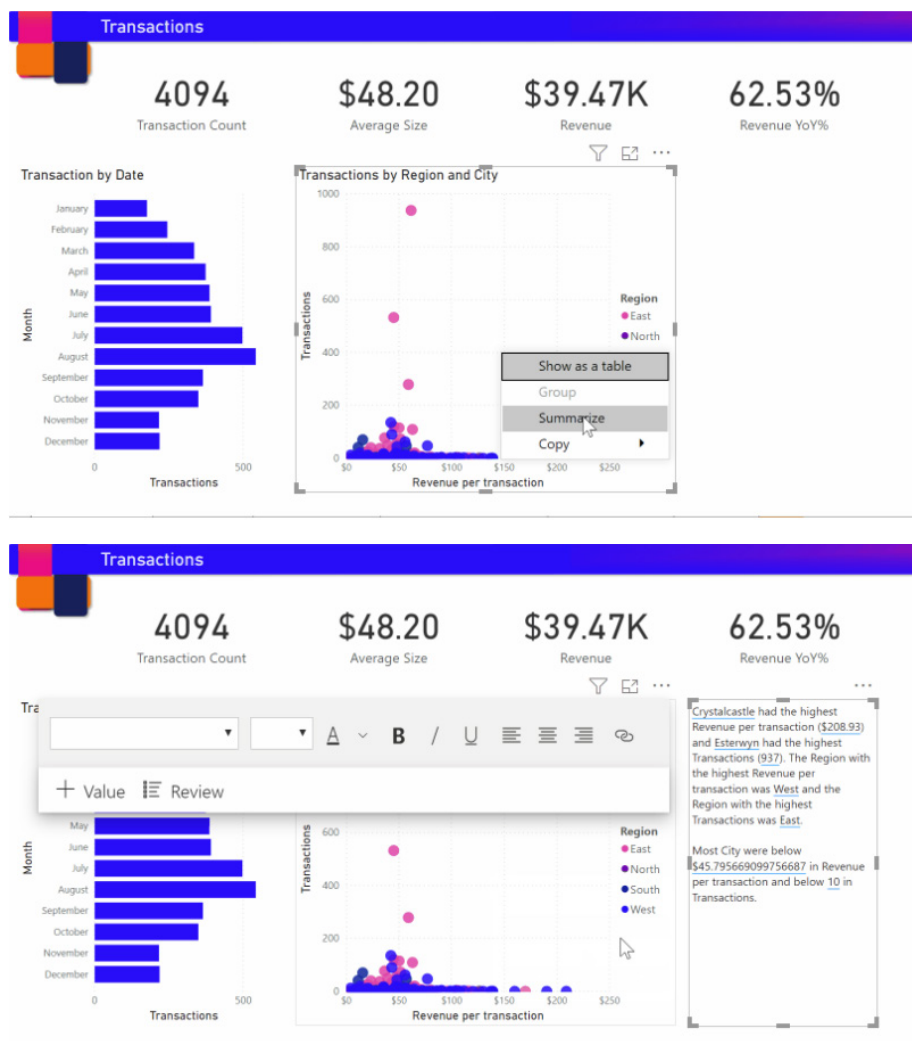
The summary is highly customisable, where you can add new text, or edit the existing text using the same controls available in the regular text box.
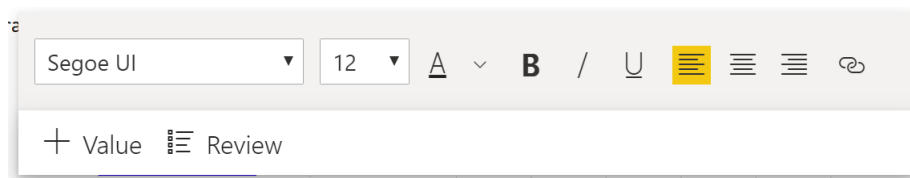
You can also customise the summary by adding dynamic values. You can map text to existing fields and measures or use natural language to define new measure to map to text.
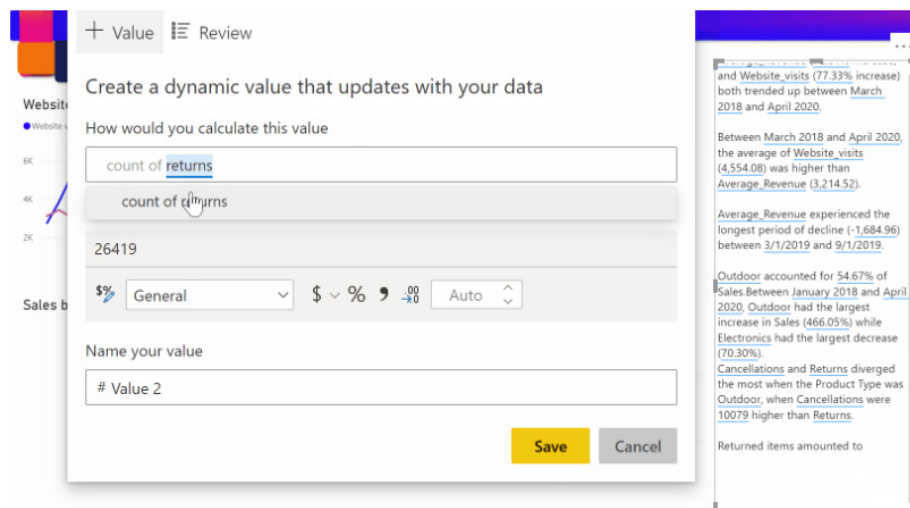
The summary is dynamic and automatically updates the generated text and dynamic values when you cross filter.
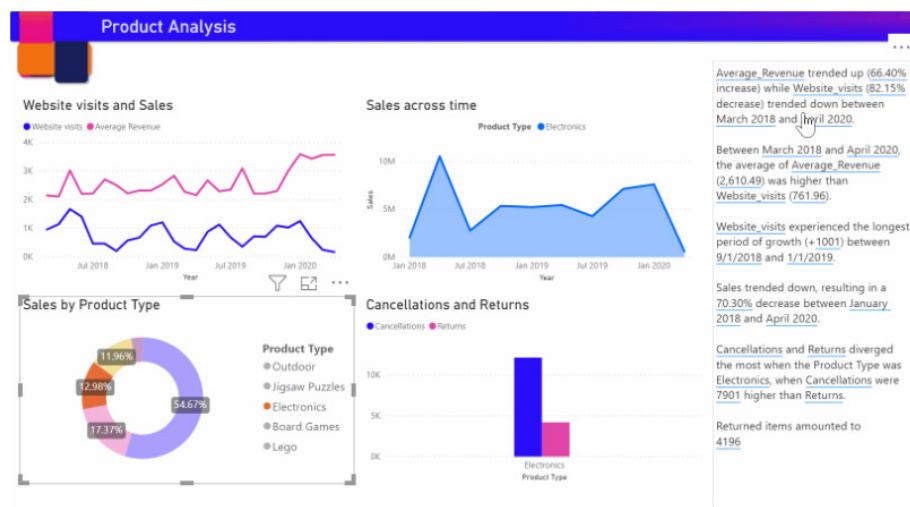
Our clients have been crying out for something like this. This could be quite amazing.

Q&A now supports arithmetic operations

Finally – Q&A now supports the following arithmetic operations:

- Addition (+)
- Subtraction (-)
- Division (/)
- Multiplication (*)

Welcome to the 16th century! This new feature is useful if want to ask questions that require a mathematical expression, such as adding measures together or multiplying a measure by a scalar value.

5.51K

(Japan Sales + EU Sales) + US Sales

To enforce a specific order of operations, you can use an open and closed parentheses:

1.30K

Total sales - (EU Sales + US Sales)

It will revolutionise brackets…

Data point rectangle select for additional charts

Last month, Microsoft released the Preview version of data point rectangle select, making it available for line, area and scatter charts. This update sees it extended to the bar and combo charts. Now you can draw a rectangle to select data points on the stacked bar / column, clustered bar / column, 100% stacked bar / column, line and stacked column, and line and clustered column charts too.

This is a Preview feature, so remember to go to the 'Preview features' section of the Options menu to enable it.

Added general visual option to maintain layer order

Typically, when you select an object on the canvas, it will be automatically brought to the front, above other overlapping visuals. Clicking away from it will return it to its original position. While this behaviour is intended and necessary (for example, to allow access to header menus), sometimes you would like an object, like a shape or background image, to stay in the background even when you accidentally click on them while viewing a report.

Now you can set any visual to stay in place rather than being brought to front upon selection: just turn on the 'Maintain layer order' toggle for that visual in the General card of the Formatting pane.
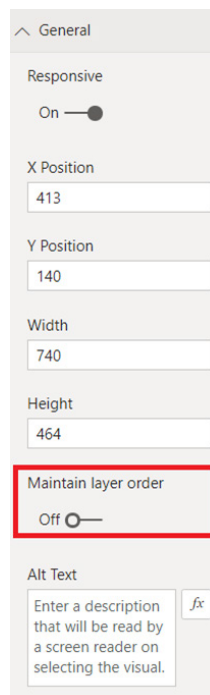
This will only adjust the behaviour for the Reading view.

Search for a workspace during Publish

This update allows you to now search your list of available workspaces during the publishing process. This has been a long time coming! After entering the Publishing dialog, you will now see a search bar at the top of your list of available workspaces that will allow you to filter them.

Total labels for stacked visuals

You can now turn on total labels for your stacked bar / column, stacked area, and line and stacked column charts, allowing you to see the aggregates of your data at a glance:
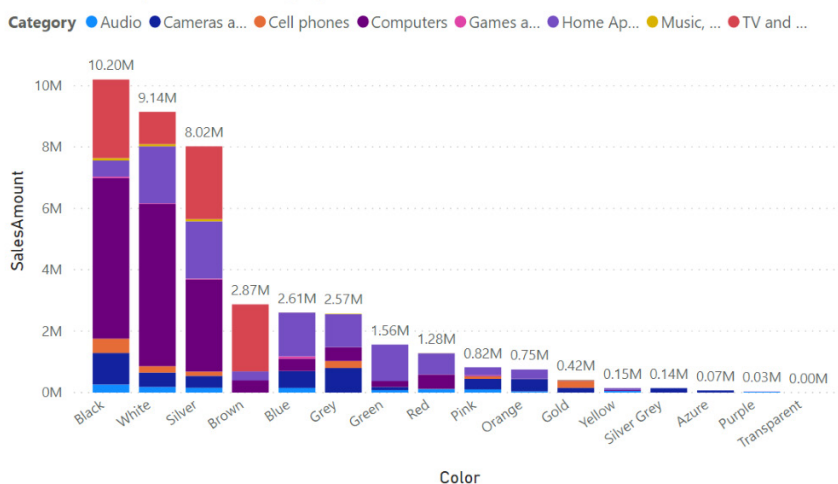
If your chart has a field in the Legend (for stacked bar / column) or Column Series (for combo) field well, you can enable 'Total labels' in its card within the Formatting pane:

You will also be able to format the text of the labels, show a background colour around them (for example, to provide contrast with the visual background), adjust their transparency, and decide if you would like to sum the positive and negative values of your columns separately (that last feature will prove quite useful).

Mobile authoring enhancements

Mobile authoring has had some improvements this month too.

BOOKMARK PANE IS NOW AVAILABLE IN THE MOBILE LAYOUT VIEW

Starting with this release, when you are working on your mobile optimised layout using the Mobile view you can open the Bookmark pane and select a bookmark to see how it impacts the report in the mobile layout, without the need to go back to the Web view.

NEW OPTIONS: TURN OFF GRIDLINES AND SNAP TO GRID

Microsoft has introduced a new option to remove the gridlines from the canvas, so you may view the report without the square boxes – just like it will look on a real phone. You can also remove the 'Snap to grid' constraint when designing the mobile optimised layout. This will let you create a pixel perfect report, since you can place visuals anywhere on the canvas.
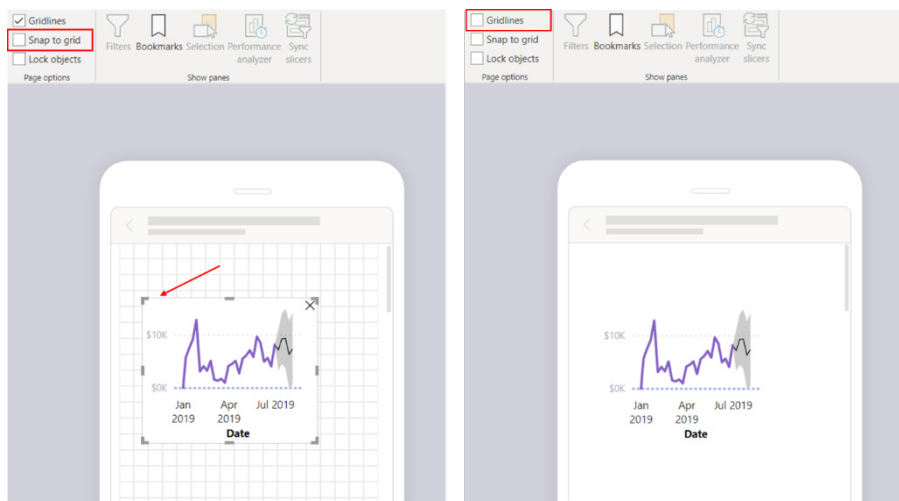
Improved navigation tree (iOS and Android)

Now you can get around your content quickly and easily with a new navigation tree, available from the header drop down in reports, dashboards and apps. You can see the location hierarchy of your content at a glance, and you can easily navigate up the content hierarchy, go to sibling content, or even get quickly back to your home page. If the item you are viewing is part of an app, the tree displays the entire contents of the app: sections, links and all reports / dashboards. If the item you are viewing is a report, you'll also find a list of all visible report pages.
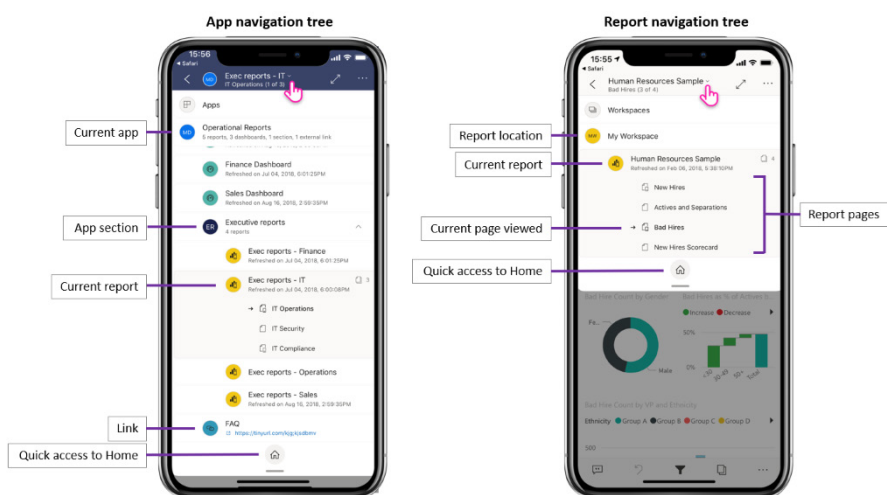
Share from Power BI using your favourite apps (iOS and Android)

This update allows you to share links to Power BI content with your contacts. You can use the new share action in the header to send the link, using any collaboration app you have on your device, such as Microsoft Teams, a mail app, *etc.* The link captures the current view, so you can even share filtered report views.
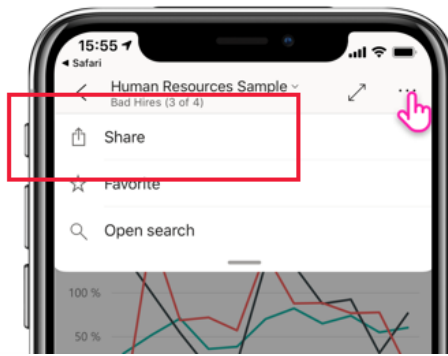
Pinch and zoom is now available in all report views – on both phones and tablets (iOS and Android)

Pinch and zoom is now enabled in all Report views, making it easier for you to zoom in and out of your report content, whether you are on your phone or on your tablet.

Auto play a slideshow on start-up (Windows)

You can choose a report to automatically play in a slideshow when the Power BI Windows app is launched. This is useful for creating a kiosk-like experience that runs a report in public displays without any manual intervention.

New capabilities in Lineage view

Two new features to mention here.

SEARCH WITHIN LINEAGE VIEW

Microsoft has introduced search within Lineage view to improve productivity while using this view. With the new search box, you can search across all the content in your workspace, quickly find items in the graph, view their lineage, and explore their metadata by clicking on the card.

To use the search, either type **CTRL + F** on the keyboard or click the search box on the top menu. Use keyboard **ENTER** or a mouse click to move to the next search result.

When you search in Lineage view, you can find what you're looking for by searching for the artefact name (*e.g.* Sales report). You can also find it by typing any detail that is displayed on the card itself, for example, data source type and connection details, external workspace name and gateway.

DATA SOURCE IMPACT ANALYSIS

A few months ago, dataset impact analysis was introduced. Now, this update has released data source impact analysis. With one click, you may now check which datasets and dataflows across the whole Power BI tenant use a specific data source.

For example:

1. When a data source (*e.g.* an SQL database) is temporarily or permanently taken offline, and you want to get an idea about who is impacted

2. When you build a certified dataset or dataflow that gets data from a specific data source (*e.g.* a CSV file in Azure Blob storage) and you want everyone who uses this data source to start using

your certified dataset rather than other datasets that use the same source. By eliminating dataset redundancy in this way, you:

- o reduce the load on both Power BI and the source system
- o create a single version of the truth and a single model that has to be maintained.

Once you see the lineage between the data source and the datasets and dataflows that are built on top of it, the next step in some cases is to contact the dataset and dataflow owners. With Notify-Contacts, data source owners can let dataset and dataflow owners know about problems or changes in the data-source. Notify-Contacts can be also used to ask dataset and dataflow owners to stop using a certain data source and to use instead a certified or promoted dataset or dataflow.
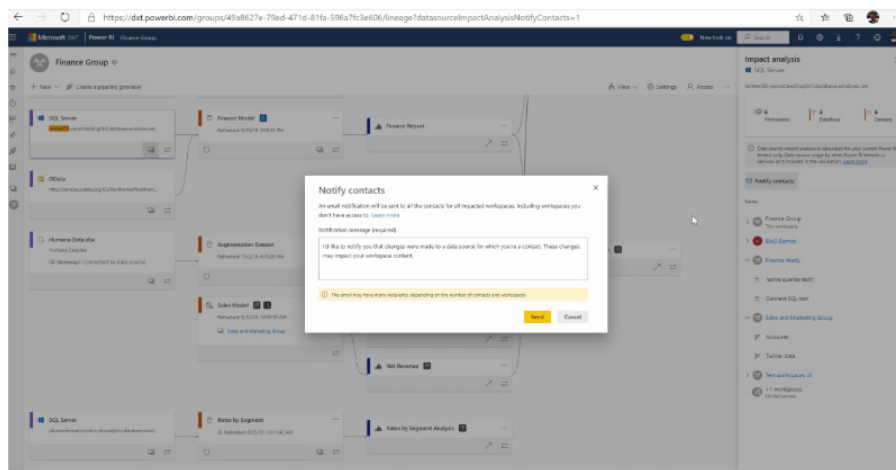
Excel inherits the Power BI dataset's sensitivity label when using a PivotTable connection

Excel is very popular with Power BI users, especially for analysing Power BI data using a PivotTable. This update now extends sensitivity label inheritance from Power BI to Excel files to include the PivotTable connection; a sensitivity label applied on a Power BI dataset will automatically be applied on the Excel file when you create a PivotTable in Excel.
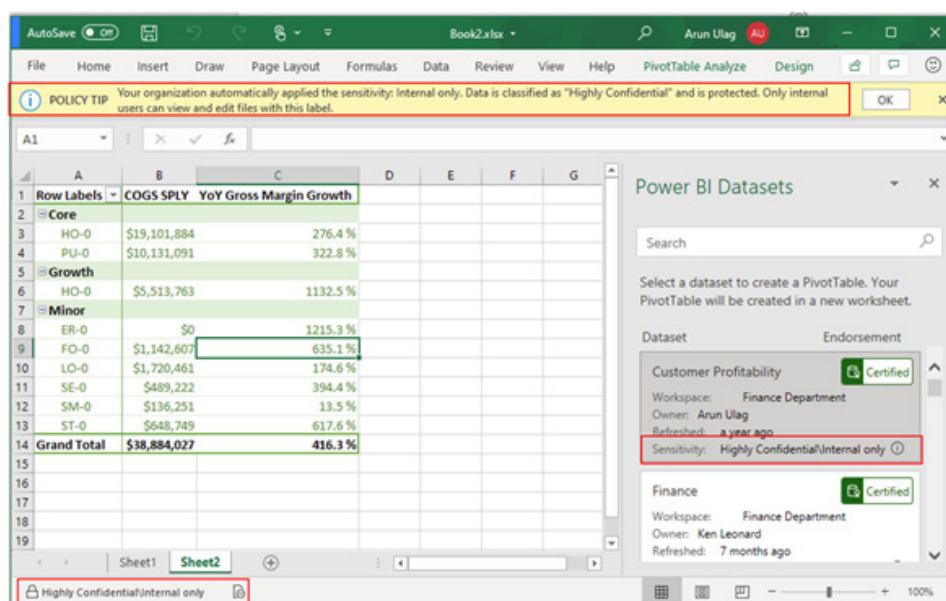
If the label on the dataset later changes to a more restrictive one, the label applied on the Excel file will automatically update upon data refresh in Excel. If the dataset's sensitivity label is less restrictive than the Excel file's sensitivity label, no label inheritance or update takes place. Sensitivity labels in Excel that were manually set are not automatically overwritten by the dataset's label. If Excel file has a manually set label, a policy tip will show with a recommendation to upgrade the label.

This feature is available for customers with Microsoft 365 E3 and above.

Analyze in Excel provides Excel file instead of .ODC

Now, when you click on 'Analyze in Excel' in the Power BI Service, it will download an Excel file that includes a PivotTable connection to the Power BI dataset, instead of the .ODC file that was used until now. This makes it easier to use straightaway.

Deployment pipelines is now Generally Available

Deployment pipelines allows content creators to improve Power BI content publishing efficiency and accuracy by moving it through development, test and production environments. Next to making them Generally Available, this release includes support in incremental refresh, government clouds availability and improved user experiences.

New simplified Action Bar

The "new look" is already rolling out; it is envisaged all users will have access to it by September 25, 2020 – that is, before this newsletter has come out!

The Action Bar has been made simpler and has now been organised so that it is easier to find related actions and putting most common actions in the foreground. These have been updated for both reports and dashboards.
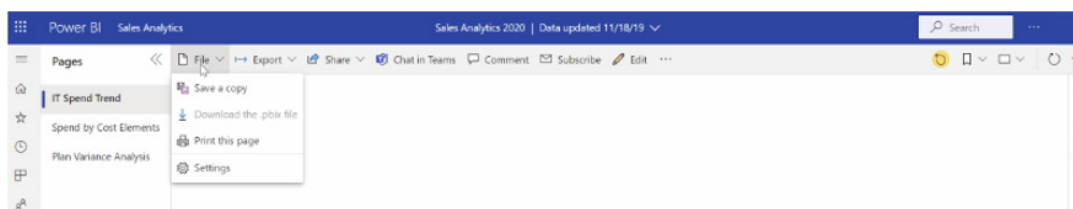
Page navigation settings

Report authors can choose where the report page navigation sits, on the left, as a pane, or across the bottom, as tabs. Go to **File -> Settings** and find the setting under 'Pages pane'.
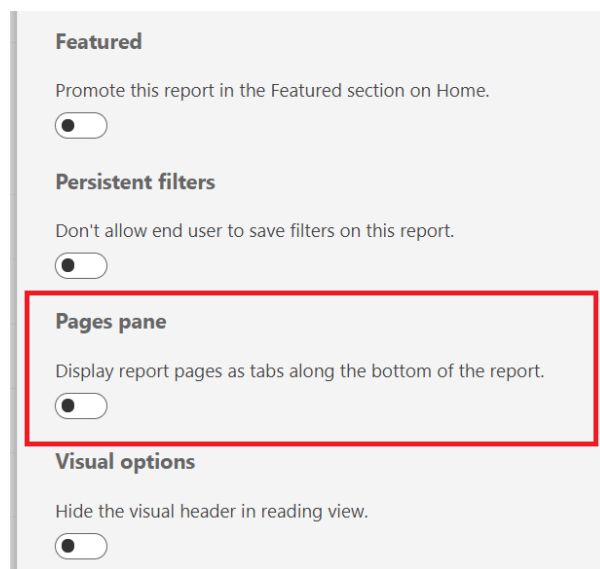
Minimise global navigation and collapse left page navigation

To give end users more room to view and interact with their reports, Microsoft has updated interactions to minimise the global navigation and collapse the left pages navigation. Clicking the global navigation 'hamburger' icon will minimise the navigation pane to just show the navigation icons. When using the left page navigation within reports (as opposed to bottom tabs), clicking the pages icon arrows will collapse the navigation completely, so end users have more room to interact with content. The interaction is now similar to Power BI apps.
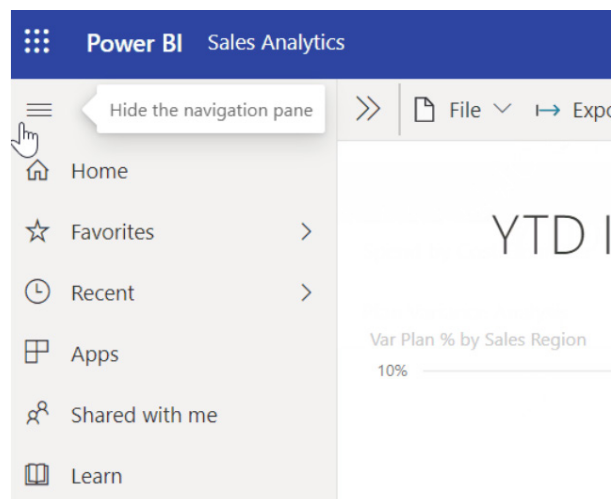
Tenant early opt-in and release plan

By the end of September, the updates mentioned above will appear for users who have set the 'new look on'.

Further, around the same time, a tenant administration setting will appear in the Admin portal under 'Tenant settings' that will allow tenant administrators to switch all users to the 'new look' and remove the old and new look toggle from the header.

At the end of October, all tenants and users will be moved to the 'new look' and the user-facing toggle will be removed from the header.

'Other' improvements

Here's a recap of all the existing 'new look' improvements:

- **New workspaces:** easier to scan, find what you need, get data, search, take quick actions, and more
- **Updated personal bookmarks:** previously, selecting a personal bookmark would update the bread crumb in the top bar with the name of the bookmark. Moving forward, the bookmark name will be updated inline within the context of the Report Action bar
- **View report details:** see details such as last refresh date and contact information quickly, right in the top banner
- **Vertical list of pages:** report page names are now in a list in a vertical pane. They are now more prominent, harder to miss and similar to the navigation features in Word and PowerPoint
- **Improved filter experience:** updates such as viewing applied filters and the new Filters pane are available by default with the 'new look'
- **Dashboard experience:** dashboards also have a simplified Action bar, just like reports and apps, for a consistent experience, while retaining the functional differences.

Enhanced Dataset Metadata is now Generally Available

Enhanced dataset metadata is now Generally Available. In the past, only loadable queries generated in Power Query were mapped to the data model. Now, all queries will be mapped to objects in the data model, and the queries will be regenerated based off of the data model upon opening of that PBIX. This backend update has helped unlock future features improvements and will continue to do so in the future.

For example:

- With the addition of external tools in Power BI Desktop (which is currently in Preview), tables added through these external tools will now appear as queries once you reopen your report
- For those of you who have tried exporting a PBIT and unzipping the file, you'll now see the model in JSON and will no longer get errors about corrupted files.

Keep in mind that if you have an older PBIX that cannot be automatically updated for reasons such as unapplied changes, you'll need to successfully upgrade your model before you can make any additional modelling changes.

Performance improvements to aggregation expressions involving columns of currency data type

Microsoft has now improved the performance of aggregations over expressions that reference columns of the 'currency' data type over large imported tables, *e.g.*

$$\text{SUMX(Sales, [Sales Amount] * [Discount Rate])},$$

by pushing more calculations to the Vertipaq Engine.

CDS connector (Preview)

There is a new connector for CDS in Power BI is going into public Beta. With this new connector, Power BI users have more options when connecting to Common Data Services (CDS) environments. It should be noted that due to a previous deployment error, some Power BI August Desktop users may have seen this connector but were unable to use it.

This connector uses the Tabular Data Stream endpoint for the Common Data Service environment. This endpoint enables better relationship discovery in the Power BI dataset model. In addition, complex data types, such as lookups, option sets and currency are flattened for easy consumption in the model.

To make sure that you're using the new connector, choose the Common Data Service (Beta) connector in 'Get Data' in Power BI Desktop, under the 'Power Platform' category.
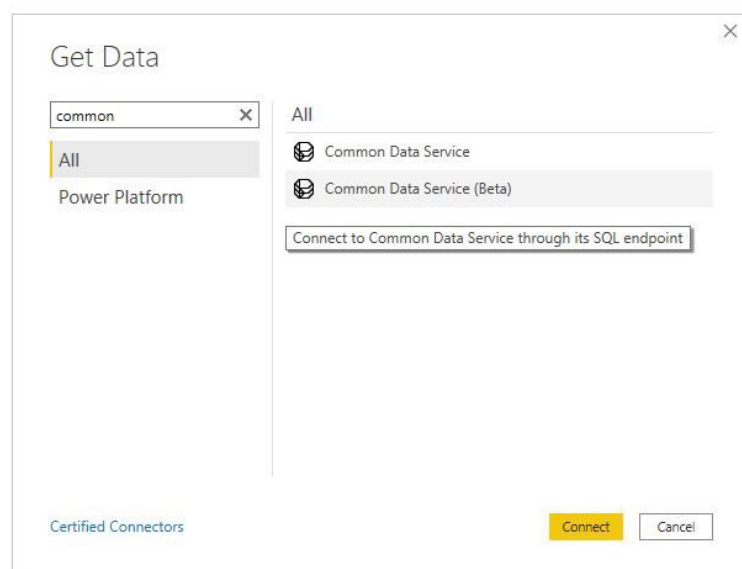
Azure Databricks

Azure Databricks is an Apache Spark-based analytics platform optimised for the Microsoft Azure cloud services platform. Designed with the founders of Apache Spark, Databricks is integrated with Azure to provide one-click setup, streamlined workflows, and an interactive workspace that enables collaboration between data scientists, data engineers and business analysts.

Azure Databricks is a collaborative Apache Spark-based analytics service. For a big data pipeline, the data (raw or structured) is ingested into Azure through Azure Data Factory in batches, or streamed near real-time using Kafka, Event Hub or IoT Hub. This data lands in a data lake for long term persisted storage, in Azure Blob Storage or Azure Data Lake Storage. As part of users' analytics workflow, they may use Azure Databricks to read data from multiple data sources such as Azure Blob Storage, Azure Data Lake Storage, Azure Cosmos DB or Azure SQL Data Warehouse and turn it into breakthrough insights using Spark.

This connector will be available in the **Azure** section of the 'Get data' dialog.

MariaDB

MariaDB Platform is a complete enterprise open source database solution. It has the versatility to support transactional, analytical and hybrid workloads as well as relational, JSON and hybrid data models. It has the scalability to grow from standalone databases and data warehouses to fully distributed SQL for executing millions of transactions per second and performing interactive, *ad hoc* analytics on billions of rows. MariaDB can be deployed on prem on commodity hardware, is available on all major public clouds and through MariaDB SkySQL as a fully managed cloud database.

This connector will be available in the **Database** section of the 'Get data' dialog.

Hexagon PPM Smart API

Intergraph Smart® APIs (application programming interfaces) are RESTful OData web APIs developed by Hexagon PPM. These APIs provide access to data associated with Intergraph Smart® 2D, 3D, Information Management and Materials software applications. The Hexagon PPM Smart API Connector enables Microsoft's analytics and visualisations to be applied to real time and historical data, associated with applications hosted in Intergraph Smart Cloud or on-premises.

This connector will be available in the **Other** section of the 'Get data' dialog.

Other data connectivity updates

There is always more:

- Dremio has added support for .PBIDS files, and to enable users to connect to Power BI from within Dremio
- Kongsberg Vessel Insights has added support for fleet based queries or queries containing wildcards
- Azure Time Series Insights includes bug fixes for column types shown in the response.

Spanish language community forum is now available

Power BI now has a Spanish speaking community forum! If Spanish is your native tongue, you might want to check it out to learn all things Power BI *en español.*

Data Stories Gallery theme for October

Talking of Power BI communities, if you have not already connected with Microsoft's Power BI community, you might want to check it out and make useful contacts. Each month, community members post in the Data Stories Gallery and October's theme is particularly relevant: "Power BI and Excel go better together". Apparently, there are some prizes available…

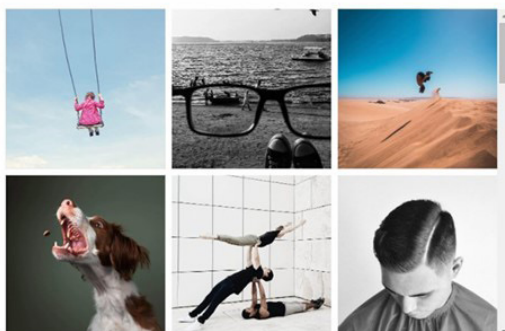## Collage by CloudScope

Collage displays images in the style of popular social networks, using either a grid or detail display:
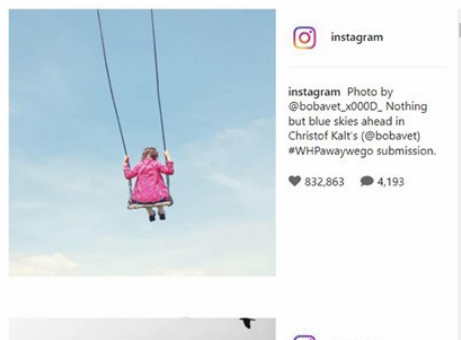
You can display images in either a compact grid display or a larger detail view in a style similar to Instagram.

To display an image, you provide a URL. In addition to the image url, you can optionally display any of the following field types:

- Caption
- Media date
- Media type
- Video url
- Comment count
- Like count
- Permalink
- Author profile image
- Author name
- Caption sentiment.

In addition, you can provide any generic data fields that you wish (number, true / false, date, string). These data elements will be automatically formatted in the familiar Instagram style for numbers and dates. Some of the above fields are only shown in the detail view.

Collage can act as a filter to other visuals within your report. It also fully supports the Power BI bookmark feature and may be downloaded from AppSource.

Advanced Trellis / Small Multiples Chart by xViz

xViz has released a new version (1.1.4) of the xViz Advanced Trellis chart (also known as small multiples) with several new chart types, features and an improved user experience. More than 10 new chart options have been added with dedicated Styling and Data Label sections to style each chart individually. There is also an improved chart readability with additional layout options, such as Row scale and Top/Bottom 'N' ranking on a chart level to focus on key drivers.

Business end users can now search and pin panels and visualise outliers quickly with additional conditional formatting options for chart background and titles. The Animated section has been updated with Animated title, Speed (delay), and new styling and formatting options.
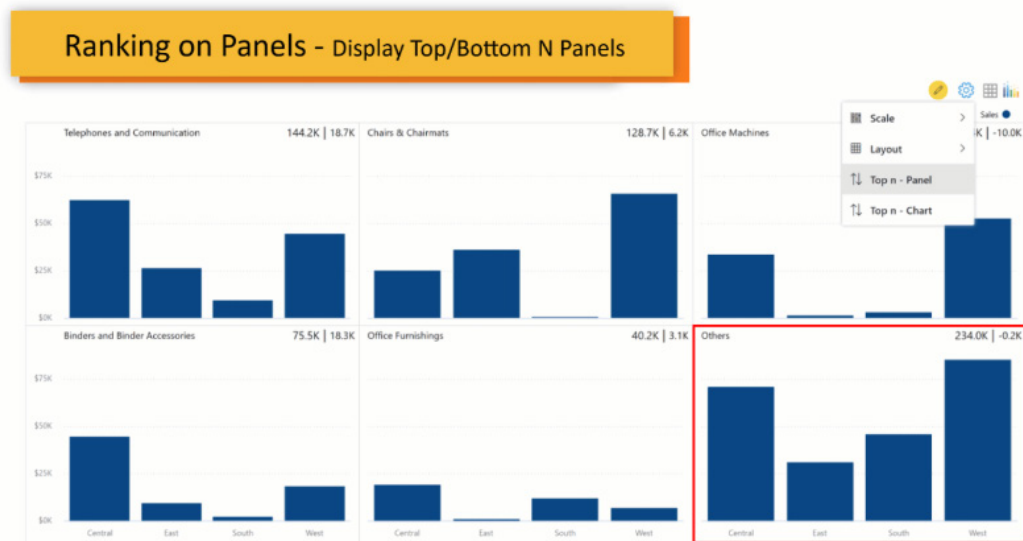
Again, this visual may be downloaded from AppSource.

Waterfall Chart by xViz

xViz has also released a new PBI Certified version (1.1.5) of the Waterfall Chart, which now supports the commonly requested idea place request for Stacked Waterfall chart option and 'Only values waterfall' along with existing use cases of Variance & breakdown analysis.

There is also a new Ranking feature to help users focus on the most important categories and group the remaining items into 'Others'. Further enhancements include an improved deviation bar and sorting options, together with data point annotations features.

And guess what? This visual may be downloaded from AppSource.

Enhanced Intermediate Sum
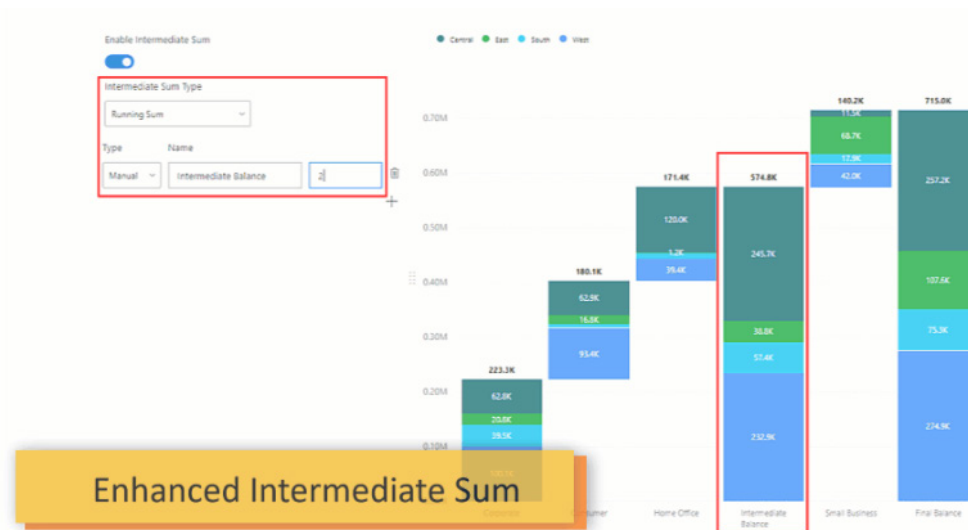
Multichannel Attribution Dashboard

The Multichannel Attribution Dashboard by Windsor.ai helps performance marketers to visualise and connect all their performance marketing data across all media, analytics and CRM. It contains integrations to Google Analytics, Google Ads, Facebook Ads, LinkedIn Ads and Bing Ads which automatically refresh data to ensure data freshness. The connected data is modelled using a data driven attribution model to provide insights on how to improve marketing performance.

This template app has a visually rich report page with filters for performance marketers to get a summary on how marketing campaigns are contributing towards marketing and business goals.
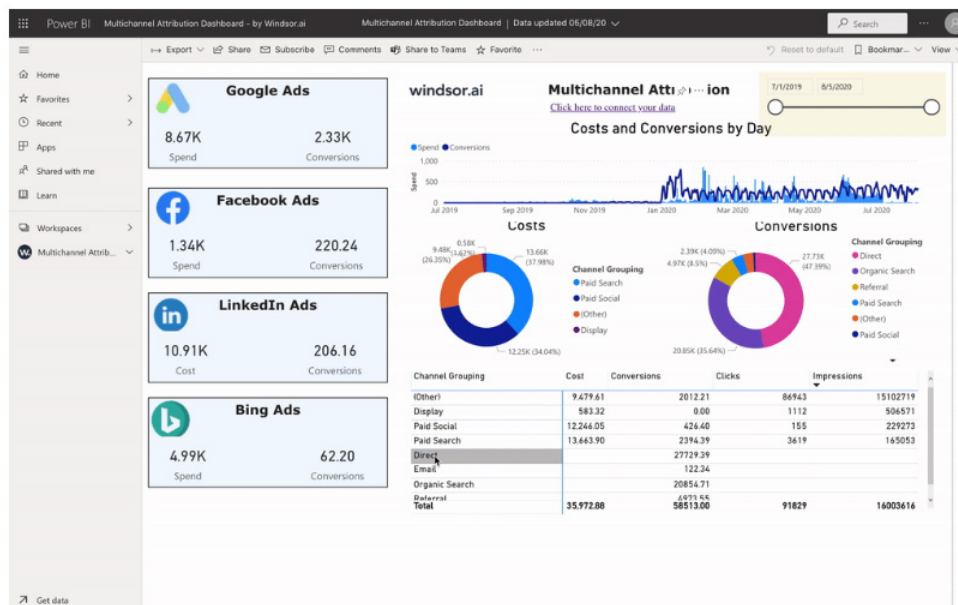
To connect data, you need a Windsor.ai account. Once registered and logged in, you may connect your data on the onboarding page:

- Google Analytics
- Google Ads (optional)
- Bing/Microsoft Ads (optional)
- Facebook Ads (optional)
- LinkedIn Ads (optional)
- Salesforce, Hubspot, Dynamics CRM (optional).

Workspace Analytics Dashboard

In the current world lockdown environment, as employees move to working remotely *(get it?)* and collaboration becomes digital, employee support becomes even more important. The Workspace Analytics Dashboard by Data Maru can help answer the following questions:

- Are collaboration hours changing significantly as collaboration becomes digital?
- How are external network managed as employees move to remote work?
- How do employees adopt Microsoft Teams?
- Are employees collaborating in different ways?
- Can Teams channels replace scheduled meetings?
- Are employees working after-hours?

It sounds like some sort of spying software, but that's not what it is.
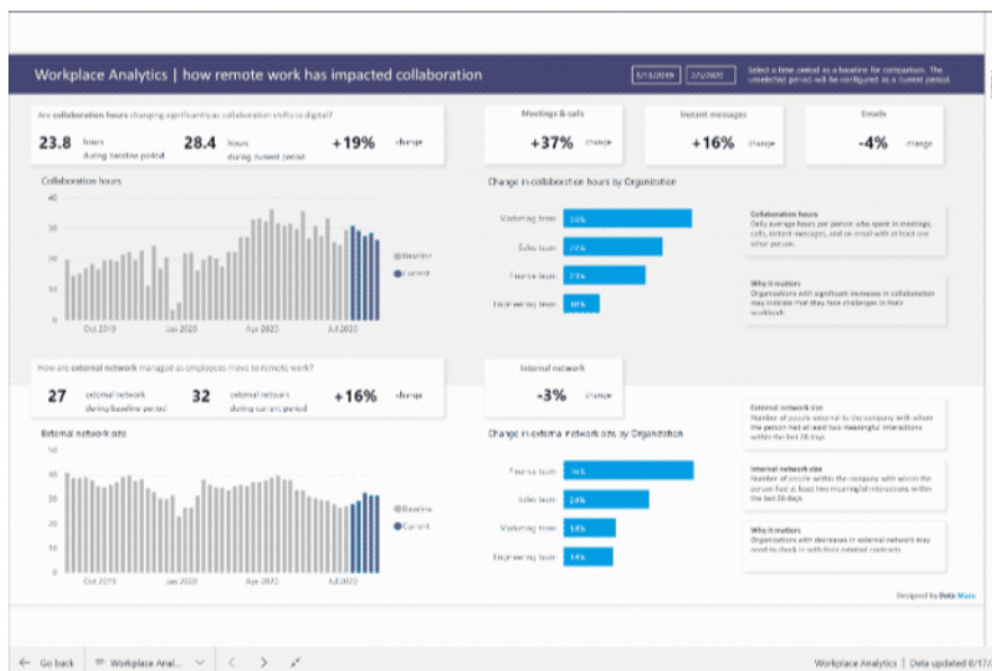
To connect data, before you can connect the Workplace Analytics dashboard, you must:

- Be assigned the role of Analyst in Workplace Analytics
- Run predefined queries in Workplace Analytics: Standard person query and Teams Insights.

Then:

1. Log into PowerBI.com and go to Apps and select 'Workplace Analytics Dashboard'. If you haven't installed it, search Workplace Analytics Dashboard from AppSource and install it first
2. Enter the URL of OData link required for both the Standard person query and the Teams Insights query

3. For the Standard person query, sign in with an account logged into Workplace Analytics. Choose 'Microsoft account' for Authentication method and 'Organizational' for the Privacy level setting

4. For the Teams Insights query, sign in with an account logged into Workplace Analytics. Choose 'Microsoft account' for Authentication method and 'Organizational' for the Privacy level setting once more.

This may also be downloaded from AppSource.

That's it for this month – more next month, we're sure!

The A to Z of Excel Functions: FACT

In mathematics, the factorial of a non-negative integer n, denoted by **n!,** is the product of all positive integers less than or equal to n. For example,

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120.$$

The value of 0! is 1, according to the convention for what is known as an empty product, being the multiplicative identity (just as zero (0) is the additive identity).

The factorial operation is encountered in many areas of mathematics, notably in combinatorics, algebra, and mathematical analysis. Its most basic occurrence is the fact that there are n! ways to arrange n distinct objects into a sequence. These arrangements are called the permutations of the set of objects.

These numbers become astronomical (technical term) *very* quickly.

In **FACT**, Excel has a function, **FACT**, which calculates these factorials and has the following syntax:

FACT(number).

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

• **number:** this is required and is a non-negative number for which you require the factorial.

It should be further noted that:

• if **number** is not an integer, it is truncated
• the factorial of a negative **number** returns a *#NUM!* error
• the largest allowed positive number (which has to be calculated rather than input) is 1.7976931348623158 x 10^{308} (also denoted as 1.79769E+308). 171! is larger than this upper bound and hence 171! or any higher value will return a *#NUM!* error.

Please see the example below:

	A	B	C
1	Formula	Description	Result
2	=FACT(5)	Factorial of 5, or 1 x 2 x 3 x 4 x 5.	120
3	=FACT(5.64)	Factorial of the integer of 5.64.	120
4	=FACT(0)	Factorial of zero (0).	1
5	=FACT(-1)	Factorial of a negative number returns an error value.	#NUM!
6	=FACT(1)	Factorial of 1.	1
7	=FACT(171)	Factorial of 171 is the first number larger than may be displayed in Excel.	#NUM!

Let's take a closer look at the **FACT** function:

Number	Factorial	Length
1	1	1
2	2	1
3	6	1
4	24	2
5	120	3
6	720	3
7	5040	4
8	40320	5
9	362880	6
10	3628800	7
11	39916800	8
12	479001600	9
13	6227020800	10
14	87178291200	11
15	1.30767E+12	13
16	2.09228E+13	14
17	3.55687E+14	15
18	6.40237E+15	16
19	1.21645E+17	18
20	2.4329E+18	19
21	5.10909E+19	20
22	1.124E+21	20
23	2.5852E+22	19

Do you see what happens from **FACT(15)** onwards? These numbers are expressed – and more importantly, stored – in Scientific (Exponential) notation. 15! is actually 1,307,674,368,000, although it is displayed as 1.30767E+12 and is stored as 1307674368000 (deliberately no commas), which is why its length is 13 (there are 13 digits – more precisely, characters – in the text string).

Similarly:

- 22! is actually 1,124,000,727,777,607,680,000, which is displayed by default as 1.124E+21 and is stored as 1.12400072777761E+21. This stored string has 20 characters: 15 digits (the maximum significant figures Excel can display), a decimal point and four characters for "E+21". This means that the maximum length for a number smaller than 10^{100} is 20 characters

- 23! is actually 25,852,016,738,884,976,640,000, which is displayed by default as 2.5852E+22 and is stored as 2.5852016738885E+22. This stored string has 19 characters. This time only 14 digits are included: this is because the 15th number would be "0" and hence is suppressed. This is why 23! has a length of 19 rather than 22! which has a length of 20. 23! is definitely larger than 22!

Therefore, precision is of concern with larger numbers in Excel as they will only display to a maximum of 15 significant figures.

There are two more issues though.

Firstly, let's take a look at 171!

Number	Factorial	Length
1	1	1
2	2	1
3	6	1
4	24	2
5	120	3
6	720	3
7	5040	4
8	40320	5
9	362880	6
10	3628800	7
161	7.5907E+286	20
162	1.2297E+289	20
163	2.0044E+291	20
164	3.2872E+293	20
165	5.4239E+295	20
166	9.0037E+297	20
167	1.5036E+300	19
168	2.5261E+302	20
169	4.2691E+304	20
170	7.2574E+306	19
171	#NUM!	#NUM!

It's the first number in the sequence Excel cannot calculate. The *#NUM!* error is well earned. The largest allowed positive number (which has to be calculated rather than input) is 1.7976931348623158 x 10^{308} (also denoted as 1.79769E+308). 171! is larger than this upper bound.

Secondly, I note using numbers only will <u>not</u> retain precision. I need to convert the number to text so that Excel will store all the characters (that's OK – the maximum number of characters allowed in one cell is 32,767 if I link it in from a closed workbook). The problem is, many Excel functions – including most of the useful text manipulation functions, such as **LEFT**, **RIGHT** and **LEN** will only work with a maximum of 255 characters.

To solve the challenge, you need to get creative and I will demonstrate this by calculating 171!, which is (big drum roll please)…

<div align="center" style="background:#dfe5c0">

124101807021766782342484052410310399261660557750169318538889518036119960752216917529927519781204875855764649595016703870528098898586907107673312420322184843643104735778899685482782907545415619648521534683180442923239598173696889965723590394761615227855818006117636510842880000000000000000000000000000000000000000000

</div>

This is a screenshot from an Excel workbook which calculates 171! As 1,241,018,070,217,667,823,424,840,524,103,103,992,616,605,577,501,693,185,388,951,803,611,996,075,221,691,752,992,751,978,120,487,585,576,464,959,501,670,387,052,809,889,858,690,710,767,331,242,032,218,484,364,310,473,577,889,968,548,278,290,754,541,561,964,852,153,468,318,044,293,239,598,173,696,899,657,235,903,947,616,152,278,558,180,061,176,365,108,428,800,000,000,000,000,000,000,000,000,000,000,000,000 – only without the commas!

How was this achieved? Without any VBA, I created a table in Excel to calculate the following:

1. I need to identify the largest factorial in my table (171) and multiply this by 9.99999999999999… (rounded up to 10) to work out the number of characters I need to keep in reserve, which is 171 x 10 which is 1710 (without commas). This is four characters. Given one character is already used, I need to keep three characters in reserve (this is used for the next step)
2. Since the maximum number of significant figures is 15, I need to separate my number into blocks (what I called "batches" in the model) into text strings of no more than 15 – 3 = 12 characters. This was defined as the **Batch_Length**
3. Define 1! as 1
4. Convert 1! (1) to a text string ("1")
5. Now we need to calculate the next factorial
6. Calculate the character length of this string
7. Divide this length by **Batch_Length** (*i.e.* 12) rounded <u>up</u> to the nearest whole number. This is how many batches are needed
8. Split the text factorial into batches: Batch 1 is the final 12 characters, Batch 2 is the 24th from last to 13th from last digit, Batch 3 is the 36th from last to the 25th from last digit, and so on
9. For each batch, convert the text string back to a number simply by multiplying by the factorial you are trying to calculate (*e.g.* if you have just calculated 1! then multiply by two, if it is 17! then multiply by 18)
10. If the resulting number contains more than 12 characters, split the number in two: the "edited" number is the last 12 characters and the "residual" is any digits at the beginning not included
11. Add the residual from Batch **n-1** to the Edited number in Batch **n**
12. Convert all of the numbers back to text strings
13. Concatenate the batches using the ampersand ('&') operator (note this cannot be done with a text function because only 255 characters are allowed and only 15 significant figures would be displayed)
14. This is the next factorial in the series
15. To calculate the next factorial in the sequence, return to Step 5 *(above)*.

This is more complicated than it sounds (and it sounds complicated!) due to having to consider what happens if a batch in the middle of the text string starts with one or more zeros, for example. For those who would like to know more (or simply suffer with insomnia), please review the table in the Excel file.

You might think, "who cares about 171 factorial?" and you may have a point. However, this simple question has a non-trivial solution and highlights key issues that need to be considered when with large computations and / or numbers:

- Even when you encounter a limitation in Excel, where there's a will there's a way (and often a relative too)
- You need to be mindful of the degree of precision in Excel's outputs (only 15 significant figures)
- Larger numbers may not be manipulable using Excel's built-in functions
- Factorials (even large ones) are often used in combinatoric problems, such as selecting a subset **x** from a larger set **y**. Given **x** and **y**, the solution Excel may give may not be quite correct. This is why many statisticians often use software other than Excel.

The A to Z of Excel Functions: FACTDOUBLE

Once voted the most useless function ever in Excel, chances are you have never used the **FACTDOUBLE** function – and you are exceedingly unlikely to do so in the future too. This function, denoted **n!!** for **FACTDOUBLE(n)**, returns the double factorial of a number.

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

FACTDOUBLE(number)

The **FACTDOUBLE** function has the following argument:

- **number:** this is required and is a non-negative number for which you require the factorial.

It should be further noted that:

- if **number** is not an integer, it is truncated
- the factorial of a negative number less than -1 returns a *#NUM!* error (not sure why **FACTDOUBLE (-1)** equals 1)
- if **number** is even, **n!! = n x (n − 2) x (n − 4) x … x 4 x 2**
- if **number** is odd, **n!! = n x (n − 2) x (n − 4) x … x 3 x 1**
- the largest allowed positive number (which has to be calculated rather than input) is $1.7976931348623158 \times 10^{308}$ (also denoted as 1.79769E+308). 301!! is larger than this upper bound and hence 301!! or any higher value will return a *#NUM!* error.

We understand it may be useful for working out the odds of winning in poker…

Please see our example below:

	A	B	C
1	**Formula**	**Description**	**Result**
2	=FACTDOUBLE(6)	Double factorial of 6, or 6 x 4 x 2.	48
3	=FACTDOUBLE(7.93)	Double factorial of the integer of 7.93. or 7 x 5 x 3 x 1.	105
4	=FACTDOUBLE(0)	Double factorial of zero (0).	1
5	=FACTDOUBLE(-1)	Double factorial of -1 returns 1 (?).	1
6	=FACTDOUBLE(-1.00000001)	Double factorial of a negative number less than -1 returns an error value.	#NUM!
7	=FACTDOUBLE(1)	Factorial of 1.	1
8	=FACTDOUBLE(300)	Factorial of 300 is the first number larger than may be displayed in Excel presently.	8.15E+307

More Excel Functions next month…

Beat the Boredom Suggested Solution

As mentioned earlier in the newsletter, in a recent financial model build, we needed to work out how much of a certain product was sold, which reduced each period, based on two multiplicative factors. Over the life of the project, the proportion that needed to be considered was:

$$\frac{1}{2 \times 5} + \frac{1}{5 \times 8} + \frac{1}{8 \times 11} + \ldots + \frac{1}{998 \times 1{,}001}$$

In Excel, I just needed to sum this as *efficiently* as possible¬ – returning the total as a fraction in its simplest form.

Therefore, the challenge was to create an Excel spreadsheet that can calculate the result and be sufficiently flexible to allow for alternative, similar sequences of varying length. I stipulated you should not use dynamic arrays, VBA or megaformulae. So how did you do?

Suggested Solution

Often under time pressure, we resort to becoming hapless automatons that simply crunch numbers without thought. Yes, I could just add the numbers up constructing an Excel summation. However, the spreadsheet would return a decimal such as

0.166333666333666…

which provides little insight. Furthermore, I actually wanted the number expressed as a fraction.

It's trivial to note that the numbers in the denominator were consecutive pairs in the sequence

2, 5, 8, 11, …, 998, 1001

i.e. the pairs were always a gap of three (3) apart (*e.g.* 5 − 2 = 3, 8 − 5 = 3, 1,001 − 998 = 3).

However, did you spot that

$$\frac{1}{2 \times 5} = \frac{1}{3} \left(\frac{1}{2} - \frac{1}{5} \right)$$

and, more generally,

$$\frac{1}{a \times b} = \frac{1}{b - a} \left(\frac{1}{a} - \frac{1}{b} \right)$$

This is where readers who are parents may note their children might have helped! The trouble is many of us learned fraction subtraction a lifetime ago and either (a) have long since forgotten it and / or (b) never understood it in the first place!

After this, the problem becomes straightforward:

Then $\quad \dfrac{1}{2 \times 5} + \dfrac{1}{5 \times 8} + \dfrac{1}{8 \times 11} + \dots + \dfrac{1}{998 \times 1{,}001}$

is equivalent to $\quad \dfrac{1}{3} \left(\dfrac{1}{2} - \dfrac{1}{5} \right) + \dfrac{1}{3} \left(\dfrac{1}{5} - \dfrac{1}{8} \right) + \dfrac{1}{3} \left(\dfrac{1}{8} - \dfrac{1}{11} \right) + \dots + \dfrac{1}{3} \left(\dfrac{1}{998} - \dfrac{1}{1{,}001} \right)$

which reduces to $\quad \dfrac{1}{3} \left(\dfrac{1}{2} - \cancel{\dfrac{1}{5}} + \cancel{\dfrac{1}{5}} - \cancel{\dfrac{1}{8}} + \cancel{\dfrac{1}{8}} - \cancel{\dfrac{1}{11}} \dots \cancel{\dfrac{1}{998}} - \dfrac{1}{1{,}001} \right)$
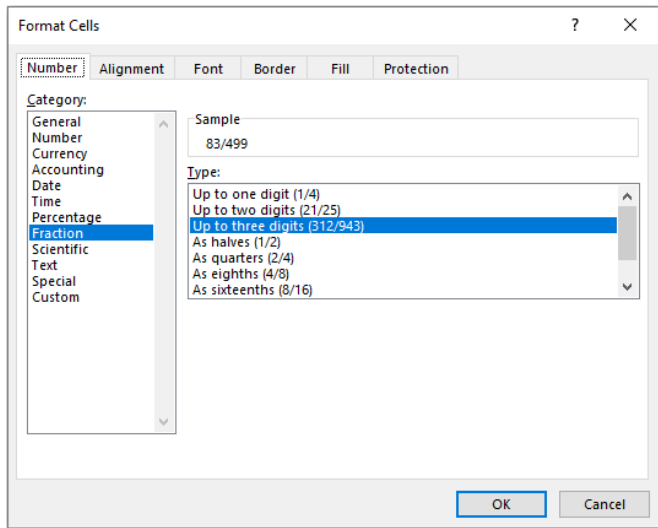
which further simplifies to $\quad \dfrac{1}{3} \left(\dfrac{1}{2} - \dfrac{1}{1{,}001} \right)$

which equates to $\quad \dfrac{333}{2{,}002}$

You could create this automatically in a spreadsheet.

At this point some of you will state that they could have done this simply by formatting cells and choosing 'Fraction' for the result:

But that will not always work – like here. If you did this with this month's challenge you would have obtained 83/499 and **not** 333/2,002. These two fractions are not equivalent. Therefore, if you did this you would have calculated the wrong answer. We need to work out the numerator and denominator in separate cells.

Even if you have done what I have done so far, there is still one more step. The fraction has to be in its simplest form, *i.e.* where the numerator and the denominator share no common divisor greater than one (1). This may be achieved using Excel's **GCD** function.

In mathematics, the greatest common divisor (GCD), also known as the greatest common denominator or the highest common factor, of two or more non-zero integers, is the largest positive integer that divides the numbers without a remainder.

The Excel function **GCD** returns the greatest common divisor of two or more integers. The greatest common divisor is the largest integer that divides both **number1** and **number2** without a remainder. It has the following syntax:

$$\textbf{GCD(number1, [number2], …)}$$

For example, the GCD of 333 and 2,002 is 1, so this is the simplest fraction. However, if we extend our sequence to

$$\dfrac{1}{2 \times 5} + \dfrac{1}{5 \times 8} + \dfrac{1}{8 \times 11} + \dots + \dfrac{1}{1{,}199 \times 1{,}202}$$

Then the result is

$$\dfrac{1}{3} \left(\dfrac{1}{2} - \dfrac{1}{1{,}202} \right)$$

which equates to $\quad \dfrac{400}{2{,}404}$

In simplest form: $\quad \dfrac{100}{601}$

This is because **GCD(400,2404)** equals four (4), so both the numerator and denominator may be quartered.

Word to the Wise

Whether you took a similar approach, chose a more convoluted route or simply didn't bother, do note that sometimes financial modelling is about thinking more *simply*. It's not always about who knows IFRS, the latest fancy functions in Excel or VBA, sometimes it's simply a case of spotting there's a wood in those trees.

Until next time.

Upcoming SumProduct Training Courses - COVID-19 update

Due to the COVID-19 pandemic that is currently spreading around the globe, we are suspending our in-person courses until further notice. However, to accommodate the new working-from-home dynamic, we are switching our public and in-house courses to an online delivery stream, presented via Microsoft Teams, with a live presenter running through the same course material, downloadable workbooks to complete the hands-on exercises during the training session, and a recording of the sessions for

your use within 1 month for you to refer back to in the event of technical difficulties. To assist with the pacing and flow of the course, we will also have a moderator who will help answer questions during the course.

If you're still not sure how this will work, please contact us at training@sumproduct.com and we'll be happy to walk you through the process.

Location	Course	Date	Date	Duration	Duration
Online (Australia)	Power Pivot, Power Query and Power BI	9 - 11 Nov 2020	09:00-17:00 AEDT	(-1 day) 22:00-07:00 GMT	3 Days
Online (Australia)	Excel Tips and Tricks	16 Nov 2020	09:00-17:00 AEDT	(-1 day) 22:00-07:00 GMT	1 Day
Online (Australia)	Financial Modelling	17 - 18 Nov 2020	09:00-17:00 AEDT	(-1 day) 22:00-07:00 GMT	2 Days
Online (Australia)	Power Pivot, Power Query and Power BI	14 - 16 Dec 2020	09:00-17:00 AEDT	(-1 day) 22:00-07:00 GMT	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, we thought we bring **CTRL** to 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

Keystroke	What it does
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 *c.*550 keyboard shortcuts in Excel. For a comprehensive list, please download our Excel file at www.sumproduct.com/thought/keyboard-shortcuts. Also, check out our new daily **Excel Tip of the Day** feature on the www.sumproduct.com homepage.

Our Services

We have undertaken a vast array of assignments over the years, including:

· **Business planning**
· **Building three-way integrated financial statement projections**
· **Independent expert reviews**
· **Key driver analysis**
· **Model reviews / audits for internal and external purposes**
· **M&A work**
· **Model scoping**
· **Power BI, Power Query & Power Pivot**
· **Project finance**
· **Real options analysis**
· **Refinancing / restructuring**
· **Strategic modelling**
· **Valuations**
· **Working capital management**

If you require modelling assistance of any kind, please do not hesitate to contact us at contact@sumproduct.com.

Link to Others

These newsletters are not intended to be closely guarded secrets. Please feel free to forward this newsletter to anyone you think might be interested in converting to "the SumProduct way".

If you have received a forwarded newsletter and would like to receive future editions automatically, please subscribe by completing our newsletter registration process found at the foot of any www.sumproduct.com web page.

Any Questions?

If you have any tips, comments or queries for future newsletters, we'd be delighted to hear from you. Please drop us a line at newsletter@sumproduct.com.

Training

SumProduct offers a wide range of training courses, aimed at finance professionals and budding Excel experts. Courses include Excel Tricks & Tips, Financial Modelling 101, Introduction to Forecasting and M&A Modelling.

Check out our more popular courses in our training brochure:

Drop us a line at training@sumproduct.com for a copy of the brochure or download it directly from www.sumproduct.com/training.