

Working with Excel Data. Power Query and Power Pivot

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Power Query and Power Pivot

If you work with data that has been exported from another system such as a general ledger, accounting, ERP, CRM, Salesforce etc. then you probably spend a lot of time transforming and re-shaping your data to create additional reports, Pivot tables or charts.

This can be boring, repetitive and time consuming. Consider using the Power Query and Power Pivot Add-ins that are now available for Excel. The methods of working are rather different to what we are used to and involve our importing data into Excel's data model and then manipulating it rather than opening the file where the data is stored.

Power Query is included in Excel 2016 and is found on the Data tab in the Get & Transform group. The examples in this document use the command **New Query** from the Get & Transform group. You may find that you have a slightly different version and you need to use the **Get Data** control.

Excel 2013 and Excel 2010 do not include Power Query but you can download and install the Power Query Add-in. There is a separate Power Query tab available when you install the Add-in.

Power Pivot is included in most commercial editions of Excel 2016 but you need to turn it on before you can use it. Some of the commercial editions of Excel 2013 include Power Pivot. You can download the Power Pivot Add-in for Excel 2010.

Turning on Power Pivot in Excel 2016

1. Click the File tab and then Options (down the end)
2. Click Add-ins on the left
3. Down the bottom, click COM Add-ins from the Manage list
4. Click the Go button
5. Click Microsoft Power Pivot for Excel and then OK

If you wish to work through the examples included in this document then you can download the sample files from the following website:

www.cleesy.com

Go down the page until you find the section headed **Excel Course Files**.

Appending worksheet data using Power Query

Appending is where you are combining data from different worksheets into one large, summary worksheet. You can combine data from worksheets in the same workbook or from different files.

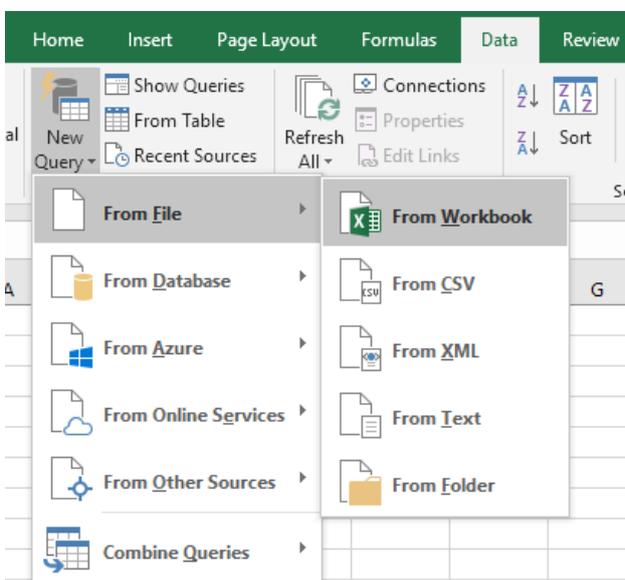
Once the Append Query has been created all you have to do is refresh your query and then your summary data updates to show the current state of each worksheet. This is so much easier than having to open each file on a regular basis and copy and paste the current data onto the summary sheet.

The method we are going to use does not involve opening the files to create the summary sheet. Instead we shall create a link to the files to be combined and store their data in the data model. Then we create the Append query and finally, deliver the appended data onto an Excel worksheet.

North	Milan	Third Part	Shave	2343	97982			
North	Bilbao	Agency	Shave	187	92504			
North	Hamburg	In Store	Laundry	349	104557			
North	Stuer	Agency	Kitchen	1435	81722			
North	Milan	In Store	Soap	278	81460			
North	Modena	Third Part	Laundry	1724	97982			
North	Hamburg	Third Part	South	Stuttgart	Business	Dental	2035	81
North	Paris	In Store	South	London	Agency	Soap	1374	79
North	Bilbao	Third Part	South	Athens	Third Part	Dental	1119	69
North	Hamburg	In Store	South	Odense	Agency	Dental	953	11
North	Manchest	Business	South	Stuttgart	Third Part	Shave	2104	81
North	Manchest	Third Part	South	Seville	Third Part	Soap	11	39
North	South	+	South	Athens	Agency	Soap	1073	59
			South	Slough	In Store	Soap	177	29
			South	Slough	Third Part	Kitchen	589	99
			South	Nice	Agency	Laundry	2312	69
			South	Odense	In Store	Kitchen	1910	39
			South	Bari	Business	Dental	524	59
	North	South	+					

You will need the following files to follow the demonstration: **append-north-south** and **append-east-west**. Download the files and save them to a convenient location. Open one of the files to examine the contained data and you will see that they contain similar worksheets but with a different data population. Close the file.

Getting the data into the data model



Click the **Data** tab and then click **New Query** in the **Get & Transform** group. Click **From File** and then **From Workbook**.

Navigator

Search:

Select multiple items

Display Options ▾ 

append-east-west.xlsx [4]

- east
- west
- East
- West

West

Country	Region	City	Type
UK	West	Bristol	In Store
Netherlands	West	Leiden	In Store
France	West	Carcassone	Third Party
Germany	West	Munster	Third Party
Denmark	West	Flensburg	Agency
UK	West	Bristol	Agency
Netherlands	West	Haarlem	In Store
Germany	West	Munster	In Store
Netherlands	West	Leiden	Business Unit
Denmark	West	Flensburg	Third Party
Spain	West	Barcelona	Third Party
Germany	West	Dusseldorf	Business Unit
France	West	Carcassone	Business Unit
Netherlands	West	Haarlem	Business Unit
UK	West	Bristol	Agency
Denmark	West	Ebsjerg	In Store
Spain	West	Barcelona	Business Unit
UK	West	Cardiff	Business Unit
Netherlands	West	Leiden	Business Unit
Netherlands	West	Haarlem	Agency
Germany	West	Dusseldorf	Third Party
UK	West	Cardiff	Third Party
Netherlands	West	Leiden	In Store

Load ▾

Choose the append-east-west file from the list and click the **Import** button. Check **Select Multiple items** in the Navigator and then click either the worksheets or the tables for East and West. Click the **Load** button. Repeat this process for the append-south-north file.

Workbook Queries

4 queries

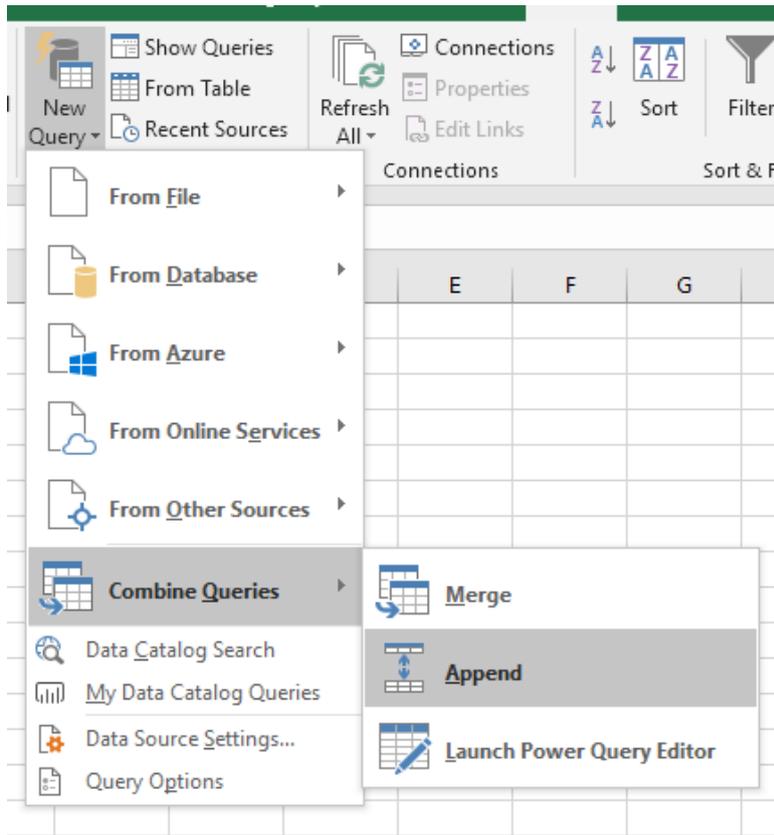
-  East
72 rows loaded.
-  West
75 rows loaded.
-  North
75 rows loaded.
-  South
78 rows loaded.

Where is your data? It's not in the worksheet; it's in the data model. You should see that the Workbook Queries pane is visible so that you can see the queries that you have made.

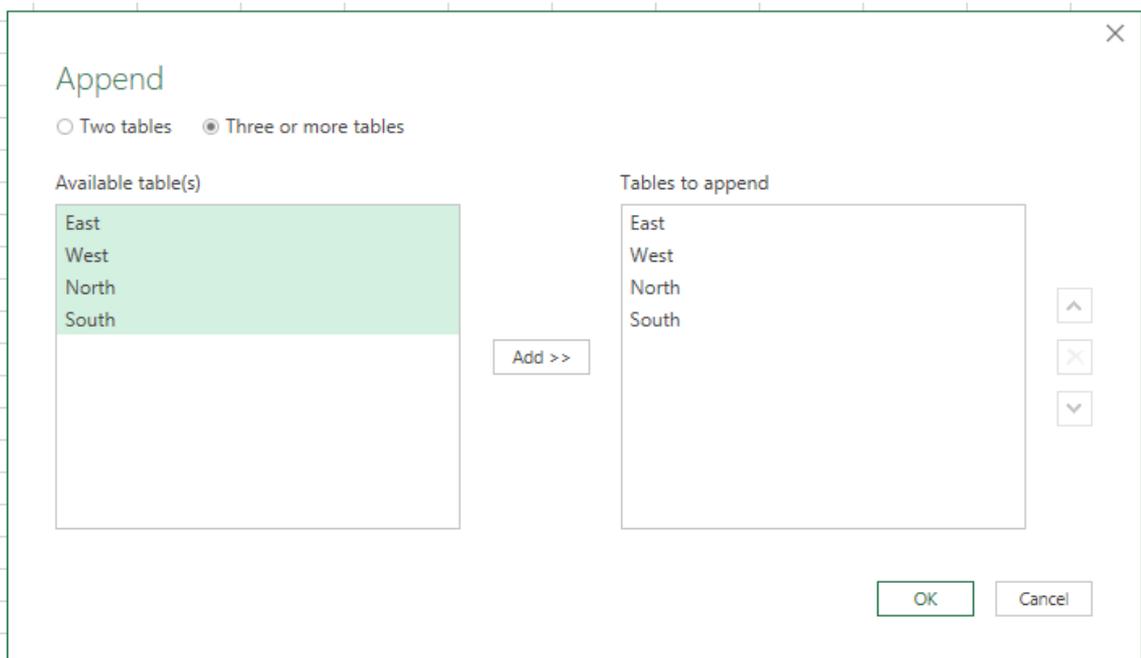
If you can't see it, click the **Show Queries** control in the **Get & Transform** group.

Appending the data

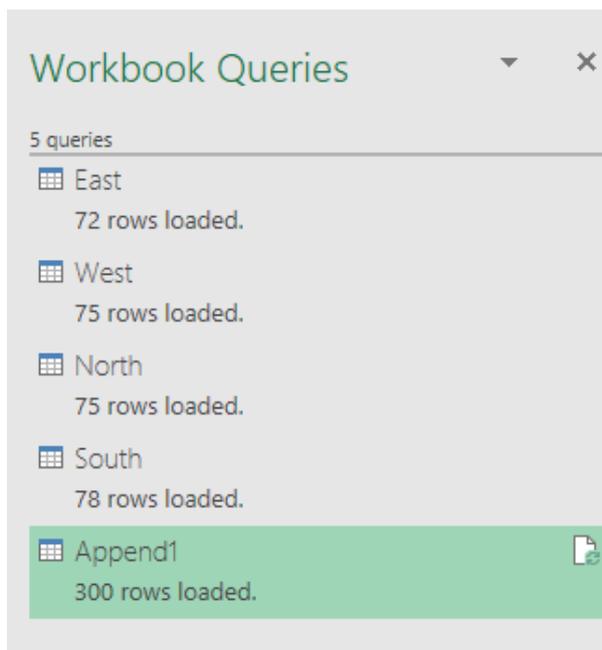
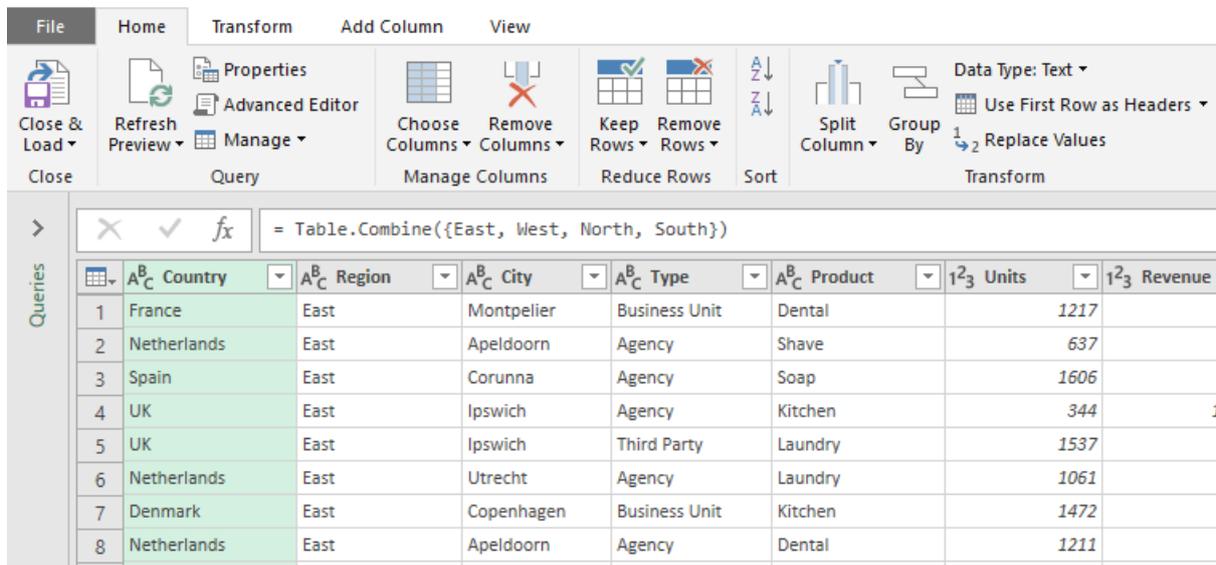
Click **New Query** again and then **Combine Queries, Append**.



Click the **Three or more tables** option button and then select your tables from the **Available tables** list and add them to the **Tables to append** list. You can use the CTRL or SHIFT keys to make a multiple selection before clicking the **Add** button. Click **OK**.



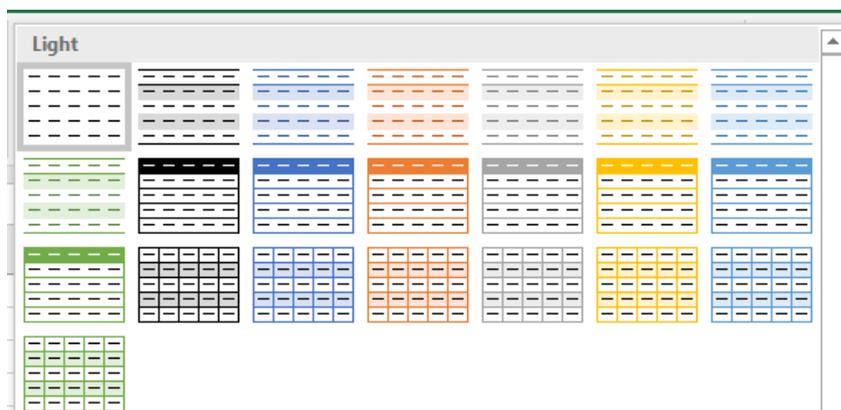
Your appended data will be displayed in the Power Query Editor so that you could continue working on it but all we needed was the append so you click the **Close & Load** control and all your data will appear in Excel.



Here's the list of Workbook Queries that we have created and we do not have to repeat them. Next time you need your appended data you just refresh the queries.

No more copy and paste!

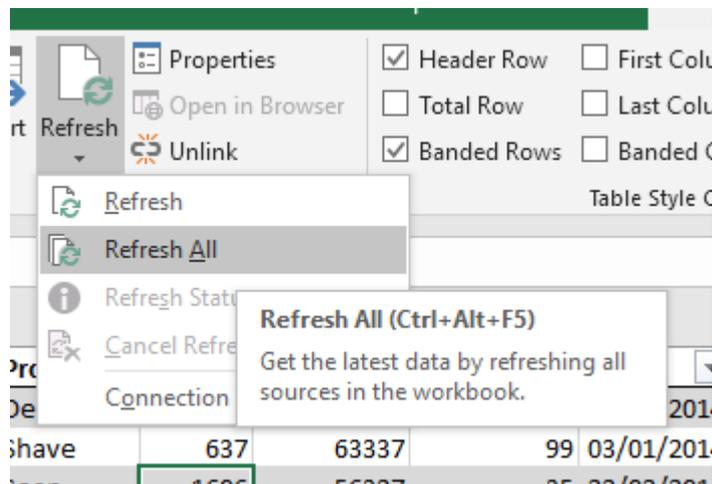
When your data appears in the Excel worksheet it is contained in an Excel table, which is a perfect data source for a Pivot Table or summary formulas. If you don't like the table formatting that Excel applies then choose a different colour scheme from the **Tables Styles** gallery, which is found on the **Tables Tools, Design** tab in Excel



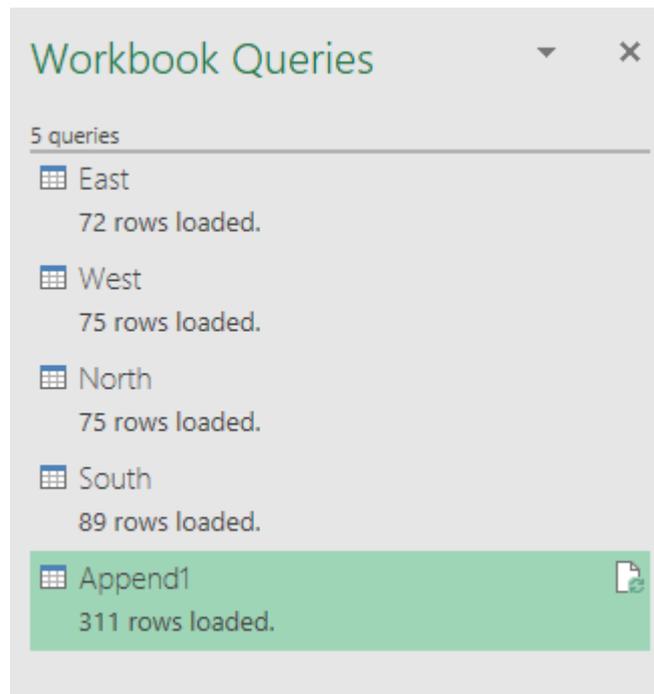
If you don't want any fancy formatting at all then click on the very first table design in the **Light** category.

Refreshing the data

We had better check that everything is working. Open one of your source data files, make a few changes and then save the file.



Click **Refresh** on the **Table Tools** tab and then **Refresh All** to update your queries.



We added a few new rows to the South table and you see that the updated data has flowed through to the append query.

If you have a Pivot Table using this as its source data refresh the Query first and then refresh the Pivot Table.

Editing an Append query

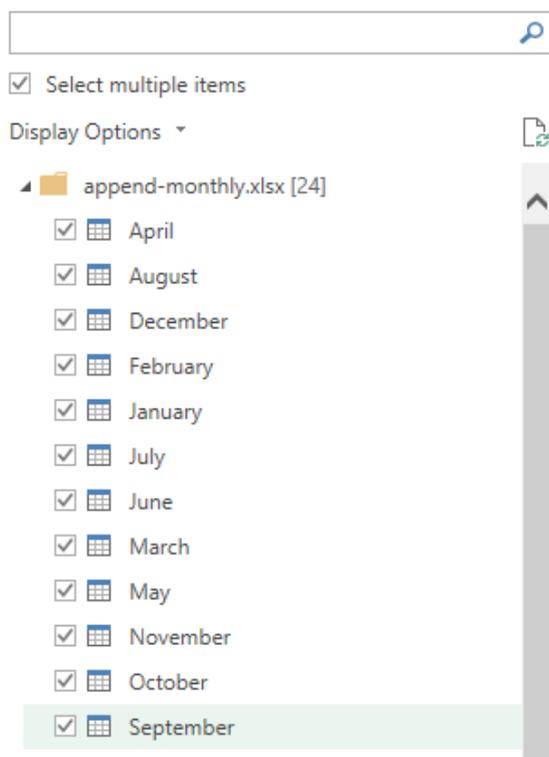
You need the **append-monthly** file to follow the demonstration. Download the file and save to a convenient location. Open the files to examine the contained data and you will see that you have twelve monthly worksheets, we need to regularly create a summary sheet from the sheets.

Once the Append Query has been created all we will have to do is refresh the query and have our summary data updated to show the current state of each worksheet. This is so much easier than having to open each file on a regular basis and copy and paste the current data onto the summary sheet. Notice that some of the headings are in a different order. Close the file.

	A	B	C	D	E	F	
1	Country	Region	Type	Product	City	Units	
17	Spain	South	Third Part	Soap	Seville	11	
18	Greece	South	Agency	Soap	Athens	1073	
19	UK						
20	UK						
21	France						
22	Denmark						
	1	Country	Region	City	Type	Product	Units
	2	Greece	South	Athens	Third Part	Kitchen	991
	3	Spain	South	Seville	In Store	Shave	888
	4	UK	South	London	Business	Laundry	1244
	5	UK	South	London	Business	Shave	372
	6	Denmark	South	Aarhus	Business	Soap	2305

As before, we need to populate the data model. Click the **Data** tab and then click **New Query** in the **Get & Transform** group. Click **From File** and then **From Workbook**.

Navigator



In the Navigator, you will see 24 items, 12 tables and 12 worksheets. Either will do.

So glad we know how to do block selection. Click **Select multiple items** then check the April box, hold down the SHIFT key and check the September box.

Workbook Queries

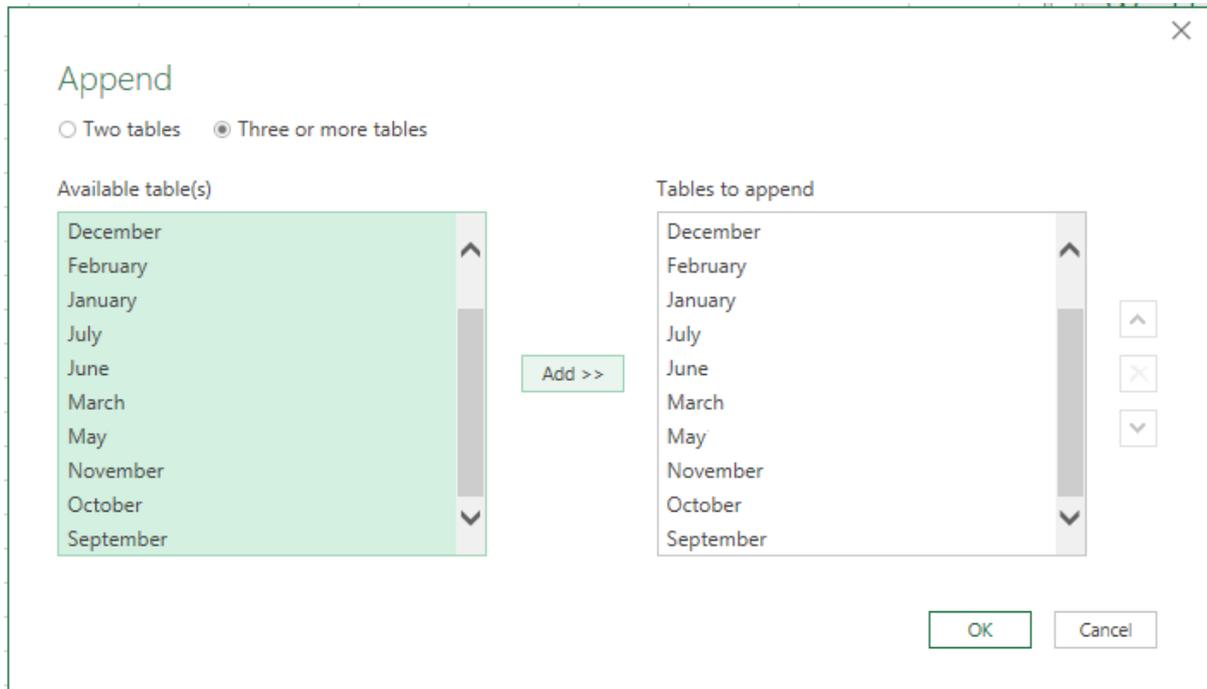
12 queries

April	1 row loaded.
August	1 row loaded.
December	1 row loaded.
February	78 rows loaded.
January	75 rows loaded.
July	1 row loaded.
June	1 row loaded.

This is the boring bit. Watching whilst the data is loaded and the queries are created. But you only have to do it once.

You will see that the empty tables have one row loaded, that's because a table must have a header row and at least one row for the first element of data.

At last. Click **Combine Queries** and **Append** as before.



Now we shall try the append query. Click **Three or more tables** and choose the tables from the **Available tables** list. Click the first table, hold down the SHIFT key and then click the last one. Click **Add** and then **OK**.

	ABC 123 Country	ABC 123 Region	ABC 123 City	ABC 123 Type	ABC 123 Product	ABC 123 Units	ABC 123 Revenue	ABC 123 Unit Price	ABC 123 Date
1	null	null	null	null	null	null	null	null	null
2	null	null	null	null	null	null	null	null	null
3	null	null	null	null	null	null	null	null	null
4	Greece	South	Athens	Third Party	Kitchen	991	23378	8	12/02/2014
5	Spain	South	Seville	In Store	Shave	888	87187	98	14/03/2014
6	UK	South	London	Business Unit	Laundry	1244	92504	74	24/03/2014
7	UK	South	London	Business Unit	Shave	372	69445	24	07/04/2014
8	Denmark	South	Aarhus	Business Unit	Soap	2305	81722	35	16/04/2014

The tables are appended in the alpha order. Notice that the mismatch of column order does not matter, so long as the field name is the same they will append successfully. Note the null values for those tables where we had empty rows.

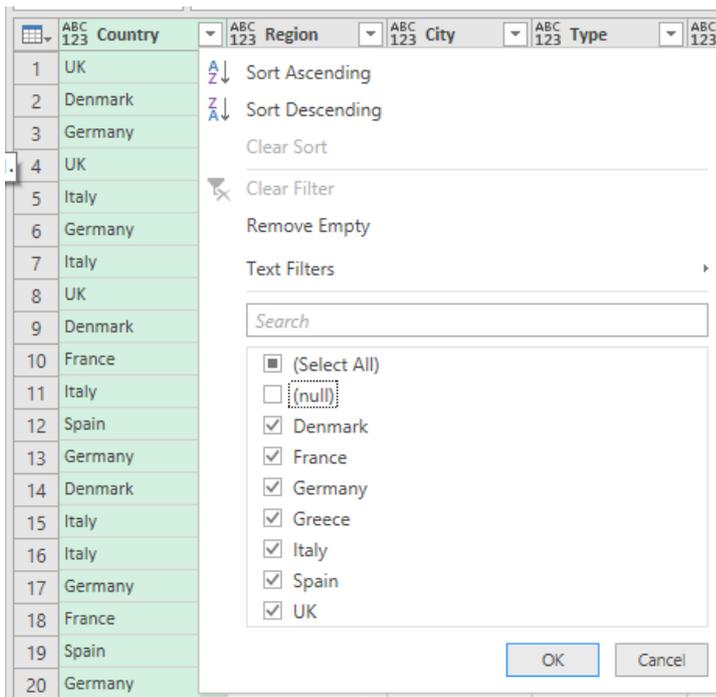
When we click **Close & Load** to return the data to the Excel worksheet we notice that the date format is wrong and we have blank rows for the nulls. The nulls values in the date column have prevented the dates from being read successfully. They are the right values—date serial values but we need to format them as dates to make them readable. You easily sort this out in Excel but the whole point of using Power Query is that it's a script for your data routines, get it right once and then you'll never have to repeat any work in the future.

	A	B	C	D	E	F	G	H	I	J
1	Country	Region	City	Type	Product	Units	Revenue	Unit Price	Date	TransNo
2										
3										
4										
5	Greece	South	Athens	Third Party	Kitchen	991	23378	8	41682	PR960005
6	Spain	South	Seville	In Store	Shave	888	87187	98	41712	PR960008
7	UK	South	London	Business Unit	Laundry	1244	92504	74	41722	PR960009
8	UK	South	London	Business Unit	Shave	372	69445	24	41736	PR960013
9	Denmark	South	Aarhus	Business Unit	Soap	2305	81722	35	41745	PR960016
10	Germany	South	Mannheim	In Store	Dental	1962	55381	28	41749	PR960017
11	Greece	South	Athens	Agency	Kitchen	759	69445	91	41804	PR960030

We'll edit our query, remove the blank rows, format the dates and sort the data into calendar order.

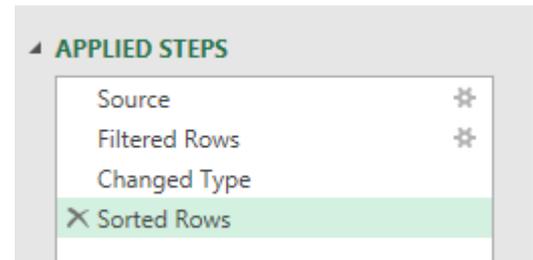
The screenshot shows the 'Combine Queries' dropdown menu in the Power Query ribbon. The options are: Merge, Append, and Launch Power Query Editor. The 'Launch Power Query Editor' option is highlighted. A tooltip for this option is displayed, which reads: 'Launch Power Query Editor: Open the Power Query Editor window to create or modify queries.'

Click **Launch Power Query Editor** to return to the editor.

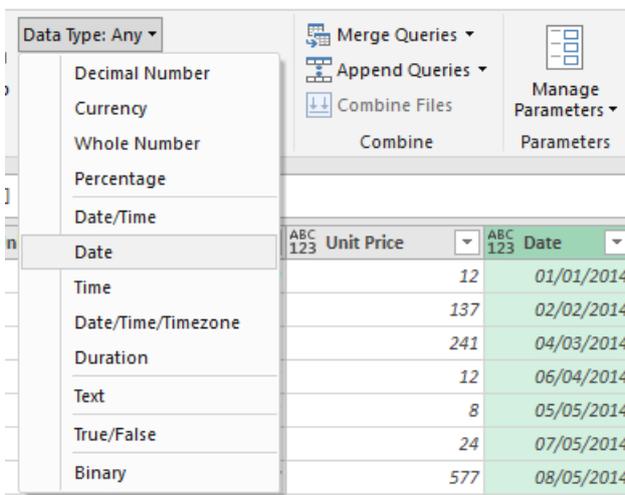


To remove the Null values, click the filter drop down list at top of any column and clear the check box for (null)

Now that action is added to your M script. Everything you do in Power Query is recorded in the M language. You can see the actions in your script in the **Applied Steps** list on the left.



To format the date column to dates, click the column and then set the **Data Type** to **Date** then choose a suitable date format picture from the list.

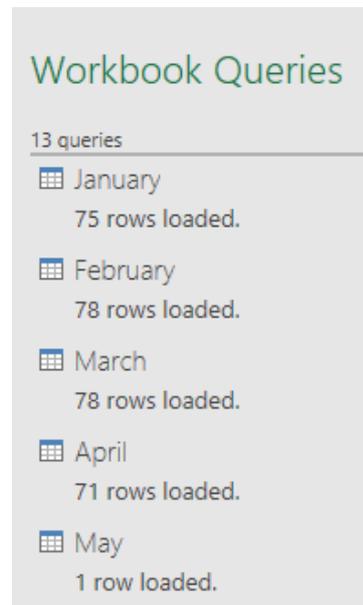


Right-click the date column and sort the data in Ascending order.

Click **Close & Load** and we're back in Excel with our perfectly formed data.



Once you get the Append query working perfectly you don't need to go back into the Query Editor again. You just click Refresh, then **Refresh All** on the Query tab.



Workbook Queries

13 queries

- January
75 rows loaded.
- February
78 rows loaded.
- March
78 rows loaded.
- April
71 rows loaded.
- May
1 row loaded.

We are particularly pleased that we don't have to do the twelve-month summary manually any more. It was a monthly task and although it was primarily just the new data for that month that needed including in the summary we found that, in practice, people were always going back and changing their historic data so each month had to be done again. But now clicking Refresh combines the current state of the data. And that's a copy and paste we shall not miss.

Merging worksheet data using Power Query

Merging is where you are joining different tables together. For example, you have a data table of sales records and you are using VLOOKUP to bring in information about the product based on the name of the product sold. Your product class information is located in another table on a different sheet or workbook.

VLOOKUP formulas are great fun, but they usually entail adding thousands of formulas to your workbook, thus increasing the file size and calculation time. Power Query uses SQL joins; this is much easier to do and far more efficient.

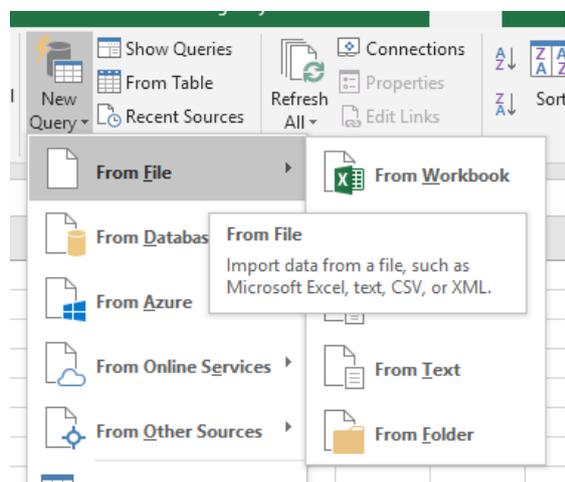
Again, the method we are going to use does not involve opening the files to create the merged data. Instead we shall create a link to the files to be merged and store their data in the data model. Then we create the Merge query and finally, deliver the merged data onto an Excel worksheet.

	A	B	C	D	E	F
1	Country	Region	City	Type	Product	Units
2	UK	North	York	Third Part	Soap	1789
3	France	East	Montpelie	Business U	Dental	1217
4	Netherland	East	Apeldoorn	Agency	Shave	637
5	Denmark	North	Stuer	In Store	Laundry	713
6	Greece	South	Athens	Third Part	Kitchen	991
7	Spain	East	Corunna	Agency	Soap	1606

	A	B
1	Product	Class
2	Dental	Personal
3	Shave	Personal
4	Soap	Domestic
5	Kitchen	Domestic
6	Laundry	Commercial
7		

You will need the following files to follow the demonstration: **transactions** and **class**. Download the files and save them to a convenient location. Open the files to examine the contained data and you will see that **transactions** is a table of sales records and **class** is a lookup table cross referencing the product name with its class. We need to add a Class column to the transactions worksheet. Close the files.

Getting the data into the data model



Click the **Data** tab and then click **New Query** in the **Get & Transform** group. Click **From File** and then **From Workbook**.

Navigator

Product	Class
Dental	Personal
Shave	Personal
Soap	Domestic
Kitchen	Domestic
Laundry	Commercial

Select the **class** file from the list and click **Import**. In the Navigator, click the **productclass** table and then click the drop-down arrow next to the **Load** button at the bottom of the Navigator and click **Load To**.

Load To

Select how you want to view this data in your workbook.

Table

Only Create Connection

Select where the data should be loaded.

New worksheet

Existing worksheet:

\$D\$3

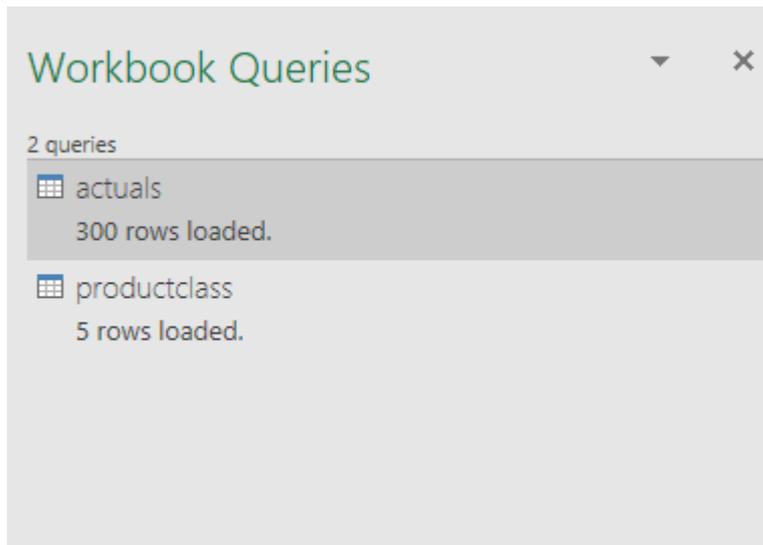
Add this data to the Data Model

Load Cancel

Click **Only Create Connection** under **Select how you want to view this data in your workbook**.

Then click the **Add this data to the Data Model** checkbox. Click the **Load** button.

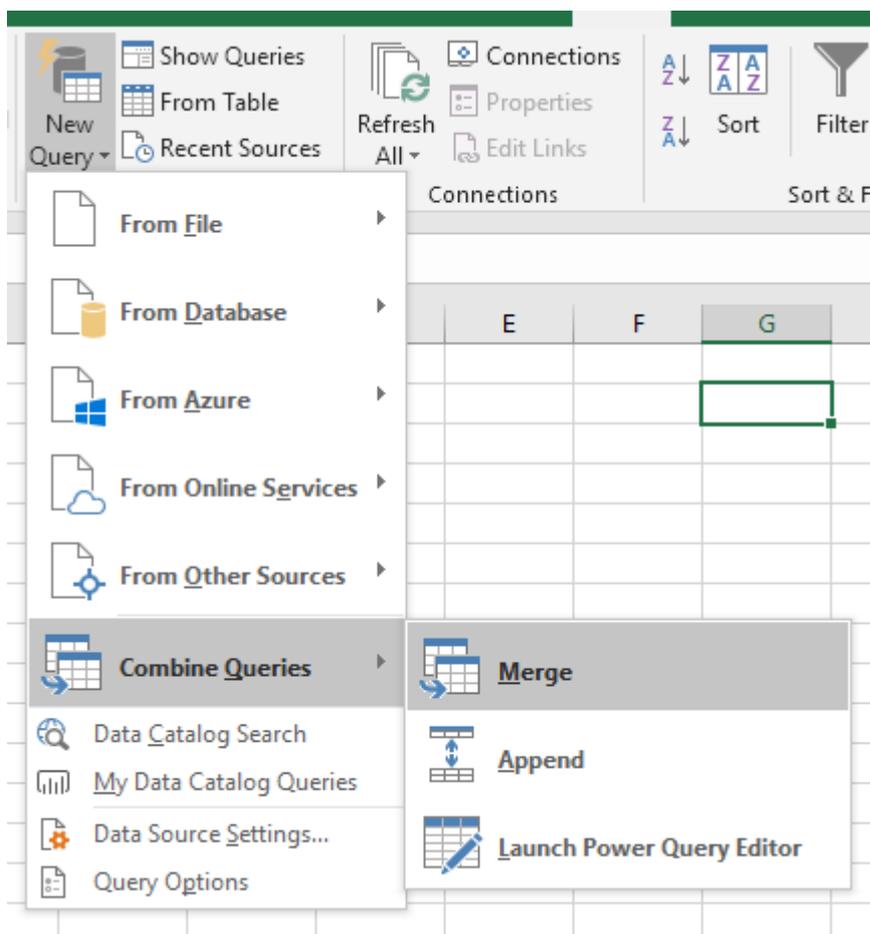
Repeat the process on the **transactions** file and load the **actuals** table.

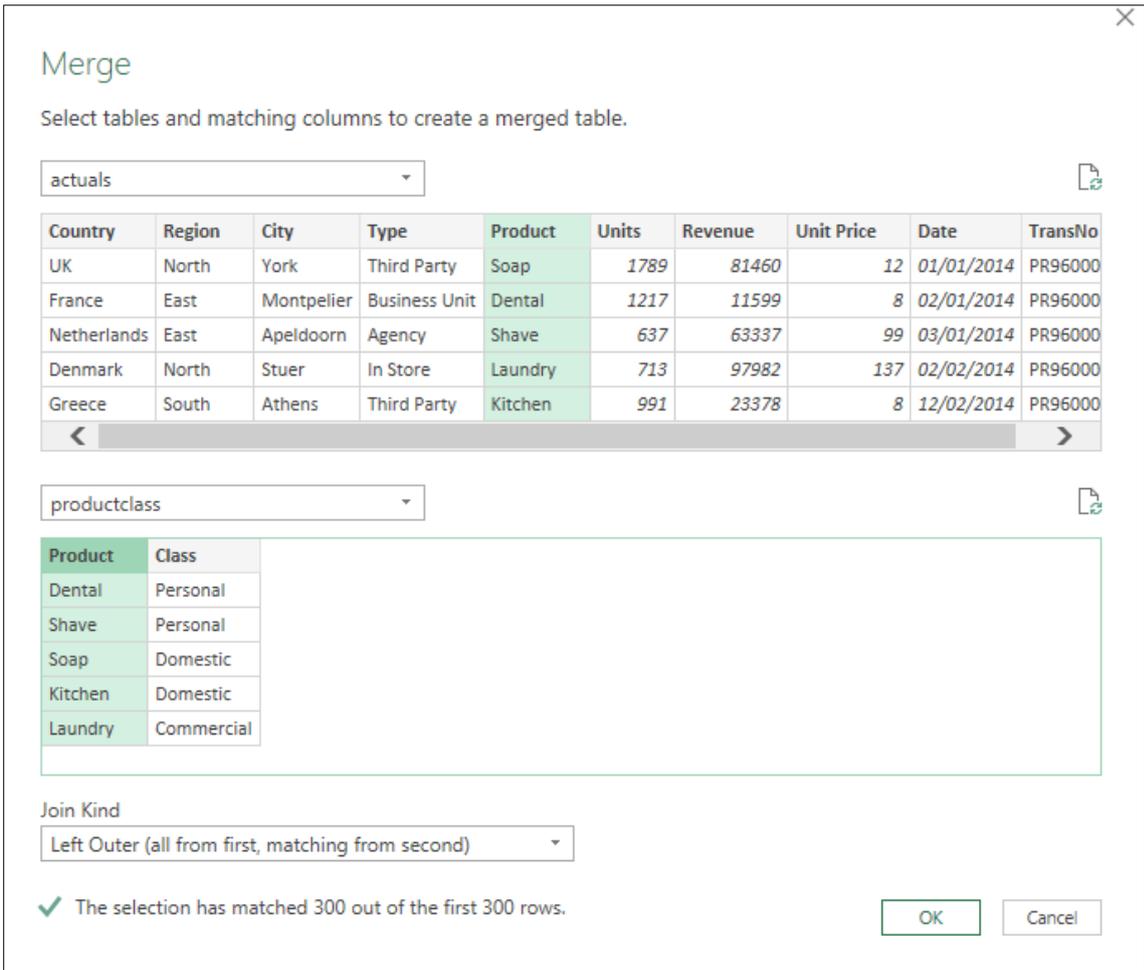


The data model is now populated.

Merging the data

Click **New Query** again and then **Combine Queries, Merge**.

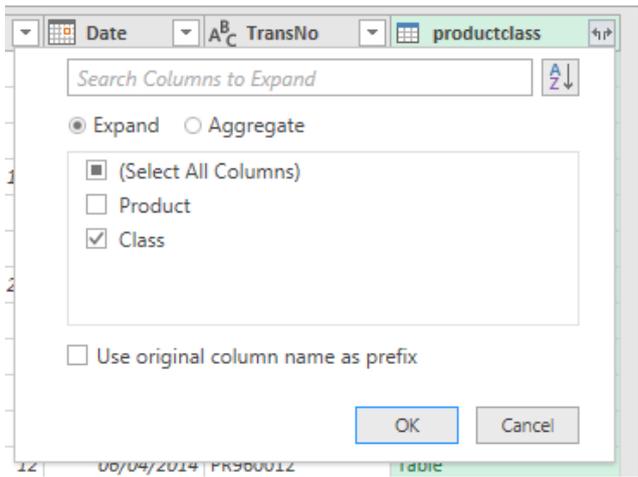




We now need to select the matching columns that will create the merge. Click **actuals** from the drop-down list of tables and then click **Product** to nominate it as the matching column. Then select **productclass** from the other list and again click **Product**. The match is made and you click the OK button to merge the tables.

= Table.NestedJoin(actuals,{"Product"},productclass,{"Product"},"productclass",JoinKind.LeftOuter)

Region	City	Type	Product	Units	Revenue	Unit Price	Date	TransNo	productclass
North	York	Third Party	Soap	1789	81460	12	01/01/2014	PR960001	Table
East	Montpelier	Business Unit	Dental	1217	11599	8	02/01/2014	PR960002	Table

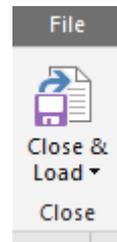


Your merged data will be displayed in the Power Query Editor where there's a new column at the end. We're nearly finished, click the expand control (double-headed arrow on the right)

Click the **Expand** option and the **Class** checkbox. Clear the **Use original column name as prefix** checkbox. Click OK and you will see your Class column displayed as you want it.

	Date	TransNo	Class
12	01/01/2014	PR960001	Domestic
35	22/02/2014	PR960006	Domestic
8	02/01/2014	PR960002	Personal
99	03/01/2014	PR960003	Personal
137	02/02/2014	PR960004	Commercial

The merge is completed so you click the **Close & Load** control and all your data will appear in an Excel table.



Product	Units	Revenue	Unit Price	Date	TransNo	Class
Soap	1789	81460	12	01/01/2014	PR960001	Domestic
Soap	1606	56327	35	22/02/2014	PR960006	Domestic
Dental	1217	11599	8	02/01/2014	PR960002	Personal
Shave	637	63337	99	03/01/2014	PR960003	Personal
Laundry	713	97982	137	02/02/2014	PR960004	Commercial
Kitchen	991	23378	8	12/02/2014	PR960005	Domestic
Dental	46	11101	241	04/03/2014	PR960007	Personal
Shave	888	87187	98	14/03/2014	PR960008	Personal
Laundry	1244	92504	74	24/03/2014	PR960009	Commercial
Kitchen	344	104557	45	04/04/2014	PR960010	Domestic
Soap	2229	35990	16	05/04/2014	PR960011	Domestic
Dental	1407	79548	12	06/04/2014	PR960012	Personal

Workbook Queries

- 3 queries
- actuals
300 rows loaded.
- productclass
5 rows loaded.
- Merge1
300 rows loaded.

Refreshing the data

We had better check that everything is working. Open the **class** file and change the **Commercial** entry to **Virtual**, then save the file. Click **Refresh** to update your data.

Product	Units	Revenue	Unit Price	Date	TransNo	Class
Soap	1789	81460	12	01/01/2014	PR960001	Domestic
Soap	1606	56327	35	22/02/2014	PR960006	Domestic
Dental	1217	11599	8	02/01/2014	PR960002	Personal
Shave	637	63337	99	03/01/2014	PR960003	Personal
Laundry	713	97982	137	02/02/2014	PR960004	Virtual
Kitchen	991	23378	8	12/02/2014	PR960005	Domestic
Dental	46	11101	241	04/03/2014	PR960007	Personal
Shave	888	87187	98	14/03/2014	PR960008	Personal
Laundry	1244	92504	74	24/03/2014	PR960009	Virtual
Kitchen	344	104557	45	04/04/2014	PR960010	Domestic
Soap	2229	35990	16	05/04/2014	PR960011	Domestic

If you have a Pivot Table using this table as source data refresh the Query first and then refresh the Pivot Table. I'm missing my VLOOKUP's already.

Unpivoting worksheet data using Power Query

When you need worksheet data as a source for your Pivot Table is it often in the usual matrix form that people prefer to use. Here is the worksheet with my Product and Country estimates.

2016 Estimates	Dental	Kitchen	Laundry	Shave	Soap	Total
Denmark	148,000	260,000	188,000	154,000	90,000	840,000
France	32,000	22,000	176,000	100,000	170,000	500,000
Germany	214,000	236,000	150,000	225,000	175,000	1,000,000
Greece	14,000	104,000	105,000	12,000	50,000	285,000
Italy	5,000	325,000	95,000	95,000	80,000	600,000
Netherlands	219,000	100,000	46,000	160,000	175,000	700,000
Spain	82,000	55,000	63,000	75,000	45,000	320,000
UK	285,000	200,000	165,000	150,000	140,000	940,000
Total	999,000	1,302,000	988,000	971,000	925,000	5,185,000

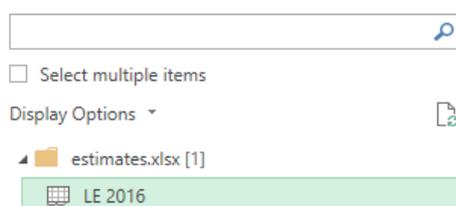
Country	Product	Budget
Denmark	Dental	148000
Denmark	Kitchen	260000
Denmark	Laundry	188000
Denmark	Shave	154000
Denmark	Soap	90000
France	Dental	32000
France	Kitchen	22000
France	Laundry	176000
France	Shave	100000
France	Soap	170000
Germany	Dental	214000

Pivot Tables can't read data in the matrix form, they need to be fed data in the tabular form. Human beings don't produce worksheet data in this form, we must unpivot our original data.

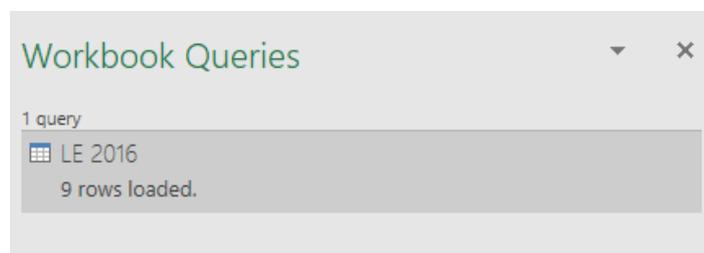
You need the **estimates** file for this demonstration.

Click the **Data** tab and then click **New Query** in the **Get & Transform** group. Click **From File** and then **From Workbook**. In the Navigator choose the LE 2016 sheet and load to the data model.

Navigator



Wait for the query to be created and then click **Launch Power Query Editor**.

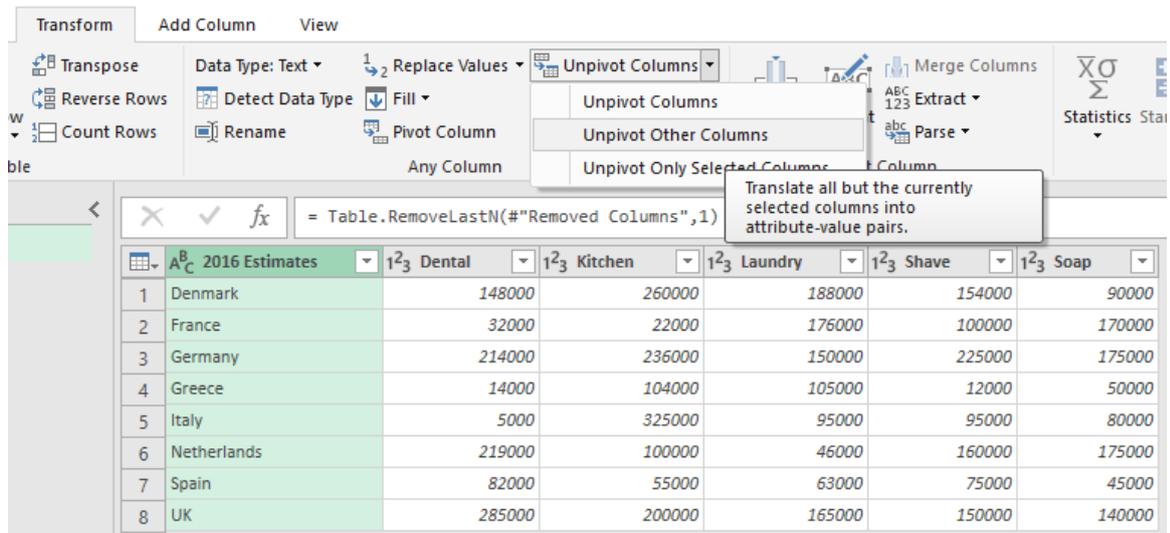


	2016 Estimates	Dental	Kitchen	Laundry	Shave	Soap	Total
1	Denmark	148000	260000	188000	154000	90000	840000
2	France	32000	22000	176000	100000	170000	500000
3	Germany	214000	236000	150000	225000	175000	1000000
4	Greece	14000	104000	105000	12000	50000	285000
5	Italy	5000	325000	95000	95000	80000	600000
6	Netherlands	219000	100000	46000	160000	175000	700000
7	Spain	82000	55000	63000	75000	45000	320000
8	UK	285000	200000	165000	150000	140000	940000
9	Total	999000	1302000	988000	971000	925000	5185000

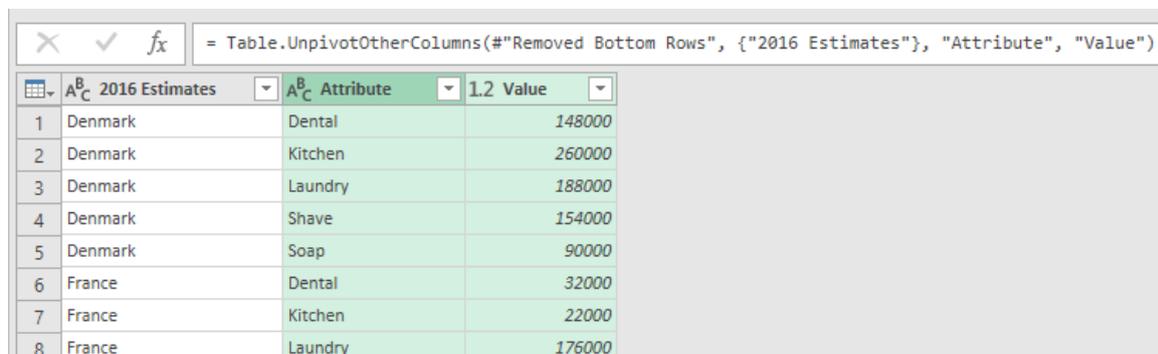
We need to remove the total column from the end and also the total row from the bottom. Then we turn the columns the other way round.

Click the Total column and then click **Remove Columns** on the Home tab.

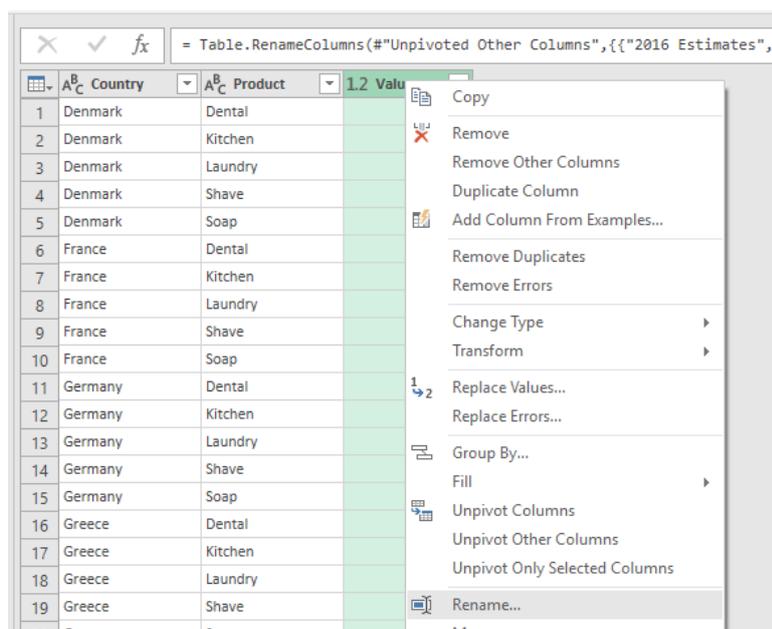
Then click the **Remove Rows** control, choose **Remove Bottom Rows** from the menu and enter the value of 1 to remove the bottom row from the table.



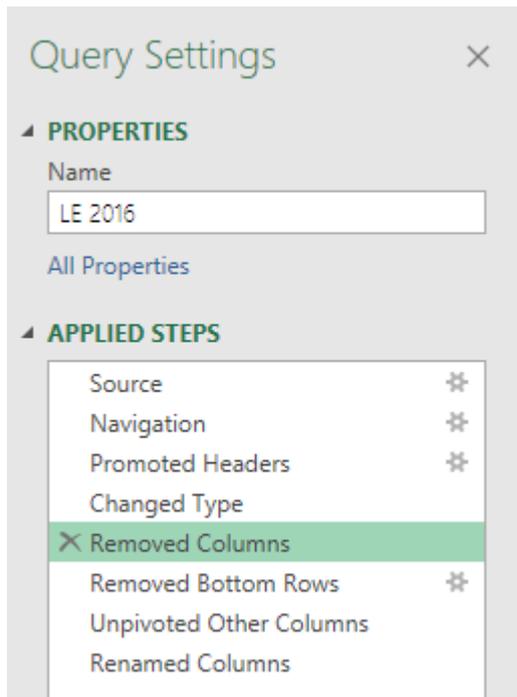
To turn the table around, select the first column and then click the **Unpivot Columns** control on the **Transform** tab. Then choose **Unpivot Other Columns**.



The data is now transformed into the tabular form which we need for our Pivot Tables. All we need to do is rename the column headings.



Just right-click each heading in turn and choose **Rename** from the shortcut menu.



Once again, we can see that all our actions have created a script which is visible in the **Applied Steps** list.

This means that we can update the values on our original estimates worksheet and then **Refresh** to have those changes expressed in our Pivot Table report.

If you ever wish to see the M language instructions in Power Query then click the **Formula Bar** checkbox in the **Layout** group on the **View** tab.

As you click the step you can see the M instruction. Don't click the cross on the left hand right, that is Undo.

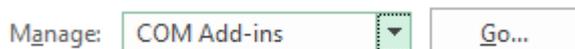
```
= Table.RemoveColumns("#Changed Type",{"Total"})
```

Beyond Pivot Tables: Power Pivot

You can use Power Pivot to create Pivot Tables directly from different data sources, link them together through table relationships and then calculate on the results using the DAX (Data Analysis Expressions) formula language.

Turn on Power Pivot

Power Pivot is available in most commercial versions of Excel 2016 but you have to turn it on first. Click **File, Options, Add-ins**. Look down the bottom for **Manage** and then choose **COM Add-ins** from the drop down list. Click the **Go** button. Select **Microsoft Power Pivot for Excel** from the list.



This should give you a **Power Pivot** tab on the ribbon.

Creating a Report

You will need the **transactions** file to follow the demonstration. Download the file and save it to a convenient location. Open the file and examine the contained data and you will see that there are two worksheets, **Actual** and **Budget**. Historic sales data for a few years and sales estimates for 2016 analysed by Country and Product.

In some of the illustrations here, the original table name **Data** is used instead of **Actual**.

	A	B	C	D	E	F	
1	Country	Region	City	Type	Product	Units	Re
2	UK	North	York	Third Part	Soap	1789	
3	France	East	Montpelie	Business	Dental	1217	
4	Netherlands	East	Apeldoorn	Agency	Shave	637	
5	Denmark	North	Stuer	In Store	Laundry	713	
6	Greece	South	Athens	Third Part	Kitchen	991	
7	Spain	East	Corunna	Agency	Soap	1606	
8	Germany	North	Bremen	Third Part	Dental	46	
9	Spain	South	Seville	In Store	Shave	888	
10	UK	South	London	Business	Laundry	1244	
11	UK	East	Ipswich	Agency	Kitchen	344	
12	UK	West	Bristol	In Store	Soap	2229	
13	UK	North	York	Agency	Dental	1407	
14	UK	South	London	Business	Shave	372	

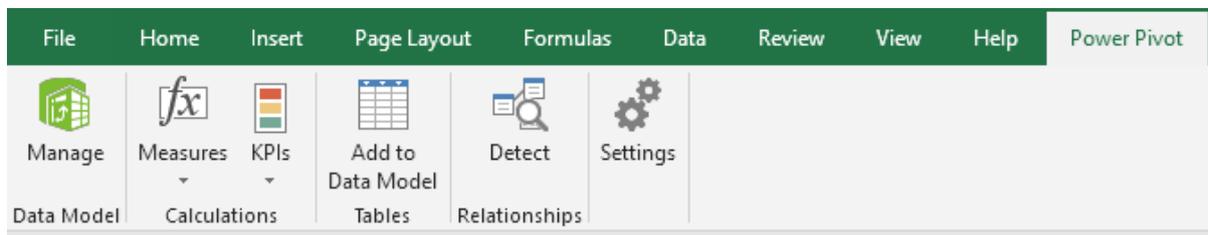
Country	Product	Budget
Denmark	Dental	148000
Denmark	Kitchen	260000
Denmark	Laundry	188000
Denmark	Shave	154000
Denmark	Soap	90000
France	Dental	32000
France	Kitchen	22000
France	Laundry	176000
France	Shave	100000
France	Soap	170000
Germany	Dental	214000

We need to compare our actual performance against our estimates. We can't merge or append our tables, as they are completely different. We need to relate them so that we can do our reports.

Close the file and we will bring the data into the data model then relate our tables. Finally, we produce a Pivot Table report from the data in the data model.

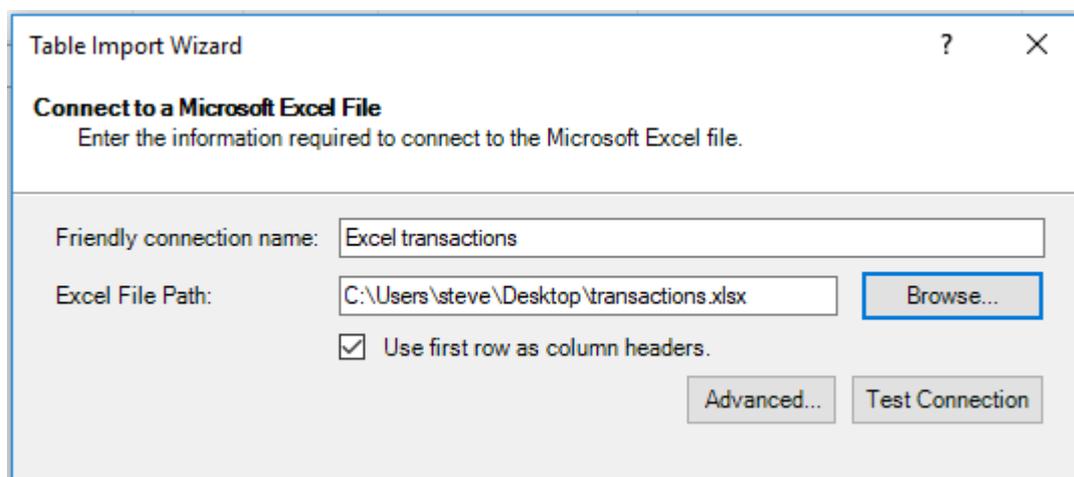
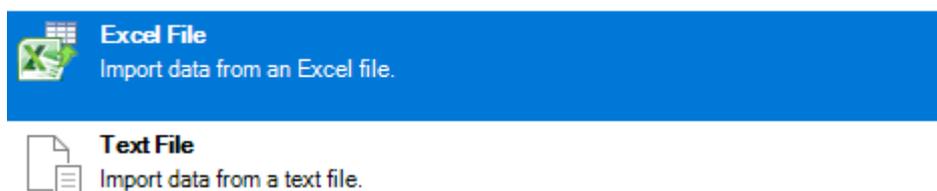
Getting the data into the Data model

Let's go in the front door to Power Pivot. Click **Manage** on the Power Pivot tab and wait while everything loads.

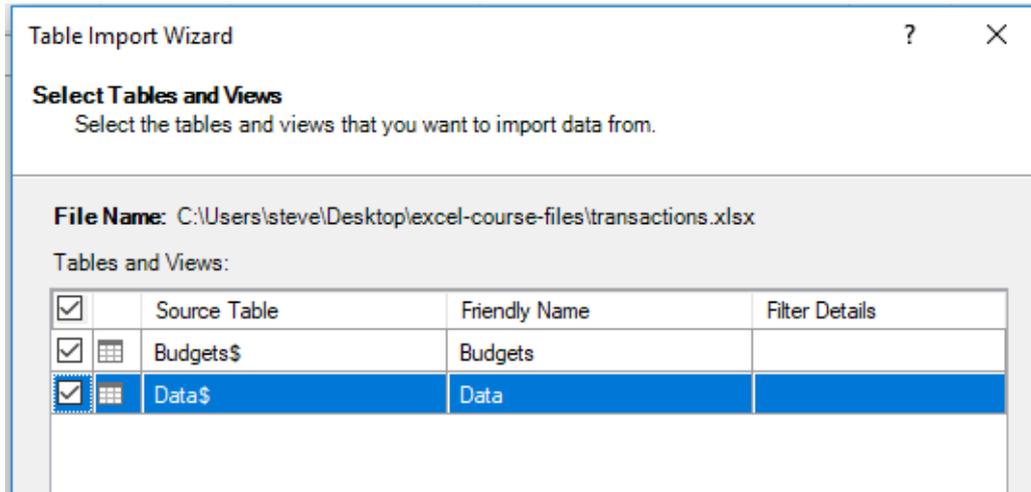


In the Power Pivot window, click **From Other Sources** in the **Get External Data** group. Scroll all the way down to the end and click **Excel File**. Click **Next**. Click the **Browse** button, locate the **transactions** file and click the **Open** button. Don't forget to check the **Use first row as column headers** checkbox. Click **Next**.

Text Files

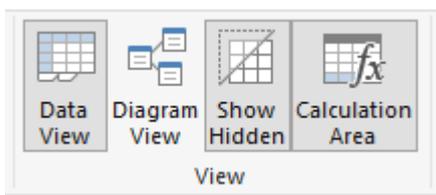


We are now in the Table Import Wizard. Click the **Budget** and **Actual** checkboxes; click **Finish** then **Close** when your data is imported. We are now in the data model and we can see the table data.



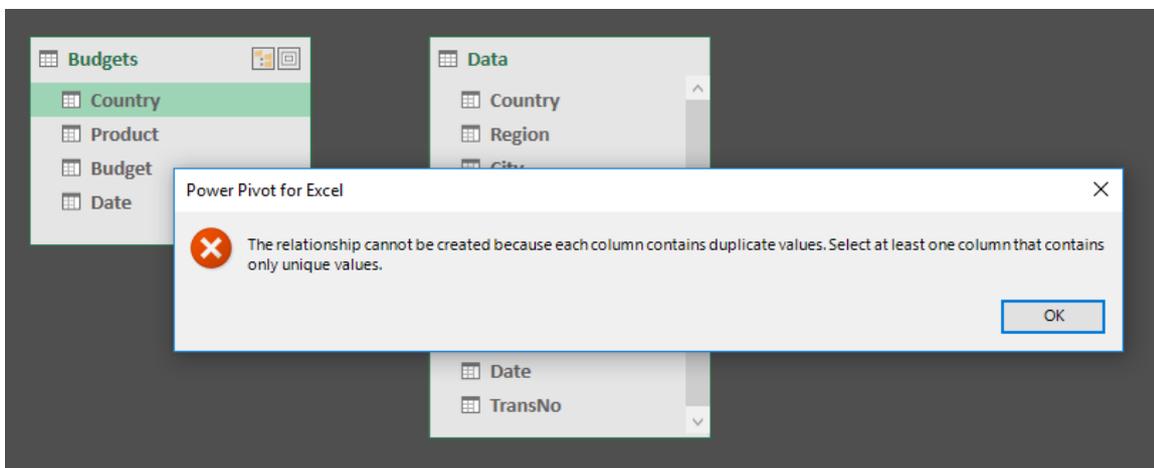
This is populating the data model using the Power Pivot interface. We could just have well started as we did in the previous examples Click the **Data** tab and then click **New Query** in the **Get & Transform** group. Click **From File** and then **From Workbook**.

Relating the tables



We are in the **Data View** and we need to click **Diagram View** to get into the view where we can relate our tables.

Drag the Country field from Budgets over to the Country field from Data to create the relationship. But there's a problem!



We can only produce One-to-Many relationships, where one table has a unique list of values and the other contains duplicate values. But both our tables contain duplicate values. We need a Many-to-Many relationship. No problem, we just use the old database trick of creating bridge tables. We need two tables, one containing a unique list of Country names and the other a unique list of Product names.

We can either do this in Excel by copying the sheets and using the **Remove Duplicates** control on the **Data** tab removing duplicates for both countries and products. Or we could do it through Power Query by duplicating the Budgets table twice and then removing duplicates.

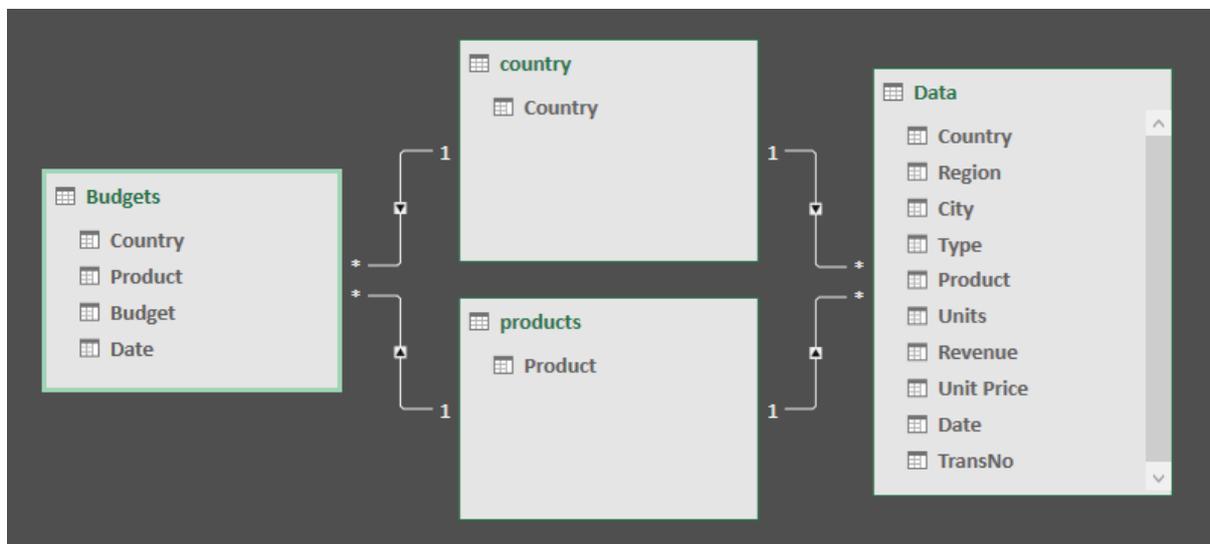
Country	Product
Denmark	Kitchen
France	Laundry
Germany	Shave
Greece	Soap
Italy	Dental
Netherlands	
Spain	
UK	

Here's the Excel method, I have two tables with unique values for Country and Product.

On the Tables worksheet, click any cell in the Country table and then click **Add to Data Model** on the **Power Pivot** tab. Repeat this for the Product table.

Now we can relate the Budget table to the Actual table by linking them through the Country and Products tables.

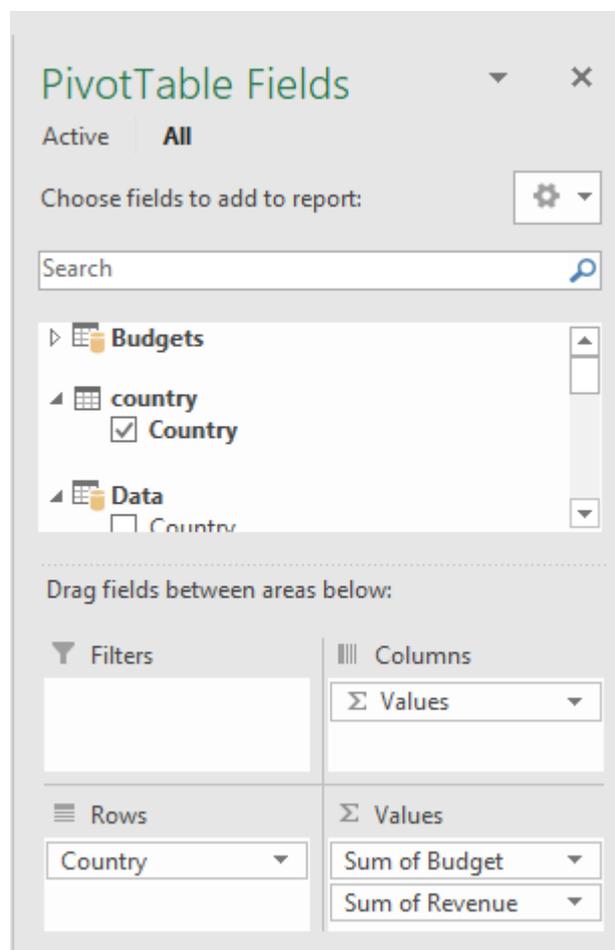
Click **Diagram View** again in the Power Pivot window and drag the Country field from Budgets to the Country field of Country. Then drag the Country field from Actual to the Country field of Country. Repeat the process for the Product fields. We have created Bridge Tables and linked our original tables together through a series of One-to-Many relationships.



There is no real need to move the tables into this harmonious arrangement but some people find it pleasing. Now we are ready to create our Pivot Table report comparing our actuals against budget.

Creating the Pivot Table report

Now everything is linked together the reports are easy to do. Click either **PivotTable** in the Power Pivot window or switch back to Excel and click **Insert, Pivot Table** and **Use this workbook's Data Model**.



In the PivotTable fields list you will see the different tables and their contained fields.

Whenever you need a list of Countries or Products take these fields from the Country or Product tables--the **one** tables. Don't take them from either Budgets or Data, these are the **many** tables and you will get some strange looking results where every number is the same. Only take the data to be aggregated from the many tables.

In the Pivot Table below, the countries are the **Country** field from the Country table. **Sum of Budget** is from the Budget table and **Sum of Revenue** from the Actual table.

Row Labels	Sum of Budget	Sum of Revenue
Denmark	840000	2791269
France	500000	1602277
Germany	1000000	3083461
Greece	285000	888137
Italy	600000	1920922
Netherlands	700000	2372356
Spain	320000	1586249
UK	940000	4291068
Grand Total	5185000	18535739

The results look a bit odd; our Revenue is way over Budget. That's because the Budget numbers are for one year, 2016 and the Revenue is historic for 2014 to 2016. We could put a Timeline filter on Revenue to show only the year 2016 but then we also want to calculate the difference between Budget and Revenue and for that we must use DAX.

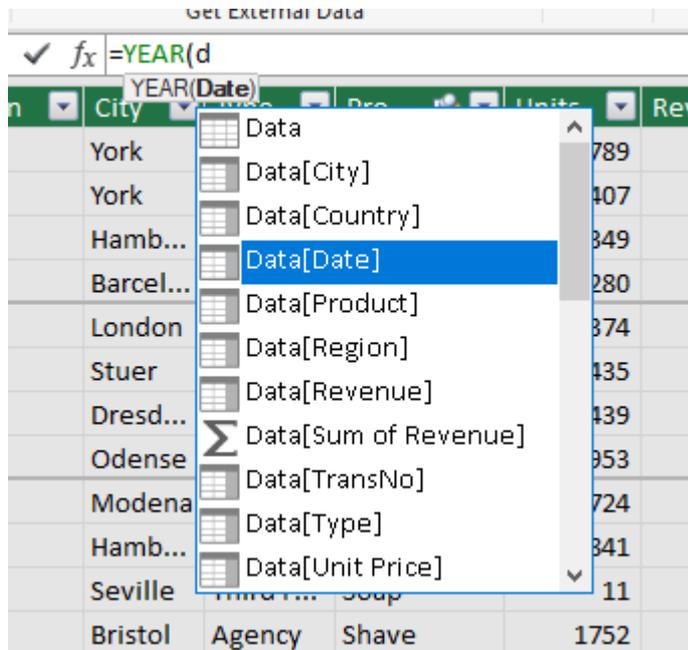
There are two types of DAX formula. Firstly, **Calculated Columns**, which are entered in the data model and which generate new columns of data and secondly, **Measures**.

Measures are entered in the Pivot Table. They do not generate new columns of data but rather deliver filtered data that is used in the Pivot Table report. We shall have a Calculated Column to help us make the filter for 2016 Revenue then two Measures, one to calculate the 2016 Revenue and the second to calculate the difference between Budget and Revenue.

DAX Calculated Columns

Back in the Data Model the Actuals table needs a calculated column to return the year value from the Date column. Click **Add Column** and enter the YEAR function, type-in an equals sign, then a “Y” and select the YEAR function from the list by double-clicking or pressing the Tab key. Type-in a “D” to trigger the tables and fields list. The final formula reads as follows:

```
=YEAR(Data[Date])
```



Don't forget your closing bracket for the YEAR function, DAX is not as forgiving as Excel; it usually closes automatically on most functions but not on all.

Double-click or right-click to rename the field as **FinYr**. You always drag to move the fields into a different order. Now our filter will be really easy to make, it's so much easier to say “FinYr = 2016” than it is to express a range of date values from 1/1/2016 to 31/12/2016.

Date	FinYr	TransNo	A
01/01/2014	2014	PR960001	
06/04/2014	2014	PR960012	
09/08/2014	2014	PR960044	
10/08/2014	2014	PR960045	
11/08/2014	2014	PR960046	
15/08/2014	2014	PR960050	
16/08/2014	2014	PR960051	

DAX Measures

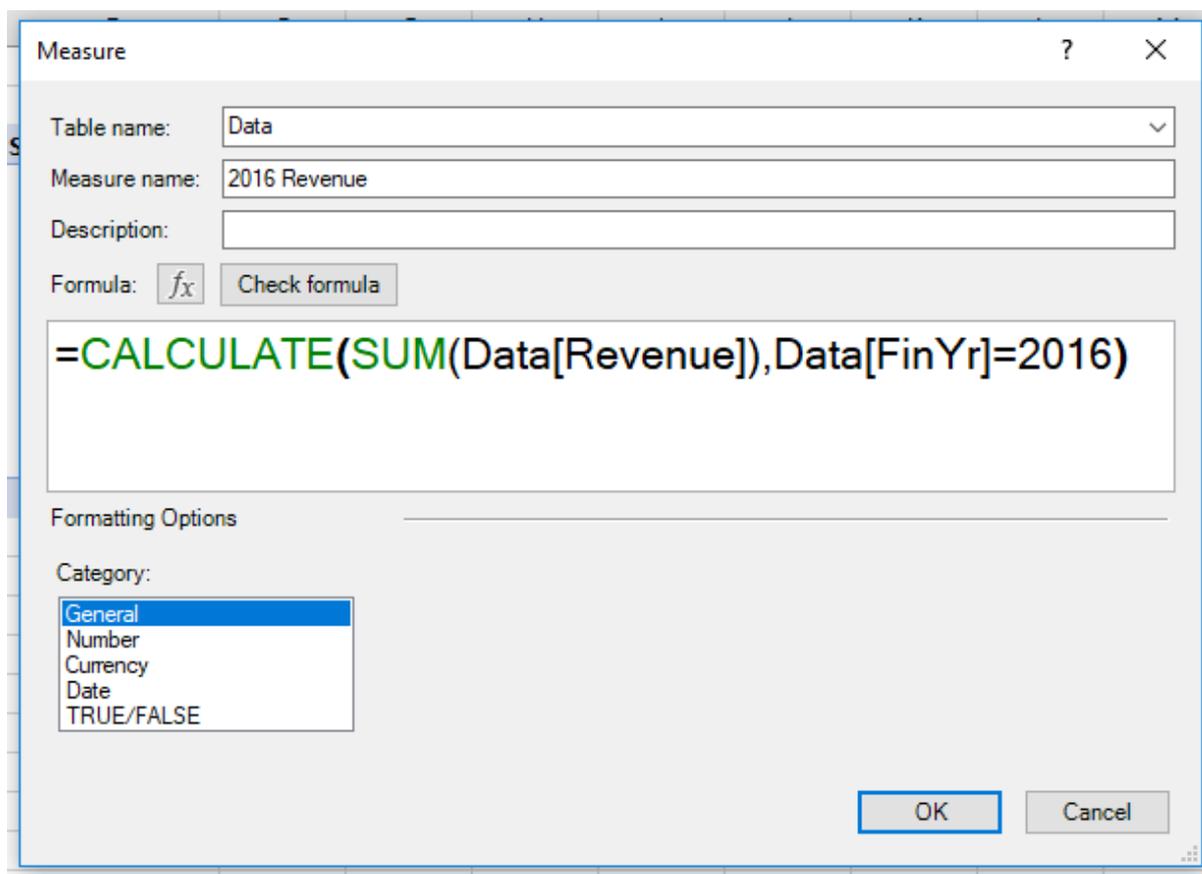
Now, back to the Pivot Table to enter a Measure to calculate the 2016 Revenue. DAX does not have filtering functions like SUMIFS, SUMIF, COUNTIFS, AVERAGEIFS etc. It has one universal filter function that does the job of all of them, namely CALCULATE.

CALCULATE(Expression, Filter1, Filter2 etc.)

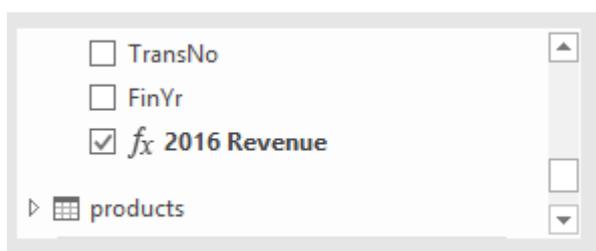
Expression is the function you want to use, such as SUM, COUNT or AVERAGE etc. and the field you want to calculate and then you list the filters to apply. (You may also need other functions like FILTER or ALL to help you make more complex filters)

In Excel, 2016 Revenue would be a job for SUMIF or SUMIFS. In DAX it is:

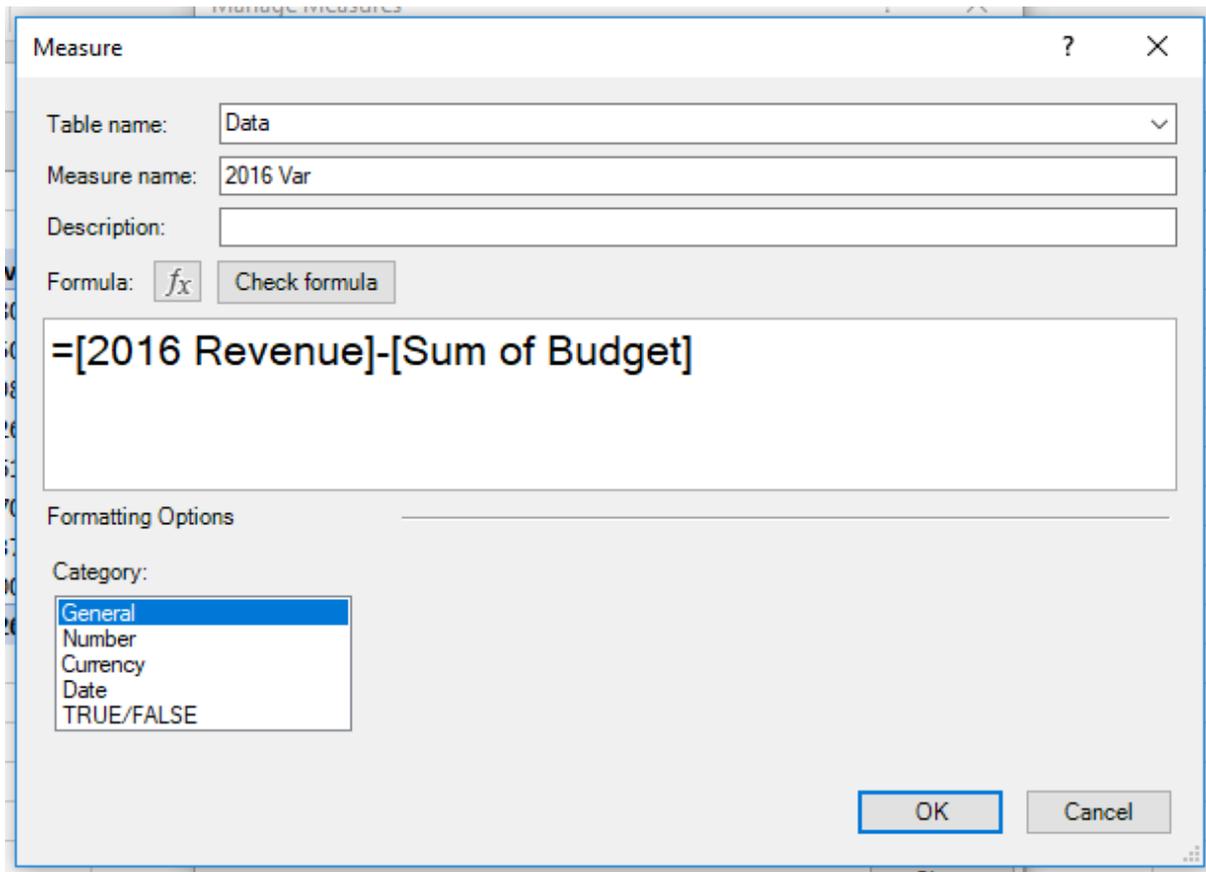
=CALCULATE(SUM(Data[Revenue]), Data[FinYr]=2016)



Click **Measures**, set the **Table name** to Data, the **Measure name** to 2016 Revenue and enter the formula by typing "C", "S", "D", "D" to trigger the drop down lists. Be careful with your brackets and click **Check formula** before entering. If you have a mouse you can hold down the CTRL key on the keyboard and spin the mouse scroll wheel to zoom in or out the view of the formula.



If your measure is a success then it will appear in your Pivot Table. If you have to edit it before it works then turn it on in the pivot table field list.



Our next measure is entered to calculate the difference between 2016 Revenue and Budget. Don't type-in from scratch, enter opening square brackets, [to trigger the lists where you can choose the measures to include in your calculation. This measure uses the measure previously calculated and the existing Sum of Budget (implicit measures), which the Pivot table has calculated. The formula is:

`= [2016 Revenue] - [Sum of Budget]`

Row Labels	2016 Budget	2016 Revenue	2016 Var
Denmark	840,000	802,172 -	37,828
France	500,000	505,755	5,755
Germany	1,000,000	986,441 -	13,559
Greece	285,000	264,570 -	20,430
Italy	600,000	618,154	18,154
Netherlands	700,000	706,594	6,594
Spain	320,000	377,679	57,679
UK	940,000	1,003,459	63,459
Grand Total	5,185,000	5,264,824	79,824

In the Pivot Table above we have renamed the **Sum of Budget** field as **2016 Budget**.