

Microsoft Power Tools for Data Analysis #13

Power Pivot Into #1: Relationships Rather Than VLOOKUP

Notes from Video:

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1. What is Power Pivot (Basic Answer)?

- 1) **Power Pivot comes in Office 365.** It is a new feature in Office 365 that allows us to create reports from Multiple Tables and Big Data.
 - i. It has been around in earlier versions, as far back as Excel 2010, but you either had to add it as an add-in or buy the correct version of Excel.
- 2) **Excel Power Pivot provides 3 Data Tools:**
 - i. Columnar Database = Behind the scenes in RAM Memory Efficient Big Data Analytics Database
 - ii. Relationships Between Tables = replace VLOOKUP and allow criteria and filters to affect reports and visualizations from one table to another.
 - iii. DAX Formulas:
 1. Efficiently Calculate Over Big Data.
 2. Many More Calculations than in Standard PivotTable
 3. Build One Formula that can work in many reports
 4. Add Number Formatting to Formulas
- 3) **Data Model = Name for Power Pivot's 3 Data Tools :**
 - i. The Columnar Database, Relationships and DAX Formulas together are called the "Data Model".
- 4) **From the Data Model we make Data Model PivotTables.**
 - i. Synonyms for Data Model PivotTable:
 1. Power Pivot Report
 2. Power Pivot PivotTable
 - ii. Data Model PivotTables create summary reports with one or more calculations based on conditions / criteria / filters
- 5) **Basic Advantages of Excel Power Pivot:**
 - i. Can work on Millions of rows of data
 - ii. Can Reduce file size on data sets with less than a million rows
 - iii. Can use Relationships and Multiple Tables rather than VLOOKUP and a single Flat Table.
 - iv. DAX formulas provide:
 1. More variety than in a Standard PivotTable
 2. Can work efficiently on Big Data that is stored in the Columnar Database.
- 6) **Relationship feature works in versions of Excel 2013 or later**
 - i. This means that if you have Excel 2013 or 2016, but you do not have the correct version with the Power Pivot Com Add-in, you can still use the Relationships feature to add two or more tables to a PivotTable field list and then make a PivotTable based on multiple tables. However, if you do not have the correct version with the Com-Add-in, you will not be able to work in the Power Pivot Data Model Window.
- 7) **Show Power Pivot Ribbon Tab in Excel**
 - i. Click on the File Tab, then click on Options, then on the left, click on Add-ins, then in the Manage textbox dropdown, select "Com Add-ins", then check the check Box for Power Pivot.

2. Power Pivot Data Model PivotTable is different than a Standard PivotTable in these ways :

Standard PivotTable	Standard PivotTable	Data Model Pivot Table Power Pivot PivotTable	Reason to Use Data Model Pivot Table
Data Source	*Excel Sheet *Connect To External	*Data Model *Connect To External	Data Model allows more sophistication in Modeling Data
Calculations	*Summarize Values By *Show Values As *Calculated Field/Item	*Summarize Values By *Show Values As *DAX Formulas	DAX Formulas have many more options
Number Formatting	Add for each new calculation	Attached to Formula	Less Time Formatting
Reuse Formulas	No	Yes for DAX	Reuse Formulas
Data Size	Limited To Sheet size (about 1 m. Rows)	Millions up to a Billion	Can hold more data
Multiple Tables	No	Yes	Work from Multiple Tables
Relationships	No	Yes	Don't have to use many VLOOKUP Functions
File Size	Bigger	Smaller	If you load the data, the Data Model (Columnar Database) is MUCH Smaller

3. Example in this video: Create Relationships, Add Tables to Power Pivot Data Model, Create Data Model PivotTable:

Here are the Steps for the Project in this video:

- 1) **Step 1: Convert each Table to an Excel Table** and name the tables smartly. We have three tables that we have to name on the sheet names "SalesData".
 - i. To name each table, click in one cell and use Ctrl + T to convert it to an Excel Table.
 - ii. Here is a picture of the three tables and the names for each:

The screenshot shows an Excel spreadsheet with three tables highlighted by red arrows and labels:

- SalesTable**: Points to a table with columns Date, Product, County Code, Units, Rev, and COGS.
- CountyLookupTable**: Points to a table with columns CountyCode and Country.
- ProductLookupTable**: Points to a table with columns Product, Retail Price, Standard Cost, and ProductCategory.

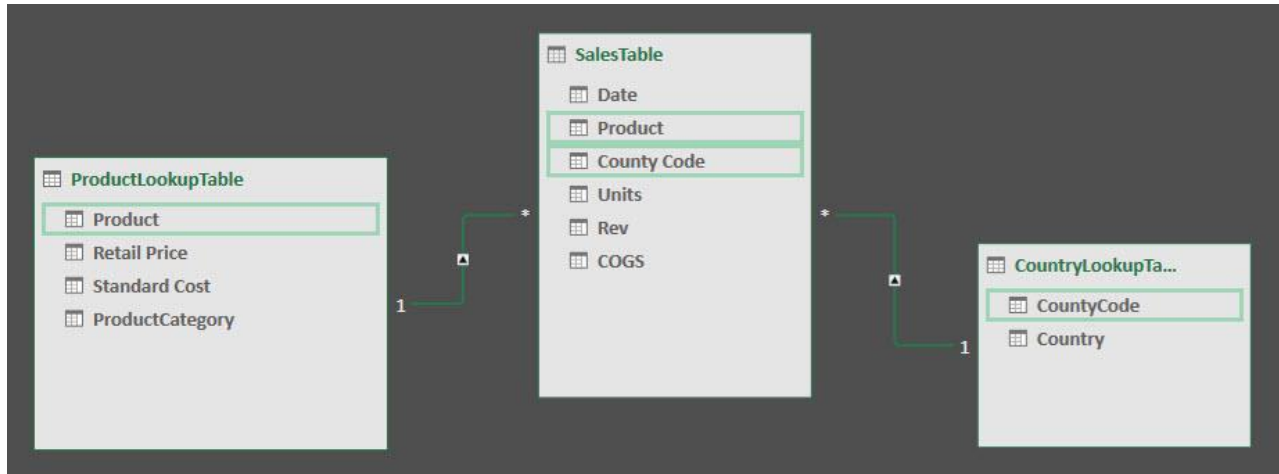
2) Notice that the Sales Table has a Product Field with many duplicate values and it has a Country Code Field with many duplicates:

17	Date	Product	County Code	Units	Rev	COGS
18	12/16/2017	Fun Fly	MEX	36	\$161.05	\$114.66
19	8/12/2017	Eagle	DZA	1	\$23.95	\$9.15
20	12/28/2018	Carlota	FRA	3	\$65.85	\$26.97
21	12/28/2018	Phoenix	USA	4	\$103.80	\$41.23
22	4/2/2017	Yanaki	CAN	2	\$51.98	\$21.64
23	10/3/2018	Manu LD	USA	4	\$1,008.00	\$376.94
24	11/17/2017	Aspen	JPN	2	\$47.90	\$20.67
25	9/28/2017	Majestic Beaut	AUS	3	\$86.85	\$32.40
26	12/16/2017	Darnell Tri Fly	PER	1	\$11.95	\$4.46
27	10/4/2017	GelFast	ECU	2	\$52.00	\$24.29
28	9/21/2017	Carlota	LKA	2	\$43.90	\$14.59
29	12/14/2018	Manu LD	ARM	1	\$252.00	\$105.26
30	7/2/2016	GelFast	KHM	4	\$104.00	\$44.16
31	10/7/2018	Fun Fly	NLD	2	\$13.98	\$6.70
32	10/30/2018	Sunshine	NLD	1	\$21.95	\$9.34
33	8/25/2017	Phoenix	VNM	1	\$25.95	\$9.77
34	7/28/2018	Fun Fly	NOR	5	\$34.60	\$15.76
35	1/8/2018	Fun Fly	USA	1	\$6.99	\$3.54
36	6/21/2016	Fun Fly	HKG	1	\$6.99	\$3.54

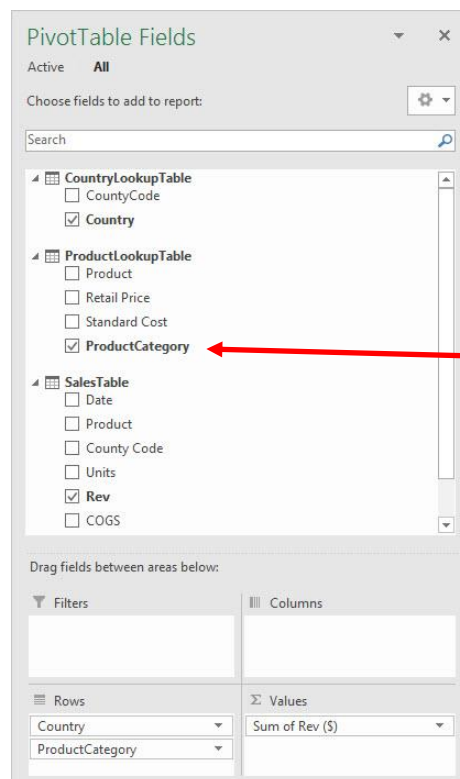
3) Notice that for both of our Lookup Tables, the first column has a unique list of values:

16	H	I	J	K	L	M	N	O	P
17		CountyCode	Country			Product	Retail Price	Standard Cost	ProductCategory
18		AFG	Afghanistan			Alpine	23.95	10.09	Beginner
19		ALB	Albania			Aspen	23.95	9.48	Beginner
20		APR	Aprine			Bellen	26.99	10.75	Beginner
21		ARE	United Arab Emirates			Bower Aussie Round	45	18.45	Competition
22		ARG	Argentina			Carlota	21.95	8.48	Beginner
23		ARM	Armenia			Carlota Doublers	71	30.25	Freestyle
24		AUS	Australia			Crested Beaut	19.95	8.5	Intermediate
25		AUT	Austria			Darnell Tri Fly	11.95	5.25	Beginner
26		AZE	Azerbaijan			Eagle	23.95	8.97	Intermediate
27		BEL	Belgium			Fire Aspen	23.5	9.55	Advanced
28		BGD	Bangladesh			Frido Fast Catch	41.95	21.45	Competition
29		BGR	Bulgaria			Fun Fly	6.99	3.25	Beginner
30		BHR	Bahrain			GelFast	26	11.04	Competition
31		BHS	Bahamas			Majestic Beaut	28.95	11.49	Intermediate
32		BIH	Bosnia and Herzegovina			Manu LD	252	100.25	Advanced
33		BLZ	Belize			Manu MTA	122	49.78	Competition
34		BOL	Bolivia			Phoenix	25.95	10.85	Intermediate
35		BRA	Brazil			Quad	41.95	16	Freestyle
36		BRB	Barbados			Sunset	25.5	10.51	Competition
37		BRN	Brunei Darussalam			Sunshine	21.95	8.65	Beginner
38		BWA	Botswana			Sunspot	14.5	6	Novelty
39		CAN	Canada			Yanaki	25.99	10.02	Intermediate
40		CHE	Switzerland						

- 4) When we use VLOOKUP to lookup a value from the Sales Table we are allowed to have many duplicate Product Names or Country Code names, but in the first column of the lookup tables we can never have duplicate values because if we did, VLOOKUP would not know how to do a lookup – the duplicate values would cause an ambiguous situation.
- The first column in a lookup table must always have a unique list of values.
 - This is important because if we do have a unique list of values in the first column of the lookup table and we are doing Exact Match Lookup, rather than use VLOOKUP, we can simply connect the first column of the lookup table to the Sales Table using a Relationship. In a picture, it would look like this:



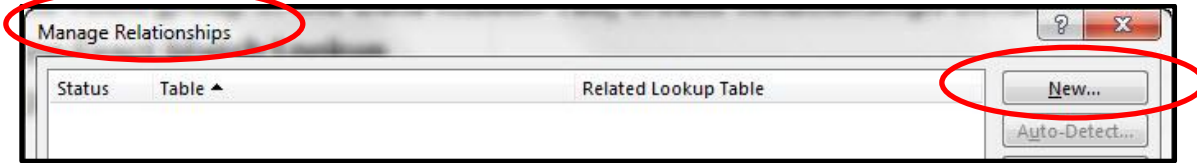
- 5) In the picture, the Number “1” means that the first column of the lookup table is only allowed to have “One of Each Value” in the first column. The asterisk on the other side of the Relationship line means that this side can have many duplicates. This is called a “One-To-Many” Relationship. And it makes sense, because in the Lookup Table you can list the Product only one time, but on the “Many” side of the relationship you are allowed to sell that one product many times!!!
- 6) Once we create these One-To-Many Relationships between the Lookup Tables and the Sales Table, we can then have multiple tables in our PivotTable Field List and drag and drop field from which ever table we would like, like in this picture:



With Relationships we are allowed to have many Tables in the PivotTable Fields Task Pane.

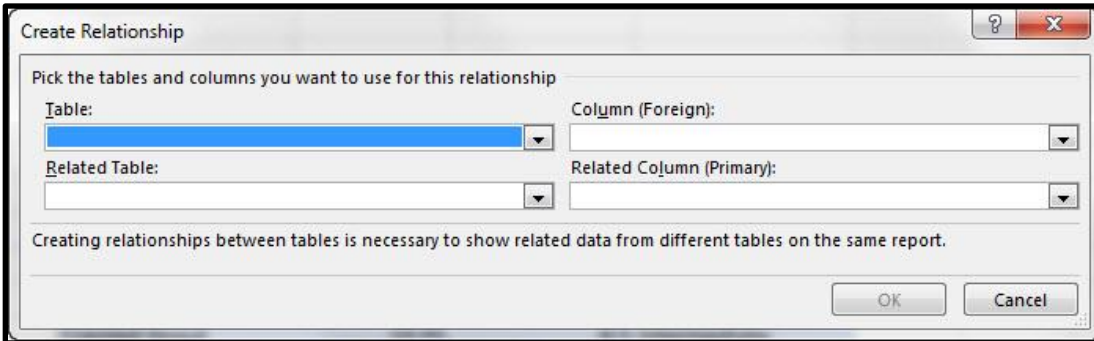
7) **Step 2: Create the Relationships** between the tables.

- i. Go to the Data Ribbon Tab, then in the Data Tools group click the Relationships button. The Manage Relationships dialog box looks like this:



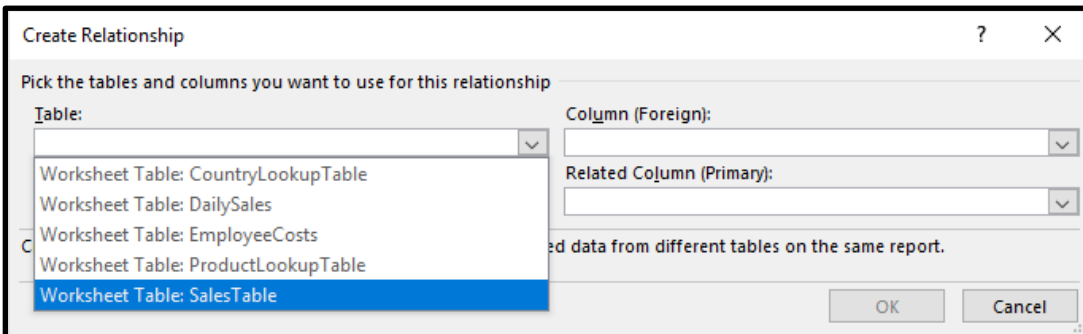
8) Click the New Button and you will see the Create Relationship dialog box.

- i. The Table field is where you put the Sales Table
- ii. The “Related Table” is always the Lookup Table.



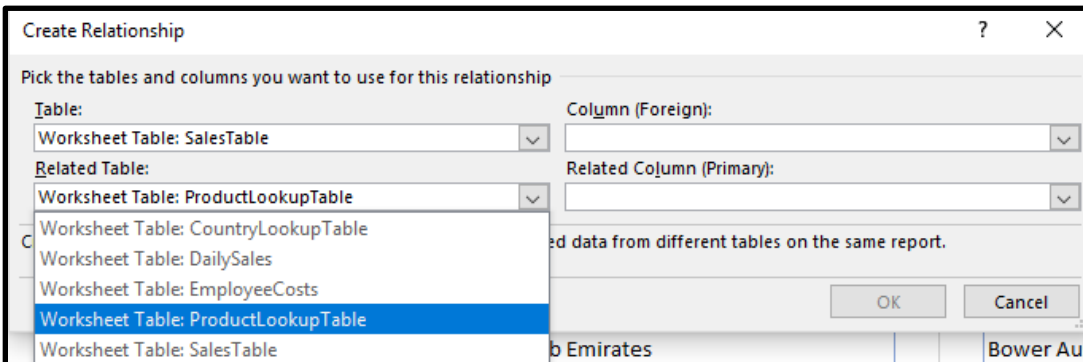
9) Click the dropdown in the Table textbox and select “Worksheet Table: SalesTable”

- i. Notice that there are five Worksheet Tables. (There are two tables in our workbook that we are not using for our PivotTable, but it still shows up in this list.)
- ii. “Worksheet Table” is a synonym for “Excel Table”.

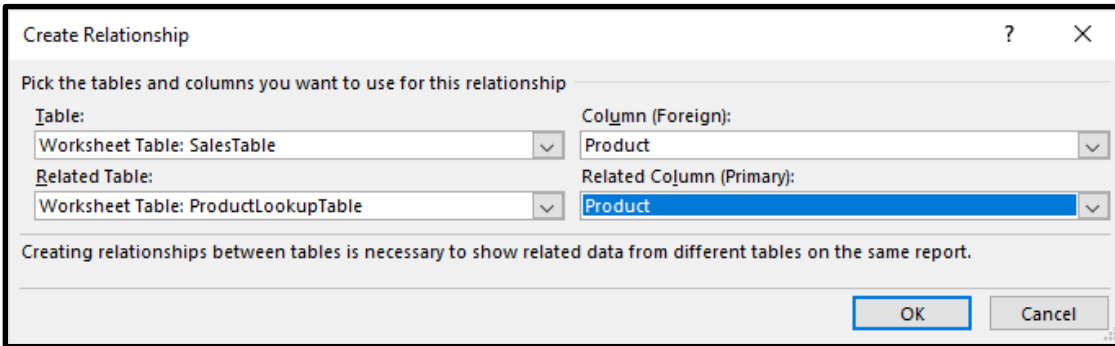


10) From the Related Table textbook, select the first Lookup Table, “Worksheet Table ProductLookupTable”

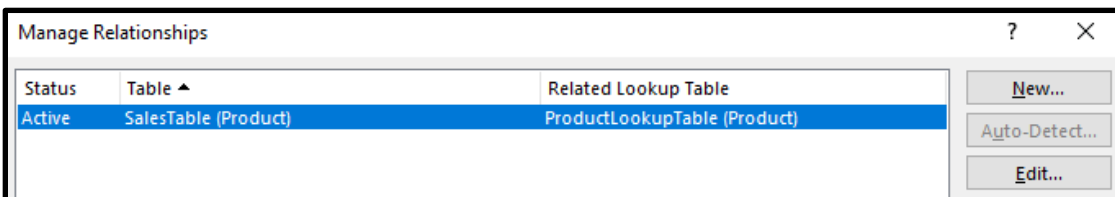
- i. The Related Table is always the Lookup Table.
- ii. “Primary” refers to the fact that the first column in the lookup table has a unique list of “primary” elements. The phrase “Primary Key” is used in Access and in Database terminology to mean the first column of the lookup table that contains a unique list.



- 11) Now that we can select the Product Field from the SalesTable in the “Column (Foreign):” textbox and we can select the Product Field from the ProductLookupTable in the “Related Column (Primary):” textbox.
- i. When we click OK, a One-To-Many Relationship will be created between the Product Field in the ProductLookupTable and the Product Field in the SalesTable.



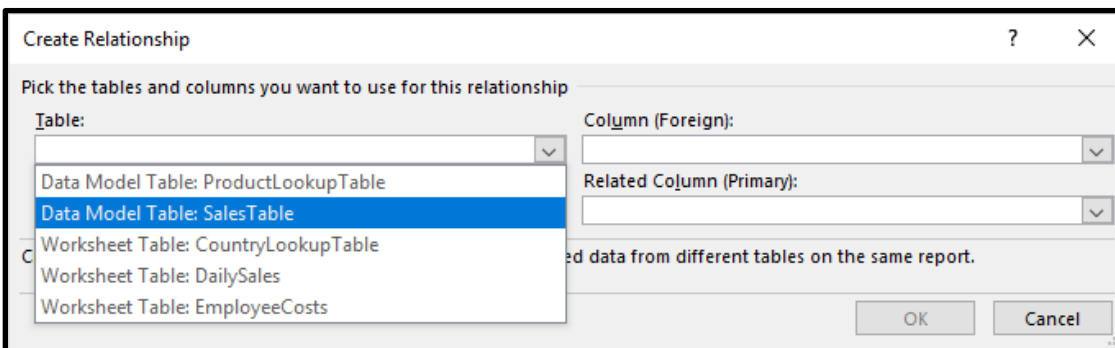
- 12) After creating the Relationship, the Manage Relationships dialog Box lists our first Relationship.



Important Note:

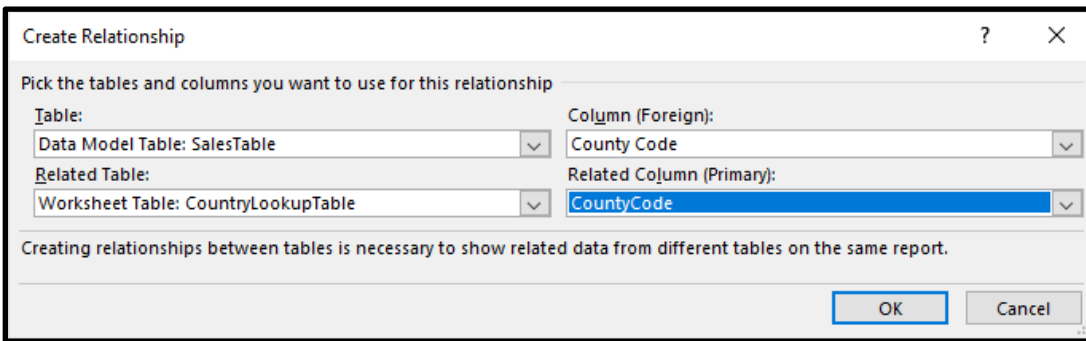
We you create a Relationship between two tables, the tables and the Relationship are stored in a behind the scenes database called the “Data Model”. This Data Model is an efficient and compact way of storing tables and relationships. In fact, if you compare the same PivotTable Report using VLOOKUP and the Data Model and Relationships, you will see that the file size is much smaller for the Data Model and Relationships PivotTable Report. You can check the size of the file named “013-PivotTablesVLOOKUPFinished.xlsxm” and compare it to the size of the file named “013-MSPTDA-RelationshipsRatherThanVLOOKUP.xlsx” using Windows Explorer. If you have a lot of data using Relationships rather than VLOOKUP can significantly reduce file size and formula calculation time.

- 13) Now, we want to create our second Relationship between the SalesTable and the CountryLookupTable.
- 14) Click the New button in the Manage Relationships dialog box and then select the SalesTable in the dropdown for the Table textbox, like in this picture:



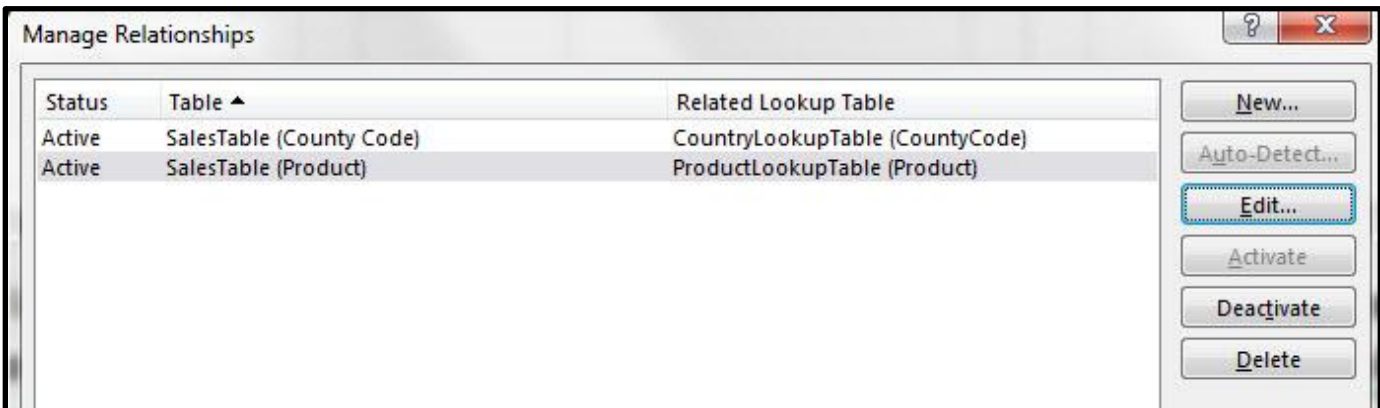
- 15) When we create the second relationship, notice that the Table textbox now lists the “SalesTable” as a “Data Model Table”.

16) Complete the textboxes in the Create Relationships dialog box as seen here:

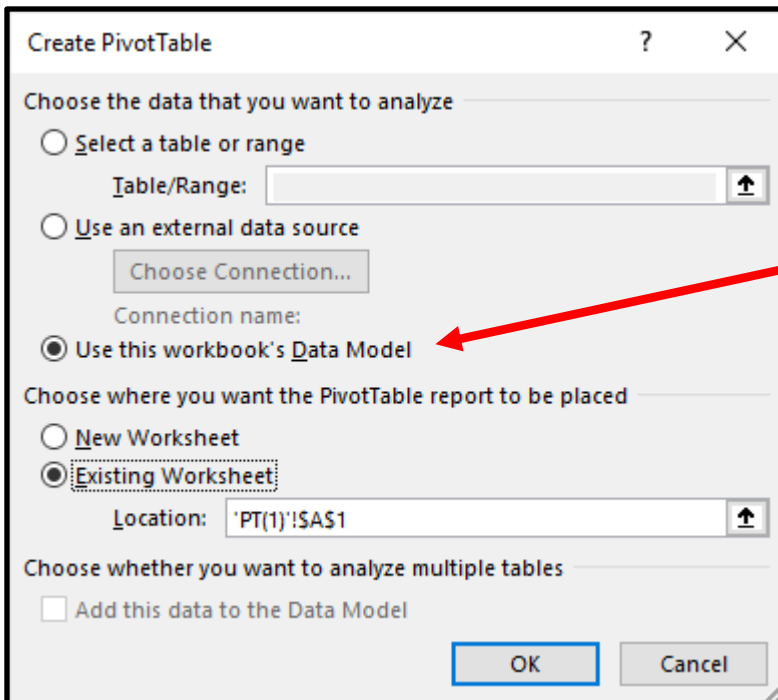


17) When you click OK the Manage Relationships dialog box will list two One-To-Many Relationships.

- i. Note: Relationships can be used when you are doing Exact Match Lookup.

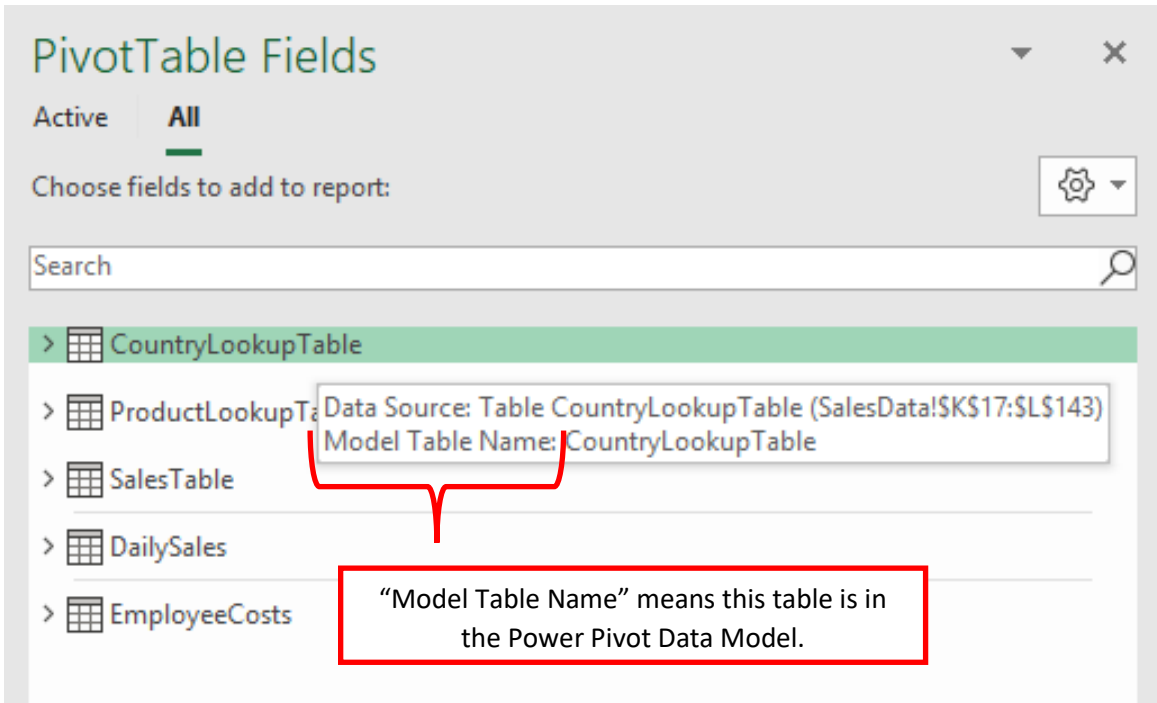


18) **Step 3: The Create PivotTable dialog Box has an option named "Use this workbook's Data Model".** Select cell A1 on the Excel Worksheet named "PT(1)". Then create a PivotTable and in the Create PivotTable dialog Box, check the dialog button "Use this workbook's Data Model", as seen below:

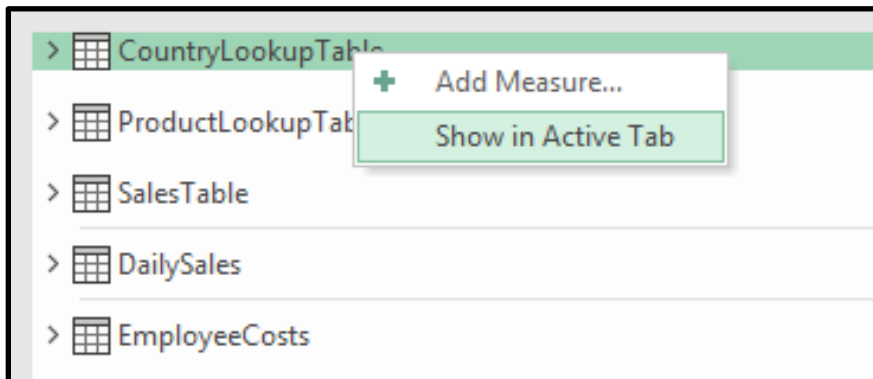


19) **Step 4: Data Model PivotTable Field List.** After you click OK in the Create PivotTable dialog box, you will see that there are five tables listed.

- i. If you hover your cursor over each table, the tables that have been added to the Data Model, say: **“Model Table Name”**



20) **Step 5:** In the PivotTable Fields List, right-click each of the three Data Model Tables and point to “Show in Active Tab”. This adds the tables to the Active Tab in the PivotTable Field List so that we can build a PivotTable Report from just the tables in the Data Model.



21) **Step 5:** Expand the tables and drag the Country field from the CountyLookupTable to Rows area, ProductCategory Field from the ProductLookupTable to Columns area and Rev Field from SalesTable to Values area, as seen below. Then complete the PivotTable as seen here:

	A	B	C	D	E	F	G	H	I
1	Country	Product	Sum of Rev						
2	Algeria	Alpine	2720.72						
3		Aspen	4595.53						
4		Bellen	6744.54						
5		Bower Aussie Round	1980						
6		Carlota	5392.45						
7		Carlota Doublers	1775						
8		Crested Beaut	577.35						
9		Darnell Tri Fly	191.2						
10		Eagle	1435.8						
11		Fire Aspen	2079.05						
12		Frido Fast Catch	865.85						
13		Fun Fly	2437.69						
14		GelFast	1763.84						
15		Majestic Beaut	5454.18						
16		Manu LD	10243.8						
17		Manu MTA	5734						
18		Phoenix	3714.22						
19		Quad	5607.89						
20		Sunset	1969.11						
21		Sunshine	8496.41						
22		Sunspot	767.34						
23		Yanaki	3535.42						
24	Algeria Total		78081.39						
25	Argentina	Alpine	4225.74						
26		Aspen	8727.13						
27		Bellen	14186.21						
28		Bower Aussie Round	2983.05						
29		Carlota	10300.26						
30		Carlota Doublers	3594.02						
31		Crested Beaut	1765.18						

22) **Implicit Measures.** As seen the above picture, and as demonstrated in the video, when we drag a Field from a Data Model Table into the Values area of the Data Model PivotTable, the calculation that is made is called an “Implicit Measure”.

- i. Implicit Measures are hidden DAX Formulas that are automatically made when you drag a Field from a Data Model Table into the Values area of the Data Model PivotTable.
- ii. There are multiple disadvantages to use Implicit Measure sin a Data Model PivotTable. We will discuss these disadvantages in full detail in MSPTDA Video #15 - Power Pivot Video Intro Video #3. However, Implicit Measures are perfectly okay to use when you are making a simple PivotTable report, like adding to get totals. In this case, the advantages of being able to quickly create the PivotTable outweigh the disadvantages. Much more in video MSPTDA Video #15 - Power Pivot Video Intro Video #3.

23) **Step 6:** If we have Office 365 or the correct version of Excel, we can look at the Power Pivot Data Model by clicking the Data Model button in the Data Tools group in the Data Ribbon Tab. The finished Data Model with Tables and Relationships looks like this:

