PowerPivot for the Data Analyst: Microsoft Excel 2010

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PowerPivot for the Data Analyst: Microsoft® Excel 2010

Bill Jelen
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Two Important Rules with Pivot Tables

- Pivot Tables Do Not Recalculate When Underlying Data Changes
- You Cannot Move or Change Part of a Pivot Table

### Two Important Rules with Pivot Tables

Pivot Tables Do Not Recalculate When Underlying Data Changes

You Cannot Move or Change Part of a Pivot Table

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Dedication

To Mark Hauser, for trusting me to be a data analyst. We would have thought we were in heaven if we had PowerPivot way back then.

About the Author

Bill Jelen, Excel MVP and the host of MrExcel.com, has been using spreadsheets since 1985, and he launched the MrExcel.com website in 1998. Bill was a regular guest on Call for Help with Leo Laporte and has produced more than 1,200 episodes of his daily video podcast, Learn Excel from MrExcel. He is the author of 30 books about Microsoft Excel and writes the monthly Excel column for Strategic Finance magazine. You will most frequently find Bill taking his show on the road, doing half-day Power Excel seminars wherever he can find a room full of accountants or Excellers. Before founding MrExcel.com, Jelen spent 12 years in the trenches working as a financial analyst for finance, marketing, accounting, and operations departments of a $500 million public company. He lives near Akron, Ohio, with his wife, Mary, Ellen and his sons, Josh and Zeke.
Acknowledgments

Rob Collie moved to Cleveland, Ohio, in 2009. Rob is one of the project managers on the PowerPivot team. If you’ve ever lived in Cleveland, you understand the words “snow belt” and “lake effect snow.” Sitting on the southern coast of Lake Erie, Cleveland is one of five places in the world to experience lake effect snow. There is a section of Cleveland, on the leeward side of Lake Erie where the snowfall triples. As well as Clevelanders understand Mr. Jingaling, we’ve lived with the words “expect 2 inches of snow overnight, 8 inches in the snow belt.” Of course, Rob relocated to the heart of the snow belt and is probably cursing Cleveland as I write this. However, for me, being the guy writing the first book about PowerPivot, having Rob, one of the most knowledgeable guys about PowerPivot, move into practically my backyard was an amazing coincidence. Thanks to Rob for many lunches where he talked about the vision and the reasoning behind PowerPivot. Did I mention Rob spent several years as a project manager on the Excel team? When my head was spinning with DAX formulas, we could always go back to the comfortable territory of why Excel does something bizarre. Thanks to Rob and Jocelyn for happening to end up in Cleveland during the writing of this book.

Thanks to David Gainer for laying the groundwork for Excel 2010 and for sending that e-mail saying that Rob was moving to Cleveland.

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Thanks to Dan Bricklin and Bob Frankston for inventing the computer spreadsheet. Thanks to Mitch Kapor for Lotus 1-2-3.

Here are a few new names to thank: Bob Frankston’s brother, Charles Frankston, went to work for another Cambridge start-up. In 1985, Charles, along with Rob Firmin, Stan Kugell, Christopher Herot, Arye Gittleman, John Levine, Louise Cousins, and Peter Pathe, developed some software called Javelin. In 1985, Javelin and Microsoft Excel 1.0 were nominated for InfoWorld’s Product of the Year. In a close battle, Javelin won. The concepts debuted in Javelin went on to be used in Lotus Improv and went on to be used in Excel pivot tables. Now—the Microsoft Excel team has expanded pivot tables way beyond the capabilities of Javelin and Improv. But, as the PowerPivot team takes Pivot Tables to unimaginable heights, the original Javelin team deserves a tip o’ the cap.

Like everyone else who uses computers to make a living, I owe a debt of gratitude to these three pioneers.

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Finally, thanks to Josh Jelen, Zeke Jelen, and Mary Ellen Jelen. In particular, it was Mary Ellen who realized that things had to change if I were going to get the books done on time.
We Want to Hear from You!

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I am a PowerPivot FanBoy.

I remember the exact moment that this happened. Once a year, Microsoft invites all of their MVPs to Redmond, Washington, for the MVP Summit. The event consists of two days of executive keynotes and two useful days spent with the project managers of your individual technology. I always go to the MVP Summit, looking forward to spending time with the Excel project managers. During those two days, you go from meeting to meeting on the Redmond campus, hearing about various plans for the next version of Excel.

On Wednesday of the 2009 Summit, the noon meeting was not in the usual building 33 that houses the Excel team. As I walked into that room in another building, I noticed something strange. The left side of the room was filled with people I knew: the Excel MVPs. They are people whom you know of if you read Excel books or if you’ve asked a few questions at the MrExcel.com message board: Curt Frye, Bob Umlas, Richard Schollar, Smitty, Greg Truby. The right side of the room was full of a bunch of people whom I had never seen before. They were eyeing us suspiciously, and we were wondering what the heck they were doing in our meeting.

The speaker that day was Donald Farmer. Scottish. Hair longer than JWalk’s. He comes walking in, carrying a desktop PC under his arm. Read that again. He came walking in with a desktop PC. Who shows up to a presentation carrying a desktop PC? Donald set up the PC in the front of the room, plugged it into the projector, and proceeded to start a demo about something called Project Gemini.
“There’s Row 20 Million”

Donald Farmer had carried in a 64-bit windows machine with 8GB of RAM. By Christmas of 2009, you could walk into Best Buy and buy such a machine, but I had never seen a machine with more than 3GB of RAM in early 2009.

Donald sets up a scenario. He had two data sets:

- Data set 1 was every DVD rental transaction at a fictitious chain of video stores.
- Data set 2 was box office data that he had downloaded from the Internet.

Donald fires up something that looks basically like Excel and shows us data set 1. He grabs the vertical scrollbar on the right side of the data and starts to scroll. Like a hot knife through butter, the PC responded snappily and Donald says, “There’s row 20 million.”

It literally did not sink in with me.

Donald continued...

“There’s row 40 million.”
“There’s row 60 million.”
“There’s row 100 million.”

I am thinking to myself that it is 2009 and seeing row 1 million in Excel was exciting at the 2006 Summit, but really why is this guy wasting our time showing us that Excel now has a million rows?

Wait. Did. He. Just. Say. 100. Million? I looked at the screen and tried to focus on how many digits were in the row count at the bottom of the screen.

Donald went on to sort 100 million rows. He used the AutoFilter drop-downs to filter 100 million rows.

Here is a guy who carried in a desktop PC and had a 100 million row data set in something that looked like Excel. I decided I better close my Outlook and pay attention.

“The PivotTable Field List Has Fields from Both Tables”

Donald proceeds to build a pivot table from the 100 million rows of data. This seems only natural. What else would you do with 100 million rows of data? Just about any time that I get a data set, my first inclination is to build a pivot table, so making a pivot table makes perfect sense.

There is something weird with the pivot table field list, however. It is listing fields from both table 1 and table 2. Donald is only using data from table 1, though. He adds one of the new slicer filters that we had just learned about the day before.
Then, Donald suggested that we compare rentals by genre with box office receipts by genre.

For all of the Excel people reading this book, a very easy quiz. To mash up the data from Sheet1 with Sheet2 what tried and true method will you have to use?

a. \texttt{=VLOOKUP()} functions  
b. \texttt{=INDEX()} functions  
c. Cut and paste 
d. \texttt{=VABRACADABRA()} function, preferably while waving a magic wand

Of course, the answer is a. A nice set of VLOOKUPs will get the data from one sheet onto another sheet. Although, I cringed, 100 million VLOOKUPs are going to take a long time.

Except Donald didn’t knock out a VLOOKUP function.

All he did was clicked a field from table 2 in the pivot table field list. This was an early version of the product and a T oolTip popped up saying “We’ve inferred a relationship between table 1 and table 2”. The box office data was now summarized in the same pivot table as the DVD rental information.

According to Rob Collie, “stuff that looks good in a demo may not actually work well when real people try to use the product.” Microsoft ended up backing off from the automatic relationship detection in favor of giving people some control over setting up a relationship. It is still very easy to do, easier than setting up a VLOOKUP.

**NOTE**

Now, I Love VLOOKUPs

To me, there are two kinds of people in the world.

- People who can do a VLOOKUP with their eyes closed
- Everyone else

If you’ve happened to catch one of my live Power Excel seminars, I usually talk about how I used to be a manager of financial analysis. When we needed to hire financial analysts, the person in Human Resources would ask about what requirements I wanted on the job posting notice. I usually had a single requirement: “Can do VLOOKUPs in their sleep.” As long as someone could do VLOOKUPs, everything else would fall into place.

I don’t want to sound harsh, but it comes down to this; if you can do VLOOKUPs, you are employable. If you can’t do VLOOKUPs, well, you might be employable, just not by me.

When Donald Farmer clicked a box next to field from Sheet 2 and Excel produced a pivot table from two worksheets without having anyone enter a VLOOKUP function, that was a game-changer.
Suddenly, hundreds of millions of people who (a) know how to use a mouse and (b) don’t know how to do a VLOOKUP are suddenly able to perform jaw-dropping business intelligence analyses. They all might actually be employable, by *me*.

“How Much Will This Cost? Well, the Client Is Free”

It was crazy talk.

Microsoft was demonstrating the greatest invention in a decade and they were giving it away for free.

It wasn’t unprecedented. Lotus used to sell Lotus Improv for $199, and Microsoft borrowed all of that technology and gave it away on the Excel data menu back in 1993. Of course, it would have been a blatant rip-off if they would have put “Improv” on Data menu in Excel 5, so they changed the name to something called a “pivot table.”

Pivot tables were the greatest computing invention since VisiCalc, and Microsoft bundled that for free with their Excel product.

I was watching the greatest computing invention since pivot tables, and now Microsoft was planning on bundling it for free with Excel 2010.

This Book Was Pitched Eight Hours Later

Based on the two facts: (a) 100 million rows in Excel and (b) a pivot table from multiple worksheets without a VLOOKUP, I knew that I wanted to write a book about this new product. Loretta Yates from Que was in town for the MVP Summit, and I had tentative approval for this new book less than eight hours after I saw the product.

There Could Be Five Titles for This Book

Any one of these mega-benefits would make PowerPivot worthy of a book:

- **100 Million Rows: Miracle Product Allows Unlimited Rows in Microsoft Excel!**
- **VLOOKUPs Shrugged: Why You Don’t Need VLOOKUPs Any More**
- **ATOM & CSV: The Marriage of Disparate Data**
- **L.Y. Actuals & C.Y. Budget: How Named Sets Enabled the Obvious But Previously Impossible Pivot Table Report**
- **Calculated Fields: Designed by an Intern? How DAX is Empowering Real Calculations in Pivot Tables**

This sixth title might not appeal to the Excel audience, but would make a great whitepaper:

- **Store It Columnwise, Stupid! How to achieve world-class data compression**
At that first meeting with Donald Farmer, only the first two points really sunk in with me. (1) They had busted through the one million row limit in Excel. (2) You could join Sheet1 and Sheet2 without VLOOKUP.

There are other benefits to PowerPivot that I did not begin to understand until I was working on these books, including the following:

■ PowerPivot can consume data from many places and present them all in the same workbook. You can have low-tech data like flat text files. You can have data coming from SQL Server. You can have data from Excel. Data from Access. RSS feeds.

■ All pivot tables are lousy at handling asymmetric reports. If you try to show last year’s sales and this year’s budget in the same pivot report, you are going to have to endure having last year’s budget and this year’s actuals in the report, too. This means you will manually be hiding some columns and replacing the built-in total column with your own column. The Excel team fixed this in Excel 2010, but only for people reporting from OLAP data sets. Here is the funny thing about PowerPivot: It makes regular Excel data into OLAP data sets. Saying that you want to use PowerPivot just to enable asymmetric reporting is like saying that you want to use a $100 million laser to heat up your coffee. It is a huge underutilization of a $100 million laser. But...the fact is that the laser will heat up coffee, and you’ve frankly been living without a microwave since 1993 when the first pivot table hit Excel. So, if you have a need to report last year’s actuals next to this year’s budget, well, PowerPivot is going to enable this for you.

■ Calculated fields in pivot tables were always sort of quirky. They would work for simple things. When you see how the new DAX formula language enables you to do really powerful things with calculated measures in PowerPivot, you will realize that calculated fields can’t hold a candle to these new calculations.

Any one of those benefits should be enough to get the Excel data analyst to want to upgrade to Excel 2010. Put all of the benefits into a single product, and price that product at the price of $Free and there will be a lot of Excel people who should be drooling.

To see a demo of the benefits of PowerPivot, search for PowerPivot Data Analyst 1 at YouTube.

Who Are Those Other People in the Room?

There are at least three audiences who are watching PowerPivot with great interest:

■ There is us. You know us: You. Me. Excel people. We do everything in Excel. We think that Microsoft Word is a useless add-in for people who can’t manage to use Edit, Fill, Justify. We are the front lines of the decision-making process.

■ There are SQL Server people: They are the people who are sitting on top of 100 million rows of transactional data. They are the people who get us the nice and tidy one million row summaries of the transactional data. (Between you and me, if they embrace PowerPivot and just let us get to that 100 million rows of transactional data, we can actually run a few different iterations before we figure out what data we actually need.)
There are SharePoint people: SharePoint people keep talking about having “one version of the truth” and it is stored in SharePoint. The SharePoint people like PowerPivot because if you and I design a cool report in PowerPivot, we can publish it to SharePoint and that helps to justify why the company needs SharePoint.

I have to tell you, it is a little bit uncomfortable being in the same room with all these people because frankly, our relationship had been a little adversarial over the years. PowerPivot is in a sweet spot between these three groups.

The SQL Server people will actually have less requests from the Excel people. Get us the data and we will slice and dice it.

The SQL Server people feel like they have more control because they get to make sure that the original link to the data is to data that they bless. Also, the relationships in PowerPivot help to make sure that the Excel people don’t screw up the data.

The Excel people can iterate over various attempts at producing reports without having to go back to the SQL Server people in IT. It gets expensive buying a dozen chocolate Krispy Cream donuts every time you need a new report from the IT department.

For the Excel people, if the SharePoint people will host our reports, we’ve secretly offloaded the need to refresh the report every night because the SharePoint people can schedule a nightly refresh. That means that we can spend a week at the beach without having to dial in every morning to run the reports.

For the SharePoint people, you can see which reports are being accessed and by whom. Those Excel people create a boatload of reports and there are probably two or three that are actually used by the big important people in the company. With SharePoint, you can see which reports are actually getting traffic and thus know which reports you should (a) make sure don’t go down, and (b) know which reports are good candidates for turning into other systems.

This Book Is For The Excel People

I have configured exactly one SharePoint server in my lifetime, and that was with a lot of hand holding from a write-up by Vidas Matelis on the Web. I’ve installed SQL Server three times, and only two of those installations were successful. (I still can’t figure out what I did wrong with the third installation.)

If you are a SharePoint person or a SQL Server person, I don’t have a clue about the things you are talking about. I know that you both have an interest in PowerPivot, and I hope that Rob Collie or someone writes a book for you. My goal is to get those Excel people up to speed with PowerPivot. I realize that the three groups of people can have a great symbiotic relationship with PowerPivot. I hope to deliver the Excel masses to your door, clamoring for access to your SQL Server data and your SharePoint servers.
How This Book Is Organized

I am writing this book for the Excel audience (the 500 million people who use Excel day in and day out). All but one chapter will be focused on using the PowerPivot client inside of Excel 2010.

The first two chapters gets PowerPivot installed and show you what is possible with PowerPivot.

Chapter 3 takes a look at the upsides and downsides to using PowerPivot.

Chapters 4 through 6 cover how to get your data into PowerPivot, how to define relationships, and how to work with data before it becomes a pivot table.

Chapters 7 through 9 deal with the process of creating and using pivot tables with PowerPivot.

Chapters 10 and 11 deal with the really powerful ways to use Data Analysis Expression (DAX) measures.

Chapters 12 and 13 cover how to format your PowerPivot reports.

Chapter 14 identifies the benefits of using the server version of PowerPivot.

The appendix offers a list of additional resources.

Conventions Used in This Book

The special conventions used throughout this book are designed to help you get the most from the book as well as Excel 2010.

Text Conventions

Different typefaces are used to convey various things throughout the book. They include those shown in Table I.1.

<table>
<thead>
<tr>
<th>Table I.1 Typeface Conventions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typeface</strong></td>
</tr>
<tr>
<td>Monospace</td>
</tr>
<tr>
<td><em>Italic</em></td>
</tr>
<tr>
<td><strong>Bold</strong></td>
</tr>
</tbody>
</table>

Tab names on the Ribbon, dialog box names, and dialog box elements are capitalized in this book (for example, Add Formatting Rule dialog, Home tab).
In this book, key combinations are represented with a plus sign. If the action you need to take is to press the Ctrl key and the T key simultaneously, the text tells you to press Ctrl+T. There were not many changes from Excel 97 to Excel 2000 to Excel 2002 to Excel 2003. Most people upgrading to Excel 2010 will be coming from one of these versions of Excel. I collectively refer to these versions as “Legacy versions of Excel.”

**Special Elements**

Throughout this book, you’ll find tips, notes, cautions, cross-references, and case studies. These elements provide a variety of information, ranging from warnings you shouldn’t miss to ancillary information that will enrich your Excel experience but isn’t required reading.

---

**NOTE**

Tips point out special features, quirks, or software tricks that will help you increase your productivity with Excel 2010.

**TIP**

Notes contain extra information or alternative techniques for performing tasks.

**CAUTION**

Cautions call out potential gotchas.

---

In most chapters, a YouTube video demo will be available for one topic.

**Cross References**


---

**CASE STUDY: OTHER ELEMENTS**

Case studies are set off in boxes such as this one:

Case studies walk you through the steps to complete a task.

---

**Sidebars**

Historical glimpses and other information that is not critical to your understanding appear as sidebars. I imagine that if the Cliff Claven character from *Cheers* knew a lot about Excel, these would be the kinds of things he would write.
Preparing Your Data for PowerPivot

If you are using your own data in PowerPivot, you need to ensure that your data is formatted appropriately. PowerPivot can deal with many different types of data. But unfortunately, people and software vendors do a lot of weird stuff with their data.

One of my favorite large data sets comes from a cash register vendor. They produce these large 1.8 million row data sets as flat text files and send them to my client every day.

In Figure 2.1, you can see the top of the data set. Row 1 contains the words “Run for:” and the date. Row 2 is blank. Row 3 has headings. Row 4 has underscores. Seriously? Underscores? Who are those really for?

PowerPivot cannot deal with three of those first four rows. PowerPivot can deal with the field headings, but the Run For, the blank row, and the underscores have to go. This either means a request sent to the software vendor or a daily trip through Notepad to delete those rows.

If you want PowerPivot to treat a column as a date column, then 100% of the values in that column...
have to be dates. This same vendor loves to use dates of **/**/**** for new items that are not yet in inventory.

The point is that any date is going to have strange characteristics that you will have to deal with. Work the IT department or your vendor to get the data cleaned up for PowerPivot.

In Figure 2.2, removing three headings solves the problem.

If your data is in Excel, you want to follow the same format. One row of headings followed by data rows. No blank columns. No blank rows. Make sure that any date columns are 100% filled with dates.

In the text file, there is only a store number. It would be nice to add store name, region, and so on. In Figure 2.3, a small 150-row data set provides information about each store.

### Getting Your Data into PowerPivot

In this example, you will be importing two different data sets into PowerPivot. You will be importing the text file. For the Excel data about the stores, you can either copy and paste into PowerPivot, or define a table and link it to PowerPivot. For this example, a simple copy and paste will work.

→ See Chapter 4, “Getting Your Data into PowerPivot,” for details on using the linked table method.
Decide on a Sequence for Importing

You should import the main transaction table first. In this case, the main transaction table is the 1.8 million row file with sales information. After that file is imported, you can import the lookup table information.

You should follow this sequence for two reasons:

■ In the PowerPivot Field List, the tables are presented in the order that they were imported. You will want your main table at the top of the list when building pivot tables.
■ The PowerPivot relationship detection logic expects the main table to be first.

So, for this example, you will be loading the text file first, and then pasting the stores data into PowerPivot.

Import a Text File

To import the 1.8 million row file into PowerPivot, follow these steps:

2. Select the PowerPivot Window icon. A new PowerPivot application window will appear. PowerPivot offers two ribbon tabs: Home and Design. The left side of the Home tab is shown in Figure 2.4.

![Figure 2.4](image)

The Home tab of the PowerPivot application.

3. You want to import your main table first. This will be the large CSV file shown in Figure 2.2. From the Get External Data group, select From Text. PowerPivot shows the Table Import Wizard (see Figure 2.5).
4. Because your first row of the file contains headers, select the Use First Row as Column Headers check box.
5. Click the Browse button and locate your text file. PowerPivot will pause for a second and fetch the first 50 rows of data from the text file to provide a data preview, as shown in Figure 2.6.
6. If there are any columns that you don’t need to import, clear them.
7. Note that there are filter drop-downs for each field. You can actually sort and filter this 1.8 million row data set here, although it will be slower than in a few steps from now. If you open a filter field, PowerPivot will scan the entire file to build the list of filters, as shown in Figure 2.7. You can choose to exclude certain values from the import.

8. Click Finish and PowerPivot will begin loading the file into memory. The wizard will show how many rows have been fetched so far (see Figure 2.8). Loading data can take a long time. If you would need to interrupt the import, the Stop Import button is available at the bottom of the wizard.

9. When the file is imported, the wizard confirms how many rows have been imported, as shown in Figure 2.9. Click Close to return to the PowerPivot window.
The 1.8 million row data set is shown in the PowerPivot Window. Go ahead. Grab the vertical scrollbar and scroll through the records. You can also sort, change the number format, or filter (see Figure 2.10).

To see a demo of importing data, search for PowerPivot Data Analyst 2 at YouTube.
The filters in PowerPivot are not as powerful as the new filters introduced in Excel 2007. In particular, the date columns do not show a hierarchical filter where you can choose a year or month.

If you right-click a column heading, a menu appears where you can rename, freeze, copy, hide, unhide the columns (see Figure 2.11).

Bottom line: You have 1.8 million records that you can sort, filter, and later, pivot. This is going to be cool.

---

**Add Excel Data by Copying and Pasting**

Next, you want to add your store information to PowerPivot. As mentioned previously, you could either link to the Excel data or copy and paste. For this example, a simple copy and paste will work.

1. Open the StoreInfo.xlsx file in Excel.
2. Select the data with Ctrl+*.
3. Copy it with Ctrl+C.
4. Click the PowerPivot Window icon. PowerPivot returns and you see your 1.8 million row data set.

---

Note that although this feels like Excel, it is not Excel. You cannot edit an individual cell. If you add a calculation in what amounts to cell F1, that calculation will automatically get copied to all rows. If you format the revenue in one cell, all of the cells in that column will get formatted. You can change column widths by dragging the border between the column names just like in Excel.
5. Click the Paste icon on the left side of the PowerPivot Home tab. You will see a Paste Preview window.

6. Give the new table a better name than Table. Perhaps StoreInfo (see Figure 2.13). Click OK.

You will now see the store information in a new StoreInfo tab at the bottom of the screen. Notice that there are now two worksheet tabs in PowerPivot, as shown in Figure 2.14.

**Define Relationships**

Normally, in regular Excel you would be creating VLOOKUPs to match the two tables. It is far easier in PowerPivot. Follow these steps:
1. You will be linking from one column in your main table to a column in another table. To simplify the relationship process, navigate to your main table and select a cell in the column from which you will be linking.

2. Click the Design tab in the PowerPivot Ribbon.

3. Select Create Relationship. The Create Relationship dialog appears. By default, the selected table and column will appear in the first two fields, as shown in Figure 2.15.

4. If you skipped step 1 and the correct table is not shown in the Table drop-down, then select Demo from the Table drop-down.

---

**Figure 2.14**
You now have two unrelated tables in the PowerPivot window.

**Figure 2.15**
Define a relationship between tables. By selecting the key column before starting, 2 of the 4 fields are populated.
5. If you did not select the correct column in step 1, open the Column drop-down. Select StoreID.

6. Open the Related Lookup table drop-down. Select StoreInfo.

7. Open the Related Lookup Column drop-down and select Store (see Figure 2.16).

8. Click Create. You’ve now created a relationship between the two tables.

Add Calculated Columns Using DAX

One downside to pivot tables created from PowerPivot data is that they cannot automatically group daily data up to years. Before building the pivot table, let’s use the Data Analysis Expression (DAX) formula language to add a new calculated column to the Demo table.

Follow these steps to add a Year field to the Demo table:

1. Click the Demo worksheet tab at the bottom of the PowerPivot Window.

2. The column to the right of Revenue has a heading of Add Column. Click in the first cell of this blank column.

3. Click the fx icon to the left of the formula bar. The Insert Function dialog appears with categories for All, Date & Time, Math & Trig, Statistical, Text, Logical, and Filter. Select Date & Time from the drop-down. You will instantly notice that this is not the same list of functions in Excel. Five of the first six functions that appear in the window are exotic and new (see Figure 2.17).

4. Luckily, some familiar old functions are in the list as well. Scroll down and select the YEAR function. Click the first date in the Date column. PowerPivot proposes a formula of =year(demo[Date]). Type the closing parentheses and press Enter. Excel will fill in the column with the year associated with the date, as shown in Figure 2.18.

5. Right-click the column and select Rename Column. Type a name, such as Year.

6. Repeat the process to add a Month column using a formula of =Month(demo[Date]). Figure 2.19 shows the table after adding two columns.
There are many more columns that you might think of adding, but let’s move on to using the pivot table.

**Build a Pivot Table**

One of the advantages of PowerPivot is that multiple pivot tables can share the same data and slicers. Open the PivotTable drop-down on the Home tab of the PowerPivot Ribbon.
As shown in Figure 2.20, you have choices for a single pivot table, a single chart, a chart and a table, two charts, four charts, and so on.

→ To read more about layouts with multiple elements, see Chapter 7, “Building Pivot Tables.”

Follow these steps:

1. Select PivotTable. You now see the PowerPivot tab back in the Excel window.
2. Choose to put the pivot table on a new worksheet (see Figure 2.21).

There are many things to notice. The icon for a blank pivot table occupies cell B3:D20. This allows room for slicers to go above and left of the pivot table (see Figure 2.22).

Docked on the right side of the screen is the PowerPivot Field List. This is now a third variation of the PivotTable Field List.

---

Excel already offers two different field lists, one for OLAP data sets and one for PivotCache data sets. Figure 2.23 shows the PowerPivot Field List.
Both tables are available in the top of the Field List. The main table is expanded to show the field names, but you can expand the other table and add those fields to this pivot table.

Two new sections in the drop zones offer vertical or horizontal slicers.

**NOTE**
For the purposes of the screen shots in this book, I will undock the PowerPivot Field List and float it near the pivot table. To undock the field list, grab the title bar and drag away from the edge of the screen. To later redock the field list, grab the title bar and drag it more than half way off the right side of the Excel window.

Because you are in a pivot table, the PivotTable Tools tabs are available in the Excel Ribbon.
3. Select Revenue from the PowerPivot Field List by adding a check box next to it. Because Revenue is a numeric field, it automatically moves to the Values drop zone at the bottom of the field list. Your pivot table now shows Sum of Revenue, which is the total revenue in the entire 1.8 million row file (see Figure 2.24).

4. Expand the StoreInfo table. Select Region from the StoreInfo table. Excel builds a pivot table showing sales by region. At this point, you have a pivot table from 1.8 million rows of data with a virtual link to a lookup table.

5. Drag the Division field from the Demo table to the Column Labels drop zone. Your pivot table is now mashing up data from two different tables (see Figure 2.25).

6. Drag the Store Name field to the Row Labels drop zone. Drop Store Name below the Region field.

To show off some more features of the PowerPivot pivot table, let's add some slicer functionality:
1. Drag Year to the Slicers Vertical drop zone.
2. Drag Month to the Slicers Vertical drop zone.
3. Drag Mall Developer to the Slicers Horizontal drop zone.

To clean up the formatting of the pivot table, follow these steps:

1. Go to the PivotTable Tools Design tab in the Ribbon. Select Banded Rows.
2. On the same tab, open the PivotTable Styles gallery and choose a light, medium, or dark color scheme.
3. Go to the Options tab. The Active Field should say Sum of Revenue. If it does not, choose a numeric cell in the pivot table.
4. Click the Field Settings icon in the PivotTable Tools Options tab.
5. In the lower left corner of the Value Field Settings dialog, select the Number Format button.
6. Select the Number category. Select Use 1000 Separator. Select 0 decimal places (see Figure 2.26). Click OK to close the Format Cells dialog. Click OK to close the Value Field Settings dialog.

The numeric formatting is hidden two levels deep.

The result is an impressive interactive report, as shown in Figure 2.27.
7. Select the year 2000 from the Year slicer. The report instantly redraws to show only the stores that were open in the year 2000. The Mall Developer slicer redraws to show only the five developers with whom you had contracts in 2000 (see Figure 2.28).

World-Class Data Compression

When you are creating PowerPivot data sets, all of the data is loaded into computer memory. When you save a PowerPivot workbook, the data from the imported text files is stored in the workbook. Amir Netz from the PowerPivot team came up with an impressive methodology for compressing the data.

Figure 2.28 tells an impressive story. This chapter mashed up a text file that occupies 58MB. It also incorporated the StoreInfo.xlsx file which takes up 19K. All of that data is stored in the StoreMashup.xlsx file in an amazingly small 3.6MB file (see Figure 2.29).

Figure 2.28
Choose a year and the report updates, as well as the other slicers.

Figure 2.29
58MB of text file fits in a 3.6MB Excel file.

Storing Data Columnwise

When you are storing a database on a medium like a hard drive, it makes sense to keep each record together. Because hard drives are relatively slow, you want that data stored in a contiguous block as shown in Figure 2.30.

Figure 2.30
In a traditional disk-based database, all of the fields for one record are stored in close proximity to each other.
The problem with storing data in a row-wise fashion is that there is little opportunity for compression. In the entire 1.8 million rows of the text file, there are no records that match 100%.

Early on, the PowerPivot team decided that PowerPivot was only going to be dealing with data in memory. Thus, they don't need to store data in a row-wise fashion.

When you start to look at a single column of data, there are many columns with huge amounts of duplicates. For example, 1.8 million rows of category information really only has nine possible values. There are massive numbers of adjacent values that are exactly the same (see Figure 2.31).

**Figure 2.31**
Look at one column of the data, and there are many possibilities for compression.

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>211</td>
<td>340056</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>212</td>
<td>340057</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>340058</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>340059</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>215</td>
<td>340060</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>216</td>
<td>340061</td>
<td>2/22/2009</td>
<td>Luggage</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>217</td>
<td>340017</td>
<td>2/22/2009</td>
<td>Shoes</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>218</td>
<td>340018</td>
<td>2/22/2009</td>
<td>Shoes</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>219</td>
<td>340019</td>
<td>2/22/2009</td>
<td>Shoes</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you sort the data by category, you really end up with huge rainbow stripes of records that fit in each category (see Figure 2.32). The space to store the entire column of 1.8 million category values comes down to 9 pointers that say everything from this record to this records is "Jewelry."

**Figure 2.32**
Conceptually, PowerPivot is reducing the data to rainbow stripes of different values in each column.

Microsoft calls this VertiPaq compression. (That is kind of a catchy name, isn't it. Vertical packing of the data. Geeky.) This is why PowerPivot does not do well with long text values in a column. If you have a comment field, remove that field as you are importing the data to allow PowerPivot to do its full compression.

**NOTE**
Microsoft is cautiously saying that they might sometimes see 15X compression. The simple example in this chapter was not designed to compress extremely well, but it does demonstrate a 16X compression factor.
I hate to extrapolate, but if the file size limit is 2GB on disk, and if you could somehow keep up the 16X compression, then that is a theoretical maximum of 32GB of data in a single pivot table. That would be 993 million rows of demo.txt type data. You would have to own a serious computer. 64-bit Windows and 64-bit Office to be sure.

Most of us were limited to 65,536 rows just a year or two ago. Now the simple demo file for this book is 27 times larger than that limit, with a theoretical upper limit that is 15,000 times larger than 65,536 rows. I would gladly personally shell out the full purchase price of the PowerPivot client to get access to that much analytical power.

Asymmetric Reporting with PowerPivot

Asymmetric reporting is not possible with pivot tables that are built from pivot caches of Excel data. In Figure 2.33, a small data set in A1:D37 is used to produce the pivot table in columns G:N.

Out of seven data columns in the report, you don’t want to see five of them. You are interested in last year’s actuals and this year’s forecast. This is not really possible with a regular pivot table.

You could use PivotTable Tools Options, Options, Totals & Filters, and then clear Show Grand Total For Rows to get rid of the grand total in column N.

Then, you can click a year heading in the pivot table, use PivotTable Tools Options, Field Settings and select None for the Subtotals to get rid of two more columns. But then, you are left with no good way to delete 2009 Budget or 2010 Actuals. If you try to filter out the Budget, it will be removed from both years. If you try to delete column I, you will be met with the warning that you cannot Move a Part of A Pivot Table report message (see Figure 2.34).

Option 1 is to use Home, Format, Column, Hide to hide the columns that you don’t want to see. Option 2 is to convert the pivot table to values using Copy and then Paste, Paste Values.

With PowerPivot, a third option becomes available. Because data in the PowerPivot window becomes an online analytical processing (OLAP) cube, you have access to OLAP tools, including named sets.
Follow these steps to create an asymmetric report:

1. Open your regular data set in Excel.
2. Select one cell in the data and press Ctrl+T. Confirm that your data has headings. Click OK. The data is formatted and a new Table Tools Design tab appears. On the left side, the Table Name appears as Table 1. Type a new name, such as Financials.
3. On the PowerPivot tab, select Create Linked Table.
4. In the PowerPivot Window, open the Pivot Table drop-down and select Pivot Table.
5. Choose a location for the pivot table.
6. Select State and Revenue from the Pivot Table Field List. Drag Year and Measure to the Column Labels drop zone.
7. You now have a pivot table that looks identical to the one in Figure 2.33. The difference is that Named Sets are not grayed out anymore on the Options tab.
8. Go to PivotTable Tools Options. Open the Fields, Items, and Sets drop-down. Select Create Set Based on Column Items.
9. Type a set name, such as BudAct. The Display Folder can be blank. Excel shows you the 7 columns currently in your pivot table.
10. Select the row for FY2009 Budget, as shown in Figure 2.35. Click Delete Row.
11. Repeat step 10 for the other four rows that you don’t want to show in the pivot table. When you are done, you should see only two rows, as shown in Figure 2.36.
12. Click OK to complete the set.

As shown in Figure 2.37, you will now have a pivot table that will report asymmetric sets of columns.

Next Steps

This chapter showed you what is possible with pivot tables. In the next chapter, you will see both the benefits of the drawbacks of using PowerPivot.
Figure 2.35
Select a pair of values and click Delete.

Figure 2.36
Repeat for each item that you want to delete.

Figure 2.37
This pivot table would be very difficult to create without PowerPivot.
This page intentionally left blank
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