



Beginning Power BI

A Practical Guide to Self-Service Data
Analytics with Excel 2016 and Power
BI Desktop

—
Second Edition

—
Dan Clark

Apress®

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Contents at a Glance

About the Author	xi
About the Technical Reviewer	xiii
Acknowledgments	xv
Introduction	xvii
■ Part I: Building Models in Power Pivot	1
■ Chapter 1: Introducing Power Pivot	3
■ Chapter 2: Importing Data into Power Pivot.....	19
■ Chapter 3: Data Munging with Power Query	55
■ Chapter 4: Creating the Data Model	77
■ Chapter 5: Creating Calculations with DAX	101
■ Chapter 6: Creating Measures with DAX	119
■ Chapter 7: Incorporating Time Intelligence	145
■ Chapter 8: Data Analysis with Pivot Tables and Charts.....	165
■ Part II: Building Interactive Reports and Dashboards with Power BI Desktop	191
■ Chapter 9: Introducing Power BI Desktop	193
■ Chapter 10: Creating Reports with Power BI Desktop.....	217
■ Chapter 11: Publishing Reports and Creating Dashboards in the Power BI Portal	251

■ Chapter 12: Creating a Complete Solution	283
■ Chapter 13: Advanced Topics in Power Query	301
■ Chapter 14: Advanced Topics in Power BI	319
Index	343

Contents

About the Author	xi
About the Technical Reviewer	xiii
Acknowledgments	xv
Introduction	xvii
■ Part I: Building Models in Power Pivot	1
■ Chapter 1: Introducing Power Pivot	3
Why Use Power Pivot?.....	3
The xVelocity In-memory Analytics Engine	4
Enabling Power Pivot for Excel.....	5
Exploring the Data Model Manager Interface.....	8
Summary.....	18
■ Chapter 2: Importing Data into Power Pivot.....	19
Importing Data from Relational Databases	19
Importing Data from Text Files	34
Importing Data from a Data Feed	39
Importing Data from an OLAP Cube.....	41
Reusing Existing Connections to Update the Model.....	43
Summary.....	54
■ Chapter 3: Data Munging with Power Query	55
Discovering and Importing Data.....	55
Transforming, Cleansing, and Filtering Data.....	58
Merging and Shaping Data.....	61

Grouping and Aggregating Data	65
Inserting Calculated Columns	67
Summary.....	75
■ Chapter 4: Creating the Data Model	77
What Is a Data Model?	77
Creating Table Relations.....	79
Creating a Star Schema	83
Understanding When to Denormalize the Data.....	85
Creating Linked Tables	86
Creating Hierarchies.....	88
Making a User-Friendly Model	88
Summary.....	99
■ Chapter 5: Creating Calculations with DAX	101
What Is DAX?.....	101
Implementing DAX Operators	103
Working with Text Functions	105
Using DAX Date and Time Functions	107
Using Informational and Logical Functions	108
Getting Data from Related Tables	109
Using Math, Trig, and Statistical Functions	110
Tips for Creating Calculations in Power Pivot	112
Summary.....	117
■ Chapter 6: Creating Measures with DAX	119
Measures vs. Attributes.....	119
Creating Common Aggregates.....	121
Mastering Data Context.....	124
Altering the Query Context	125

Using Filter Functions.....	127
Creating KPIs.....	132
Summary.....	143
■ Chapter 7: Incorporating Time Intelligence.....	145
Date-Based Analysis	145
Creating a Date Table	147
Time Period–Based Evaluations	150
Shifting the Date Context	151
Using Single Date Functions	155
Creating Semi-Additive Measures.....	156
Summary.....	164
■ Chapter 8: Data Analysis with Pivot Tables and Charts.....	165
Pivot Table Fundamentals	165
Slicing the Data.....	168
Adding Visualizations to a Pivot Table	170
Working with Pivot Charts	174
Using Multiple Charts and Tables	178
Using Cube Functions	180
Summary.....	189
■ Part II: Building Interactive Reports and Dashboards with Power BI Desktop	191
■ Chapter 9: Introducing Power BI Desktop	193
Setting Up the Power BI Environment.....	193
Getting, Cleaning, and Shaping Data	196
Creating Table Relationships	202
Adding Calculations and Measures	207
Incorporating Time-based Analysis	210
Summary.....	216

- **Chapter 10: Creating Reports with Power BI Desktop** 217
 - Creating Tables and Matrices 217
 - Constructing Bar, Column, and Pie Charts 222
 - Building Line and Scatter Charts 229
 - Creating Map-Based Visualizations 234
 - Linking Visualizations in Power BI 239
 - Drilling Through Visualizations 243
 - Summary 249
- **Chapter 11: Publishing Reports and Creating Dashboards in the Power BI Portal** 251
 - Creating a User-Friendly Model 251
 - Publishing Power BI Desktop Files to the Power BI Service 254
 - Adding Tiles to a Dashboard 257
 - Sharing Dashboards 262
 - Refreshing Data in Published Reports 266
 - Summary 281
- **Chapter 12: Creating a Complete Solution** 283
 - Use Case 1: Reseller Sales Analysis 283
 - Load the Data 283
 - Create the Model 284
 - Create Calculated Columns 286
 - Create Measures 286
 - Create the Dashboard 288
 - Use Case 2: Sales Quota Analysis 290
 - Load the Data 290
 - Create the Model 294
 - Create Measures 295
 - Create the Report 296

Use Case 3: Sensor Analysis	297
Load the Data	298
Summary.....	300
■ Chapter 13: Advanced Topics in Power Query	301
Writing Queries with M.....	301
Creating and Using Parameters.....	304
Creating and Using Functions	309
Summary.....	318
■ Chapter 14: Advanced Topics in Power BI	319
Using Custom Visuals	319
Implementing Geo-spatial Analysis	323
Implementing Row-Based Security	328
Creating Templates and Content Packs.....	330
Summary.....	342
Index.....	343

About the Author



Dan Clark is a senior business intelligence (BI)/programming consultant specializing in Microsoft technologies. He is focused on learning new BI/data technologies and on training others how to best implement the technology. Dan has published several books and numerous articles on .NET programming and BI development. He is a regular speaker at various developer/database conferences and user group meetings and enjoys interacting with the Microsoft developer and database communities. In a previous life, he was a physics teacher; he is still inspired by the wonder and awe of studying the universe and figuring out why things behave the way they do. Dan can be reached at Clark.drc@gmail.com.

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Massimo Nardone has more than 22 years of experiences in security, web/mobile development, cloud, and IT architecture. His true IT passions are security and Android. He has been programming and teaching programming with Android, Perl, PHP, Java, VB, Python, C/C++, and MySQL for more than 20 years. He holds a Master of Science degree in computing science from the University of Salerno, Italy. He has worked as a project manager, software engineer, research engineer, chief security architect, information security manager, PCI/SCADA auditor, and senior lead IT security/cloud/SCADA architect for many years. His technical skills include: security, Android, cloud, Java, MySQL, Drupal, Cobol, Perl, web and mobile development, MongoDB, D3, Joomla, Couchbase, C/C++, WebGL, Python, Pro Rails, Django CMS, Jekyll, Scratch, and others. He currently works as chief information security office (CISO) for Cargotec Oyj. He has worked as visiting lecturer and supervisor for exercises at the Networking Laboratory of the Helsinki University of Technology (Aalto University). He holds four

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—Dan Clark

Introduction

Self-service business intelligence (BI)—you have heard the hype, seen the sales demos, and are ready to give it a try. Now what? You have probably checked out a few web sites for examples, given them a try, and learned a thing or two, but you are probably still left wondering how all the pieces fit together and how you go about creating a complete solution. If so, this book is for you. It takes you step by step through the process of analyzing data using the tools that are at the core of Microsoft’s self-service BI offering: Power Query, Power Pivot, and Power BI.

Quite often, you need to take your raw data and transform it in some way before you load it into the data model. You may need to filter, aggregate, or clean the raw data. I show you how Power Query allows you to easily transform and refine data before incorporating it into your data model. Next, I show you how to create robust, scalable data models using Power Pivot. Because Power Pivot is the core tool you will use to create self-service BI solutions, I cover it extensively in this book. Next up, I show you how to use Power BI Desktop to easily build interactive visualizations that allow you to explore your data to discover trends and gain insight. Finally, I show you how to deploy your solution to the Power BI Service for your colleagues to use.

I strongly believe that one of the most important aspects of learning is doing. You can’t learn how to ride a bike without jumping on a bike, and you can’t learn to use the BI tools without actually interacting with them. Any successful training program includes both theory and hands-on activities. For this reason, I have included a hands-on activity at the end of every chapter designed to solidify the concepts covered in the chapter. I encourage you to work through these activities diligently. It is well worth the effort.

PART I



Building Models in Power Pivot

CHAPTER 1



Introducing Power Pivot

The core of Microsoft's self-service business intelligence (BI) toolset is Power Pivot. It is integrated into both Excel 2016 and Power BI and forms the foundation on top of which you will build your analytical reports and dashboards. This chapter provides you with some background information on why Power Pivot is such an important tool and what makes it perform so well. The chapter also provides you with an overview of the Power Pivot interface in Excel 2016 and gives you with some experience using the different areas of the interface.

After reading this chapter you will be familiar with the following:

- Why you should use Power Pivot
- The xVelocity in-memory analytics engine
- Exploring the Data Model Management interface
- Analyzing data using a pivot table

Why Use Power Pivot?

You may have been involved in a traditional BI project consisting of a centralized data warehouse where the various data stores of the organization are loaded, scrubbed, and then moved to an online analytical processing (OLAP) database for reporting and analysis. Some goals of this approach are to create a data repository for historical data, create one version of the truth, reduce silos of data, clean the company data and make sure it conforms to standards, and provide insight into data trends through dashboards. Although these are admirable goals and are great reasons to provide a centralized data warehouse, there are some downsides to this approach. The most notable is the complexity of building the system and implementing change. Ask anyone who has tried to get new fields or measures added to an enterprise-wide data warehouse. Typically, this is a long, drawn-out process requiring IT involvement along with data steward committee reviews, development, and testing cycles.

What is needed is a solution that allows for agile data analysis without so much reliance on IT and formalized processes. To solve these problems, many business analysts have used Excel to create pivot tables and perform ad hoc analysis on sets of data gleaned from various data sources. Some problems with using isolated Excel workbooks for analysis are conflicting versions of the truth, silos of data, and data security.

So how can you solve this dilemma of the centralized data warehouse being too rigid while the Excel solution is too loose? This is where Microsoft's self-service BI toolset comes in. These tools do not replace your centralized data warehouse solution but rather augment it to promote agile data analysis. Using Power Pivot, you can pull data from the data warehouse, extend it with other sources of data such as text files or web data feeds, build custom measures, and analyze the data using pivot tables and pivot charts. You can create quick proofs of concepts that can be easily promoted to become part of the enterprise-wide solution. Power Pivot also promotes one-off data analysis projects without the overhead of a drawn-out development

cycle. When combined with SharePoint 2016, SQL Server Reporting Services 2016, and/or One Drive, workbooks can be shared, secured, and managed. This goes a long way to satisfying IT's need for governance without impeding the business user's need for agility.

Here are some of the benefits of Power Pivot:

- Functions as a free add-in to Excel
- Easily integrates data from a variety of sources
- Handles large amounts of data, upward of tens to hundreds of millions of rows
- Uses familiar Excel pivot tables and pivot charts for data analysis
- Includes a powerful Data Analysis Expressions (DAX) language
- Has data in the model that is read only, which increases security and integrity

When Excel Power Pivot workbooks are hosted in SharePoint, Reporting Services, and/or One Drive, here are some of its added benefits:

- Enables the sharing and collaboration of Excel Power Pivot solutions
- Can schedule and automate data refresh
- Can audit changes through version management
- Can secure users for read-only and updateable access

Now that you know some of the benefits of Power Pivot, let's see what makes it tick.

The xVelocity In-memory Analytics Engine

The special sauce behind Power Pivot is the xVelocity in-memory analytics engine (yes, that is really the name). xVelocity allows Power Pivot to provide fast performance on large amounts of data. One of the keys to this is it uses a columnar database to store the data. Traditional row-based data storage stores all the data in the row together and is efficient at retrieving and updating data based on the row key, for example, updating or retrieving an order based on an order ID. This is great for the order-entry system but not so great when you want to perform analysis on historical orders (say you want to look at trends for the past year to determine how products are selling, for example). Row-based storage also takes up more space by repeating values for each row; if you have a large number of customers, common names like John or Smith are repeated many times. A columnar database stores only the distinct values for each column and then stores the row as a set of pointers back to the column values. This built-in indexing saves a lot of space and allows for significant optimization when coupled with data-compression techniques that are built into the xVelocity engine. It also means that data aggregations (like those used in typical data analysis) of the column values are extremely fast.

Another benefit provided by the xVelocity engine is the in-memory analytics. Most processing bottlenecks associated with querying data occur when data is read from or written to a disk. With in-memory analytics, the data is loaded into the RAM memory of the computer and then queried. This results in much faster processing times and limits the need to store pre-aggregated values on disk. This advantage is especially apparent when you move from 32-bit to 64-bit operating systems and applications, which are becoming the norm these days.

Another benefit worth mentioning is the tabular structure of the Power Pivot model. The model consists of tables and table relationships. This tabular model is familiar to most business analysts and database developers. Traditional OLAP databases such as SQL Server Analysis Server (SSAS) present the data model as a three-dimensional cube structure that is difficult to work with and requires a complex query language called Multidimensional Expressions (MDX). I find that in most cases (but not all), it is easier to work with tabular models and DAX than OLAP cubes and MDX.

Enabling Power Pivot for Excel

Power Pivot is a free add-in to Excel and has been available since Excel 2010. If you are using Excel 2010, you have to download and install the add-in from the Microsoft Office website. If you are using Excel 2013, the add-in is already installed and you just have to enable it. If you are using Excel 2016 (the version covered in this book), it is already installed and enabled for you. To check what edition you have installed, click the File menu in Excel and select the Account tab, as shown in Figure 1-1.

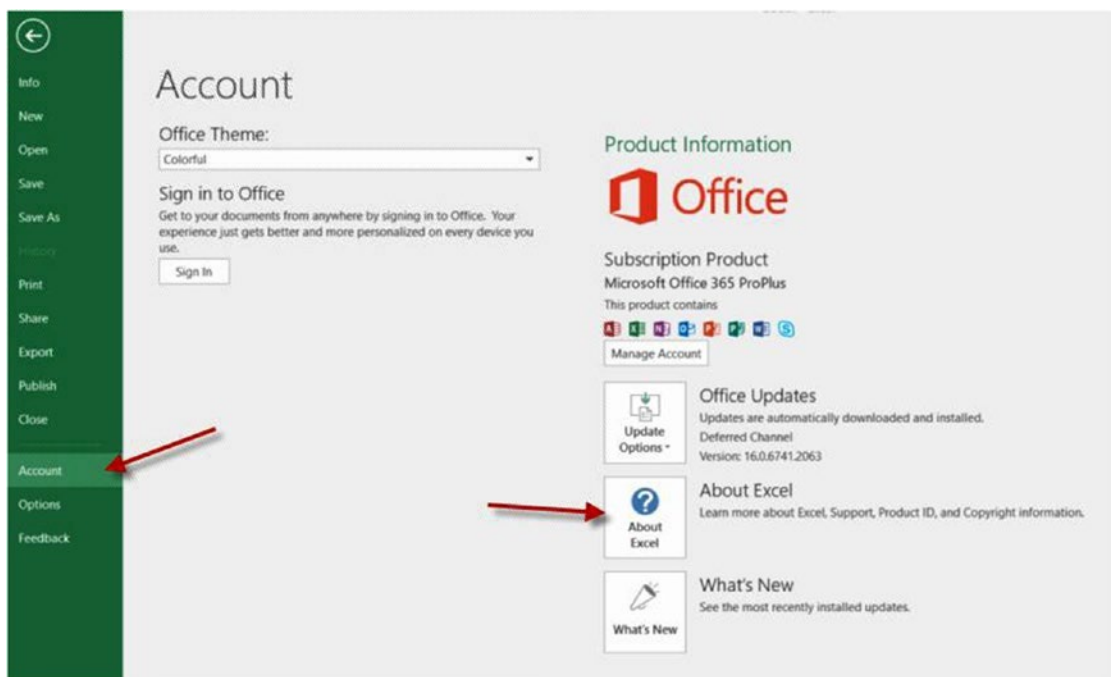


Figure 1-1. Checking for the Excel version

On the Account tab, click the About Excel button. You are presented with a screen showing version details, as shown in Figure 1-2. Take note of the edition and the version. Although the 32-bit version will work fine for smaller data sets, to get the optimal performance and experience from Power Pivot you should use the 64-bit version running on a 64-bit version of Windows with at least 8 GB of RAM.

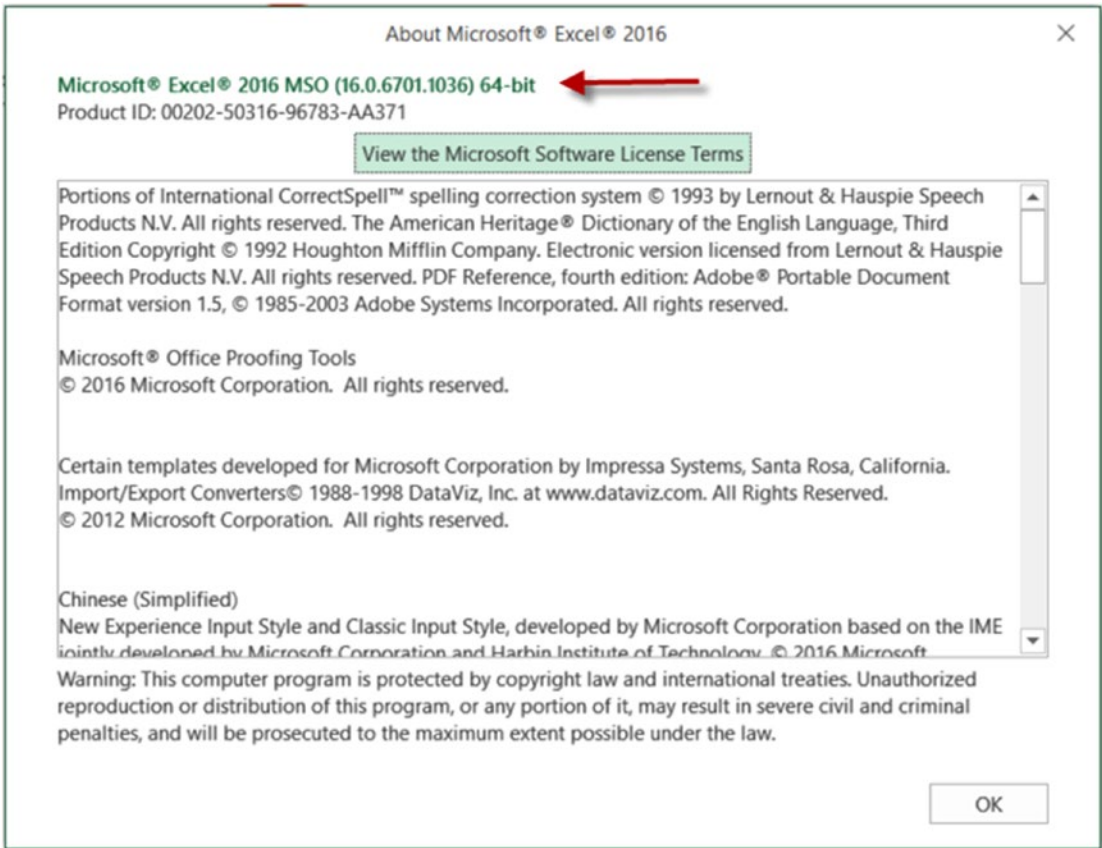


Figure 1-2. Checking the Excel edition and version

Once you have determined that you are running the correct version, you can enable/disable the Power Pivot add-in by clicking the File menu and selecting the Options tab. In the Excel Options window, click the Add-Ins tab. In the Manage drop-down select COM Add-ins and click the Go button (see Figure 1-3).

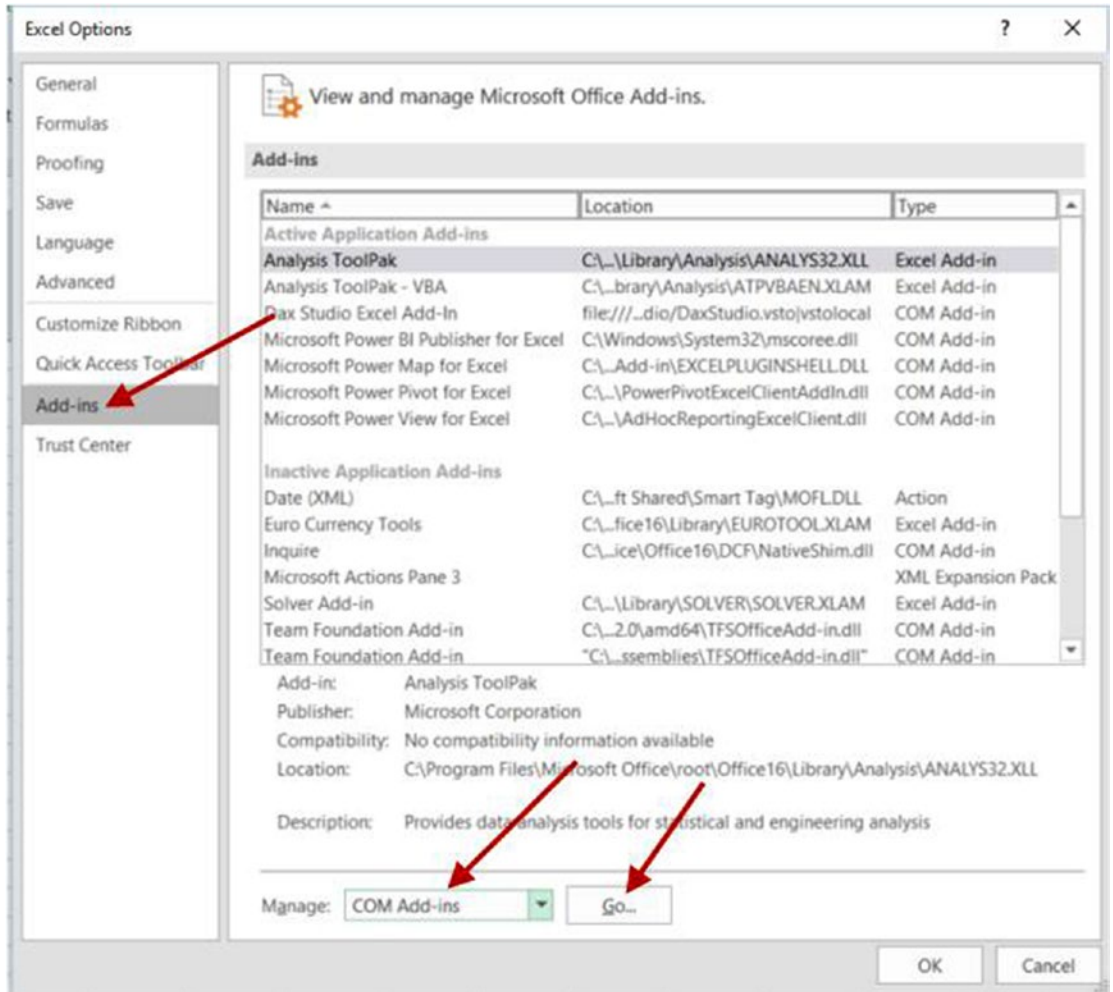


Figure 1-3. Managing COM add-ins

You are presented with the COM Add-ins window (see Figure 1-4). Make sure Microsoft Power Pivot for Excel is checked and click OK.

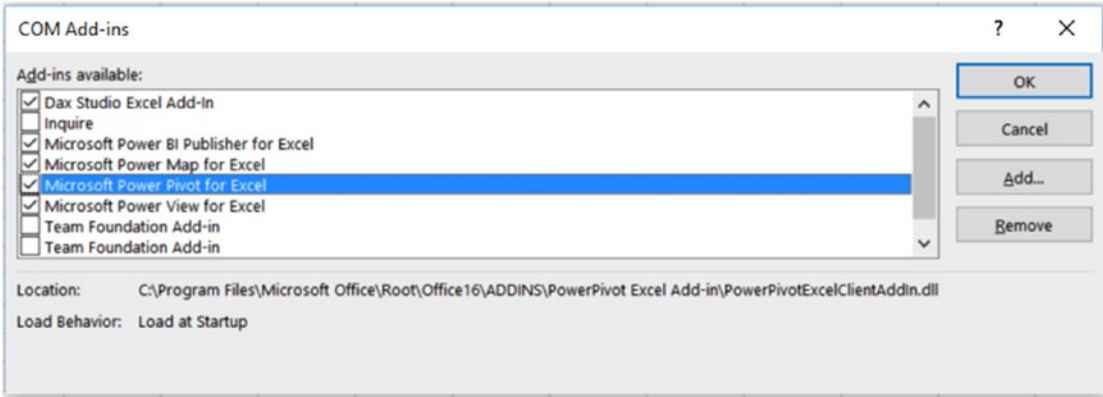


Figure 1-4. Selecting the Power Pivot add-in

Now that you have ensured that the Power Pivot add-in for Excel is enabled, it is time to explore the Data Model Manager.

Exploring the Data Model Manager Interface

If Power Pivot is enabled, you should see a Power Pivot tab in Excel (see Figure 1-5). Clicking the Manage button launches the Data Model Management interface.

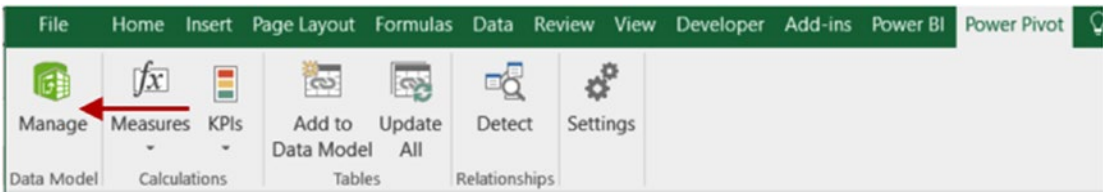


Figure 1-5. Launching the Data Model Manager

When the Data Model Manager launches, you will have two separate but connected interfaces. You can switch back and forth between the normal Excel interface and the Data Model Management interface. This can be quite confusing for new Power Pivot users. Remember, the Data Model Manager (Figure 1-6) is where you define the model including tables, table relationships, measures, calculated columns, and hierarchies. The Excel interface (Figure 1-7) is where you analyze the data using pivot tables and pivot charts.

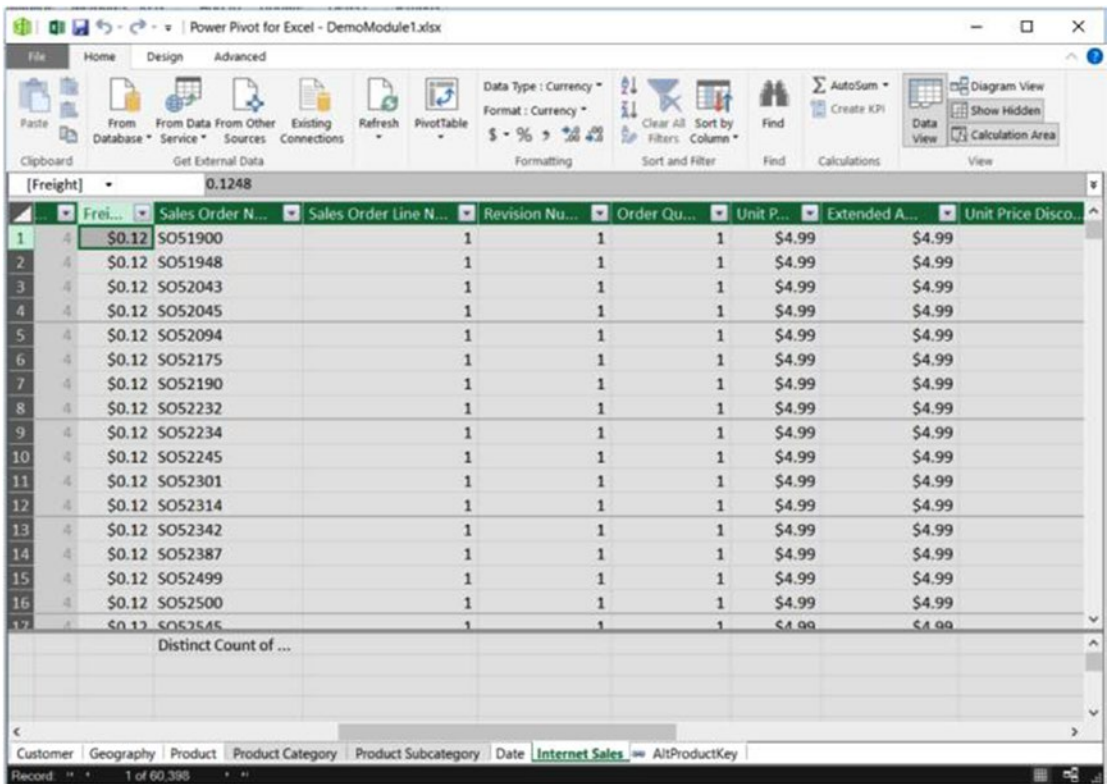


Figure 1-6. The Data Model Manager interface

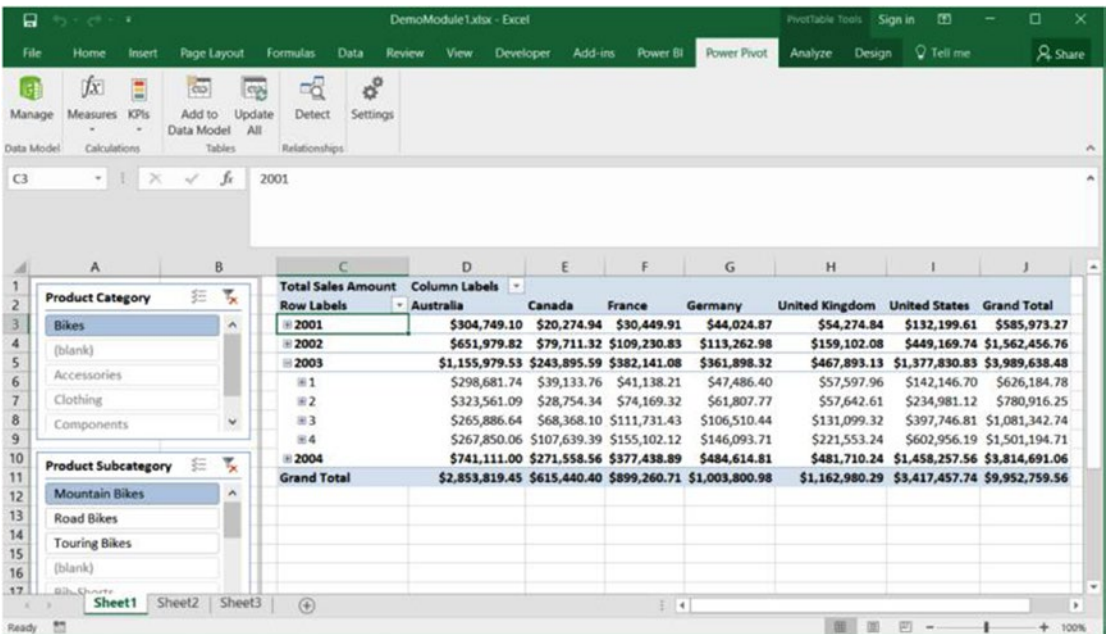


Figure 1-7. The Excel Workbook interface

There are two views of the data model in the Data Model Manager: the data view and the diagram view. When it first comes up, it is in the data view mode. In data view mode, you can see the data contained in the model. Each table in the model has its own tab in the view. Tables can include columns of data retrieved from a data source and also columns that are calculated using DAX. The calculated columns appear a little darker and have a different-colored header than the other columns. Figure 1-8 shows the Full Name column, which is derived by concatenating the First Name and Last Name columns.

	First Name	Middle Name	Last Name	Full Name	Birth ...
1	Latasha		Suarez	Latasha Suarez	9/25/197...
2	Larry		Gill	Larry Gill	4/13/197...
3	Edgar		Sanchez	Edgar Sanchez	6/3/1977...
4	Shelby		Bailey	Shelby Bailey	6/3/1977...
5	Alexa		Watson	Alexa Watson	8/25/197...
6	Jacquelyn		Dominguez	Jacquelyn Dominguez	9/27/197...
7	Kate		Shan	Kate Shan	1/24/197...
8	Colleen		Lu	Colleen Lu	7/17/197...
9	Dale		Shen	Dale Shen	3/16/197...
10	Tammy		Sai	Tammy Sai	11/14/19...
11	Leah		Li	Leah Li	10/6/197...
12	Andrea		Cox	Andrea Cox	8/3/1977...
13	Alyssa		Lee	Alyssa Lee	8/13/197...
14	Jill		Rubio	Jill Rubio	6/27/197...
15	Dennis		Li	Dennis Li	7/17/197...
16	Natasha		Sanz	Natasha Sanz	5/18/197...
17	Autumn		Zhu	Autumn Zhu	10/23/19...

Figure 1-8. A calculated column in the Data Model Manager

Each tab also contains a grid area below the column data. The grid area is where you define measures in the model. The measures usually consist of some sort of aggregation function. For example, you may want to look at sales rolled up by month or by products. Figure 1-9 shows some measures associated with the Internet Sales table.

	Total Produc...	Sales Amount	Margin	
1	\$1.87		\$4.99	\$3.12
2	\$1.87		\$4.99	\$3.12
3	\$1.87		\$4.99	\$3.12
4	\$1.87		\$4.99	\$3.12
5	\$1.87		\$4.99	\$3.12
6	\$1.87		\$4.99	\$3.12
Total Sales Amount: \$29,358,677.22			Total Margin: \$12,080,883.65	

Figure 1-9. The measures grid area in the Data Model Manager

There are four menu tabs at the top of the designer: File, Home, Design, and Advanced. If you don't see the Advanced tab, you can show it by clicking the File menu tab and selecting Switch To Advanced Mode. You will become intimately familiar with the menus in the designer as you progress through this book. For now, suffice it to say that this is where you initiate various actions such as connecting to data sources, creating data queries, formatting data, setting default properties, and creating key performance indicators (KPIs). Figure 1-10 shows the Home menu in the Data Model Manager.

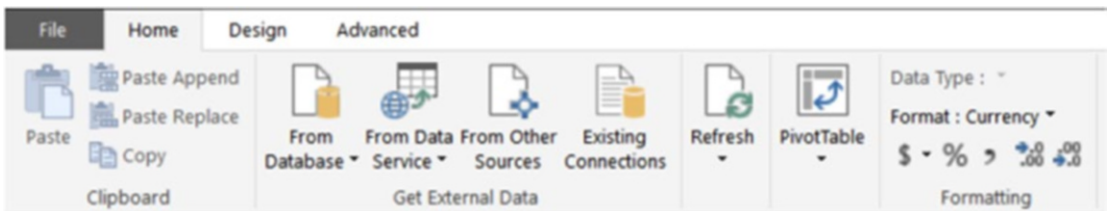


Figure 1-10. The Home menu tab in the Data Model Manager

On the right side of the Home menu you can switch from the data view mode to the diagram view mode. The diagram view shown in Figure 1-11 illustrates the tables and the relationships between the tables. This is where you generally go to establish relationships between tables and create hierarchies for drilling through the model. The menus are much the same in both the data view and the diagram view. You will find, however, that some things can only be done in the data view, and some things can only be done in the diagram view.

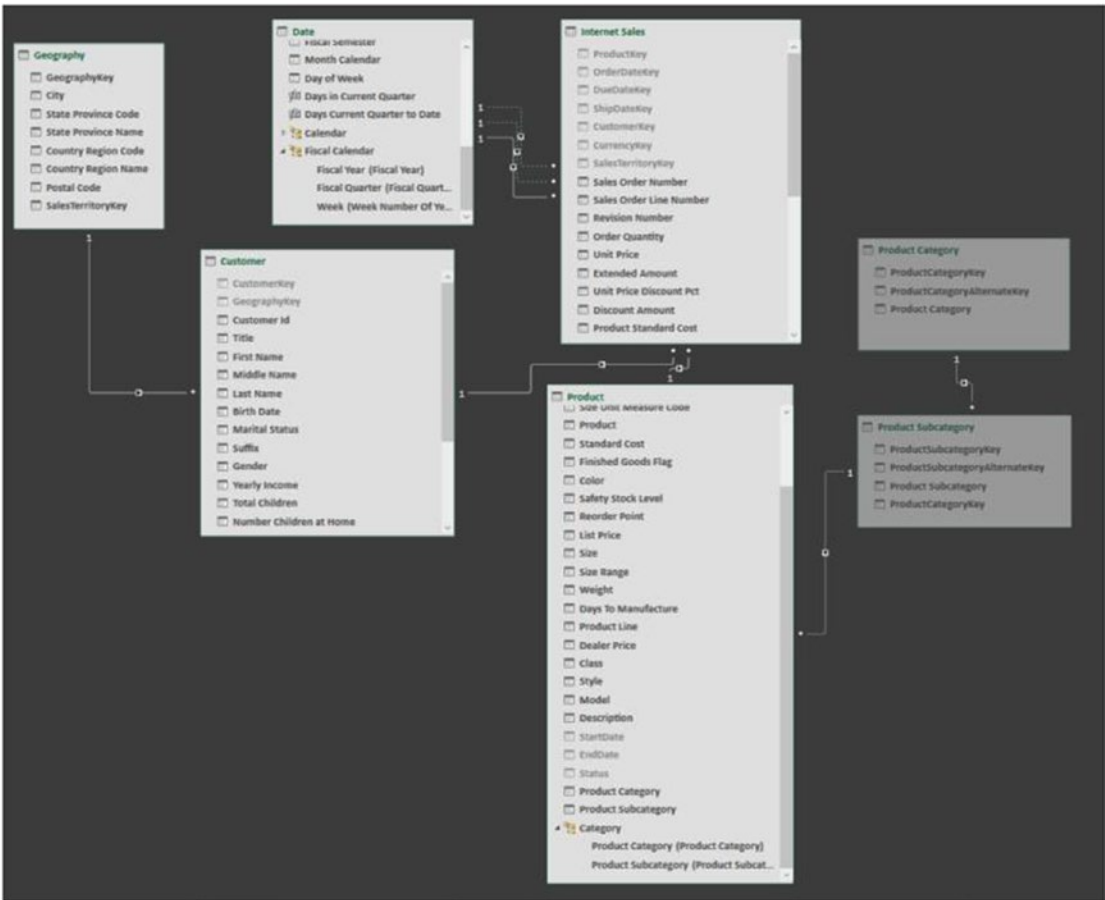


Figure 1-11. Using the diagram view in the Data Model Manager

Now that you are familiar with the various parts of the Data Model Manager, it’s time to get your hands dirty and complete the following hands-on lab. This lab will help you become familiar with working in the Data Model Manager.

Note To complete the labs in this book, make sure you download the starter files from <https://github.com/Apress/beginning-power-bi-2ed>.

HANDS-ON LAB: EXPLORING POWER PIVOT

In this following lab you will

- Verify that the Power Pivot add-in is enabled.
 - Analyze data using pivot tables.
 - Explore the Data Model Manager.
1. Open Excel 2016.
 2. On the File menu, select Account (refer to Figure 1-1).
 3. Click About Excel and check the version (32-bit or 64-bit) you are using.
 4. On the File menu select Options and then click the Add-Ins tab. In the Manage drop-down, select COM Add-ins and click Go.
 5. In the COM Add-ins window, make sure the Power Pivot add-in (refer to Figure 1-4) is checked.
 6. Open the Chapter1Lab1.xlsx file located in the LabStarterFiles folder.
 7. Click Sheet1. You should see a basic pivot table showing sales by year and country, as shown in Figure 1-12.

Total Sales Amount		Column Labels					
Row Labels	Australia	Canada	France	Germany	United Kingdom	United States	Grand Total
2001	\$1,309,047.20	\$146,829.81	\$180,571.69	\$237,784.99	\$291,590.52	\$1,100,549.45	\$3,266,373.66
2002	\$2,154,284.88	\$621,602.38	\$514,942.01	\$521,230.85	\$591,586.85	\$2,126,696.55	\$6,530,343.53
2003	\$3,033,784.21	\$535,784.46	\$1,026,324.97	\$1,058,405.73	\$1,298,248.57	\$2,838,512.36	\$9,791,060.30
2004	\$2,563,884.29	\$673,628.21	\$922,179.04	\$1,076,890.77	\$1,210,286.27	\$3,324,031.16	\$9,770,899.74
Grand Total	\$9,061,000.58	\$1,977,844.86	\$2,644,017.71	\$2,894,312.34	\$3,391,712.21	\$9,389,789.51	\$29,358,677.22

Figure 1-12. Using a pivot table

8. Click anywhere in the pivot table. You should see the field list on the right side, as shown in Figure 1-13.

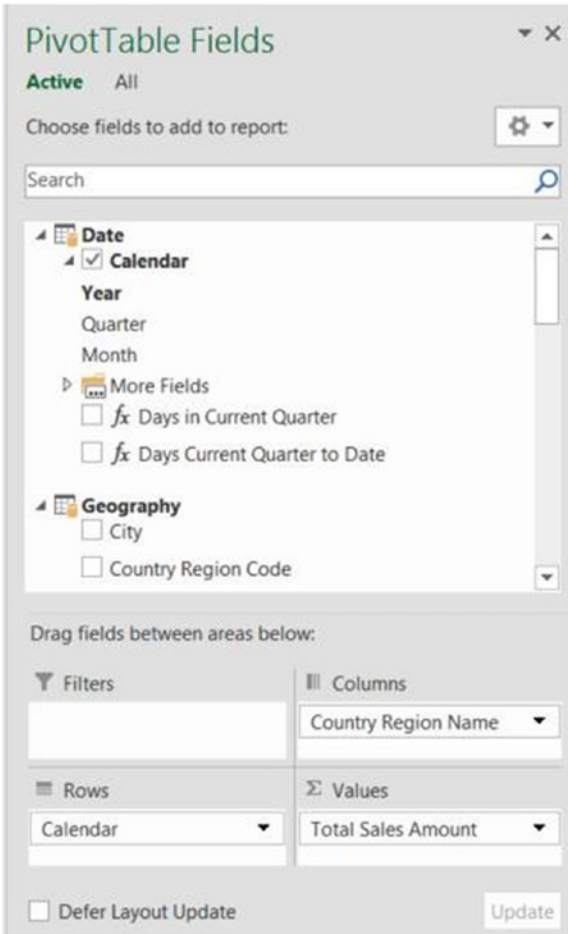


Figure 1-13. The pivot table field list

9. Below the field list are the drop areas for the filters, rows, columns, and values. You drag and drop the fields into these areas to create the pivot table.
10. Click the All tab at the top of the PivotTable Fields window. Expand the Product table in the field list. Find the Product Category field and drag it to the Report Filter drop zone.
11. A filter drop-down appears above the pivot table. Click the drop-down filter icon. You should see Product Categories.
12. Change the filter to Bikes and notice the values changing in the pivot table.
13. When you select multiple items from a filter, it's hard to tell what is being filtered on. Filter on Bikes and Clothing. Notice that when the filter drop-down closes, it just shows (Multiple Items). Remove the Product Category field from the Report Filter drop zone.

14. Slicers act as filters but they give you a visual to easily determine what is selected. On the Insert menu, click the Slicer. In the pop-up window that appears, select the All tab and then select the Category hierarchy under the Product table, as shown in Figure 1-14.

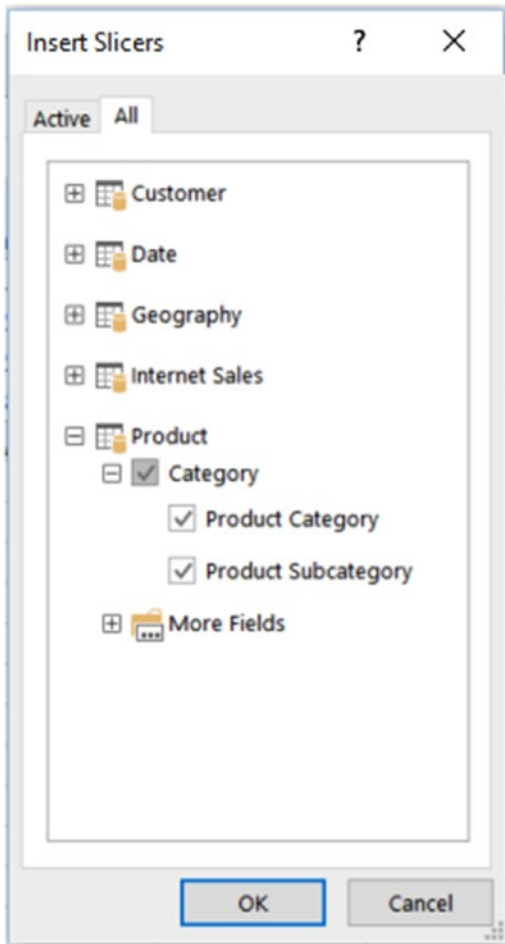


Figure 1-14. Selecting slicer fields

15. Product Category and Product Subcategory slicers are inserted and are used to filter the pivot table. To filter by a value, click the value button. To select multiple buttons, hold down the Ctrl key while clicking (see Figure 1-15). Notice that because these fields were set up as a hierarchy, selecting a product category automatically filters to the related subcategories in the Product Subcategory slicer.

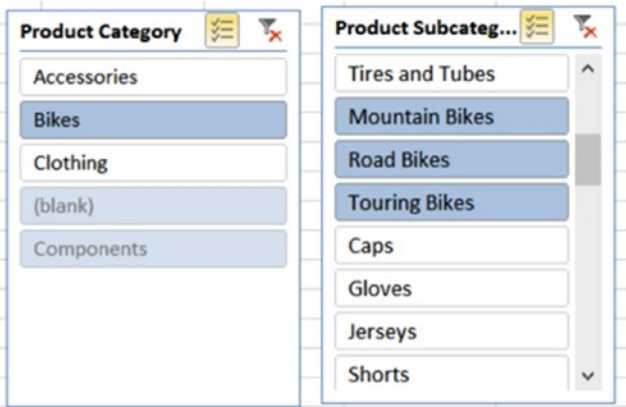


Figure 1-15. Using slicers to filter a pivot table

- 16. Hierarchies are groups of columns arranged in levels that make it easier to navigate the data. For example, if you expand the Date table in the field list, you can see the Calendar hierarchy, as shown in Figure 1-16. This hierarchy consists of the Year, Quarter, and Month fields and represents a natural way to drill down into the data.

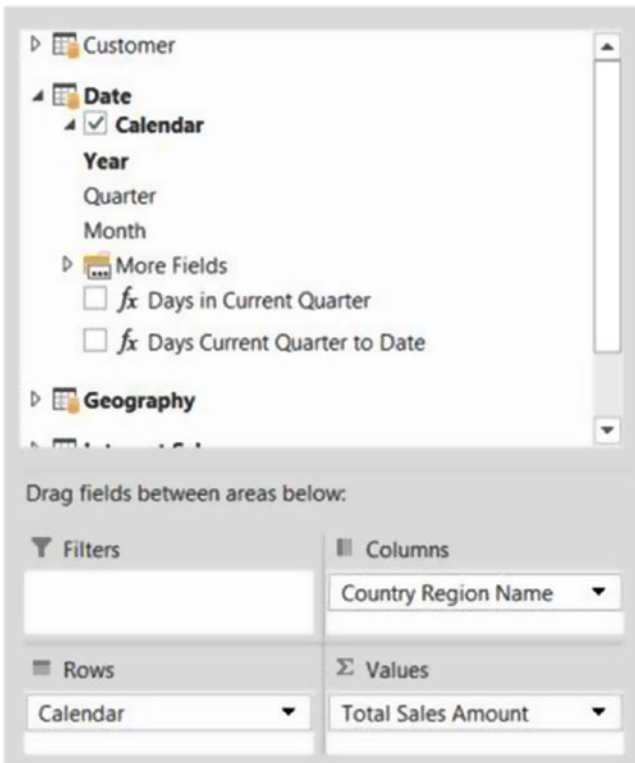


Figure 1-16. Using hierarchies in a pivot table

17. If you expand the Internet Sales table in the field list, you will see a traffic light icon. This icon represents a KPI. KPIs are used to gauge the performance of a value. They are usually represented by a visual indicator to quickly determine performance.
18. Under the Power Pivot menu, click the Manage Data Model button.
19. In the Data Model Manager, select the different tabs at the bottom to switch between the different tables.
20. Go to the ProductAlternateKey column in the Product table. Notice that it's grayed out. This means it's hidden from any client tool. You can verify this by switching back to the Excel pivot table on sheet 1 and verifying that you cannot see the field in the field list.
21. In the Internet Sales table, click the Margin column. Notice this is a calculated column. It has also been formatted as currency.
22. Below the Sales Amount column in the Internet Sales table, there is a measure called Total Sales Amount. Click the measure and note that in the formula bar above the table is the DAX code used to calculate the measure.
23. On the left side of the Home tab of the Data Model Manager, switch to the diagram view. Observe the relationships between the tables.
24. If you hover over the relationship with the mouse pointer, you can see the fields involved in the relationship, as shown in Figure 1-17.

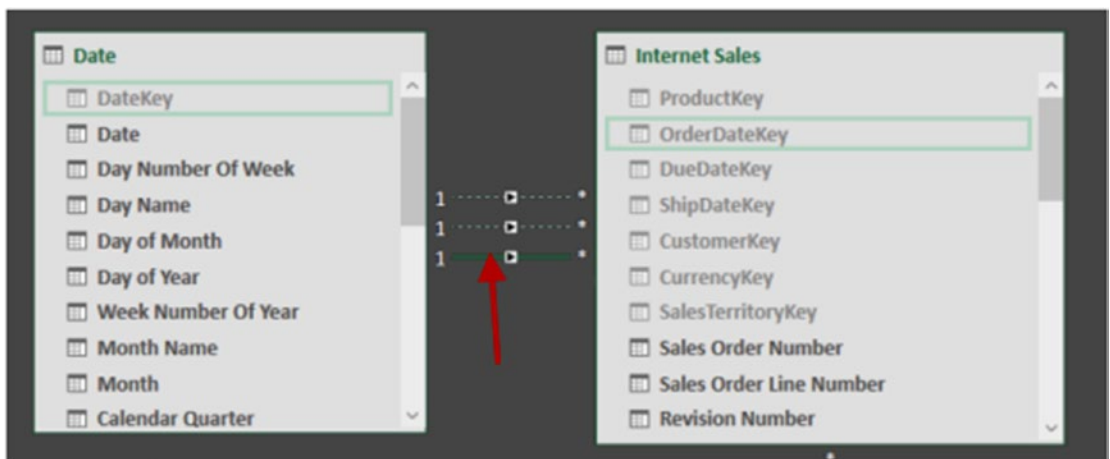


Figure 1-17. Exploring relationships