

Beginning Microsoft Power BI

A Practical Guide to
Self-Service Data Analytics

—

Third Edition

—

Dan Clark

Apress®

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Data Analytics**

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Dan Clark
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About the Author



Dan Clark is a senior business intelligence (BI) and programming consultant specializing in Microsoft technologies. He is focused on learning new BI and data technologies and training others on 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 and database conferences and user group meetings and enjoys interacting with the Microsoft communities. In a previous life, Dan 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.

About the Technical Reviewer



Al MacKinnon is a principal customer success manager with CDW, focusing on Microsoft Cloud solutions with customers in the Mid-Atlantic region. He has a long background in IT, including 10 years with Microsoft. That experience includes technical training, consulting, project management, solutions architecture, and course development. He's held numerous certifications from Novell, Microsoft, and CompTIA and has been a CISSP since 2003. He gets the most satisfaction from helping organizations map technology to business goals and challenges. Al is supported by his wife of over 30 years, and, when not working, he often discusses our place in the universe with the author. Finally, he's gratified that his BA in English is finally starting to pay off.

Acknowledgments

Once again, thanks to the team at Apress for making the writing of this book an enjoyable experience. A special thanks goes to my good friend and technical reviewer, Al—thank you for your attention to detail and excellent suggestions while reviewing this book.

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 and Power BI Desktop.

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 BI Desktop. Because creating robust Power BI models is essential to creating 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.

As you start working with Power BI, you will soon realize it is constantly evolving (for the better). Every month there is an update to Power BI Desktop that introduces new features and changes to the interface. For this reason, some of the screenshots may not look exactly like the current version of Power BI. They will be, however, close enough to figure out what has changed.

Good luck on your journey, and don’t hesitate to provide feedback and suggestions for improving the experience!

CHAPTER 1

Introducing Power BI

The core of Microsoft's self-service business intelligence (BI) toolset is the Power BI data engine (also known as Power Pivot). It is integrated into both Power BI Desktop and Excel (2010 and later) 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 BI is such an important tool and what makes it perform so well. The chapter also provides you with an overview of the Power BI Desktop interface and gives you 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 Power BI Desktop interface
- Analyzing data in a Power BI report

Why Use Power BI?

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 BI, 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 powerful visuals to gain insight into the data. You can create quick proofs of concepts that can be easily promoted to become part of the enterprise-wide solution. Power BI also promotes one-off data analysis projects without the overhead of a drawn-out development cycle. When combined with the Power BI Service portal, reports and dashboards 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 BI:

- Power BI Desktop is a free tool for creating reports.
- Easily integrates data from a variety of sources.
- Handles large amounts of data, upward of tens to hundreds of millions of rows.
- Includes a powerful Data Analysis Expressions (DAX) language.
- Has data in the model that is read-only, which increases security and integrity.

When Power BI reports are hosted in the Power BI Service portal, some added benefits are

- Enables sharing and collaboration
- Scheduling and automation of 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 BI, let's see what makes it tick.

The xVelocity In-Memory Analytics Engine

The special sauce behind Power BI is the xVelocity in-memory analytics engine (yes, that is really the name). xVelocity allows Power BI 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 preaggregated values on disk. This advantage is especially apparent when you move from 32-bit to 64-bit operating systems and applications, which are the norm these days.

Another benefit worth mentioning is the tabular structure of the Power BI data 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.

Setting Up the Power BI Environment

Power BI Desktop is a free tool used to create visual analytic reports that can be hosted in the Power BI portal. You can download it from the Power BI web site at <https://powerbi.microsoft.com/en-us/desktop/>. If you sign up for the Power BI portal or have an Office 365 subscription, you can log into the portal (<https://powerbi.microsoft.com>) and download the tool (see Figure 1-1).

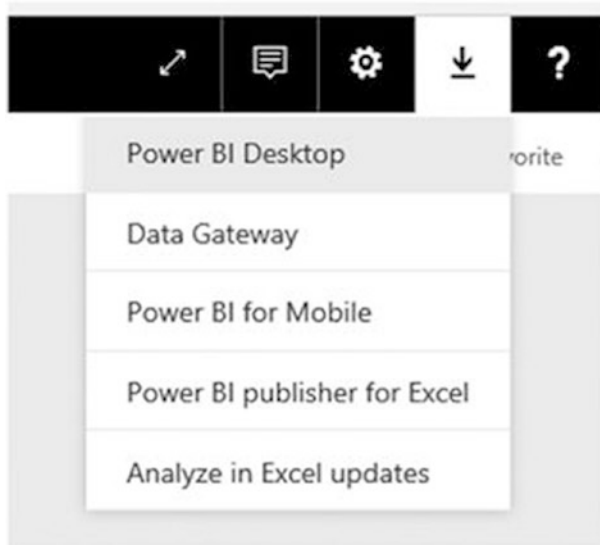


Figure 1-1. Downloading Power BI Desktop

Once you download Power BI Desktop, click Run to begin the install. Follow the installation wizard, which is straightforward. After the install, launch Power BI Desktop. Click the File tab ► Options and Settings ► Options to set up the various options for your development environment (see Figure 1-2).

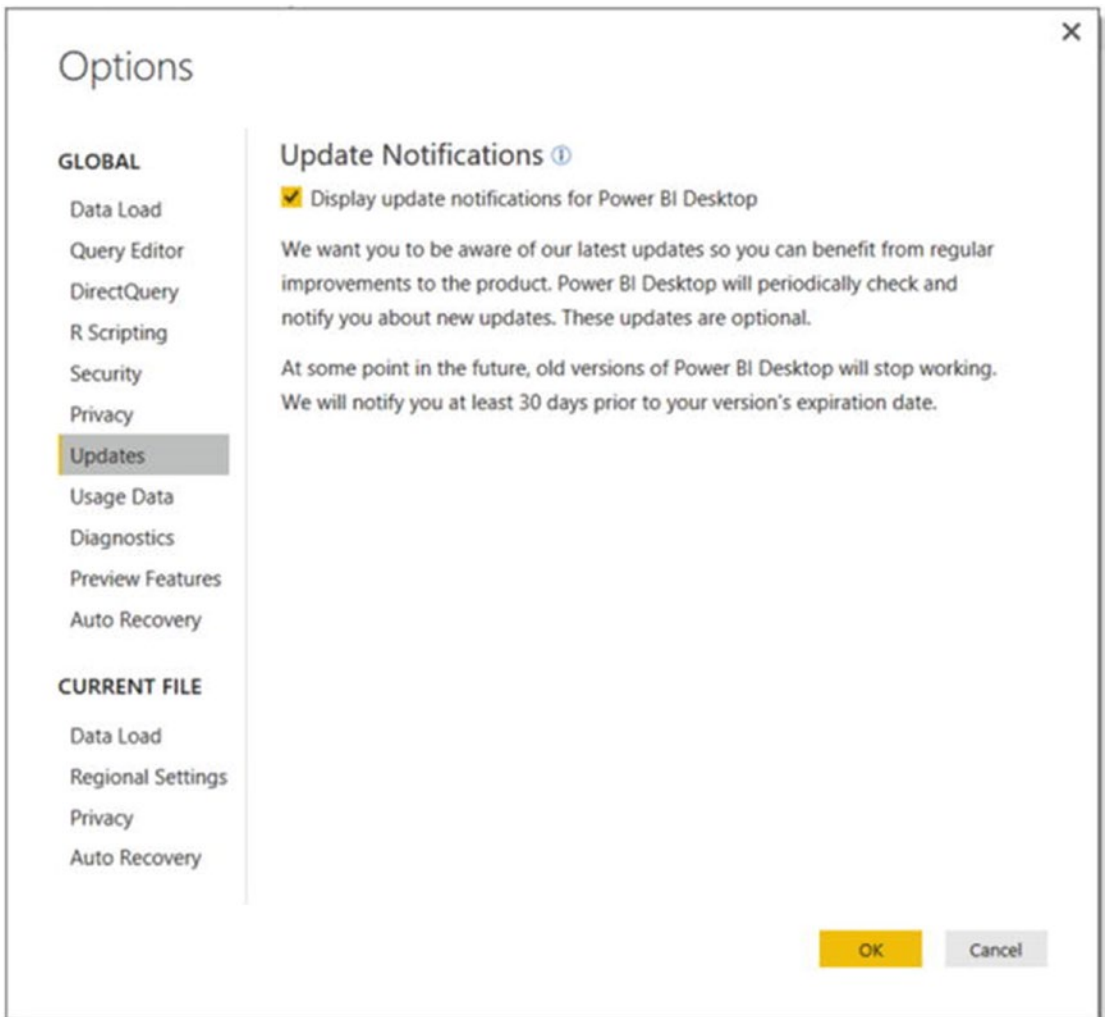


Figure 1-2. Setting options for Power BI Desktop

One thing to be aware of is that Microsoft has been releasing monthly updates that include new features. Make sure you get notified and install these updates when they are released. You can check which version you have installed by selecting the Diagnostics tab in the Options window. If you are like me and want to play with upcoming features that are still in development, you can turn them on in the Preview Features tab in the Options window.

Now that you have installed and set up the Power BI Desktop development environment, you are ready to explore the interface.

Exploring the Power BI Desktop Interface

When you launch Power BI Desktop, you are presented with a startup screen (see Figure 1-3).

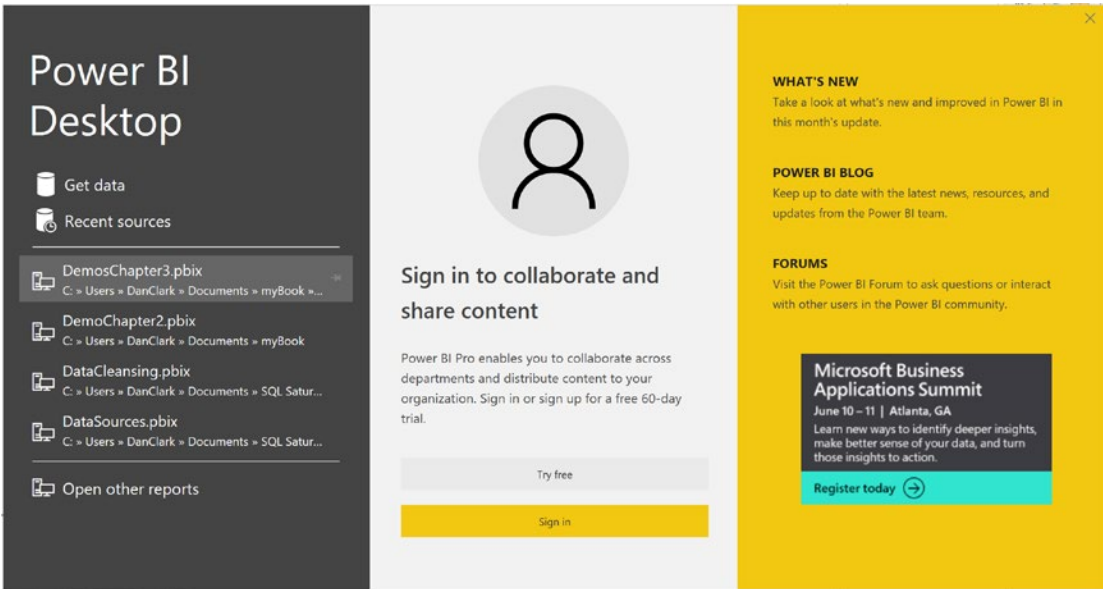


Figure 1-3. The Power BI startup screen

You can use this screen to launch recent reports, start a new report using recent sources, or start a new report with a new data source. In the middle of the screen, you can sign into the Power BI Service to collaborate with others or sign up for a 60-day free trial of Power BI Pro. On the left side of the screen, you can link to the Power BI blog and the Power BI forums.

Note There is a limited Power BI Free version; however this book is based on the Power BI Pro version.

Figure 1-4 shows a recent Power BI report opened in the Power BI Desktop.

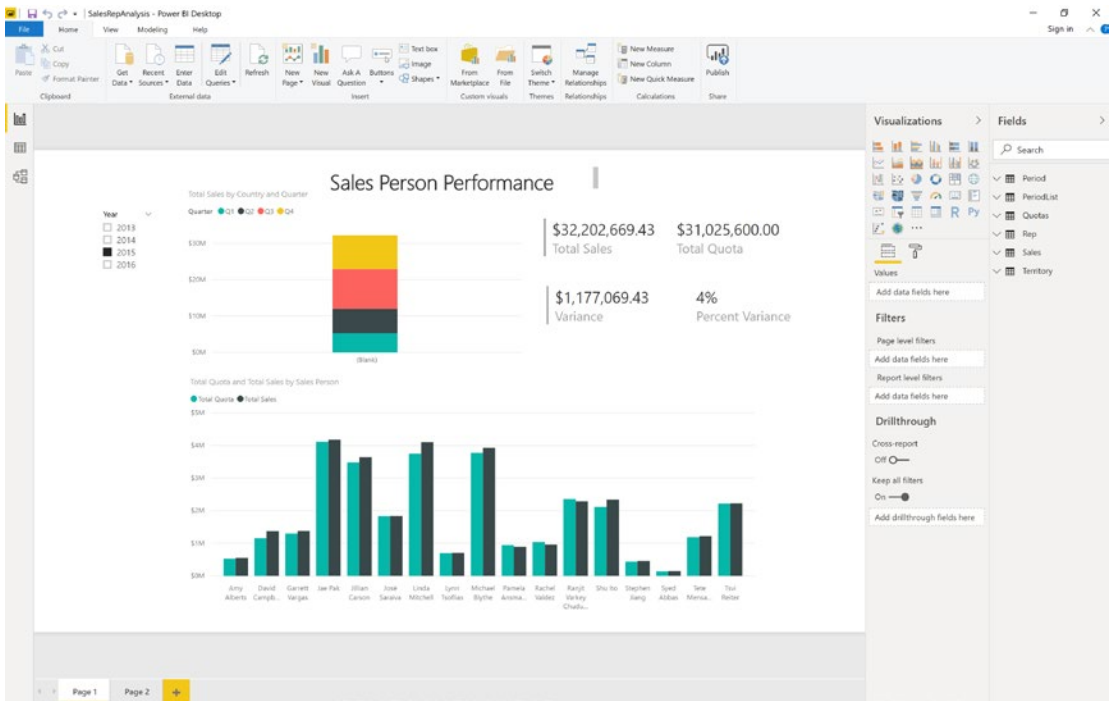


Figure 1-4. Creating a report in Power BI Desktop

When you first open a report in Power BI Desktop, you see the Report view. There are two other views you can select—the Data view and the Model view. To switch views, you use the tabs on the left side of the designer (see Figure 1-5).

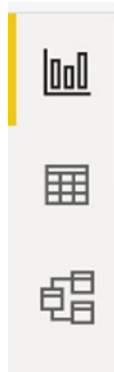
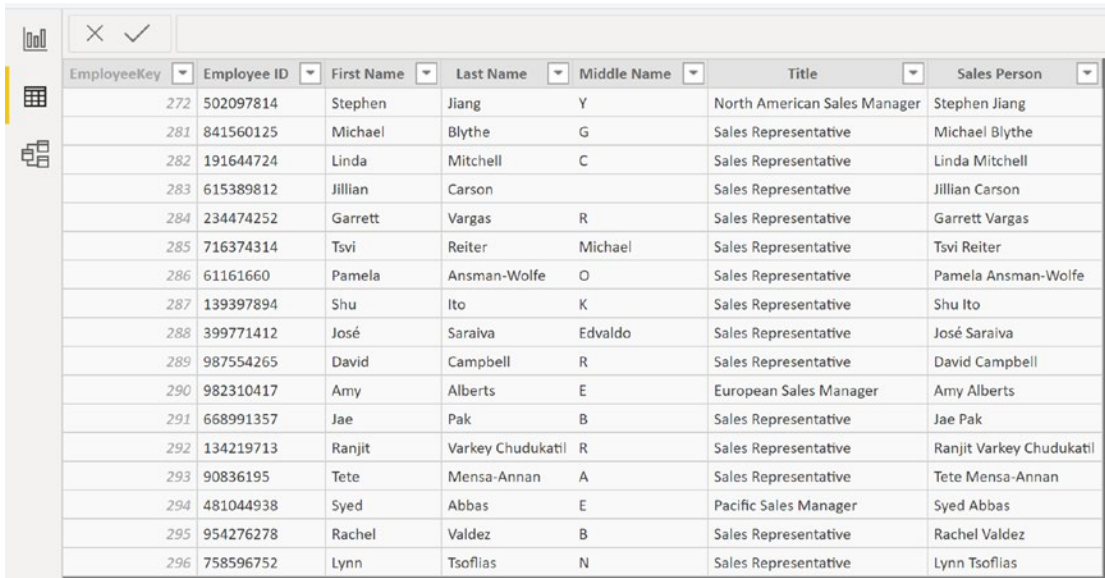


Figure 1-5. Switching views in the Power BI Desktop

If you select the Data view tab, you can see the data tables and the data that has been imported into the model (see Figure 1-6).



The screenshot shows the Data view tab in Power BI. The table contains the following data:

EmployeeKey	Employee ID	First Name	Last Name	Middle Name	Title	Sales Person
272	502097814	Stephen	Jiang	Y	North American Sales Manager	Stephen Jiang
281	841560125	Michael	Blythe	G	Sales Representative	Michael Blythe
282	191644724	Linda	Mitchell	C	Sales Representative	Linda Mitchell
283	615389812	Jillian	Carson		Sales Representative	Jillian Carson
284	234474252	Garrett	Vargas	R	Sales Representative	Garrett Vargas
285	716374314	Tsvi	Reiter	Michael	Sales Representative	Tsvi Reiter
286	61161660	Pamela	Ansman-Wolfe	O	Sales Representative	Pamela Ansman-Wolfe
287	139397894	Shu	Ito	K	Sales Representative	Shu Ito
288	399771412	José	Saraiva	Edvaldo	Sales Representative	José Saraiva
289	987554265	David	Campbell	R	Sales Representative	David Campbell
290	982310417	Amy	Alberts	E	European Sales Manager	Amy Alberts
291	668991357	Jae	Pak	B	Sales Representative	Jae Pak
292	134219713	Ranjit	Varkey Chudukatil	R	Sales Representative	Ranjit Varkey Chudukatil
293	90836195	Tete	Mensa-Annan	A	Sales Representative	Tete Mensa-Annan
294	481044938	Syed	Abbas	E	Pacific Sales Manager	Syed Abbas
295	954276278	Rachel	Valdez	B	Sales Representative	Rachel Valdez
296	758596752	Lynn	Tsoflias	N	Sales Representative	Lynn Tsoflias

Figure 1-6. Viewing data in the Data view tab

The Model view tab shows the relationships and the filter direction between the tables in the model (see Figure 1-7).

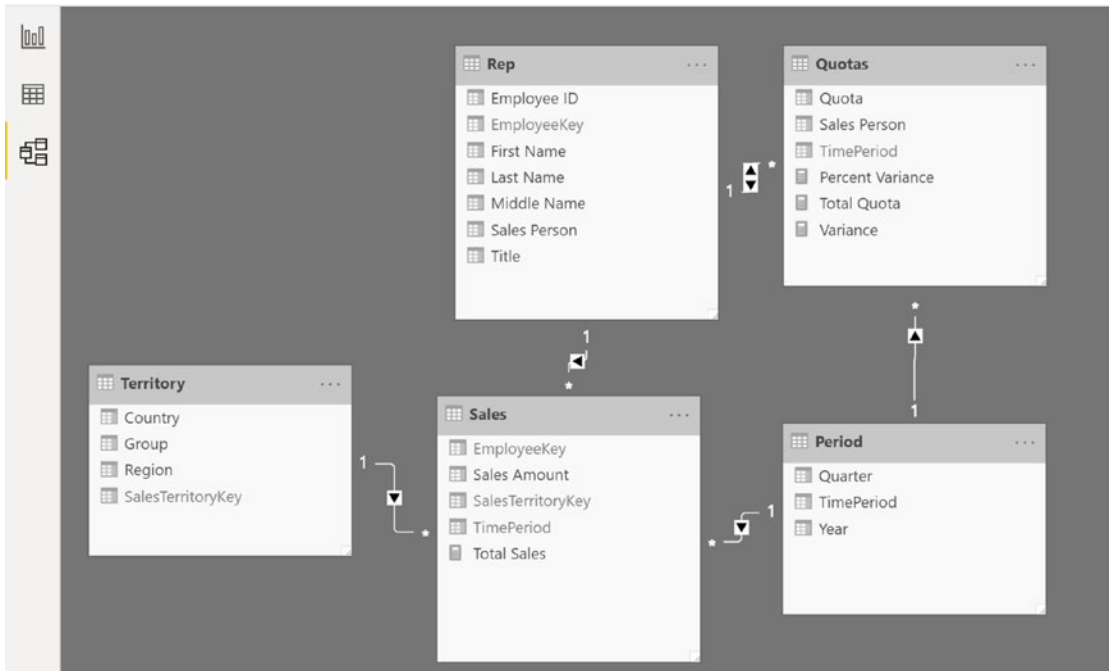


Figure 1-7. *The Model view tab*

The menus at the top of the designer will change depending on what view you have selected. Figure 1-8 shows the menus available when you are in the Report view tab. 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 editing visual interactions.

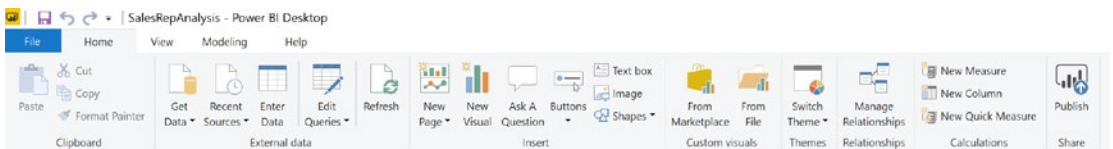


Figure 1-8. *The Home menu in the Report view*

On the right side of the report designer are the Visualizations and the Fields windows (see Figure 1-9). This is where you select the visualizations you want on the report, add fields to the visualizations, and set the properties of the visualizations.

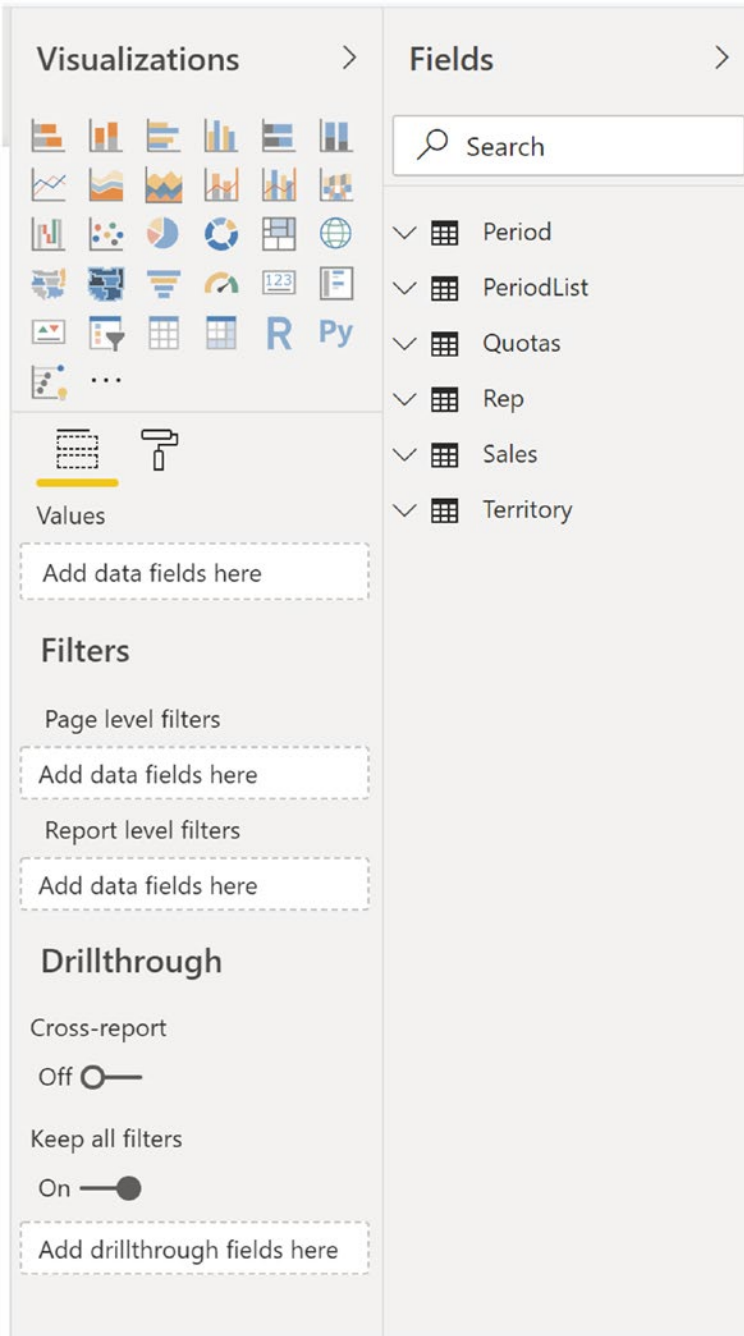


Figure 1-9. *The Visualizations and Fields windows*

Now that you are familiar with the various parts of the Power BI Desktop report designer, 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 Power BI Desktop.

Note To complete the labs in this book, make sure you download the starter files from <https://github.com/Apress/beginning-power-bi-3ed>.

HANDS-ON LAB: EXPLORING POWER PIVOT

In this following lab, you will

- Install Power BI Desktop
 - View the various tabs of Power BI Desktop
 - Explore the data using a matrix
1. Go to <https://powerbi.microsoft.com/en-us/desktop/> and download and install Power BI Desktop.
 2. Launch Power BI Desktop and dismiss the startup screen.
 3. On the File menu, select Options and Settings and then Options. You should see the Options window (see Figure 1-10).

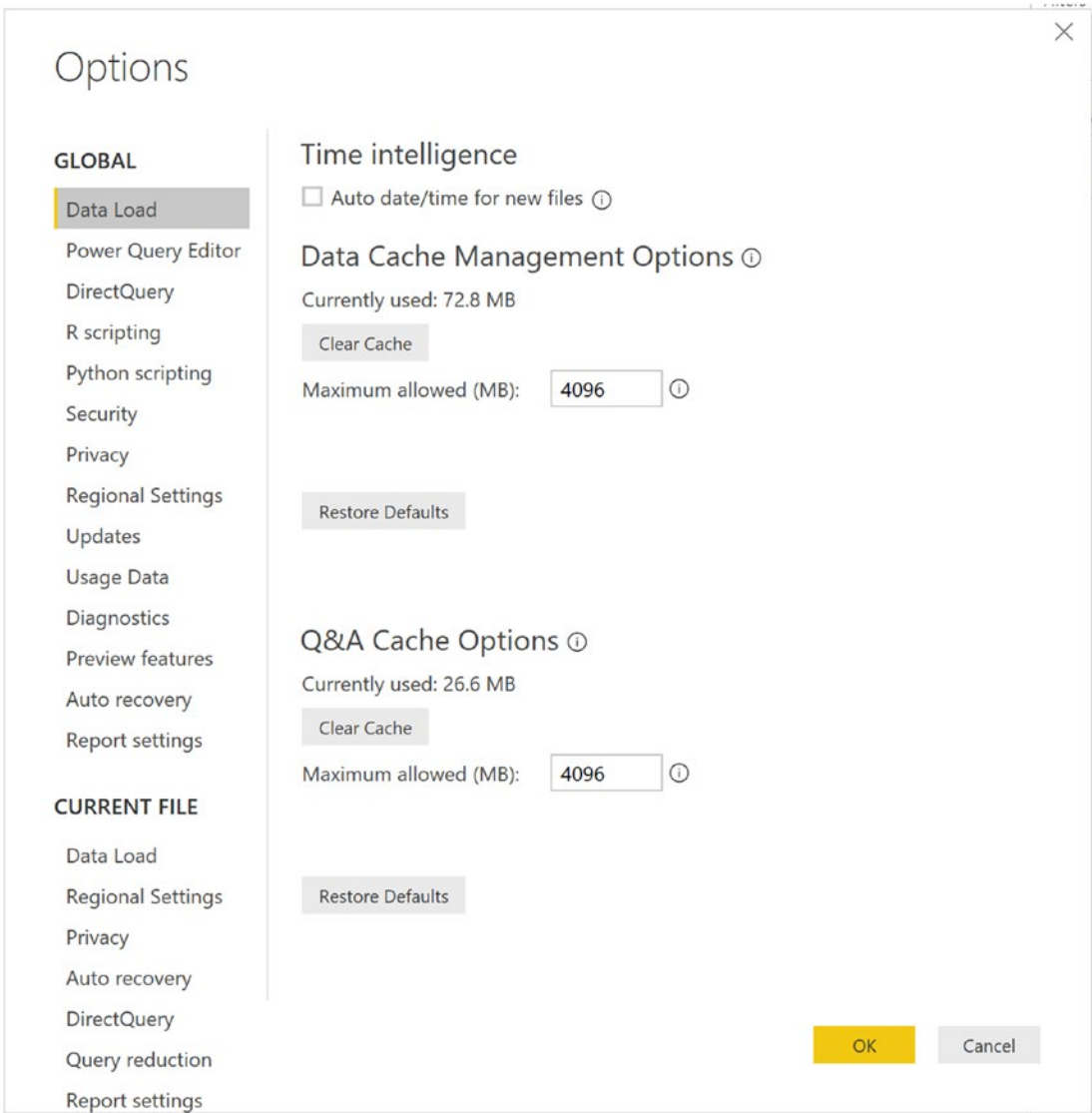


Figure 1-10. Viewing the Options settings

4. On the Global Data Load tab, make sure the Auto date/time for new files option is unchecked.
5. View some of the other setting options available.
6. Open the Chapter1Lab1.pbix file located in the LabStarterFiles folder.
7. You should see a basic matrix showing sales by year and country, as shown in Figure 1-11.

The screenshot shows the Power BI ribbon with the 'Sort by Column' option selected under the 'Sort' group. Below the ribbon, a matrix table displays sales data by year and country. The table has columns for CalendarYear, Australia, Canada, France, Germany, United Kingdom, United States, and Total. The rows represent years from 2010 to 2014, plus a Total row. The values are formatted with commas as thousands separators and dollar signs for currency.

CalendarYear	Australia	Canada	France	Germany	United Kingdom	United States	Total
2010	\$20,909.78	\$3,578.27	\$3,399.99		\$699,0982	\$14,833.8982	\$43,421.0364
2011	\$2,563,732.2493	\$571,571.7984	\$410,845.326	\$520,500.1642	\$550,591.2186	\$2,458,285.1726	\$7,075,525.9291
2012	\$2,128,407.4551	\$307,604.5237	\$648,065.5383	\$608,657.984	\$712,700.9641	\$1,437,048.73	\$5,842,485.1952
2013	\$4,339,443.38	\$1,085,632.65	\$1,578,511.8	\$1,761,876.36	\$2,124,007.29	\$5,462,078.86	\$16,351,550.34
2014	\$8,507.72	\$9,457.62	\$3,195.06	\$3,277.83	\$3,713.64	\$17,542.85	\$45,694.72
Total	\$9,061,000.5844	\$1,977,844.8621	\$2,644,017.7143	\$2,894,312.3382	\$3,391,712.2109	\$9,389,789.5108	\$29,358,677.2207

Figure 1-11. Using a matrix table

8. Click anywhere in the matrix. You should see the visual properties and the field list on the right side, as shown in Figure 1-12.

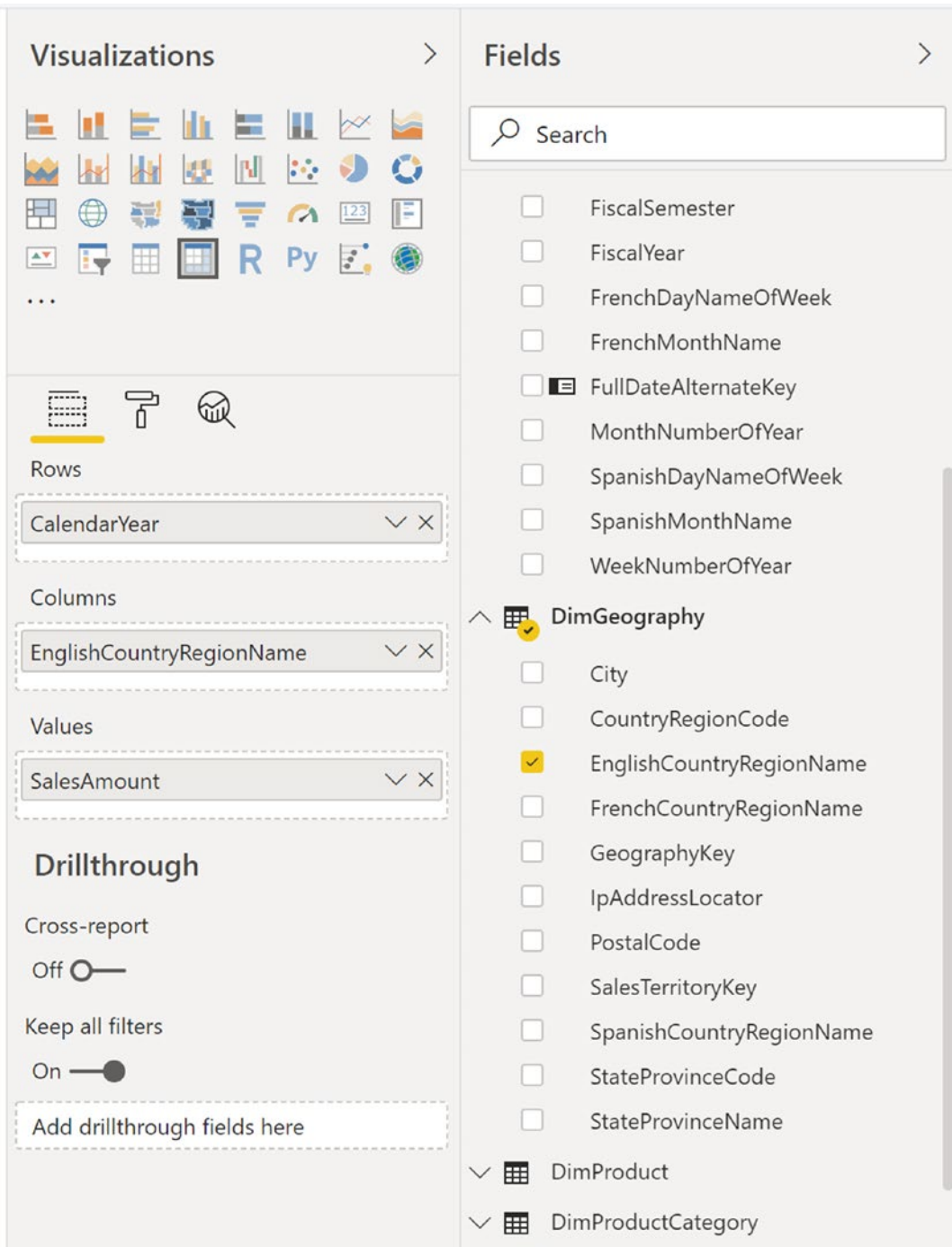


Figure 1-12. The visual properties and field list

9. In the visual properties, there are drop areas for the rows, columns, and values referred to as wells. You drag and drop the fields into these wells to create the matrix.
10. In the Fields list, expand the DimProductCategory table. Find the EnglishProductCategoryName field and drag it to the rows well under the CalendarYear field.
11. In the Visualizations window, select the paint roller icon and expand the Row Headers tab. Turn on the +/- icons for expanding the matrix rows (see Figure 1-13).

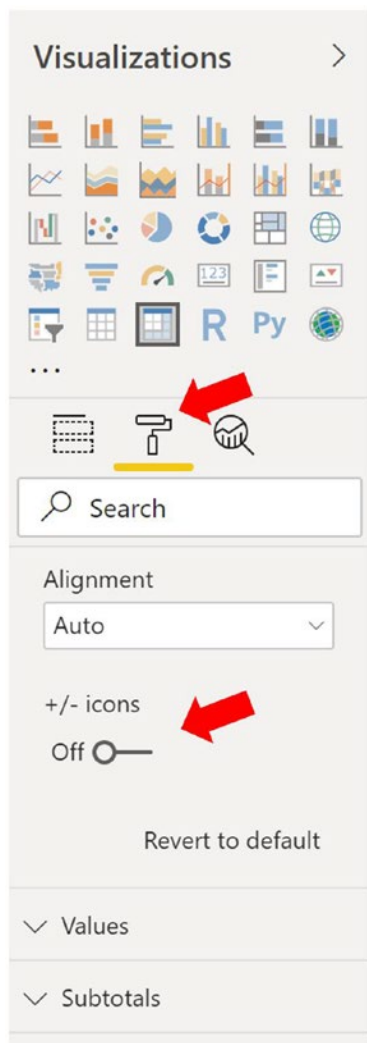


Figure 1-13. Turning on the +/- icons

12. Notice that you can now expand and collapse the matrix (see Figure 1-14). Investigate some of the other format settings available for the matrix.

CalendarYear	Australia	Canada	France	Germany	United Kingdom	United States	Total
2010	\$20,909.78	\$3,578.27	\$3,399.99		\$699.0982	\$14,833.8982	\$43,421.0364
2011	\$2,563,732.2493	\$571,571.7984	\$410,845.326	\$520,500.1642	\$550,591.2186	\$2,458,285.1726	\$7,075,525.9291
2012	\$2,128,407.4551	\$307,604.5237	\$648,065.5383	\$608,657.984	\$712,700.9641	\$1,437,048.73	\$5,842,485.1952
Accessories	\$573.99	\$56.97	\$442.12	\$360.17	\$278.47	\$435.36	\$2,147.08
Bikes	\$2,127,687.0151	\$307,497.5637	\$647,605.4383	\$608,121.864	\$712,341.5341	\$1,436,441.91	\$5,839,695.3252
Clothing	\$146.45	\$49.99	\$17.98	\$175.95	\$80.96	\$171.46	\$642.79
2013	\$4,339,443.38	\$1,085,632.65	\$1,578,511.8	\$1,761,876.36	\$2,124,007.29	\$5,462,078.86	\$16,351,550.34
Accessories	\$132,763.21	\$96,922.04	\$60,599.81	\$59,388.39	\$73,967.62	\$244,600.46	\$668,241.53
Bikes	\$4,139,720.96	\$938,654.76	\$1,491,724.96	\$1,679,892.32	\$2,019,210.81	\$5,090,298.55	\$15,359,502.36
Clothing	\$66,959.21	\$50,055.85	\$26,187.03	\$22,595.65	\$30,828.86	\$127,179.85	\$323,806.45
2014	\$8,507.72	\$9,457.62	\$3,195.06	\$3,277.83	\$3,713.64	\$17,542.85	\$45,694.72
Accessories	\$5,353.43	\$6,398.84	\$2,364.85	\$2,484.03	\$2,383.95	\$11,386.25	\$30,371.35
Clothing	\$3,154.29	\$3,058.78	\$830.21	\$793.8	\$1,329.69	\$6,156.6	\$15,323.37
Total	\$9,061,000.5844	\$1,977,844.8621	\$2,644,017.7143	\$2,894,312.3382	\$3,391,712.2109	\$9,389,789.5108	\$29,358,677.2207

Figure 1-14. Expanding and collapsing rows in a matrix

13. Click on an empty area on the page so that the matrix is not selected. Select the Slicer visual as highlighted in Figure 1-15 and add the EnglishProductCategoryName.

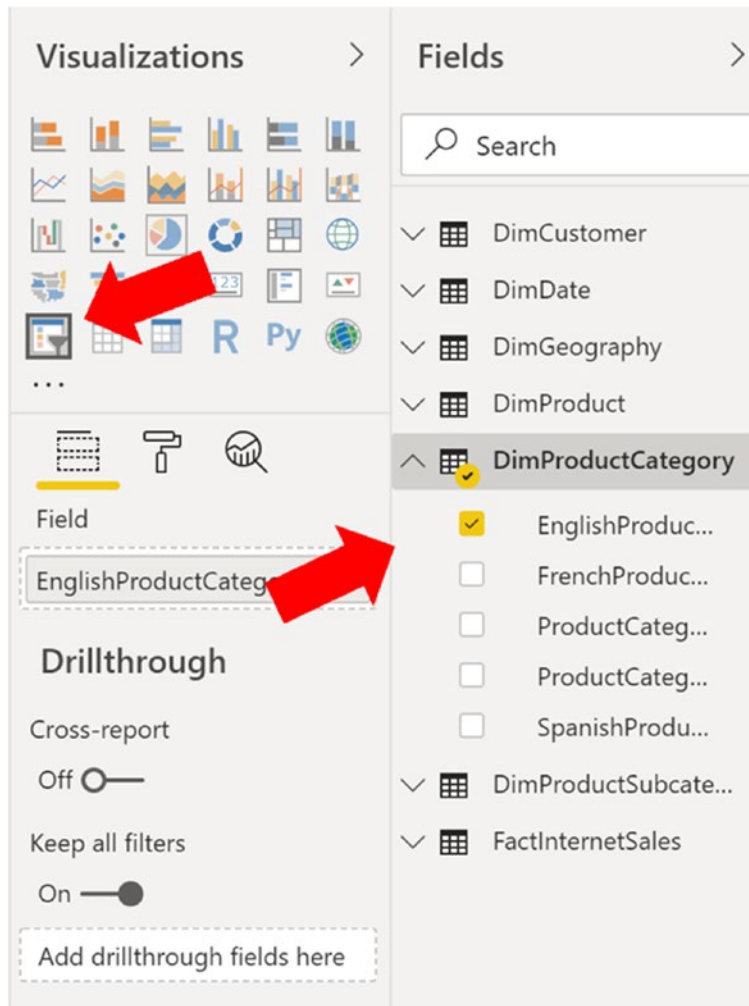


Figure 1-15. Adding a slicer to the report

14. Rearrange the slicer and the matrix on the page and notice selecting categories in the slicer filters the matrix.
15. On the left side of the designer, switch to the Data view (see Figure 1-16).

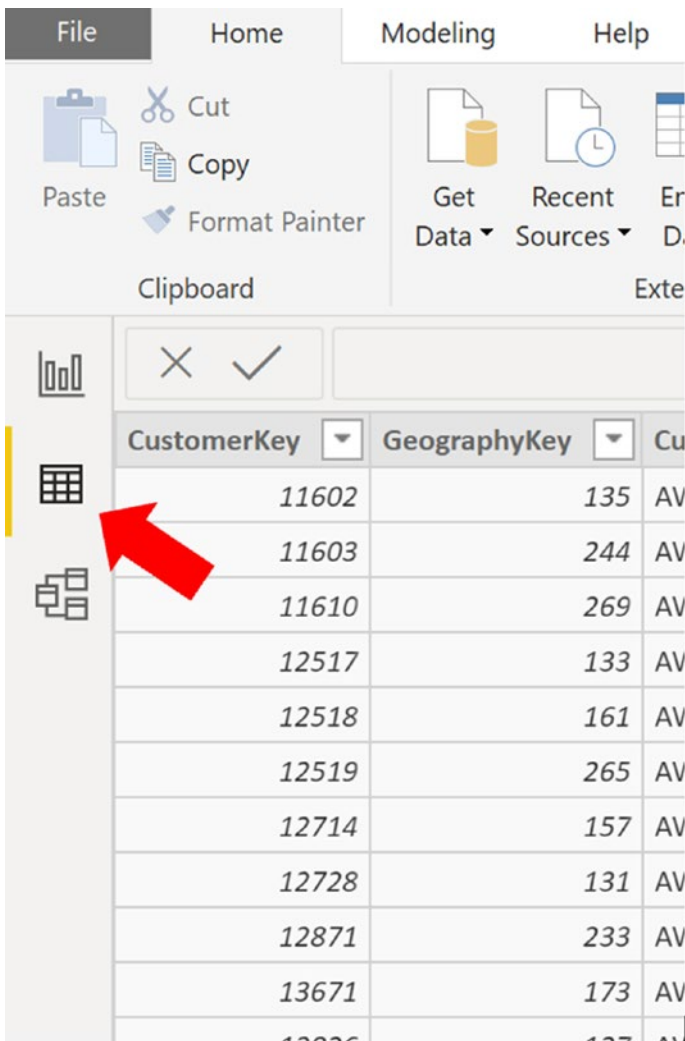


Figure 1-16. Switching to the Data view

16. Explore the data in the different tables using the Fields list on the right side of the designer.
17. Go to the ProductAlternateKey column in the DimProduct table. Notice that it's grayed out. This means it's hidden in the Report view. You can verify this by switching back to the Report view and verifying that you cannot see the field in the field list.