THE EXPERT'S VOICE® IN BIG DATA

Beginning Big Data with Power BI and Excel 2013

Neil Dunlop

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Contents at a Glance

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About the Author

Neil Dunlop is a professor of business and computer information systems at Berkeley City College, Berkeley, California. He served as chairman of the Business and Computer Information Systems Departments for many years. He has more than 35 years' experience as a computer programmer and software designer and is the author of three books on database management. He is listed in Marquis's *Who's Who in America*. Check out his blog at `http://bigdataondesktop.com/`.

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Introduction

This book is intended for anyone with a basic knowledge of Excel who wants to analyze and visualize data in order to get results. It focuses on understanding the underlying structure of data, so that the most appropriate tools can be used to analyze it. The early working title of this book was "Big Data for the Masses," implying that these tools make Business Intelligence (BI) more accessible to the average person who wants to leverage his or her Excel skills to analyze large datasets.

As discussed in Chapter 1, big data is more about volume and velocity than inherent complexity. This book works from the premise that many small- to medium-sized organizations can meet most of their data needs with Excel and Power BI. The book demonstrates how to import big data file formats such as JSON, XML, and HDFS and how to filter larger datasets down to thousands or millions of rows instead of billions.

This book starts out by showing how to import various data formats into Excel (Chapter 2) and how to use Pivot Tables to extract summary data from a single table (Chapter 3). Chapter 5 demonstrates how to use Structured Query Language (SQL) in Excel. Chapter 10 offers a brief introduction to statistical analysis in Excel.

This book primarily covers Power BI—Microsoft's self-service BI tool—which includes the following Excel add-ins:

1. *PowerPivot*. This provides the repository for the data (see Chapter 4) and the DAX formula language (see Chapter 7). Chapter 4 provides an example of processing millions of rows in multiple tables.

2. *Power View*. A reporting tool for extracting meaningful reports and creating some of the elements of dashboards (see Chapter 6).

3. *Power Query*. A tool to Extract, Transform, and Load (ETL) data from a wide variety of sources (see Chapter 8).

4. *Power Map*. A visualization tool for mapping data (see Chapter 9).

Chapter 11 demonstrates how to use HDInsight (Microsoft's implementation of Hadoop that runs on its Azure cloud platform) to import big data into Excel.

This book is written for Excel 2013, but most of the examples it includes will work with Excel 2010, if the PowerPivot, Power View, Power Query, and Power Map add-ins are downloaded from Microsoft. Simply search on download and the add-in name to find the download link.

■ **Disclaimer** All links and screenshots were current at the time of writing but may have changed since publication. The author has taken all due care in describing the processes that were accurate at the time of writing, but neither the author nor the publisher is liable for incidental or consequential damages arising from the furnishing or performance of any information or procedures.

CHAPTER 1

Big Data

The goal of business today is to unlock intelligence stored in data. We are seeing a confluence of trends leading to an exponential increase in available data, including cheap storage and the availability of sensors to collect data. Also, the Internet of Things, in which objects interact with other objects, will generate vast amounts of data.

Organizations are trying to extract intelligence from unstructured data. They are striving to break down the divisions between silos. Big data and NoSQL tools are being used to analyze this avalanche of data.

Big data has many definitions, but the bottom line involves extracting insights from large amounts of data that might not be obvious, based on smaller data sets. It can be used to determine which products to sell, by analyzing buying habits to predict what products customers want to purchase. This chapter will cover the evolution of data analysis tools from early primitive maps and graphs to the big data tools of today.

Big Data As the Fourth Factor of Production

Traditional economics, based on an industrial economy, teaches that there are three factors of production: land, labor, and capital. The December 27, 2012, issue of the *Financial Times* included an article entitled "Why 'Big Data' is the fourth factor of production," which examines the role of big data in decision making. According to the article "As the prevalence of Big Data grows, executives are becoming increasingly wedded to numerical insight. But the beauty of Big Data is that it allows both intuitive and analytical thinkers to excel. More entrepreneurially minded, creative leaders can find unexpected patterns among disparate data sources (which might appeal to their intuitive nature) and ultimately use the information to alter the course of the business."

Big Data As Natural Resource

IBM's CEO Virginia Rometty has been quoted as saying "Big Data is the world's natural resource for the next century." She also added that data needs to be refined in order to be useful. IBM has moved away from hardware manufacturing and invested $30 billion to enhance its big data capabilities.

Much of IBM's investment in big data has been in the development of Watson—a natural language, question-answering computer. Watson was introduced as a *Jeopardy!* player in 2011, when it won against previous champions. It has the computing power to search 1 million books per second. It can also process colloquial English.

One of the more practical uses of Watson is to work on cancer treatment plans in collaboration with doctors. To do this, Watson received input from 2 million pages of medical journals and 600,000 clinical records. When a doctor inputs a patient's symptoms, Watson can produce a list of recommendations ranked in order of confidence of success.

Data As Middle Manager

An April 30, 2015, article in the *Wall Street Journal* by Christopher Mims entitled “Data Is Now the New Middle Manager” describes how some startup companies are substituting data for middle managers. According to the article “Startups are nimbler than they have ever been, thanks to a fundamentally different management structure, one that pushes decision-making out to the periphery of the organization, to the people actually tasked with carrying out the actual business of the company. What makes this relatively flat hierarchy possible is that front line workers have essentially unlimited access to data that used to be difficult to obtain, or required more senior management to interpret.” The article goes on to elaborate that when databases were very expensive and business intelligence software cost millions of dollars, it made sense to limit access to top managers. But that is not the case today. Data scientists are needed to validate the accuracy of the data and how it is presented. Mims concludes “Now that every employee can have tools to monitor progress toward any goal, the old role of middle managers, as people who gather information and make decisions, doesn’t fit into many startups.”

Early Data Analysis

Data analysis was not always sophisticated. It has evolved over the years from the very primitive to where we are today.

First Time Line

In 1765, the theologian and scientist Joseph Priestley created the first time line charts, in which individual bars were used to compare the life spans of multiple persons, such as in the chart shown in Figure 1-1.

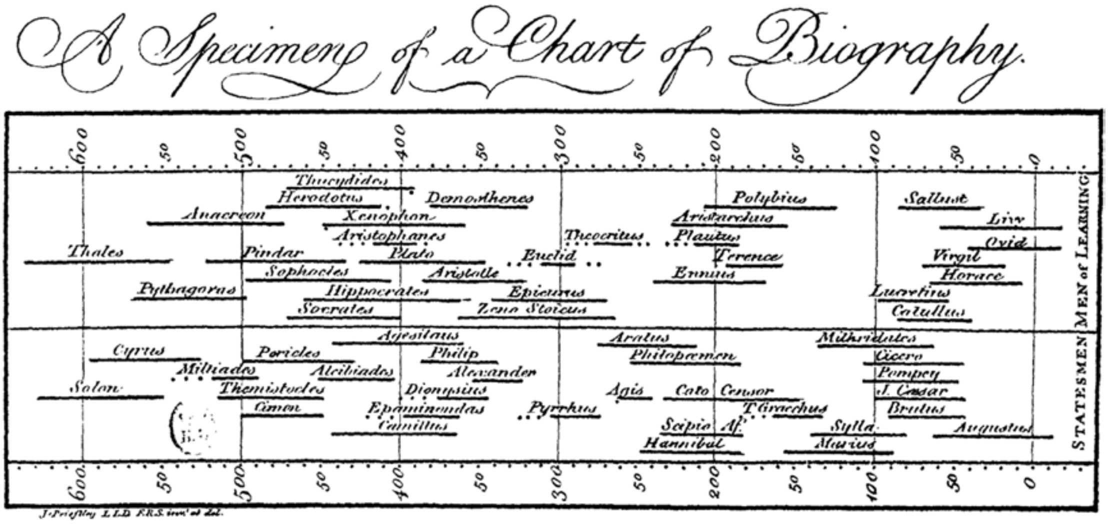


Figure 1-1. *An early time line chart*

First Bar Chart and Time Series

The Scottish engineer William Playfair has been credited with inventing the line, bar, and pie charts. His time-series plots are still presented as models of clarity. Playfair first published *The Commercial and Political Atlas* in London in 1786. It contained 43 time-series plots and one bar chart. It has been described as the first major work to contain statistical graphs. Playfair's *Statistical Breviary*, published in London in 1801, contains what is generally credited as the first pie chart. One of Playfair's time-series charts showing the balance of trade is shown in Figure 1-2.

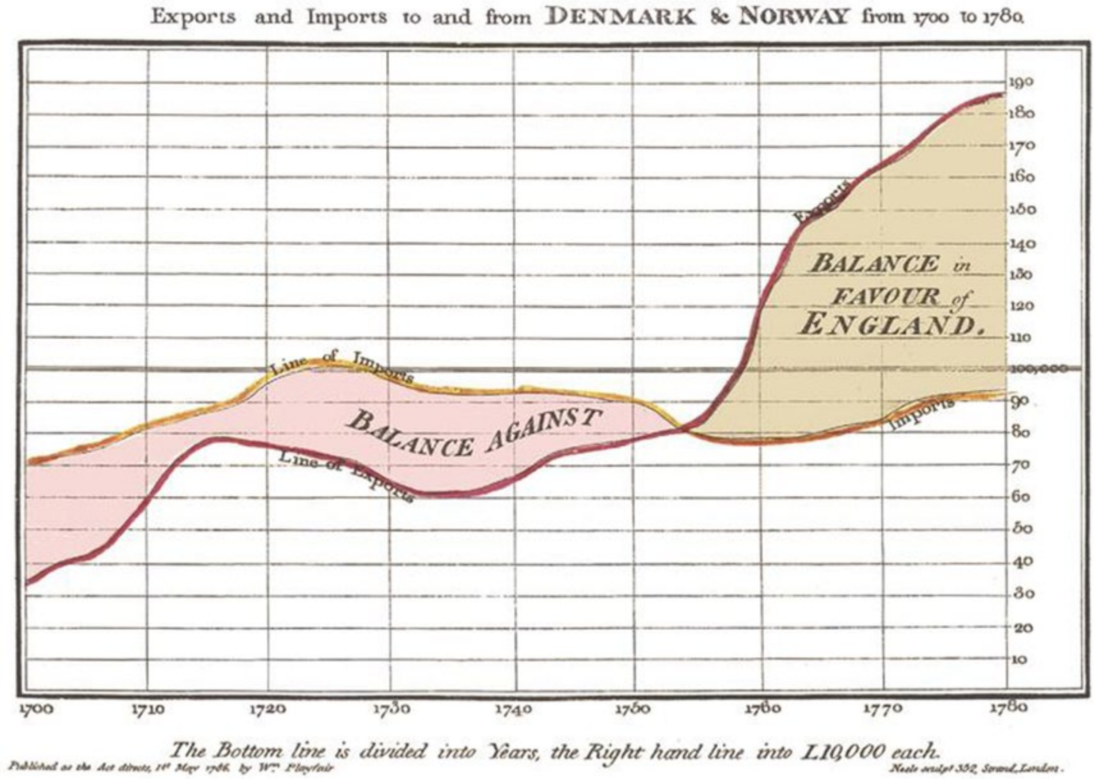


Figure 1-2. *Playfair's balance-of-trade time-series chart*

Cholera Map

In 1854, the physician John Snow mapped the incidence of cholera cases in London to determine the linkage to contaminated water from a single pump, as shown in Figure 1-3. Prior to that analysis, no one knew what caused cholera. This is believed to be the first time that a map was used to analyze how disease is spread.

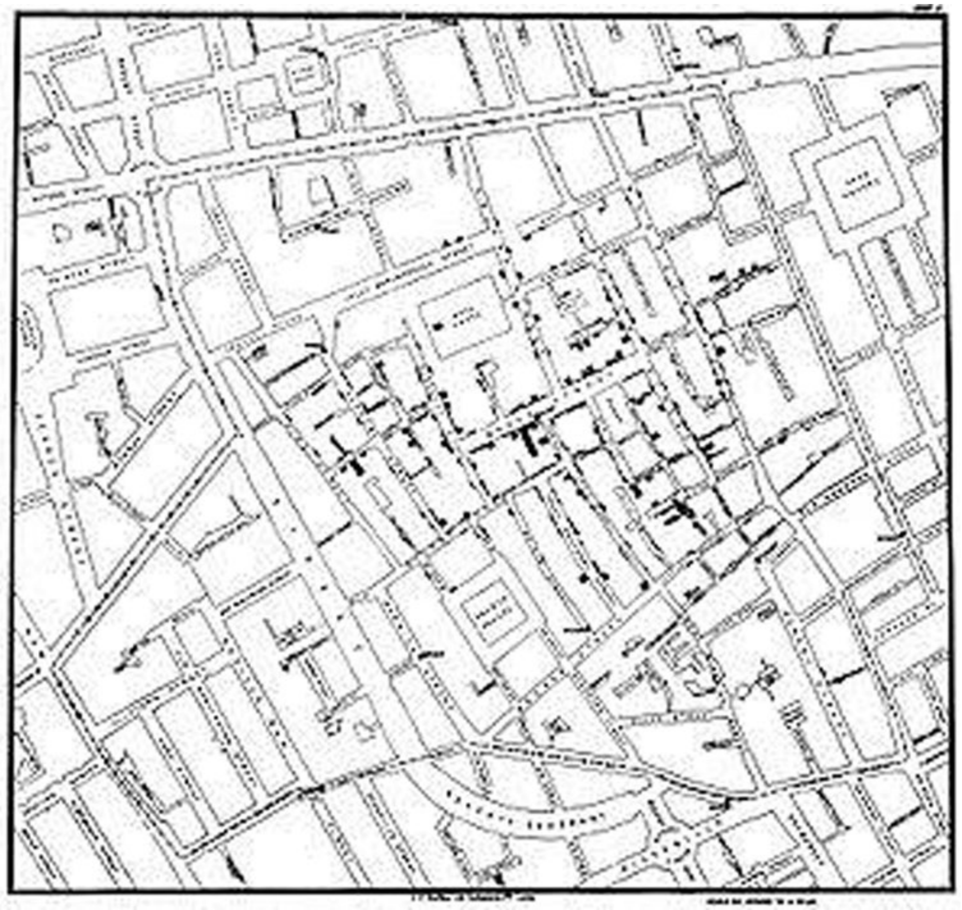


Figure 1-3. *Cholera map*

Modern Data Analytics

The Internet has opened up vast amounts of data. Google and other Internet companies have designed tools to access that data and make it widely available.

Google Flu Trends

In 2009, Google set up a system to track flu outbreaks based on flu-related searches. When the H1N1 crisis struck in 2009, Google's system proved to be a more useful and timely indicator than government statistics with their natural reporting lags *(Big Data* by Viktor Mayer-Schonberger and Kenneth Cukier [Mariner Books, 2013]). However, in 2012, the system overstated the number of flu cases, presumably owing to media attention about the flu. As a result, Google adjusted its algorithm.

Google Earth

The precursor of Google Earth was developed in 2005 by the computer programmer Rebecca Moore, who lived in the Santa Cruz Mountains in California, where a timber company was proposing a logging operation that was sold as fire prevention. Moore used Google Earth to demonstrate that the logging plan would remove forests near homes and schools and threaten drinking water.

Tracking Malaria

A September 10, 2014, article in the *San Francisco Chronicle* reported that a team at the University of California, San Francisco (UCSF) is using Google Earth to track malaria in Africa and to track areas that may be at risk for an outbreak. According to the article, "The UCSF team hopes to zoom in on the factors that make malaria likely to spread: recent rainfall, plentiful vegetation, low elevations, warm temperatures, close proximity to rivers, dense populations." Based on these factors, potential malaria hot spots are identified.

Big Data Cost Savings

According to a July 1, 2014, article in the *Wall Street Journal* entitled "Big Data Chips Away at Cost," Chris Iervolino, research director at the consulting firm Gartner Inc., was quoted as saying "Accountants and finance executives typically focus on line items such as sales and spending, instead of studying the relationships between various sets of numbers. But the companies that have managed to reconcile those information streams have reaped big dividends from big data."

Examples cited in the article include the following:

- Recently, General Motors made a decision to stop selling Chevrolets in Europe based on an analysis of costs compared to projected sales, based on analysis that took a few days rather than many weeks.
- Planet Fitness has been able to analyze the usage of their treadmills based on their location in reference to high-traffic areas of the health club and to rotate them to even out wear on the machines.

Big Data and Governments

Governments are struggling with limited money and people but have an abundance of data. Unfortunately, most governmental organizations don't know how to utilize the data that they have to get resources to the right people at the right time.

The US government has made an attempt to disclose where its money goes through the web site USAspending.gov. The city of Palo Alto, California, in the heart of Silicon Valley, makes its data available through its web site data.cityofpaloalto.org. The goal of the city's use of data is to provide agile, fast government. The web site provides basic data about city operations, including when trees are planted and trimmed.

Predictive Policing

Predictive policing uses data to predict where crime might occur, so that police resources can be allocated with maximum efficiency. The goal is to identify people and locations at increased risk of crime.

A Cost-Saving Success Story

A January 24, 2011, *New Yorker* magazine article described how 30-something physician Jeffrey Brenner mapped crime and medical emergency statistics in Camden, New Jersey, to devise a system that would cut costs, over the objections of the police. He obtained medical billing records from the three main hospitals and crime statistics. He made block-by-block maps of the city, color-coded by the hospital costs of the residents. He found that the two most expensive blocks included a large nursing home and a low-income housing complex. According to the article, "He found that between January 2002 and June of 2008 some nine hundred people in the two buildings accounted for more than four thousand hospital visits and about two hundred million dollars in health-care bills. One patient had three hundred and twenty-four admissions in five years. The most expensive patient cost insurers $3.5 million." He determined that 1% of the patients accounted for 30% of the costs.

Brenner's goal was to most effectively help patients while cutting costs. He tried targeting the sickest patients and providing preventative care and health monitoring, as well as treatment for substance abuse, to minimize emergency room visits and hospitalization. He set up a support system involving a nurse practitioner and a social worker to support the sickest patients. Early results of this approach showed a 56% cost reduction.

Internet of Things or Industrial Internet

The Internet of Things refers to machine to machine (M2M) communication involving networked connectivity between devices, such as home lighting and thermostats. CISCO Systems uses the term *Internet of Everything*.

An article in the July/August 2014 issue of *Fast Company* magazine described how General Electric Corporation (GE) is using the term *Industrial Internet*, which involves putting intelligence into machines to collect and analyze their data in order to predict failure, so that problems can be anticipated and corrected. One example is the GE jet engine. GE plans to use data generated from engines to predict when an engine part requires repairs, so that the problem can be corrected before a failure occurs. GE's assumption is that small gains in productivity and reliability can drive massive economic benefits.

GE is also working on trip-optimizer, an intelligent cruise control for locomotives, which use trains' geographical location, weight, speed, fuel consumption, and terrain to calculate the optimal velocity to minimize fuel consumption.

Cutting Energy Costs at MIT

An article in the September 28, 2014, *Wall Street Journa*l entitled "Big Data Cuts Buildings' Energy Use" describes how cheap sensors are allowing collection of real-time data on how energy is being consumed. For example, the Massachusetts Institute of Technology (MIT) has an energy war room in which energy use in campus buildings is monitored. Energy leaks can be detected and corrected.

The Big Data Revolution and Health Care

An April 2013 report from McKinsey & Company entitled "The big-data revolution in US health care: Accelerating value and innovation" describes how a big data revolution is occurring in health care, based on pharmaceutical companies aggregating years of research into medical databases and health care providers digitizing patient records. There is a trend toward evidence-based medicine based on data. Big data algorithms are being used to provide the best evidence.

Health care spending currently accounts for more than 17% of US gross domestic product (GDP). McKinsey estimates that implementation of these big data strategies in health care could reduce health expenses in the United States by 12% to 17%, saving between $300 billion to $450 billion per year.

"Biological research will be important, but it feels like data science will do more for medicine than all the biological sciences combined," according to the venture capitalist Vinod Khosla, speaking at the Stanford University School of Medicine's Big Data in Biomedicine Conference (quoted in the *San Francisco Chronicle*, May 24, 2014). He went on to say that human judgment cannot compete against machine learning systems that derive predictions from millions of data points. He further predicted that technology will replace 80%–90% of doctors' roles in decision making.

The Medicalized Smartphone

A January 10, 2015, *Wall Street Journal* article reported that "the medicalized smartphone is going to upend every aspect of health care." Attachments to smartphones are being developed that can measure blood pressure and even perform electrocardiograms. Wearable wireless sensors can track blood-oxygen and glucose levels, blood pressure, and heart rhythm. Watches will be coming out that can continually capture blood pressure and other vital signs. The result will be much more data and the potential for virtual physician visits to replace physical office visits.

In December 2013, IDC Health Insights released a report entitled "U.S. Connected Health 2014 Top 10 Predictions: The New Care Delivery Model" that predicts a new health care delivery model involving mobile health care apps, telehealth, and social networking that will provide "more efficient and cost-effective ways to provide health care outside the four walls of the traditional healthcare setting." According to the report, these changes will rely on four transformative technologies:

1. Mobile
2. Big data analytics
3. Social
4. Cloud

The report cites the Smartphone Physical project at Johns Hopkins. It uses "a variety of smartphone-based medical devices that can collect quantitative or qualitative data that is clinically relevant for a physical examination such as body weight, blood pressure, heart rate, blood oxygen saturation, visual acuity, optic disc and tympanic membrane images, pulmonary function values, electrocardiogram, heart and lung sounds and ultrasound visualization (such as carotid artery imaging)."

According to the report, "With greater consumer uptake of mobile health, personal health, and fitness modeling, and social technologies, there will be a proliferation of consumer data across diverse data sources that will yield rich information about consumers."

A May 2011 paper by McKinsey & Company entitled "Big data: The next frontier for innovation, competition, and productivity" posits five ways in which using big data can create value, as follows:

1. Big data can unlock significant value by making information transparent and usable in much higher frequency.
2. As organizations create and store more transactional data in digital form, they can collect more accurate and detailed performance information on everything from product inventories to sick days, and therefore boost performance.
3. Big data allows ever-narrower segmentation of customers and, therefore, much more precisely tailored products or services.
4. Sophisticated analytics can substantially improve decision making.
5. Big data can be used to improve the development of the next generation of products and services.

Improving Reliability of Industrial Equipment

General Electric (GE) has made implementing the Industrial Internet a top priority, in order to improve the reliability of industrial equipment such as jet engines. The company now collects 50 million data points each day from 1.4 million pieces of medical equipment and 28,000 jet engines. The goal is to improve the reliability of the equipment. GE has developed Predix, which can be used to analyze data generated by other companies to build and deploy software applications.

Big Data and Agriculture

The goal of precision agriculture is to increase agricultural productivity to generate enough food as the population of the world increases. Data is collected on soil and air quality, elevation, nitrogen in soil, crop maturity, weather forecasts, equipment, and labor costs. The data is used to determine when to plant, irrigate, fertilize, and harvest. This is achieved by installing sensors to measure temperature and the humidity of soil. Pictures are taken of fields that show crop maturity. Predictive weather modeling is used to plan when to irrigate and harvest. The goal is to increase crop yields, decrease costs, save time, and use less water.

Cheap Storage

In the early 1940s, before physical computers came into general use, *computer* was a job title. The first wave of computing was about speeding up calculations. In 1946, the Electrical Numerical Integrator and Computer (ENIAC)—the first general purpose electronic computer—was installed at the University of Pennsylvania. The ENIAC, which occupied an entire room, weighed 30 tons, and used more than 18,000 vacuum tubes, had been designed to calculate artillery trajectories. However, World War II was over by 1946, so the computer was then used for peaceful applications.

Personal Computers and the Cost of Storage

Personal computers came into existence in the 1970s with Intel chips and floppy drives for storage and were used primarily by hobbyists. In August 1981, the IBM PC was released with 5¼-inch floppy drives that stored 360 kilobytes of data. The fact that IBM, the largest computer company in the world, released a personal computer was a signal to other companies that the personal computer was a serious tool for offices. In 1983, IBM released the IBM-XT, which had a 10 megabyte hard drive that cost hundreds of dollars. Today, a terabyte hard drive can be purchased for less than $100. Multiple gigabyte flash drives can be purchased for under $10.

Review of File Sizes

Over the history of the personal computer, we have gone from kilobytes to megabytes and gigabytes and now terabytes and beyond, as storage needs have grown exponentially. Early personal computers had 640 kilobytes of RAM. Bill Gates, cofounder of Microsoft Corporation, reportedly said that no one would ever need more than 640 kilobytes. Versions of Microsoft's operating system MS-DOS released during the 1980s could only address 640 kilobytes of RAM. One of the selling points of Windows was that it could address more than 640 kilobytes. Table 1-1 shows how data is measured.

***Table 1-1.** Measurement of Storage Capacity*

Unit	Power of 2	Approximate Number
Kilobytes	2^10	Thousands
Megabytes	2^20	Millions
Gigabytes	2^30	Billions
Terabytes	2^40	Trillions
Petabytes	2^50	Quadrillions
Exabytes	2^60	Sextillions
Zettabytes	2^70	Septillions

Data Keeps Expanding

The New York Stock Exchange generates 4 to 5 terabytes of data every day. IDC estimates that the digital universe was 4.4 petabytes in 2013 and is forecasting a tenfold increase by 2920, to 44 zettabytes.

We are also dealing with exponential growth in Internet connections. According to CISCO Systems, the 15 billion worldwide network connections today are expected to grow to 50 billion by 2020.

Relational Databases

As computers became more and more widely available, more data was stored, and software was needed to organize that data. Relational database management systems (RDBMS) are based on the relational model developed by E. F. Codd at IBM in the early 1970s. Even though the early work was done at IBM, the first commercial RDBMS were released by Oracle in 1979.

A relational database organizes data into tables of rows and columns, with a unique key for each row, called the primary key. A database is a collection of tables. Each entity in a database has its own table, with the rows representing instances of that entity. The columns store values for the attributes or fields.

Relational algebra, first described by Codd at IBM, provides a theoretical foundation for modeling the data stored in relational databases and defining queries. Relational databases support selection, projection, and joins. *Selection* means selecting specified rows of a table based on a condition. *Projection* entails selecting certain specified columns or attributes. *Joins* means joining two or more tables, based on a condition.

As discussed in Chapter 5, Structured Query Language (SQL) was first developed by IBM in the early 1970s. It was used to manipulate and retrieve data from early IBM relational database management systems (RDBMS). It was later implemented in other relational database management systems by Oracle and later Microsoft.

Normalization

Normalization is the process of organizing data in a database with the following objectives:

1. To avoid repeating fields, except for key fields, which link tables
2. To avoid multiple dependencies, which means avoiding fields that depend on anything other than the primary key

There are several normal forms, the most common being the Third Normal Form (3NF), which is based on eliminating transitive dependencies, meaning eliminating fields not dependent on the primary key. In other words, data is in the 3NF when each field depends on the primary key, the whole primary key, and nothing but the primary key.

Figure 1-4, which is the same as Figure 4-11, shows relationships among multiple tables. The lines with arrows indicate relationships between tables. There are three primary types of relationships.

1. One to one (1-1) means that there is a one-to-one correspondence between fields. Generally, fields with a one-to-one correspondence would be in the same table.
2. One to many means that for each record in one table, there are many records in the corresponding table. The many is indicated by an arrow at the end of the line. Many means zero to n. For example, as shown in Figure 1-4, for each product code in the products table, there could be many instances of Product ID in the order details table, but each Product ID is associated with only one product code in the products table.
3. Many to many means a relationship from many of one entity to many of another entity. For example, authors and books: Each author can have many books, and each book can have many authors. Many means zero to n.

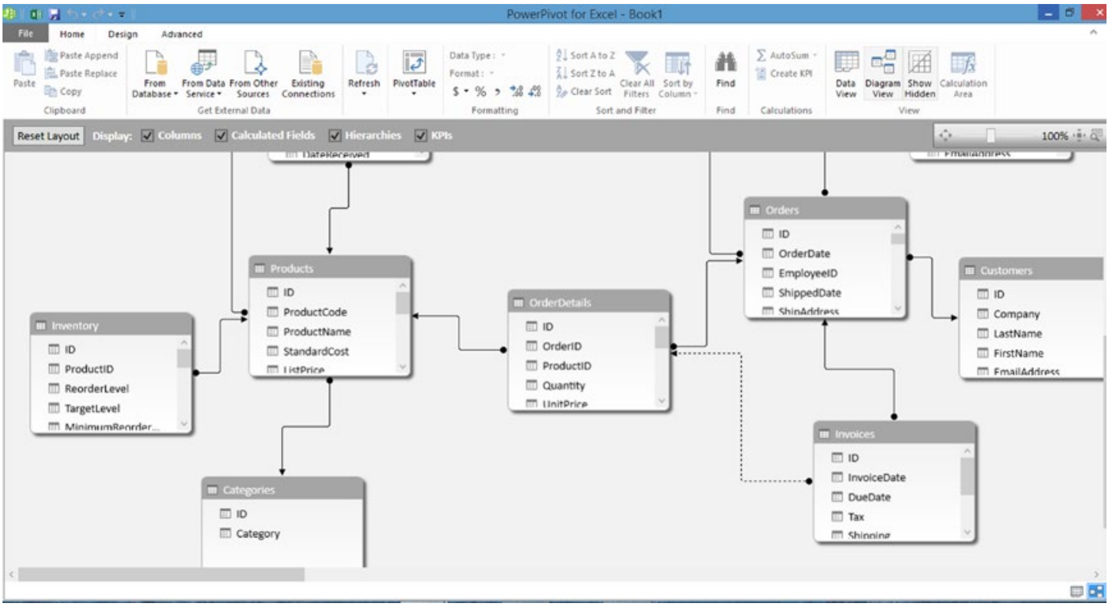


Figure 1-4. *Showing relations among tables*

Database Software for Personal Computers

In the 1980s, database programs were developed for personal computers, as they became more widely used. dBASE II, one of the first relational programmable database systems for personal computers, was developed by Wayne Ratliff at the Jet Propulsion Lab (JPL) in Pasadena, California. In the early 1980s, he partnered with George Tate to form the Ashton-Tate company to market dBASE II, which became very successful. In the mid-1980s, dBASE III was released with enhanced features.

dBASE programs were interpreted, meaning that they ran more slowly than a compiled program, where all the instructions are translated to machine language at once. Clipper was released in 1985 as a compiled version of dBASE and became very popular. A few years later, FoxBase, which later became FoxPro, was released with additional enhanced features.

The Birth of Big Data and NoSQL

The Internet was popularized during the 1990s, owing in part to the World Wide Web, which made it easier to use. Competing search engines allowed users to easily find data. Google was founded in 1996 and revolutionized search. As more data became available, the limitations of relational databases, which tried to fit everything into rectangular tables, became clear.

In 1998, Carlo Strozzi used the term *NoSQL*. He reportedly later regretted using that term and thought that *NoRel*, or non-relational, would have been a better term.

Hadoop Distributed File System (HDFS)

Much of the technology of big data came out of the search engine companies. Hadoop grew out of Apple Nutch, an open source web search engine that was started in 2002. It included a web crawler and search engine, but it couldn't scale to handle billions of web pages.

A paper was published in 2003 that described the architecture of Google's Distributed File System (GFS), which was being used by Google to store the large files generated by web crawling and indexing. In 2004, an open source version was released as the Nutch Distributed File System (NDFS).

In 2004, Google published a paper about MapReduce. By 2005, MapReduce had been incorporated into Nutch. MapReduce is a batch query process with the ability to run ad hoc queries against a large dataset. It unlocks data that was previously archived. Running queries can take several minutes or longer.

In February 2006, Hadoop was set up as an independent subproject. Building on his prior work with Mike Cafarella, Doug Cutting went to work for Yahoo!, which provided the resources to turn Hadoop into a system that could be a useful tool for the Web. By 2008, Yahoo! based its search index on a Hadoop cluster. Hadoop was titled based on the name that Doug Cutting's child gave a yellow stuffed elephant. Hadoop provides a reliable, scalable platform for storage and analysis running on cheap commodity hardware. Hadoop is open source.

Big Data

There is no single definition of big data, but there is currently a lot of hype surrounding it, so the meaning can be diluted. It is generally accepted to mean large volumes of data with an irregular structure involving hundreds of terabytes of data into petabytes and higher. It can include data from financial transactions, sensors, web logs, and social media. A more operational definition is that organizations have to use big data when their data processing needs get too big for traditional relational databases.

Big data is based on the feedback economy where the Internet of Things places sensors on more and more equipment. More and more data is being generated as medical records are digitized, more stores have loyalty cards to track consumer purchases, and people are wearing health-tracking devices. Generally, big data is more about looking at behavior, rather than monitoring transactions, which is the domain of traditional relational databases. As the cost of storage is dropping, companies track more and more data to look for patterns and build predictive models.

The Three V's

One way of characterizing big data is through the three V's:

1. *Volume*: How much data is involved?
2. *Velocity*: How fast is it generated?
3. *Variety*: Does it have irregular structure and format?

Two other V's that are sometimes used are

1. *Variability*: Does it involve a variety of different formats with different interpretations?
2. *Veracity*: How accurate is the data?

The Data Life Cycle

The data life cycle involves collecting and analyzing data to build predictive models, following these steps:

1. Collect the data.
2. Store the data.
3. Query the data to identify patterns and make sense of it.
4. Use visualization tools to find the business value.
5. Predict future consumer behavior based on the data.

Apache Hadoop

Hadoop is an open source software framework written in Java for distributed storage and processing of very large datasets stored on commodity servers. It has built-in redundancy to handle hardware failures. Hadoop is based on two main technologies: MapReduce and the Hadoop Distributed File System (HDFS). Hadoop was created by Doug Cutting and Mike Cafarella in 2005.

MapReduce Algorithm

MapReduce was developed at Google and released through a 2004 paper describing how to use parallel processing to deal with large amounts of data. It was later released into the public domain. It involves a two-step batch process.

1. First, the data is partitioned and sent to mappers, which generate key value pairs.
2. The key value pairs are then collated, so that the values for each key are together, and then the reducer processes the key value pairs to calculate one value per key.

One example that is often cited is a word count. It involves scanning through a manuscript and counting the instances of each word. In this example, each word is a key, and the number of times each word is used is the value.

Hadoop Distributed File System (HDFS)

HDFS is a distributed file system that runs on commodity servers. It is based on the Google File System (GFS). It splits files into blocks and distributes them among the nodes of the cluster. Data is replicated so that if one server goes down, no data is lost. The data is immutable, meaning that tables cannot be edited; it can only be written to once, like CD-R, which is based on write once read many. New data can be appended to an existing file, or the old file can be deleted and the new data written to a new file. HDFS is very expandable, by adding more servers to handle more data.

Some implementations of HDFS are append only, meaning that underlying tables cannot be edited. Instead, writes are logged, and then the file is re-created.

Commercial Implementations of Hadoop

Hadoop is an open source Apache project, but several companies have developed their own commercial implementations. Hortonworks, which was founded by Doug Cutting and other former Yahoo! employees, is one of those companies that offers a commercial implementation. Other such companies include Cloudera and MapR. Another Hadoop implementation is Microsoft's HD Insight, which runs on the Azure cloud platform. An example in Chapter 11 shows how to import an HD Insight database into Power Query.

CAP Theorem

An academic way to look at NoSQL databases includes the CAP Theorem. CAP is an acronym for Consistency, Availability, and Partition Tolerance. According to this theorem, any database can only have two of those attributes. Relational databases have consistency and partition tolerance. Large relational databases are weak on availability, because they have low latency when they are large. NoSQL databases offer availability and partition tolerance but are weak on consistency, because of a lack of fixed structure.

NoSQL

As discussed elsewhere in this book, NoSQL is a misnomer. It does not mean "no SQL." A better term for this type of database might be *non-relational.* NoSQL is designed to access data that has no relational structure, with little or no schema. Early versions of NoSQL required a programmer to write a custom program to retrieve that data. More and more implementations of NoSQL databases today implement some form of SQL for retrieval of data. A May 29, 2015, article on Data Informed by Timothy Stephan entitled "What NoSQL Needs Most Is SQL" (`http://data-informed.com/what-nosql-needs-most-is-sql/`) makes the case for more SQL access to NoSQL databases.

NoSQL is appropriate for "web scale" data, which is based on high volumes with millions of concurrent users.

Characteristics of NoSQL Data

NoSQL databases are used to access non-relational data that doesn't fit into relational tables. Generally, relational databases are used for mission-critical transactional data. NoSQL databases are typically used for analyzing non-mission-critical data, such as log files.

Implementations of NoSQL

There are several categories of NoSQL databases:

- *Key-Value Stores*: This type of database stores data in rows, but the schema may differ from row to row. Some examples of this type of NoSQL database are Couchbase, Redis, and Riak.
- *Document Stores*: This type of database works with documents that are JSON objects. Each document has properties and values. Some examples are CouchDB, Cloudant, and MongoDB.
- *Wide Column Stores*: This type of database has column families that consist of individual column of key-value pairs. Some example of this type of database are HBase and Cassandra.
- *Graph*: Graph databases are good for social network applications. They have nodes that are like rows in a table. Neo4j is an example of this type of database.

One product that allows accessing data from Hadoop is Hive, which provides an SQL-like language called HiveQL for querying Hadoop. Another product is Pig, which uses Pig Latin for querying. The saying is that 10 lines of Pig Latin do the work of 200 lines of Java.

Spark

Another technology that is receiving a lot of attention is Apache Spark—an open source cluster computing framework originally developed at UC Berkeley in 2009. It uses an in-memory technology that purportedly provides performance up to 100 times faster than Hadoop. It offers Spark SQL for querying. IBM recently announced that it will devote significant resources to the development of Spark.

Microsoft Self-Service BI

Most of these big data and NoSQL technologies came out of search engine and online retailers that process vast amounts of data. For the smaller to medium-size organizations that are processing thousands or millions of rows of data, this book shows how to tap into Microsoft's Power BI running on top of Excel.

Much has been written about the maximum number of rows that can be loaded into PowerPivot. The following link to a blog post at Microsoft Trends documents loading 122 million records: `www.microsofttrends.com/2014/02/09/how-much-data-can-powerpivot-really-manage-how-about-122-million-records`.

Summary

This chapter provides a brief history of the evolution of data analysis, culminating with the big data tools of today. It covers the evolution of data structures, from relational databases to the less structured data that NoSQL addresses.

CHAPTER 2

Excel As Database and Data Aggregator

Spreadsheets have a long history of making data accessible to ordinary people. This chapter chronicles the evolution of Excel from spreadsheet to powerful database. It then shows how to import data from a variety of sources. Subsequent chapters will demonstrate how Excel with Power BI is now a powerful Business Intelligence tool.

From Spreadsheet to Database

The first spreadsheet program, VisiCalc (a contraction of *visible calculator*), was released in 1979 for the Apple II computer. It was the first "killer app." A saying at the time was that "VisiCalc sold more Apples than Apple." VisiCalc was developed by Dan Bricklin and Bob Franken. Bricklin was attending Harvard Business School and came up with the idea for the program after seeing a professor manually write out a financial model. Whenever the professor wanted to make a change, he had to erase the old data and rewrite the new data. Bricklin realized that this process could be automated, using an electronic spreadsheet running on a personal computer.

In those days, most accounting data was trapped in mainframe programs that required a programmer to modify or access. For this reason, programmers were called the "high priests" of computing, meaning that end users had little control over how programs worked. VisiCalc was very easy to use for a program of that time. It was also very primitive, compared to the spreadsheets of today. For example, all columns had to be the same width in the early versions of VisiCalc.

Success breeds competition. VisiCalc did not run on CP/M computers, which were the business computers of the day. CP/M, an acronym originally for *Control Program/Monitor*, but that later came to mean "Control Program for Microcomputers," was an operating system used in the late 1970s and early 1980s. In 1980, Sorcim came out with SuperCalc as the spreadsheet for CP/M computers. Microsoft released Multiplan in 1982. All of the spreadsheets of the day were menu-driven.

When the IBM PC was released in August 1981, it was a signal to other large companies that the personal computer was a serious tool for big business. VisiCalc was ported to run on the IBM PC but did not take into account the enhanced hardware capabilities of the new computer.

Seeing an opportunity, entrepreneur Mitch Kapor, a friend of the developers of VisiCalc, founded Lotus Development to write a spreadsheet specifically for the IBM PC. He called his spreadsheet program Lotus 1-2-3. The name 1-2-3 indicated that it took the original spreadsheet functionality and added the ability to create graphic charts and perform limited database functionality such as simple sorts.

Lotus 1-2-3 was the first software program to be promoted through television advertising. Lotus 1-2-3 became popular hand-in-hand with the IBM PC, and it was the leading spreadsheet through the early 1990s.

Microsoft Excel was the first spreadsheet using the graphical user interface that was popularized by the Apple Macintosh. Excel was released in 1987 for the Macintosh. It was later ported to Windows. In the early 1990s, as Windows became popular, Microsoft packaged Word and Excel together into Microsoft Office and priced it aggressively. As a result, Excel displaced Lotus 1-2-3 as the leading spreadsheet. Today, Excel is the most widely used spreadsheet program in the world.

More and more analysis features, such as Pivot Tables, were gradually introduced into Excel, and the maximum number of rows that could be processed was increased. Using VLOOKUP, it was possible to create simple relations between tables. For Excel 2010, Microsoft introduced PowerPivot as a separate download, which allowed building a data model based on multiple tables. PowerPivot ships with Excel 2013. Chapter 4 will discuss how to build data models using PowerPivot.

Interpreting File Extensions

The file extension indicates the type of data that is stored in a file. This chapter will show how to import a variety of formats into Excel's native `.xlsx` format, which is required to use the advanced features of Power BI discussed in later chapters. This chapter will deal with files with the following extensions:

`.xls`: Excel workbook prior to Excel 2007

`.xlsx`: Excel workbook Excel 2007 and later; the second x was added to indicate that the data is stored in XML format

`.xlsm`: Excel workbook with macros

`.xltm`: Excel workbook template

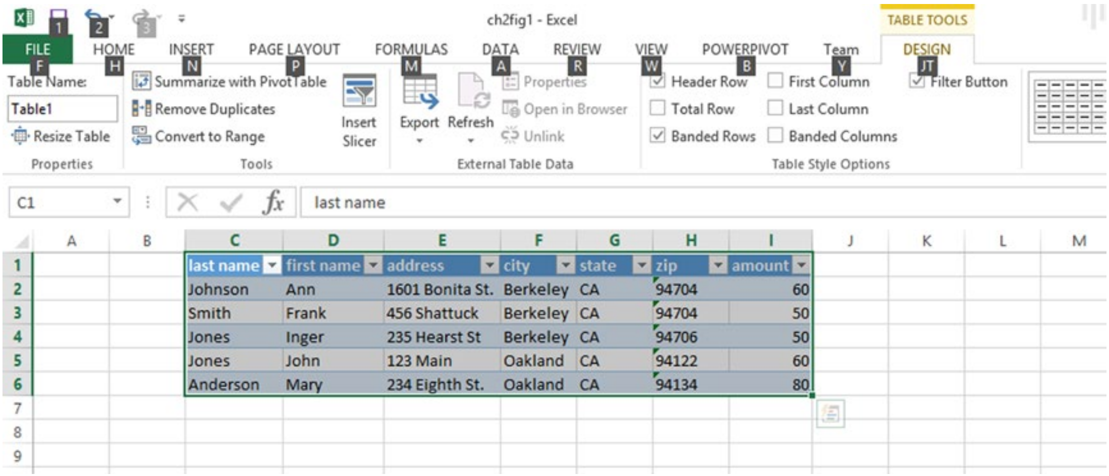
`.txt`: a file containing text

`.xml`: a text file in XML format

Using Excel As a Database

By default, Excel works with tables consisting of rows and columns. Each row is a record that includes all the attributes of a single item. Each column is a field or attribute.

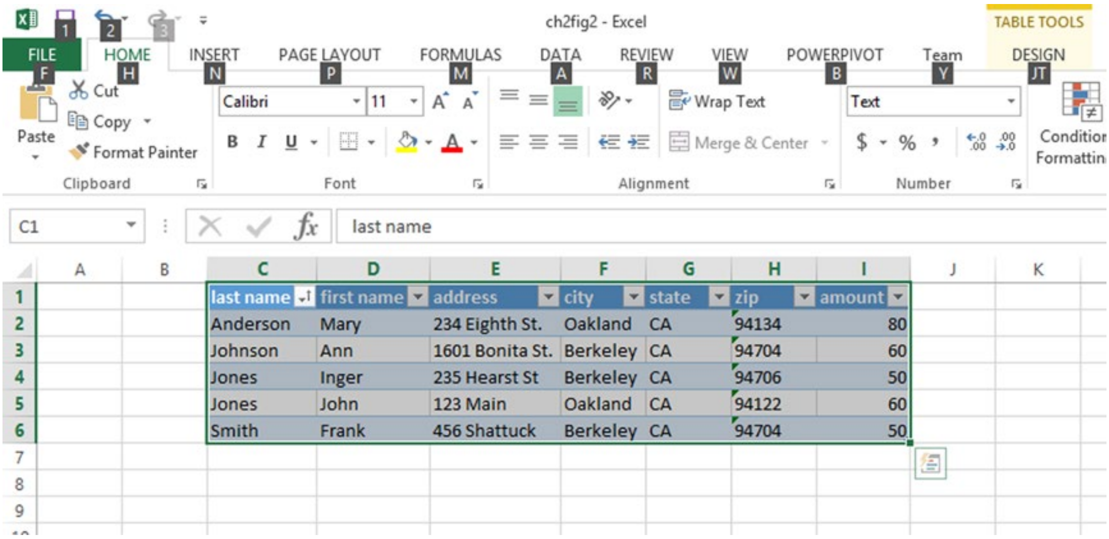
A table should show the field names in the first row and have whitespace around it—a blank column on each side and a blank row above and below, unless the first row is row 1 or the first column is A. Click anywhere inside the table and press Ctrl+T to define it as a table, as shown in Figure 2-1. Notice the headers with arrows at the top of each column. Clicking the arrow brings up a menu offering sorting and filtering options.



	A	B	C	D	E	F	G	H	I
1			last name	first name	address	city	state	zip	amount
2			Johnson	Ann	1601 Bonita St.	Berkeley	CA	94704	60
3			Smith	Frank	456 Shattuck	Berkeley	CA	94704	50
4			Jones	Inger	235 Hearst St	Berkeley	CA	94706	50
5			Jones	John	123 Main	Oakland	CA	94122	60
6			Anderson	Mary	234 Eighth St.	Oakland	CA	94134	80

Figure 2-1. *An Excel table*

Note that, with the current version of Excel, if you sort on one field, it is smart enough to bring along the related fields (as long as there are no blank columns in the range), as shown in Figure 2-2, where a sort is done by last name. To sort by first and last name, sort on first name first and then last name.



	A	B	C	D	E	F	G	H	I
1			last name	first name	address	city	state	zip	amount
2			Anderson	Mary	234 Eighth St.	Oakland	CA	94134	80
3			Johnson	Ann	1601 Bonita St.	Berkeley	CA	94704	60
4			Jones	Inger	235 Hearst St	Berkeley	CA	94706	50
5			Jones	John	123 Main	Oakland	CA	94122	60
6			Smith	Frank	456 Shattuck	Berkeley	CA	94704	50

Figure 2-2. *Excel Table sorted by first and last name*

Importing from Other Formats

Excel can be used to import data from a variety of sources, including data stored in text files, data in tables on a web site, data in XML files, and data in JSON format. This chapter will show you how to import some of the more common formats. Chapter 4 will cover how to link multiple tables using Power BI.

Opening Text Files in Excel

Excel can open text files in comma-delimited, tab-delimited, fixed-length-field, and XML formats, as well as in the file formats shown in Figure 2-3. When files in any of these formats are opened in Excel, they are automatically converted to a spreadsheet.

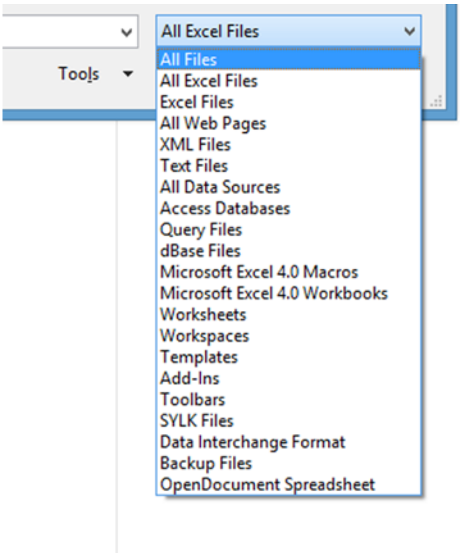
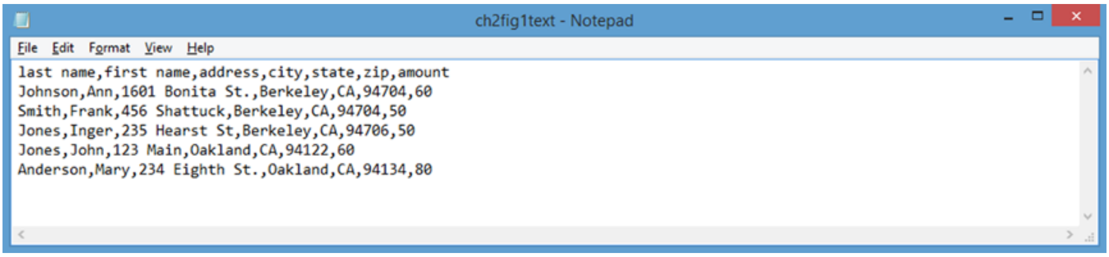


Figure 2-3. *File formats that can be imported into Excel*

When importing files, it is best to work with a copy of the file, so that the original file remains unchanged in case the file is corrupted when it is imported.

Figure 2-4 shows a comma-delimited file in Notepad. Note that the first row consists of the field names. All fields are separated by commas. Excel knows how to read this type of file into a spreadsheet. If a text file in this format is opened with Excel, it will appear as a spreadsheet, as shown in Figure 2-1.

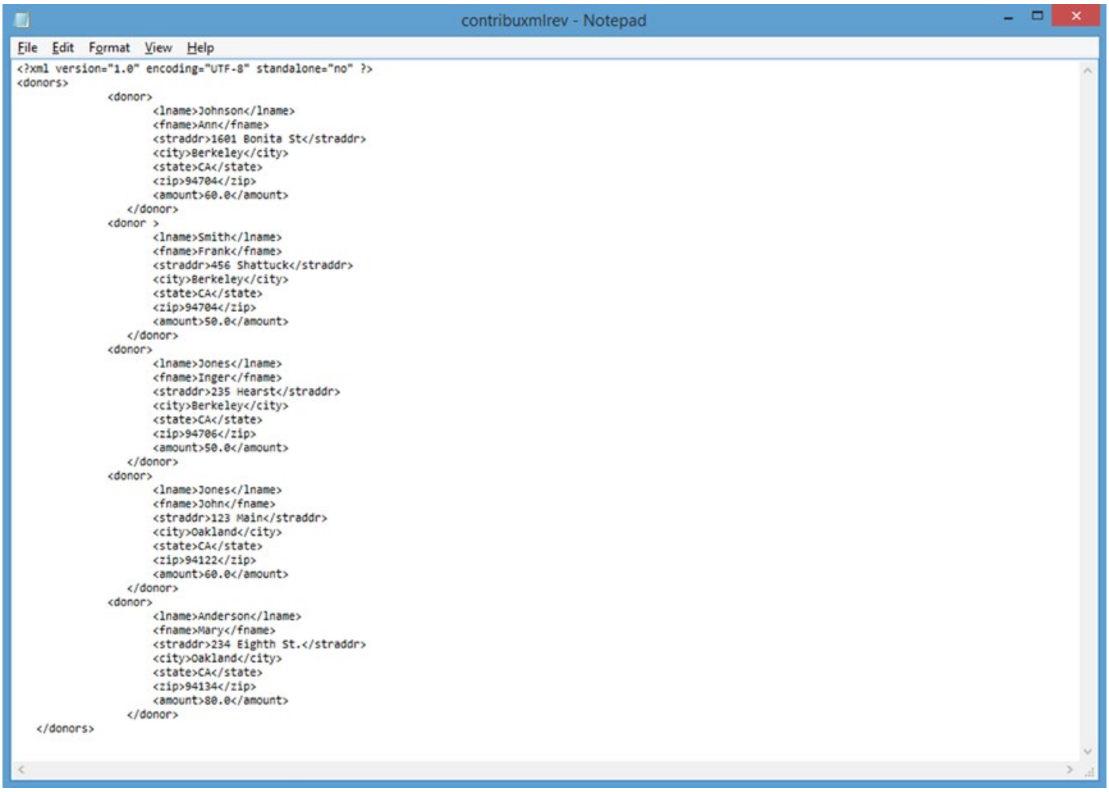


```
last name,first name,address,city,state,zip,amount
Johnson,Ann,1601 Bonita St.,Berkeley,CA,94704,60
Smith,Frank,456 Shattuck,Berkeley,CA,94704,50
Jones,Inger,235 Hearst St,Berkeley,CA,94706,50
Jones,John,123 Main,Oakland,CA,94122,60
Anderson,Mary,234 Eighth St.,Oakland,CA,94134,80
```

Figure 2-4. *Comma-separated values format*

Importing Data from XML

Extensible Markup Language (XML) is a popular format for storing data. As in HTML, it uses paired tags to define each element. Figure 2-5 shows the data we have been working with in XML format. The first line is the declaration that specifies the version of XML, UTF encoding, and other information. Note the donors root tag that surrounds all of the other tags.



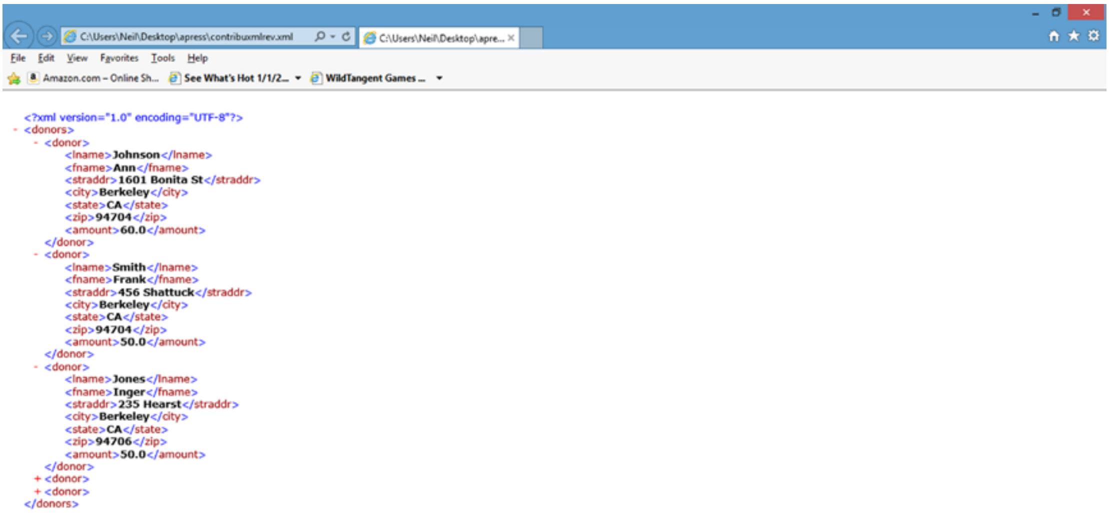
```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<donors>
             <donor>
                    <lname>Johnson</lname>
                    <fname>Ann</fname>
                    <straddr>1601 Bonita St</straddr>
                    <city>Berkeley</city>
                    <state>CA</state>
                    <zip>94704</zip>
                    <amount>60.0</amount>
                <donor>
             <donor >
                    <lname>Smith</lname>
                    <fname>Frank</fname>
                    <straddr>456 Shattuck</straddr>
                    <city>Berkeley</city>
                    <state>CA</state>
                    <zip>94704</zip>
                    <amount>50.0</amount>
                </donor>
             <donor>
                    <lname>Jones</lname>
                    <fname>Inger</fname>
                    <straddr>235 Hearst</straddr>
                    <city>Berkeley</city>
                    <state>CA</state>
                    <zip>94706</zip>
                    <amount>50.0</amount>
                </donor>
             <donor>
                    <lname>Jones</lname>
                    <fname>John</fname>
                    <straddr>123 Main</straddr>
                    <city>Oakland</city>
                    <state>CA</state>
                    <zip>94122</zip>
                    <amount>60.0</amount>
                </donor>
             <donor>
                    <lname>Anderson</lname>
                    <fname>Mary</fname>
                    <straddr>234 Eighth St.</straddr>
                    <city>Oakland</city>
                    <state>CA</state>
                    <zip>94134</zip>
                    <amount>80.0</amount>
                </donor>
   </donors>
```

Figure 2-5. *XML format*

The data is self-descriptive. Each row or record in this example is surrounded by a donor tag. The field names are repeated twice for each field in the opening and closing tags. This file would be saved as a text file with an `.xml` extension.

An XML file can be opened directly by Excel. On the first pop-up after it opens, select “As an XML table.” Then, on the next pop-up, click yes for “Excel will create the schema.”

As shown in Figure 2-6, XML files can be displayed in a web browser such as Internet Explorer. Note the small plus and minus signs to the left of the donor tab. Click minus to hide the details in each record. Click plus to show the details.



C:\Users\Neil\Desktop\apress\contribuxmlrev.xml
C:\Users\Neil\Desktop\apre...
File
Edit
View
Favorites
Tools
Help
Amazon.com – Online Sh...
See What's Hot 1/1/2...
WildTangent Games ...

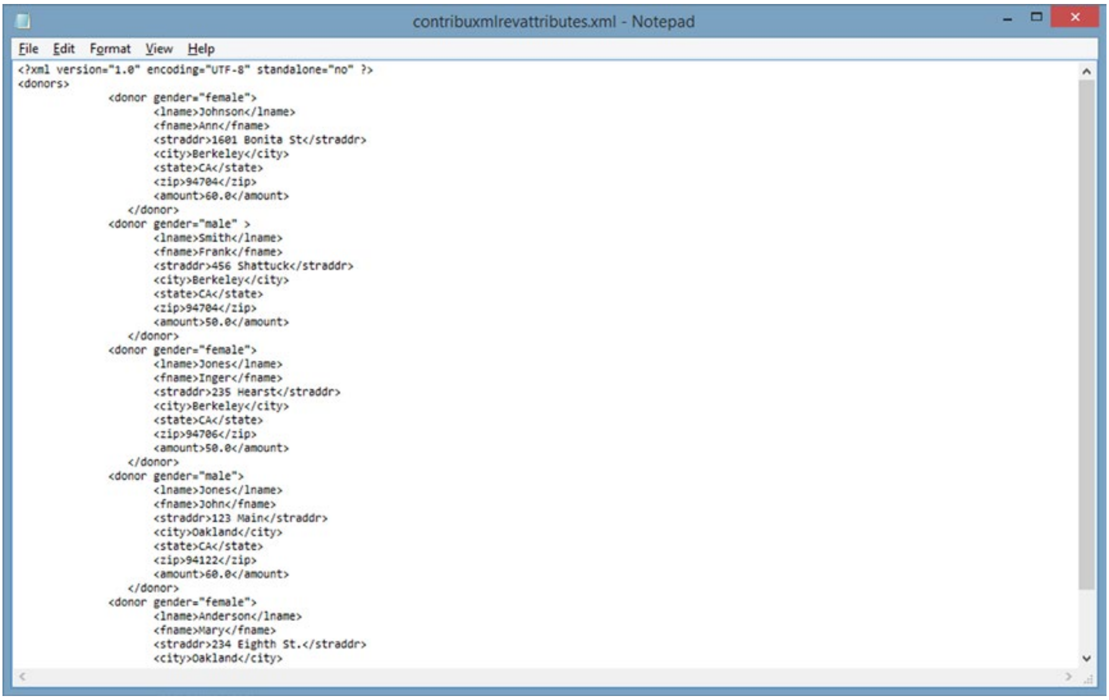
```
  <?xml version="1.0" encoding="UTF-8"?>
- <donors>
  - <donor>
        <lname>Johnson</lname>
        <fname>Ann</fname>
        <straddr>1601 Bonita St</straddr>
        <city>Berkeley</city>
        <state>CA</state>
        <zip>94704</zip>
        <amount>60.0</amount>
    </donor>
  - <donor>
        <lname>Smith</lname>
        <fname>Frank</fname>
        <straddr>456 Shattuck</straddr>
        <city>Berkeley</city>
        <state>CA</state>
        <zip>94704</zip>
        <amount>50.0</amount>
    </donor>
  - <donor>
        <lname>Jones</lname>
        <fname>Inger</fname>
        <straddr>235 Hearst</straddr>
        <city>Berkeley</city>
        <state>CA</state>
        <zip>94706</zip>
        <amount>50.0</amount>
    </donor>
  + <donor>
  + <donor>
  </donors>
```

***Figure 2-6.** XML file displayed in a web browser*

Importing XML with Attributes

As does HTML, XML can have attributes. Figure 2-7 shows an example of adding a gender attribute as part of the donor tag

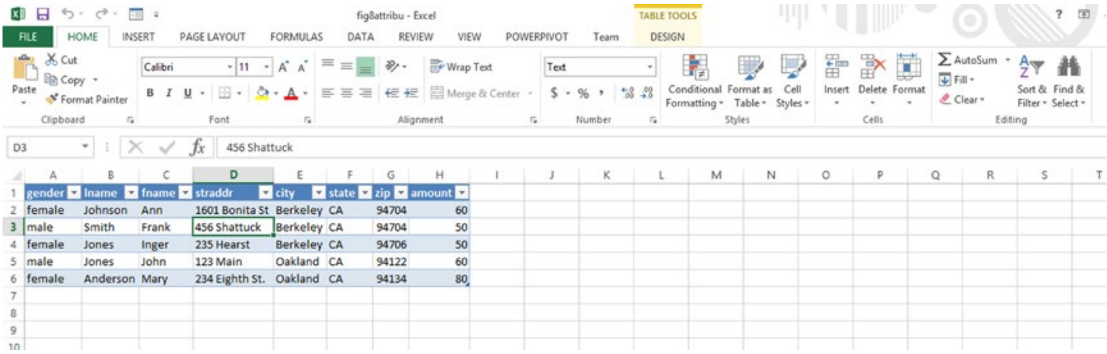
```
<donor gender = "female">
...
</donor>
```


contribuxmlrevattributes.xml - Notepad
File Edit Format View Help

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<donors>
              <donor gender="female">
                     <lname>Johnson</lname>
                     <fname>Ann</fname>
                     <straddr>1601 Bonita St</straddr>
                     <city>Berkeley</city>
                     <state>CA</state>
                     <zip>94704</zip>
                     <amount>60.0</amount>
                 </donor>
              <donor gender="male" >
                     <lname>Smith</lname>
                     <fname>Frank</fname>
                     <straddr>456 Shattuck</straddr>
                     <city>Berkeley</city>
                     <state>CA</state>
                     <zip>94704</zip>
                     <amount>50.0</amount>
                 </donor>
              <donor gender="female">
                     <lname>Jones</lname>
                     <fname>Inger</fname>
                     <straddr>235 Hearst</straddr>
                     <city>Berkeley</city>
                     <state>CA</state>
                     <zip>94706</zip>
                     <amount>50.0</amount>
                 </donor>
              <donor gender="male">
                     <lname>Jones</lname>
                     <fname>John</fname>
                     <straddr>123 Main</straddr>
                     <city>Oakland</city>
                     <state>CA</state>
                     <zip>94122</zip>
                     <amount>60.0</amount>
                 </donor>
              <donor gender="female">
                     <lname>Anderson</lname>
                     <fname>Mary</fname>
                     <straddr>234 Eighth St.</straddr>
                     <city>Oakland</city>
```

Figure 2-7. *XML with attributes*

There are two schools of thought about using attributes. Some people believe that attributes should be avoided and that all values should be presented in paired tags. However, XML with attributes may be encountered. Excel can interpret either format. Figure 2-8 shows the Excel spreadsheet that would be displayed by opening the XML file shown in Figure 2-7.



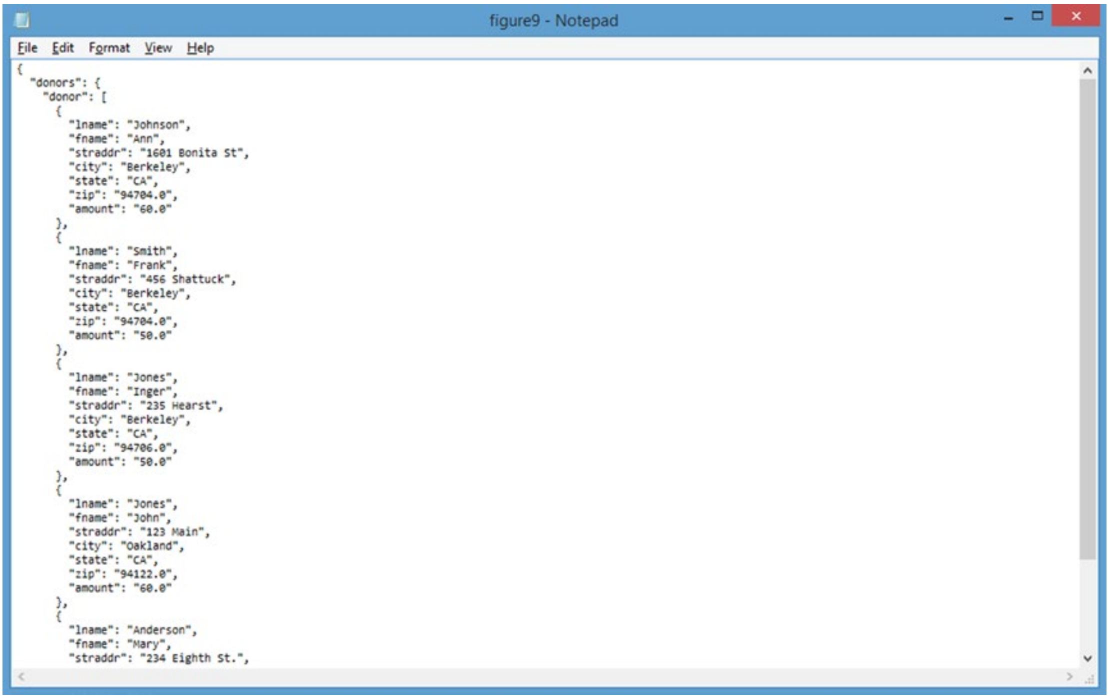
D3 fx 456 Shattuck

	A	B	C	D	E	F	G	H
1	gender	lname	fname	straddr	city	state	zip	amount
2	female	Johnson	Ann	1601 Bonita St	Berkeley	CA	94704	60
3	male	Smith	Frank	456 Shattuck	Berkeley	CA	94704	50
4	female	Jones	Inger	235 Hearst	Berkeley	CA	94706	50
5	male	Jones	John	123 Main	Oakland	CA	94122	60
6	female	Anderson	Mary	234 Eighth St.	Oakland	CA	94134	80

Figure 2-8. *XML with attributes imported into Excel*

Importing JSON Format

Much NoSQL data is stored in JavaScript Object Notation (JSON) format. Unfortunately, Excel does not read JSON files directly, so it is necessary to use an intermediate format to import them into Excel. Figure 2-9 shows our sample file in JSON format. Note the name-value pairs in which each field name is repeated every time there is an instance of that field.

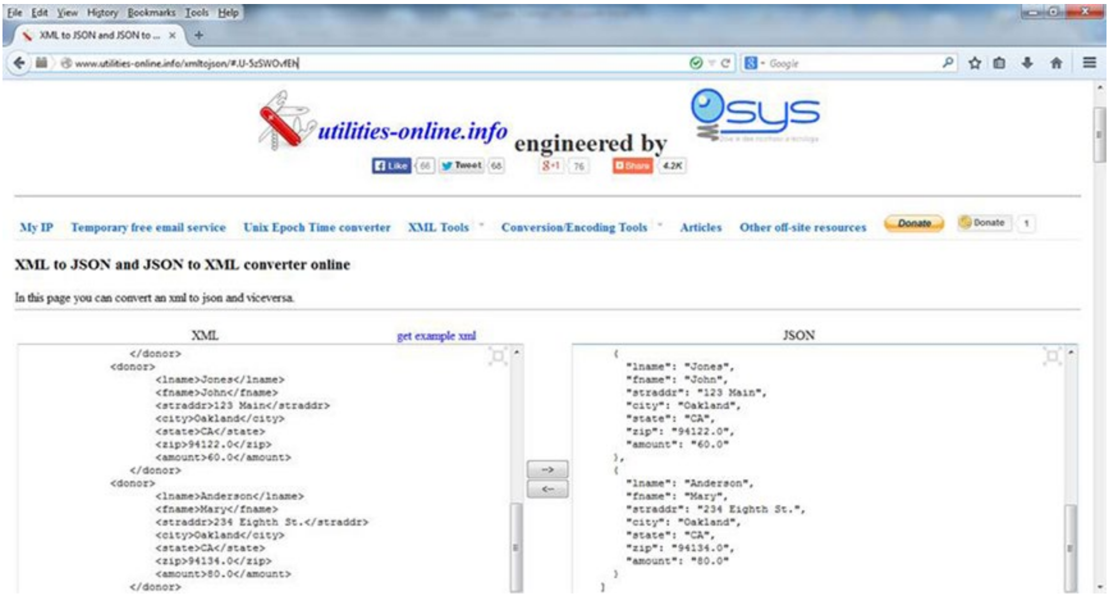


```
{
  "donors": {
    "donor": [
      {
        "lname": "Johnson",
        "fname": "Ann",
        "straddr": "1601 Bonita St",
        "city": "Berkeley",
        "state": "CA",
        "zip": "94704.0",
        "amount": "60.0"
      },
      {
        "lname": "Smith",
        "fname": "Frank",
        "straddr": "456 Shattuck",
        "city": "Berkeley",
        "state": "CA",
        "zip": "94704.0",
        "amount": "50.0"
      },
      {
        "lname": "Jones",
        "fname": "Inger",
        "straddr": "235 Hearst",
        "city": "Berkeley",
        "state": "CA",
        "zip": "94706.0",
        "amount": "50.0"
      },
      {
        "lname": "Jones",
        "fname": "John",
        "straddr": "123 Main",
        "city": "Oakland",
        "state": "CA",
        "zip": "94122.0",
        "amount": "60.0"
      },
      {
        "lname": "Anderson",
        "fname": "Mary",
        "straddr": "234 Eighth St.",
```

Figure 2-9. *JSON format*

Because Excel cannot read JSON files directly, you would have to convert this JSON-formatted data into a format such as XML that Excel can read. A number of free converters are available on the Web, such as the one at `http://bit.ly/1s2Oi6L`.

The interface for the converter is shown in Figure 2-10. (Remember to work with a copy of the file, so that the original will not be corrupted.) The JSON file can be pasted into the JSON window and then converted to XML by clicking the arrow. The result is an XML file having the same name and that you can open directly from Excel.


File Edit View History Bookmarks Tools Help
XML to JSON and JSON to ...
www.utilities-online.info/xmltojson/#.U-5zSWOvfEN
Google
utilities-online.info
engineered by
Osys
Like 66
Tweet 68
8+1 76
Share 4.2K
My IP
Temporary free email service
Unix Epoch Time converter
XML Tools
Conversion/Encoding Tools
Articles
Other off-site resources
Donate
Donate 1
XML
get example xml
JSON
-->
<--

XML to JSON and JSON to XML converter online

In this page you can convert an xml to json and viceversa.

```
        </donor>
     <donor>
            <lname>Jones</lname>
            <fname>John</fname>
            <straddr>123 Main</straddr>
            <city>Oakland</city>
            <state>CA</state>
            <zip>94122.0</zip>
            <amount>60.0</amount>
        </donor>
     <donor>
            <lname>Anderson</lname>
            <fname>Mary</fname>
            <straddr>234 Eighth St.</straddr>
            <city>Oakland</city>
            <state>CA</state>
            <zip>94134.0</zip>
            <amount>80.0</amount>
        </donor>
```

```
    {
      "lname": "Jones",
      "fname": "John",
      "straddr": "123 Main",
      "city": "Oakland",
      "state": "CA",
      "zip": "94122.0",
      "amount": "60.0"
    },
    {
      "lname": "Anderson",
      "fname": "Mary",
      "straddr": "234 Eighth St.",
      "city": "Oakland",
      "state": "CA",
      "zip": "94134.0",
      "amount": "80.0"
    }
  ]
```

Figure 2-10. *XML and JSON*

Using the Data Tab to Import Data

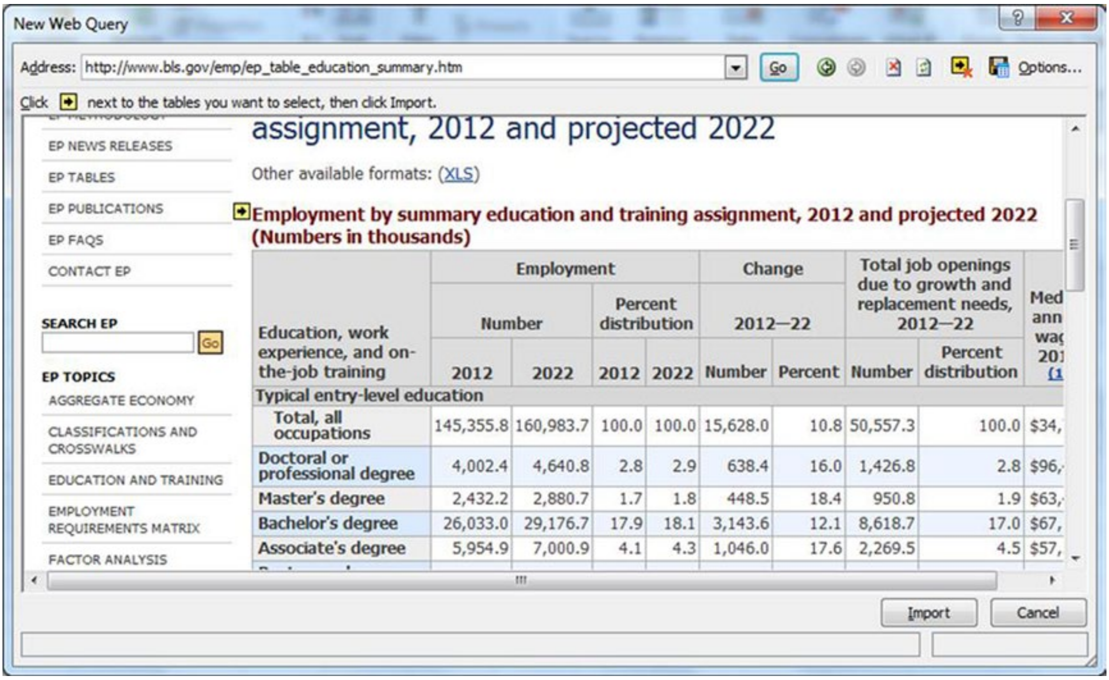
So far, we have been importing data from text files directly into Excel to create a new spreadsheet. The options on the Data tab can be used to import data from a variety of formats, as part of an existing spreadsheet.

Importing Data from Tables on a Web Site

As an example, let's look at importing data from a table on a web site.

To import data from a table on a web site, do the following:

1. Click the Data tab to display the Data ribbon.
2. Click From Web.
3. A browser window will appear. Type in the address of the web site you want to access. We will access a Bureau of Labor Statistics example of employment based on educational attainment. For this example, we will use `http://www.bls.gov/emp/ep_table_education_summary.htm`.
4. As shown in Figure 2-11, a black arrow in a small yellow box will appear next to each table. Click the black arrow in the small yellow box at the upper left-hand corner of the table, and it will change to a check mark in a green box. Click Import. The Import Data dialog will appear as shown in Figure 2-12.



Address: http://www.bls.gov/emp/ep_table_education_summary.htm

Click next to the tables you want to select, then click Import.

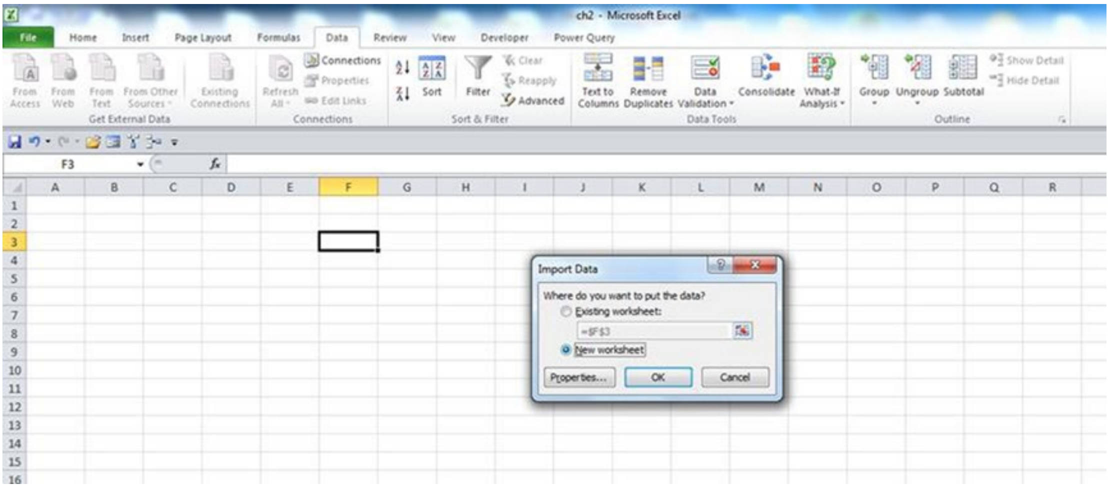
assignment, 2012 and projected 2022

Other available formats: (XLS)

Employment by summary education and training assignment, 2012 and projected 2022 (Numbers in thousands)

	Employment				Change		Total job openings due to growth and replacement needs, 2012—22		Med ann wag 201 (1
	Number		Percent distribution		2012—22				
Education, work experience, and on-the-job training	2012	2022	2012	2022	Number	Percent	Number	Percent distribution	
Typical entry-level education									
Total, all occupations	145,355.8	160,983.7	100.0	100.0	15,628.0	10.8	50,557.3	100.0	$34,
Doctoral or professional degree	4,002.4	4,640.8	2.8	2.9	638.4	16.0	1,426.8	2.8	$96,
Master's degree	2,432.2	2,880.7	1.7	1.8	448.5	18.4	950.8	1.9	$63,
Bachelor's degree	26,033.0	29,176.7	17.9	18.1	3,143.6	12.1	8,618.7	17.0	$67,
Associate's degree	5,954.9	7,000.9	4.1	4.3	1,046.0	17.6	2,269.5	4.5	$57,

Figure 2-11. Importing data from the Web



Import Data

Where do you want to put the data?

○ Existing worksheet:

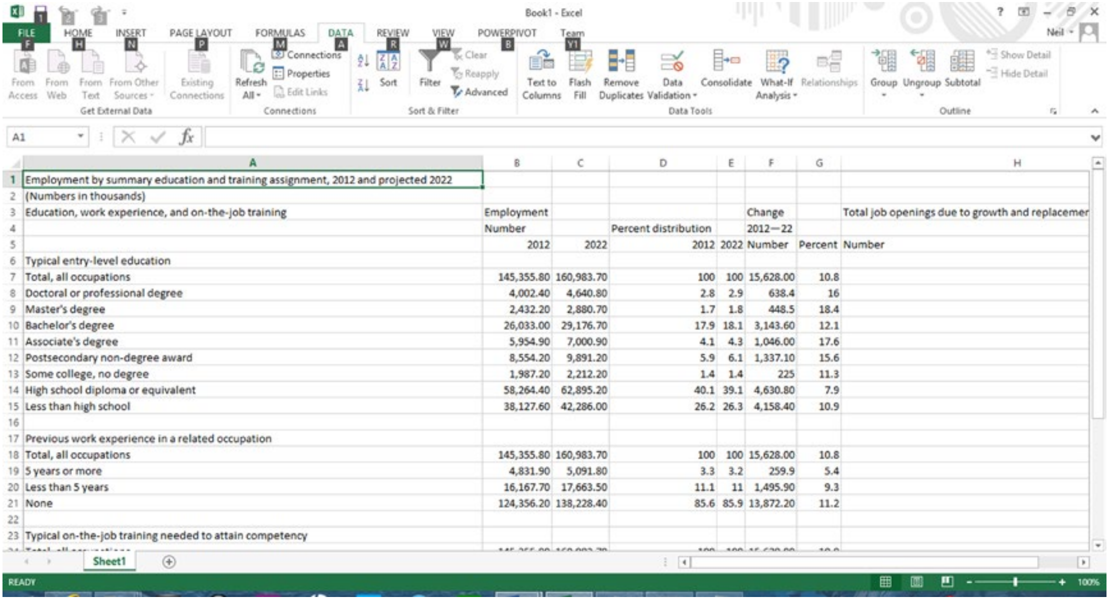
=$F$3

● New worksheet

Properties... | OK | Cancel

Figure 2-12. Import Data dialog

5. Select new Worksheet and then OK. The table will be imported, as shown in Figure 2-13. Some formatting may be required in Excel to get the table to be precisely as you want it to be for further analysis.



	A	B	C	D	E	F	G	H
1	Employment by summary education and training assignment, 2012 and projected 2022							
2	(Numbers in thousands)							
3	Education, work experience, and on-the-job training	Employment				Change		Total job openings due to growth and replacemer
4		Number		Percent distribution		2012—22		
5		2012	2022	2012	2022	Number	Percent	Number
6	Typical entry-level education							
7	Total, all occupations	145,355.80	160,983.70	100	100	15,628.00	10.8	
8	Doctoral or professional degree	4,002.40	4,640.80	2.8	2.9	638.4	16	
9	Master's degree	2,432.20	2,880.70	1.7	1.8	448.5	18.4	
10	Bachelor's degree	26,033.00	29,176.70	17.9	18.1	3,143.60	12.1	
11	Associate's degree	5,954.90	7,000.90	4.1	4.3	1,046.00	17.6	
12	Postsecondary non-degree award	8,554.20	9,891.20	5.9	6.1	1,337.10	15.6	
13	Some college, no degree	1,987.20	2,212.20	1.4	1.4	225	11.3	
14	High school diploma or equivalent	58,264.40	62,895.20	40.1	39.1	4,630.80	7.9	
15	Less than high school	38,127.60	42,286.00	26.2	26.3	4,158.40	10.9	
16								
17	Previous work experience in a related occupation							
18	Total, all occupations	145,355.80	160,983.70	100	100	15,628.00	10.8	
19	5 years or more	4,831.90	5,091.80	3.3	3.2	259.9	5.4	
20	Less than 5 years	16,167.70	17,663.50	11.1	11	1,495.90	9.3	
21	None	124,356.20	138,228.40	85.6	85.9	13,872.20	11.2	
22								
23	Typical on-the-job training needed to attain competency							

***Figure 2-13.** Data from the Web imported into Excel*

Data Wrangling and Data Scrubbing

Imported data is rarely in the form in which it is needed. Data can be problematic for the following reasons:

- It is incomplete.
- It is inconsistent.
- It is in the wrong format.

Data wrangling involves converting raw data into a usable format. *Data scrubbing* means correcting errors and inconsistencies. Excel provides tools to scrub and format data.

Correcting Capitalization

One of the functions that Excel provides to correct capitalization is the `Proper()` function. It capitalizes the first letter of each word and lowercases the rest. Figure 2-14 shows some text before and after executing the function. To use the `Proper()` function, as shown in Figure 2-14, perform the following steps:

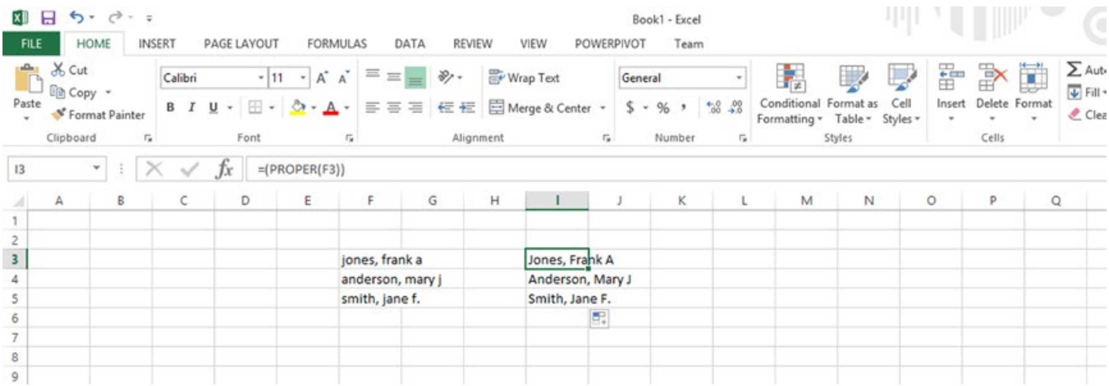
1. In a new column, type “`=Proper(`.”
2. Click the first cell that you want to apply it to and then type the closing parentheses (`)`). Then press Enter.

3. Click the cell in which you just entered the formula and then drag the fill handle in the lower right corner of the cell, to copy the formula down the column.

4. Convert the content of the cells from formulas to values. For a small number of cells, do that by selecting each cell, pressing F2 to edit, then pressing F9 to convert to values, and then pressing Enter.

5. For a larger number of cells, select the column, right-click, and select copy. Then select the top cell in the range to be copied to, press Ctrl+Alt+V, to open the Paste Special Box, select Values, and click OK.

6. Then you can delete the original column by right-clicking anywhere in the column and selecting Delete ➤ Entire Column.



I3 =(PROPER(F3))

Row	F	I
3	jones, frank a	Jones, Frank A
4	anderson, mary j	Anderson, Mary J
5	smith, jane f.	Smith, Jane F.

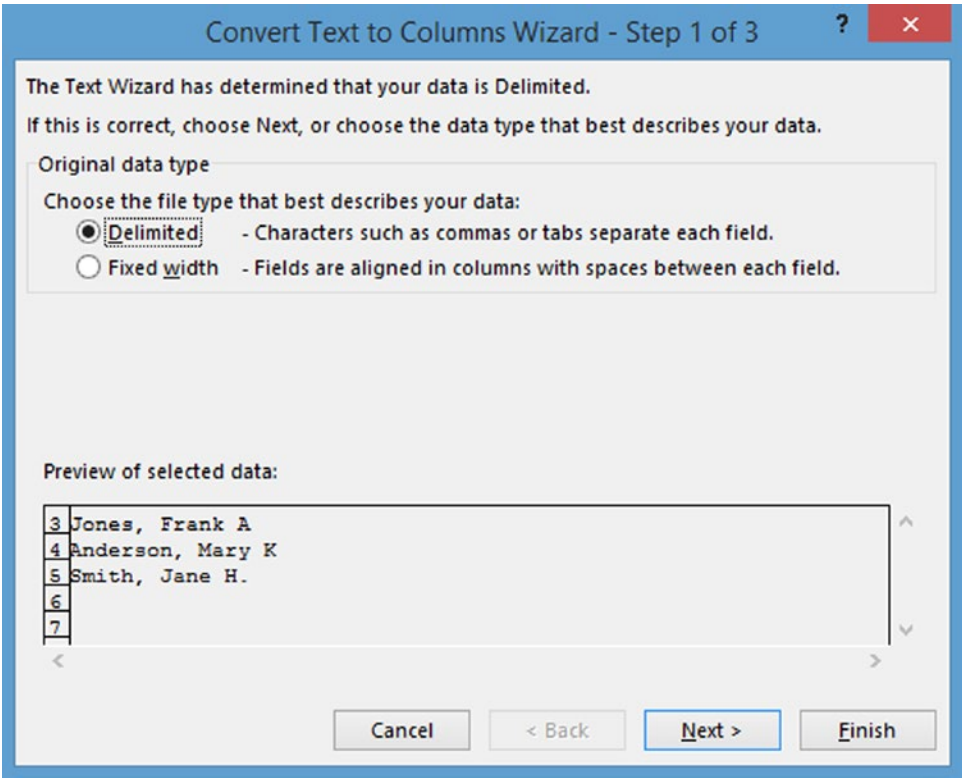
Figure 2-14. *Use of the* `Proper()` *function*

Splitting Delimited Fields

In some cases, first and last names are included in the same field and are separated by commas. These and similar fields can be split using the Text to Columns option on the Data tab.

1. Highlight the range of cells that you want to convert.

2. Click Text to Columns on the Data tab. In the pop-up window, select Delimited, as shown in Figure 2-15. Then click Next.



The Text Wizard has determined that your data is Delimited.

If this is correct, choose Next, or choose the data type that best describes your data.

Original data type

Choose the file type that best describes your data:

● Delimited - Characters such as commas or tabs separate each field.

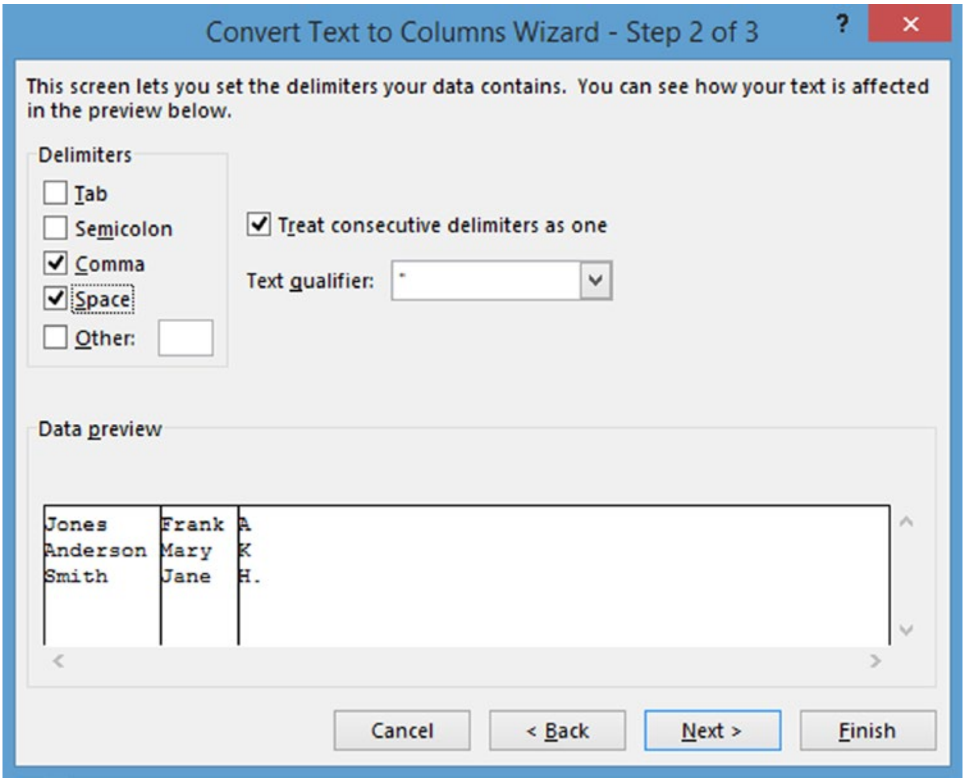
○ Fixed width - Fields are aligned in columns with spaces between each field.

Preview of selected data:

```
3 Jones, Frank A
4 Anderson, Mary K
5 Smith, Jane H.
6
7
```

Figure 2-15. *Convert Text to Columns Dialog*

3. On the next pop-up window, shown in Figure 2-16, select Comma and Space as the delimiters and review the preview. If the preview looks right, click Next. The reason for including the space as a delimiter is to accommodate middle initials, which are, in this example, separated from their respective first names by a space.



Convert Text to Columns Wizard - Step 2 of 3

This screen lets you set the delimiters your data contains. You can see how your text is affected in the preview below.

Delimiters

☐ Tab

☐ Semicolon

☑ Comma

☑ Space

☐ Other:

☑ Treat consecutive delimiters as one

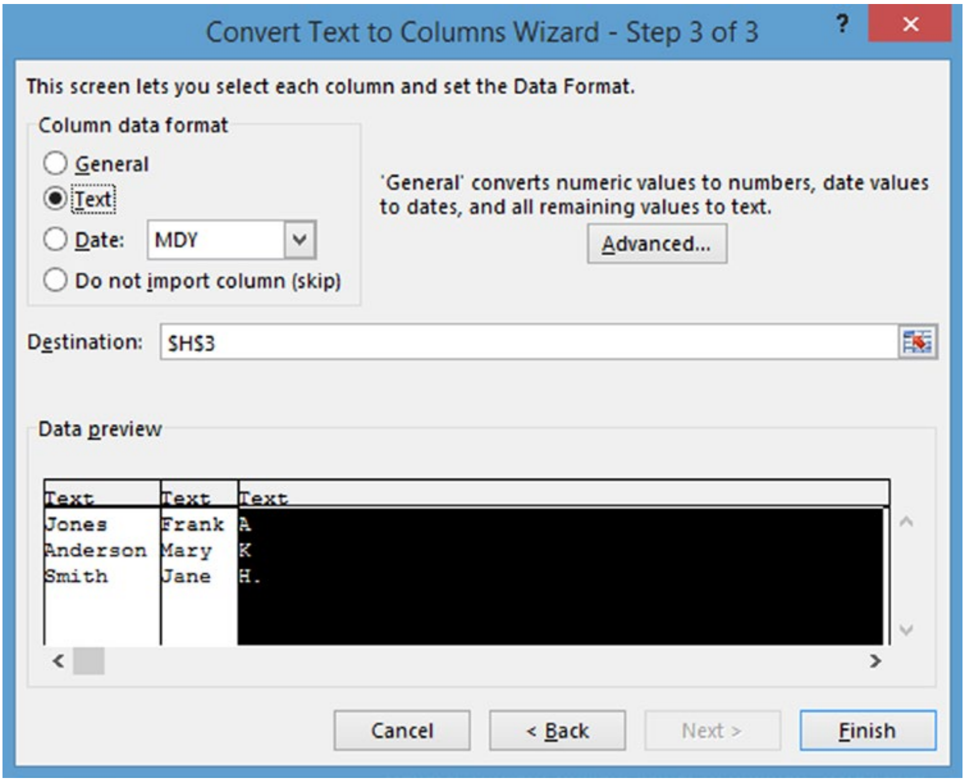
Text qualifier: "

Data preview

Jones	Frank	A
Anderson	Mary	K
Smith	Jane	H.

Figure 2-16. *Data preview of Text to Columns*

4. In the next pop-up window, select each column in the Data Preview window and click Text as the format, as shown in Figure 2-17. Enter the destination where you want the results to appear, then click Finish.



Convert Text to Columns Wizard - Step 3 of 3

This screen lets you select each column and set the Data Format.

Column data format

○ General
● Text
○ Date: MDY
○ Do not import column (skip)

'General' converts numeric values to numbers, date values to dates, and all remaining values to text.

Destination: $H$3

Data preview

Text	Text	Text
Jones	Frank	A
Anderson	Mary	K
Smith	Jane	H.

__Figure 2-17.__ Last step of Convert Text to Columns

Splitting Complex, Delimited Fields

More complex cases involving multiple data elements in a single field can often be solved through using Excel's built-in functions. Some of the functions that are available for string manipulation are shown in Table 2-1.

Table 2-1. *Available Functions for String Manipulation*

Function	Description
`LEN(text)`	Returns the number of characters in the text string
`LEFT(text,num_chars)`	Returns the leftmost number of characters specified by `num_chars`
`RIGHT(text,num_chars)`	Returns the rightmost number of characters specified by `num_chars`
`MID(text,start,num_chars)`	Returns the number of characters specified by `num_chars`, starting from the position specified by `start`
`SEARCH(find_text, within_text,start_num)`	Returns the position at which the specified `find_text` starts in `within_text` when reading from left to right. Not case sensitive. `start_num` specifies the occurrence of the text that you want. The default is 1.

(*continued*)

Table 2-1. *(continued)*

Function	Description
`TRIM(text)`	Removes all leading and trailing spaces from a text string, except single spaces between words
`CLEAN(text)`	Removes all non-printable characters from a text string
`LOWER(text)`	Returns string with all characters converted to lower case
`UPPER(text)`	Returns string with all characters converted to upper case
`PROPER(text)`	Returns string with first letter of each word in upper case

Functions can be nested. For example, we could extract the last name by using the following formula:

```
=LEFT(F7,SEARCH(",",F7)-1)
```

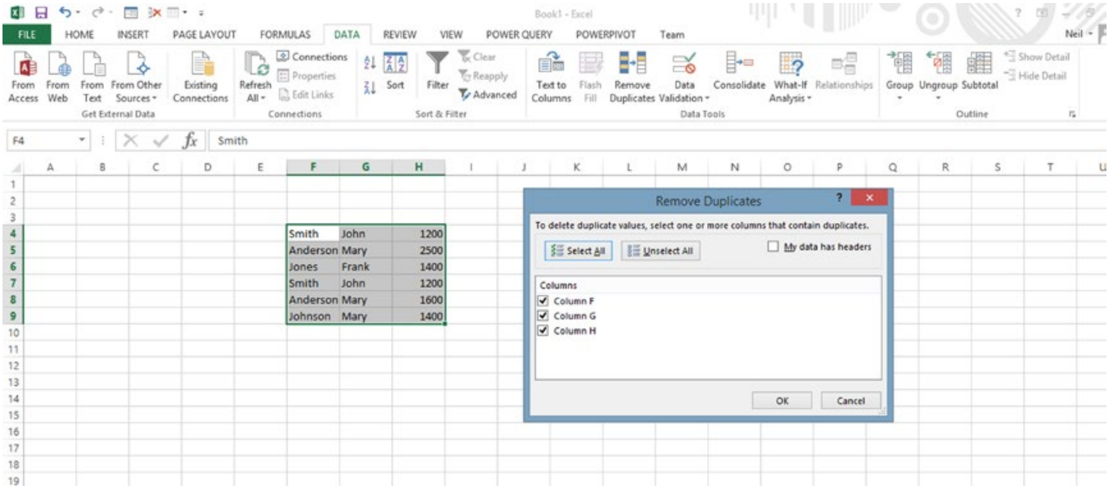
This function would extract the leftmost characters up to the position of the comma. To extract the first name and middle initial, use the following:

```
=RIGHT(F7,SEARCH(", ",F7)+1)
```

Removing Duplicates

It is not unusual for imported data to include duplicate records. Duplicate records can be removed by using the Remove Duplicates option on the Data tab.

It is always a good idea to work with a copy of the original files, to prevent valid data from being deleted. To delete duplicates, simply highlight the columns that contain duplicate values and click Remove Duplicates, as shown in Figure 2-18. Confirm the columns that contain duplicates and click OK. Only the rows in which all the values are the same will be removed.



F4 | Smith

F	G	H
Smith	John	1200
Anderson	Mary	2500
Jones	Frank	1400
Smith	John	1200
Anderson	Mary	1600
Johnson	Mary	1400

Remove Duplicates

To delete duplicate values, select one or more columns that contain duplicates.

Select All | Unselect All | □ My data has headers

Columns

☑ Column F

☑ Column G

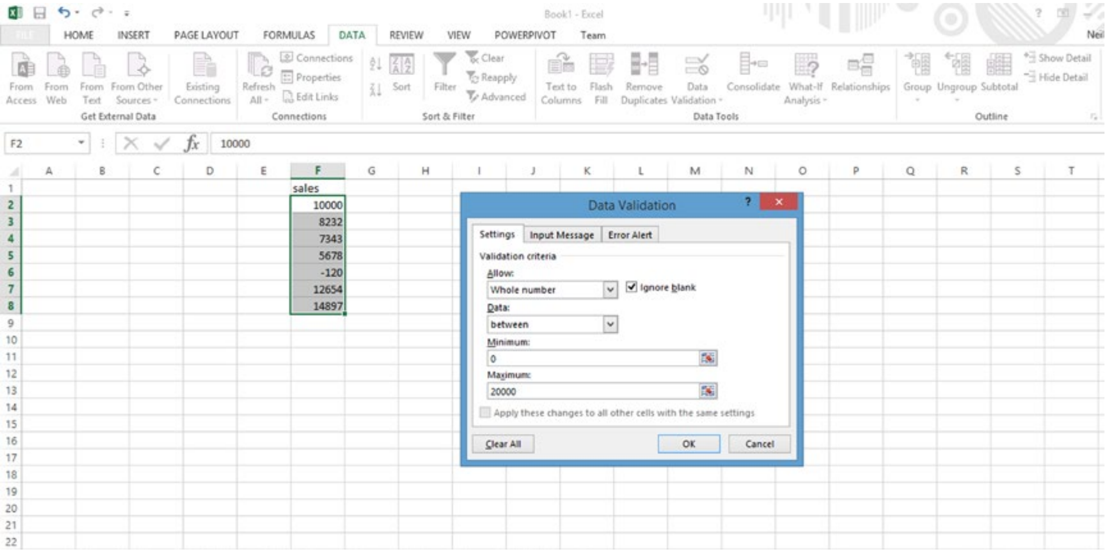
☑ Column H

OK | Cancel

Figure 2-18. *Removing duplicates*

Input Validation

Excel provides tools to check for valid input. If data is not valid, the result can be Garbage In, Garbage Out (GIGO). Excel provides data validation tools that are usually associated with data entry; however, they can be used to flag cells from data that has already been entered. In the example shown in Figure 2-19, the valid range for sales figures is 0 to $20,000, as defined through the Data Validation option on the Data tab.


Book1 - Excel
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWERPIVOT Team
From Access From Web From Text From Other Sources Existing Connections
Get External Data
Refresh All Connections Properties Edit Links
Connections
Sort Filter Clear Reapply Advanced
Sort & Filter
Text to Columns Flash Fill Remove Duplicates Data Validation Consolidate What-If Analysis Relationships
Data Tools
Group Ungroup Subtotal Show Detail Hide Detail
Outline

F2 | 10000

F
sales
10000
8232
7343
5678
-120
12654
14897

Data Validation

Settings | Input Message | Error Alert

Validation criteria

Allow: Whole number ☑ Ignore blank

Data: between

Minimum: 0

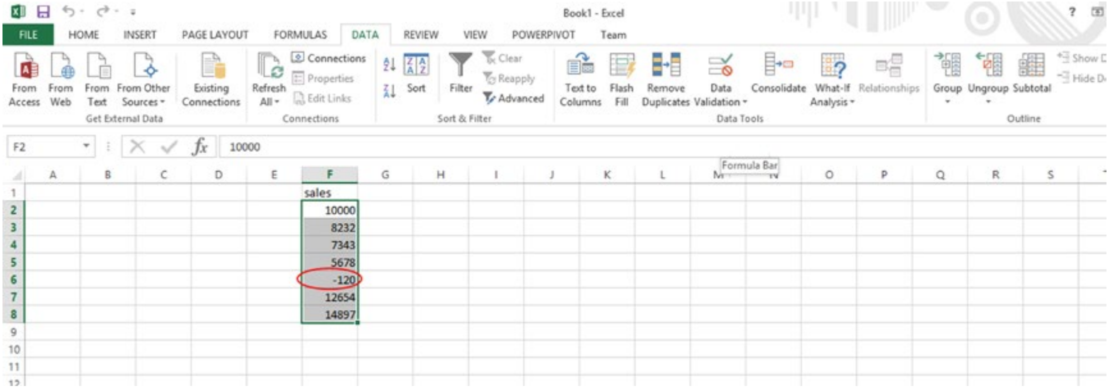
Maximum: 20000

□ Apply these changes to all other cells with the same settings

Clear All | OK | Cancel

Figure 2-19. *Data Validation dialog*

Any values outside of the range can be highlighted by selecting the Circle Invalid Data option under Data Validation on the Data tab. The result is shown in Figure 2-20.


Book1 - Excel
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWERPIVOT Team
From Access From Web From Text From Other Sources Existing Connections
Get External Data
Refresh All Connections Properties Edit Links
Connections
Sort Filter Clear Reapply Advanced
Sort & Filter
Text to Columns Flash Fill Remove Duplicates Data Validation Consolidate What-If Analysis Relationships
Data Tools
Group Ungroup Subtotal Show D Hide D
Outline
Formula Bar

F2 | 10000

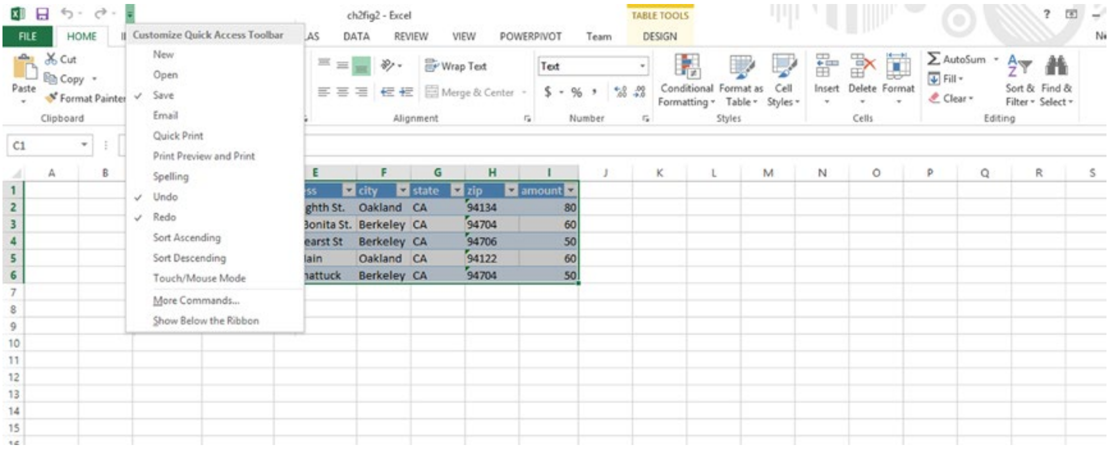
F
sales
10000
8232
7343
5678
-120
12654
14897

Figure 2-20. *Invalid data flagged with red circle*

Working with Data Forms

One of the hidden and less documented features in Excel is the Data Forms feature. Sometimes it is easier to read data in which each record is displayed as a form rather than just in tabular format. By default, there is no Data Forms icon on the toolbars. Data Forms can be accessed by clicking a cell in a table with row headings and pressing Alt+D and then O (as in Oscar). Data Forms can also be added to the Quick Access Toolbar. This can be done via the following steps:

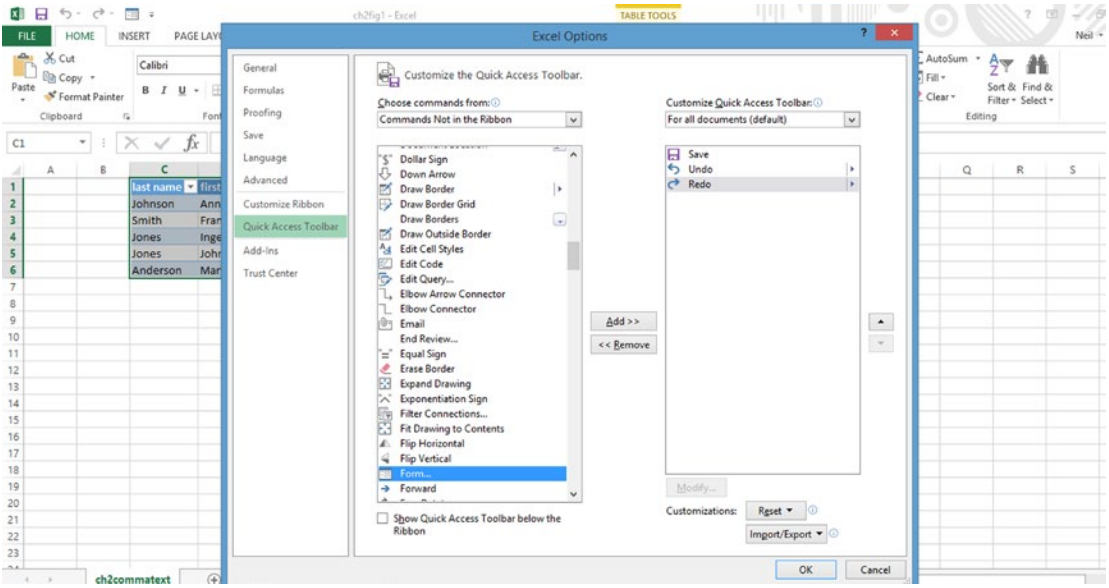
1. Click the down arrow at the rightmost end of the Quick Access Toolbar (located at the top-left section of the screen) and click More Commands, as shown in Figure 2-21.



ss	city	state	zip	amount
ghth St.	Oakland	CA	94134	80
Bonita St.	Berkeley	CA	94704	60
earst St	Berkeley	CA	94706	50
lain	Oakland	CA	94122	60
hattuck	Berkeley	CA	94704	50

Figure 2-21. Customize Quick Access Toolbar menu

2. After clicking More Commands, select “Commands Not in the Ribbon,” at the top of the screen. The screen shown in Figure 2-22 will appear. Find and select the icon for forms and press the Add ➤ button in the middle to put it on the Quick Access Toolbar.



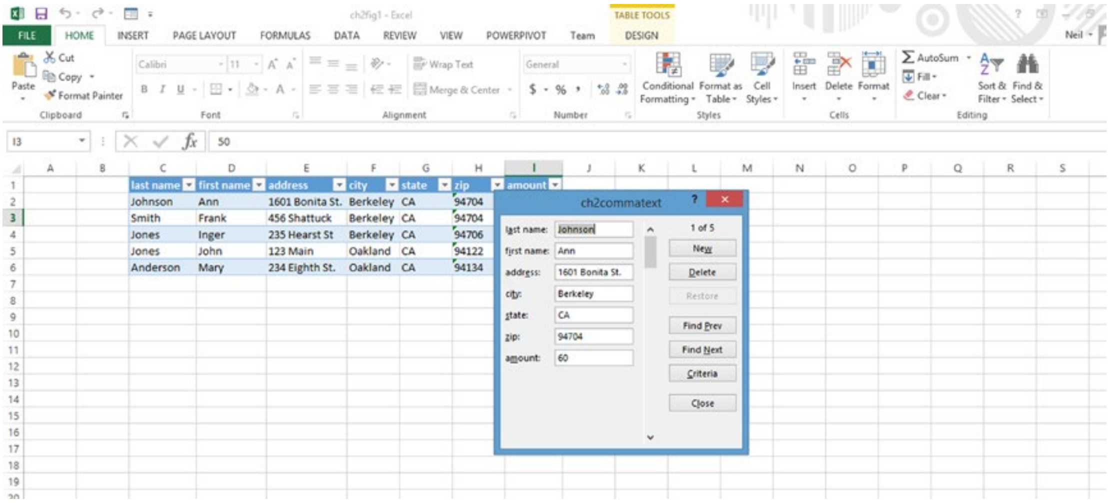
Choose commands from: Commands Not in the Ribbon

Customize Quick Access Toolbar: For all documents (default)

□ Show Quick Access Toolbar below the Ribbon

Figure 2-22. *Customize the Quick Access Toolbar menu*

3. To use data forms, click the row that contains the data to be viewed in the form. Then click the Form icon in the Quick Access Toolbar to see the display shown in Figure 2-23. Fields can be edited in the data form. Click the Find Next and Find Previous buttons to move through the records.



I3 | 50

last name	first name	address	city	state	zip	amount
Johnson	Ann	1601 Bonita St.	Berkeley	CA	94704	
Smith	Frank	456 Shattuck	Berkeley	CA	94704	
Jones	Inger	235 Hearst St	Berkeley	CA	94706	
Jones	John	123 Main	Oakland	CA	94122	
Anderson	Mary	234 Eighth St.	Oakland	CA	94134	

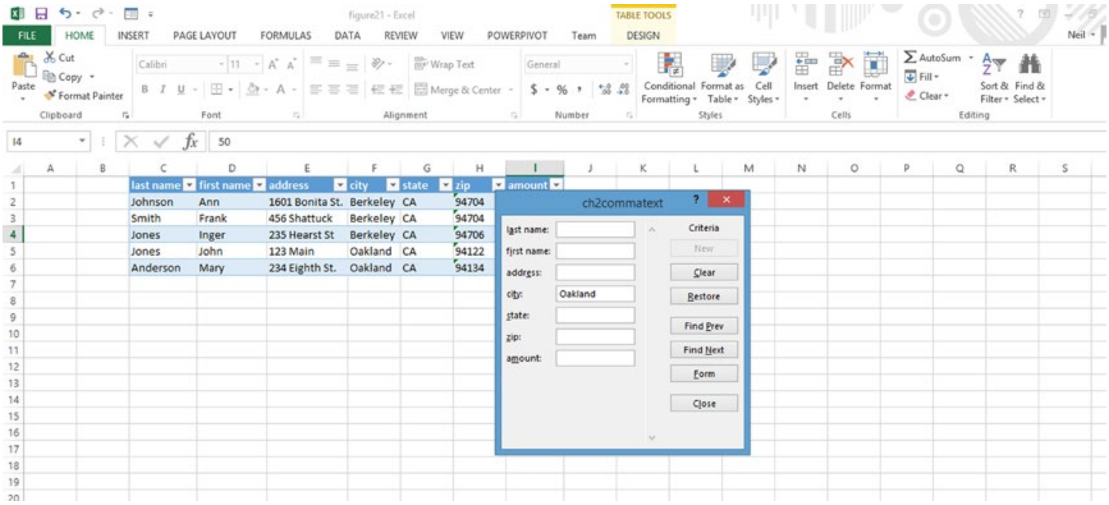
last name:	Johnson
first name:	Ann
address:	1601 Bonita St.
city:	Berkeley
state:	CA
zip:	94704
amount:	60

Figure 2-23. *Using a data form*

Selecting Records

Data forms can be used to selectively look at certain records based on a criterion by following these steps:

1. Click a cell in the table.
2. Click the Form icon in the Quick Access Toolbar or press Alt+D, then O.
3. In the form, click Criteria and enter the criteria you want to use, such as City=Oakland, as shown in Figure 2-24.



I4 50

last name	first name	address	city	state	zip	amount
Johnson	Ann	1601 Bonita St.	Berkeley	CA	94704	
Smith	Frank	456 Shattuck	Berkeley	CA	94704	
Jones	Inger	235 Hearst St	Berkeley	CA	94706	
Jones	John	123 Main	Oakland	CA	94122	
Anderson	Mary	234 Eighth St.	Oakland	CA	94134	

last name:
first name:
address:
city: Oakland
state:
zip:
amount:

Figure 2-24. *Using a data form to select records based on a criterion*

4. Then click Find Next, and Find Previous will only show rows that meet the designated criteria.

Summary

This chapter has shown you how to import data into Excel. Figures 2-1, 2-2, 2-4, 2-5, 2-6, 2-7, 2-9, and 2-10 illustrate different ways of representing the same data. Excel can read all these formats, with the exception of JSON, which can be imported by converting it to XML as an intermediate step. You also saw how to use Tables in Excel as flat files. Chapter 3 will demonstrate how to use Pivot Tables to extract summary data from large datasets. Chapter 4 will show you how to set up relational data models.

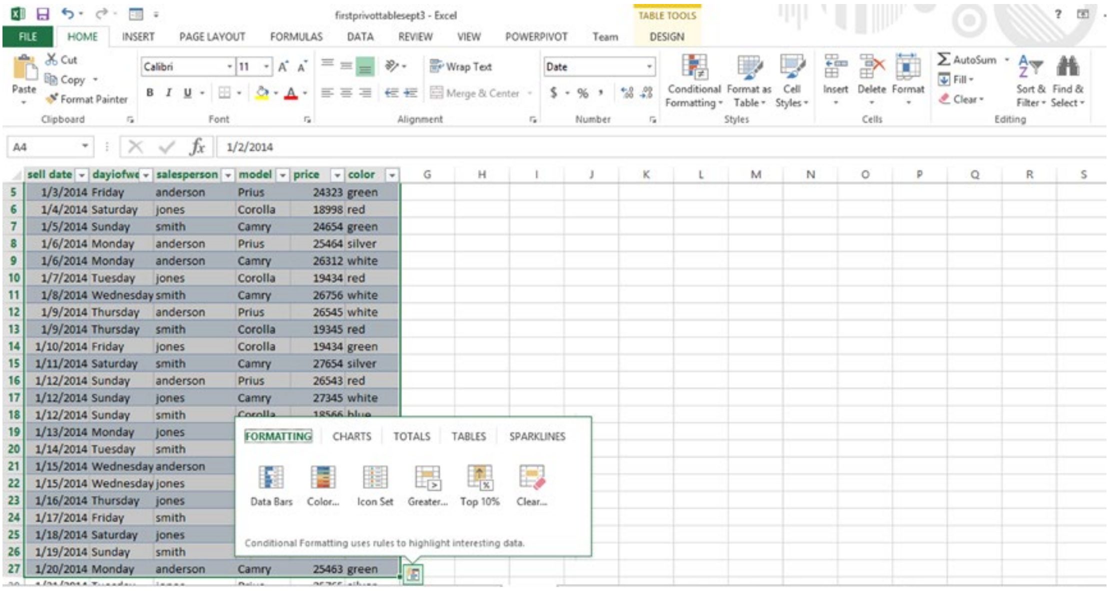
CHAPTER 3

Pivot Tables and Pivot Charts

This chapter covers extracting summary data from a single table, using Pivot Tables and Pivot Charts. The chapter also describes how to import data from the Azure Data Marketplace, using Pivot Tables. Chapter 4 will show how to extract summary data from multiple tables, using the Excel Data Model.

Recommended Pivot Tables in Excel 2013

Excel 2013 tries to anticipate your needs by recommending conditional formatting, charts, tools, and Pivot Tables. When data is highlighted or Ctrl+Q is pressed with any cell in the data range selected, a Quick Analysis Lens button is displayed at the lower right of the range. Clicking the lens will show the Analysis Tool window, which displays various conditional formatting options, as shown in Figure 3-1. Moving the cursor over a conditional formatting option will show a preview of that conditional formatting in the data. Clicking the Tables tab at the top right of the Analysis Tool window will result in several suggested Pivot Tables being shown. Hovering over each Pivot Table presents a preview, as shown in Figure 3-2.

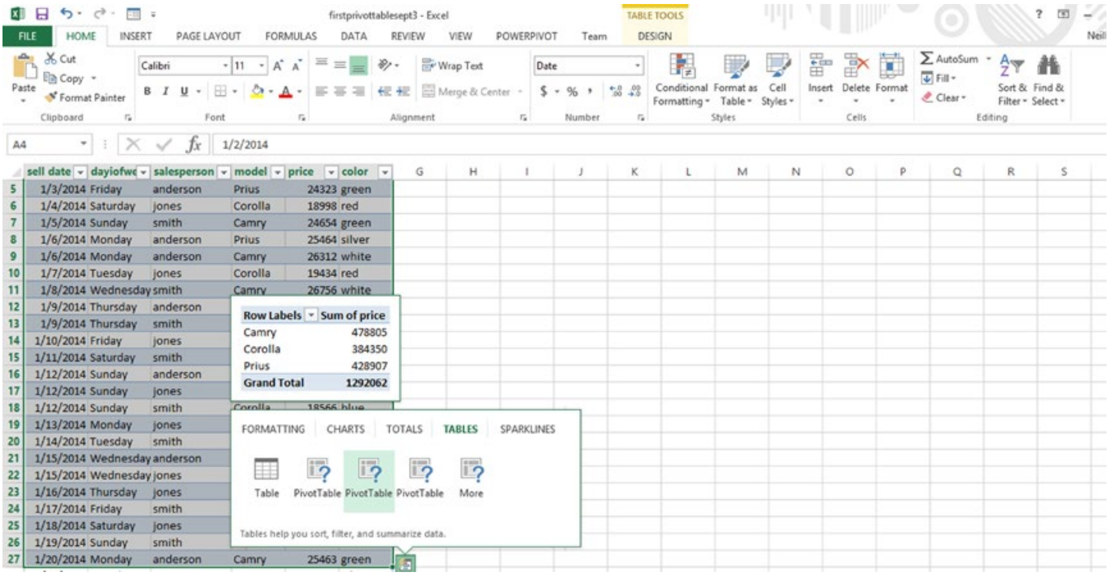


A4 1/2/2014

	sell date	dayiofwe	salesperson	model	price	color	G	H	I	J	K	L	M	N	O	P	Q	R	S
5	1/3/2014	Friday	anderson	Prius	24323	green													
6	1/4/2014	Saturday	jones	Corolla	18998	red													
7	1/5/2014	Sunday	smith	Camry	24654	green													
8	1/6/2014	Monday	anderson	Prius	25464	silver													
9	1/6/2014	Monday	anderson	Camry	26312	white													
10	1/7/2014	Tuesday	jones	Corolla	19434	red													
11	1/8/2014	Wednesday	smith	Camry	26756	white													
12	1/9/2014	Thursday	anderson	Prius	26545	white													
13	1/9/2014	Thursday	smith	Corolla	19345	red													
14	1/10/2014	Friday	jones	Corolla	19434	green													
15	1/11/2014	Saturday	smith	Camry	27654	silver													
16	1/12/2014	Sunday	anderson	Prius	26543	red													
17	1/12/2014	Sunday	jones	Camry	27345	white													
18	1/12/2014	Sunday	smith	Corolla	18566	blue													
19	1/13/2014	Monday	jones																
20	1/14/2014	Tuesday	smith																
21	1/15/2014	Wednesday	anderson																
22	1/15/2014	Wednesday	jones																
23	1/16/2014	Thursday	jones																
24	1/17/2014	Friday	smith																
25	1/18/2014	Saturday	jones																
26	1/19/2014	Sunday	smith																
27	1/20/2014	Monday	anderson	Camry	25463	green													

Conditional Formatting uses rules to highlight interesting data.

Figure 3-1. *Analysis Tool window*



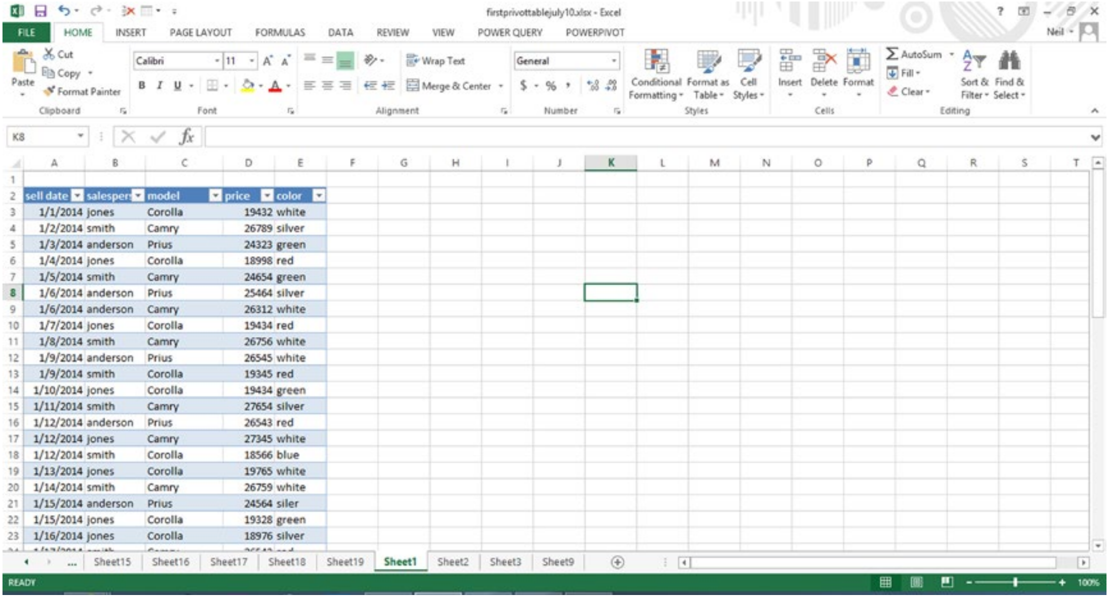
	sell date	dayiofwe	salesperson	model	price	color
5	1/3/2014	Friday	anderson	Prius	24323	green
6	1/4/2014	Saturday	jones	Corolla	18998	red
7	1/5/2014	Sunday	smith	Camry	24654	green
8	1/6/2014	Monday	anderson	Prius	25464	silver
9	1/6/2014	Monday	anderson	Camry	26312	white
10	1/7/2014	Tuesday	jones	Corolla	19434	red
11	1/8/2014	Wednesday	smith	Camry	26756	white
12	1/9/2014	Thursday	anderson			
13	1/9/2014	Thursday	smith			
14	1/10/2014	Friday	jones			
15	1/11/2014	Saturday	smith			
16	1/12/2014	Sunday	anderson			
17	1/12/2014	Sunday	jones			
18	1/12/2014	Sunday	smith	Corolla	18566	blue
19	1/13/2014	Monday	jones			
20	1/14/2014	Tuesday	smith			
21	1/15/2014	Wednesday	anderson			
22	1/15/2014	Wednesday	jones			
23	1/16/2014	Thursday	jones			
24	1/17/2014	Friday	smith			
25	1/18/2014	Saturday	jones			
26	1/19/2014	Sunday	smith			
27	1/20/2014	Monday	anderson	Camry	25463	green

Row Labels	Sum of price
Camry	478805
Corolla	384350
Prius	428907
Grand Total	1292062

Figure 3-2. *Pivot Table preview*

Defining a Pivot Table

This section covers how to define a Pivot Table based on a simple transaction table of hypothetical Toyota sales data that lists transactions, including date of sale, model, salesperson, color, and selling price, as shown in Figure 3-3. Tables on which Pivot Tables are based should contain both numeric data and category fields, so that the numeric data can be sliced and diced by categories.



	A	B	C	D	E
1					
2	sell date	salespers	model	price	color
3	1/1/2014	jones	Corolla	19432	white
4	1/2/2014	smith	Camry	26789	silver
5	1/3/2014	anderson	Prius	24323	green
6	1/4/2014	jones	Corolla	18998	red
7	1/5/2014	smith	Camry	24654	green
8	1/6/2014	anderson	Prius	25464	silver
9	1/6/2014	anderson	Camry	26312	white
10	1/7/2014	jones	Corolla	19434	red
11	1/8/2014	smith	Camry	26756	white
12	1/9/2014	anderson	Prius	26545	white
13	1/9/2014	smith	Corolla	19345	red
14	1/10/2014	jones	Corolla	19434	green
15	1/11/2014	smith	Camry	27654	silver
16	1/12/2014	anderson	Prius	26543	red
17	1/12/2014	jones	Camry	27345	white
18	1/12/2014	smith	Corolla	18566	blue
19	1/13/2014	jones	Corolla	19765	white
20	1/14/2014	smith	Camry	26759	white
21	1/15/2014	anderson	Prius	24564	siler
22	1/15/2014	jones	Corolla	19328	green
23	1/16/2014	jones	Corolla	18976	silver

Figure 3-3. *Auto sales transaction table*

Creating a Pivot Table doesn't change the underlying data; rather, it takes a snapshot of the data. When the underlying data is changed, the Pivot Table does not automatically refresh. To refresh, click anywhere within the Pivot Table to highlight the Pivot Table Tools Analyze tab and click Refresh.

Defining Questions

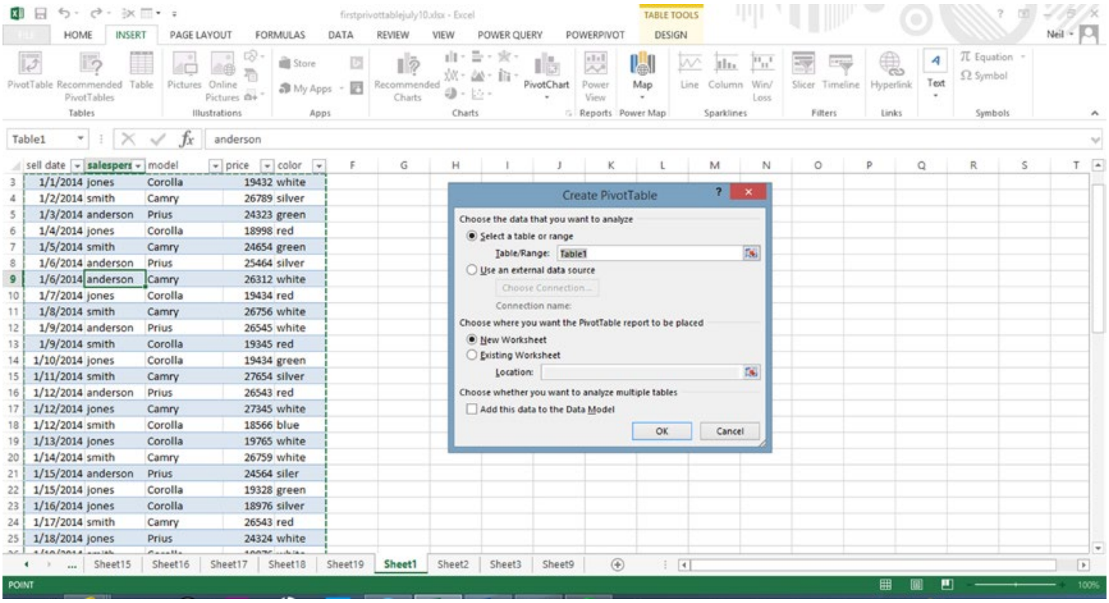
It is good practice to think through what questions you want answered by the Pivot Table. Some typical questions would be the following:

- What are the average sales per day?
- Who is the best performing salesperson?
- What days of the week have the most sales?
- What months have the highest sales?

Creating a Pivot Table

The steps to define a Pivot Table are as follows:

1. Make sure that the underlying data is in table format, with the first row showing the field names, and that the data is surrounded by blank rows and columns or starts in row 1 or column A. Press Ctrl+T to define the data, as a table as shown in Figure 3-3.
2. Click anywhere within the table and highlight the Insert tab. Click PivotTable. The screen shown in Figure 3-4 will appear. Note that the current table is selected and that by default, the Pivot Table will be placed in a new worksheet. Click OK.



	sell date	salespers	model	price	color
3	1/1/2014	jones	Corolla	19432	white
4	1/2/2014	smith	Camry	26789	silver
5	1/3/2014	anderson	Prius	24323	green
6	1/4/2014	jones	Corolla	18998	red
7	1/5/2014	smith	Camry	24654	green
8	1/6/2014	anderson	Prius	25464	silver
9	1/6/2014	anderson	Camry	26312	white
10	1/7/2014	jones	Corolla	19434	red
11	1/8/2014	smith	Camry	26756	white
12	1/9/2014	anderson	Prius	26545	white
13	1/9/2014	smith	Corolla	19345	red
14	1/10/2014	jones	Corolla	19434	green
15	1/11/2014	smith	Camry	27654	silver
16	1/12/2014	anderson	Prius	26543	red
17	1/12/2014	jones	Camry	27345	white
18	1/12/2014	smith	Corolla	18566	blue
19	1/13/2014	jones	Corolla	19765	white
20	1/14/2014	smith	Camry	26759	white
21	1/15/2014	anderson	Prius	24564	siler
22	1/15/2014	jones	Corolla	19328	green
23	1/16/2014	jones	Corolla	18976	silver
24	1/17/2014	smith	Camry	26543	red
25	1/18/2014	jones	Prius	24324	white

Create PivotTable

Choose the data that you want to analyze

● Select a table or range

Table/Range: Table1

○ Use an external data source

Choose Connection...

Connection name:

Choose where you want the PivotTable report to be placed

● New Worksheet

○ Existing Worksheet

Location:

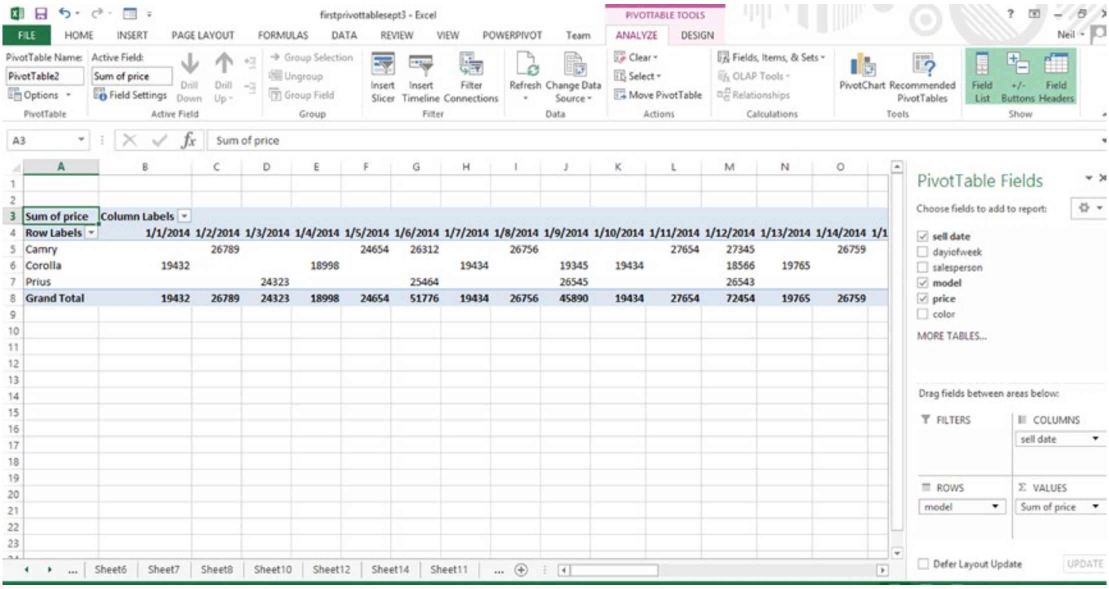
Choose whether you want to analyze multiple tables

□ Add this data to the Data Model

OK Cancel

Figure 3-4. *Create PivotTable dialog*

3. At this point, you have to think through what type of data you want to extract. We will start with a summary of sales per day, with a breakout of models sold per day. We will do this by dragging sell date to the Columns box, model to Rows, and price to Values, as shown in Figure 3-5. Note that the default display is Sum of price.



A3 Sum of price

Sum of price	Column Labels													
Row Labels	1/1/2014	1/2/2014	1/3/2014	1/4/2014	1/5/2014	1/6/2014	1/7/2014	1/8/2014	1/9/2014	1/10/2014	1/11/2014	1/12/2014	1/13/2014	1/14/2014
Camry		26789			24654	26312		26756			27654	27345		26759
Corolla	19432			18998			19434		19345	19434		18566	19765	
Prius			24323			25464			26545			26543		
Grand Total	19432	26789	24323	18998	24654	51776	19434	26756	45890	19434	27654	72454	19765	26759

☑ sell date
□ dayofweek
□ salesperson
☑ model
☑ price
□ color

FILTERS

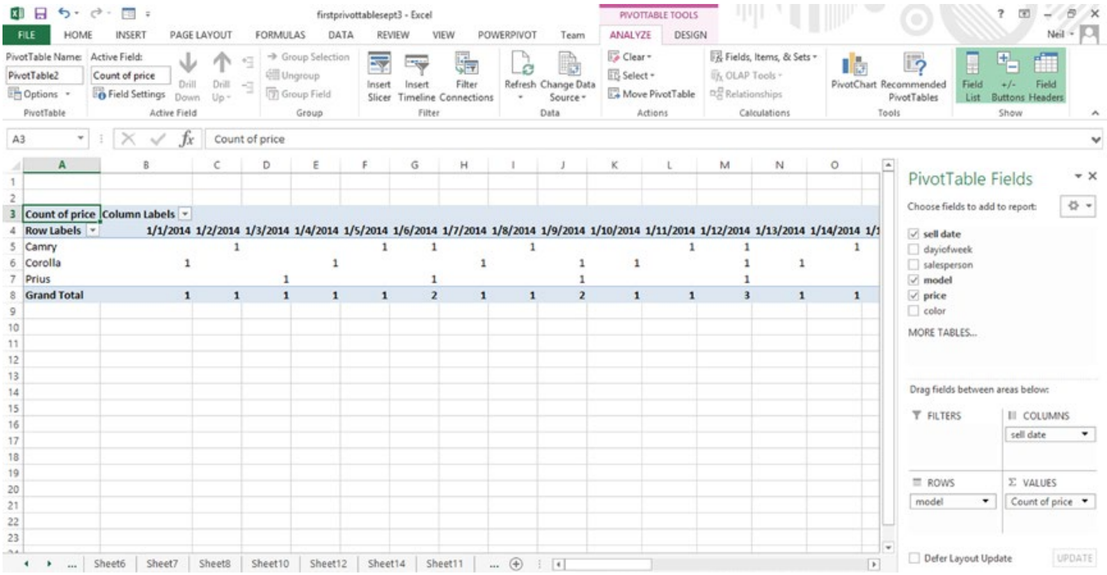
COLUMNS: sell date

ROWS: model

VALUES: Sum of price

Figure 3-5. *Basic Pivot Table showing count of car sales by model*

4. To change Sum of price to Count of price, right-click cell A3 or pull down the arrow on Count of price under Values and select “Summarize Values by” and count. The result is shown in Figure 3-6.



firstprivottablesept3 - Excel

A3 Count of price

Count of price	Column Labels														
Row Labels	1/1/2014	1/2/2014	1/3/2014	1/4/2014	1/5/2014	1/6/2014	1/7/2014	1/8/2014	1/9/2014	1/10/2014	1/11/2014	1/12/2014	1/13/2014	1/14/2014	1/1
Camry		1			1	1		1			1	1		1	
Corolla	1			1			1		1	1		1	1		
Prius			1			1			1			1			
Grand Total	1	1	1	1	1	2	1	1	2	1	1	3	1	1	

PivotTable Fields

Choose fields to add to report:

☑ sell date
□ dayofweek
□ salesperson
☑ model
☑ price
□ color

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS: sell date

ROWS: model

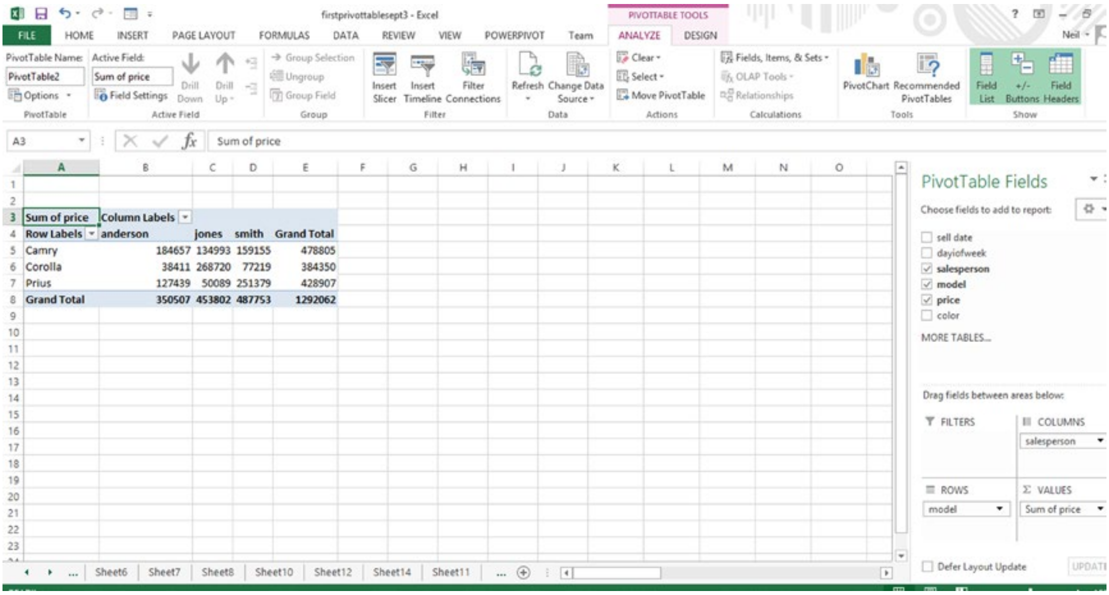
VALUES: Count of price

□ Defer Layout Update UPDATE

Figure 3-6. *Pivot Table showing value of car sales by model*

Changing the Pivot Table

It is very easy to make changes to the Pivot Table. To change the horizontal axis from dates to salesperson, simply click sell date from the Columns box back and select "remove field." Then drag salesperson from the Fields list to the Columns box. The result is shown in Figure 3-7.



firstprivottablesept3 - Excel

A3 Sum of price

Sum of price	Column Labels			
Row Labels	anderson	jones	smith	Grand Total
Camry	184657	134993	159155	478805
Corolla	38411	268720	77219	384350
Prius	127439	50089	251379	428907
Grand Total	350507	453802	487753	1292062

PivotTable Fields

Choose fields to add to report:

□ sell date
□ dayofweek
☑ salesperson
☑ model
☑ price
□ color

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS: salesperson

ROWS: model

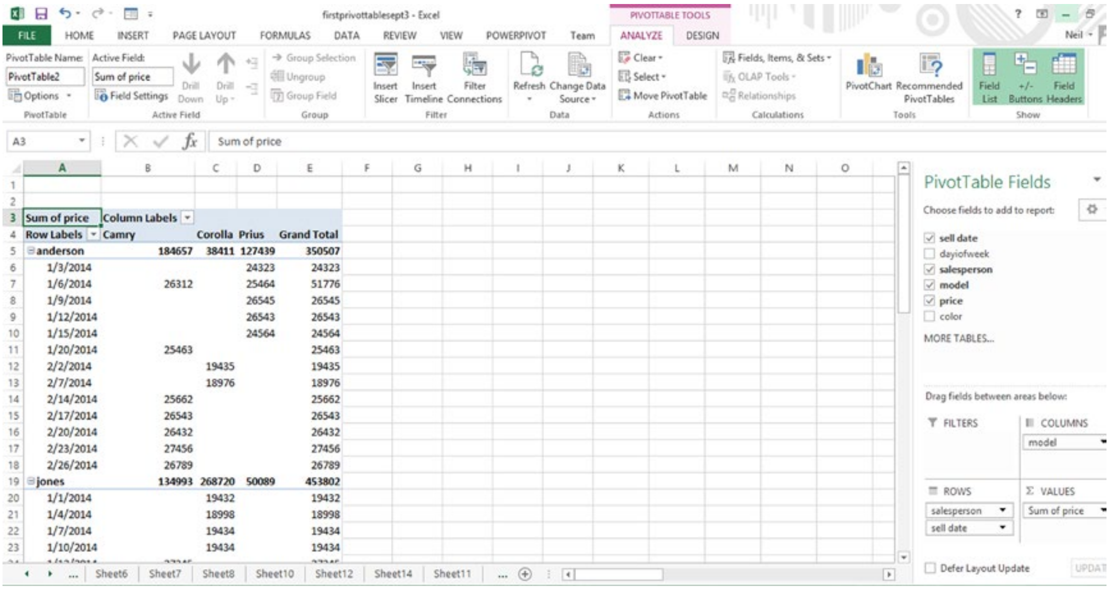
VALUES: Sum of price

□ Defer Layout Update UPDATE

Figure 3-7. *Pivot Table showing sales by model and salesperson*

Creating a Breakdown of Sales by Salesperson for Each Day

The Pivot Table can be modified to show the sales by salesperson and model for each day. Simply drag the model field to the Columns box and salesperson and sell date fields to the Rows box, so that both sell date and salesperson are shown in the Rows box. The results are shown in Figure 3-8.



A3 | *fx* Sum of price

Sum of price	Column Labels			
Row Labels	Camry	Corolla	Prius	Grand Total
anderson	184657	38411	127439	350507
1/3/2014			24323	24323
1/6/2014	26312		25464	51776
1/9/2014			26545	26545
1/12/2014			26543	26543
1/15/2014			24564	24564
1/20/2014	25463			25463
2/2/2014		19435		19435
2/7/2014		18976		18976
2/14/2014	25662			25662
2/17/2014	26543			26543
2/20/2014	26432			26432
2/23/2014	27456			27456
2/26/2014	26789			26789
jones	134993	268720	50089	453802
1/1/2014		19432		19432
1/4/2014		18998		18998
1/7/2014		19434		19434
1/10/2014		19434		19434

PivotTable Fields

Choose fields to add to report:

☑ sell date
☐ dayiofweek
☑ salesperson
☑ model
☑ price
☐ color

COLUMNS: model

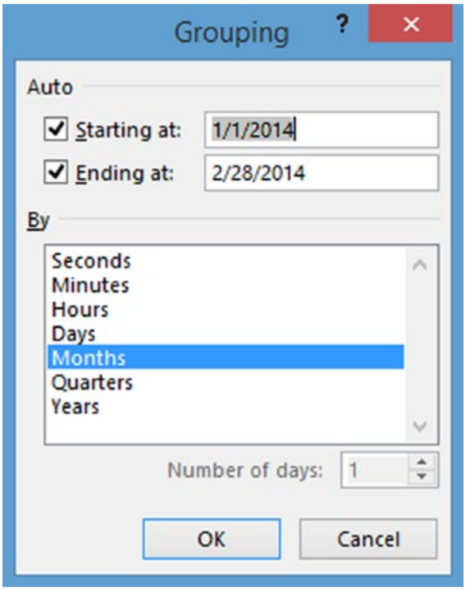
ROWS: salesperson, sell date

VALUES: Sum of price

Figure 3-8. *Pivot Table showing breakdown by salesperson and model for each day*

Showing Sales by Month

To display a sales report by month, right-click any cell in the sell date column and select Months from the Grouping window, as shown in Figure 3-9, and click OK.



Grouping

Auto

☑ Starting at: 1/1/2014

☑ Ending at: 2/28/2014

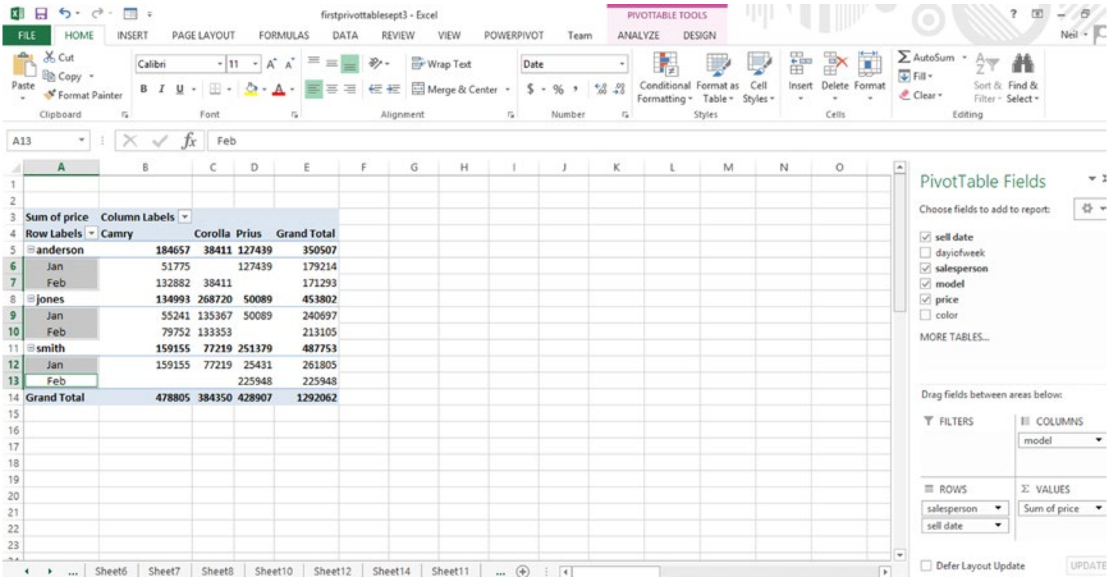
By

Seconds
Minutes
Hours
Days
Months
Quarters
Years

Number of days: 1

***Figure 3-9.** Dialog to select grouping by month*

The resulting Pivot Table is shown in Figure 3-10.



A13 Feb

Sum of price	Column Labels			
Row Labels	Camry	Corolla	Prius	Grand Total
anderson	184657	38411	127439	350507
Jan	51775		127439	179214
Feb	132882	38411		171293
jones	134993	268720	50089	453802
Jan	55241	135367	50089	240697
Feb	79752	133353		213105
smith	159155	77219	251379	487753
Jan	159155	77219	25431	261805
Feb			225948	225948
Grand Total	478805	384350	428907	1292062

PivotTable Fields

Choose fields to add to report:

☑ sell date
☐ dayofweek
☑ salesperson
☑ model
☑ price
☐ color

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS: model

ROWS: salesperson, sell date

VALUES: Sum of price

☐ Defer Layout Update

***Figure 3-10.** Pivot Table showing sales by salesperson and model by month*

Creating a Pivot Chart

To create a Pivot Chart from a Pivot Table, with the Pivot Table displayed on the screen, do the following:

1. Go to the Pivot Table Tools Analyze tab and select Pivot Chart.
2. From the Insert Chart pop-up shown in Figure 3-11, select the type of chart desired and click OK. For this example, we will use a stacked column chart.

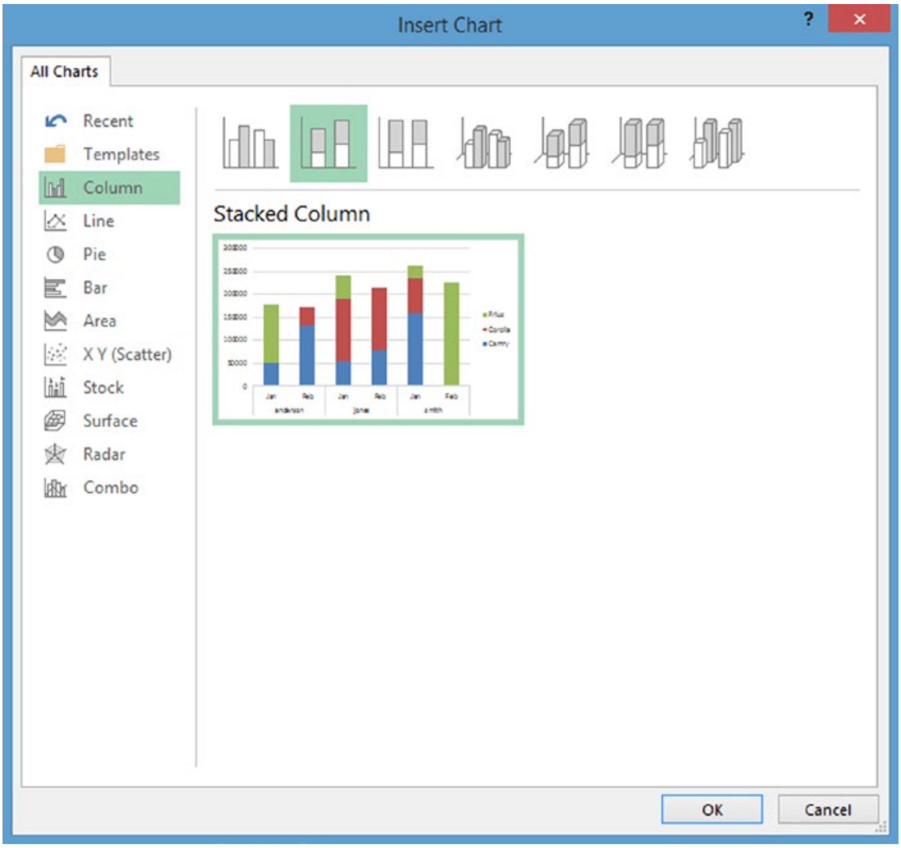
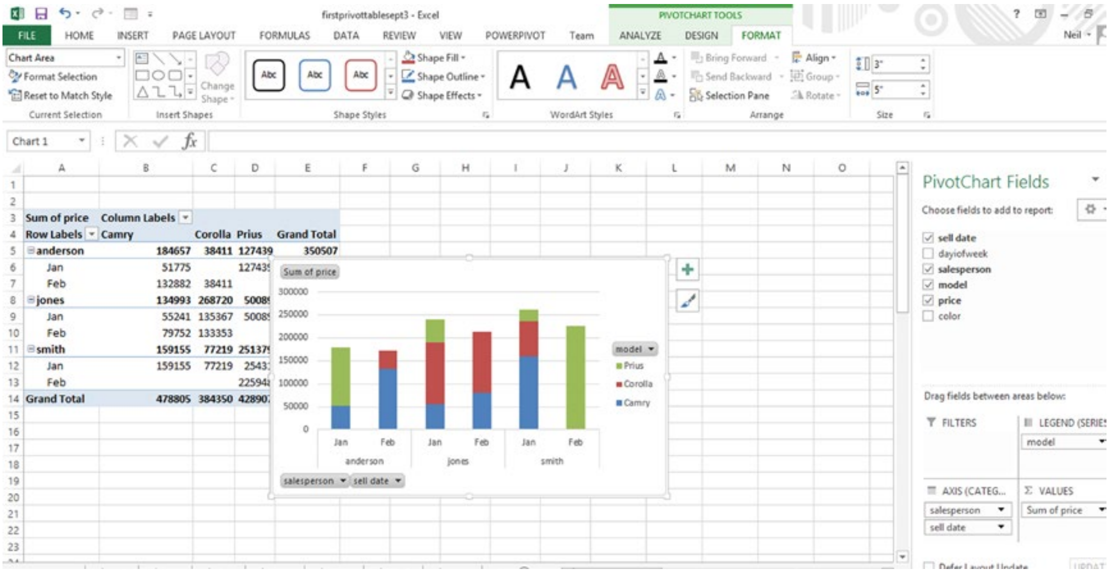


Figure 3-11. *Insert Chart dialog*

3. The result will be displayed as shown in Figure 3-12.



Sum of price	Column Labels			
Row Labels	Camry	Corolla	Prius	Grand Total
⊟anderson	184657	38411	127439	350507
Jan	51775		12743	
Feb	132882	38411		
⊟jones	134993	268720	5008	
Jan	55241	135367	5008	
Feb	79752	133353		
⊟smith	159155	77219	25137	
Jan	159155	77219	2543	
Feb			22594	
Grand Total	478805	384350	42890	

PivotChart Fields

Choose fields to add to report:

☑ sell date
□ dayofweek
☑ salesperson
☑ model
☑ price
□ color

Drag fields between areas below:

FILTERS

LEGEND (SERIES): model

AXIS (CATEG...: salesperson, sell date

VALUES: Sum of price

Figure 3-12. Pivot Chart with Pivot Table

Adjusting Subtotals and Grand Totals

The subtotals can be adjusted on the Pivot Table Tools Design tab. Click Subtotals to see the options.

- Do not show subtotals
- Show all subtotals at bottom of group
- Show all subtotals at top of group

Click Grand Totals to see the following options:

- Off for rows and columns
- On for rows and columns
- On for rows only
- On for columns only

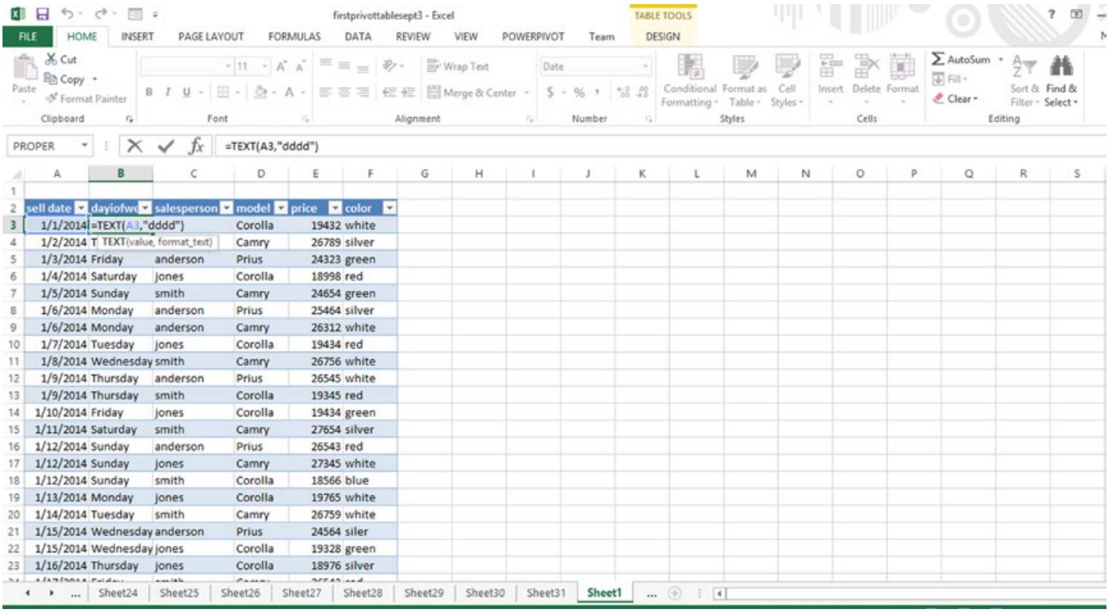
Analyzing Sales by Day of Week

It can be useful to analyze sales by day of the week. In this example, we have added a column for day of week, using the following steps:

1. Insert a column to the left of salesperson. Name the new column “day of week.”
2. Enter the following formula in cell B3, to extract the day of week:

   ```
   =TEXT(A3,"dddd")
   ```

3. The formula will be automatically copied down the column, because this is a table. The result is as shown in Figure 3-13.



PROPER =TEXT(A3,"dddd")

	A	B	C	D	E	F
1						
2	sell date	dayiofwe	salesperson	model	price	color
3	1/1/2014	=TEXT(A3,"dddd")		Corolla	19432	white
4	1/2/2014	T TEXT(value, format_text)		Camry	26789	silver
5	1/3/2014	Friday	anderson	Prius	24323	green
6	1/4/2014	Saturday	jones	Corolla	18998	red
7	1/5/2014	Sunday	smith	Camry	24654	green
8	1/6/2014	Monday	anderson	Prius	25464	silver
9	1/6/2014	Monday	anderson	Camry	26312	white
10	1/7/2014	Tuesday	jones	Corolla	19434	red
11	1/8/2014	Wednesday	smith	Camry	26756	white
12	1/9/2014	Thursday	anderson	Prius	26545	white
13	1/9/2014	Thursday	smith	Corolla	19345	red
14	1/10/2014	Friday	jones	Corolla	19434	green
15	1/11/2014	Saturday	smith	Camry	27654	silver
16	1/12/2014	Sunday	anderson	Prius	26543	red
17	1/12/2014	Sunday	jones	Camry	27345	white
18	1/12/2014	Sunday	smith	Corolla	18566	blue
19	1/13/2014	Monday	jones	Corolla	19765	white
20	1/14/2014	Tuesday	smith	Camry	26759	white
21	1/15/2014	Wednesday	anderson	Prius	24564	siler
22	1/15/2014	Wednesday	jones	Corolla	19328	green
23	1/16/2014	Thursday	jones	Corolla	18976	silver

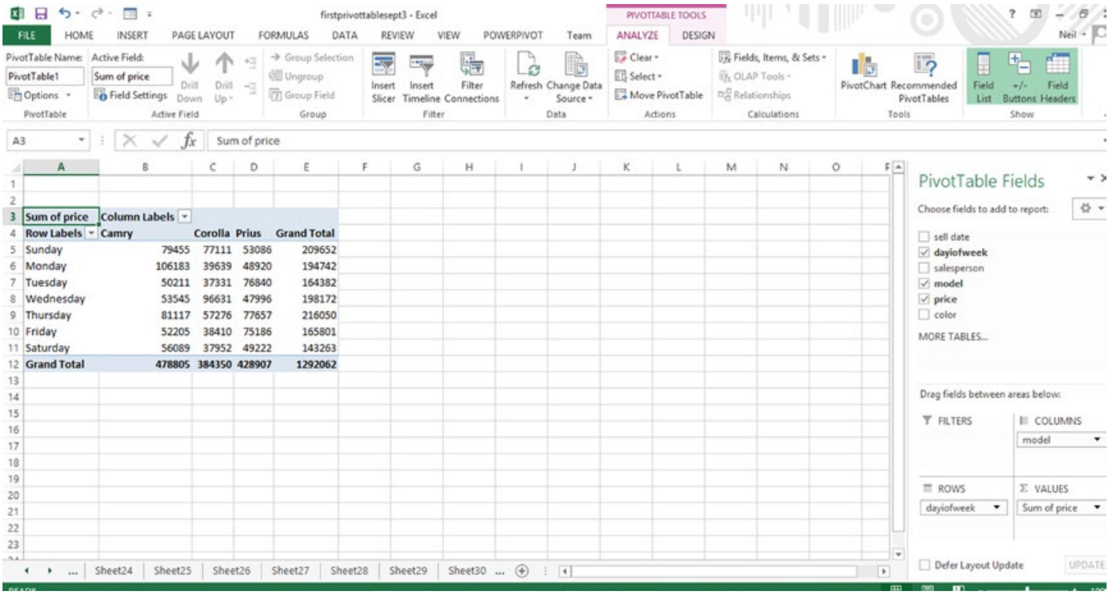
Figure 3-13. *Extracting day of week*

4. Save the spreadsheet.

5. On the Insert tab, click PivotTable. Click OK in the Create PivotTable pop-up window to accept the default.

6. If necessary, click Refresh on the Pivot Table Analyze tab to display the new column.

7. On the PivotTable Fields tab, drag model to the Columns box, day of week to Rows, and Sum of price to Values to get the Pivot Table shown in Figure 3-14.



Sum of price

Sum of price	Column Labels			
Row Labels	Camry	Corolla	Prius	Grand Total
Sunday	79455	77111	53086	209652
Monday	106183	39639	48920	194742
Tuesday	50211	37331	76840	164382
Wednesday	53545	96631	47996	198172
Thursday	81117	57276	77657	216050
Friday	52205	38410	75186	165801
Saturday	56089	37952	49222	143263
Grand Total	478805	384350	428907	1292062

PivotTable Fields

Choose fields to add to report:

□ sell date
☑ dayiofweek
□ salesperson
☑ model
☑ price
□ color

MORE TABLES...

Drag fields between areas below:

FILTERS

COLUMNS: model

ROWS: dayiofweek

VALUES: Sum of price

□ Defer Layout Update

UPDATE

Figure 3-14. *Pivot Table of sales by day of week and model*

Creating a Pivot Chart of Sales by Day of Week

To get a visual representation of sales by day of the week, create a Pivot Chart from a Pivot Table. With the Pivot Table displayed on the screen, do the following:

1. Go to the Pivot Table Tools Analyze tab and select Pivot Chart.
2. From the Insert Chart pop-up shown in Figure 3-15, select the type of chart desired.

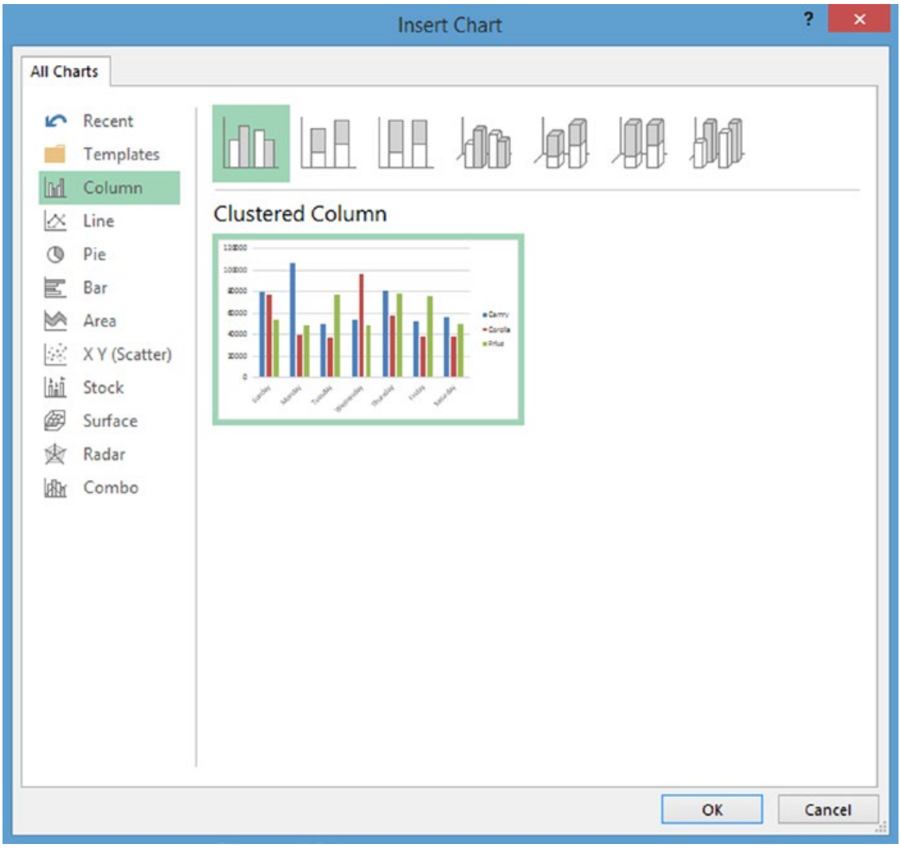
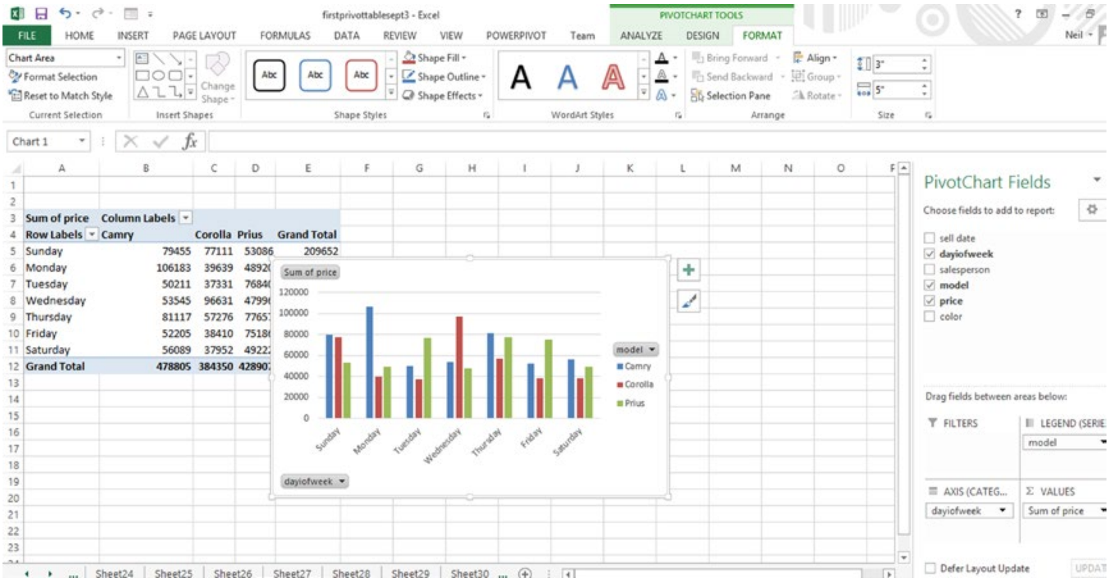


Figure 3-15. *Insert Chart dialog*

3. If a clustered column chart is selected, the results will be as shown in Figure 3-16.



Sum of price	Column Labels			
Row Labels	Camry	Corolla	Prius	Grand Total
Sunday	79455	77111	53086	209652
Monday	106183	39639	4892	
Tuesday	50211	37331	7684	
Wednesday	53545	96631	4799	
Thursday	81117	57276	7765	
Friday	52205	38410	7518	
Saturday	56089	37952	4922	
Grand Total	478805	384350	42890	

PivotChart Fields

Choose fields to add to report:

☐ sell date
☑ dayiofweek
☐ salesperson
☑ model
☑ price
☐ color

Drag fields between areas below:

FILTERS

LEGEND (SERIE: model

AXIS (CATEG...: dayiofweek

VALUES: Sum of price

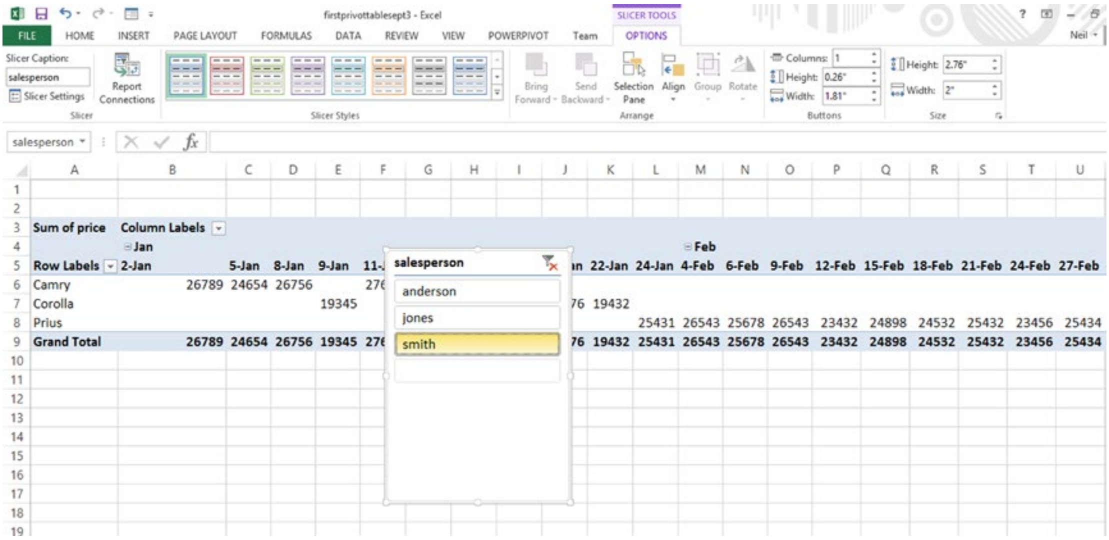
☐ Defer Layout Update

Figure 3-16. *Pivot Chart for sales by day of week*

Using Slicers

Slicers can be used to filter data and to zoom in on specific field values in the Pivot Table. To set up a slicer, do the following:

1. Go to the Pivot Table Tools Analyze tab and select Insert Slicer.
2. From the Insert Slicers pop-up window, select the fields that you want to slice, such as salesperson and date, and click OK.
3. The result is shown in Figure 3-17, which displays the sales by salesperson for each model and date…A specific salesperson can be selected, and the slicer menu can be selected to view sales for that salesperson.



Sum of price	Column Labels																	
	Jan								Feb									
Row Labels	2-Jan	5-Jan	8-Jan	9-Jan	11-	an	22-Jan	24-Jan	4-Feb	6-Feb	9-Feb	12-Feb	15-Feb	18-Feb	21-Feb	24-Feb	27-Feb
Camry	26789	24654	26756		276												
Corolla				19345		76	19432										
Prius								25431	26543	25678	26543	23432	24898	24532	25432	23456	25434
Grand Total	26789	24654	26756	19345	276	76	19432	25431	26543	25678	26543	23432	24898	24532	25432	23456	25434

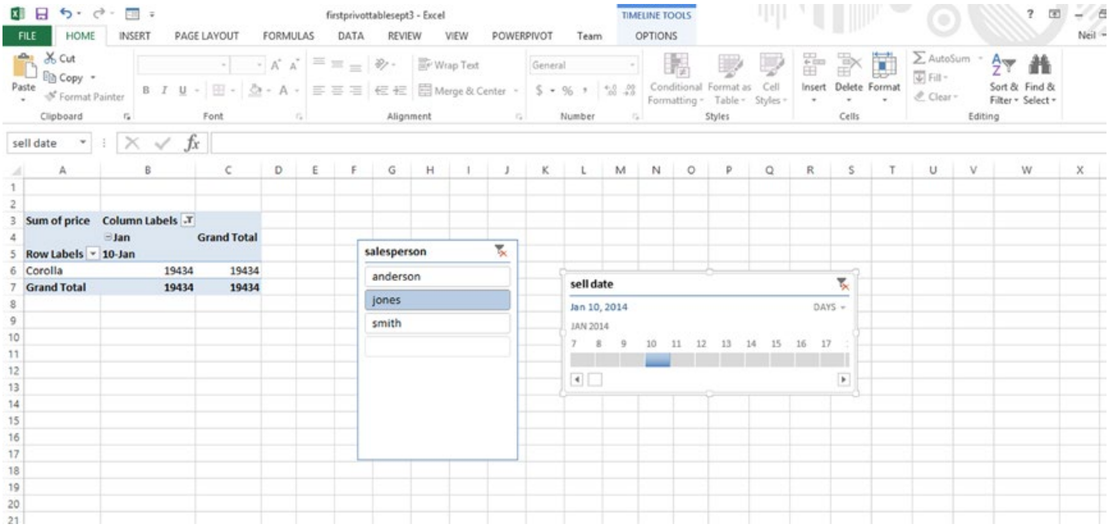
Figure 3-17. *Filtering results using salesperson slicer*

Adding a Time Line

A time line can be added to slice by time intervals. To add a time line, do the following:

1. From the Pivot Table Tool Analyze tab, select Insert Timeline. Select sell date in the Insert Timeline window and click OK. The time period for the time line can be selected by clicking the down arrow at the upper right of the Timeline window to select years, quarters, months, or days.

2. As seen in Figure 3-18, Timeline and Slicer work together. A specific salesperson and date can be selected to view sales by that salesperson on that date.



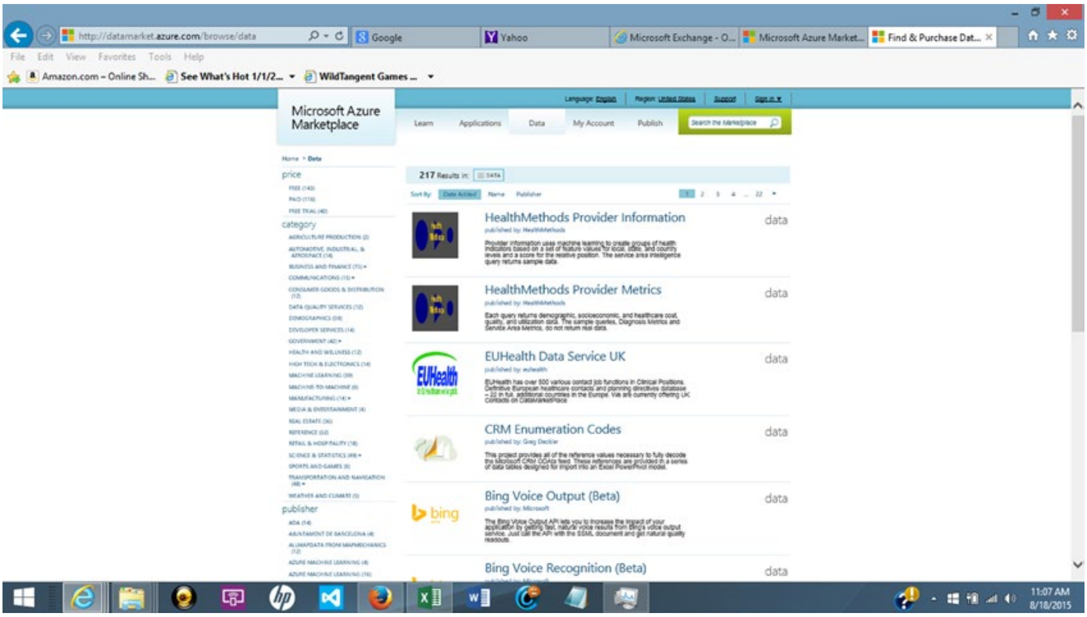
Sum of price	Column Labels	
	⊟Jan	Grand Total
Row Labels	10-Jan	
Corolla	19434	19434
Grand Total	19434	19434

Figure 3-18. *Filtering data with a time line plus salesperson slicer*

Importing Pivot Table Data from the Azure Marketplace

Data can be imported into a Pivot Table from the Azure Marketplace, which includes a wide variety of data, such as demographic, environmental, financial, retail, and sports. Some of the data is free, and some is not. The following example shows how to access free data.

1. Go to the Azure Marketplace web site at `datamarket.azure.com/browse/data`. The screen shown in Figure 3-19 will appear as of August 2015.

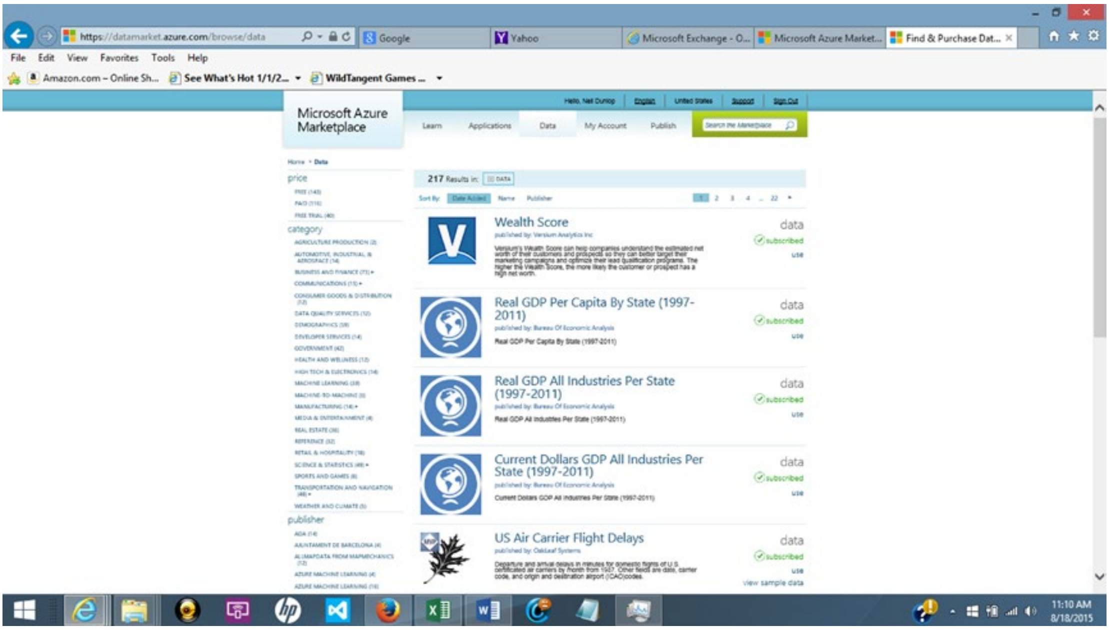


http://datamarket.azure.com/browse/data
Google
Yahoo
Microsoft Exchange - O...
Microsoft Azure Market...
Find & Purchase Dat...
File Edit View Favorites Tools Help
Amazon.com – Online Sh...
See What's Hot 1/1/2...
WildTangent Games ...
Microsoft Azure Marketplace
Learn
Applications
Data
My Account
Publish
price
category
publisher
217 Results in
HealthMethods Provider Information
HealthMethods Provider Metrics
EUHealth Data Service UK
CRM Enumeration Codes
Bing Voice Output (Beta)
Bing Voice Recognition (Beta)
data
11:07 AM
8/18/2015

Figure 3-19. *Azure data market browse screen*

2. The first time you use the site, you may be asked to fill in account information and to create a free account ID. If you already have a free Microsoft account, such as a Hotmail.com or Outlook.com account, you can use that.

3. Click Data at the top of the screen. The screen shown in Figure 3-20 will appear.


https://datamarket.azure.com/browse/data
Google
Yahoo
Microsoft Exchange - O...
Microsoft Azure Market...
Find & Purchase Dat...
File Edit View Favorites Tools Help
Amazon.com – Online Sh...
See What's Hot 1/1/2...
WildTangent Games ...
Hello, Neil Dunlop
English
United States
Support
Sign Out
Microsoft Azure Marketplace
Learn
Applications
Data
My Account
Publish
Search the Marketplace
Home › Data
price
FREE (143)
PAID (116)
FREE TRIAL (40)
category
AGRICULTURE PRODUCTION (2)
AUTOMOTIVE, INDUSTRIAL, & AEROSPACE (14)
BUSINESS AND FINANCE (71)
COMMUNICATIONS (13)
CONSUMER GOODS & DISTRIBUTION (12)
DATA QUALITY SERVICES (12)
DEMOGRAPHICS (58)
DEVELOPER SERVICES (14)
GOVERNMENT (42)
HEALTH AND WELLNESS (12)
HIGH TECH & ELECTRONICS (14)
MACHINE LEARNING (38)
MACHINE-TO-MACHINE (3)
MANUFACTURING (14)
MEDIA & ENTERTAINMENT (4)
REAL ESTATE (30)
REFERENCE (32)
RETAIL & HOSPITALITY (18)
SCIENCE & STATISTICS (49)
SPORTS AND GAMES (8)
TRANSPORTATION AND NAVIGATION (48)
WEATHER AND CLIMATE (5)
publisher
AGA (14)
AJUNTAMENT DE BARCELONA (4)
ALLMAPDATA FROM MAPMECHANICS (12)
AZURE MACHINE LEARNING (4)
AZURE MACHINE LEARNING (16)
217 Results in: DATA
Sort By: Date Added Name Publisher
1 2 3 4 ... 22
data
subscribed
use
view sample data
11:10 AM
8/18/2015

Wealth Score
published by: Versium Analytics Inc
Versium's Wealth Score can help companies understand the estimated net worth of their customers and prospects so they can better target their marketing campaigns and optimize their lead qualification programs. The higher the Wealth Score, the more likely the customer or prospect has a high net worth.

Real GDP Per Capita By State (1997-2011)
published by: Bureau Of Economic Analysis
Real GDP Per Capita By State (1997-2011)

Real GDP All Industries Per State (1997-2011)
published by: Bureau Of Economic Analysis
Real GDP All Industries Per State (1997-2011)

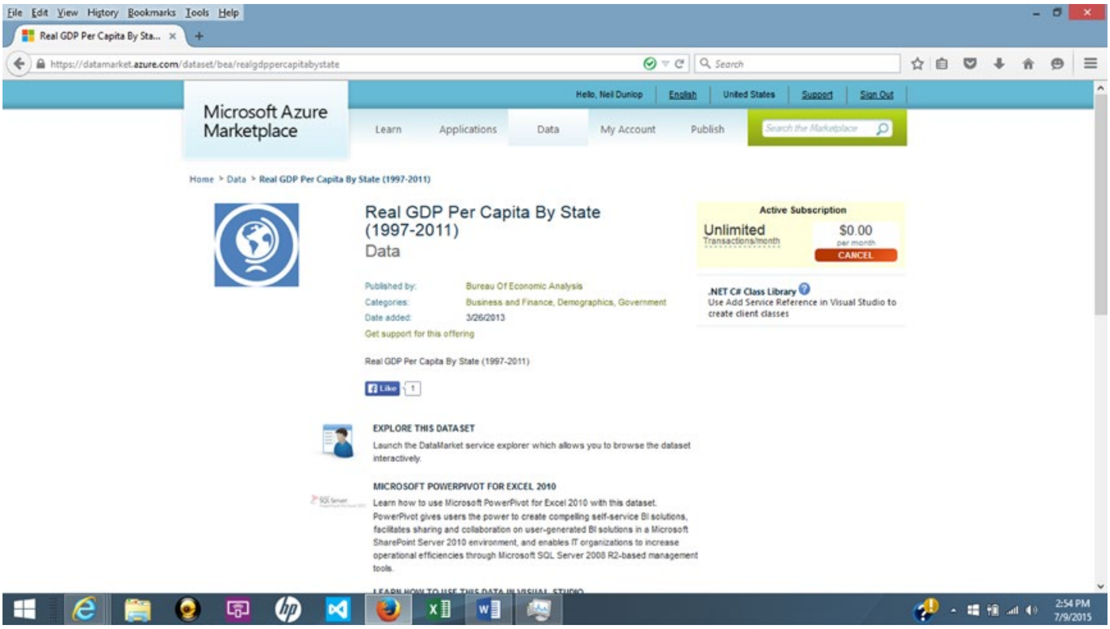
Current Dollars GDP All Industries Per State (1997-2011)
published by: Bureau Of Economic Analysis
Current Dollars GDP All Industries Per State (1997-2011)

US Air Carrier Flight Delays
published by: OakLeaf Systems
Departure and arrival delays in minutes for domestic flights of U.S. certificated air carriers by month from 1987. Other fields are date, carrier code, and origin and destination airport (ICAO)codes.

Figure 3-20. *Azure Marketplace*

4. Scroll through the data sources. You may have to go through an additional sign-up process to use free data.

5. For this example, we will use Real GDP Per Capita By State (1997–2011), as shown in Figure 3-21. If prompted, enter your Microsoft ID and agree to the terms of use.


File Edit View History Bookmarks Tools Help
Real GDP Per Capita By Sta...
https://datamarket.azure.com/dataset/bea/realgdppercapitabystate
Search
Hello, Neil Dunlop
English
United States
Support
Sign Out
Microsoft Azure Marketplace
Learn
Applications
Data
My Account
Publish
Search the Marketplace
Home > Data > Real GDP Per Capita By State (1997-2011)
Like
1
CANCEL
2:54 PM
7/9/2015

Real GDP Per Capita By State (1997-2011)
Data

Published by: Bureau Of Economic Analysis
Categories: Business and Finance, Demographics, Government
Date added: 3/26/2013
Get support for this offering

Real GDP Per Capita By State (1997-2011)

Active Subscription
Unlimited Transactions/month $0.00 per month

.NET C# Class Library
Use Add Service Reference in Visual Studio to create client classes

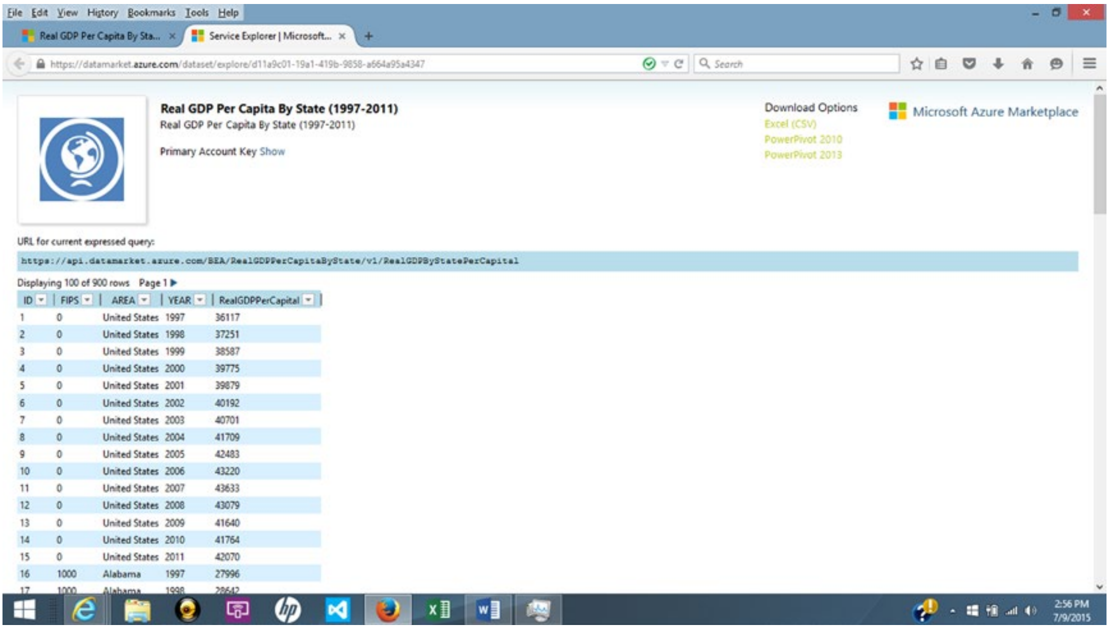
EXPLORE THIS DATASET
Launch the DataMarket service explorer which allows you to browse the dataset interactively.

MICROSOFT POWERPIVOT FOR EXCEL 2010
Learn how to use Microsoft PowerPivot for Excel 2010 with this dataset. PowerPivot gives users the power to create compelling self-service BI solutions, facilitates sharing and collaboration on user-generated BI solutions in a Microsoft SharePoint Server 2010 environment, and enables IT organizations to increase operational efficiencies through Microsoft SQL Server 2008 R2-based management tools.

LEARN HOW TO USE THIS DATA IN VISUAL STUDIO

Figure 3-21. *Real GDP all industries per state database*

6. Click Explore this Dataset in the middle of the screen.
7. The data will be displayed, as shown in Figure 3-22. Note, in the upper-right corner of the screen, the Download Options of Excel (CSV), PowerPivot 2010, and PowerPivot 2013. Select PowerPivot 2013.


File Edit View History Bookmarks Tools Help
Real GDP Per Capita By Sta...
Service Explorer | Microsoft...
https://datamarket.azure.com/dataset/explore/d11a9c01-19a1-419b-9858-a664a95a4347
Search
Download Options
Excel (CSV)
PowerPivot 2010
PowerPivot 2013
Microsoft Azure Marketplace
2:56 PM
7/9/2015

Real GDP Per Capita By State (1997-2011)

Real GDP Per Capita By State (1997-2011)

Primary Account Key Show

URL for current expressed query:

```
https://api.datamarket.azure.com/BEA/RealGDPPerCapitaByState/v1/RealGDPByStatePerCapital
```

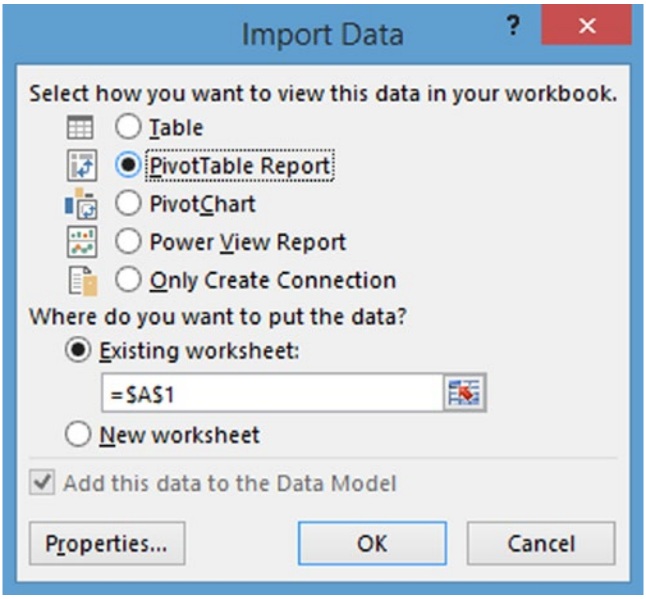
Displaying 100 of 900 rows Page 1 ▶

ID	FIPS	AREA	YEAR	RealGDPPerCapital
1	0	United States	1997	36117
2	0	United States	1998	37251
3	0	United States	1999	38587
4	0	United States	2000	39775
5	0	United States	2001	39879
6	0	United States	2002	40192
7	0	United States	2003	40701
8	0	United States	2004	41709
9	0	United States	2005	42483
10	0	United States	2006	43220
11	0	United States	2007	43633
12	0	United States	2008	43079
13	0	United States	2009	41640
14	0	United States	2010	41764
15	0	United States	2011	42070
16	1000	Alabama	1997	27996
17	1000	Alabama	1998	28642

Figure 3-22. *Display of real GDP per capita records*

8. You will be prompted to save the file. Click OK. The file will appear in the download section of your web browser. What you will see now depends on which web browser you are using. To save the file and open in Excel, click whatever prompts appear. If using Firefox, double-click the file name to start the process. If you are prompted to select the program to use to open the file, choose Excel.

9. A pop-up window will appear, as shown in Figure 3-23, asking for how you want to view the data. Select Pivot Table Report, click OK, and wait for the data to download.



Import Data

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

○ Table
● PivotTable Report
○ PivotChart
○ Power View Report
○ Only Create Connection

Where do you want to put the data?

● Existing worksheet:
=$A$1

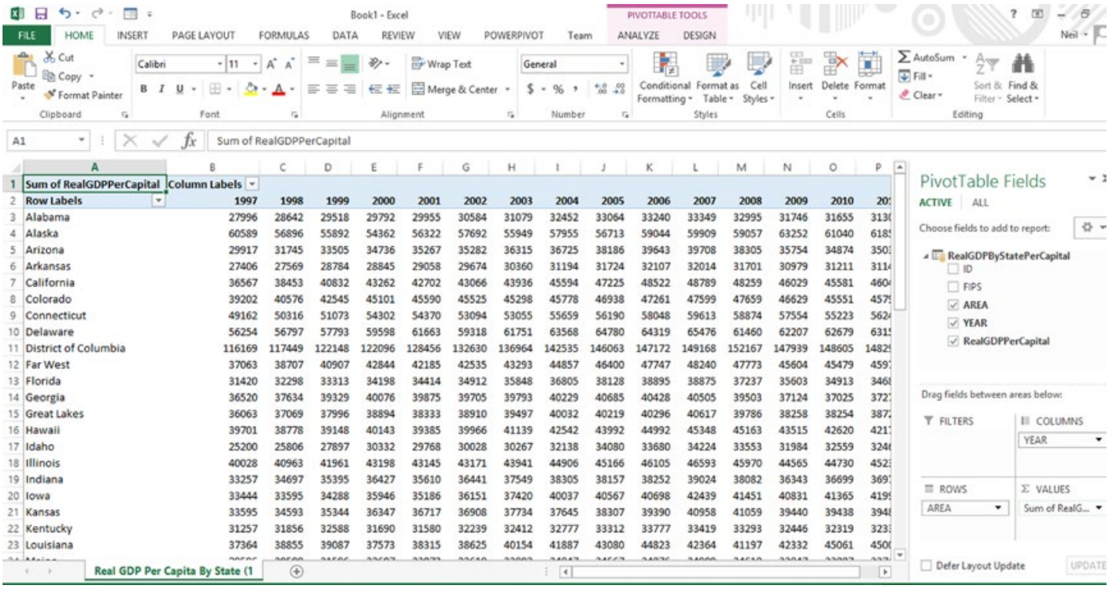
○ New worksheet

☑ Add this data to the Data Model

Figure 3-23. *Import Data dialog*

10. If a pop-up appears asking for your account key, enter your Microsoft username (e.g., a Hotmail or Outlook.com e-mail address).

11. Start designing the Pivot Table. Drag year to the Columns box, drag area to the Row box, and Real GDP to Values, as shown in Figure 3-24.



A1 Sum of RealGDPPerCapital

Sum of RealGDPPerCapital	Column Labels														
Row Labels	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	20
Alabama	27996	28642	29518	29792	29955	30584	31079	32452	33064	33240	33349	32995	31746	31655	313
Alaska	60589	56896	55892	54362	56322	57692	55949	57955	56713	59044	59909	59057	63252	61040	618
Arizona	29917	31745	33505	34736	35267	35282	36315	36725	38186	39643	39708	38305	35754	34874	350
Arkansas	27406	27569	28784	28845	29058	29674	30360	31194	31724	32107	32014	31701	30979	31211	311
California	36567	38453	40832	43262	42702	43066	43936	45594	47225	48522	48789	48259	46029	45581	460
Colorado	39202	40576	42545	45101	45590	45525	45298	45778	46938	47261	47599	47659	46629	45551	457
Connecticut	49162	50316	51073	54302	54370	53094	53055	55659	56190	58048	59613	58874	57554	55223	562
Delaware	56254	56797	57793	59598	61663	59318	61751	63568	64780	64319	65476	61460	62207	62679	631
District of Columbia	116169	117449	122148	122096	128456	132630	136964	142535	146063	147172	149168	152167	147939	148605	1482
Far West	37063	38707	40907	42844	42185	42535	43293	44857	46400	47747	48240	47773	45604	45479	459
Florida	31420	32298	33313	34198	34414	34912	35848	36805	38128	38895	38875	37237	35603	34913	346
Georgia	36520	37634	39329	40076	39875	39705	39793	40229	40685	40428	40505	39503	37124	37025	372
Great Lakes	36063	37069	37996	38894	38333	38910	39497	40032	40219	40296	40617	39786	38258	38254	387
Hawaii	39701	38778	39148	40143	39385	39966	41139	42542	43992	44992	45348	45163	43515	42620	421
Idaho	25200	25806	27897	30332	29768	30028	30267	32138	34080	33680	34224	33553	31984	32559	324
Illinois	40028	40963	41961	43198	43145	43171	43941	44906	45166	46105	46593	45970	44565	44730	452
Indiana	33257	34697	35395	36427	35610	36441	37549	38305	38157	38252	39024	38082	36343	36699	369
Iowa	33444	33595	34288	35946	35186	36151	37420	40037	40567	40698	42439	41451	40831	41365	419
Kansas	33595	34593	35344	36347	36717	36908	37734	37645	38307	39390	40958	41059	39440	39438	394
Kentucky	31257	31856	32588	31690	31580	32239	32412	32777	33312	33777	33419	33293	32446	32319	323
Louisiana	37364	38855	39087	37573	38315	38625	40154	41887	43080	44823	42364	41197	42332	45061	450

Real GDP Per Capita By State (1

PivotTable Fields

ACTIVE ALL

Choose fields to add to report:

RealGDPByStatePerCapital
□ ID
□ FIPS
☑ AREA
☑ YEAR
☑ RealGDPPerCapital

Drag fields between areas below:

FILTERS

COLUMNS: YEAR

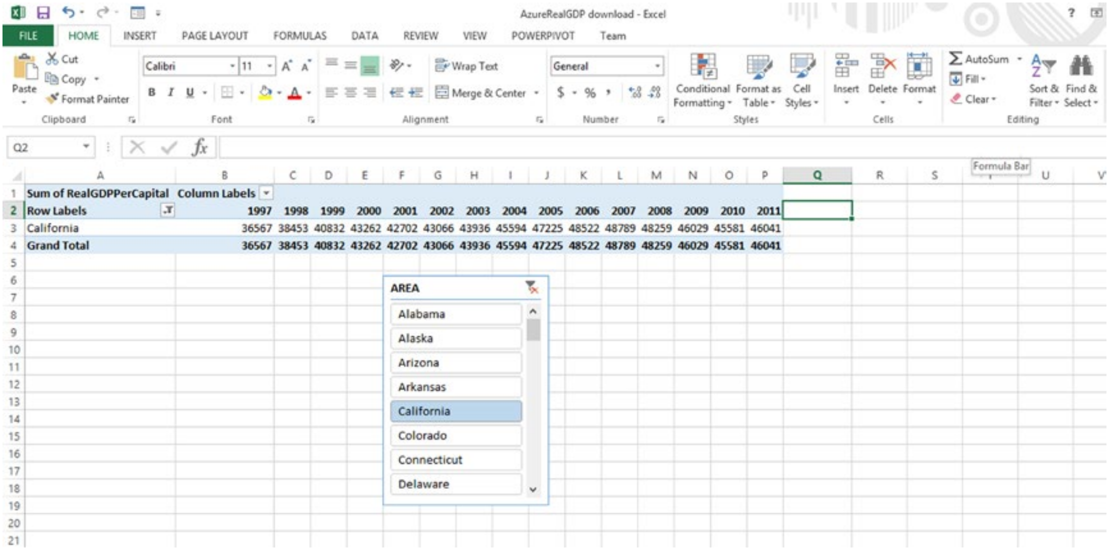
ROWS: AREA

VALUES: Sum of RealG...

□ Defer Layout Update

Figure 3-24. *Real GDP data imported into Excel*

12. To use a slicer to filter the data, click Insert Slicer on the Pivot Table Tools Analyze tab. Select the Area field and click OK. On the Slicer menu, select a state, such as California, to view its real GDP per capita, as shown in Figure 3-25.



Sum of RealGDPPerCapital	Column Labels														
Row Labels	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
California	36567	38453	40832	43262	42702	43066	43936	45594	47225	48522	48789	48259	46029	45581	46041
Grand Total	36567	38453	40832	43262	42702	43066	43936	45594	47225	48522	48789	48259	46029	45581	46041

Figure 3-25. *Real GDP data filtered by slicer*

Summary

This chapter showed how to use Pivot Tables and Pivot Charts based on a single table and how to import data from the Microsoft Azure Marketplace. Chapter 4 will show how to use the Excel Data Model to extract data from multiple tables.

CHAPTER 4

Building a Data Model

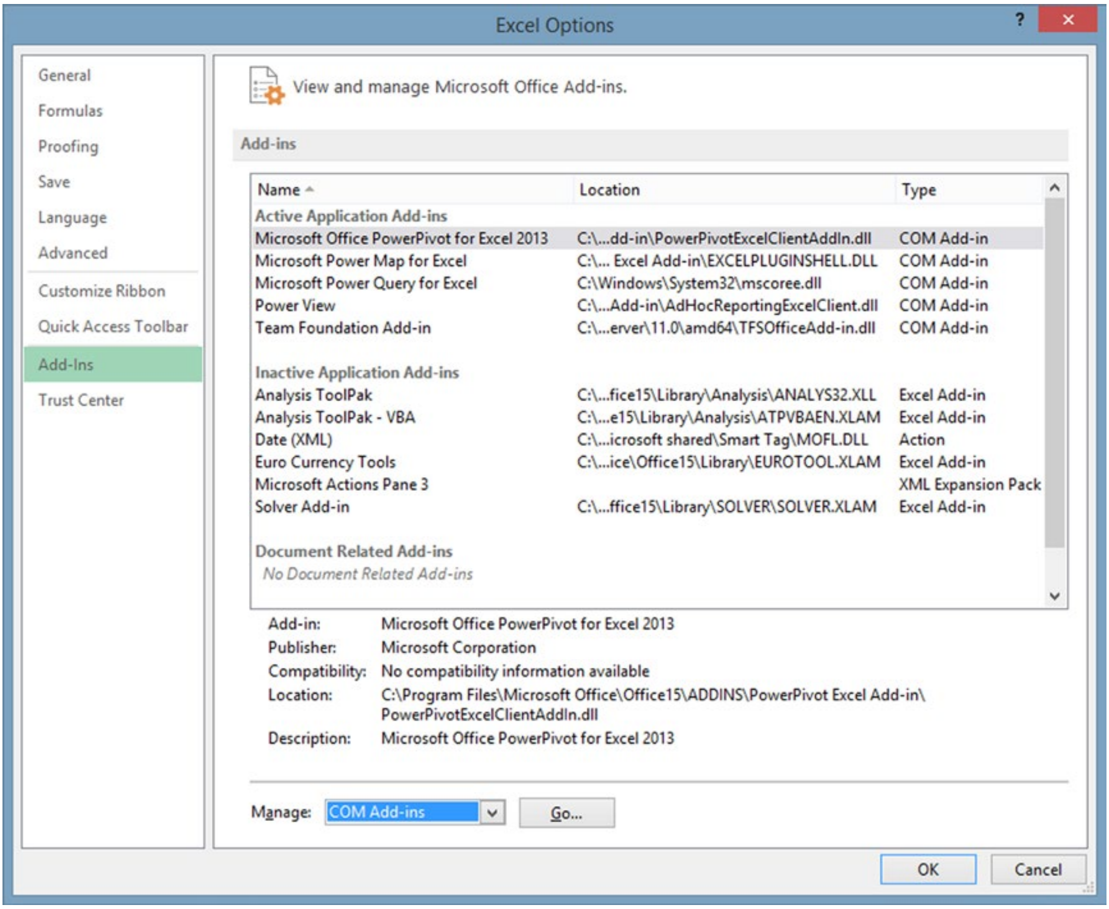
This chapter will cover the Excel Data Model also known as the PowerPivot Data Model. PowerPivot for Excel 2013 is based on the tabular engine of SQL Server Analysis Services 2012 running inside Excel. The Data Model allows relating of multiple tables. It runs completely in memory and compresses data so that it can process millions of rows.

The Excel Data Model is a collection of tables, including the relationships between them. The Data Model provides the structure for Power BI. This chapter will demonstrate how to use Pivot Tables to extract summary information from multiple tables in a Data Model. The examples used will progress from the simple to the more complex.

Enabling PowerPivot

PowerPivot is included with Excel 2013, but it is not enabled by default. To enable PowerPivot, follow these steps:

1. Click the File tab to see the Backstage view.
2. Click Options at the bottom of the left pane.
3. Select Add-Ins on the left pane.
4. At the bottom of the window, pull down the arrow after Manage, select COM Add-ins, and click Go, as shown in Figure 4-1.



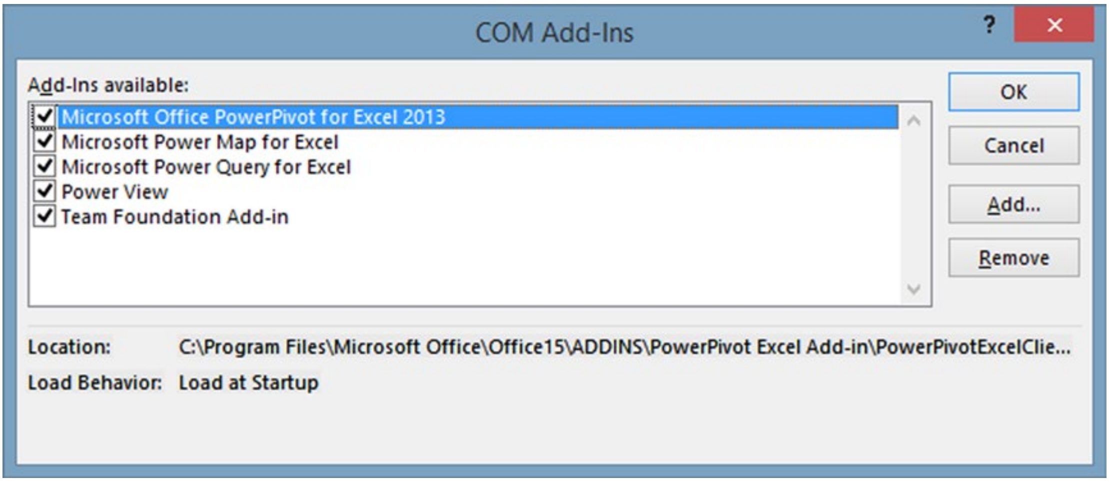
Name ▴	Location	Type
Active Application Add-ins		
Microsoft Office PowerPivot for Excel 2013	C:\...dd-in\PowerPivotExcelClientAddIn.dll	COM Add-in
Microsoft Power Map for Excel	C:\... Excel Add-in\EXCELPLUGINSHELL.DLL	COM Add-in
Microsoft Power Query for Excel	C:\Windows\System32\mscoree.dll	COM Add-in
Power View	C:\...Add-in\AdHocReportingExcelClient.dll	COM Add-in
Team Foundation Add-in	C:\...erver\11.0\amd64\TFSOfficeAdd-in.dll	COM Add-in
Inactive Application Add-ins		
Analysis ToolPak	C:\...fice15\Library\Analysis\ANALYS32.XLL	Excel Add-in
Analysis ToolPak - VBA	C:\...e15\Library\Analysis\ATPVBAEN.XLAM	Excel Add-in
Date (XML)	C:\...icrosoft shared\Smart Tag\MOFL.DLL	Action
Euro Currency Tools	C:\...ice\Office15\Library\EUROTOOL.XLAM	Excel Add-in
Microsoft Actions Pane 3		XML Expansion Pack
Solver Add-in	C:\...ffice15\Library\SOLVER\SOLVER.XLAM	Excel Add-in
Document Related Add-ins		
No Document Related Add-ins		

Add-in: Microsoft Office PowerPivot for Excel 2013
Publisher: Microsoft Corporation
Compatibility: No compatibility information available
Location: C:\Program Files\Microsoft Office\Office15\ADDINS\PowerPivot Excel Add-in\PowerPivotExcelClientAddIn.dll
Description: Microsoft Office PowerPivot for Excel 2013

Manage: COM Add-ins

***Figure 4-1.** Excel Options screen*

5. Check Microsoft Office PowerPivot for Excel 2013, Microsoft Power Map for Excel, and Power View, as shown in Figure 4-2, and click OK.



Add-Ins available:

- ☑ Microsoft Office PowerPivot for Excel 2013
- ☑ Microsoft Power Map for Excel
- ☑ Microsoft Power Query for Excel
- ☑ Power View
- ☑ Team Foundation Add-in

Location: C:\Program Files\Microsoft Office\Office15\ADDINS\PowerPivot Excel Add-in\PowerPivotExcelClie...

Load Behavior: Load at Startup

Figure 4-2. *COM Add-Ins dialog*

Relational Databases

Until a few years ago, relational databases were the most widely used type of database. In the last few years, NoSQL (or nonrelational) databases have become popular for log data and other types of big data. NoSQL databases will be covered more extensively in future chapters. Still, today, the majority of transactional business data is stored in relational databases.

One of the principles of relational database design is avoiding repeating fields. If repeating fields are encountered, the data is normalized by creating other tables, as described in Chapter 1. For instance, in a personnel example, the primary key of the employee table would be the employee Social Security number, because it is unique, and it is required for financial reporting. The employee would be assigned to a department, but only a department code would be stored in the employee table. The department code would be a foreign key that would point to the appropriate record in the department table, which would have other information, such as the department office, department manager, and phone number. Thus, the department information would not have to be repeated for each employee record.

Database Terminology

The following terms are commonly used to describe relational databases and the relationships between tables within a database.

- A *field* is the smallest unit of data in a table. Fields are stored in columns in Excel tables.
- A *record* is all of the data or information about one person or one thing. In Excel, a record is a row in a table.
- A *table* is a collection of related data stored in a structured format within a database. It consists of fields (columns) and records (rows).
- A *database* is a collection of tables.

- The *primary key* of a relational table is a field (or fields) that uniquely identifies each record in the table. For data involving people, especially data that requires tax reporting, the most common primary key is a Social Security number. It is, of course, important to have proper security when dealing with personal data such as Social Security numbers.
- A *foreign key* is a field or fields in one table that uniquely identifies a row of another table.
- A *candidate key* is a field or fields in a table that can uniquely identify any record without referring to any other data. Each table may have one or more candidate keys, but one candidate key is selected as the primary key. This is usually the best among the candidate keys.
- When a key is composed of more than one column, it is known as a *composite key*.
- A *relationship* allows accessing data from multiple tables, based on a key field.
- *Normalization* is the process of organizing the tables in a relational database to minimize redundancy. Normalization often involves dividing large tables into smaller tables and defining relationships between them.
- *Third Normal Form (3NF*), defined by relational database model inventor E. F. Codd, eliminates fields not dependent on the primary key. To be in Third Normal Form, each field in a table must depend on the primary key, and only the primary key, of that table. This is called eliminating **transitive tendencies**, where one field depends on another field that is not the primary key.
- A *source table* is the table wherein the relationship starts. In the example in the following section, the employee table is the source table.
- The *related table* is the table that contains the values to look up. In the following example, the department table is the related table.

Creating a Data Model from Excel Tables

This section will start with a simple example, to illustrate the principles of relating tables. In this example, a Data Model will be created from two small tables: employee and department. The tables are normalized, meaning that repeating fields have been eliminated. Instead of recording all the information about a single department in the employee record, only a department code is used. Then a relationship is defined between the employee and department table, so that the department information can be extracted from the department table.

A Pivot Table can be used to extract meaningful information from a Data Model. To create a Pivot Table that draws on data from both tables to show average salary by department, do the following:

1. Define each group of data as a table by clicking inside the table and pressing Ctrl+T.
2. Click anywhere in the table and click the Table Tools Design tab. On the left side of the ribbon, type in a table name, in this case, *employees*, as shown in Figure 4-3. Also, rename the departments.

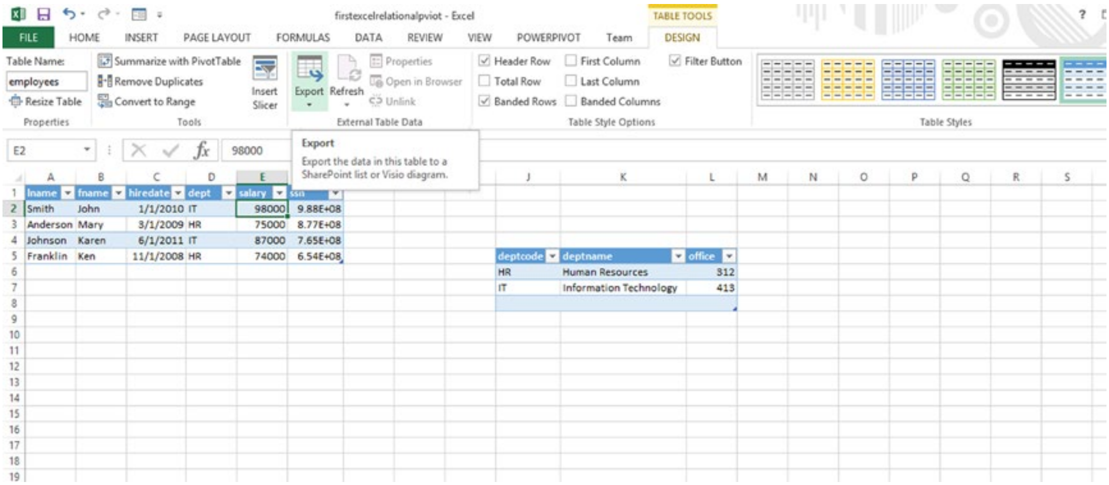


Table Name: employees

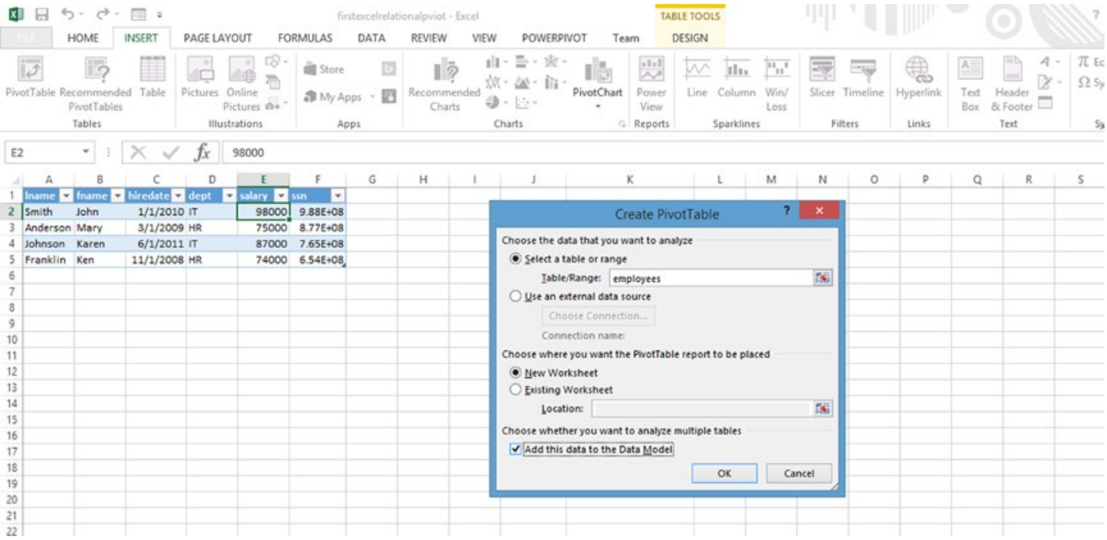
E2 98000

lname	fname	hiredate	dept	salary	ssn
Smith	John	1/1/2010	IT	98000	9.88E+08
Anderson	Mary	3/1/2009	HR	75000	8.77E+08
Johnson	Karen	6/1/2011	IT	87000	7.65E+08
Franklin	Ken	11/1/2008	HR	74000	6.54E+08

deptcode	deptname	office
HR	Human Resources	312
IT	Information Technology	413

Figure 4-3. Employee and department tables

3. Highlight the employee table. Go to the Insert tab and select Pivot Table. In the Create PivotTable dialog, select *Add this data to the Data Model* and click OK, as shown in Figure 4-4.



E2 98000

lname	fname	hiredate	dept	salary	ssn
Smith	John	1/1/2010	IT	98000	9.88E+08
Anderson	Mary	3/1/2009	HR	75000	8.77E+08
Johnson	Karen	6/1/2011	IT	87000	7.65E+08
Franklin	Ken	11/1/2008	HR	74000	6.54E+08

Create PivotTable

Choose the data that you want to analyze

● Select a table or range

Table/Range: employees

○ Use an external data source

Choose Connection...

Connection name:

Choose where you want the PivotTable report to be placed

● New Worksheet

○ Existing Worksheet

Location:

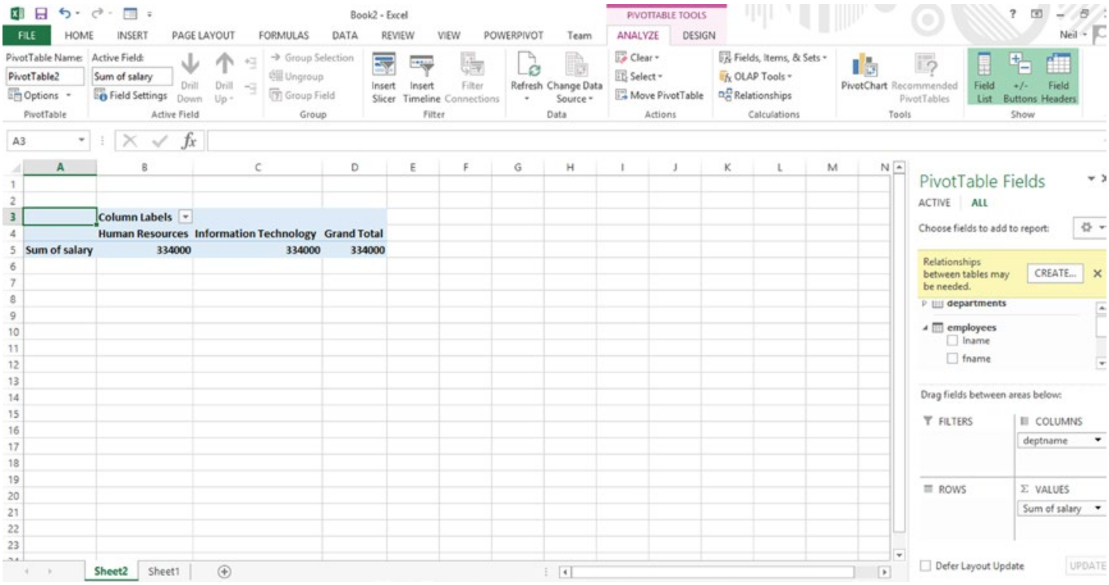
Choose whether you want to analyze multiple tables

☑ Add this data to the Data Model

OK Cancel

Figure 4-4. Create PivotTable dialog

4. In the PivotTable Fields pane, click All (at the upper right), to see both tables, as shown in Figure 4-5. Drag the deptname field from the department table to the columns box. Drag Sum of salary from the employees table to values. Note the prompt “Relationships between tables may be needed.” Click Create.

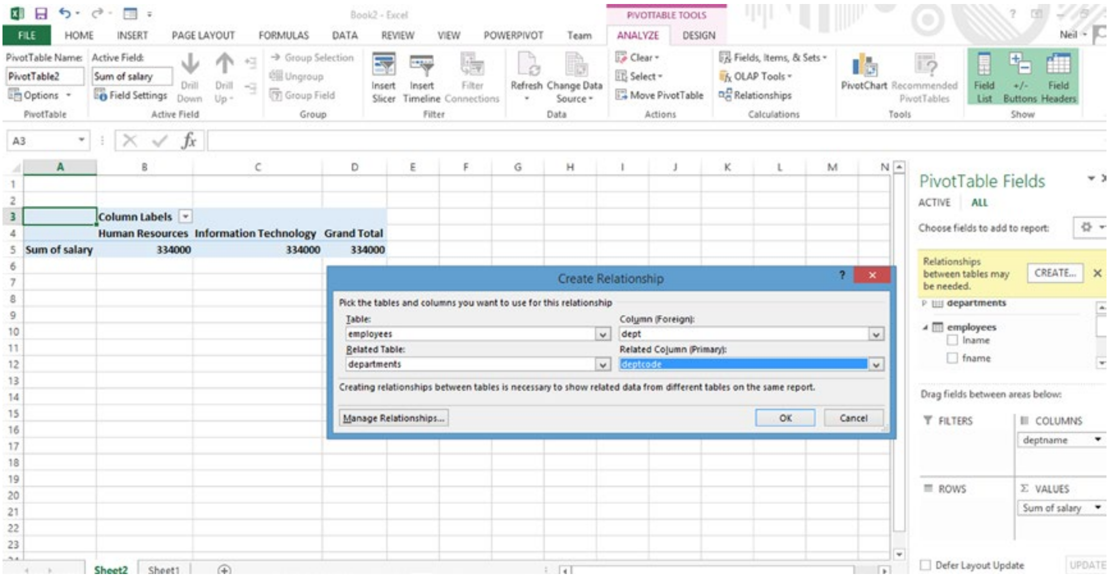


	Column Labels		
	Human Resources	Information Technology	Grand Total
Sum of salary	334000	334000	334000

Book2 - Excel
PIVOTTABLE TOOLS
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWERPIVOT Team ANALYZE DESIGN
PivotTable Name: PivotTable2
Active Field: Sum of salary
Field Settings
PivotTable Fields
ACTIVE ALL
Choose fields to add to report:
Relationships between tables may be needed. CREATE...
departments
employees
lname
fname
Drag fields between areas below:
FILTERS
COLUMNS
deptname
ROWS
VALUES
Sum of salary
Defer Layout Update
UPDATE
Sheet2 Sheet1

Figure 4-5. PivotTable showing total salaries by department

5. As shown in Figure 4-6, select employees as the first table and dept as the foreign key. Select departments as the second table and deptcode as the primary key. Click OK. Note that the field names, as defined by the column headings, do not have to be the same.



Create Relationship

Pick the tables and columns you want to use for this relationship

Table: employees

Column (Foreign): dept

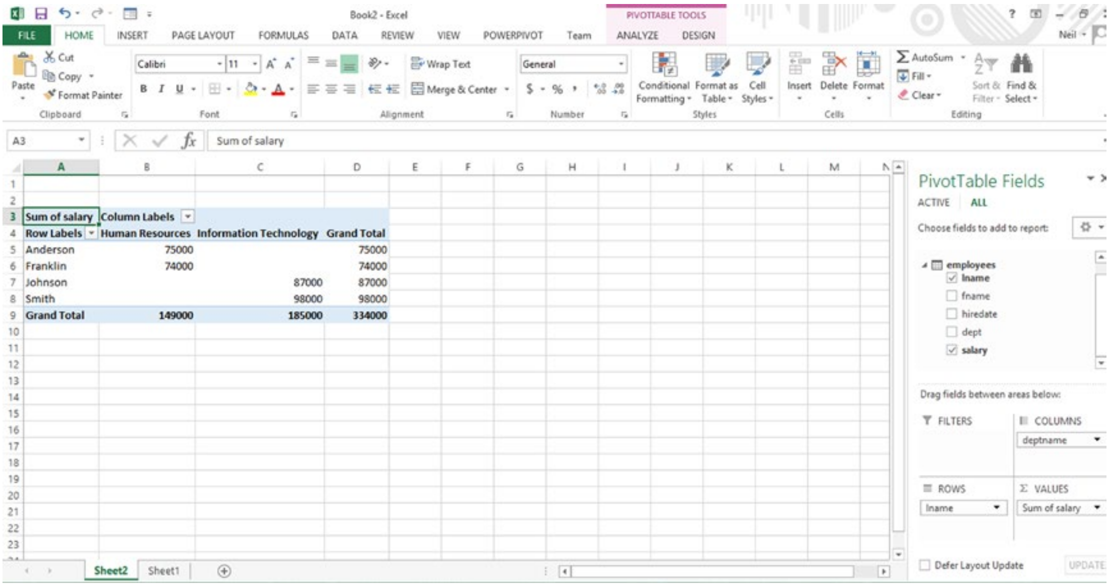
Related Table: departments

Related Column (Primary): deptcode

Creating relationships between tables is necessary to show related data from different tables on the same report.

Figure 4-6. Create Relationship dialog

6. Drag lname to the Rows box. The resulting Pivot Table, as shown in Figure 4-7, will display the sum of salaries by department.



A3 Sum of salary

Sum of salary	Column Labels		
Row Labels	Human Resources	Information Technology	Grand Total
Anderson	75000		75000
Franklin	74000		74000
Johnson		87000	87000
Smith		98000	98000
Grand Total	149000	185000	334000

PivotTable Fields

Choose fields to add to report:

employees
☑ lname
☐ fname
☐ hiredate
☐ dept
☑ salary

Drag fields between areas below:

FILTERS

COLUMNS: deptname

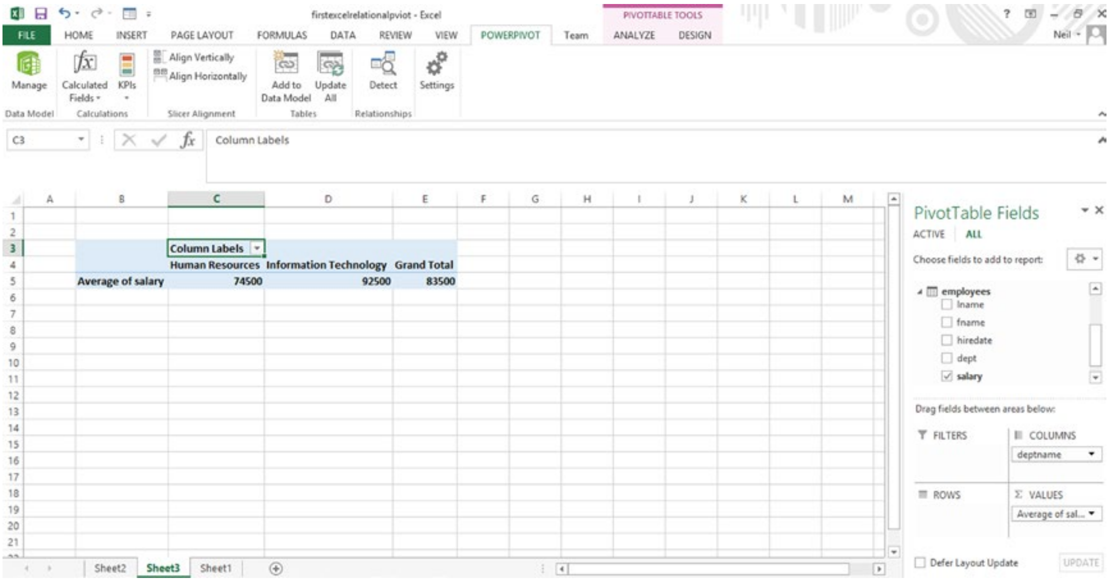
ROWS: lname

VALUES: Sum of salary

☐ Defer Layout Update

Figure 4-7. PivotTable showing employee salary by department

7. To see instead the average salary by department, first remove the lname field from the Rows box and then in the PivotTable Fields pane, click the drop-down arrow next to Sum of salary in the Values box. Select value field setting and then average to see the average salary by department, as shown in Figure 4-8.



C3 | Column Labels

	Column Labels		
	Human Resources	Information Technology	Grand Total
Average of salary	74500	92500	83500

PivotTable Fields

ACTIVE ALL

Choose fields to add to report:

- employees
  - □ lname
  - □ fname
  - □ hiredate
  - □ dept
  - ☑ salary

Drag fields between areas below:

FILTERS

COLUMNS: deptname

ROWS

VALUES: Average of sal...

□ Defer Layout Update UPDATE

Figure 4-8. *PivotTable showing average salary by department*

8. This example showed how to relate two tables, `employees` and `departments`, using department code. dept is a foreign key in the employees table, and deptcode is the primary key for the departments table. The Pivot Table relates the two tables.

Loading Data Directly into the Data Model

In this example, data will be loaded directly into the Data Model using an example from Microsoft's Northwind Access Database. This example demonstrates running PowerPivot on top of Excel.

To load data directly into the Data Model, do the following:

1. Click the PowerPivot tab to open the ribbon.

2. Click the Manage button at the top-left end of the ribbon.

3. Once the PowerPivot window is open, you can load data by clicking *From Database* in the Get External Data group. This provides a choice of database sources, as shown in Figure 4-9. For this example, *From Access* will be selected.

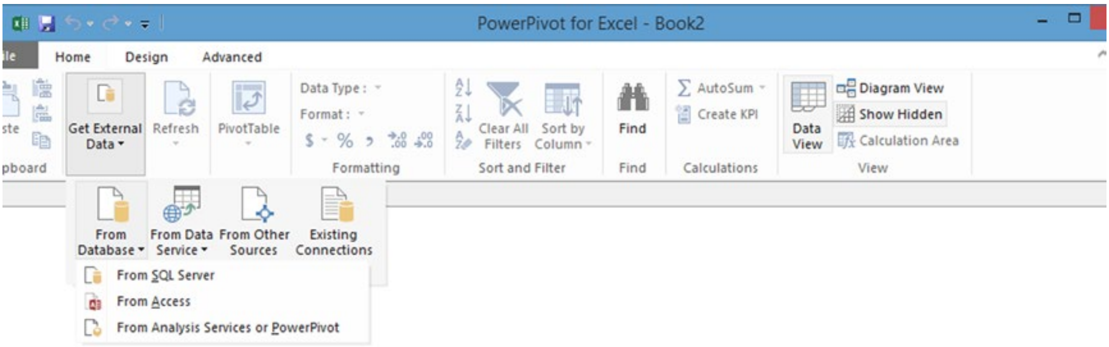


Figure 4-9. *PowerPivot Get External Data group*

4. In the Table Import Wizard dialog, click the Browse button to find the Access file you want to import. For this example, `Database1` in the documents folder will be selected. This file is available from the Apress web site.

5. Click *Test Connection*. If the test is successful, click Next.

6. PowerPivot opens the Table Import Wizard, as shown in Figure 4-10, to step you through the process of loading data. Choose *Select from a list of tables and views to choose the data to import*. Click Next.

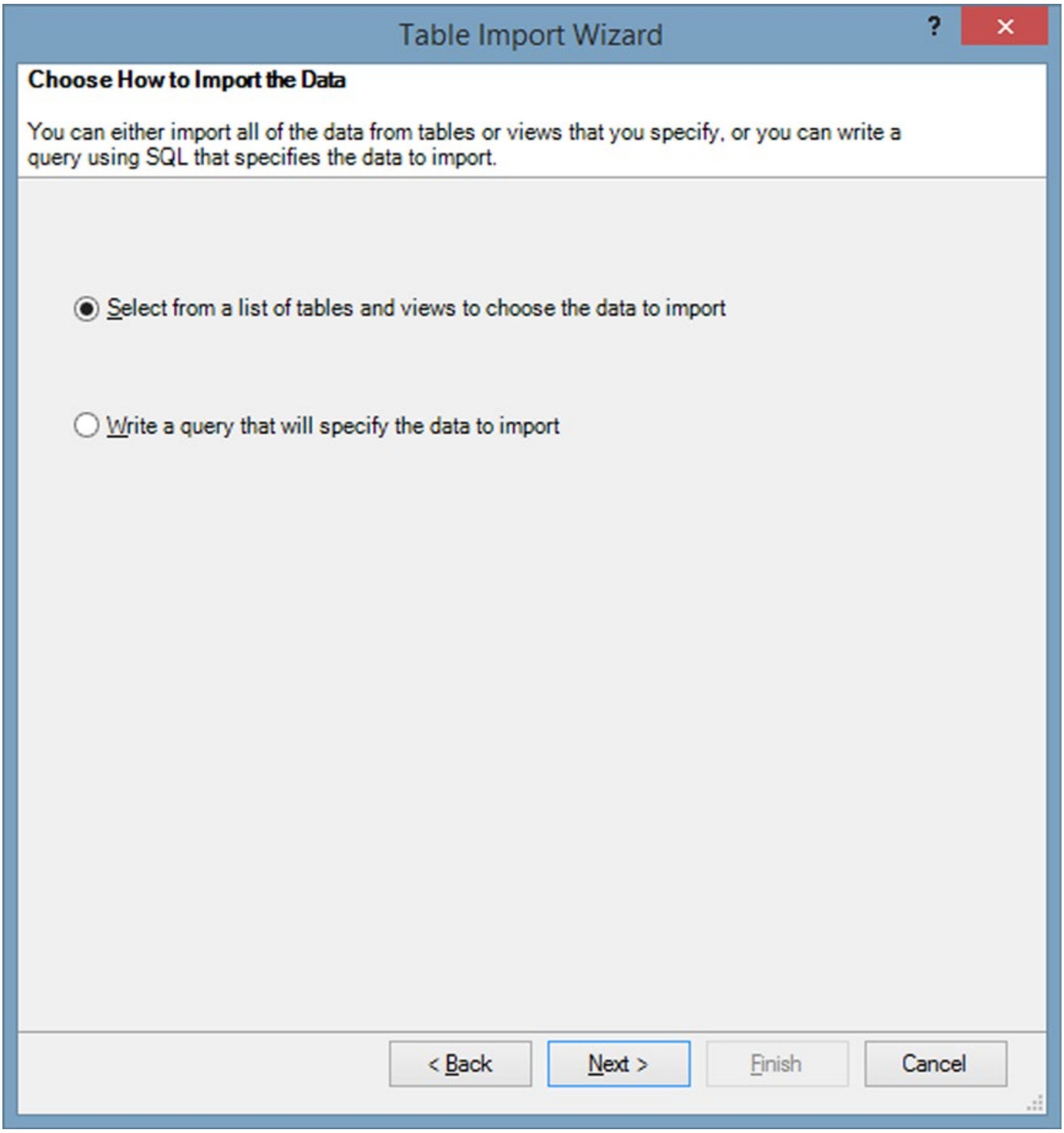


Table Import Wizard

Choose How to Import the Data

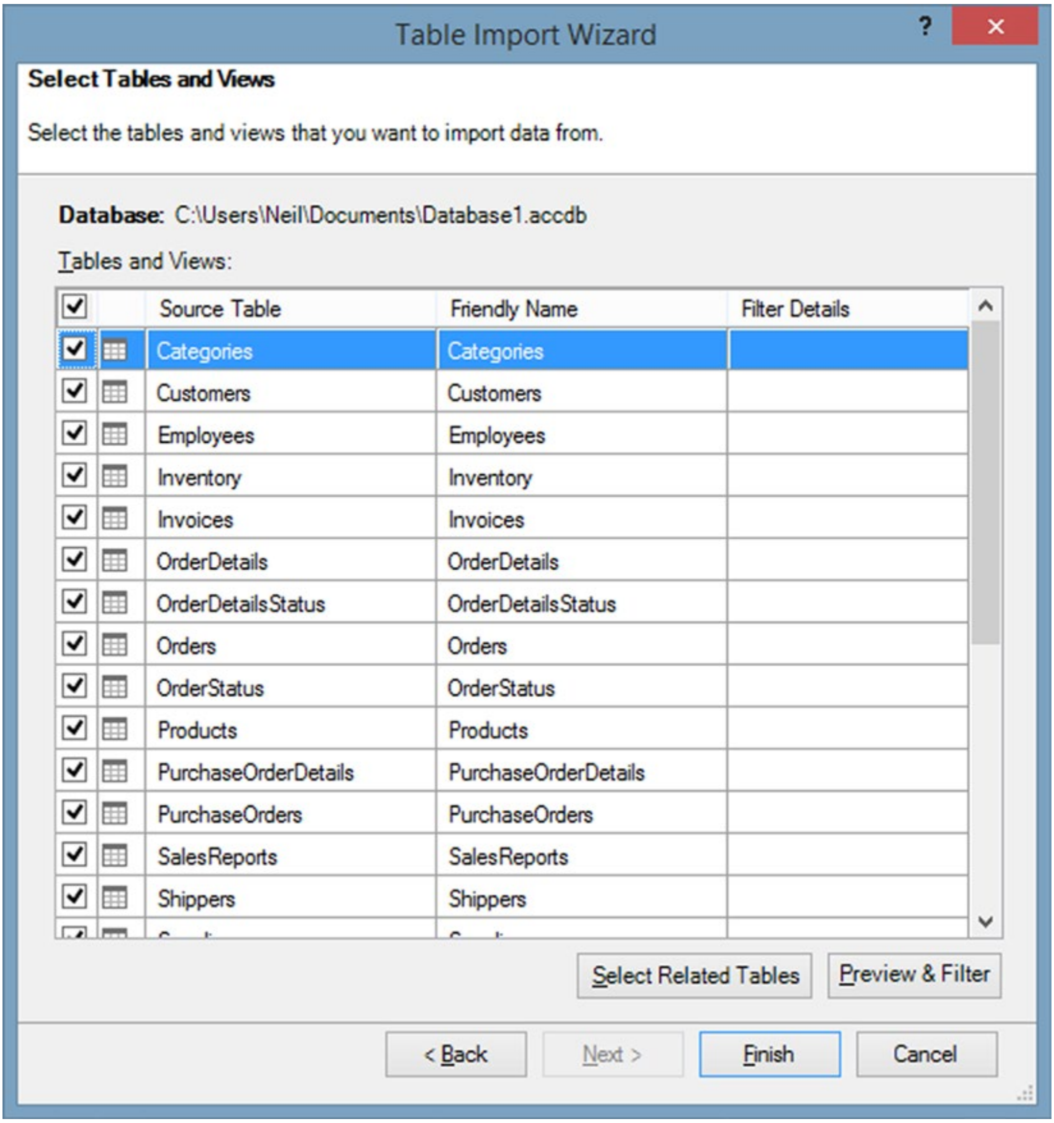
You can either import all of the data from tables or views that you specify, or you can write a query using SQL that specifies the data to import.

● Select from a list of tables and views to choose the data to import

○ Write a query that will specify the data to import

Figure 4-10. *Table Import Wizard*

7. Click the top-left box to select all tables, as shown in Figure 4-11. Note that in the lower right corner of the dialog, there is an option to *Preview & Filter.* This option can be used to select a subset of data from very large datasets. In this example, all rows in all tables will be imported. Click Finish to complete the import.



Select Tables and Views

Select the tables and views that you want to import data from.

Database: C:\Users\Neil\Documents\Database1.accdb

Tables and Views:

☑		Source Table	Friendly Name	Filter Details
☑	▦	Categories	Categories	
☑	▦	Customers	Customers	
☑	▦	Employees	Employees	
☑	▦	Inventory	Inventory	
☑	▦	Invoices	Invoices	
☑	▦	OrderDetails	OrderDetails	
☑	▦	OrderDetailsStatus	OrderDetailsStatus	
☑	▦	Orders	Orders	
☑	▦	OrderStatus	OrderStatus	
☑	▦	Products	Products	
☑	▦	PurchaseOrderDetails	PurchaseOrderDetails	
☑	▦	PurchaseOrders	PurchaseOrders	
☑	▦	SalesReports	SalesReports	
☑	▦	Shippers	Shippers	

***Figure 4-11.** Table Import Wizard—Select Tables and Views*

Relationships are automatically loaded into the data model, if they are present in the imported data. Note that PowerPivot tables are read-only, so that the data cannot be changed.

To view relationships, go to the PowerPivot tab and select Manage to open the PowerPivot window. Then click the PowerPivot Diagram View at the right end of the ribbon to see the relationships between tables, and click Finish to complete the import, as shown in Figure 4-12.

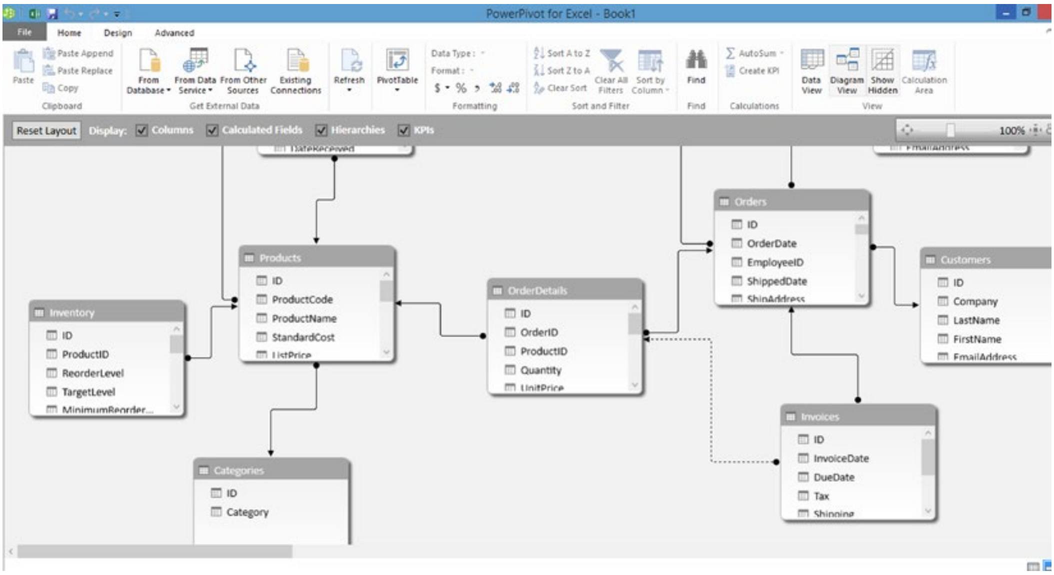
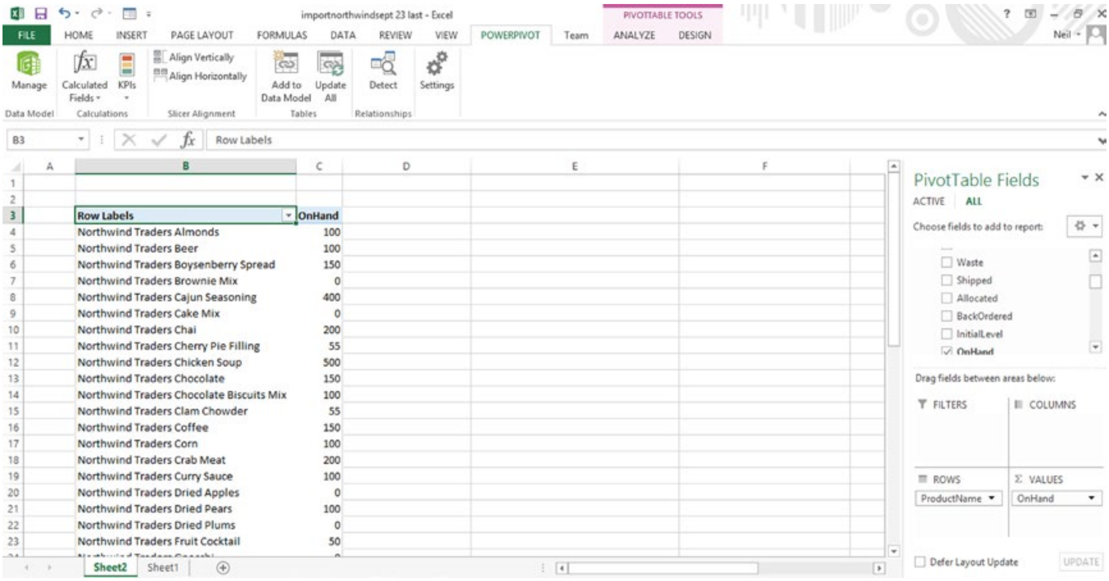


Figure 4-12. *Diagram View*

Creating a Pivot Table from Two Tables

In this example, a Pivot Table will be created, based on the inventory and products tables. Notice in Figure 4-12 that the two tables are linked, based on product code. The Inventory table includes the on-hand data for each item in inventory, with a primary key of ProductCode. To find the full product name, a lookup has to be performed in the product table, based on product ID. To create a Pivot Table based on these two tables, do the following:

1. Click Pivot Table on the File tab in the PowerPivot window and select PivotTable from the menu.
2. Click OK to put the Pivot Table in a new worksheet.
3. Click the arrow next to the products table in the Pivot Table Fields pane and drag the ProductName field to the Rows box. Then scroll up to go to the inventory table, click the left arrow to show the fields, and drag OnHand to the Values box. The results are shown in Figure 4-13, which indicates the sum of the on-hand values for each product.



B3 Row Labels

	A	B	C
1			
2			
3		Row Labels	OnHand
4		Northwind Traders Almonds	100
5		Northwind Traders Beer	100
6		Northwind Traders Boysenberry Spread	150
7		Northwind Traders Brownie Mix	0
8		Northwind Traders Cajun Seasoning	400
9		Northwind Traders Cake Mix	0
10		Northwind Traders Chai	200
11		Northwind Traders Cherry Pie Filling	55
12		Northwind Traders Chicken Soup	500
13		Northwind Traders Chocolate	150
14		Northwind Traders Chocolate Biscuits Mix	100
15		Northwind Traders Clam Chowder	55
16		Northwind Traders Coffee	150
17		Northwind Traders Corn	100
18		Northwind Traders Crab Meat	200
19		Northwind Traders Curry Sauce	100
20		Northwind Traders Dried Apples	0
21		Northwind Traders Dried Pears	100
22		Northwind Traders Dried Plums	0
23		Northwind Traders Fruit Cocktail	50

PivotTable Fields

ACTIVE ALL

Choose fields to add to report:

□ Waste
□ Shipped
□ Allocated
□ BackOrdered
□ InitialLevel
☑ OnHand

Drag fields between areas below:

FILTERS

COLUMNS

ROWS: ProductName

Σ VALUES: OnHand

□ Defer Layout Update UPDATE

Figure 4-13. PivotTable showing product name and on-hand quantity

Creating a Pivot Table from Multiple Tables

This example will demonstrate how to create Pivot Tables from more than two tables, based on the relationships between the tables. It will use the PowerPivotTutorialSample spreadsheet from the Contoso database, which can be downloaded from the following URL: `Tinyurl.com/PowerPivotSamples`.

A Pivot Table accessing fields from multiple related tables can be created by following these steps:

1. Download the PowerPivotTutorialSample spreadsheet from the preceding URL.

2. Click the Manage icon on the PowerPivot tab to open the PowerPivot window. Then click Diagram View to see the diagram of relationships, as shown in Figure 4-14. Note that the arrows show relations in a somewhat imprecise manner: using the scrollbar to scroll through the field names does not change the position of the arrow. A clearer way to see relationships is to minimize the PowerPivot window and click Relationships on the Data tab, to see the actual field names that are linked in the Manage Relationships screen, as shown in Figure 4-15. Note that you can also see a similar view by clicking Manage Relationships on the Design tab of the PowerPivot window.

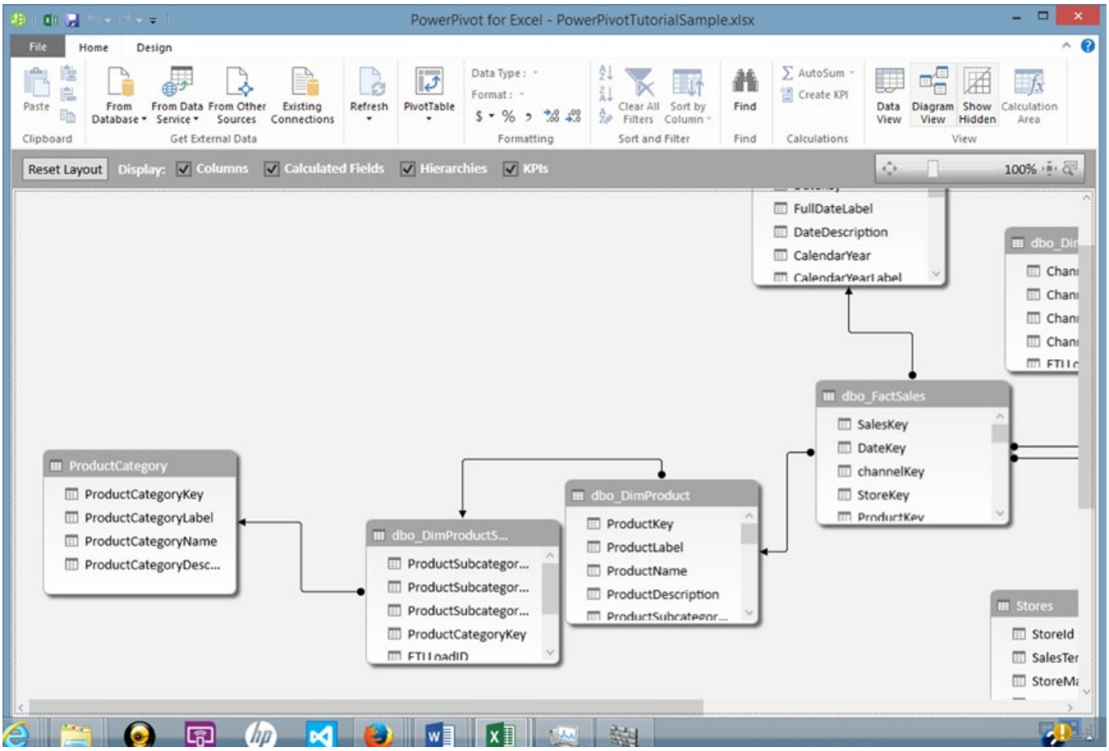
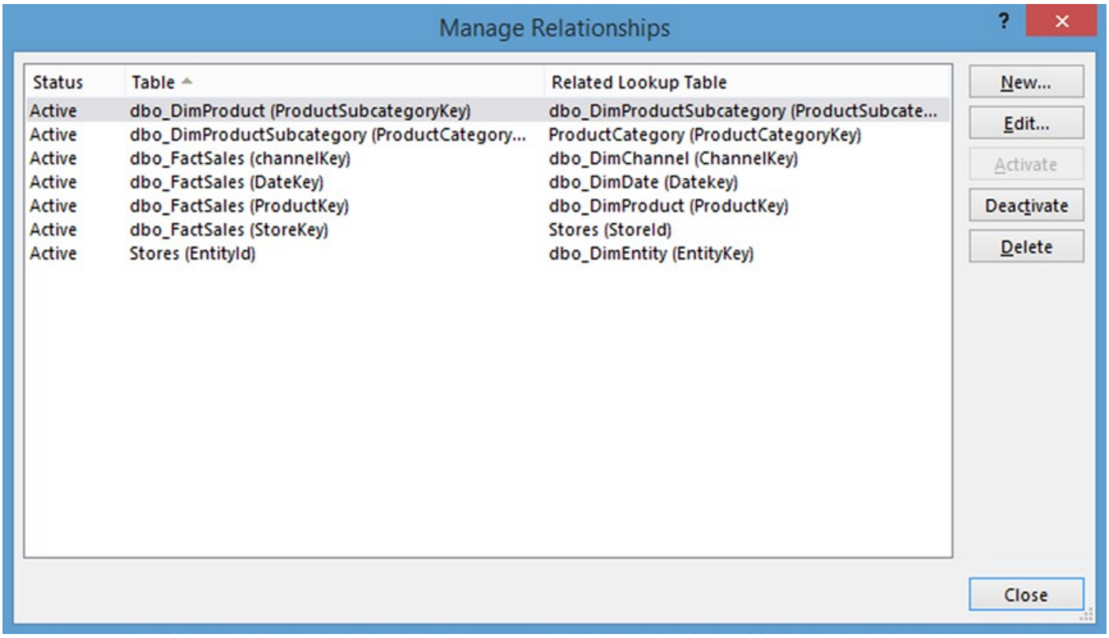


Figure 4-14. *Diagram view of relationships*



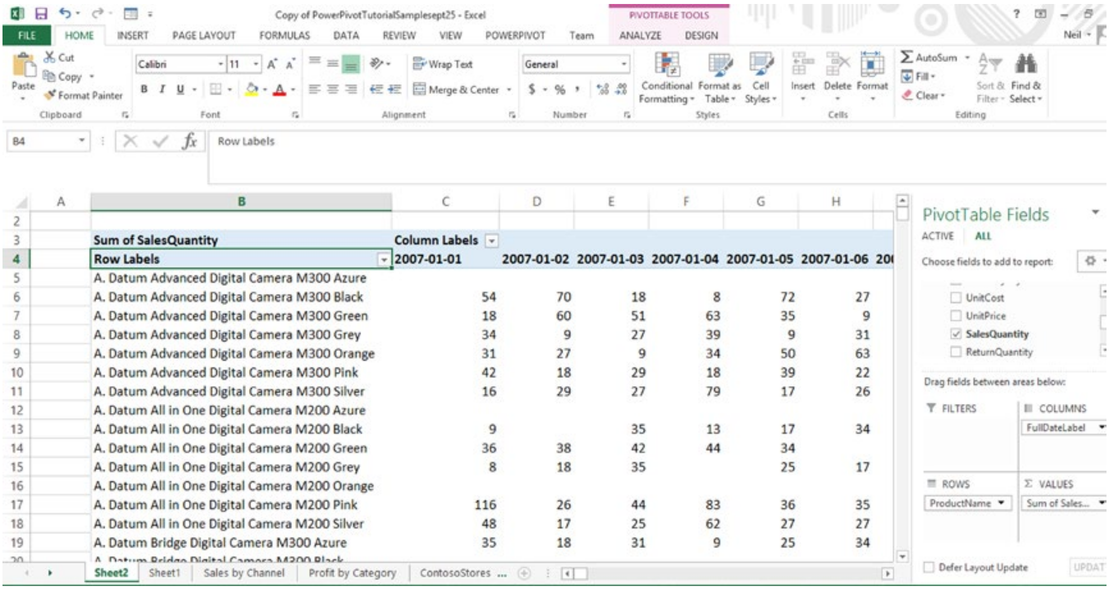
Status	Table	Related Lookup Table
Active	dbo_DimProduct (ProductSubcategoryKey)	dbo_DimProductSubcategory (ProductSubcate...
Active	dbo_DimProductSubcategory (ProductCategory...	ProductCategory (ProductCategoryKey)
Active	dbo_FactSales (channelKey)	dbo_DimChannel (ChannelKey)
Active	dbo_FactSales (DateKey)	dbo_DimDate (Datekey)
Active	dbo_FactSales (ProductKey)	dbo_DimProduct (ProductKey)
Active	dbo_FactSales (StoreKey)	Stores (StoreId)
Active	Stores (EntityId)	dbo_DimEntity (EntityKey)

Figure 4-15. *Manage Relationships screen*

3. To create a Pivot Table based on related fields, select the PowerPivot tab and Click Manage. If the Diagram View is still displayed, click Data View. Notice the tabs at the bottom of the screen that show the tables included in this example. A PivotTable will be created that links the dbo_FactSales table with the dbo_DimProduct table and the dbo_DimDate table. The purpose of the Pivot Table is to analyze product sales by date.

4. Click Pivot Table and select Pivot Table from the drop-down. In the Create PivotTable dialog, accept the default of New Worksheet by clicking OK.

5. In the PivotTable Fields pane, the tables will be shown preceded by a right-facing arrow. Click the right-facing arrow to see the fields in that table. Scroll to the dbo_DimProduct table and click the arrow. Drag the ProductName field to the Rows box. Click the arrow to the left of the dbo_DimProduct table to suppress the fields display. Scroll to the dbo_DimDate table and click the arrow, to see the fields. Drag the FullDateLabel field to the Columns box. Click the arrow to suppress the fields. Scroll to the dbo_FactSales table and click the arrow, to see the fields. Drag the SalesQuantity field to the Values box. The results will be shown in Figure 4-16. It is possible to link fields from multiple tables because of the relationships shown in Figure 4-15.



Row Labels

	A	B	C	D	E	F	G	H
2								
3		Sum of SalesQuantity	Column Labels					
4		Row Labels	2007-01-01	2007-01-02	2007-01-03	2007-01-04	2007-01-05	2007-01-06
5		A. Datum Advanced Digital Camera M300 Azure						
6		A. Datum Advanced Digital Camera M300 Black	54	70	18	8	72	27
7		A. Datum Advanced Digital Camera M300 Green	18	60	51	63	35	9
8		A. Datum Advanced Digital Camera M300 Grey	34	9	27	39	9	31
9		A. Datum Advanced Digital Camera M300 Orange	31	27	9	34	50	63
10		A. Datum Advanced Digital Camera M300 Pink	42	18	29	18	39	22
11		A. Datum Advanced Digital Camera M300 Silver	16	29	27	79	17	26
12		A. Datum All in One Digital Camera M200 Azure						
13		A. Datum All in One Digital Camera M200 Black	9		35	13	17	34
14		A. Datum All in One Digital Camera M200 Green	36	38	42	44	34	
15		A. Datum All in One Digital Camera M200 Grey	8	18	35		25	17
16		A. Datum All in One Digital Camera M200 Orange						
17		A. Datum All in One Digital Camera M200 Pink	116	26	44	83	36	35
18		A. Datum All in One Digital Camera M200 Silver	48	17	25	62	27	27
19		A. Datum Bridge Digital Camera M300 Azure	35	18	31	9	25	34
20		A. Datum Bridge Digital Camera M300 Black						

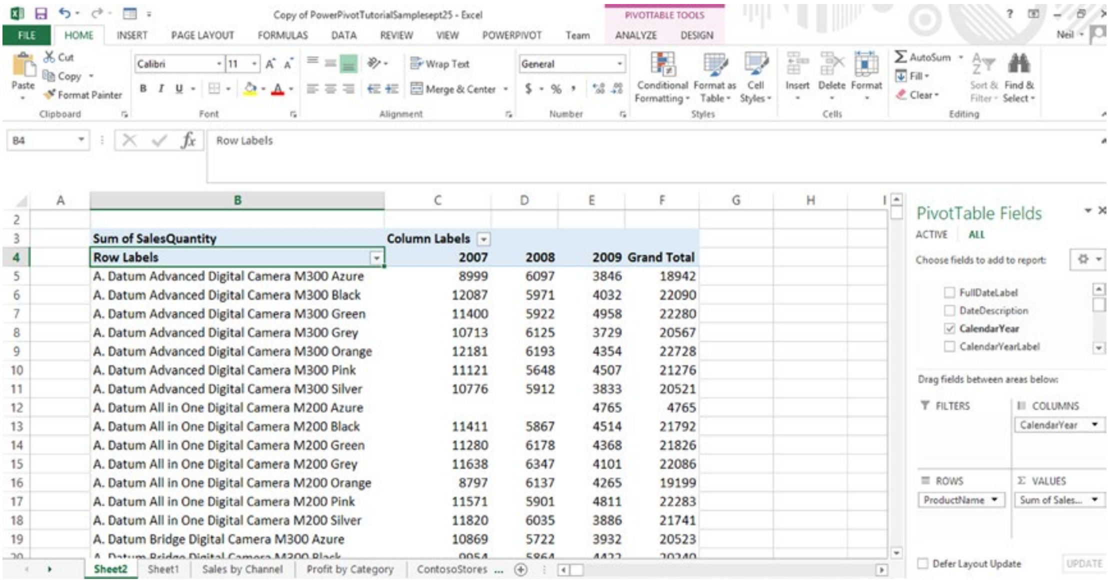
□ UnitCost
□ UnitPrice
☑ SalesQuantity
□ ReturnQuantity

COLUMNS: FullDateLabel
ROWS: ProductName
VALUES: Sum of Sales...

□ Defer Layout Update

Figure 4-16. *PivotTable showing sales by product and date*

6. To further modify the Pivot Table by viewing sales by product by year, remove FullDateLabel from the Columns box and replace it with CalenderYear from the DimDate table. The results are shown in Figure 4-17.



Row Labels

Sum of SalesQuantity	Column Labels			
Row Labels	2007	2008	2009	Grand Total
A. Datum Advanced Digital Camera M300 Azure	8999	6097	3846	18942
A. Datum Advanced Digital Camera M300 Black	12087	5971	4032	22090
A. Datum Advanced Digital Camera M300 Green	11400	5922	4958	22280
A. Datum Advanced Digital Camera M300 Grey	10713	6125	3729	20567
A. Datum Advanced Digital Camera M300 Orange	12181	6193	4354	22728
A. Datum Advanced Digital Camera M300 Pink	11121	5648	4507	21276
A. Datum Advanced Digital Camera M300 Silver	10776	5912	3833	20521
A. Datum All in One Digital Camera M200 Azure			4765	4765
A. Datum All in One Digital Camera M200 Black	11411	5867	4514	21792
A. Datum All in One Digital Camera M200 Green	11280	6178	4368	21826
A. Datum All in One Digital Camera M200 Grey	11638	6347	4101	22086
A. Datum All in One Digital Camera M200 Orange	8797	6137	4265	19199
A. Datum All in One Digital Camera M200 Pink	11571	5901	4811	22283
A. Datum All in One Digital Camera M200 Silver	11820	6035	3886	21741
A. Datum Bridge Digital Camera M300 Azure	10869	5722	3932	20523

PivotTable Fields

☐ FullDateLabel
☐ DateDescription
☑ CalendarYear
☐ CalendarYearLabel

COLUMNS: CalendarYear
ROWS: ProductName
VALUES: Sum of Sales...

Figure 4-17. PivotTable showing sales by product and year

Adding Calculated Columns

Calculated columns can be added to a table in PowerPivot, using Data Analysis Expressions (DAX). Regular Excel formulas are based on cells. By contrast, DAX formulas are based on columns. DAX will be covered more extensively in future chapters. This example will show how to set up a calculated column. To add a calculated column, take the following steps:

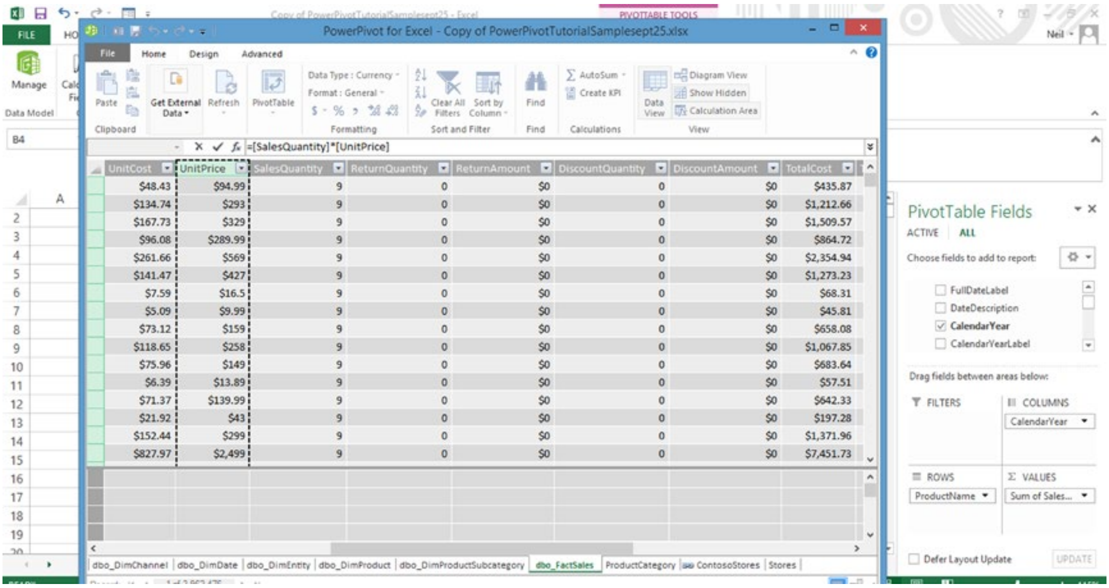
1. Select the PowerPivot tab and click Manage.

2. Select the dbo_FactSales table by clicking the tab at the bottom of the display.

3. Scroll to the right to the TotalProfit column. Note that to the right, the column heading is Add Column.

4. Select any cell in that column and type = to start a formula.

5. Create an extended price column that is the product of unit price times quantity. To do this, after typing =, click the SalesQuantity column, type *, and then click the unit price quantity. The formula is shown in Figure 4-18, in the formula bar: =[SalesQuantity]*[UnitPrice]



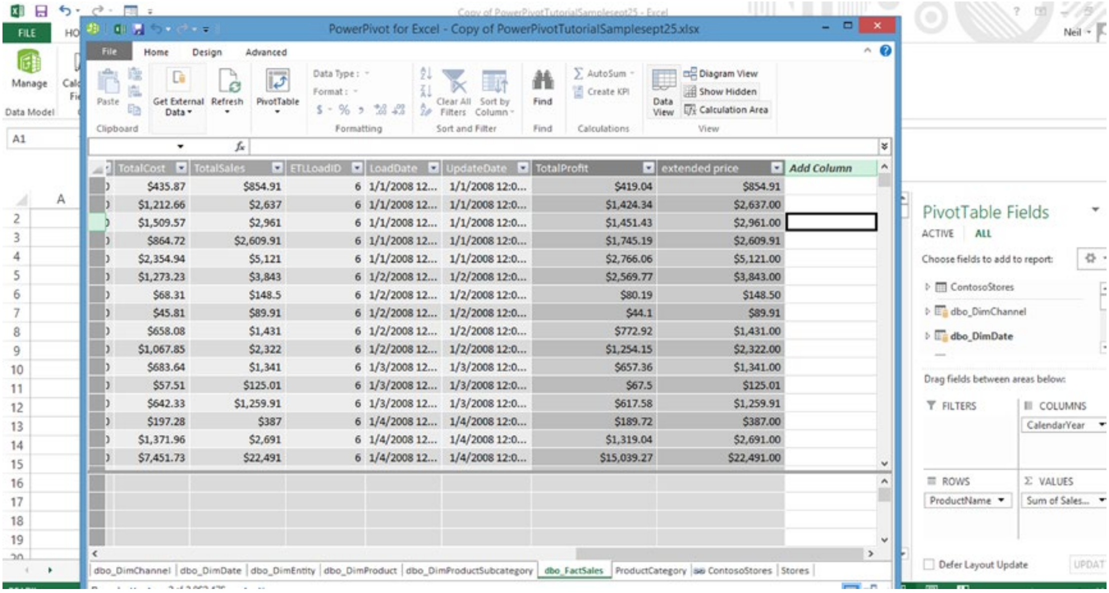
=[SalesQuantity]*[UnitPrice]

UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost
$48.43	$94.99	9	0	$0	0	$0	$435.87
$134.74	$293	9	0	$0	0	$0	$1,212.66
$167.73	$329	9	0	$0	0	$0	$1,509.57
$96.08	$289.99	9	0	$0	0	$0	$864.72
$261.66	$569	9	0	$0	0	$0	$2,354.94
$141.47	$427	9	0	$0	0	$0	$1,273.23
$7.59	$16.5	9	0	$0	0	$0	$68.31
$5.09	$9.99	9	0	$0	0	$0	$45.81
$73.12	$159	9	0	$0	0	$0	$658.08
$118.65	$258	9	0	$0	0	$0	$1,067.85
$75.96	$149	9	0	$0	0	$0	$683.64
$6.39	$13.89	9	0	$0	0	$0	$57.51
$71.37	$139.99	9	0	$0	0	$0	$642.33
$21.92	$43	9	0	$0	0	$0	$197.28
$152.44	$299	9	0	$0	0	$0	$1,371.96
$827.97	$2,499	9	0	$0	0	$0	$7,451.73

***Figure 4-18.** Adding calculated column*

6. Then press Enter to complete the formula.

7. To rename the column, right-click the column heading, select Rename Column, and name it “extended price.” The results are shown in Figure 4-19. Note that the values in the new column are the same as the TotalSales but are based on a formula.



TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	extended price	Add Column
$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	$854.91	
$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	$2,637.00	
$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	$2,961.00	
$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	$2,609.91	
$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	$5,121.00	
$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	$3,843.00	
$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	$148.50	
$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	$89.91	
$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	$1,431.00	
$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	$2,322.00	
$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	$1,341.00	
$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	$125.01	
$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	$1,259.91	
$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	$387.00	
$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	$2,691.00	
$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	$22,491.00	

***Figure 4-19.** Column renamed “extended price”*

When using PowerPivot calculated columns, all cells share the same formulas. It is not possible to use formulas involving individual cells. Aggregation functions such as SUM(), Average(), and COUNT() can apply to an entire column, to extract summary data.

Adding Calculated Fields to the Data Model

This example will show how to design a Pivot Table that shows sales quantity by product by month, using calculated fields. To do this follows these steps:

1. Click the Pivot Table icon and accept the default of a new sheet.
2. From the dbo_DimDate table, drag the CalenderMonthLabel field to the Rows box.
3. From the ProductCategory table, drag theProductCategoryName field to the Columns box.
4. From the dbo_FactSales table, drag the SalesQuantity field to the Values box.

To add a calculated field to the data model, take the following steps:

1. On the PowerPivot tab, click Calculated Field.
2. Click new Calculated Field.
3. From the drop-down, select the table on which the calculated field will be based, in this case, dbo_FactSales.
4. Name the calculated field "profitability."
5. Click the Fx icon, to see the functions. Many of the functions are similar to basic Excel functions.
6. Scroll down to SUM(), as shown in Figure 4-20, and click OK.

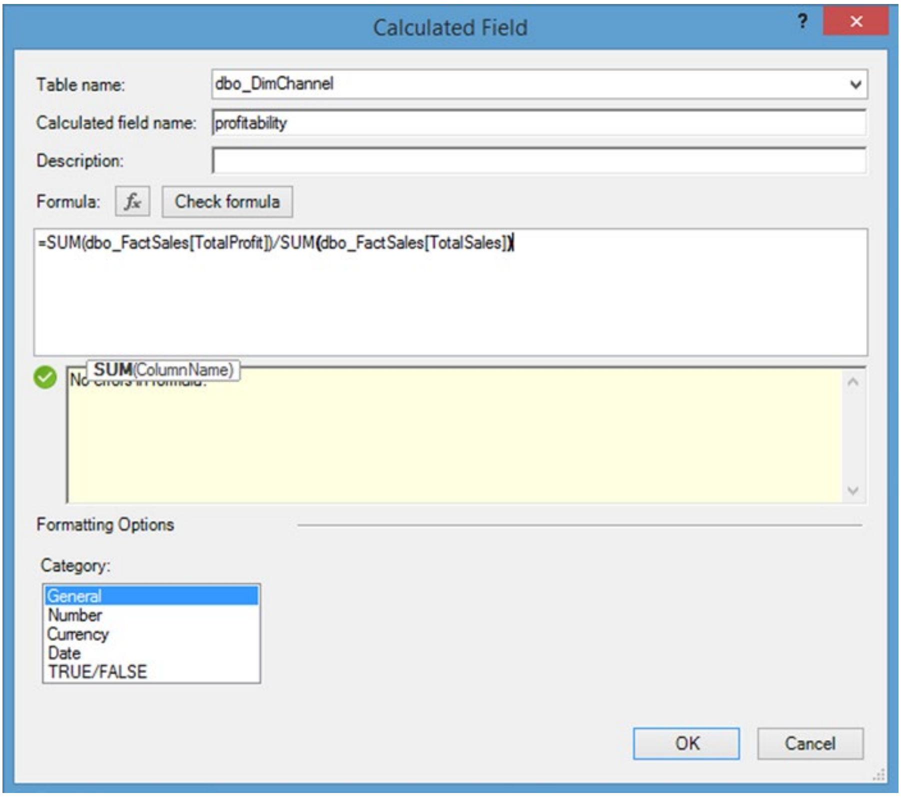


Table name: dbo_DimChannel

Calculated field name: profitability

Description:

Formula:

```
=SUM(dbo_FactSales[TotalProfit])/SUM(dbo_FactSales[TotalSales])
```

No errors in formula.

Category:

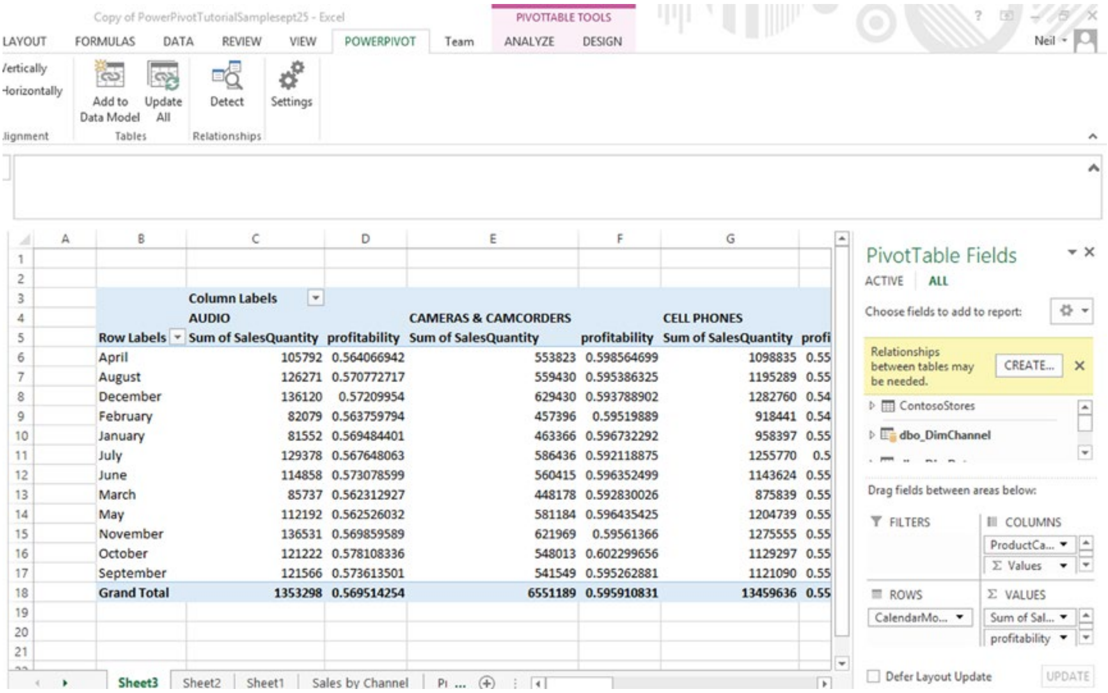
- General
- Number
- Currency
- Date
- TRUE/FALSE

Figure 4-20. *Calculated Field dialog*

7. Following the left parenthesis, start typing the name of the table to use, in this case, dbo_FactSales. The fields for that table will then be displayed. Scroll down to dbo_FactSales[totalprofit] and double-click. Type the closing parenthesis. Then type / and sum(dbo_FactsSales[totalsales] and close the parenthesis.

8. Then Click *check formula*. If the formula tests OK, click OK.

The calculated field column will appear as shown in Figure 4-21.



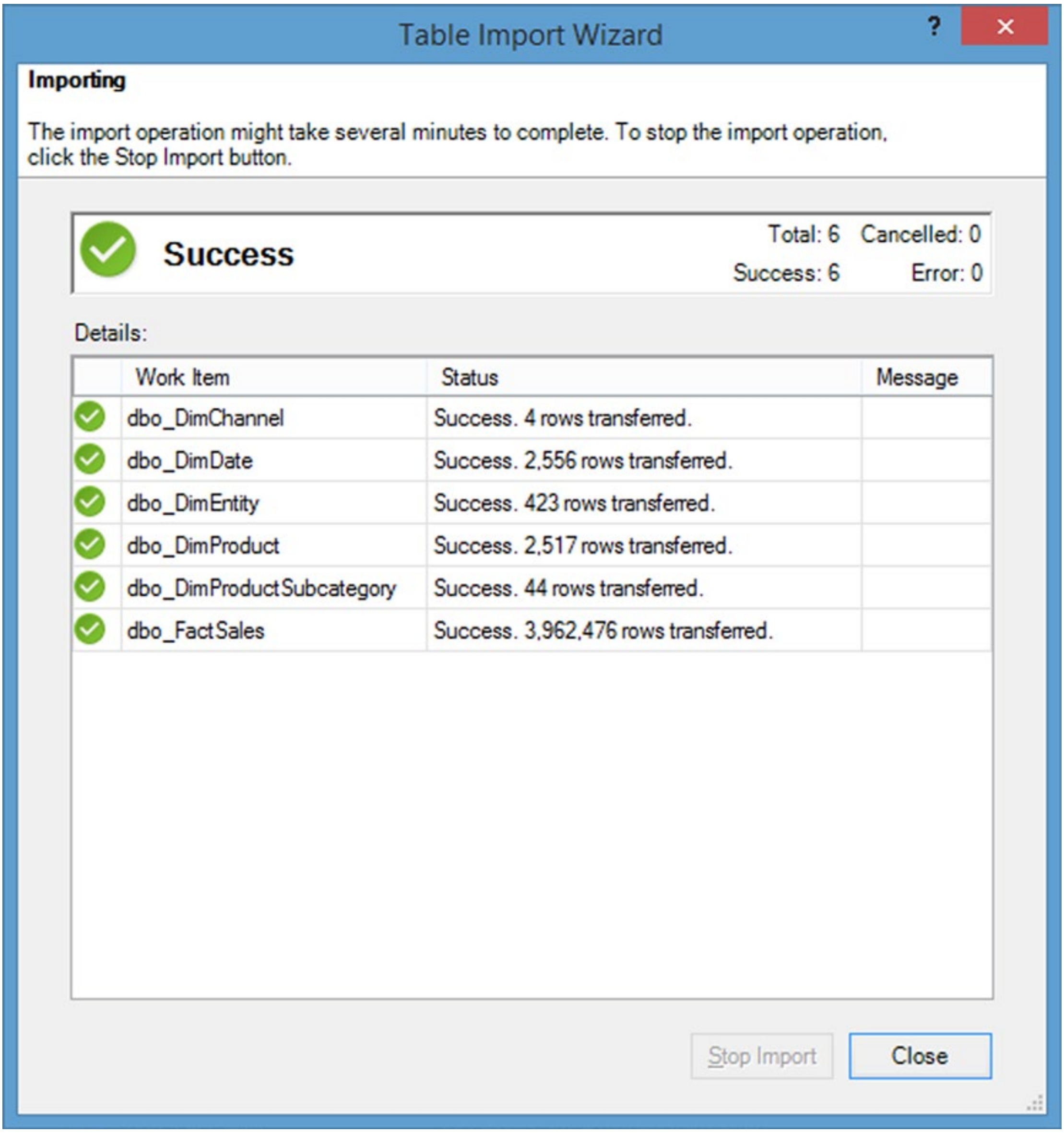
COLUMNS: ProductCa..., Σ Values
ROWS: CalendarMo...
VALUES: Sum of Sal..., profitability

	A	B	C	D	E	F	G	
1								
2								
3			Column Labels					
4			AUDIO		CAMERAS & CAMCORDERS		CELL PHONES	
5		Row Labels	Sum of SalesQuantity	profitability	Sum of SalesQuantity	profitability	Sum of SalesQuantity	profi
6		April	105792	0.564066942	553823	0.598564699	1098835	0.55
7		August	126271	0.570772717	559430	0.595386325	1195289	0.55
8		December	136120	0.57209954	629430	0.593788902	1282760	0.54
9		February	82079	0.563759794	457396	0.59519889	918441	0.54
10		January	81552	0.569484401	463366	0.596732292	958397	0.55
11		July	129378	0.567648063	586436	0.592118875	1255770	0.5
12		June	114858	0.573078599	560415	0.596352499	1143624	0.55
13		March	85737	0.562312927	448178	0.592830026	875839	0.55
14		May	112192	0.562526032	581184	0.596435425	1204739	0.55
15		November	136531	0.569859589	621969	0.59561366	1275555	0.55
16		October	121222	0.578108336	548013	0.602299656	1129297	0.55
17		September	121566	0.573613501	541549	0.595262881	1121090	0.55
18		Grand Total	1353298	0.569514254	6551189	0.595910831	13459636	0.55
19								
20								
21								

***Figure 4-21.** PivotTable showing profitability and sales by month*

Summary

This chapter provided an introduction to building a Data Model in PowerPivot. In future chapters, more advanced features of the Data Model will be explored. Figure 4-22 shows the number of rows downloaded for each table. Notice that the dbo_FactSales table has almost 4 million rows. That number of rows is supported in PowerPivot but not in Excel.



Importing

The import operation might take several minutes to complete. To stop the import operation, click the Stop Import button.

✓ **Success**

Total: 6 Cancelled: 0
Success: 6 Error: 0

Details:

	Work Item	Status	Message
✓	dbo_DimChannel	Success. 4 rows transferred.	
✓	dbo_DimDate	Success. 2,556 rows transferred.	
✓	dbo_DimEntity	Success. 423 rows transferred.	
✓	dbo_DimProduct	Success. 2,517 rows transferred.	
✓	dbo_DimProductSubcategory	Success. 44 rows transferred.	
✓	dbo_FactSales	Success. 3,962,476 rows transferred.	

Figure 4-22. *Table Import Wizard showing number of rows imported*

CHAPTER 5

Using SQL in Excel

This chapter covers using SQL (Structured Query Language) in Excel to import and manipulate subsets of large data files and to extract summary statistics.

History of SQL

SQL was first developed by IBM in the early 1970s and was called SEQUEL (Structured English Query Language). It was used to manipulate and retrieve data from early IBM relational database management systems (RDBMS). Because of trademark conflicts, SEQUEL was shortened to SQL. It was later implemented in other relational database management systems by Oracle and later Microsoft. In 1986, the American National Standards Institute (ANSI) issued an SQL standard. In my opinion, the correct pronunciation is S-Q-L, but some people still pronounce it Sequel.

SQL is a declarative language, meaning that it specifies what results are wanted without defining the how. SQL consists of a Data Definition Language and a Data Manipulation Language. In Excel, mostly the query feature of the Data Manipulation Language is used, because the data definition is performed through Excel, by importing tables from other sources. SQL was originally based on the relational model, meaning that data is stored in multiple tables, based on a fixed structure.

NoSQL

As discussed in Chapter 1, the term *NoSQL* is a misnomer, because some NoSQL systems have an SQL interface. A more accurate term would be *non-relational*, or *not only SQL*. Relational databases have a fixed schema that must be defined before any data can be entered. By contrast, NoSQL databases can access data with different schemas. This is sometimes called schema on read.

NewSQL

NewSQL tries to be a compromise between relational and NoSQL systems. These systems use a relational architecture and have SQL as their primary interface but aspire to have the same scalability and flexibility as NoSQL systems.

SQL++

SQL++ is a new form of the language, which enhances traditional SQL and is based on a semi-structured data model that can access JSON data as well as traditional relational data. It is generally backward compatible with traditional SQL.

One implementation of SQL++ is N1QL (pronounced "Nickel"), which is being developed by Couchbase based on a 2014 paper by Kian Win Ong, Yannis Papakonstantinou, and Romain Vernoux entitled "The SQL++ Unifying Semi-structured Query Language, and an Expressiveness Benchmark of SQL-on-Hadoop, NoSQL and NewSQL Databases."

SQL Syntax

The mainstay of the SQL query language is the SELECT command. The syntax of that command is shown following. Note that clauses enclosed in square brackets are optional.

```
SELECT [DISTINCT] <columns list>
[AS <optional alias name for returned columns>]
FROM <table name(s)>
[WHERE <condition>]
[GROUP BY <column expression for calculating aggregates>]
[HAVING <group level filter condition>]
[ORDER BY <sort order for the results table>]
```

The SELECT clause names the columns or column expressions to be shown. An asterisk can be used to specify all columns. The FROM clause lists the table or tables to be accessed. The WHERE clause is used to provide a criteria for relating multiple tables and/or provides a row-level filter, which is used to eliminate rows that do not meet the desired condition. GROUP BY is used to arrange the results table in groups for data aggregation such as subtotaling. The HAVING clause provides a group-level filter for the results set. The ORDER BY clause is used to arrange the results table in the specified order. The methodology for doing this in PowerPivot and Excel will be demonstrated in this chapter.

When using the SELECT statement, the following questions should be addressed:

SELECT: What are the desired columns or columns expressions to be displayed?

FROM: In what tables are these columns?

WHERE: What are the conditions that link the tables? What are the selection criteria to eliminate unwanted rows?

GROUP BY: What values are to be aggregated for such purposes as subtotals?

HAVING: What conditions must each record meet to be included in the result table when using aggregation?

ORDER BY: In what order should the results be presented?

For example, the following SQL SELECT statement extracts the name and address fields from the addrlist table in which the zip code is equal to "94704."

```
SELECT name, address FROM addrlist WHERE zip="94704"
```

SQL Aggregate Functions

SQL includes various aggregate functions to allow calculating subtotals, subaverages, subcounts, etc., based on the condition in the WHERE clause.

These functions include:

COUNT(): Returns the number of non-empty rows for the conditions specified

SUM(): Returns the sum of all values in the specified columns

MIN(): Returns the lowest value in the specified column

MAX(): Returns the largest value in the specified column

AVG(): Returns the average value for the specified column

The functions can be applied to the entire table or subsets of the table, as defined by the WHERE conditions. Look at these statements, for example:

SELECT COUNT(*) FROM offices: Would return the number of rows in the offices table

SELECT COUNT(*) FROM office WHERE region="CH": Would return the number of offices in the Chicago region

SELECT SUM(sales) FROM offices: Would return the sum of sales for all rows in the offices table

SELECT SUM(sales) FROM offices where region="CH": Would return the sum of the sales field for all offices in the Chicago region

Subtotals

It would be possible to display a count of all offices in each region, using the following statement:

```
SELECT region, COUNT(*) FROM offices GROUP BY region
```

Subtotals of sales for all regions could be generated using the following statement:

```
SELECT region, SUM(sales) FROM offices GROUP BY region
```

Joining Tables

When querying multiple tables, it is best to use a WHERE clause to specify the condition for joining the tables. This is called an equijoin, because it is based on an equality test. If the WHERE clause is omitted, every row in the first table will be paired with every row in the second table. This is called the Cartesian product, or outer join of the two tables.

Importing an External Database

This example will use the Access Northwind sample database. To execute this sample, take the following steps:

1. Click the PowerPivot tab to open the ribbon.
2. Click the Manage button.
3. On the PowerPivot tab, click "Get External Data" and "From Database." Select "From Access."
4. Click Browse and select Database2, which was previously downloaded from the Northwind Database site, as shown in Figure 5-1. This file is also available for download from the Source Code/Downloads tab on the Apress book page at `www.apress.com/9781484205303`.

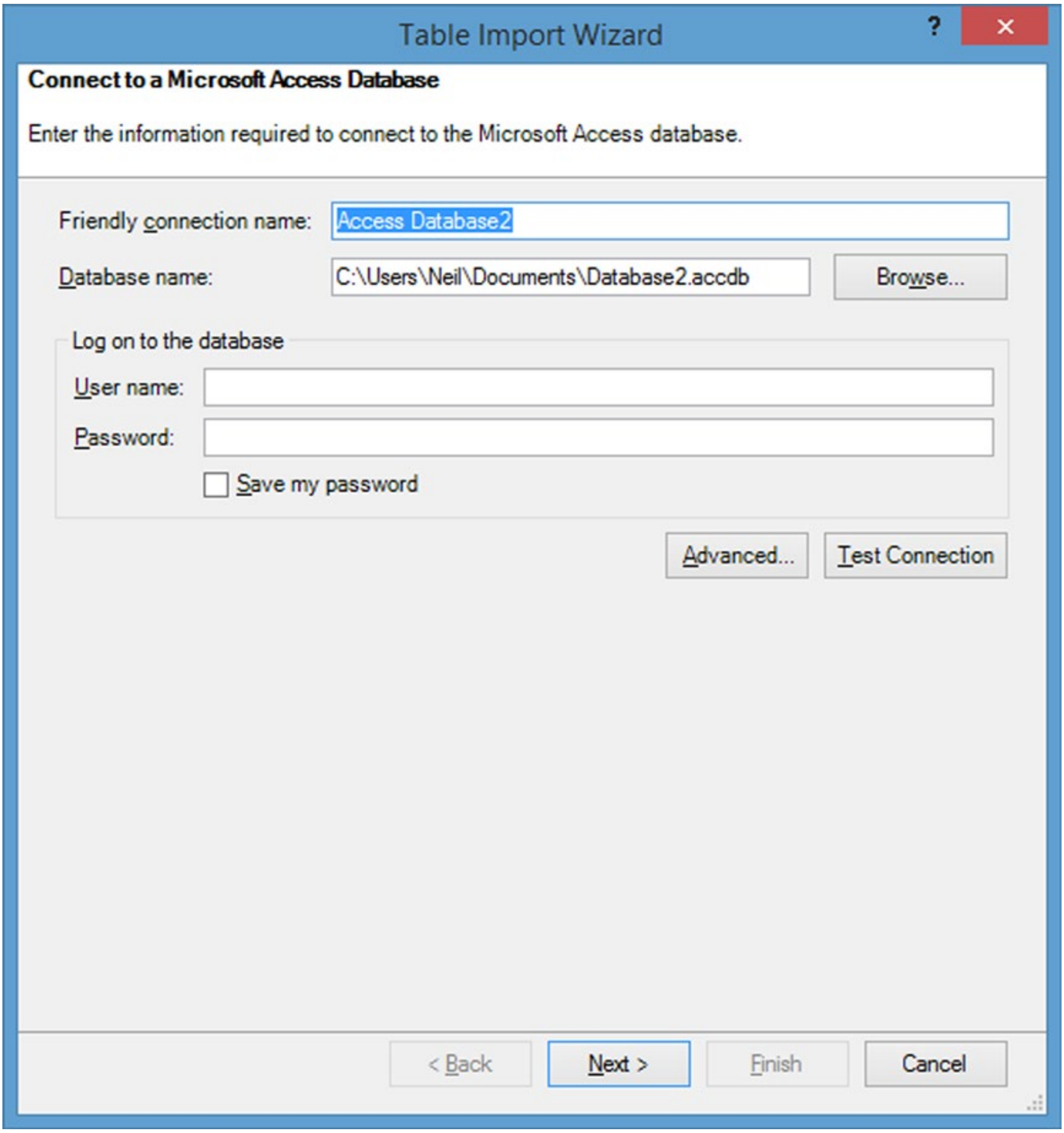


Table Import Wizard

Connect to a Microsoft Access Database

Enter the information required to connect to the Microsoft Access database.

Friendly connection name: Access Database2

Database name: C:\Users\Neil\Documents\Database2.accdb

Log on to the database

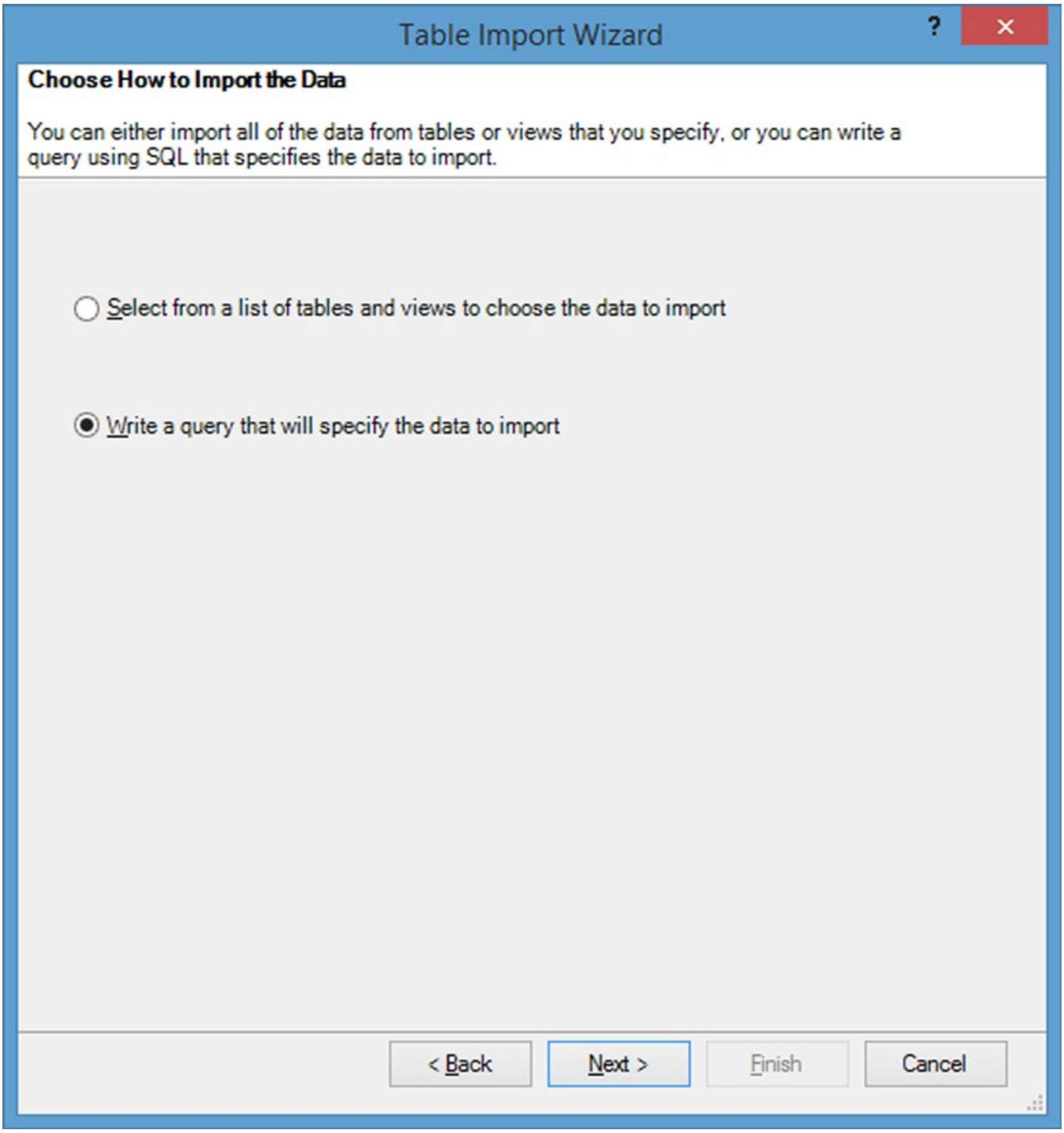
User name:

Password:

□ Save my password

Figure 5-1. Importing database with Table Import Wizard

5. Click Test Connection. If the connection tests OK, click Next.
6. Select the second option, "Write a query that will specify the data to import," as shown in Figure 5-2. Click Next.



Choose How to Import the Data

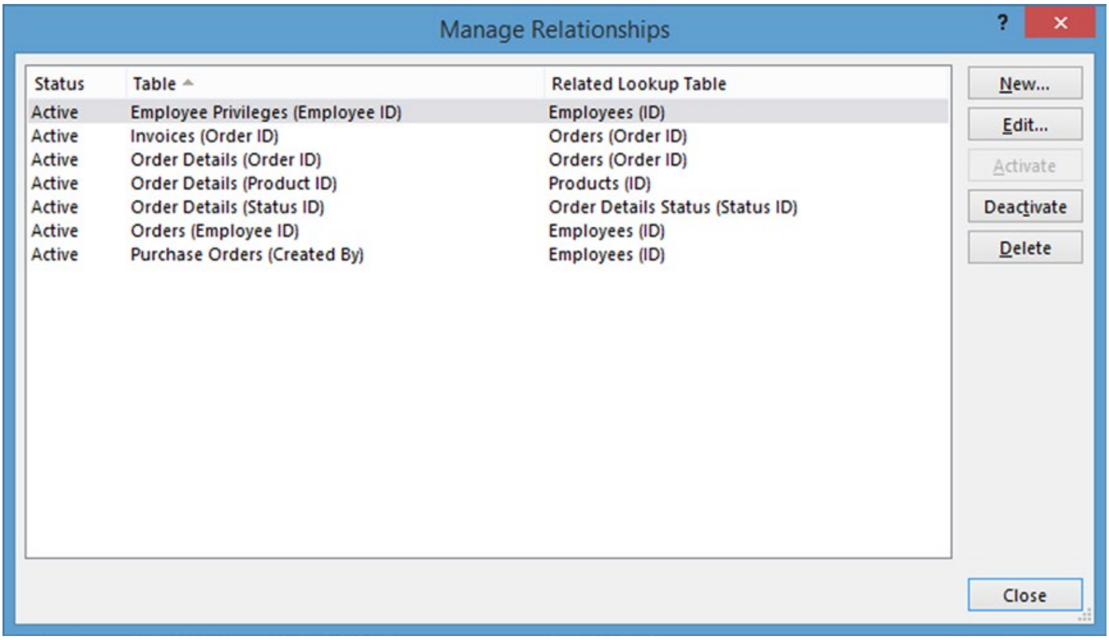
You can either import all of the data from tables or views that you specify, or you can write a query using SQL that specifies the data to import.

○ Select from a list of tables and views to choose the data to import

● Write a query that will specify the data to import

Figure 5-2. *Select "Write a query that will specify the data to import"*

Before writing a query, it is helpful to know the structure and relationships defined in the database. When importing an Access database, the relationships defined in Access are imported, as shown in Figure 5-3.



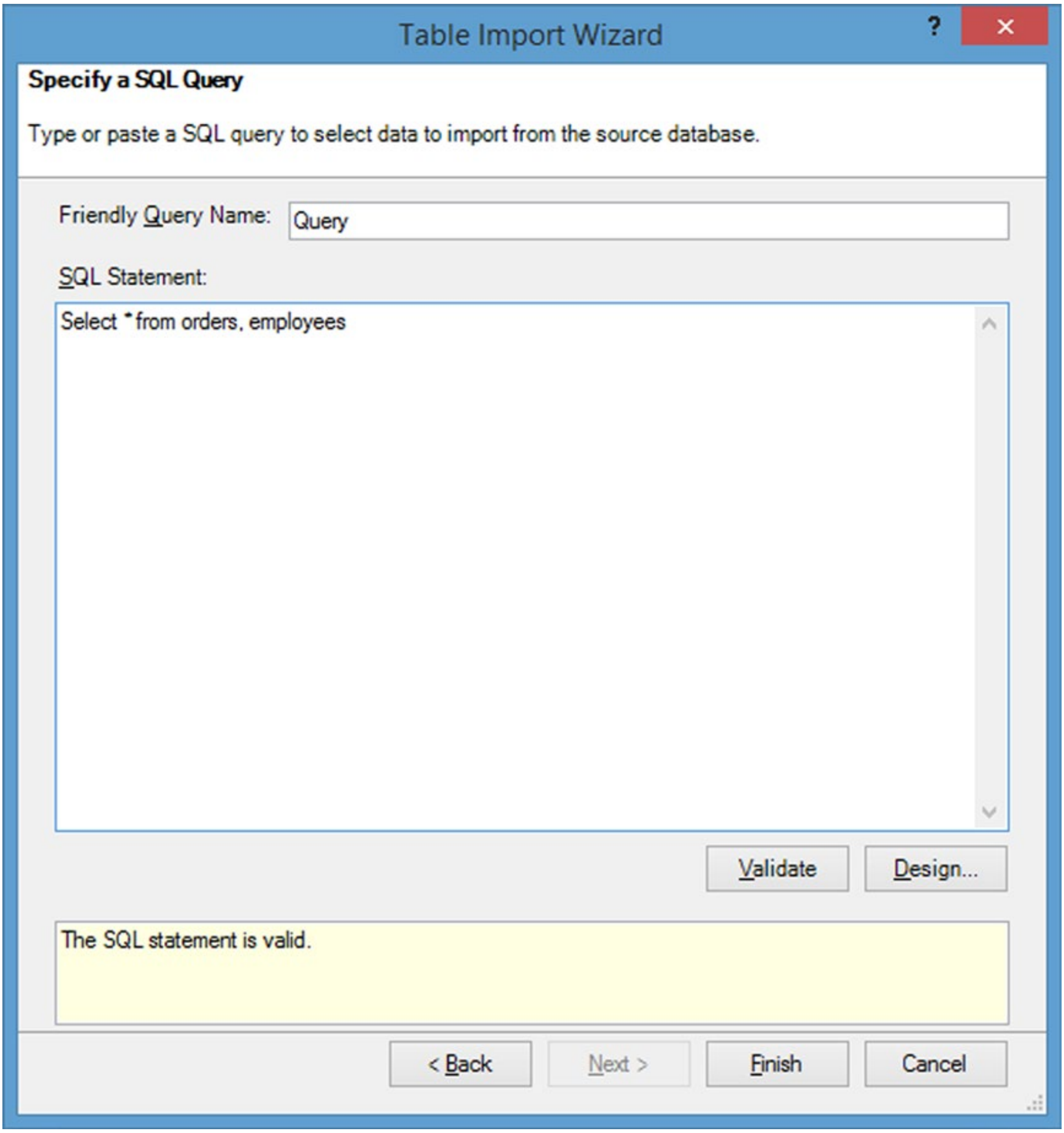
Status	Table	Related Lookup Table
Active	Employee Privileges (Employee ID)	Employees (ID)
Active	Invoices (Order ID)	Orders (Order ID)
Active	Order Details (Order ID)	Orders (Order ID)
Active	Order Details (Product ID)	Products (ID)
Active	Order Details (Status ID)	Order Details Status (Status ID)
Active	Orders (Employee ID)	Employees (ID)
Active	Purchase Orders (Created By)	Employees (ID)

Figure 5-3. *Existing relationships*

7. The first query will import all fields from the orders and employees tables, based on the relationship shown in Figure 5-3, where the EmployeeId field in the Orders table is linked to the ID field in the Employees table. In the SQL Statement window, enter the following SQL Statement:

```
SELECT * from orders, employees
```

8. Then click Validate. The window will appear as shown in Figure 5-4, if the SQL is entered correctly.



Specify a SQL Query

Type or paste a SQL query to select data to import from the source database.

Friendly Query Name: Query

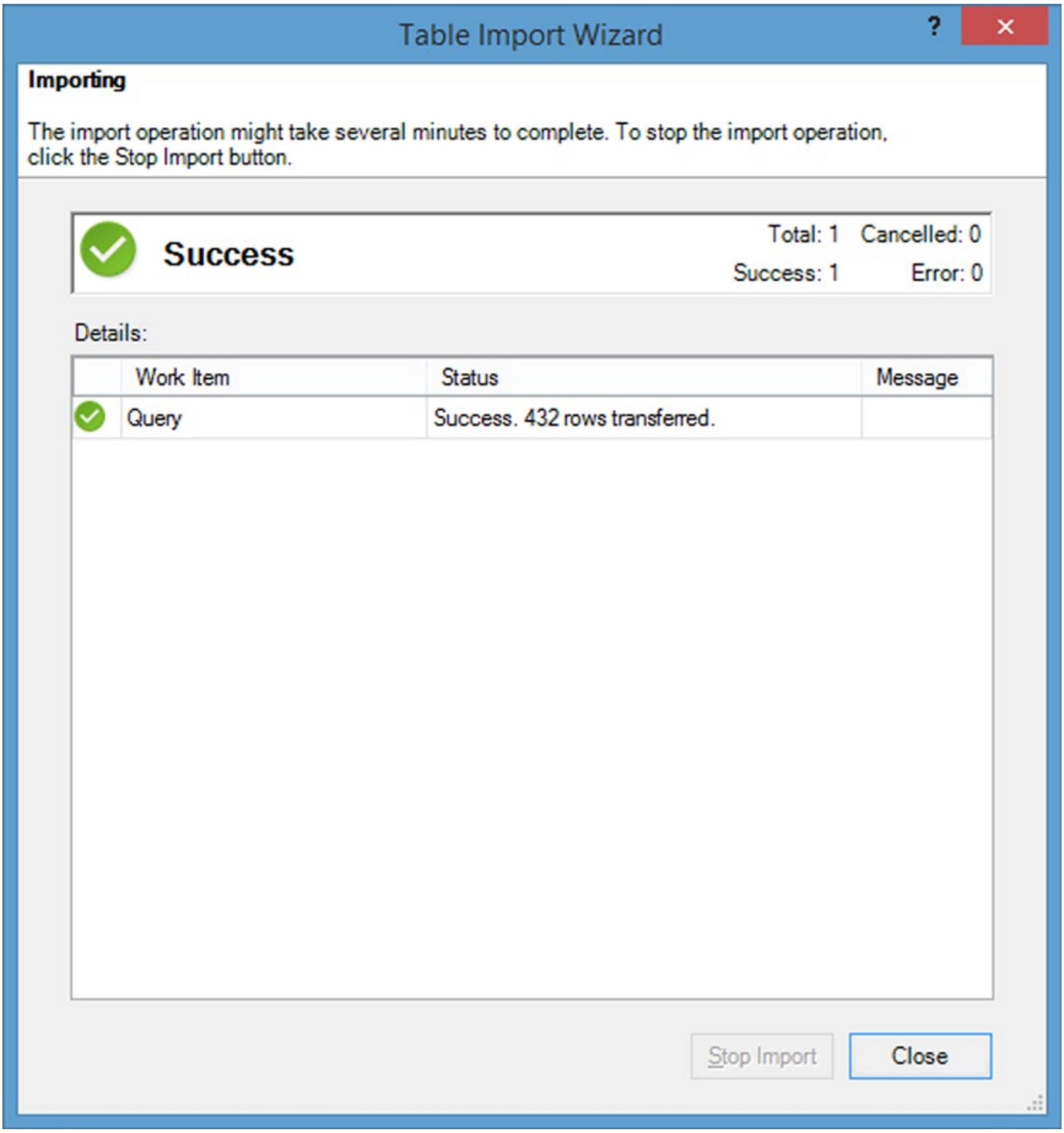
SQL Statement:

```
Select * from orders, employees
```

The SQL statement is valid.

Figure 5-4. SQL select statement

9. Click Finish to see the results, which are shown in Figure 5-5. Click Close to access the data.



Importing

The import operation might take several minutes to complete. To stop the import operation, click the Stop Import button.

Success

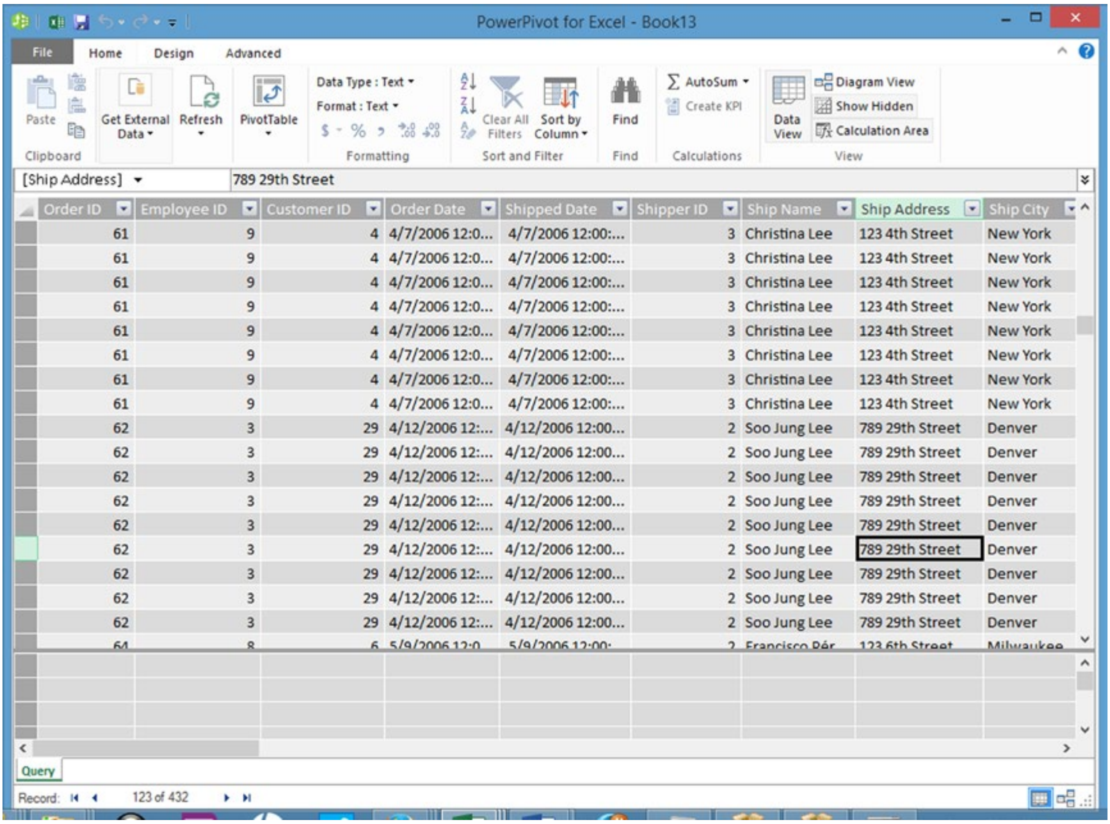
Total: 1 Cancelled: 0
Success: 1 Error: 0

Details:

	Work Item	Status	Message
✓	Query	Success. 432 rows transferred.	

Figure 5-5. *Success screen showing 432 rows imported*

The actual data retrieved after clicking Close is shown in Figure 5-6. Note that 432 rows were imported, because no relationship was specified between the tables, so every row in the first table was paired with every row in the second table. Note that 432 is the product of 9 rows in the employees table and 48 rows in the orders table.



[Ship Address] 789 29th Street

Order ID	Employee ID	Customer ID	Order Date	Shipped Date	Shipper ID	Ship Name	Ship Address	Ship City
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
61	9	4	4/7/2006 12:0...	4/7/2006 12:00:...	3	Christina Lee	123 4th Street	New York
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
62	3	29	4/12/2006 12:...	4/12/2006 12:00...	2	Soo Jung Lee	789 29th Street	Denver
64	8	6	5/9/2006 12:0...	5/9/2006 12:00:...	2	Francisco Pér...	123 6th Street	Milwaukee

Figure 5-6. *Results table from SQL query*

Specifying a JOIN Condition and Selected Fields

In this example, a join condition will be specified, so that only one order is imported for each employee. This example will show how to import only selected fields. Note that fields with spaces in them must to be enclosed in square brackets. When fields from multiple tables are imported, the field names are specified as tablename.fieldname.

For this example, follow steps 1-6 from the example in the preceding "Importing an External Database" section and then complete the following steps:

1. Enter the SQL statement, as shown in Figure 5-7. Note that the `WHERE` condition is specified, linking the two tables based on `employees.id=orders.[employee id]`. The employee last name will be displayed from the employees table. The employee ID will be displayed from both the employees and orders tables, to demonstrate that they are the same.

```
Select employees.id, employees.[last name],orders.[employee id] from employees,
orders where employees.id=orders.[employee id]
```

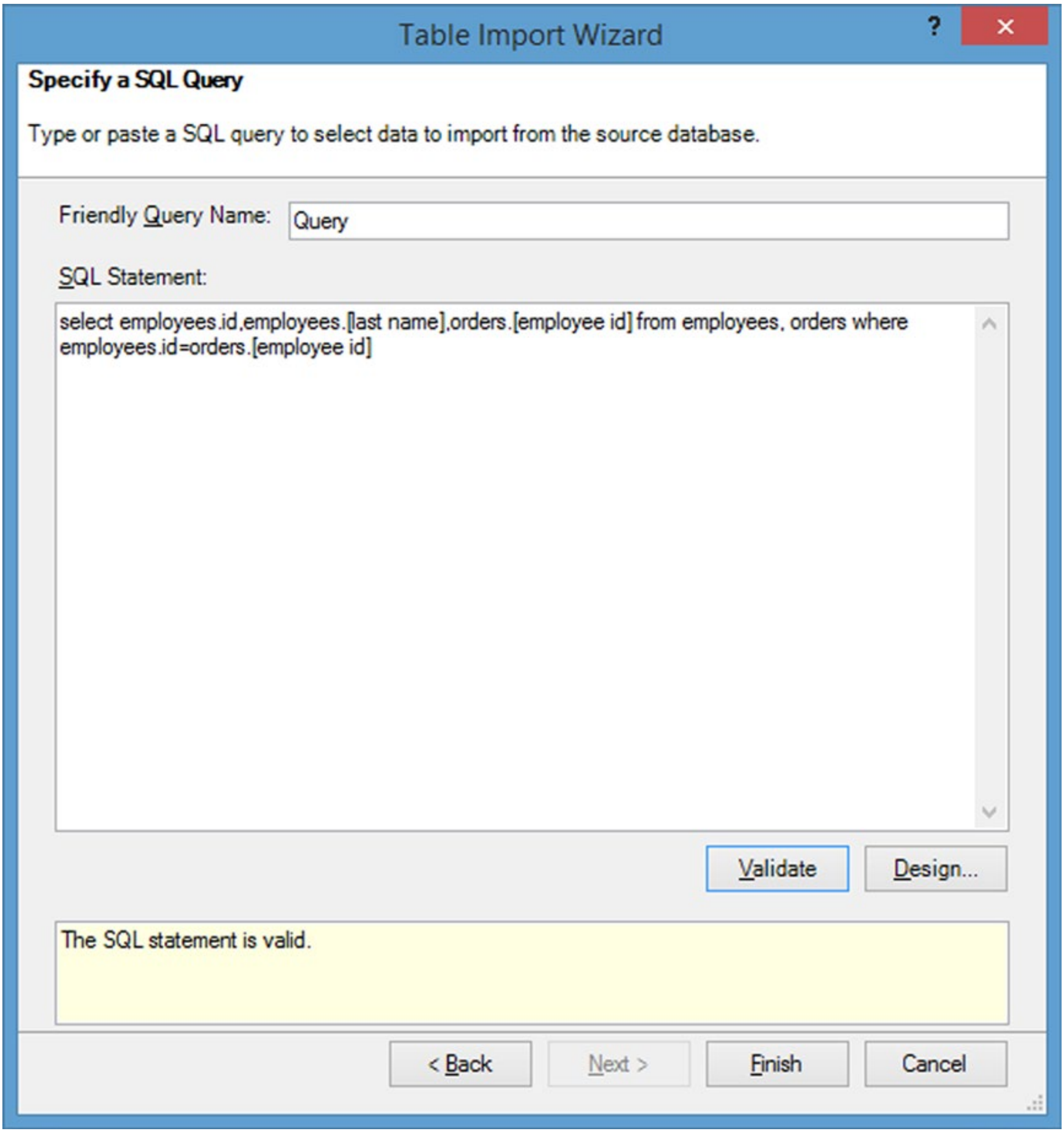


Table Import Wizard

Specify a SQL Query

Type or paste a SQL query to select data to import from the source database.

Friendly Query Name: Query

SQL Statement:

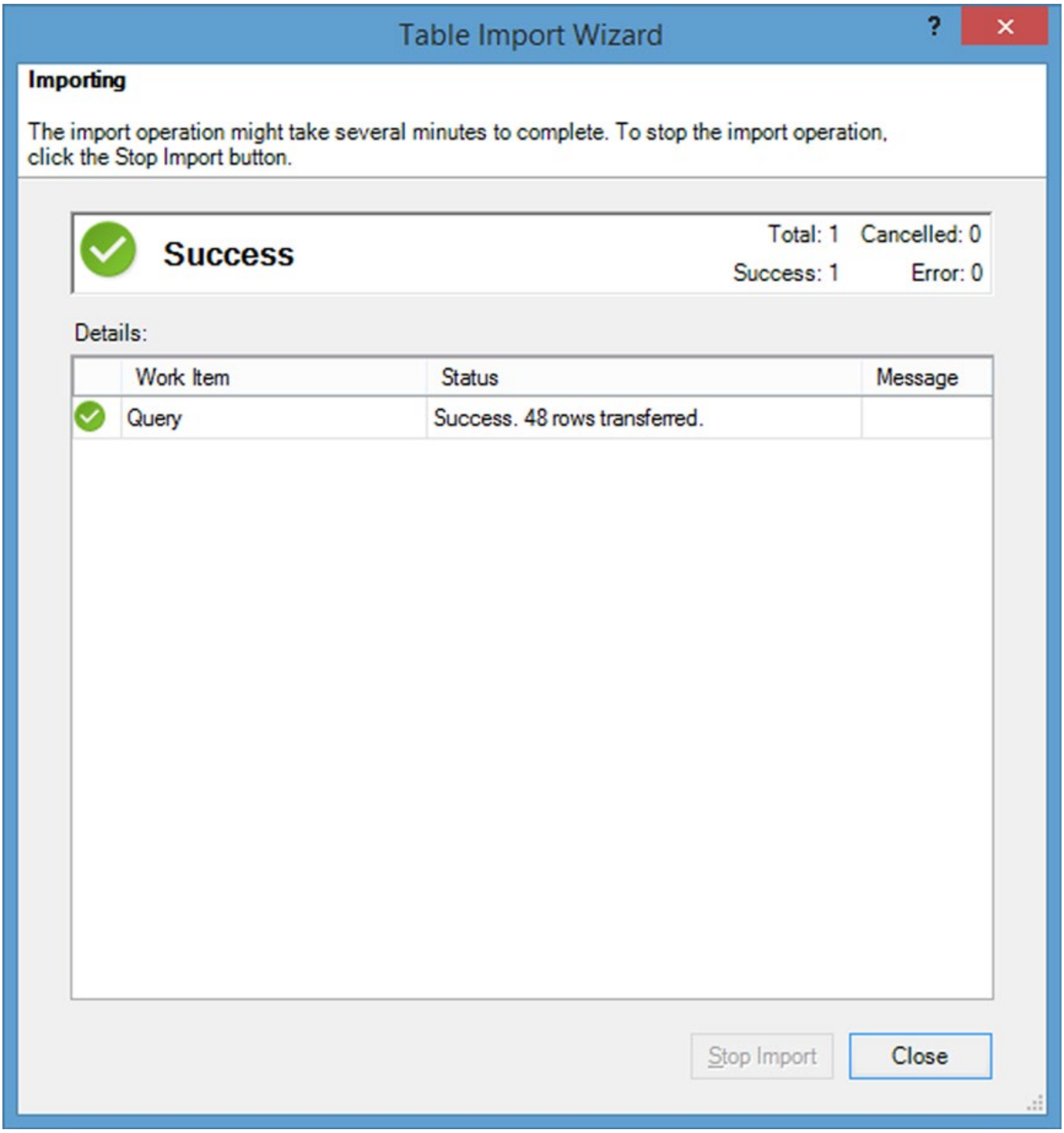
```
select employees.id,employees.[last name],orders.[employee id] from employees, orders where
employees.id=orders.[employee id]
```

The SQL statement is valid.

Figure 5-7. *SQL query*

2. Click Validate to ensure that the query is valid, as also shown in Figure 5-7.

3. Now, click Finish. Note that because the condition is specified, only 48 rows (the number of records in the orders table) were imported, as shown in Figure 5-8.



Importing

The import operation might take several minutes to complete. To stop the import operation, click the Stop Import button.

Success

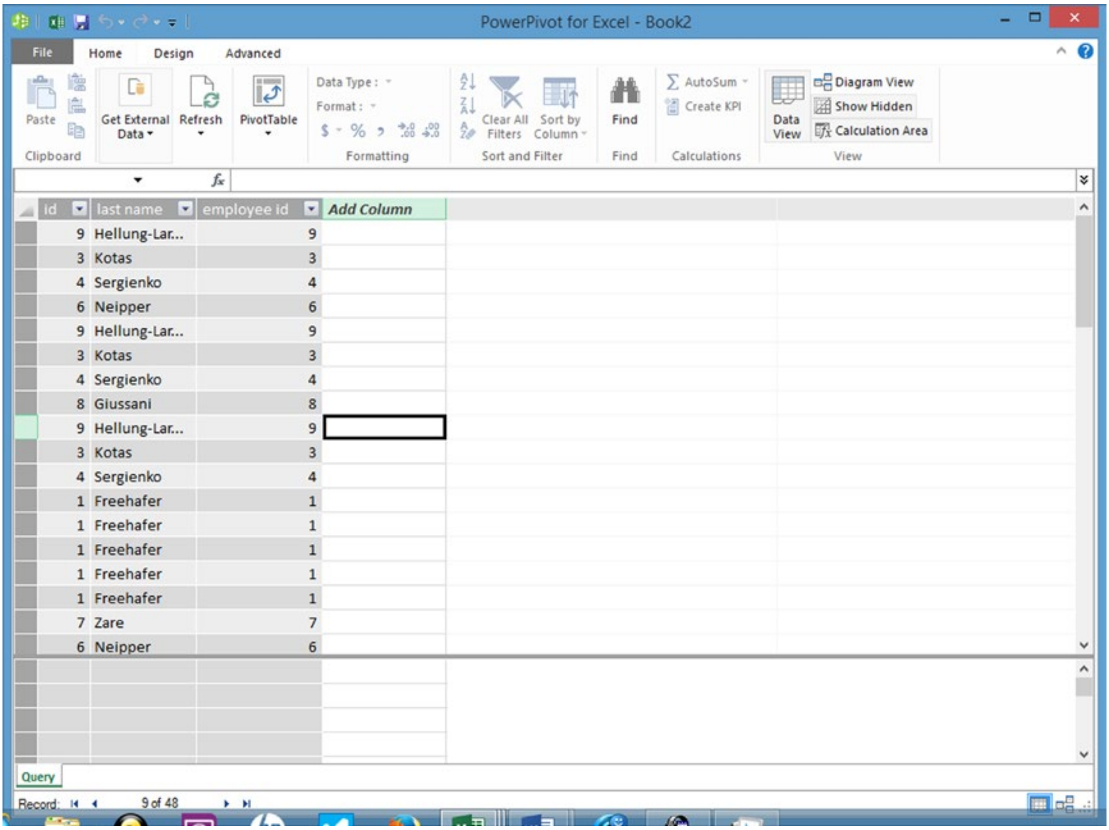
Total: 1 Cancelled: 0
Success: 1 Error: 0

Details:

	Work Item	Status	Message
✓	Query	Success. 48 rows transferred.	

Figure 5-8. *Success screen showing 48 rows imported*

4. Click Close to complete the procedure. The results are given in Figure 5-9, which shows the employee last name from the employees table and the employee ID from both the employees and orders tables.



id	last name	employee id	Add Column
9	Hellung-Lar...	9	
3	Kotas	3	
4	Sergienko	4	
6	Neipper	6	
9	Hellung-Lar...	9	
3	Kotas	3	
4	Sergienko	4	
8	Giussani	8	
9	Hellung-Lar...	9	
3	Kotas	3	
4	Sergienko	4	
1	Freehafer	1	
1	Freehafer	1	
1	Freehafer	1	
1	Freehafer	1	
1	Freehafer	1	
7	Zare	7	
6	Neipper	6	

Figure 5-9. *Result table from SQL query*

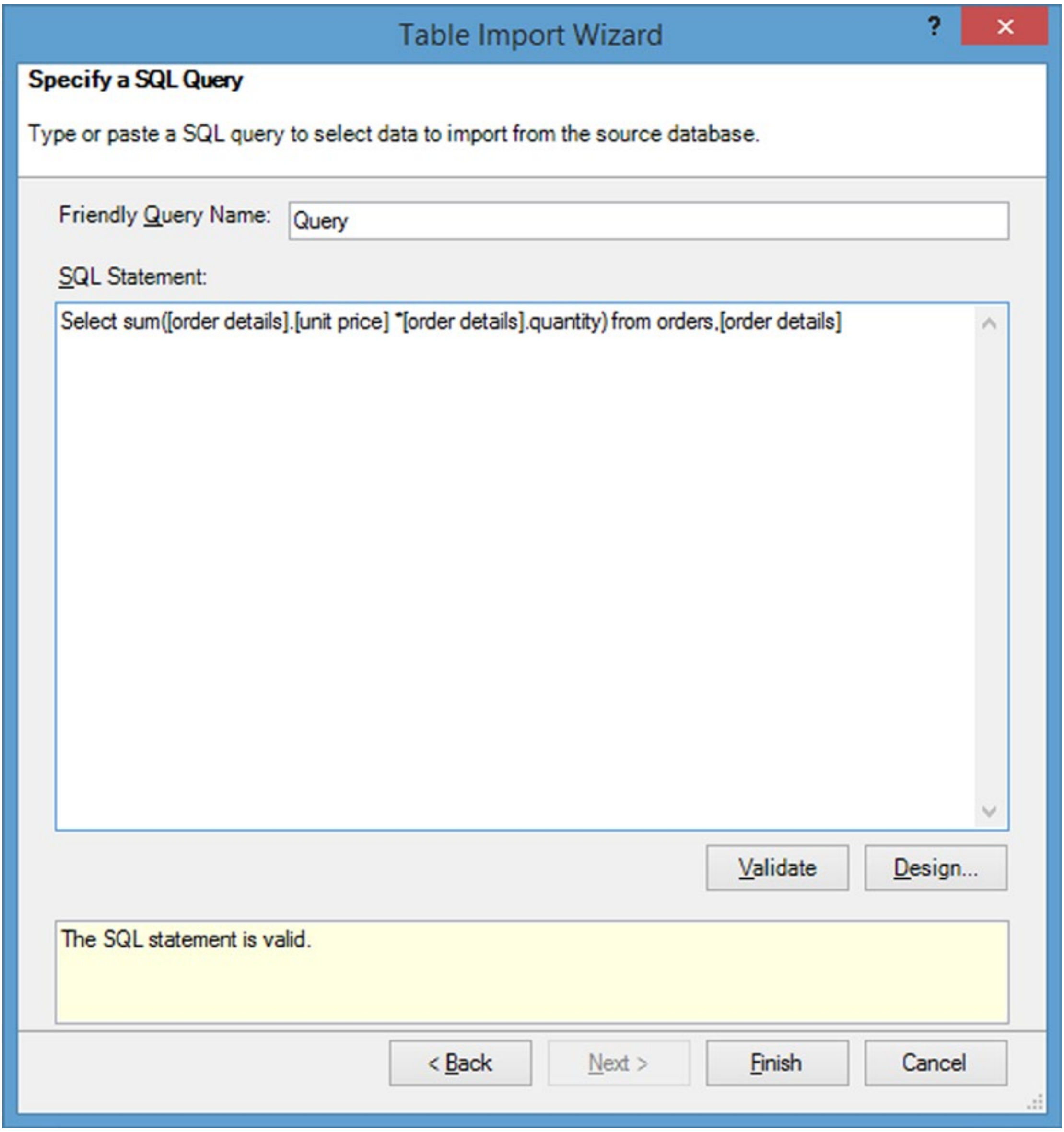
Using SQL to Extract Summary Statistics

SQL can be used to extract summary statistics from a table or tables using aggregation functions. This example will extract a single number—the sum of unit price times quantity from the orders and orders detail tables.

For this example, follow steps 1-6 from the previous example in the “Importing an External Database” section.

1. Enter the following SQL statement, as shown in Figure 5-10, to extract the sum of price time’s quantity for all records in the orders table.

```
Select sum([order details].[unit price] *[order details].quantity) from
orders,[order details]
```



Friendly Query Name: Query

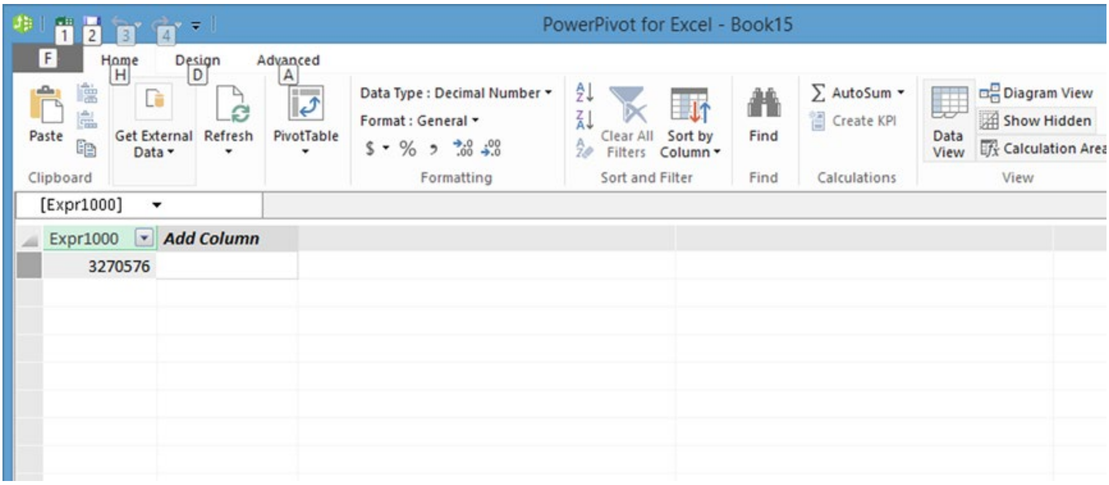
SQL Statement:

```
Select sum([order details].[unit price] *[order details].quantity) from orders,[order details]
```

The SQL statement is valid.

Figure 5-10. *SQL query*

2. Press Enter and wait until the Success screen is shown. Then click Close. The result is shown in Figure 5-11. Notice that the result is a single number, which is the sum of price times quantity for all order detail records.



[Expr1000]

Expr1000
3270576

Figure 5-11. *Results is a single number*

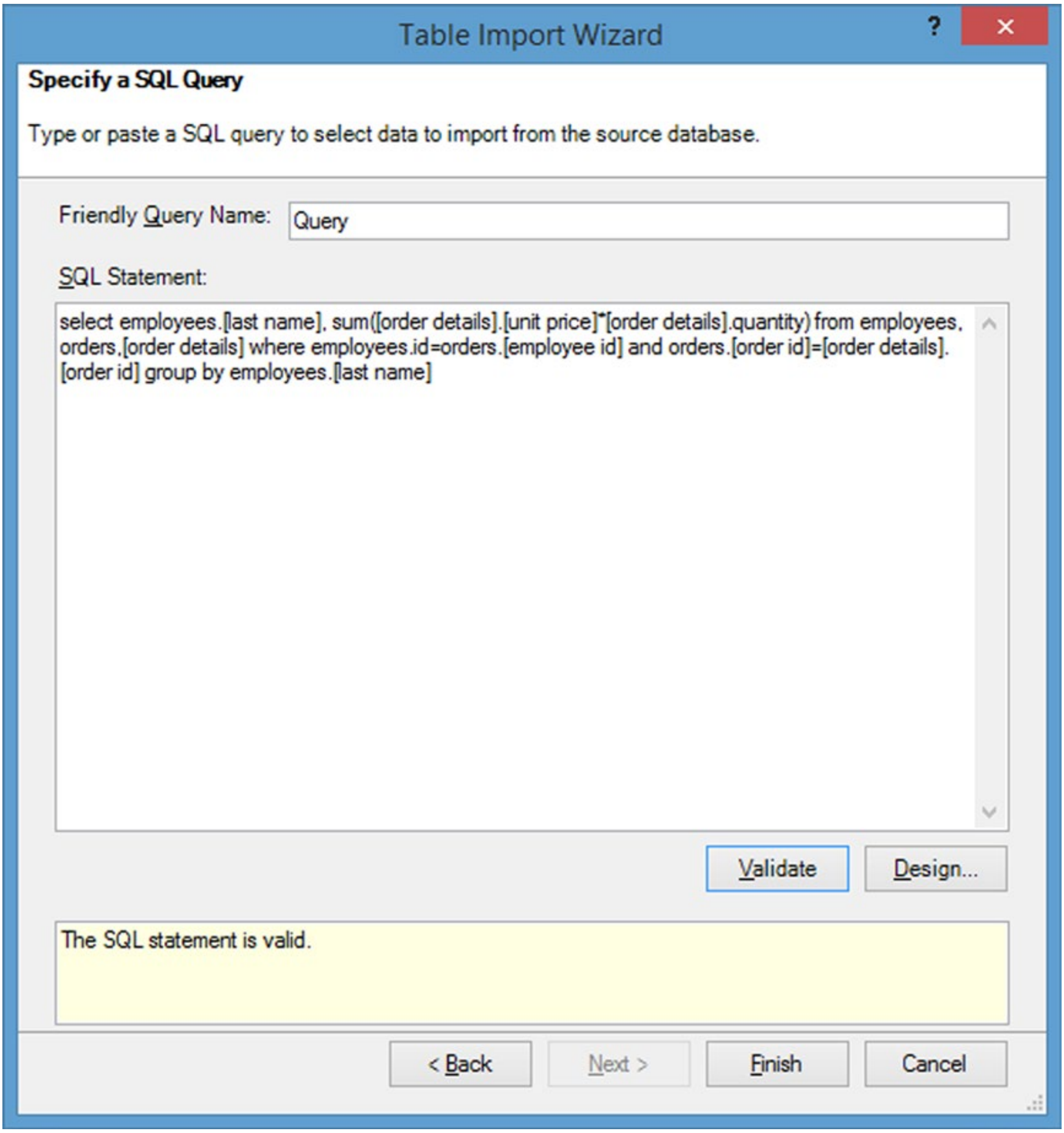
Generating a Report of Total Order Value by Employee

In this example, a report will be generated of total order value by employee. To create this report, three tables will be linked: employees, orders, and order details.

For this example, follow steps 1-6 from the previous example in the “Importing an External Database” section.

1. Enter the following SQL statements, as shown in Figure 5-12, to extract the sum of price times quantity for all orders broken down by employee. Click Validate to make sure that the SQL statement is entered correctly.

```
Select employees.[last name], sum([order details].[unit price] * [order details].
quantity) from employees, orders, [order details] where employees.id=orders.
[employee id] and orders.[order id]=[order details].[order id] group by
employees.[last name]
```



Specify a SQL Query

Type or paste a SQL query to select data to import from the source database.

Friendly Query Name: Query

SQL Statement:

```
select employees.[last name], sum([order details].[unit price]*[order details].quantity) from employees,
orders,[order details] where employees.id=orders.[employee id] and orders.[order id]=[order details].
[order id] group by employees.[last name]
```

The SQL statement is valid.

Figure 5-12. SQL query

2. Note that two relationships are used to link three tables, based on the relationships shown in Figure 5-3. No fields are displayed from the orders table, but that table is used as a link table. The following are the relationships from Figure 5-3 that are being used in this example. Click Finish to execute the SQL statement.

```
employees.id=orders.[employee id]
orders.[order id]=[order details].[order id]
```

3. This query generates eight rows, as shown in Figure 5-13.

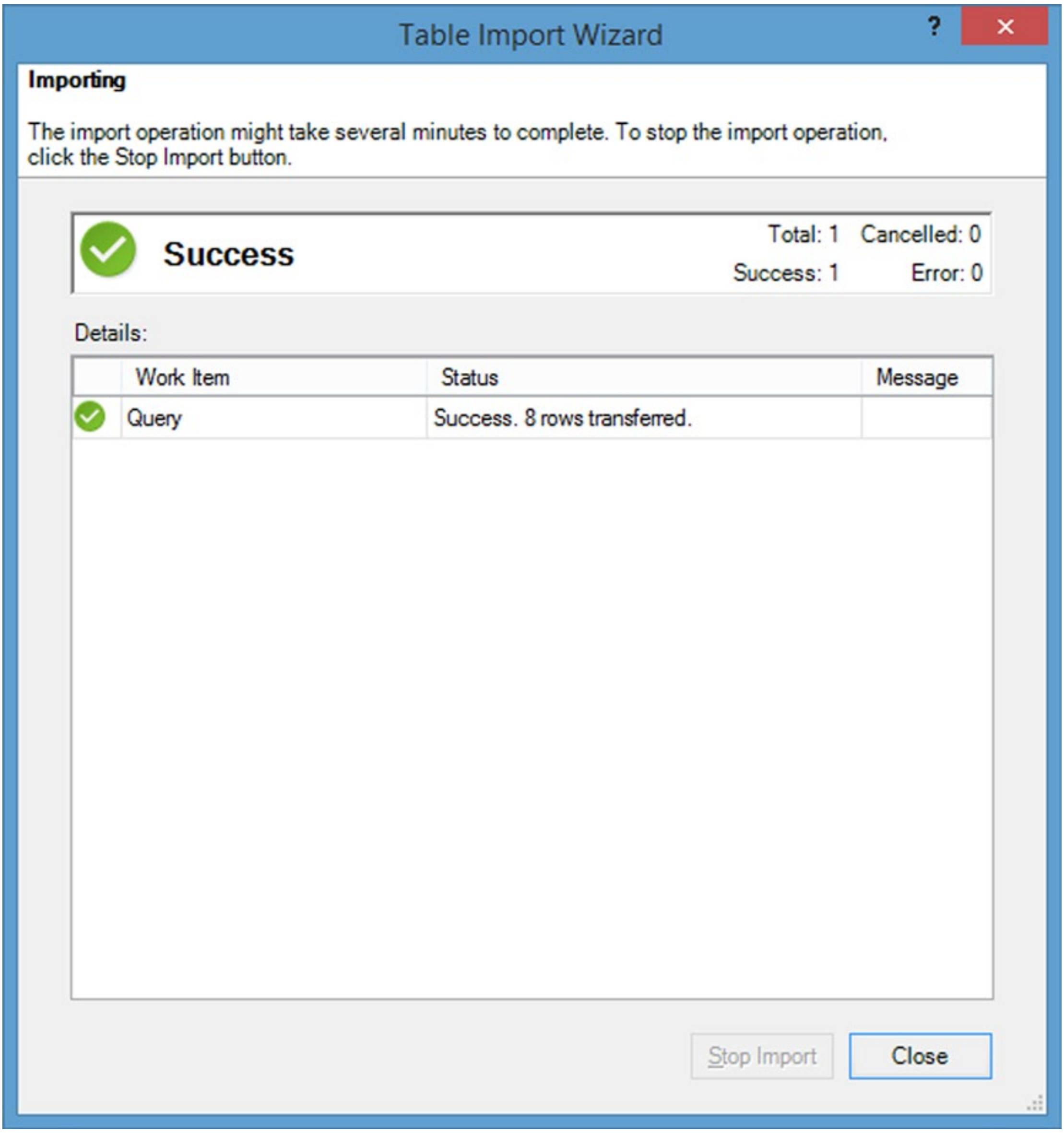


Table Import Wizard

Importing

The import operation might take several minutes to complete. To stop the import operation, click the Stop Import button.

✓ **Success**

Total: 1 Cancelled: 0

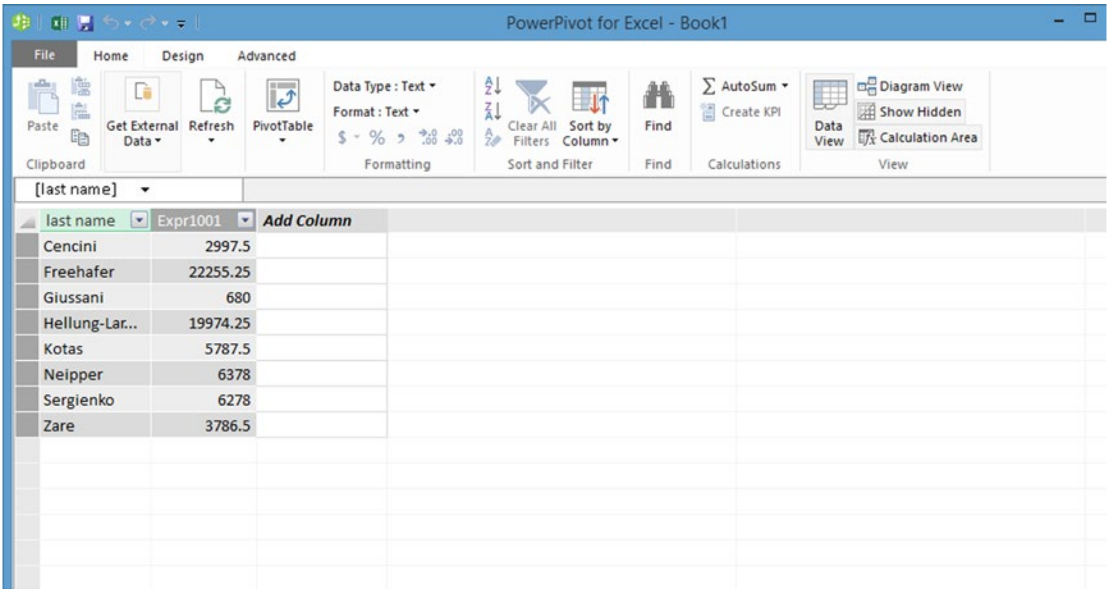
Success: 1 Error: 0

Details:

	Work Item	Status	Message
✓	Query	Success. 8 rows transferred.	

Figure 5-13. Success screen showing eight rows generated by this query

4. The actual data generated is shown in Figure 5-14—a listing of the value of orders by employees.



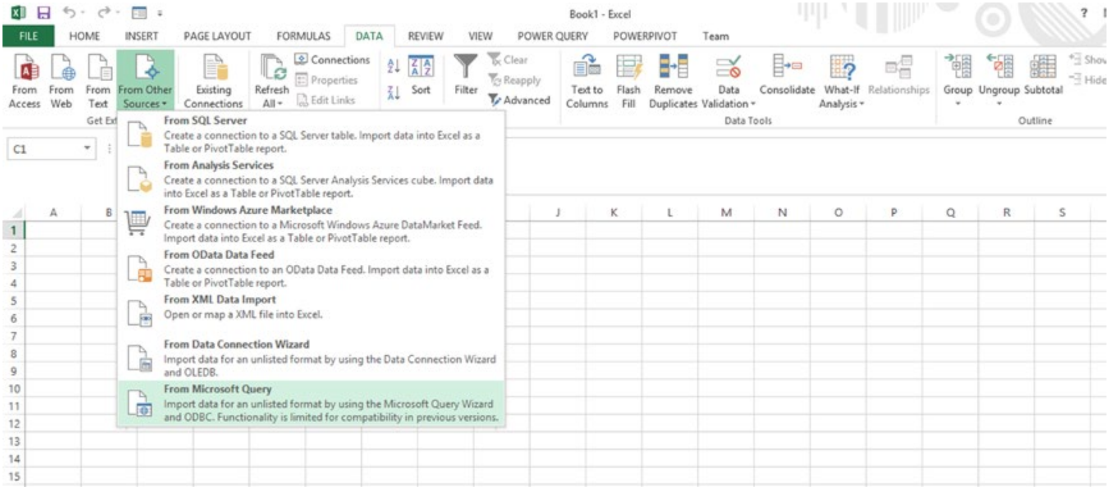
last name	Expr1001
Cencini	2997.5
Freehafer	22255.25
Giussani	680
Hellung-Lar...	19974.25
Kotas	5787.5
Neipper	6378
Sergienko	6278
Zare	3786.5

Figure 5-14. *Total value of orders by employee*

Using MSQuery

Another alternative is to use SQL with Microsoft Query. This example will show another way to access the Northwind database used earlier in this chapter. Follow these steps:

1. Click the Data tab to view the ribbon and then click "From Other Sources."
2. Then click the last item on the menu, "From Microsoft Query," as shown in Figure 5-15.



From SQL Server
Create a connection to a SQL Server table. Import data into Excel as a Table or PivotTable report.

From Analysis Services
Create a connection to a SQL Server Analysis Services cube. Import data into Excel as a Table or PivotTable report.

From Windows Azure Marketplace
Create a connection to a Microsoft Windows Azure DataMarket Feed. Import data into Excel as a Table or PivotTable report.

From OData Data Feed
Create a connection to an OData Data Feed. Import data into Excel as a Table or PivotTable report.

From XML Data Import
Open or map a XML file into Excel.

From Data Connection Wizard
Import data for an unlisted format by using the Data Connection Wizard and OLEDB.

From Microsoft Query
Import data for an unlisted format by using the Microsoft Query Wizard and ODBC. Functionality is limited for compatibility in previous versions.

Figure 5-15. *Screen showing how to access Microsoft Query*

3. Select MS Access Database in the Choose Data Source window, as shown in Figure 5-16. Uncheck “Use the Query Wizard to create/edit queries” at the bottom of the window. Then click OK.

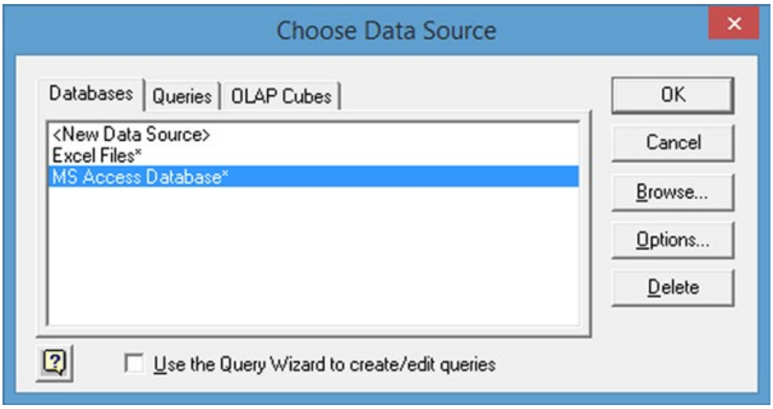


Figure 5-16. Choose Data Source window

4. Select Database2, which was downloaded previously, as shown in Figure 5-17, and click OK.

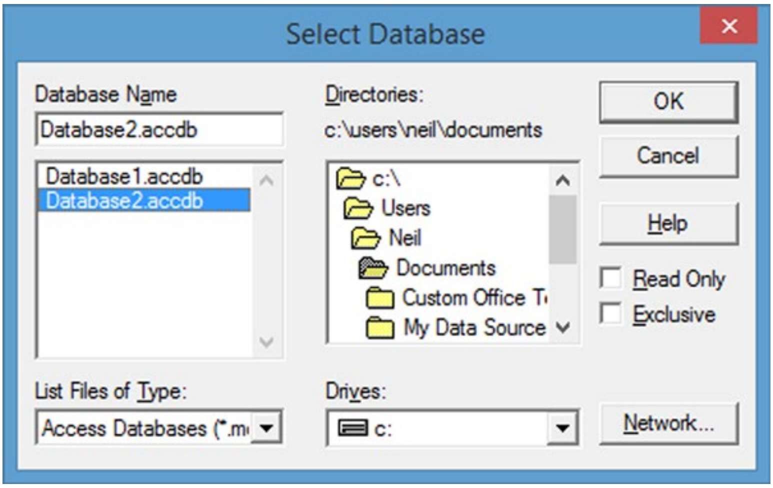


Figure 5-17. Select Database window

5. Use the Add Tables window to add the employees, orders, and order detail tables by double-clicking each table, as shown in Figure 5-18.

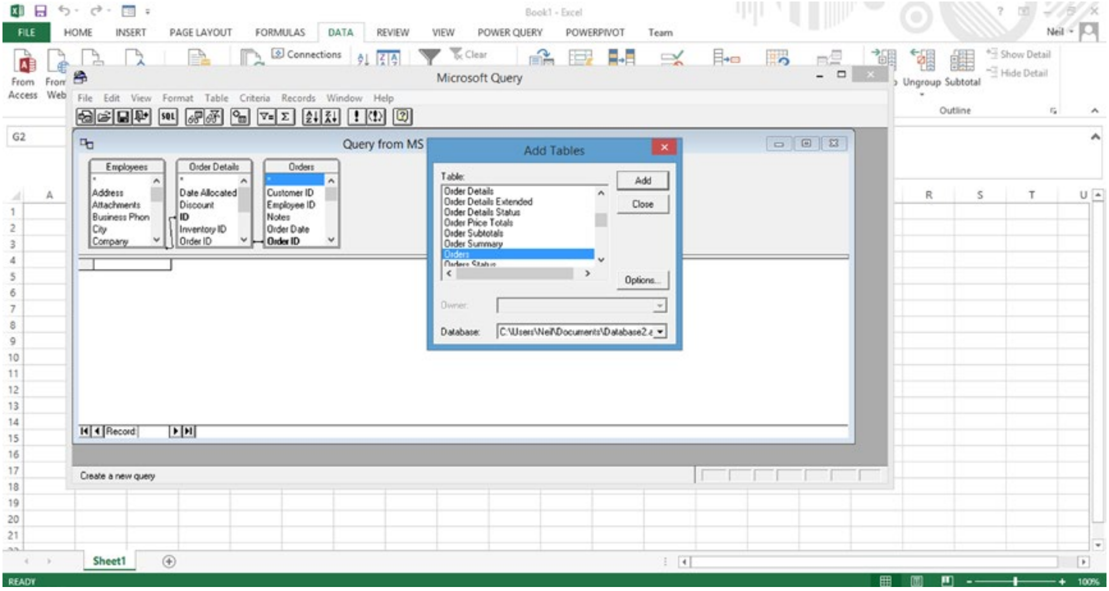


Figure 5-18. *Microsoft Query window to add tables*

6. Click Close and expand the window where the tables are displayed, to see the relationships that have been defined, as shown in Figure 5-19.

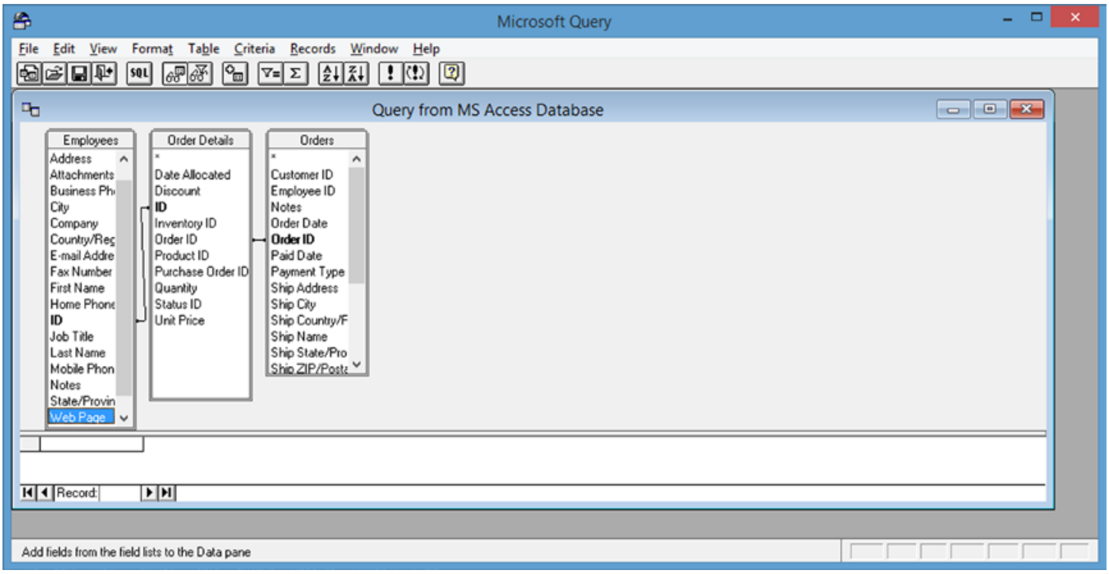
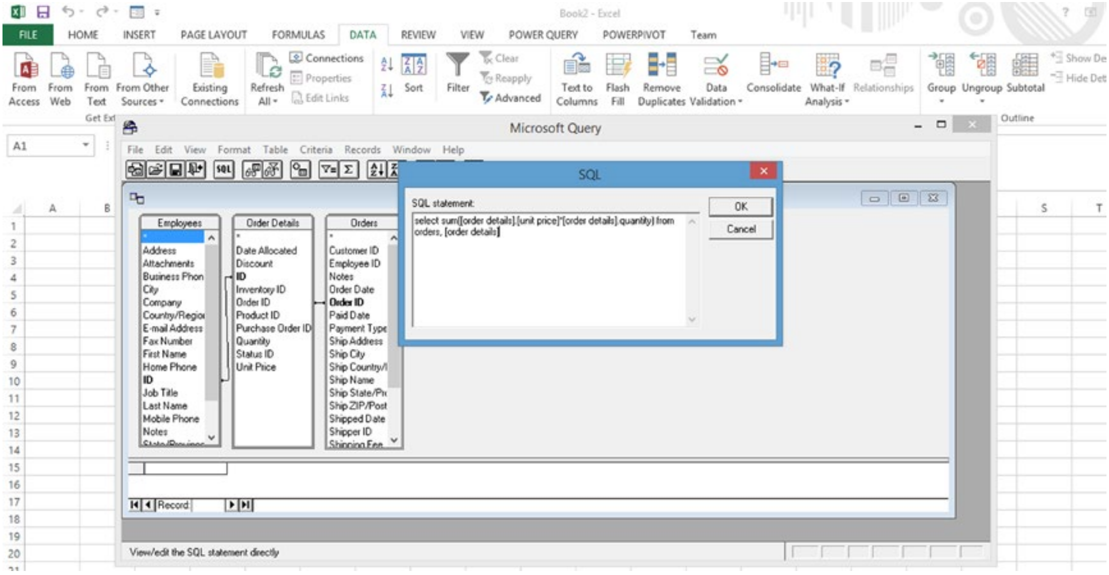


Figure 5-19. *Query screen showing tables and relationships*

7. To enter an SQL query, click the SQL button under the Menu bar and enter the SQL query, as shown in Figure 5-20.

```
Select sum([order details].[unit price] *[order details].quantity) from
orders,[order details]
```



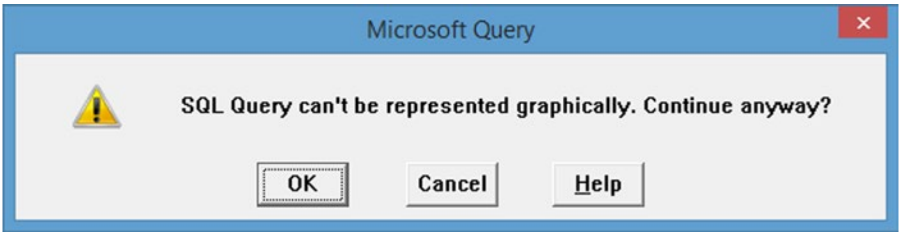
SQL statement:

```
select sum([order details].[unit price]*[order details].quantity) from
orders, [order details]
```

View/edit the SQL statement directly

Figure 5-20. *Query screen showing SQL query*

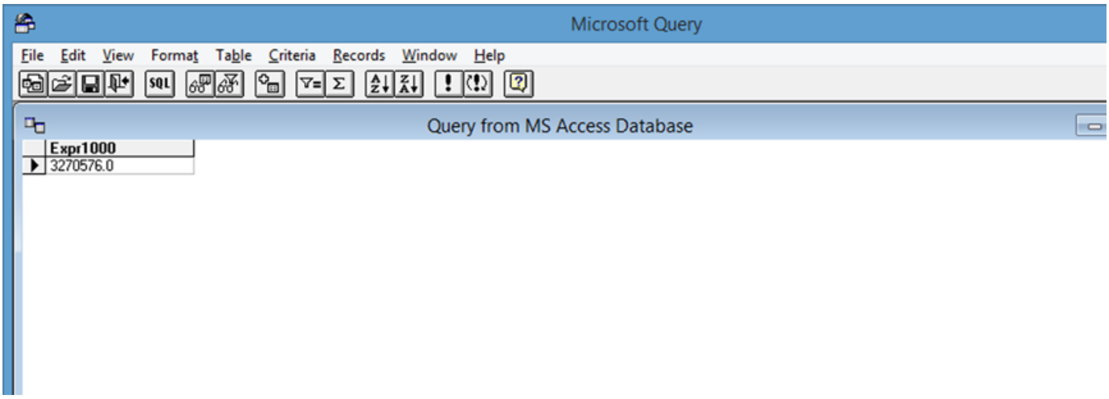
8. Click OK for the prompt "SQL Query can't be represented graphically. Continue anyway?", as shown in Figure 5-21.



SQL Query can't be represented graphically. Continue anyway?

Figure 5-21. *Microsoft Query pop-up window*

The single-number response will be displayed as shown in Figure 5-22.


Microsoft Query
File Edit View Format Table Criteria Records Window Help
SQL
Query from MS Access Database

Expr1000
3270576.0

Figure 5-22. *Results of query*

Summary

This chapter has shown several ways in which to use SQL with Excel and PowerPivot to summarize data from a large table or set of tables. It has demonstrated how to join tables based on specified conditions and how to use aggregation to extract summary statistics.

CHAPTER 6

Designing Reports with Power View

Power View is a reporting tool that creates its own type of worksheet. For users who are not otherwise proficient in Excel, it is a way of creating a "sandbox" in which to explore a subset of the data without changing it. Power View allows bringing data to life by creating dashboards containing quick and easy visualizations based on PowerPivot models or PivotTables. It is possible to create multiple Power View worksheets based on the same data.

Elements of the Power View Design Screen

The Power View screen consists of the following elements, as shown in Figure 6-1:

1. A design surface on the left
2. A filters area in the middle, where data can be filtered based on field values
3. The Power View Fields pane, where the fields to be included in the report are selected. The top part includes all the available fields, and the bottom part shows the selected fields.

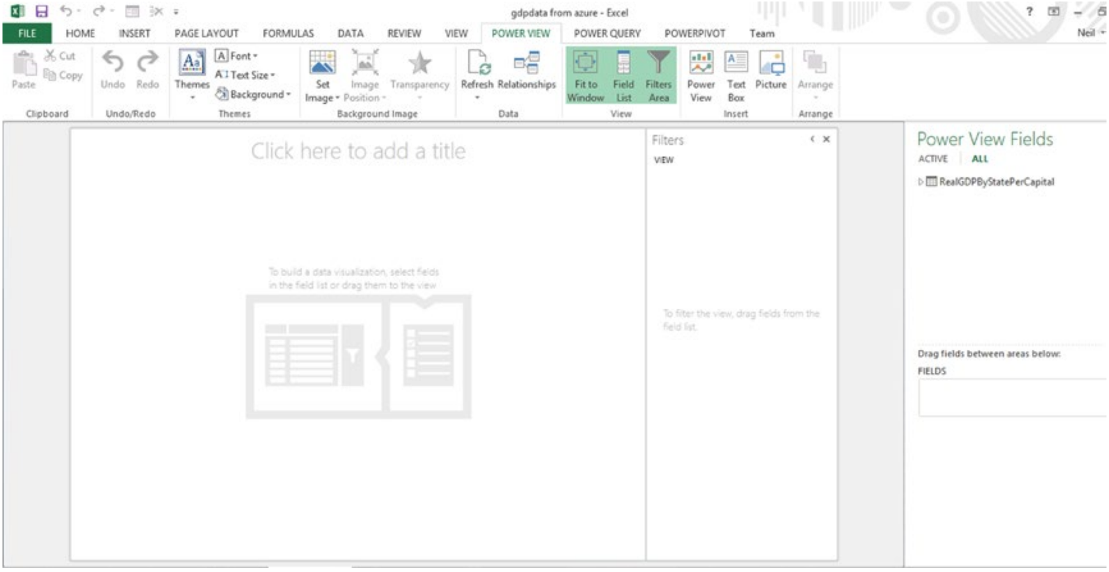


Figure 6-1. *Power View design surface*

Considerations When Using Power View

Always start with a table view, and then base the chart on the table. It is possible to add multiple tables and/or charts to the design surface. Simply click in a blank area to add a new chart.

Include on the design surface only fields that are necessary for the report. Unless they are relevant to the report, it is generally a good idea to not to include the key values that are used to link tables.

Types of Fields

There are generally two types of fields that are treated very differently.

1. Category or descriptive fields that are nonnumeric
2. Numeric fields that can include calculated fields or measures. The summation symbol is used to indicate a numeric field whose aggregation type can be changed.

Understanding How Data Is Summarized

Perhaps the trickiest part of working with Power View is understanding how data is summarized. By default, numeric fields are summed, even if they are fields in which the sum makes no sense, such as ID number or year. The type of aggregation can be easily changed by clicking the down arrow after the field name in the lower part of the Power View Field pane. The aggregation choices are as follows:

- Do Not Summarize
- Sum
- Average
- Minimum

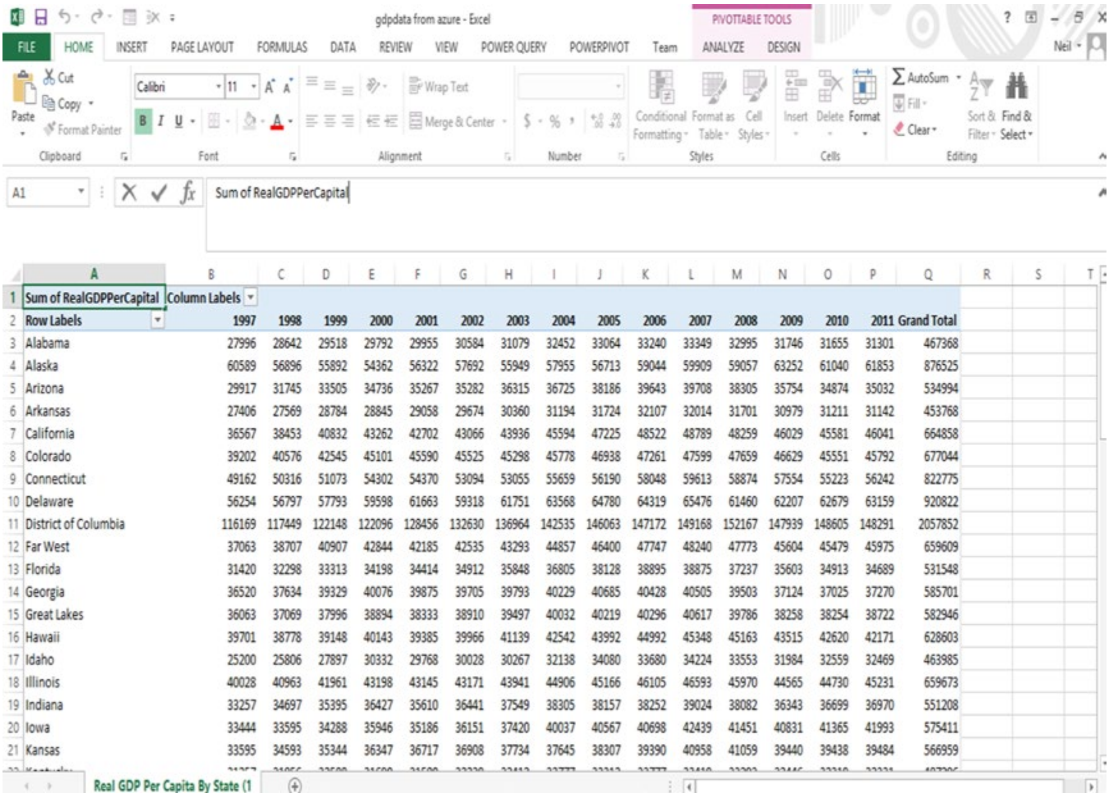
- Maximum
- Count(Not Blank)
- Count(Distinct)

Note that for data to be plotted on a chart, the field must be summarized using one of the preceding mathematical functions.

A Single Table Example

This first example will show how to use Power View based on a single spreadsheet of the real GDP (gross domestic product) per capita data by state for each year from 1997 to 2011. The instructions to download this data from the Azure Marketplace were covered in Chapter 3. To create the Power View Query, perform the following steps:

1. Open the GDP data from the Azure Spreadsheet, which is shown in Figure 6-2.



Sum of RealGDPPerCapital

Sum of RealGDPPerCapital	Column Labels															
Row Labels	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Grand Total
Alabama	27996	28642	29518	29792	29955	30584	31079	32452	33064	33240	33349	32995	31746	31655	31301	467368
Alaska	60589	56896	55892	54362	56322	57692	55949	57955	56713	59044	59909	59057	63252	61040	61853	876525
Arizona	29917	31745	33505	34736	35267	35282	36315	36725	38186	39643	39708	38305	35754	34874	35032	534994
Arkansas	27406	27569	28784	28845	29058	29674	30360	31194	31724	32107	32014	31701	30979	31211	31142	453768
California	36567	38453	40832	43262	42702	43066	43936	45594	47225	48522	48789	48259	46029	45581	46041	664858
Colorado	39202	40576	42545	45101	45590	45525	45298	45778	46938	47261	47599	47659	46629	45551	45792	677044
Connecticut	49162	50316	51073	54302	54370	53094	53055	55659	56190	58048	59613	58874	57554	55223	56242	822775
Delaware	56254	56797	57793	59598	61663	59318	61751	63568	64780	64319	65476	61460	62207	62679	63159	920822
District of Columbia	116169	117449	122148	122096	128456	132630	136964	142535	146063	147172	149168	152167	147939	148605	148291	2057852
Far West	37063	38707	40907	42844	42185	42535	43293	44857	46400	47747	48240	47773	45604	45479	45975	659609
Florida	31420	32298	33313	34198	34414	34912	35848	36805	38128	38895	38875	37237	35603	34913	34689	531548
Georgia	36520	37634	39329	40076	39875	39705	39793	40229	40685	40428	40505	39503	37124	37025	37270	585701
Great Lakes	36063	37069	37996	38894	38333	38910	39497	40032	40219	40296	40617	39786	38258	38254	38722	582946
Hawaii	39701	38778	39148	40143	39385	39966	41139	42542	43992	44992	45348	45163	43515	42620	42171	628603
Idaho	25200	25806	27897	30332	29768	30028	30267	32138	34080	33680	34224	33553	31984	32559	32469	463985
Illinois	40028	40963	41961	43198	43145	43171	43941	44906	45166	46105	46593	45970	44565	44730	45231	659673
Indiana	33257	34697	35395	36427	35610	36441	37549	38305	38157	38252	39024	38082	36343	36699	36970	551208
Iowa	33444	33595	34288	35946	35186	36151	37420	40037	40567	40698	42439	41451	40831	41365	41993	575411
Kansas	33595	34593	35344	36347	36717	36908	37734	37645	38307	39390	40958	41059	39440	39438	39484	566959

Figure 6-2. Spreadsheet for real data by GDP per capita by state

2. Click the Insert tab and select Power View Reports, then wait while the Power View screen loads, as shown in Figure 6-2. If prompted to install SilverLight, click Yes. Note the design surface on the left, the Power View Fields pane on the right, and the Filters pane in the middle.

3. In the Power View Fields pane on the right side of the screen, click the right-facing triangle to the left of RealGDPByStatePerCapita to display the fields. Then drag the year field to the Filters pane, as shown in Figure 6-3.

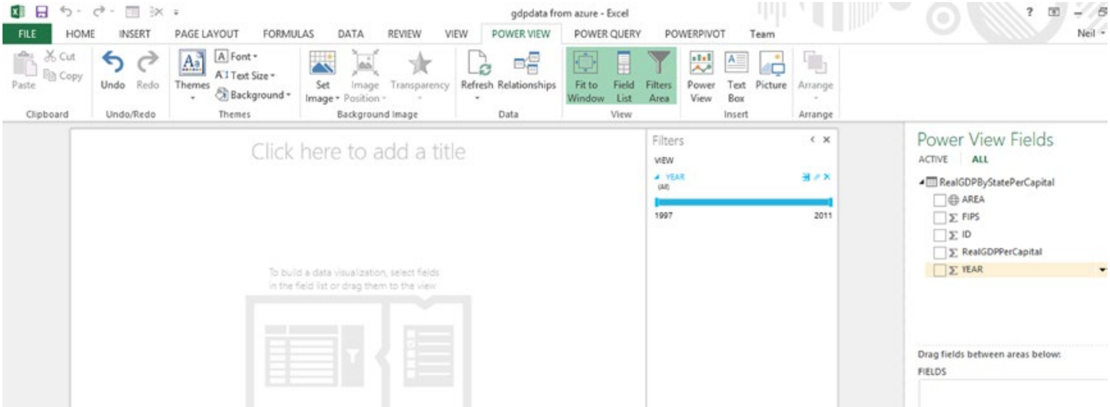


Figure 6-3. *Setting a filter*

4. To display only the most recent year, 2011, click the leftmost icon to the right of Year in the Filters pane to activate the List Filter Mode to see the list of years and select 2011, as shown in Figure 6-4.

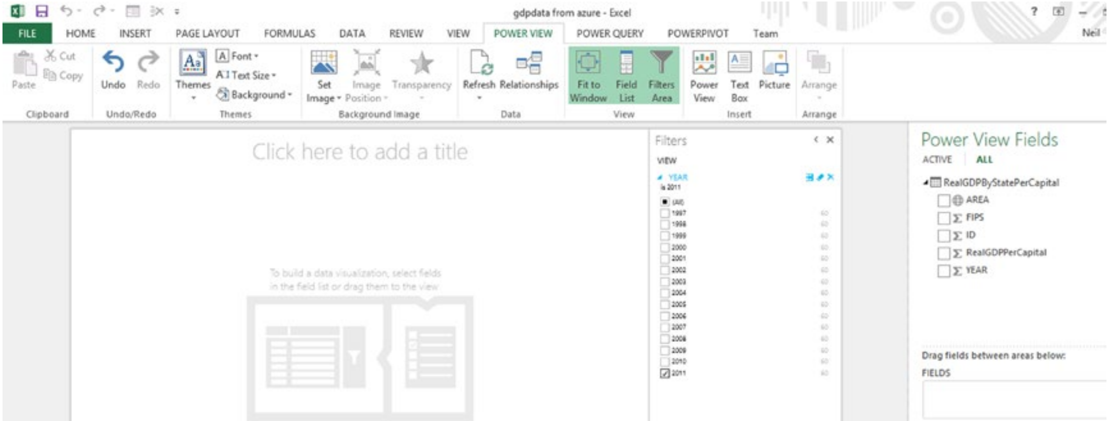
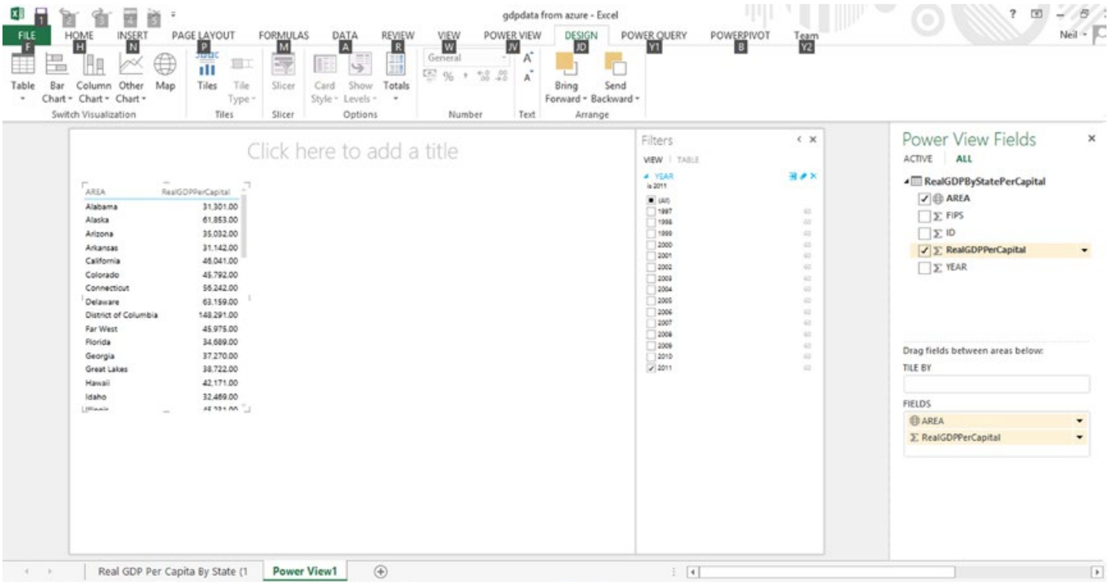


Figure 6-4. *Setting a filter, expanded view*

5. Then, in the Power View Fields pane, click the box in front of Area and RealGDPPerCapita, and a table will be created, as shown in Figure 6-5.



AREA	RealGDPPerCapital
Alabama	31,301.00
Alaska	61,853.00
Arizona	35,032.00
Arkansas	31,142.00
California	46,041.00
Colorado	45,792.00
Connecticut	56,242.00
Delaware	63,159.00
District of Columbia	148,291.00
Far West	45,975.00
Florida	34,689.00
Georgia	37,270.00
Great Lakes	38,722.00
Hawaii	42,171.00
Idaho	32,469.00

YEAR is 2011

☑ 2011

RealGDPByStatePerCapital

☑ AREA
□ FIPS
□ ID
☑ RealGDPPerCapital
□ YEAR

Drag fields between areas below:

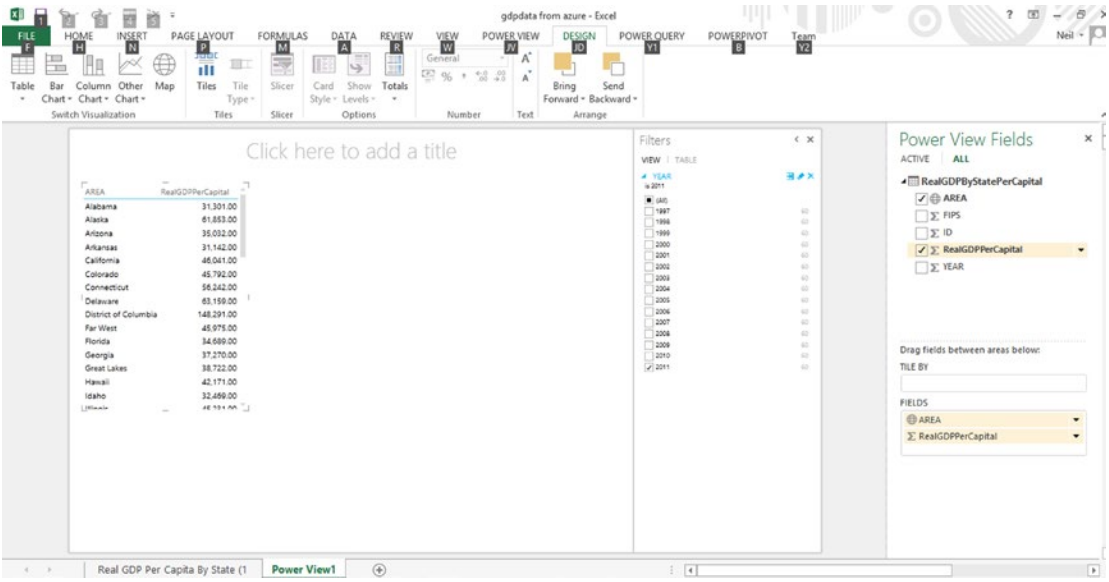
TILE BY

FIELDS

AREA
RealGDPPerCapital

Figure 6-5. *Table showing sum of real GDP per capita*

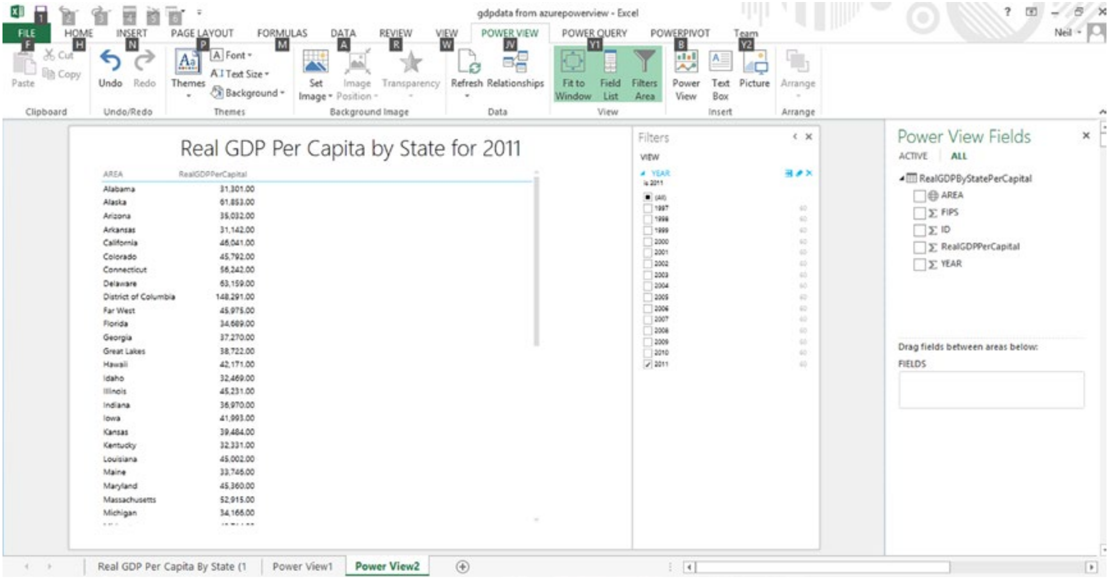
6. Note that by default, the sum of the RealGDPPerCapita is shown, which is meaningless. If you want to change that setting, at the bottom of the Power View Fields pane, click the down arrow after RealGDPPerCapita and select "Do Not Summarize." However, to plot the charts shown following, it is necessary to leave it set to Sum. The results are shown in Figure 6-6. Note the scrollbar to the right of the table, which allows scrolling through all the states. To expand the table, click it and drag the handles.



AREA	RealGDPPerCapital
Alabama	31,301.00
Alaska	61,853.00
Arizona	35,032.00
Arkansas	31,142.00
California	46,041.00
Colorado	45,792.00
Connecticut	56,242.00
Delaware	63,159.00
District of Columbia	148,291.00
Far West	45,975.00
Florida	34,689.00
Georgia	37,270.00
Great Lakes	38,722.00
Hawaii	42,171.00
Idaho	32,469.00

Figure 6-6. *Table showing real GDP per Capita by state*

7. A title can be added by clicking where it says to “Click here to add a title” and entering “Real GDP Per Capita by State for 2011,” as shown in Figure 6-7.



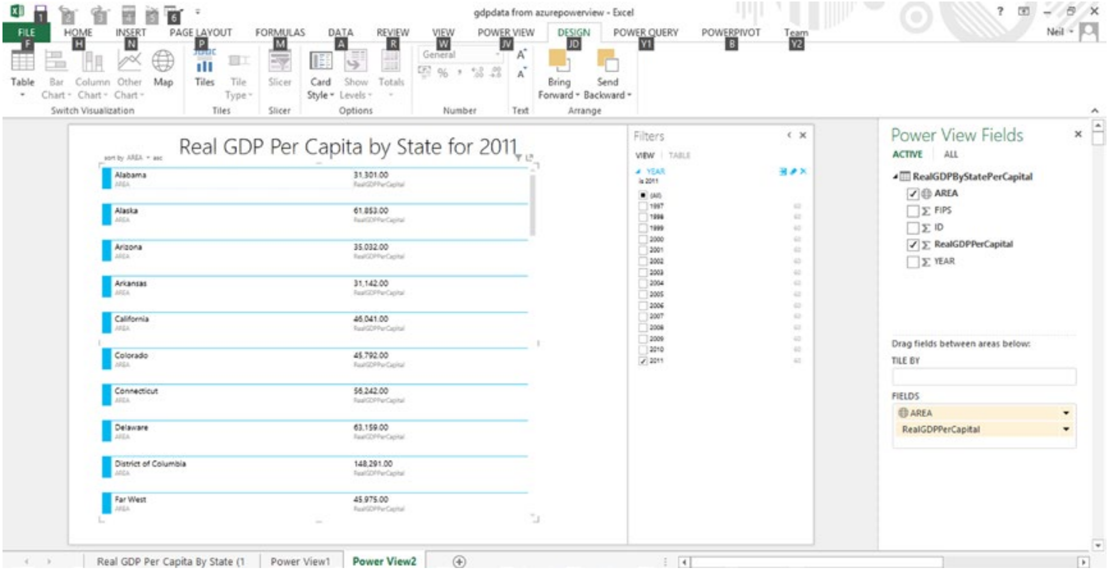
Real GDP Per Capita by State for 2011

AREA	RealGDPPerCapital
Alabama	31,301.00
Alaska	61,853.00
Arizona	35,032.00
Arkansas	31,142.00
California	46,041.00
Colorado	45,792.00
Connecticut	56,242.00
Delaware	63,159.00
District of Columbia	148,291.00
Far West	45,975.00
Florida	34,689.00
Georgia	37,270.00
Great Lakes	38,722.00
Hawaii	42,171.00
Idaho	32,469.00
Illinois	45,231.00
Indiana	36,970.00
Iowa	41,993.00
Kansas	39,484.00
Kentucky	32,331.00
Louisiana	45,002.00
Maine	33,746.00
Maryland	45,360.00
Massachusetts	52,915.00
Michigan	34,166.00

Figure 6-7. *Table with title added*

Viewing the Data in Different Ways

Power View supports multiple formats for viewing data. With the Design tab selected, click the Table icon on the left to see the options: table, matrix, and card. The card view, which creates a card for each state, is shown in Figure 6-8. The matrix view is like a table but allows drilling down. It will be demonstrated in later examples. To go back to the table format, simply click Table under the Table icon.



Real GDP Per Capita by State for 2011

sort by AREA ▾ asc

Alabama
AREA
31,301.00
RealGDPPerCapital

Alaska
AREA
61,853.00
RealGDPPerCapital

Arizona
AREA
35,032.00
RealGDPPerCapital

Arkansas
AREA
31,142.00
RealGDPPerCapital

California
AREA
46,041.00
RealGDPPerCapital

Colorado
AREA
45,792.00
RealGDPPerCapital

Connecticut
AREA
56,242.00
RealGDPPerCapital

Delaware
AREA
63,159.00
RealGDPPerCapital

District of Columbia
AREA
148,291.00
RealGDPPerCapital

Far West
AREA
45,975.00
RealGDPPerCapital

Figure 6-8. *Card view*

Creating a Bar Chart for a Single Year

To create a bar chart showing the real GDP per capita for each state, follow these steps:

1. Click anywhere in the table and select the Design tab. Click Bar Chart. Select Clustered Bar. Because there is a single data source, either clustered or stacked will show the same result.

2. The results will appear as shown in Figure 6-9. A single bar for GDP per capita is shown for each state for the year 2011.

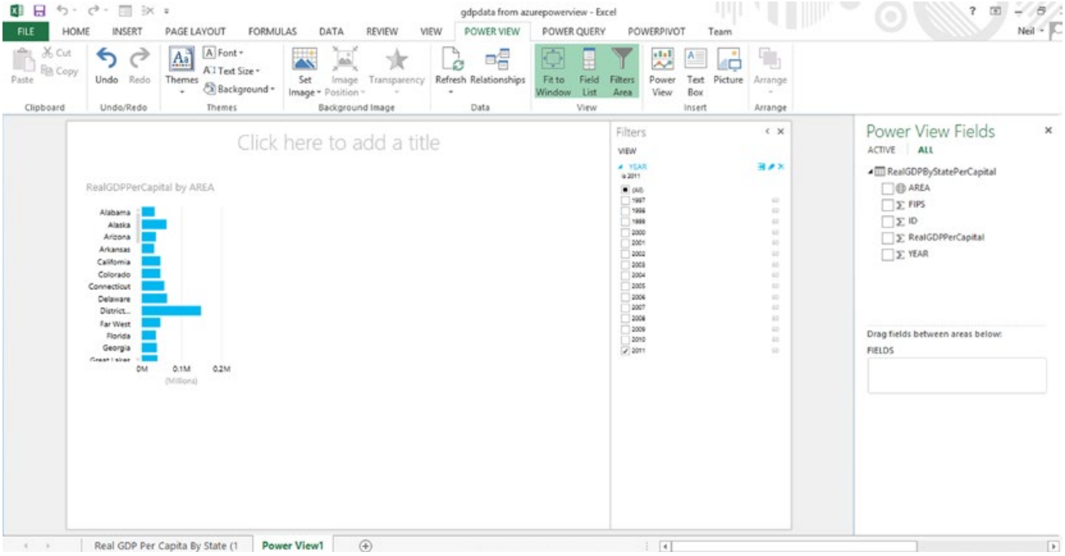


Figure 6-9. Bar chart

3. To resize the chart, click it and drag the handles.

Note that you can hover the mouse over any bar in the chart to see the GDP per capita value for that state.

Column Chart

A column chart is a bar chart flipped on its side, as shown in Figure 6-10.

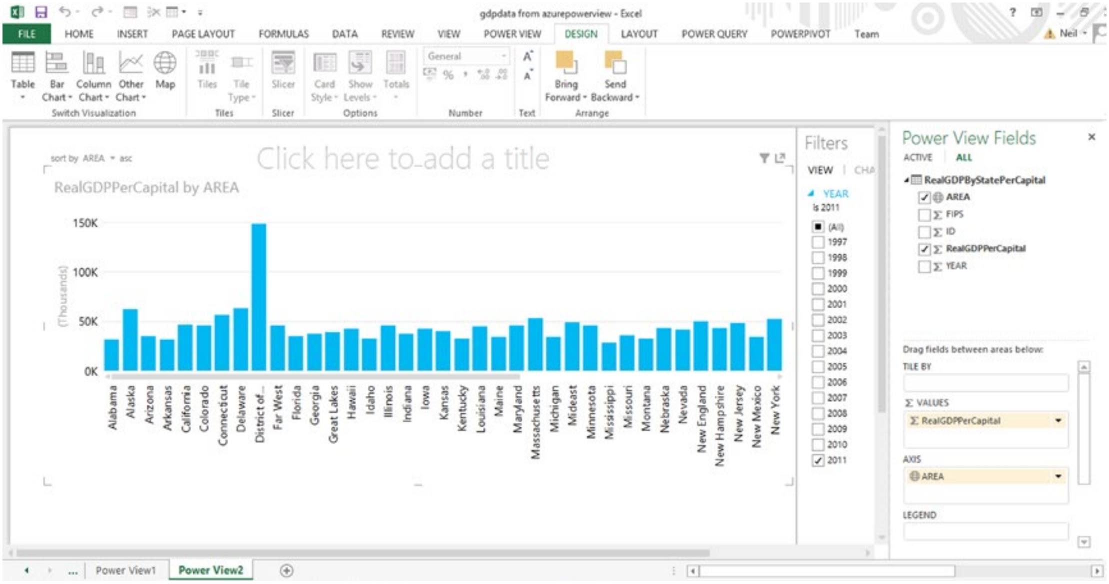
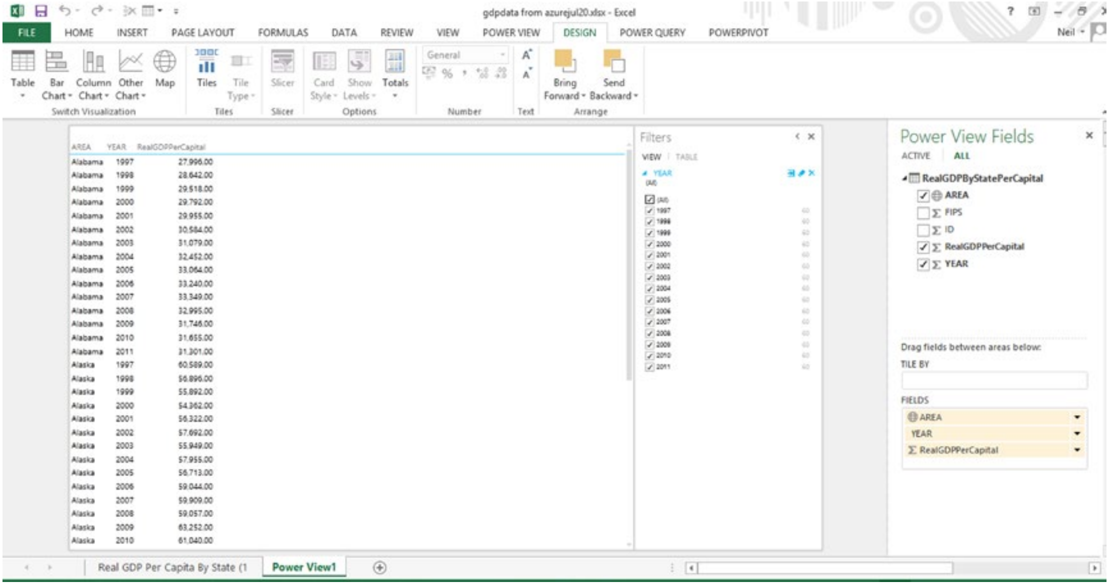


Figure 6-10. Column chart

Displaying Multiple Years

If the filter is changed to include multiple years, by clicking the All box at the top of the Years list in the Filters pane, an instance of the state for each year will be generated in the table, as shown in Figure 6-11. It is also necessary to click Year in the Power View Fields list pane, so that the year is displayed.



AREA	YEAR	RealGDPPerCapital
Alabama	1997	27,996.00
Alabama	1998	28,642.00
Alabama	1999	29,518.00
Alabama	2000	29,792.00
Alabama	2001	29,955.00
Alabama	2002	30,584.00
Alabama	2003	31,079.00
Alabama	2004	32,452.00
Alabama	2005	33,064.00
Alabama	2006	33,240.00
Alabama	2007	33,349.00
Alabama	2008	32,995.00
Alabama	2009	31,746.00
Alabama	2010	31,655.00
Alabama	2011	31,301.00
Alaska	1997	60,589.00
Alaska	1998	56,896.00
Alaska	1999	55,892.00
Alaska	2000	54,362.00
Alaska	2001	56,322.00
Alaska	2002	57,692.00
Alaska	2003	55,949.00
Alaska	2004	57,955.00
Alaska	2005	56,713.00
Alaska	2006	59,044.00
Alaska	2007	59,909.00
Alaska	2008	59,057.00
Alaska	2009	63,252.00
Alaska	2010	61,040.00

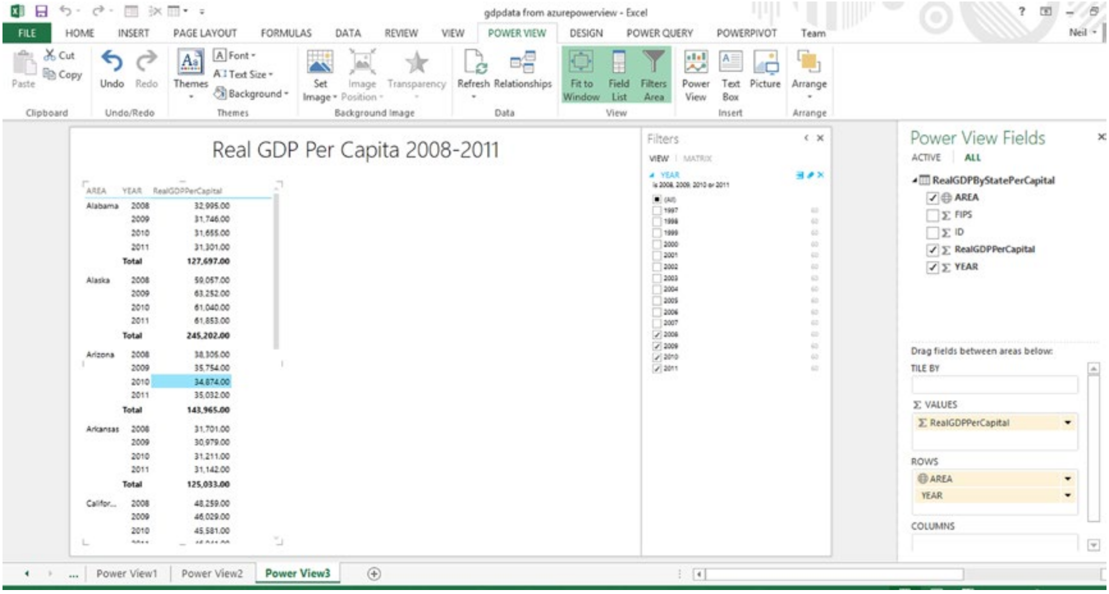
Filters
VIEW | TABLE
YEAR
(All)
☑ (All)
☑ 1997
☑ 1998
☑ 1999
☑ 2000
☑ 2001
☑ 2002
☑ 2003
☑ 2004
☑ 2005
☑ 2006
☑ 2007
☑ 2008
☑ 2009
☑ 2010
☑ 2011

Power View Fields
ACTIVE ALL
RealGDPByStatePerCapital
☑ AREA
□ Σ FIPS
□ Σ ID
☑ Σ RealGDPPerCapital
☑ Σ YEAR

Drag fields between areas below:
TILE BY
FIELDS
AREA
YEAR
Σ RealGDPPerCapital

Figure 6-11. *Table for real GDP per capita for multiple years*

If the view is changed to matrix, then it appears as shown in Figure 6-12. Note that it is necessary to tell it not to sum the years, by clicking the arrow after Year in the Fields section of the Power View Fields pane and selecting "Do not summarize."



Real GDP Per Capita 2008-2011

AREA	YEAR	RealGDPPerCapital
Alabama	2008	32,995.00
	2009	31,746.00
	2010	31,655.00
	2011	31,301.00
	Total	**127,697.00**
Alaska	2008	59,057.00
	2009	63,252.00
	2010	61,040.00
	2011	61,853.00
	Total	**245,202.00**
Arizona	2008	38,306.00
	2009	35,754.00
	2010	34,874.00
	2011	35,032.00
	Total	**143,965.00**
Arkansas	2008	31,701.00
	2009	30,979.00
	2010	31,211.00
	2011	31,142.00
	Total	**125,033.00**
Califor...	2008	48,259.00
	2009	46,029.00
	2010	45,581.00

Filters

VIEW | MATRIX

YEAR
is 2008, 2009, 2010 or 2011

■ (All)
□ 1997
□ 1998
□ 1999
□ 2000
□ 2001
□ 2002
□ 2003
□ 2004
□ 2005
□ 2006
□ 2007
☑ 2008
☑ 2009
☑ 2010
☑ 2011

Power View Fields

ACTIVE | ALL

RealGDPByStatePerCapital
☑ AREA
□ Σ FIPS
□ Σ ID
☑ Σ RealGDPPerCapital
☑ Σ YEAR

Drag fields between areas below:

TILE BY

Σ VALUES
Σ RealGDPPerCapital

ROWS
AREA
YEAR

COLUMNS

Figure 6-12. *Matrix view of GDP per capita for multiple years*

Adding a Map

To display the data using a map, follow these steps:

1. Click the table to activate the Design tab.
2. Click the Map icon. If a map of the world is displayed, use the Zoom and Pan icons at the upper right to display only the desired area of the map, as shown in Figure 6-13. Hover the mouse over a bubble to see the actual number associated with it.

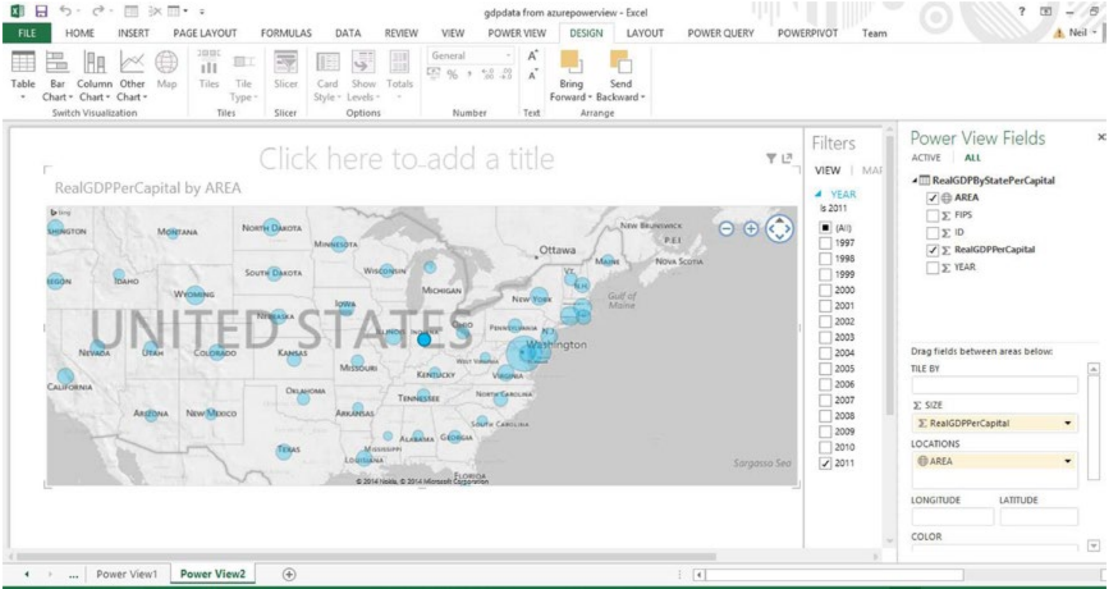
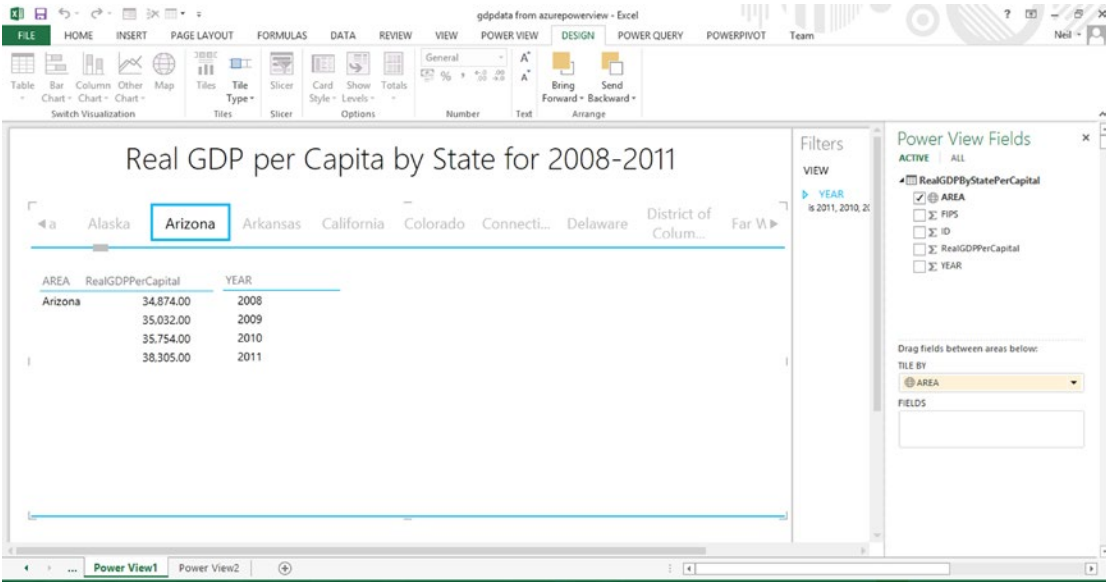


Figure 6-13. Map view showing GDP per capita by state

Note that bubbles are displayed for each state proportional to the GDP per capita for that state. In the Filters pane, individual or multiple years can be selected to see the data for those years.

Using Tiles

Another way of viewing the data is by using tiles. Simply select a table and click the Tiles icon on the Design toolbar to see a display, as shown in Figure 6-14. The default layout has a tab strip at the top of the display that allows clicking each state to see the values for that state.



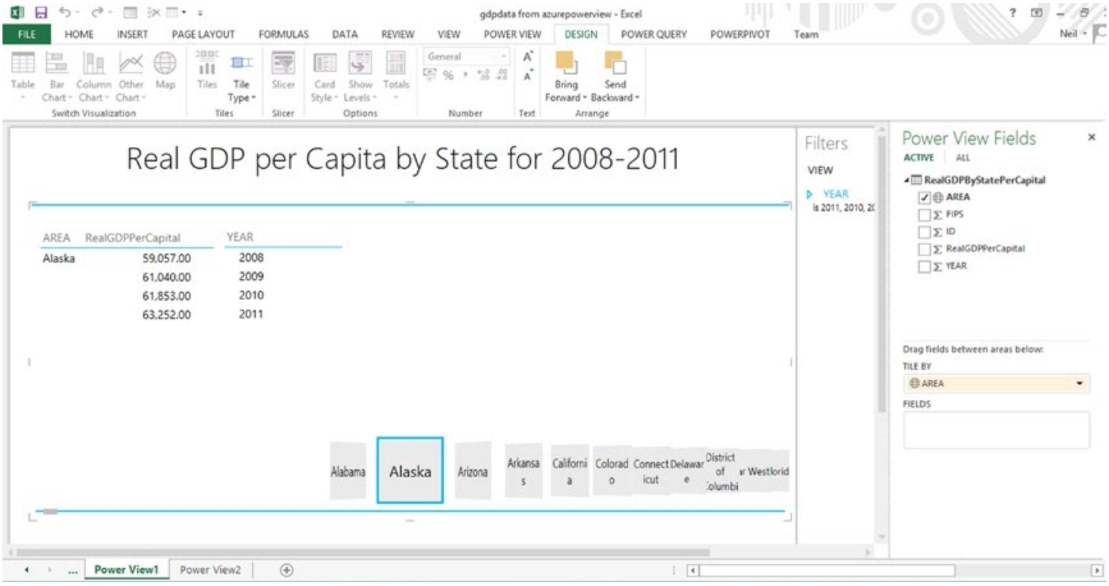
Real GDP per Capita by State for 2008-2011

AREA	RealGDPPerCapital	YEAR
Arizona	34,874.00	2008
	35,032.00	2009
	35,754.00	2010
	38,305.00	2011

☑ AREA
□ FIPS
□ ID
□ RealGDPPerCapital
□ YEAR

Figure 6-14. *Tile format*

An alternative is the tile flow format with the tiles at the bottom as shown in Figure 6-15. These views can be toggled by clicking on the Tile Type icon on the Design toolbar.



Real GDP per Capita by State for 2008-2011

AREA	RealGDPPerCapital	YEAR
Alaska	59,057.00	2008
	61,040.00	2009
	61,853.00	2010
	63,252.00	2011

☑ AREA
□ FIPS
□ ID
□ RealGDPPerCapital
□ YEAR

Figure 6-15. *Tile Flow format*

Relational Example

For this example, Access database2 (the Northwind Database) will be used. Some of the imported tables are shown in Figure 6-16. This database can be downloaded from the Apress web site.

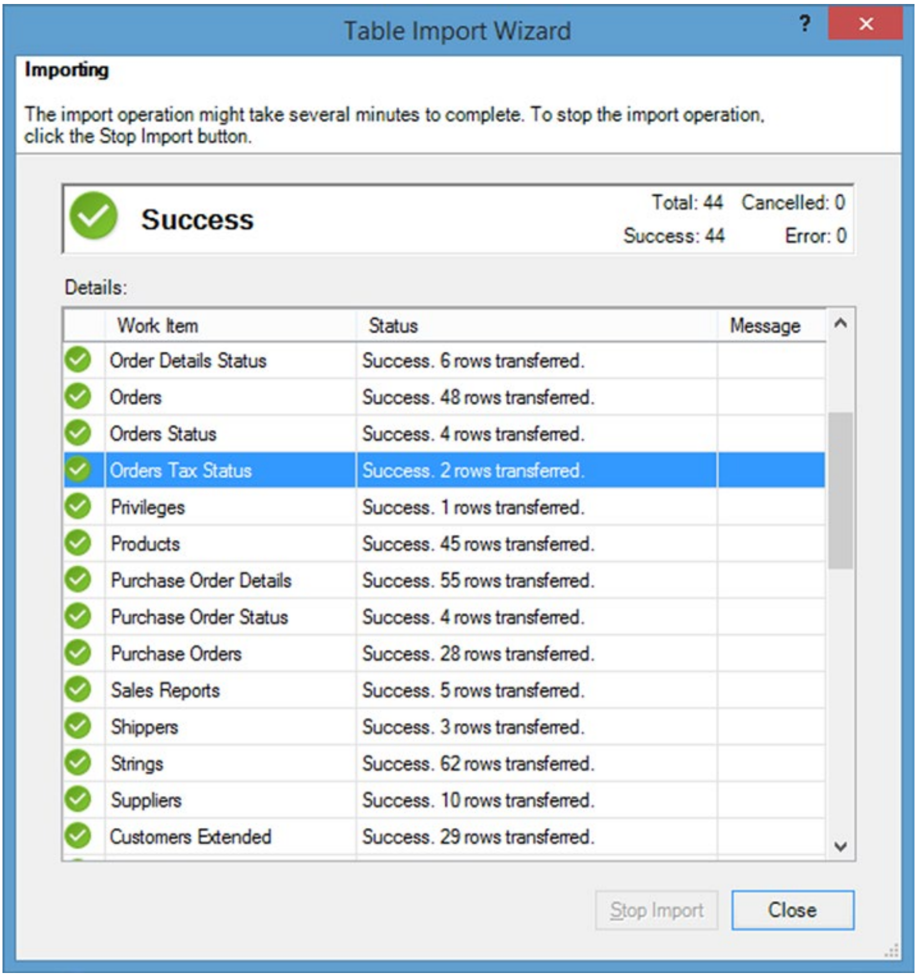


Table Import Wizard

Importing

The import operation might take several minutes to complete. To stop the import operation, click the Stop Import button.

Success

Total: 44 Cancelled: 0
Success: 44 Error: 0

Details:

	Work Item	Status	Message
✓	Order Details Status	Success. 6 rows transferred.	
✓	Orders	Success. 48 rows transferred.	
✓	Orders Status	Success. 4 rows transferred.	
✓	Orders Tax Status	Success. 2 rows transferred.	
✓	Privileges	Success. 1 rows transferred.	
✓	Products	Success. 45 rows transferred.	
✓	Purchase Order Details	Success. 55 rows transferred.	
✓	Purchase Order Status	Success. 4 rows transferred.	
✓	Purchase Orders	Success. 28 rows transferred.	
✓	Sales Reports	Success. 5 rows transferred.	
✓	Shippers	Success. 3 rows transferred.	
✓	Strings	Success. 62 rows transferred.	
✓	Suppliers	Success. 10 rows transferred.	
✓	Customers Extended	Success. 29 rows transferred.	

Figure 6-16. *Northwind tables*

Follow the steps described in Chapter 4 to import Access data.

1. Click the PowerPivot tab to open the ribbon.
2. Click the Manage button at the top-left end of the ribbon.
3. Once the PowerPivot window is open, you can load data by clicking *From Database* in the Get External Data group. This provides a choice of database sources. For this example, *From Access* will be selected.

4. In the Table Import Wizard dialog, click the Browse button to find the Access file you want to import. For this example, use `Database2.accdb`. This file is available from the Apress web site.

5. Click *Test Connection*. If the test is successful, click Next.

6. PowerPivot opens the Table Import Wizard to take you through the process of loading data. Choose *Select from a list of tables and views to choose the data you want to import*. Click Next.

7. Click the top-left box to select all tables. Note that in the lower right corner of the dialog, there is an option to *Preview & Filter.* This option can be used to select a subset of data from very large datasets. In this example, all rows in all tables will be imported. Then click Finish to complete the import.

8. The tables imported are shown in Figure 6-16.

The relationships between the tables are shown in Figure 6-17.

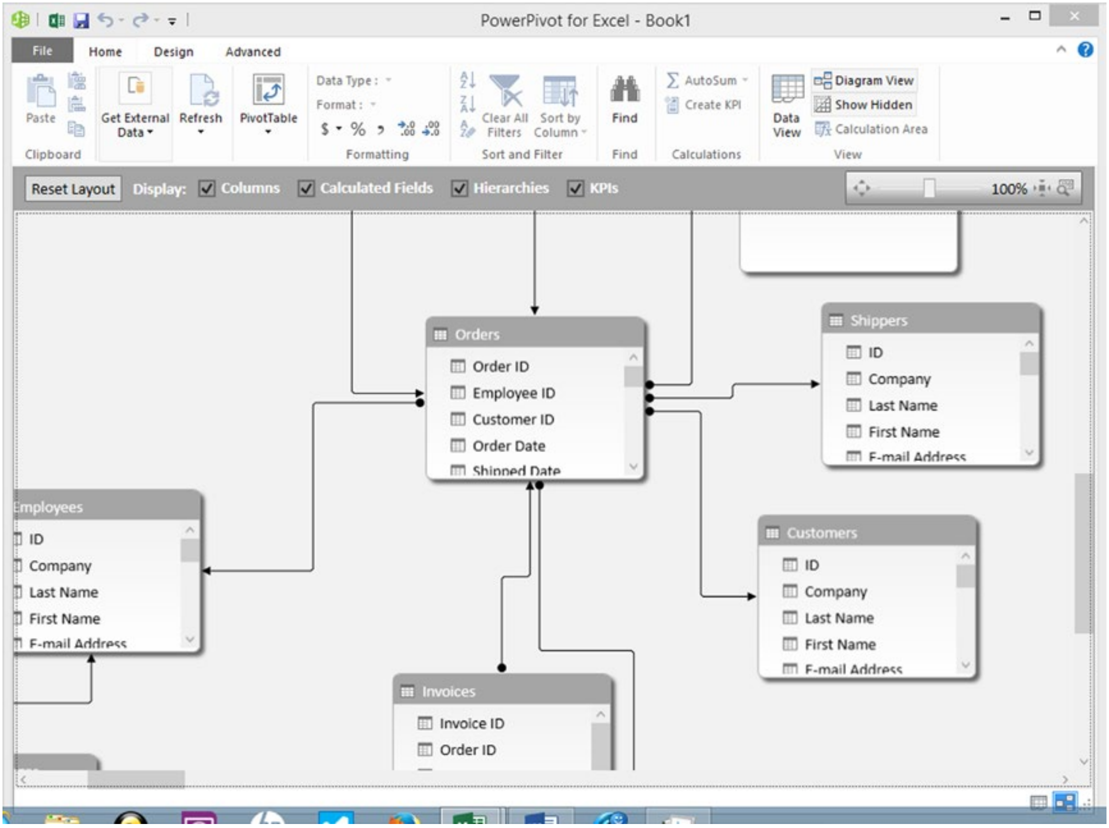
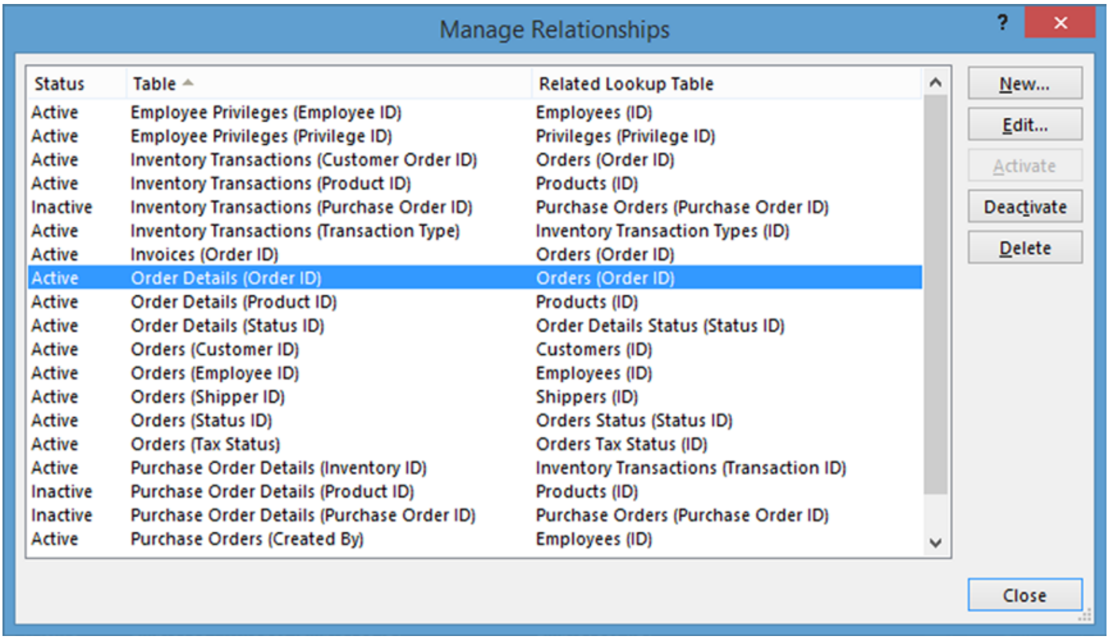


Figure 6-17. *Diagram view*

This example will use the relation between customer ID in the orders table and the ID field in the customers table.

Another view of the relationships is shown in Figure 6-18, which is accessed by clicking the Relationships icon on the Data tab.

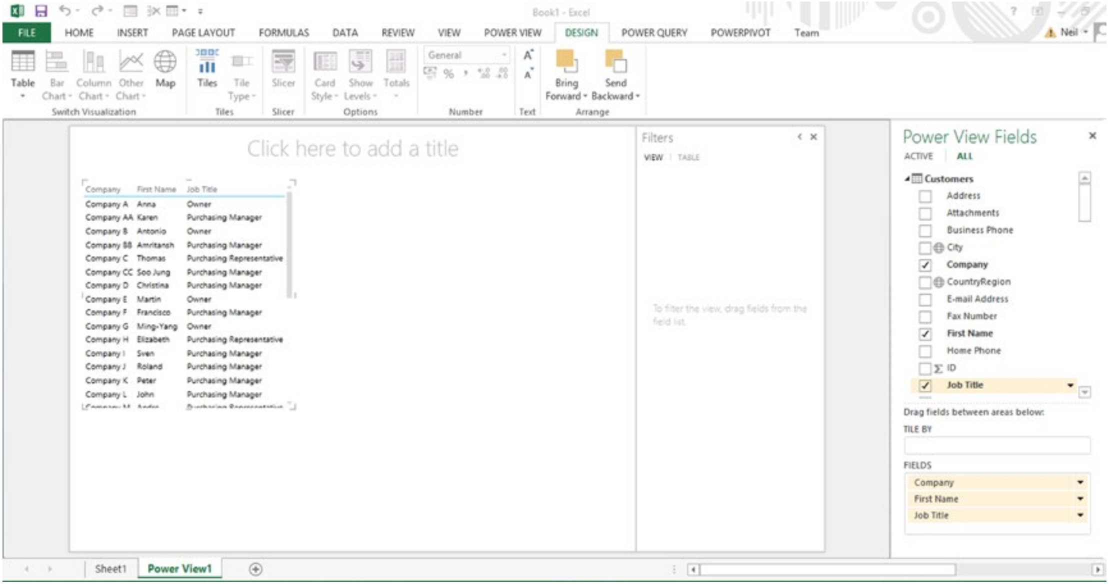


Status	Table	Related Lookup Table
Active	Employee Privileges (Employee ID)	Employees (ID)
Active	Employee Privileges (Privilege ID)	Privileges (Privilege ID)
Active	Inventory Transactions (Customer Order ID)	Orders (Order ID)
Active	Inventory Transactions (Product ID)	Products (ID)
Inactive	Inventory Transactions (Purchase Order ID)	Purchase Orders (Purchase Order ID)
Active	Inventory Transactions (Transaction Type)	Inventory Transaction Types (ID)
Active	Invoices (Order ID)	Orders (Order ID)
Active	Order Details (Order ID)	Orders (Order ID)
Active	Order Details (Product ID)	Products (ID)
Active	Order Details (Status ID)	Order Details Status (Status ID)
Active	Orders (Customer ID)	Customers (ID)
Active	Orders (Employee ID)	Employees (ID)
Active	Orders (Shipper ID)	Shippers (ID)
Active	Orders (Status ID)	Orders Status (Status ID)
Active	Orders (Tax Status)	Orders Tax Status (ID)
Active	Purchase Order Details (Inventory ID)	Inventory Transactions (Transaction ID)
Inactive	Purchase Order Details (Product ID)	Products (ID)
Inactive	Purchase Order Details (Purchase Order ID)	Purchase Orders (Purchase Order ID)
Active	Purchase Orders (Created By)	Employees (ID)

Figure 6-18. *Relationships*

To create a Power View report, follow these steps:

1. Click Power View Reports on the Excel Insert tab.
2. First create a table by selecting fields from the Power View Fields tab on the right side of the screen.
3. From the customers table, select the company, first name, and job title fields, as shown in Figure 6-19.



Company	First Name	Job Title
Company A	Anna	Owner
Company AA	Karen	Purchasing Manager
Company B	Antonio	Owner
Company BB	Amritansh	Purchasing Manager
Company C	Thomas	Purchasing Representative
Company CC	Soo Jung	Purchasing Manager
Company D	Christina	Purchasing Manager
Company E	Martin	Owner
Company F	Francisco	Purchasing Manager
Company G	Ming-Yang	Owner
Company H	Elizabeth	Purchasing Representative
Company I	Sven	Purchasing Manager
Company J	Roland	Purchasing Manager
Company K	Peter	Purchasing Manager
Company L	John	Purchasing Manager

Power View Fields

ACTIVE ALL

Customers
- ☐ Address
- ☐ Attachments
- ☐ Business Phone
- ☐ City
- ☑ Company
- ☐ CountryRegion
- ☐ E-mail Address
- ☐ Fax Number
- ☑ First Name
- ☐ Home Phone
- ☐ ID
- ☑ Job Title

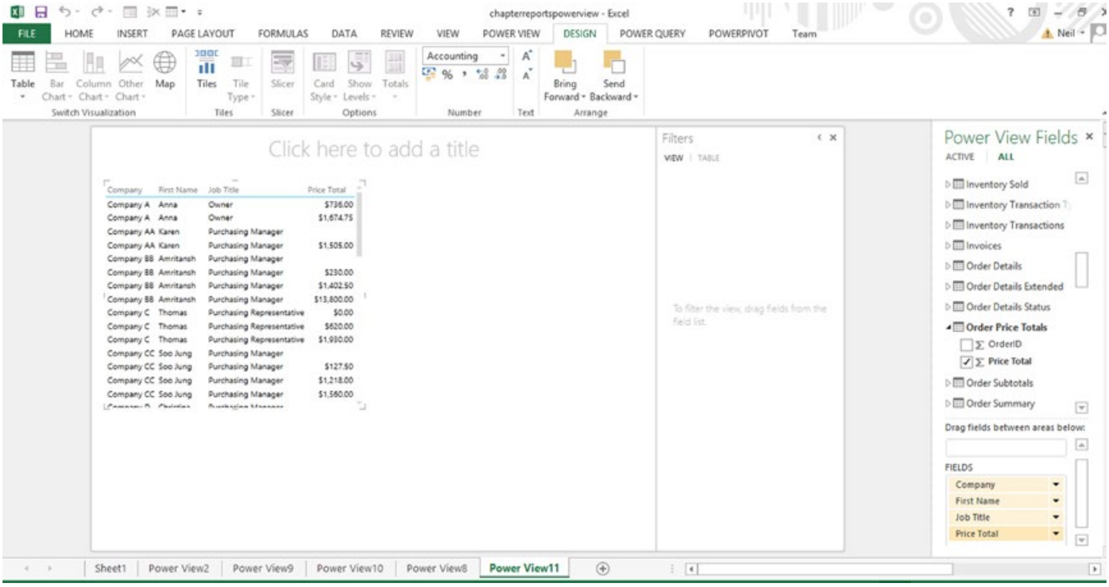
Drag fields between areas below:

TILE BY

FIELDS
- Company
- First Name
- Job Title

Figure 6-19. *Table showing company, first name, and job title*

4. Next, select Price Total from the Order Price Totals table. Doing this depends on the relationship between the customers to orders table to the order price totals table. The results are shown in Figure 6-20.



Company	First Name	Job Title	Price Total
Company A	Anna	Owner	$736.00
Company A	Anna	Owner	$1,674.75
Company AA	Karen	Purchasing Manager	
Company AA	Karen	Purchasing Manager	$1,505.00
Company BB	Amritansh	Purchasing Manager	
Company BB	Amritansh	Purchasing Manager	$230.00
Company BB	Amritansh	Purchasing Manager	$1,402.50
Company BB	Amritansh	Purchasing Manager	$13,800.00
Company C	Thomas	Purchasing Representative	$0.00
Company C	Thomas	Purchasing Representative	$620.00
Company C	Thomas	Purchasing Representative	$1,930.00
Company CC	Soo Jung	Purchasing Manager	
Company CC	Soo Jung	Purchasing Manager	$127.50
Company CC	Soo Jung	Purchasing Manager	$1,218.00
Company CC	Soo Jung	Purchasing Manager	$1,560.00

Power View Fields

ACTIVE ALL

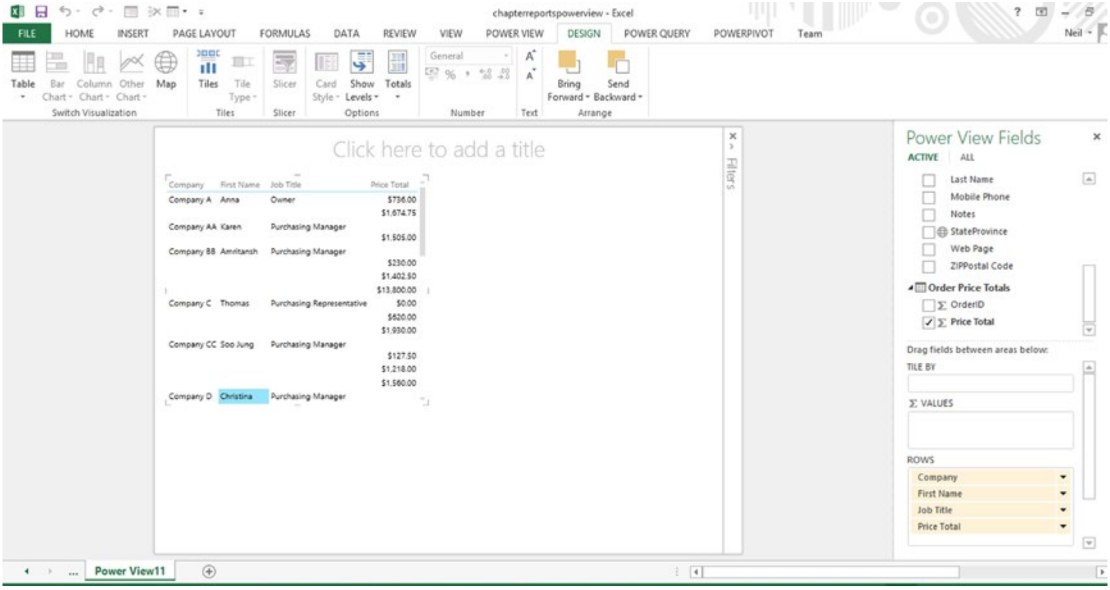
- Inventory Sold
- Inventory Transaction T
- Inventory Transactions
- Invoices
- Order Details
- Order Details Extended
- Order Details Status
- Order Price Totals
  - ☐ OrderID
  - ☑ Price Total
- Order Subtotals
- Order Summary

Drag fields between areas below:

FIELDS
- Company
- First Name
- Job Title
- Price Total

Figure 6-20. *Table showing order totals*

5. Note that for companies with multiple orders, there are multiple rows shown in the table. A matrix view, shown in Figure 6-21, makes this more obvious.



Company	First Name	Job Title	Price Total
Company A	Anna	Owner	$736.00
			$1,674.75
Company AA	Karen	Purchasing Manager	
			$1,505.00
Company BB	Amritansh	Purchasing Manager	
			$230.00
			$1,402.50
			$13,800.00
Company C	Thomas	Purchasing Representative	$0.00
			$620.00
			$1,930.00
Company CC	Soo Jung	Purchasing Manager	
			$127.50
			$1,218.00
			$1,560.00
Company D	Christina	Purchasing Manager	

Power View Fields

ACTIVE | ALL

- □ Last Name
- □ Mobile Phone
- □ Notes
- □ StateProvince
- □ Web Page
- □ ZIPPostal Code

Order Price Totals

- □ Σ OrderID
- ☑ Σ Price Total

Drag fields between areas below:

TILE BY

Σ VALUES

ROWS

- Company
- First Name
- Job Title
- Price Total

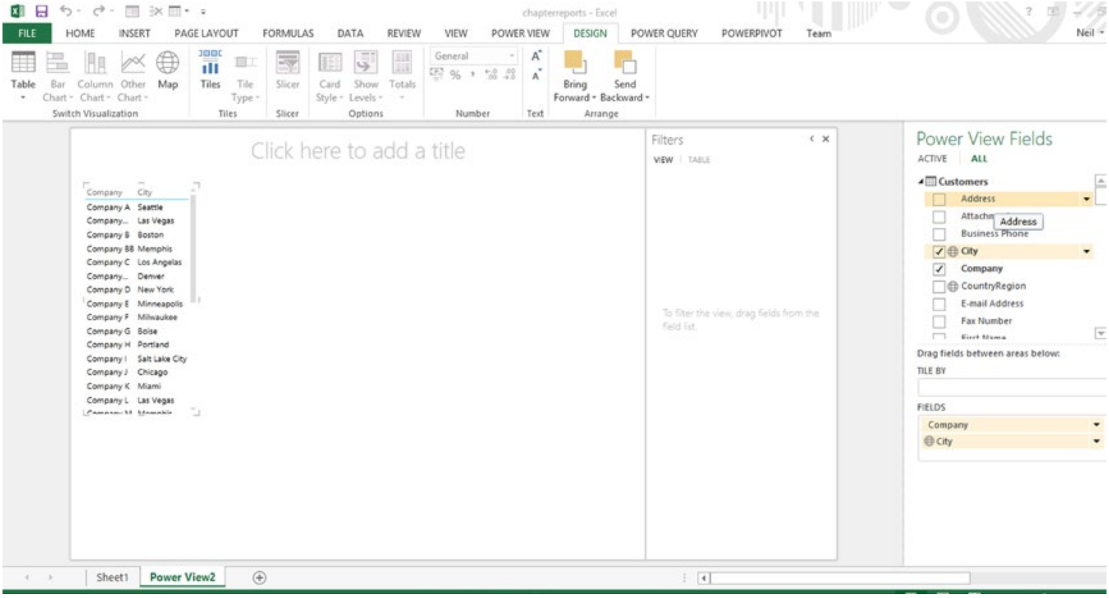
Figure 6-21. *Matrix view*

Customer and City Example

This example will show customers by city. The objective is to show the value of orders from each city. Follow these steps:

1. Click Power View Reports on the Excel Insert tab.

2. Select company and city from the Customers table, as shown in Figure 6-22. Adjust the width of the company column in the table, if necessary, by selecting the line between columns in the title bar and dragging.



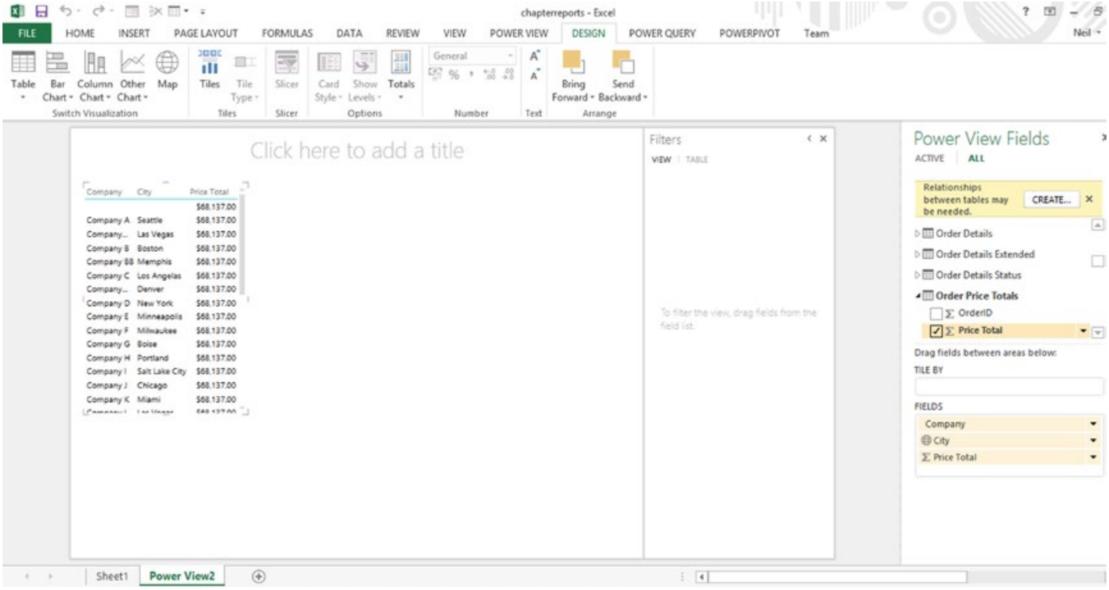
Company	City
Company A	Seattle
Company...	Las Vegas
Company B	Boston
Company BB	Memphis
Company C	Los Angelas
Company...	Denver
Company D	New York
Company E	Minneapolis
Company F	Milwaukee
Company G	Boise
Company H	Portland
Company I	Salt Lake City
Company J	Chicago
Company K	Miami
Company L	Las Vegas
Company M	Memphis

Customers:
- □ Address
- □ Attachments
- □ Business Phone
- ☑ City
- ☑ Company
- □ CountryRegion
- □ E-mail Address
- □ Fax Number
- □ First Name

FIELDS: Company, City

Figure 6-22. *Company and city table*

3. Select the price total field from the order price totals table. Note that a prompt appears to create a relation. Because no relation is created, the total of all orders is shown, as in Figure 6-23.



Company	City	Price Total
		$68,137.00
Company A	Seattle	$68,137.00
Company...	Las Vegas	$68,137.00
Company B	Boston	$68,137.00
Company BB	Memphis	$68,137.00
Company C	Los Angelas	$68,137.00
Company...	Denver	$68,137.00
Company D	New York	$68,137.00
Company E	Minneapolis	$68,137.00
Company F	Milwaukee	$68,137.00
Company G	Boise	$68,137.00
Company H	Portland	$68,137.00
Company I	Salt Lake City	$68,137.00
Company J	Chicago	$68,137.00
Company K	Miami	$68,137.00
Company L	Las Vegas	$68,137.00

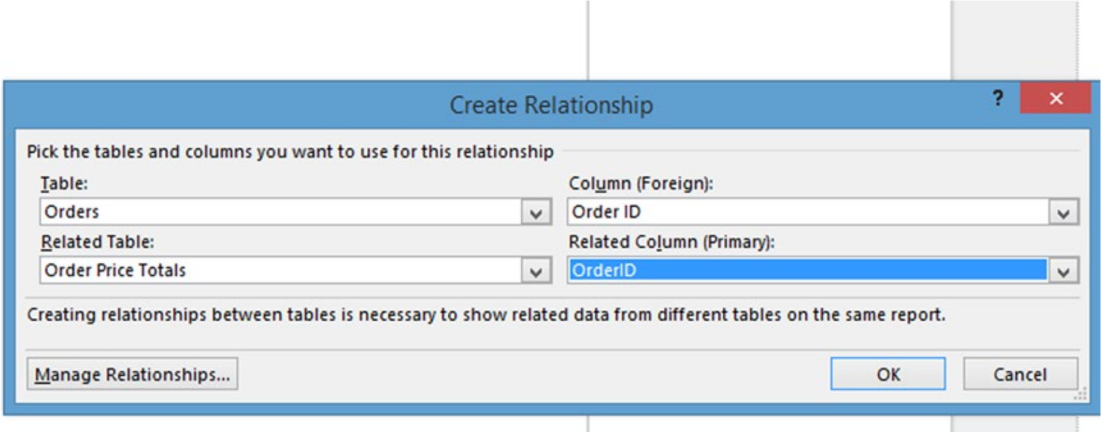
Relationships between tables may be needed.

- Order Details
- Order Details Extended
- Order Details Status
- Order Price Totals
  - □ OrderID
  - ☑ Price Total

FIELDS: Company, City, Price Total

Figure 6-23. *Table showing company, city, and order price totals*

4. Create the relationship between the orders table and the order price totals table based on the order ID, as shown in Figure 6-24, and click OK.



Create Relationship

Pick the tables and columns you want to use for this relationship

Table: Orders

Column (Foreign): Order ID

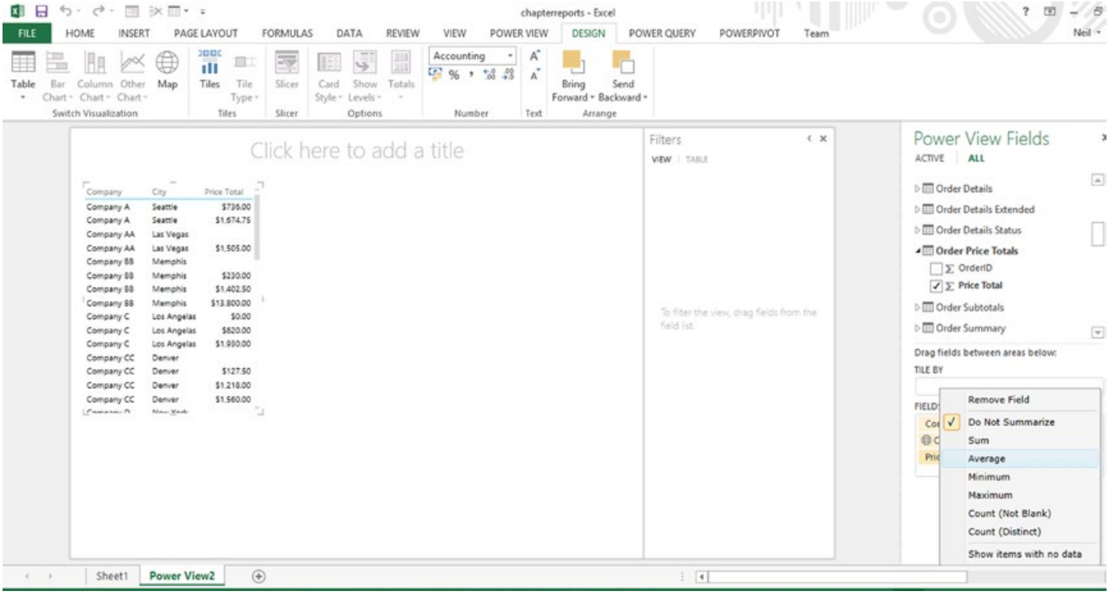
Related Table: Order Price Totals

Related Column (Primary): OrderID

Creating relationships between tables is necessary to show related data from different tables on the same report.

Figure 6-24. *Creating relationship between the orders and order price totals tables*

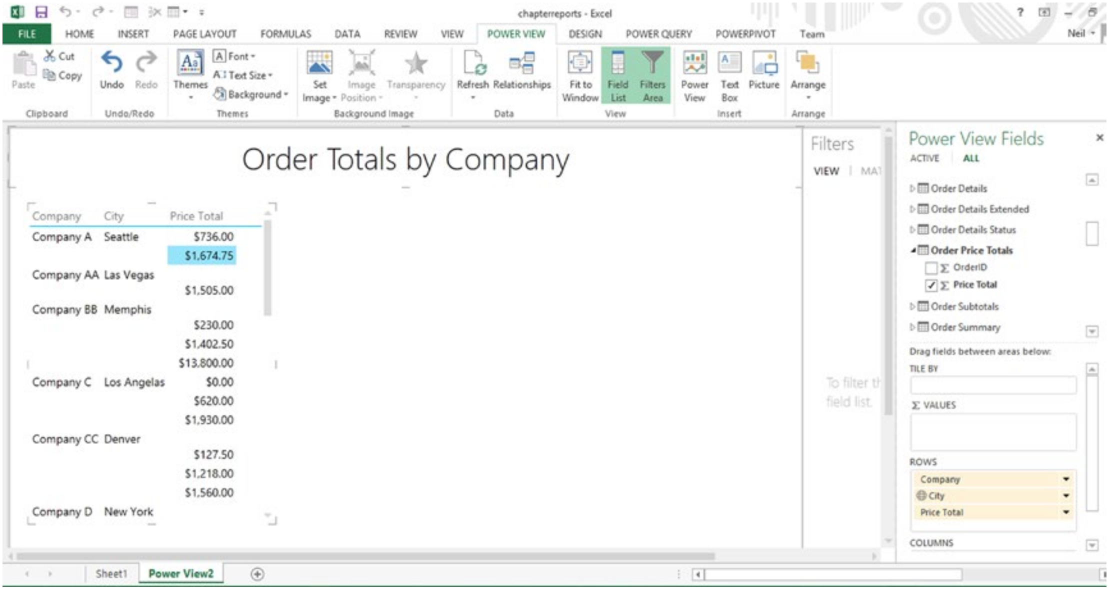
5. Next, click the arrow after Price Total in the Fields list and select “Do Not Summarize,” as shown in Figure 6-25. Note that the value of each order is now shown, instead of the total of all orders.



Company	City	Price Total
Company A	Seattle	$736.00
Company A	Seattle	$1,674.75
Company AA	Las Vegas	
Company AA	Las Vegas	$1,505.00
Company BB	Memphis	
Company BB	Memphis	$230.00
Company BB	Memphis	$1,402.50
Company BB	Memphis	$13,800.00
Company C	Los Angelas	$0.00
Company C	Los Angelas	$620.00
Company C	Los Angelas	$1,930.00
Company CC	Denver	
Company CC	Denver	$127.50
Company CC	Denver	$1,218.00
Company CC	Denver	$1,560.00

Figure 6-25. *Table showing individual order totals*

6. Selecting the matrix view by clicking Table on the Design tab and selecting Matrix and clicking "Fit to Window" will result in the display shown in Figure 6-26. Note that a title has been entered. The view can be scrolled using the scrollbars on the right.

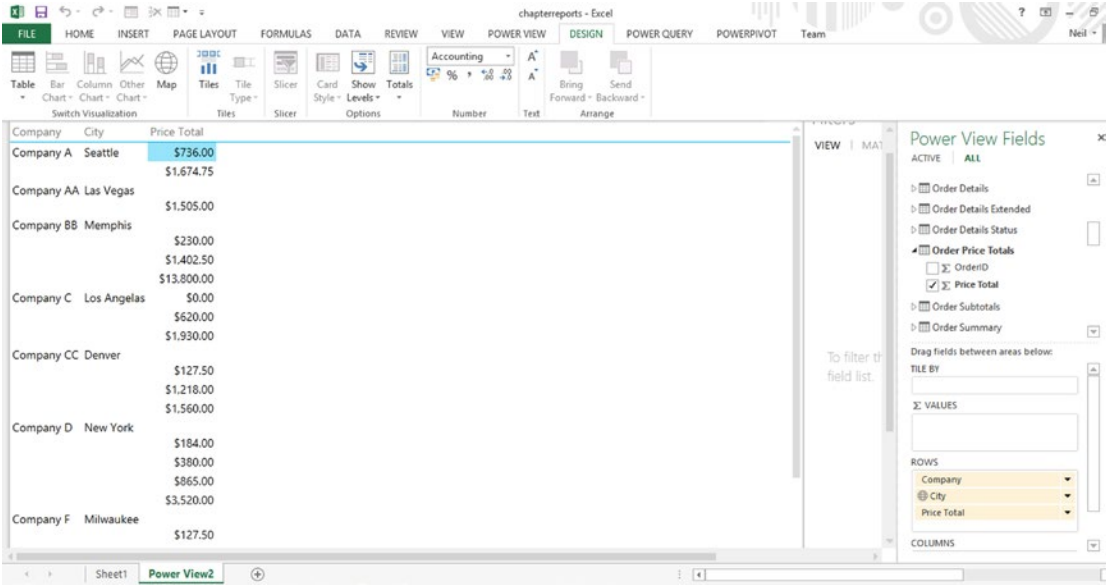


Order Totals by Company

Company	City	Price Total
Company A	Seattle	$736.00
		$1,674.75
Company AA	Las Vegas	
		$1,505.00
Company BB	Memphis	
		$230.00
		$1,402.50
		$13,800.00
Company C	Los Angelas	$0.00
		$620.00
		$1,930.00
Company CC	Denver	
		$127.50
		$1,218.00
		$1,560.00
Company D	New York	

Figure 6-26. *Matrix view*

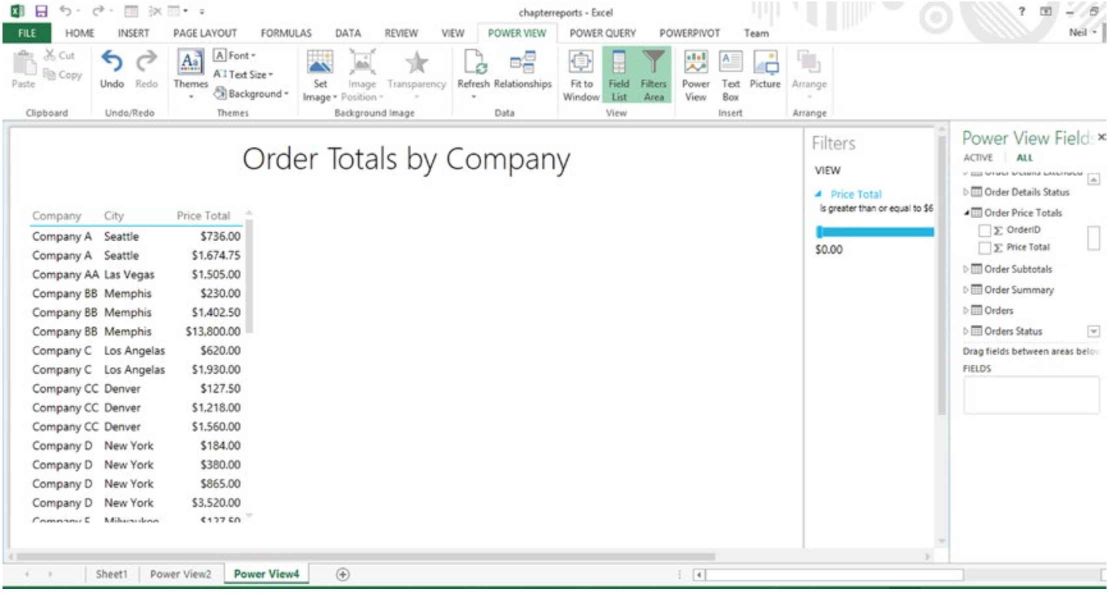
7. Clicking the pop-out icon at the upper right of the table display will result in the view shown in Figure 6-27.



Company	City	Price Total
Company A	Seattle	$736.00
		$1,674.75
Company AA	Las Vegas	
		$1,505.00
Company BB	Memphis	
		$230.00
		$1,402.50
		$13,800.00
Company C	Los Angelas	$0.00
		$620.00
		$1,930.00
Company CC	Denver	
		$127.50
		$1,218.00
		$1,560.00
Company D	New York	
		$184.00
		$380.00
		$865.00
		$3,520.00
Company F	Milwaukee	
		$127.50

Figure 6-27. *Pop-out view of the matrix*

8. To filter out records that do not have an order, drag the Price Total field to the Filters pane and drag the left bar to the right to some arbitrary small number greater than zero, as shown in Figure 6-28.



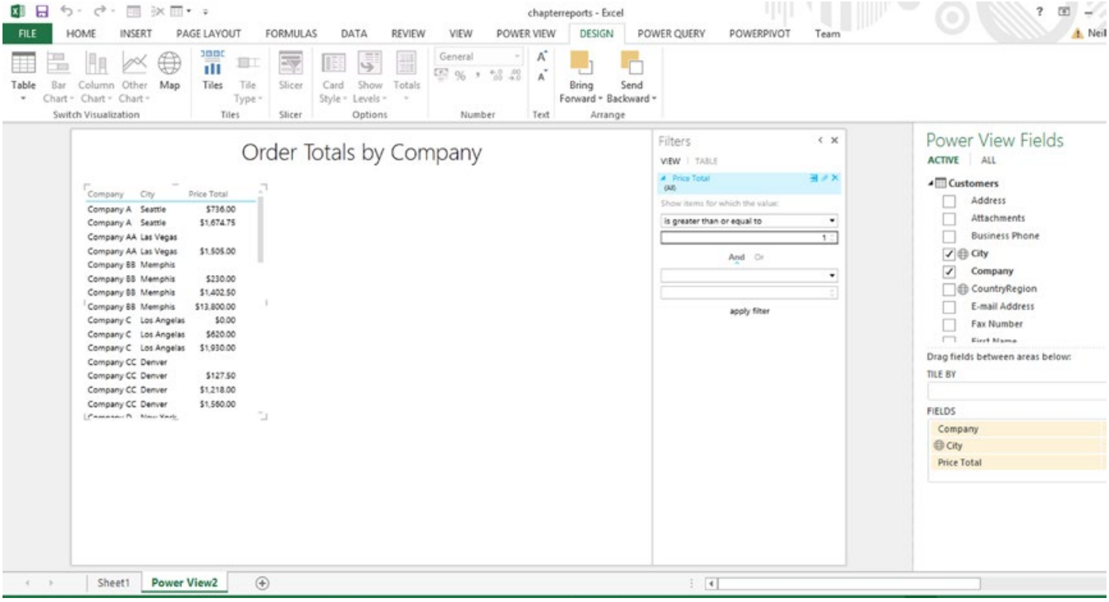
Order Totals by Company

Company	City	Price Total
Company A	Seattle	$736.00
Company A	Seattle	$1,674.75
Company AA	Las Vegas	$1,505.00
Company BB	Memphis	$230.00
Company BB	Memphis	$1,402.50
Company BB	Memphis	$13,800.00
Company C	Los Angelas	$620.00
Company C	Los Angelas	$1,930.00
Company CC	Denver	$127.50
Company CC	Denver	$1,218.00
Company CC	Denver	$1,560.00
Company D	New York	$184.00
Company D	New York	$380.00
Company D	New York	$865.00
Company D	New York	$3,520.00

Filters
VIEW
Price Total
is greater than or equal to $6
$0.00

Figure 6-28. Filtering out companies with no orders

Or click on the Price Total field name and set the filter as greater than or equal to 1 and click Apply Filter, as shown in Figure 6-29.



Order Totals by Company

Company	City	Price Total
Company A	Seattle	$736.00
Company A	Seattle	$1,674.75
Company AA	Las Vegas	
Company AA	Las Vegas	$1,505.00
Company BB	Memphis	
Company BB	Memphis	$230.00
Company BB	Memphis	$1,402.50
Company BB	Memphis	$13,800.00
Company C	Los Angelas	$0.00
Company C	Los Angelas	$620.00
Company C	Los Angelas	$1,930.00
Company CC	Denver	
Company CC	Denver	$127.50
Company CC	Denver	$1,218.00
Company CC	Denver	$1,560.00

Filters
VIEW | TABLE
Price Total
(All)
Show items for which the value:
is greater than or equal to
1
And Or
apply filter

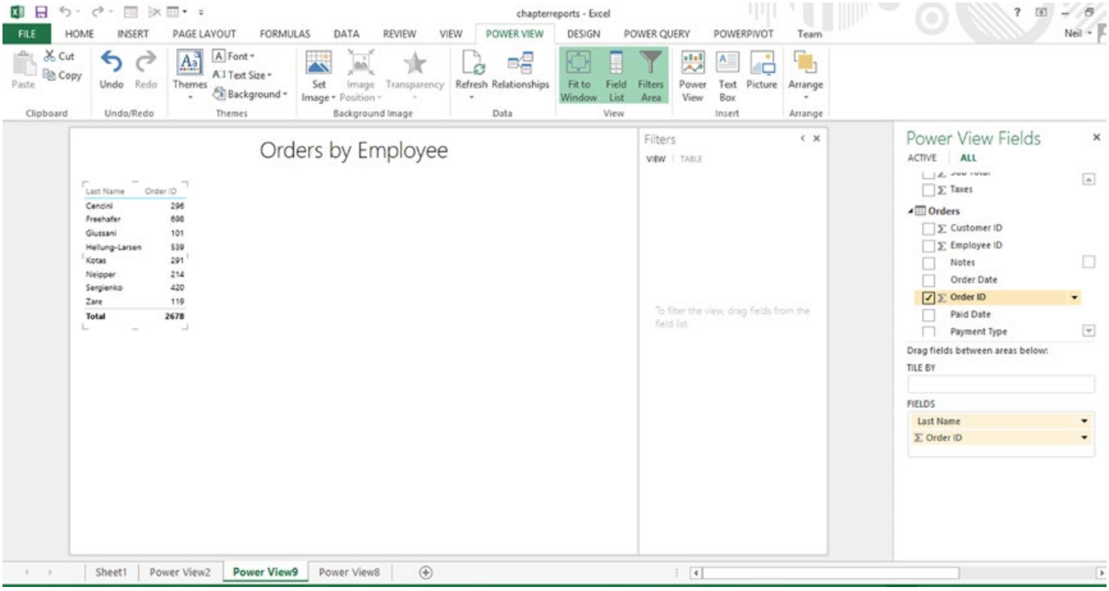
Figure 6-29. Another way to filter out companies with no orders

Showing Orders by Employee

The next example will show number of orders by employee, by taking the following steps:

1. Create a new Power View sheet by clicking Power View on the Power View tab.
2. Enter the title "Orders by Employee."
3. In the Power View Fields pane, select the Last Name field from the Employees table.

Then select the Order ID field from the Orders table. The results are shown in Figure 6-30. Note that by default, it sums the Order IDs, which is a meaningless number.

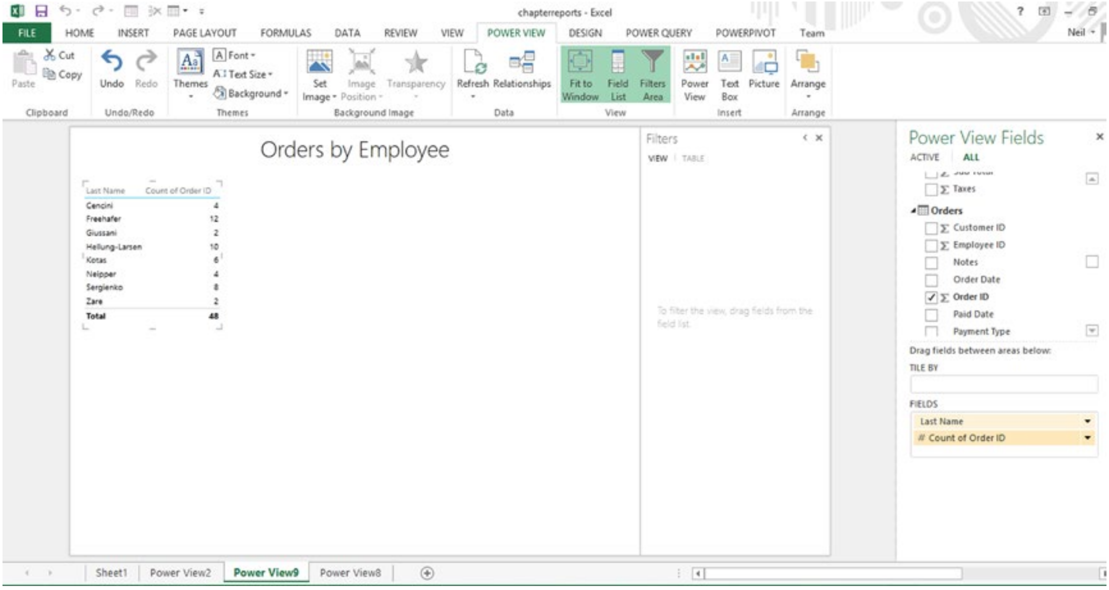


Orders by Employee

Last Name	Order ID
Cencini	296
Freehafer	698
Giussani	101
Hellung-Larsen	539
Kotas	291
Neipper	214
Sergienko	420
Zare	119
Total	**2678**

Figure 6-30. Table showing employees and orders

4. In the Fields area of the Power View Fields pane, click the arrow after Order ID and select *count (non blank)*. The results are shown in Figure 6-31. Note that a count of the orders is now shown in the table.



Orders by Employee

Last Name	Count of Order ID
Cencini	4
Freehafer	12
Giussani	2
Hellung-Larsen	10
Kotas	6
Neipper	4
Sergienko	8
Zare	2
Total	**48**

Filters

VIEW | TABLE

To filter the view, drag fields from the field list.

Power View Fields

ACTIVE ALL

□ Σ Taxes

Orders

□ Σ Customer ID

□ Σ Employee ID

□ Notes

□ Order Date

☑ Σ Order ID

□ Paid Date

□ Payment Type

Drag fields between areas below:

TILE BY

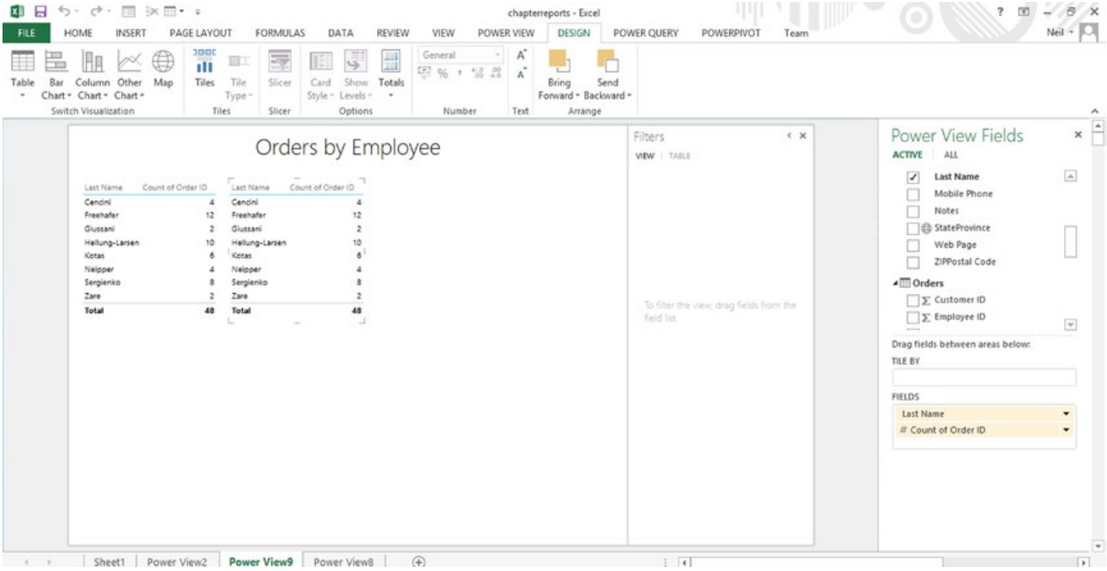
FIELDS

Last Name

Count of Order ID

Figure 6-31. Table showing employees and number of orders per employee

5. To create a chart of the data, right-click the table and select Copy. Click in the blank area next to the table, right-click, and select Paste to get another copy of the table, as shown in Figure 6-32.



Orders by Employee

Last Name	Count of Order ID
Cencini	4
Freehafer	12
Giussani	2
Hellung-Larsen	10
Kotas	6
Neipper	4
Sergienko	8
Zare	2
Total	**48**

Last Name	Count of Order ID
Cencini	4
Freehafer	12
Giussani	2
Hellung-Larsen	10
Kotas	6
Neipper	4
Sergienko	8
Zare	2
Total	**48**

Filters

VIEW | TABLE

To filter the view, drag fields from the field list.

Power View Fields

ACTIVE ALL

☑ Last Name

□ Mobile Phone

□ Notes

□ StateProvince

□ Web Page

□ ZIPPostal Code

Orders

□ Σ Customer ID

□ Σ Employee ID

Drag fields between areas below:

TILE BY

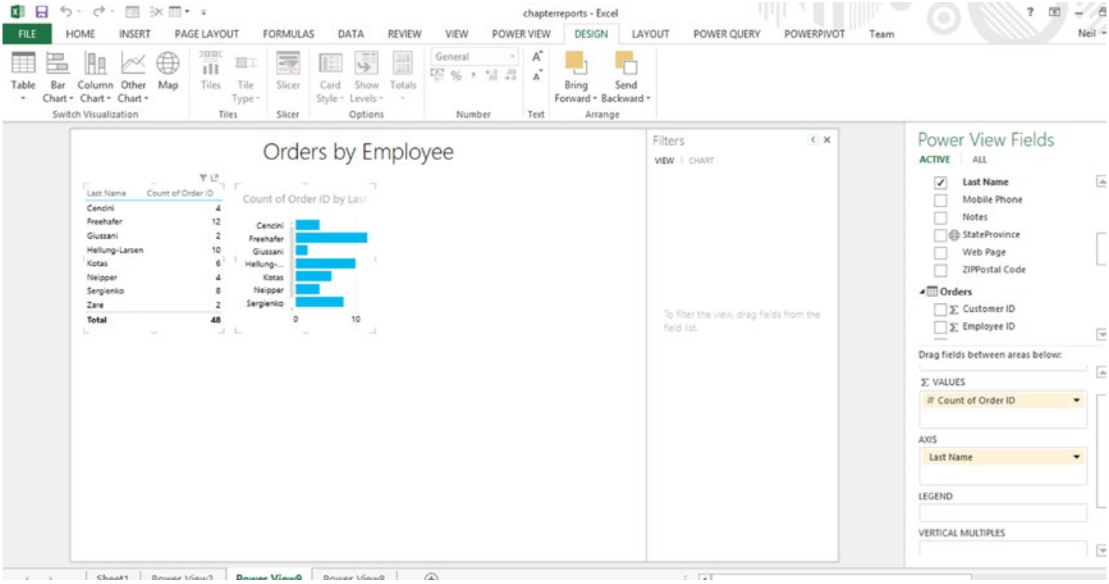
FIELDS

Last Name

Count of Order ID

Figure 6-32. Making a copy of the table prior to plotting

6. To plot the chart, select the rightmost table that was just pasted, click the Bar Chart icon on the Design tab, and select Stacked Bar to get a bar chart, as shown in Figure 6-33.



Orders by Employee

Last Name	Count of Order ID
Cencini	4
Freehafer	12
Giussani	2
Hellung-Larsen	10
Kotas	6
Neipper	4
Sergienko	8
Zare	2
Total	**48**

☑ Last Name
□ Mobile Phone
□ Notes
□ StateProvince
□ Web Page
□ ZIPPostal Code

Orders
□ Σ Customer ID
□ Σ Employee ID

Σ VALUES: # Count of Order ID

AXIS: Last Name

LEGEND

VERTICAL MULTIPLES

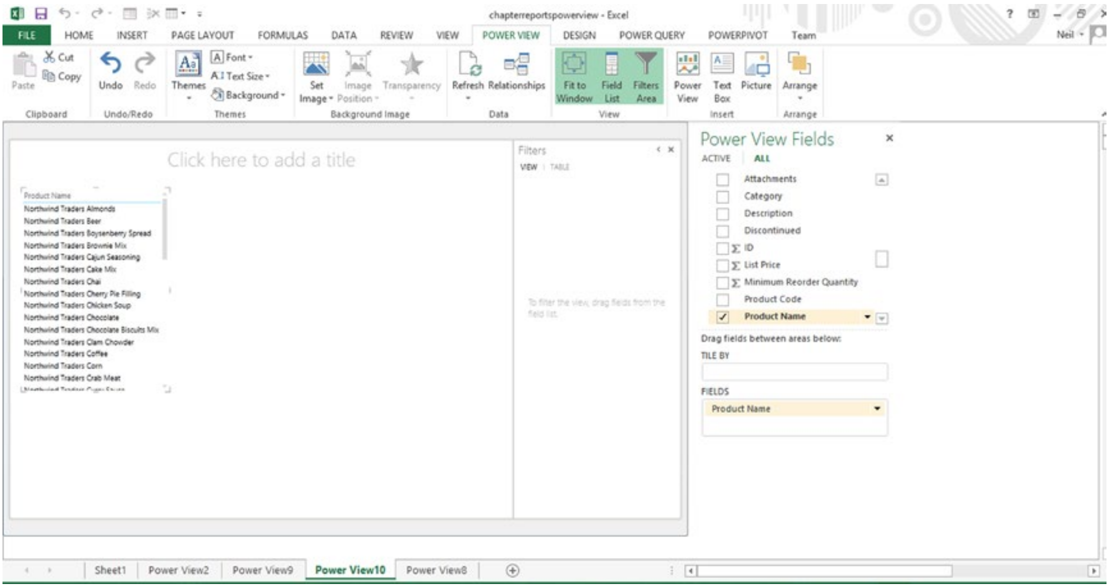
Figure 6-33. *Bar chart of orders by employee*

Aggregating Orders by Product

This example will show the number of orders by product. Follow these steps:

1. Click Power View Reports on the Excel Insert tab.

2. Select the Product Name field in the products table in the Power View Fields pane, as shown in Figure 6-34.



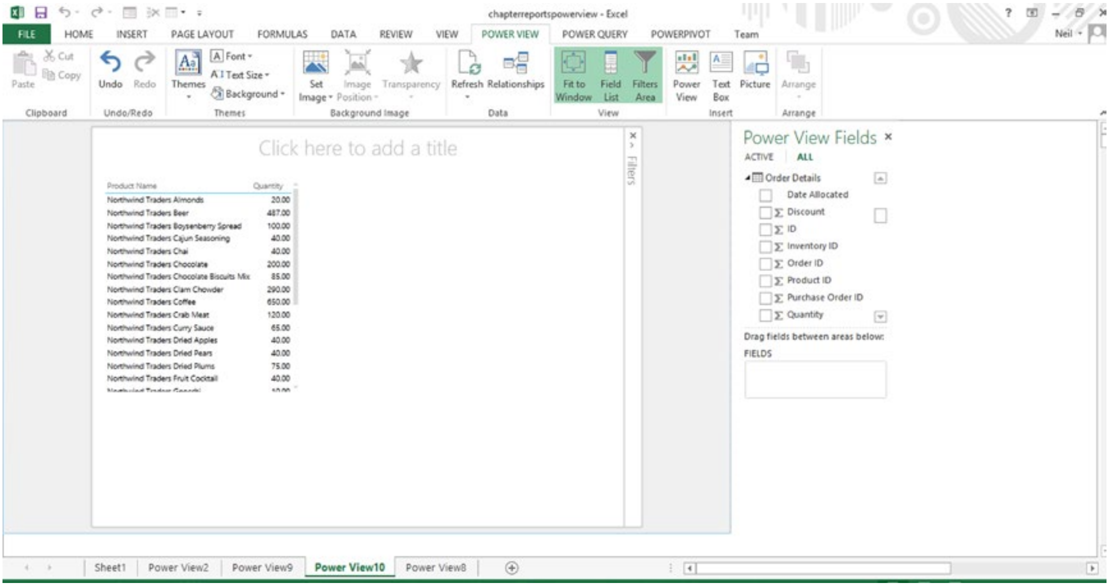
Product Name
Northwind Traders Almonds
Northwind Traders Beer
Northwind Traders Boysenberry Spread
Northwind Traders Brownie Mix
Northwind Traders Cajun Seasoning
Northwind Traders Cake Mix
Northwind Traders Chai
Northwind Traders Cherry Pie Filling
Northwind Traders Chicken Soup
Northwind Traders Chocolate
Northwind Traders Chocolate Biscuits Mix
Northwind Traders Clam Chowder
Northwind Traders Coffee
Northwind Traders Corn
Northwind Traders Crab Meat

□ Attachments
□ Category
□ Description
□ Discontinued
□ Σ ID
□ Σ List Price
□ Σ Minimum Reorder Quantity
□ Product Code
☑ Product Name

FIELDS: Product Name

***Figure 6-34.** Product list*

3. Next, select the Quantity field in the Order Details Table, as shown in Figure 6-35. Note that the sum of the quantity is shown.

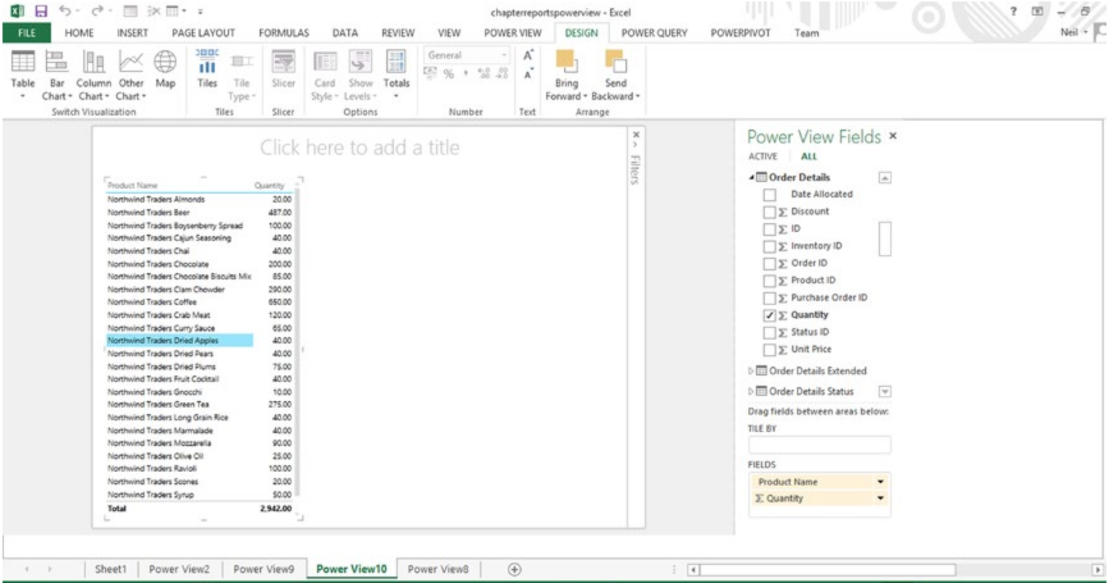


Product Name	Quantity
Northwind Traders Almonds	20.00
Northwind Traders Beer	487.00
Northwind Traders Boysenberry Spread	100.00
Northwind Traders Cajun Seasoning	40.00
Northwind Traders Chai	40.00
Northwind Traders Chocolate	200.00
Northwind Traders Chocolate Biscuits Mix	85.00
Northwind Traders Clam Chowder	290.00
Northwind Traders Coffee	650.00
Northwind Traders Crab Meat	120.00
Northwind Traders Curry Sauce	65.00
Northwind Traders Dried Apples	40.00
Northwind Traders Dried Pears	40.00
Northwind Traders Dried Plums	75.00
Northwind Traders Fruit Cocktail	40.00

Order Details
□ Date Allocated
□ Σ Discount
□ Σ ID
□ Σ Inventory ID
□ Σ Order ID
□ Σ Product ID
□ Σ Purchase Order ID
□ Σ Quantity

***Figure 6-35.** Quantity of products ordered*

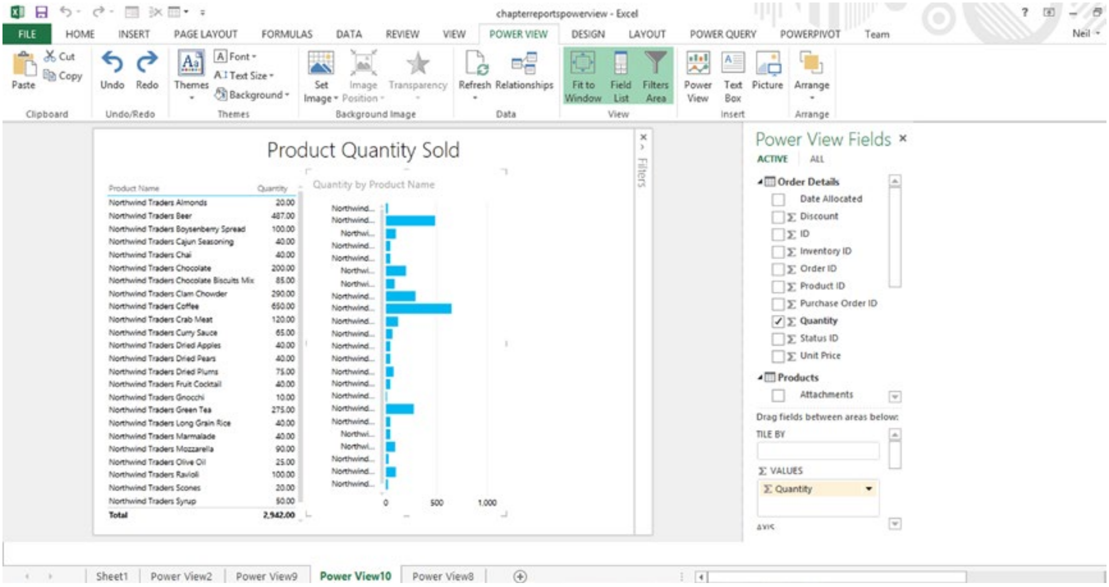
4. Click anywhere in the table and use the handles to expand it, as shown in Figure 6-36.



Product Name	Quantity
Northwind Traders Almonds	20.00
Northwind Traders Beer	487.00
Northwind Traders Boysenberry Spread	100.00
Northwind Traders Cajun Seasoning	40.00
Northwind Traders Chai	40.00
Northwind Traders Chocolate	200.00
Northwind Traders Chocolate Biscuits Mix	85.00
Northwind Traders Clam Chowder	290.00
Northwind Traders Coffee	650.00
Northwind Traders Crab Meat	120.00
Northwind Traders Curry Sauce	65.00
Northwind Traders Dried Apples	40.00
Northwind Traders Dried Pears	40.00
Northwind Traders Dried Plums	75.00
Northwind Traders Fruit Cocktail	40.00
Northwind Traders Gnocchi	10.00
Northwind Traders Green Tea	275.00
Northwind Traders Long Grain Rice	40.00
Northwind Traders Marmalade	40.00
Northwind Traders Mozzarella	90.00
Northwind Traders Olive Oil	25.00
Northwind Traders Ravioli	100.00
Northwind Traders Scones	20.00
Northwind Traders Syrup	50.00
Total	**2,942.00**

Figure 6-36. *Expanded view of table*

5. To create a chart, right-click the table and select copy. Click to the right of the table on the design surface and select Paste. Then, on the Design tab, select Bar Chart and Stacked Bar. At the top of the design screen, enter the title “Product Quantity Sold.” The result is shown in Figure 6-37.



Product Quantity Sold

Product Name	Quantity
Northwind Traders Almonds	20.00
Northwind Traders Beer	487.00
Northwind Traders Boysenberry Spread	100.00
Northwind Traders Cajun Seasoning	40.00
Northwind Traders Chai	40.00
Northwind Traders Chocolate	200.00
Northwind Traders Chocolate Biscuits Mix	85.00
Northwind Traders Clam Chowder	290.00
Northwind Traders Coffee	650.00
Northwind Traders Crab Meat	120.00
Northwind Traders Curry Sauce	65.00
Northwind Traders Dried Apples	40.00
Northwind Traders Dried Pears	40.00
Northwind Traders Dried Plums	75.00
Northwind Traders Fruit Cocktail	40.00
Northwind Traders Gnocchi	10.00
Northwind Traders Green Tea	275.00
Northwind Traders Long Grain Rice	40.00
Northwind Traders Marmalade	40.00
Northwind Traders Mozzarella	90.00
Northwind Traders Olive Oil	25.00
Northwind Traders Ravioli	100.00
Northwind Traders Scones	20.00
Northwind Traders Syrup	50.00
Total	**2,942.00**

Power View Fields ×

ACTIVE ALL

Order Details
- □ Date Allocated
- □ Σ Discount
- □ Σ ID
- □ Σ Inventory ID
- □ Σ Order ID
- □ Σ Product ID
- □ Σ Purchase Order ID
- ☑ Σ Quantity
- □ Σ Status ID
- □ Σ Unit Price

Products
- □ Attachments

Drag fields between areas below:

TILE BY

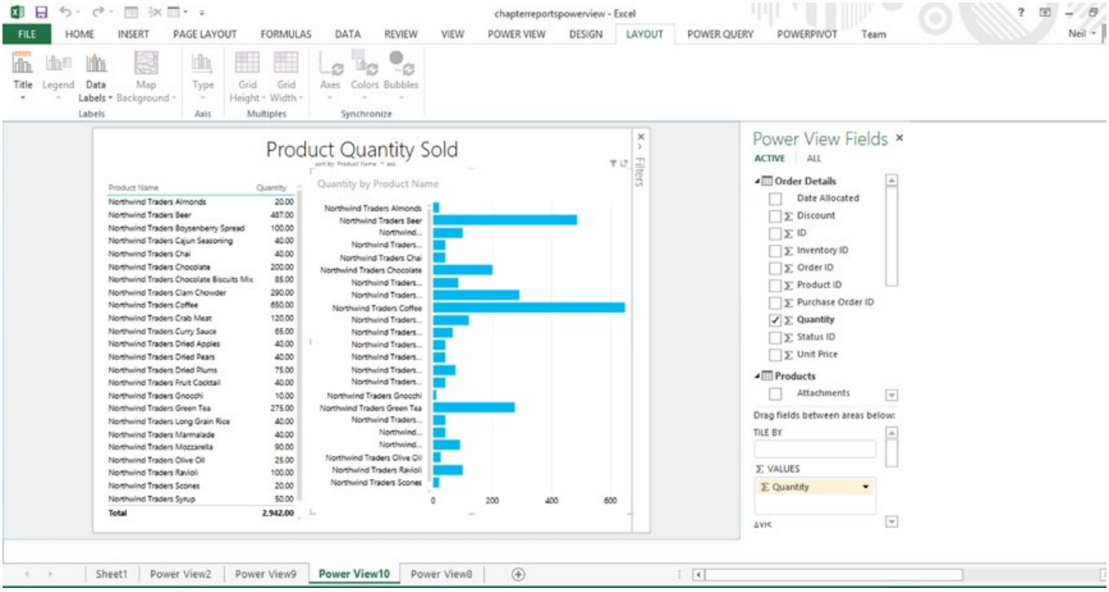
Σ VALUES

Σ Quantity

AXIS

***Figure 6-37.** Bar chart of product quantity sold*

Note that in the bar chart, only the first nine characters of the name are shown. It is possible to hover the mouse pointer over any bar in the bar chart to see the full product name and quantity sold. To display more characters, click the chart window to select it, and drag the handles to expand the size, as shown in Figure 6-38.



Product Quantity Sold

Product Name	Quantity
Northwind Traders Almonds	20.00
Northwind Traders Beer	487.00
Northwind Traders Boysenberry Spread	100.00
Northwind Traders Cajun Seasoning	40.00
Northwind Traders Chai	40.00
Northwind Traders Chocolate	200.00
Northwind Traders Chocolate Biscuits Mix	85.00
Northwind Traders Clam Chowder	290.00
Northwind Traders Coffee	650.00
Northwind Traders Crab Meat	120.00
Northwind Traders Curry Sauce	65.00
Northwind Traders Dried Apples	40.00
Northwind Traders Dried Pears	40.00
Northwind Traders Dried Plums	75.00
Northwind Traders Fruit Cocktail	40.00
Northwind Traders Gnocchi	10.00
Northwind Traders Green Tea	275.00
Northwind Traders Long Grain Rice	40.00
Northwind Traders Marmalade	40.00
Northwind Traders Mozzarella	90.00
Northwind Traders Olive Oil	25.00
Northwind Traders Ravioli	100.00
Northwind Traders Scones	20.00
Northwind Traders Syrup	50.00
Total	**2,942.00**

Power View Fields ×

ACTIVE ALL

Order Details
- □ Date Allocated
- □ Σ Discount
- □ Σ ID
- □ Σ Inventory ID
- □ Σ Order ID
- □ Σ Product ID
- □ Σ Purchase Order ID
- ☑ Σ Quantity
- □ Σ Status ID
- □ Σ Unit Price

Products
- □ Attachments

Drag fields between areas below:

TILE BY

Σ VALUES

Σ Quantity

AXIS

***Figure 6-38.** Bar chart with expanded product name*

Summary

This chapter has just scratched the surface of showing how to use Power View to easily generate data tables and charts to bring data to life. It has covered how to analyze sales by city, by employee, and product. Creating simple maps has also been demonstrated. Chapter 9 will show how to create more sophisticated maps, using Power Map.

CHAPTER 7

Calculating with Data Analysis Expressions (DAX)

This chapter covers calculations with Data Analysis Expressions (DAX) and measuring performance with Key Performance Indicators (KPIs). It will focus on some practical examples of the use of DAX and KPIs.

Understanding Data Analysis Expressions

As explained in Chapter 4, Data Analysis Expressions (DAX) is a formula language used to create calculated columns and fields based on the tabular data model of PowerPivot. DAX formulas differ from regular Excel formulas, which are cell-based, in that DAX formulas apply to all rows in the specified columns. DAX formulas are used in the following two contexts:

1. *Calculated columns*. Calculated columns can be added to an existing PowerPivot table. When a column contains a formula, the value is calculated for each row. To create a formula, click any cell in a new column and press Enter to start entering a formula that is based on column references. Column names can be referenced by pointing to them with the mouse or by entering the names enclosed in square brackets. Columns from other worksheets can be referenced by entering the worksheet name before the column name. If the worksheet name contains a space, it can be enclosed in single quotes. Up to 64 levels of functions can be nested in a DAX expression.

2. *Calculated fields or measures*. These are placed in the calculation area at the bottom of the PowerPivot window. Calculated fields often include aggregation functions, such as sum or average, which by default reference the entire column. DAX functions are very similar to Excel functions, but DAX functions are column-oriented. All available DAX functions can be viewed by clicking the fx icon on the Design tab of the PowerPivot window. When a calculated field is created, the formula is preceded by an identifier, which is like a variable name and can be used to reference the calculated field.

Caution When using DAX, it is best to avoid using the same name for a calculated field and a calculated column. To further avoid ambiguity, it is best when, referencing a column, to use the fully qualified column name, which includes the name of the worksheet.

DAX Operators

DAX uses the following:

the standard arithmetic operators

+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponentiation

the comparison operators

=	Equal
>	Greater than
<	Less than
>=	Greater than or equal to
<=	Less than or equal to
<>	Not equal to

the text concatenation operator

&	Concatenation

and the logical operators

<table>
<tr><td>&amp;&amp;</td><td>And</td></tr>
<tr><td>||</td><td>OR</td></tr>
</table>

Summary of Key DAX Functions Used in This Chapter

`SUM`: A simple sum, such as in Excel

`SUMX`: Iterates through one row at a time in order to do calculations

`CALCULATE`: Allows calculating based on a filter condition

`LEFT`: Returns the specified number of characters from the start of the named text string

Updating Formula Results

There are two ways to update the results of formulas.

1. Refreshing data involves updating the data in the underlying data source, such as SQL Server, MySQL, or Access.
2. Recalculating involves updating the results of formulas based on changes to the formulas.

ANALYZING SALES DATA

This chapter will continue the example used at the end of Chapter 4—the Contoso database available for download from `Tinyurl.com/PowerPivotSamples`. Note that the URL is case-sensitive. Once the data is downloaded, open the PowerPivotTutorialSamples spreadsheet.

One way of thinking about this example is to use a star model architecture that includes a fact table containing the numbers that have to be aggregated, surrounded by dimension tables, such as products and stores. In this example, the dboFactSales table is the fact table, as shown in Figure 7-1. To create this example, follow these steps:

1. Click Manage on the PowerPivot tab and then click on Diagram View to see the tables in Diagram View as shown in Figure 7-1.

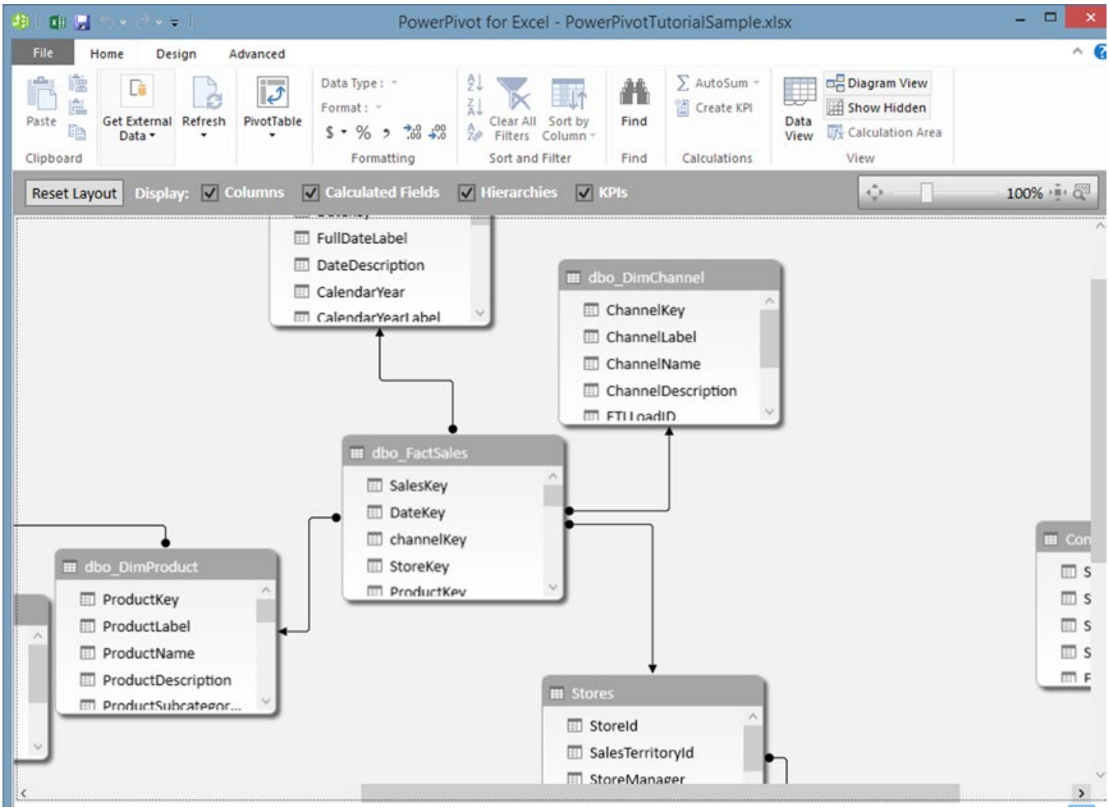
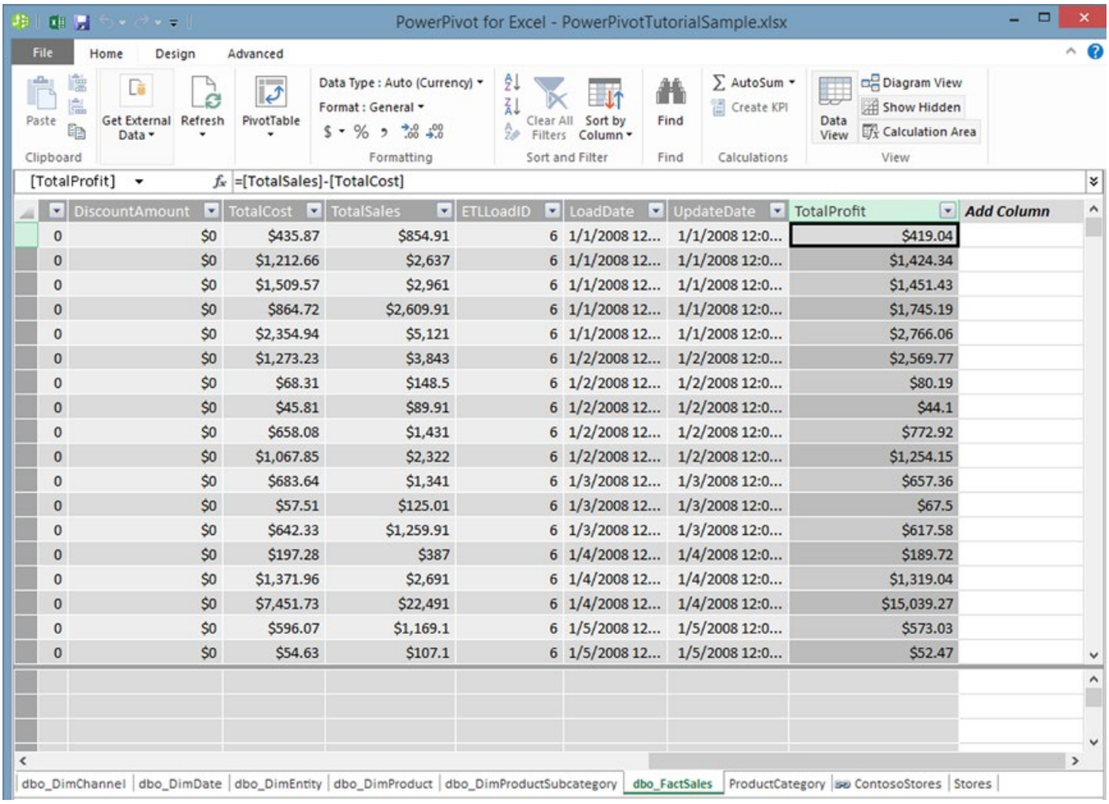


Figure 7-1. Diagram View

2. Click Data View and then click the dbo_FactSales tab at the bottom of the window to view the dbo_FactSales tab. Scroll all the way to the right and notice the final column, TotalProfit, which is a DAX calculated field based on TotalSales minus TotalCost, as shown in Figure 7-2. Click any cell in the column to see the formula displayed just below the ribbon.



[TotalProfit] =[TotalSales]-[TotalCost]

	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit
0	$0	$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04
0	$0	$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34
0	$0	$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43
0	$0	$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19
0	$0	$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06
0	$0	$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77
0	$0	$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19
0	$0	$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1
0	$0	$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92
0	$0	$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15
0	$0	$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36
0	$0	$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5
0	$0	$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58
0	$0	$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72
0	$0	$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04
0	$0	$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27
0	$0	$596.07	$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03
0	$0	$54.63	$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47

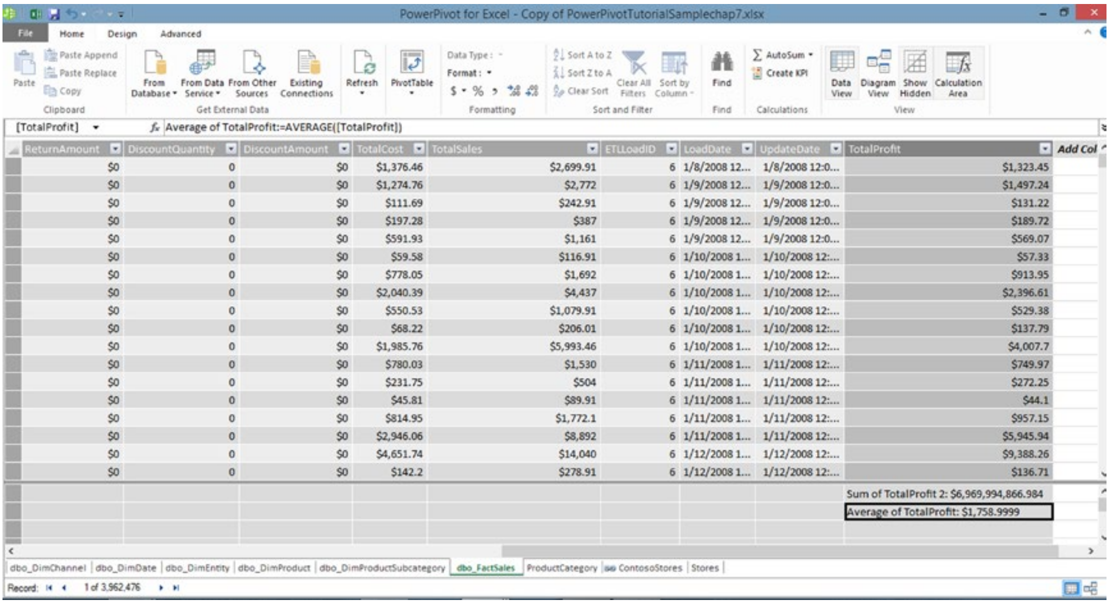
Figure 7-2. *Calculated column*

Creating Measures or Calculated Fields

This section shows how to create measures or calculated fields based on the data in the tables.

1. To add a calculated field or measure, go to the first cell below the data grid at the bottom of the TotalProfit column and select the cell. Double-click the AutoSum icon on the tab to get the sum. If the calculation area or measure grid at the bottom of the data grid is not visible, click the Calculation Area icon at the right end of the tab.

2. Next, select the cell below the sum cell just created, click the down arrow after the AutoSum icon, and from the drop-down, select average, as shown in Figure 7-3. It may be necessary to expand the column to see the totals. Do that by clicking the bar separating the column headings, and when a double arrow appears, drag to the right. Note that an identifier “Sum of Total Profits” and “Average of Total Profits” is created. This identifier acts as both a label and a variable name used to reference the calculated field.



[TotalProfit] Average of TotalProfit:=AVERAGE([TotalProfit])

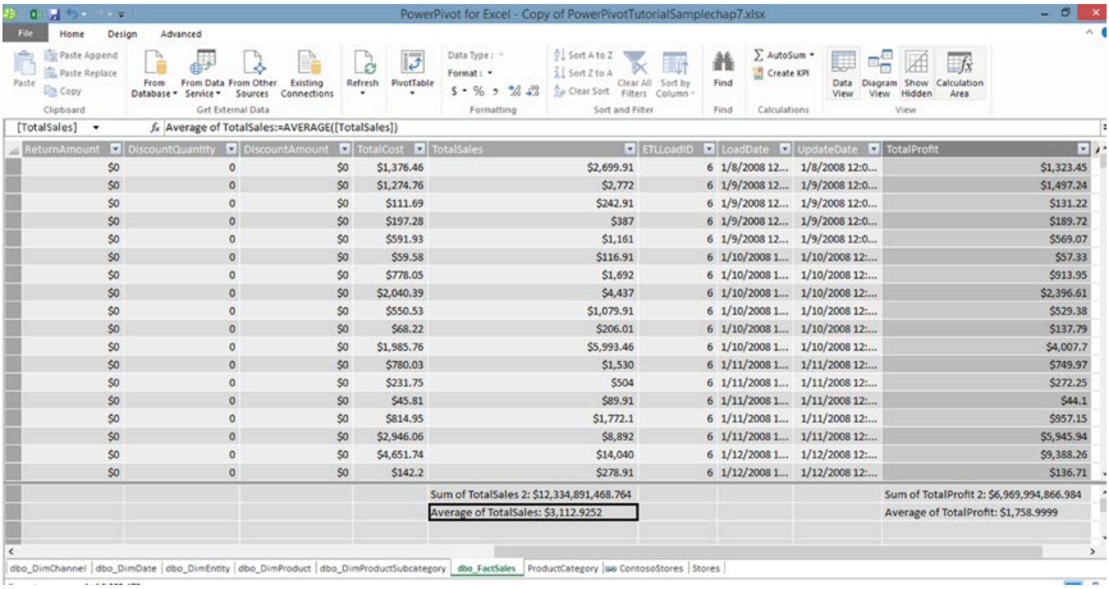
ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit
$0	0	$0	$1,376.46	$2,699.91	6	1/8/2008 12...	1/8/2008 12:0...	$1,323.45
$0	0	$0	$1,274.76	$2,772	6	1/9/2008 12...	1/9/2008 12:0...	$1,497.24
$0	0	$0	$111.69	$242.91	6	1/9/2008 12...	1/9/2008 12:0...	$131.22
$0	0	$0	$197.28	$387	6	1/9/2008 12...	1/9/2008 12:0...	$189.72
$0	0	$0	$591.93	$1,161	6	1/9/2008 12...	1/9/2008 12:0...	$569.07
$0	0	$0	$59.58	$116.91	6	1/10/2008 1...	1/10/2008 12:...	$57.33
$0	0	$0	$778.05	$1,692	6	1/10/2008 1...	1/10/2008 12:...	$913.95
$0	0	$0	$2,040.39	$4,437	6	1/10/2008 1...	1/10/2008 12:...	$2,396.61
$0	0	$0	$550.53	$1,079.91	6	1/10/2008 1...	1/10/2008 12:...	$529.38
$0	0	$0	$68.22	$206.01	6	1/10/2008 1...	1/10/2008 12:...	$137.79
$0	0	$0	$1,985.76	$5,993.46	6	1/10/2008 1...	1/10/2008 12:...	$4,007.7
$0	0	$0	$780.03	$1,530	6	1/11/2008 1...	1/11/2008 12:...	$749.97
$0	0	$0	$231.75	$504	6	1/11/2008 1...	1/11/2008 12:...	$272.25
$0	0	$0	$45.81	$89.91	6	1/11/2008 1...	1/11/2008 12:...	$44.1
$0	0	$0	$814.95	$1,772.1	6	1/11/2008 1...	1/11/2008 12:...	$957.15
$0	0	$0	$2,946.06	$8,892	6	1/11/2008 1...	1/11/2008 12:...	$5,945.94
$0	0	$0	$4,651.74	$14,040	6	1/12/2008 1...	1/12/2008 12:...	$9,388.26
$0	0	$0	$142.2	$278.91	6	1/12/2008 1...	1/12/2008 12:...	$136.71

Sum of TotalProfit 2: $6,969,994,866.984

Average of TotalProfit: $1,758.9999

Figure 7-3. *Calculated fields*

3. Follow the same steps with the Total Sales column to add the sum and average, as shown in Figure 7-4.



[TotalSales] Average of TotalSales:=AVERAGE([TotalSales])

ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit
$0	0	$0	$1,376.46	$2,699.91	6	1/8/2008 12...	1/8/2008 12:0...	$1,323.45
$0	0	$0	$1,274.76	$2,772	6	1/9/2008 12...	1/9/2008 12:0...	$1,497.24
$0	0	$0	$111.69	$242.91	6	1/9/2008 12...	1/9/2008 12:0...	$131.22
$0	0	$0	$197.28	$387	6	1/9/2008 12...	1/9/2008 12:0...	$189.72
$0	0	$0	$591.93	$1,161	6	1/9/2008 12...	1/9/2008 12:0...	$569.07
$0	0	$0	$59.58	$116.91	6	1/10/2008 1...	1/10/2008 12:...	$57.33
$0	0	$0	$778.05	$1,692	6	1/10/2008 1...	1/10/2008 12:...	$913.95
$0	0	$0	$2,040.39	$4,437	6	1/10/2008 1...	1/10/2008 12:...	$2,396.61
$0	0	$0	$550.53	$1,079.91	6	1/10/2008 1...	1/10/2008 12:...	$529.38
$0	0	$0	$68.22	$206.01	6	1/10/2008 1...	1/10/2008 12:...	$137.79
$0	0	$0	$1,985.76	$5,993.46	6	1/10/2008 1...	1/10/2008 12:...	$4,007.7
$0	0	$0	$780.03	$1,530	6	1/11/2008 1...	1/11/2008 12:...	$749.97
$0	0	$0	$231.75	$504	6	1/11/2008 1...	1/11/2008 12:...	$272.25
$0	0	$0	$45.81	$89.91	6	1/11/2008 1...	1/11/2008 12:...	$44.1
$0	0	$0	$814.95	$1,772.1	6	1/11/2008 1...	1/11/2008 12:...	$957.15
$0	0	$0	$2,946.06	$8,892	6	1/11/2008 1...	1/11/2008 12:...	$5,945.94
$0	0	$0	$4,651.74	$14,040	6	1/12/2008 1...	1/12/2008 12:...	$9,388.26
$0	0	$0	$142.2	$278.91	6	1/12/2008 1...	1/12/2008 12:...	$136.71

Sum of TotalSales 2: $12,334,891,468.764

Average of TotalSales: $3,112.9252

Sum of TotalProfit 2: $6,969,994,866.984

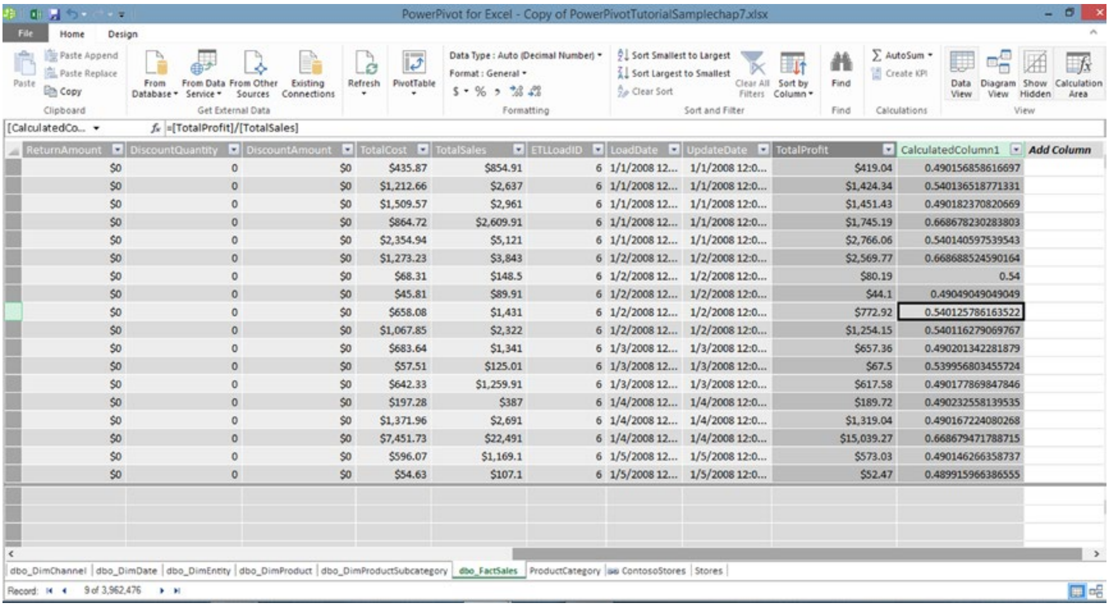
Average of TotalProfit: $1,758.9999

Figure 7-4. *Additional calculated fields*

Analyzing Profitability

This example will show how to insert a new column to analyze the profitability of each transaction.

1. Add a calculated column for profitability or profit divided by sales by clicking anywhere in the rightmost column named "Add Column" and pressing "=". Then click the TotalProfit column, press /, and click the TotalSales column to define the formula and then press Enter. The result is shown in Figure 7-5.

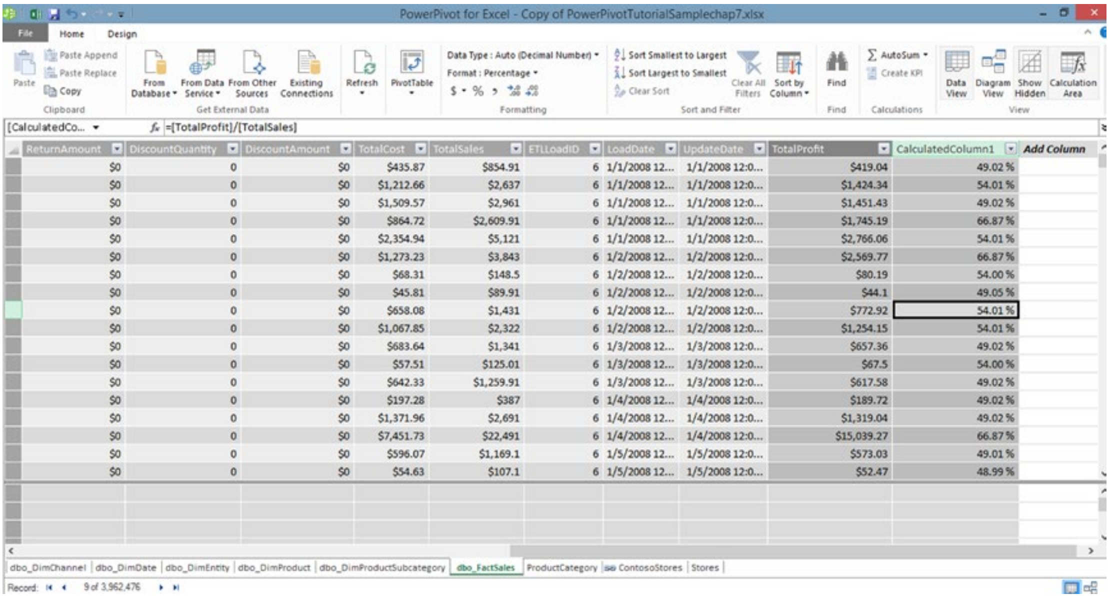


[CalculatedCo... =[TotalProfit]/[TotalSales]

ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	CalculatedColumn1	Add Column
$0	0	$0	$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	0.490156858616697	
$0	0	$0	$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	0.540136518771331	
$0	0	$0	$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	0.490182370820669	
$0	0	$0	$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	0.668678230283803	
$0	0	$0	$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	0.540140597539543	
$0	0	$0	$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	0.668688524590164	
$0	0	$0	$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	0.54	
$0	0	$0	$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	0.49049049049049	
$0	0	$0	$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	0.540125786163522	
$0	0	$0	$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	0.540116279069767	
$0	0	$0	$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	0.490201342281879	
$0	0	$0	$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	0.539956803455724	
$0	0	$0	$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	0.490177869847846	
$0	0	$0	$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	0.490232558139535	
$0	0	$0	$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	0.490167224080268	
$0	0	$0	$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	0.668679471788715	
$0	0	$0	$596.07	$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	0.490146266358737	
$0	0	$0	$54.63	$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	0.489915966386555	

***Figure 7-5.** Calculated field for profit/sales*

2. To format the column to display percentages, select the new column and then click the down arrow after Format on the Home tab and select Percentage. The result is shown in Figure 7-6.



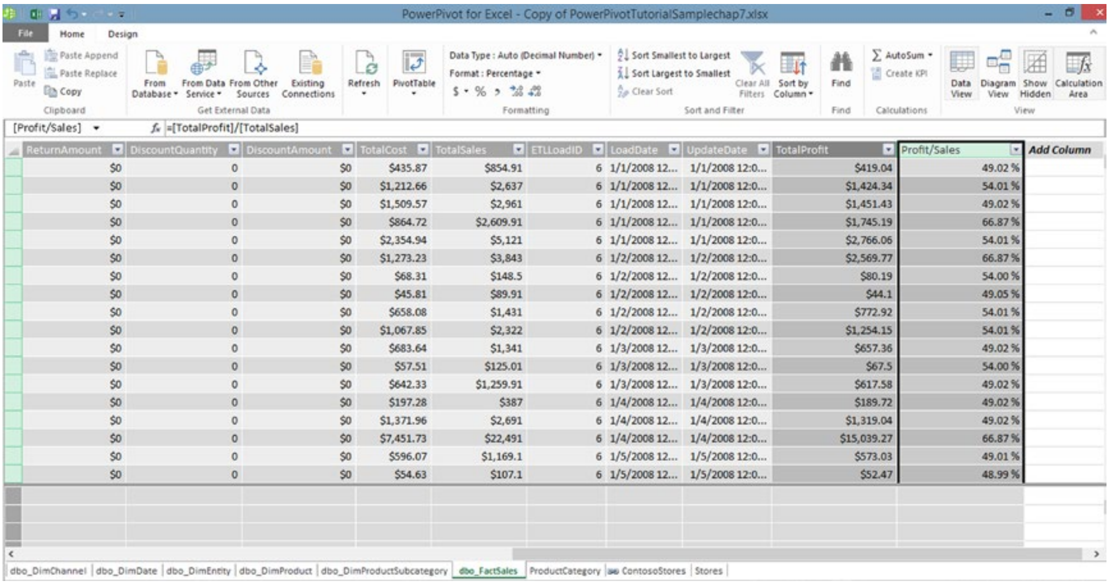
[CalculatedCo... =[TotalProfit]/[TotalSales]

ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	CalculatedColumn1	Add Column
$0	0	$0	$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	49.02 %	
$0	0	$0	$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	54.01 %	
$0	0	$0	$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	49.02 %	
$0	0	$0	$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	66.87 %	
$0	0	$0	$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	54.01 %	
$0	0	$0	$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	66.87 %	
$0	0	$0	$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	54.00 %	
$0	0	$0	$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	49.05 %	
$0	0	$0	$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	54.01 %	
$0	0	$0	$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	54.01 %	
$0	0	$0	$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	49.02 %	
$0	0	$0	$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	54.00 %	
$0	0	$0	$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	49.02 %	
$0	0	$0	$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	49.02 %	
$0	0	$0	$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	49.02 %	
$0	0	$0	$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	66.87 %	
$0	0	$0	$596.07	$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	49.01 %	
$0	0	$0	$54.63	$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	48.99 %	

Record: 9 of 3,962,476

Figure 7-6. *Formatting as percentage*

3. To rename the column, right-click the column heading, select Rename Column, and enter Profit/Sales, as shown in Figure 7-7.

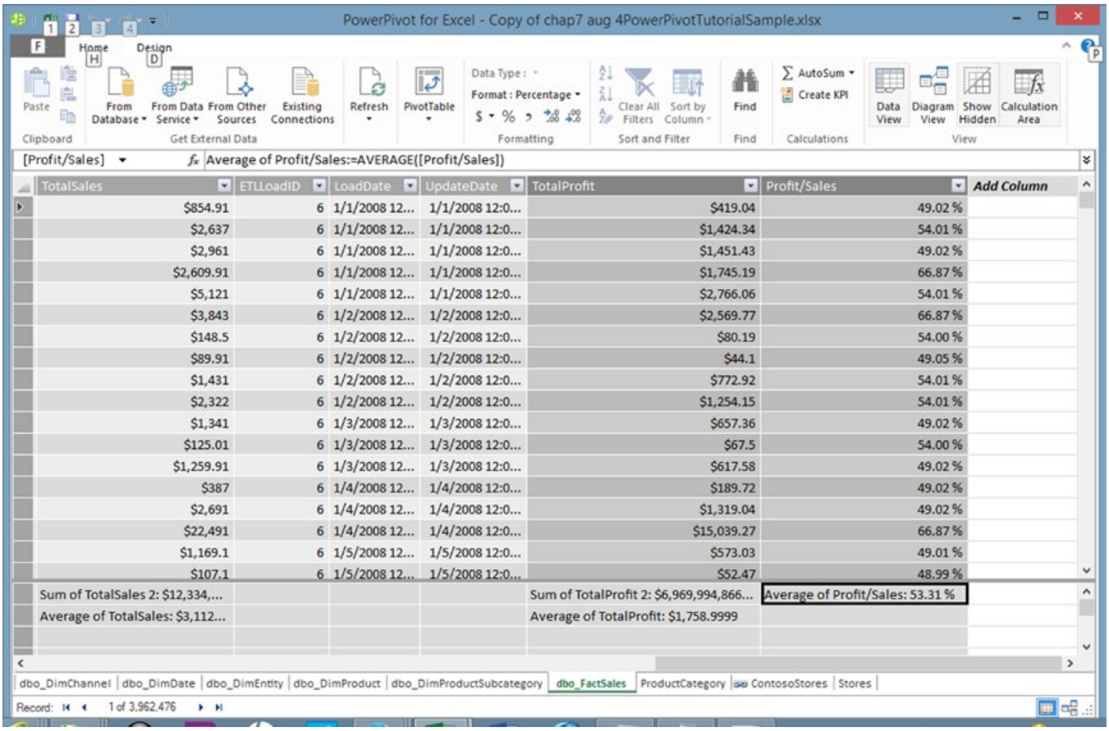


[Profit/Sales] =[TotalProfit]/[TotalSales]

ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	Profit/Sales	Add Column
$0	0	$0	$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	49.02 %	
$0	0	$0	$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	54.01 %	
$0	0	$0	$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	49.02 %	
$0	0	$0	$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	66.87 %	
$0	0	$0	$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	54.01 %	
$0	0	$0	$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	66.87 %	
$0	0	$0	$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	54.00 %	
$0	0	$0	$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	49.05 %	
$0	0	$0	$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	54.01 %	
$0	0	$0	$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	54.01 %	
$0	0	$0	$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	49.02 %	
$0	0	$0	$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	54.00 %	
$0	0	$0	$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	49.02 %	
$0	0	$0	$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	49.02 %	
$0	0	$0	$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	49.02 %	
$0	0	$0	$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	66.87 %	
$0	0	$0	$596.07	$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	49.01 %	
$0	0	$0	$54.63	$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	48.99 %	

Figure 7-7. *Renaming a calculated column*

4. To create a calculated field that is the average of all the profit/sales, go down to the calculation area below the data area. Select the cell at the bottom of the Profit/Sales column and then click the down arrow after the AutoSum icon on the ribbon and select average. A calculated field will be created, as shown in Figure 7-8. Expand the column as necessary to display the full value.



[Profit/Sales] *fx* Average of Profit/Sales:=AVERAGE([Profit/Sales])

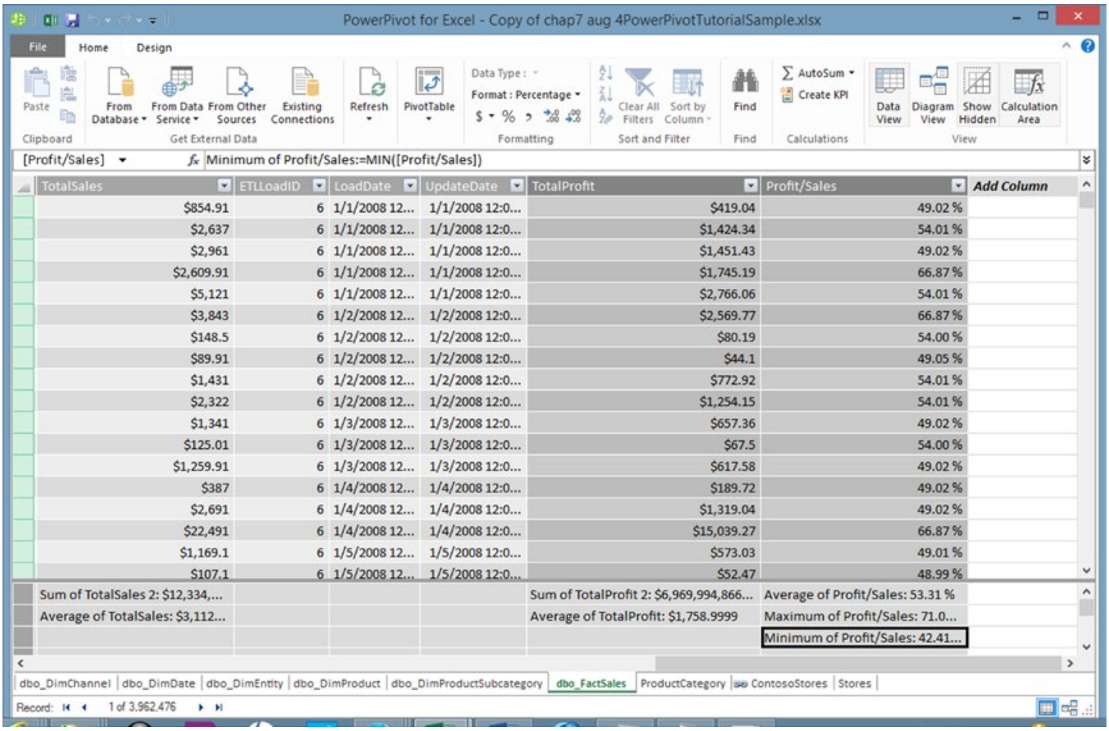
TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	Profit/Sales	Add Column
$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	49.02 %	
$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	54.01 %	
$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	49.02 %	
$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	66.87 %	
$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	54.01 %	
$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	66.87 %	
$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	54.00 %	
$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	49.05 %	
$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	54.01 %	
$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	54.01 %	
$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	49.02 %	
$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	54.00 %	
$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	49.02 %	
$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	49.02 %	
$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	49.02 %	
$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	66.87 %	
$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	49.01 %	
$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	48.99 %	
Sum of TotalSales 2: $12,334,...				Sum of TotalProfit 2: $6,969,994,866...	Average of Profit/Sales: 53.31 %	
Average of TotalSales: $3,112...				Average of TotalProfit: $1,758.9999		

dbo_DimChannel | dbo_DimDate | dbo_DimEntity | dbo_DimProduct | dbo_DimProductSubcategory | dbo_FactSales | ProductCategory | ContosoStores | Stores

Record: 1 of 3,962,476

Figure 7-8. *Average of Profit/Sales*

5. To add calculated fields for minimum and maximum profit/sales, select the cell in the calculation area just below the one where the average is. Click the arrow after AutoSum on the ribbon, select maximum, and then repeat and select minimum. Calculated fields for average minimum and maximum will be created, as shown in Figure 7-9.



[Profit/Sales] 𝑓x Minimum of Profit/Sales:=MIN([Profit/Sales])

TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	Profit/Sales	Add Column
$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	49.02 %	
$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	54.01 %	
$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	49.02 %	
$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	66.87 %	
$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	54.01 %	
$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	66.87 %	
$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	54.00 %	
$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	49.05 %	
$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	54.01 %	
$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	54.01 %	
$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	49.02 %	
$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	54.00 %	
$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	49.02 %	
$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	49.02 %	
$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	49.02 %	
$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	66.87 %	
$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	49.01 %	
$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	48.99 %	

Sum of TotalSales 2: $12,334,...				Sum of TotalProfit 2: $6,969,994,866...	Average of Profit/Sales: 53.31 %
Average of TotalSales: $3,112...				Average of TotalProfit: $1,758.9999	Maximum of Profit/Sales: 71.0...
					Minimum of Profit/Sales: 42.41...

dbo_DimChannel | dbo_DimDate | dbo_DimEntity | dbo_DimProduct | dbo_DimProductSubcategory | dbo_FactSales | ProductCategory | ContosoStores | Stores

Record: 1 of 3,962,476

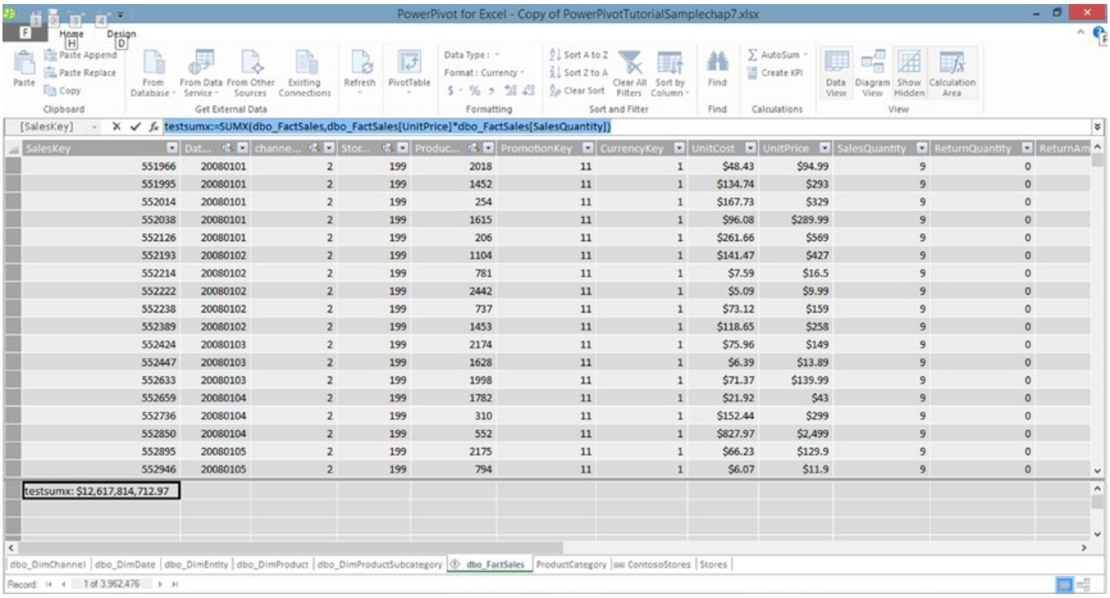
Figure 7-9. Adding calculated fields for minimum and maximum profit/sales

Using the SUMX Function

The SUM function can be used to sum a single column. By contrast, SUMX iterates through each column and performs a calculation. So, for instance, SUMX could be used to sum the product of price time's quantity for each row. To do so, follow these steps:

1. Select the next cell down in the first column of the calculation area.
2. Enter the following formula to test SUMX and format it as currency, as shown in Figure 7-10:

```
testsumx:=SUMX(dbo_FactSales,dbo_FactSales[UnitPrice]*
dbo_FactSales[SalesQuantity])
```



[SalesKey] testsumx:=SUMX(dbo_FactSales,dbo_FactSales[UnitPrice]*dbo_FactSales[SalesQuantity])

SalesKey	Dat...	channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	ReturnAm
551966	20080101	2	199	2018	11	1	$48.43	$94.99	9	0	
551995	20080101	2	199	1452	11	1	$134.74	$293	9	0	
552014	20080101	2	199	254	11	1	$167.73	$329	9	0	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	9	0	
552126	20080101	2	199	206	11	1	$261.66	$569	9	0	
552193	20080102	2	199	1104	11	1	$141.47	$427	9	0	
552214	20080102	2	199	781	11	1	$7.59	$16.5	9	0	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	9	0	
552238	20080102	2	199	737	11	1	$73.12	$159	9	0	
552389	20080102	2	199	1453	11	1	$118.65	$258	9	0	
552424	20080103	2	199	2174	11	1	$75.96	$149	9	0	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	9	0	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	9	0	
552659	20080104	2	199	1782	11	1	$21.92	$43	9	0	
552736	20080104	2	199	310	11	1	$152.44	$299	9	0	
552850	20080104	2	199	552	11	1	$827.97	$2,499	9	0	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	9	0	
552946	20080105	2	199	794	11	1	$6.07	$11.9	9	0	

testsumx: $12,617,814,712.97

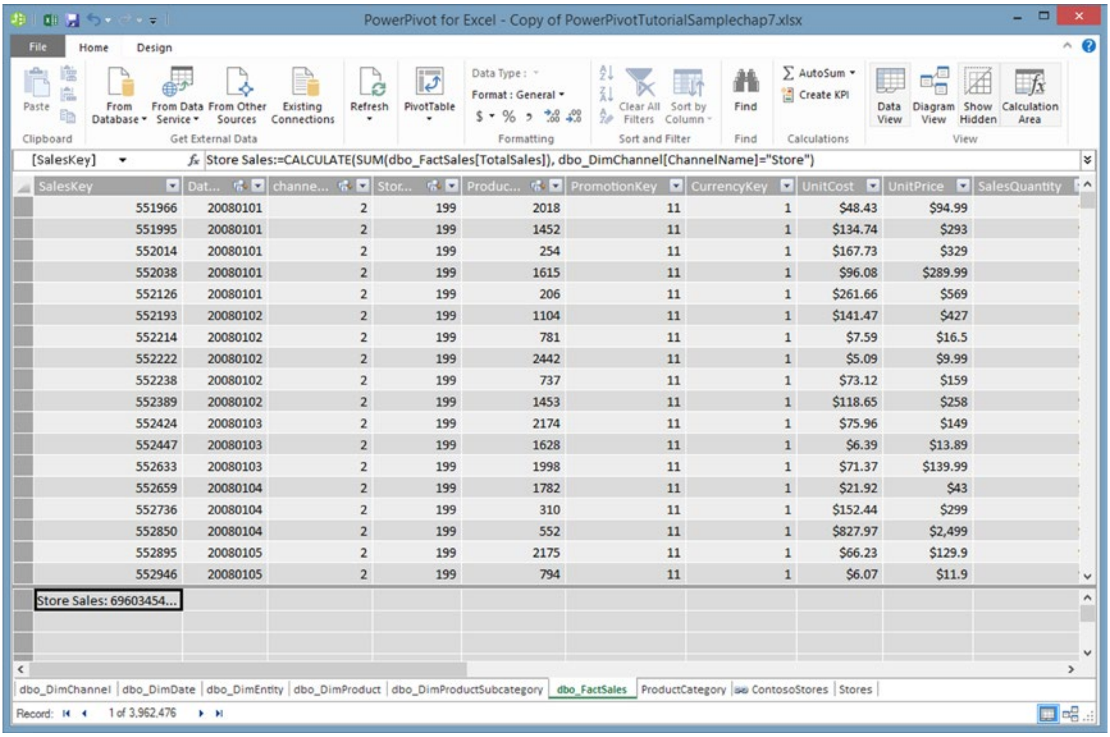
Figure 7-10. *Using the SUMX function*

Using the CALCULATE Function

The `CALCULATE()` function is used to calculate an expression based on a filter. The following example calculates total sales through the store channel. Follow these steps:

1. Select the top leftmost cell in the Calculation area.
2. Enter the formula, as shown in Figure 7-11. The DAX formula is

```
StoreSales:=CALCULATE(SUM(dbo_FactSales[TotalSales]),
dbo_DimChannel[ChannelName]="Store")
```



[SalesKey]

```
Store Sales:=CALCULATE(SUM(dbo_FactSales[TotalSales]), dbo_DimChannel[ChannelName]="Store")
```

SalesKey	Dat...	channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity
551966	20080101	2	199	2018	11	1	$48.43	$94.99	
551995	20080101	2	199	1452	11	1	$134.74	$293	
552014	20080101	2	199	254	11	1	$167.73	$329	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	
552126	20080101	2	199	206	11	1	$261.66	$569	
552193	20080102	2	199	1104	11	1	$141.47	$427	
552214	20080102	2	199	781	11	1	$7.59	$16.5	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	
552238	20080102	2	199	737	11	1	$73.12	$159	
552389	20080102	2	199	1453	11	1	$118.65	$258	
552424	20080103	2	199	2174	11	1	$75.96	$149	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	
552659	20080104	2	199	1782	11	1	$21.92	$43	
552736	20080104	2	199	310	11	1	$152.44	$299	
552850	20080104	2	199	552	11	1	$827.97	$2,499	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	
552946	20080105	2	199	794	11	1	$6.07	$11.9	

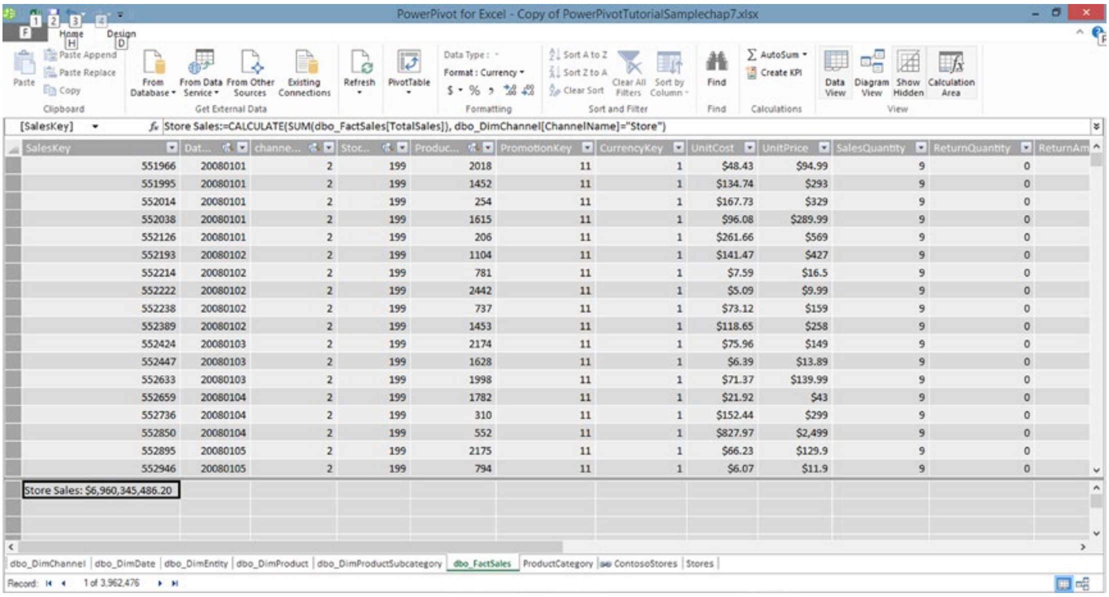
Store Sales: 69603454...

Record: 1 of 3,962,476

Figure 7-11. *Using the* CALCULATE *function to show total store sales*

Note that the formula starts with a label, followed by a colon. StoreSales is both the label and identifier for this calculated field. CALCULATE will then sum the TotalSales field from the dbo_FactSales table, in which the channel name is equal to store. When typing a function name or field name, Intellisense pops up a list of what it thinks you want to enter. Highlight the desired value and press Tab to select.

1. Note that the total sales number is not formatted. This can be corrected by selecting the field and clicking the down arrow after the Format icon on the ribbon and selecting currency. The column also needs to be expanded, which can be achieved by clicking the bar between column headings and dragging. The result is shown in Figure 7-12.



[SalesKey]

Store Sales:=CALCULATE(SUM(dbo_FactSales[TotalSales]), dbo_DimChannel[ChannelName]="Store")

SalesKey	Dat...	channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	ReturnAm
551966	20080101	2	199	2018	11	1	$48.43	$94.99	9	0	
551995	20080101	2	199	1452	11	1	$134.74	$293	9	0	
552014	20080101	2	199	254	11	1	$167.73	$329	9	0	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	9	0	
552126	20080101	2	199	206	11	1	$261.66	$569	9	0	
552193	20080102	2	199	1104	11	1	$141.47	$427	9	0	
552214	20080102	2	199	781	11	1	$7.59	$16.5	9	0	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	9	0	
552238	20080102	2	199	737	11	1	$73.12	$159	9	0	
552389	20080102	2	199	1453	11	1	$118.65	$258	9	0	
552424	20080103	2	199	2174	11	1	$75.96	$149	9	0	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	9	0	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	9	0	
552659	20080104	2	199	1782	11	1	$21.92	$43	9	0	
552736	20080104	2	199	310	11	1	$152.44	$299	9	0	
552850	20080104	2	199	552	11	1	$827.97	$2,499	9	0	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	9	0	
552946	20080105	2	199	794	11	1	$6.07	$11.9	9	0	

Store Sales: $6,960,345,486.20

Figure 7-12. *Formatting as currency*

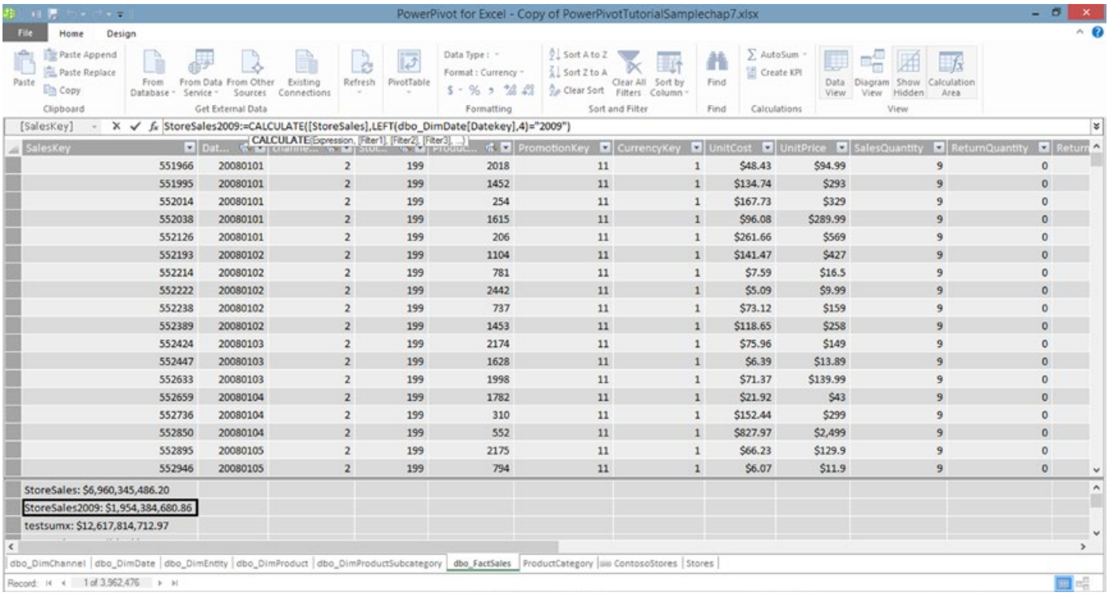
Calculating the Store Sales for 2009

Calculated fields can be based on other calculated fields. The store sales for 2009 can be calculated based on the total StoreSales calculated field. Follow these steps:

1. Select the next cell in the leftmost calculation area.
2. Enter the following formula:

```
StoreSales2009:=CALCULATE([StoreSales],LEFT(dbo_DimDate[Datekey],4)="2009")
```

The LEFT function is used to extract the year from the Datekey text string. The result is shown in Figure 7-13.



[SalesKey] StoreSales2009:=CALCULATE([StoreSales],LEFT(dbo_DimDate[Datekey],4)="2009")

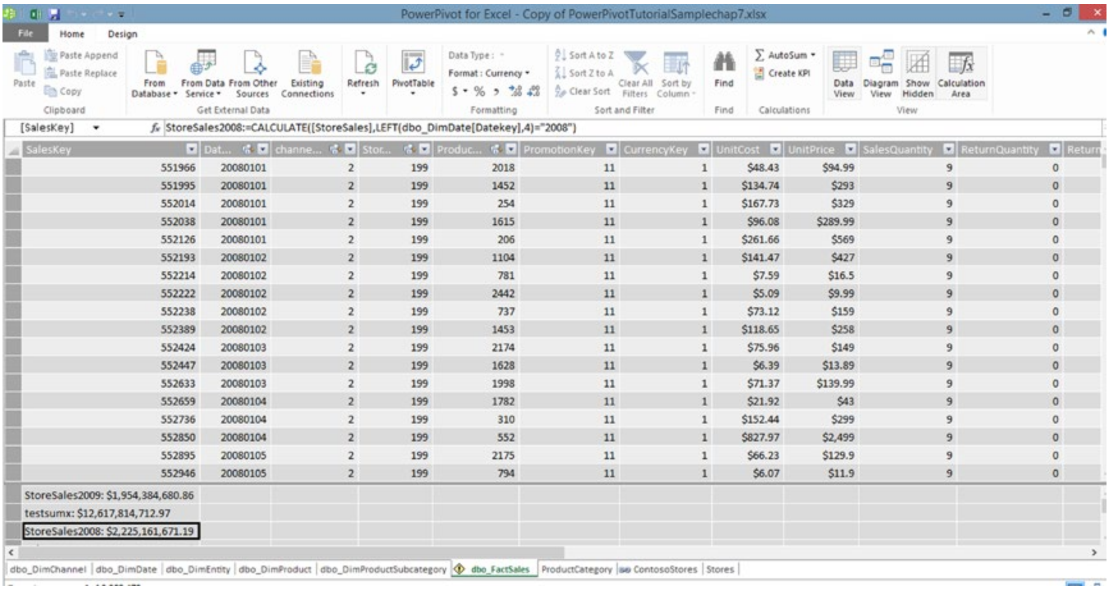
SalesKey	Dat...	Channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	Return
551966	20080101	2	199	2018	11	1	$48.43	$94.99	9	0	
551995	20080101	2	199	1452	11	1	$134.74	$293	9	0	
552014	20080101	2	199	254	11	1	$167.73	$329	9	0	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	9	0	
552126	20080101	2	199	206	11	1	$261.66	$569	9	0	
552193	20080102	2	199	1104	11	1	$141.47	$427	9	0	
552214	20080102	2	199	781	11	1	$7.59	$16.5	9	0	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	9	0	
552238	20080102	2	199	737	11	1	$73.12	$159	9	0	
552389	20080102	2	199	1453	11	1	$118.65	$258	9	0	
552424	20080103	2	199	2174	11	1	$75.96	$149	9	0	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	9	0	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	9	0	
552659	20080104	2	199	1782	11	1	$21.92	$43	9	0	
552736	20080104	2	199	310	11	1	$152.44	$299	9	0	
552850	20080104	2	199	552	11	1	$827.97	$2,499	9	0	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	9	0	
552946	20080105	2	199	794	11	1	$6.07	$11.9	9	0	

StoreSales: $6,960,345,486.20
StoreSales2009: $1,954,384,680.86
testsumx: $12,617,814,712.97

Figure 7-13. *Calculating the 2009 store sales*

3. Next, create a calculated field for store sales for the previous year, 2008, by entering the following DAX formula in the cell below, as shown in Figure 7-14.

```
StoreSales2008:=CALCULATE([StoreSales],LEFT(dbo_DimDate[Datekey],4)="2008")
```



[SalesKey] StoreSales2008:=CALCULATE([StoreSales],LEFT(dbo_DimDate[Datekey],4)="2008")

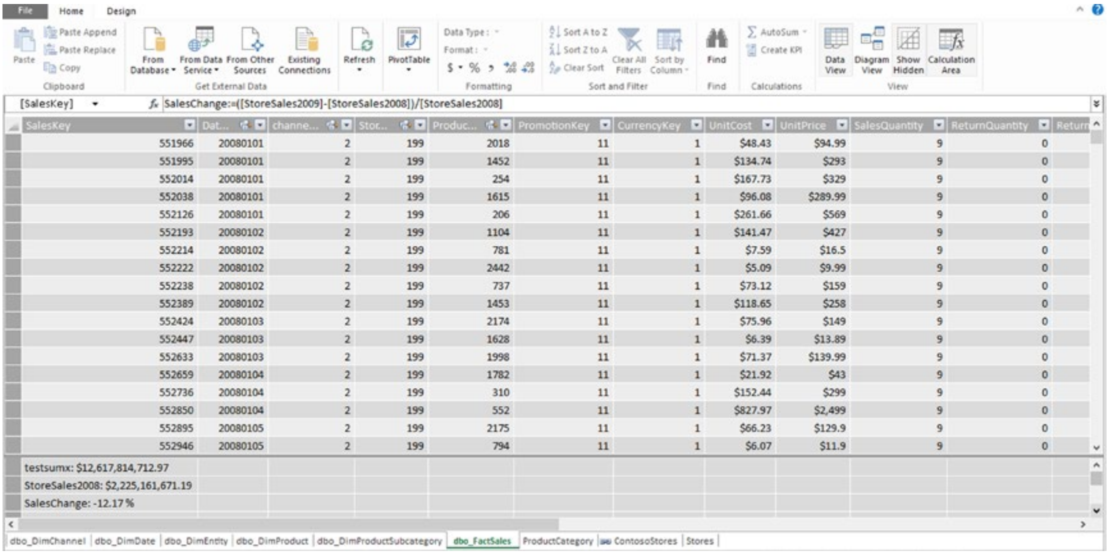
SalesKey	Dat...	channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	Return
551966	20080101	2	199	2018	11	1	$48.43	$94.99	9	0	
551995	20080101	2	199	1452	11	1	$134.74	$293	9	0	
552014	20080101	2	199	254	11	1	$167.73	$329	9	0	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	9	0	
552126	20080101	2	199	206	11	1	$261.66	$569	9	0	
552193	20080102	2	199	1104	11	1	$141.47	$427	9	0	
552214	20080102	2	199	781	11	1	$7.59	$16.5	9	0	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	9	0	
552238	20080102	2	199	737	11	1	$73.12	$159	9	0	
552389	20080102	2	199	1453	11	1	$118.65	$258	9	0	
552424	20080103	2	199	2174	11	1	$75.96	$149	9	0	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	9	0	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	9	0	
552659	20080104	2	199	1782	11	1	$21.92	$43	9	0	
552736	20080104	2	199	310	11	1	$152.44	$299	9	0	
552850	20080104	2	199	552	11	1	$827.97	$2,499	9	0	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	9	0	
552946	20080105	2	199	794	11	1	$6.07	$11.9	9	0	

StoreSales2009: $1,954,384,680.86
testsumx: $12,617,814,712.97
StoreSales2008: $2,225,161,671.19

Figure 7-14. *Calculating the 2008 store sales*

4. Next, the year-over-year growth can be calculated by entering the following formula and changing the format to percent, as shown in Figure 7-15. The identifiers for the calculated fields have to be enclosed in square brackets. Note that sales decreased by 12% in 2009.

```
SalesChange:=([StoreSales2009]-[StoreSales2008])/[StoreSales2008]
```



[SalesKey] *fx* SalesChange:=([StoreSales2009]-[StoreSales2008])/[StoreSales2008]

SalesKey	Dat...	channe...	Stor...	Produc...	PromotionKey	CurrencyKey	UnitCost	UnitPrice	SalesQuantity	ReturnQuantity	Return
551966	20080101	2	199	2018	11	1	$48.43	$94.99	9	0	
551995	20080101	2	199	1452	11	1	$134.74	$293	9	0	
552014	20080101	2	199	254	11	1	$167.73	$329	9	0	
552038	20080101	2	199	1615	11	1	$96.08	$289.99	9	0	
552126	20080101	2	199	206	11	1	$261.66	$569	9	0	
552193	20080102	2	199	1104	11	1	$141.47	$427	9	0	
552214	20080102	2	199	781	11	1	$7.59	$16.5	9	0	
552222	20080102	2	199	2442	11	1	$5.09	$9.99	9	0	
552238	20080102	2	199	737	11	1	$73.12	$159	9	0	
552389	20080102	2	199	1453	11	1	$118.65	$258	9	0	
552424	20080103	2	199	2174	11	1	$75.96	$149	9	0	
552447	20080103	2	199	1628	11	1	$6.39	$13.89	9	0	
552633	20080103	2	199	1998	11	1	$71.37	$139.99	9	0	
552659	20080104	2	199	1782	11	1	$21.92	$43	9	0	
552736	20080104	2	199	310	11	1	$152.44	$299	9	0	
552850	20080104	2	199	552	11	1	$827.97	$2,499	9	0	
552895	20080105	2	199	2175	11	1	$66.23	$129.9	9	0	
552946	20080105	2	199	794	11	1	$6.07	$11.9	9	0	

testsumx: $12,617,814,712.97
StoreSales2008: $2,225,161,671.19
SalesChange: -12.17 %

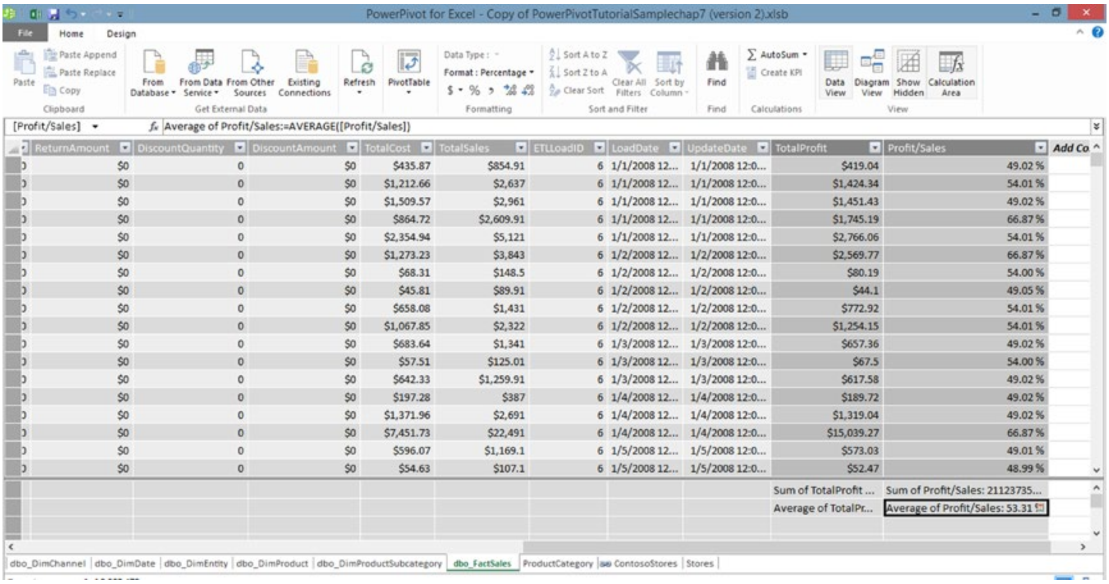
Figure 7-15. *Calculating a year or a year sales change*

Creating a KPI for Profitability

A KPI, or Key Performance Indicator, is based on the relationship between a calculated field and a value. Create a KPI for profitability by initiating the following steps:

1. Create a calculated field for average of profit/sales, as shown in Figure 7-16, by entering the following formula:

```
Average of Profit/Sales:=AVERAGE([Profit/Sales])
```

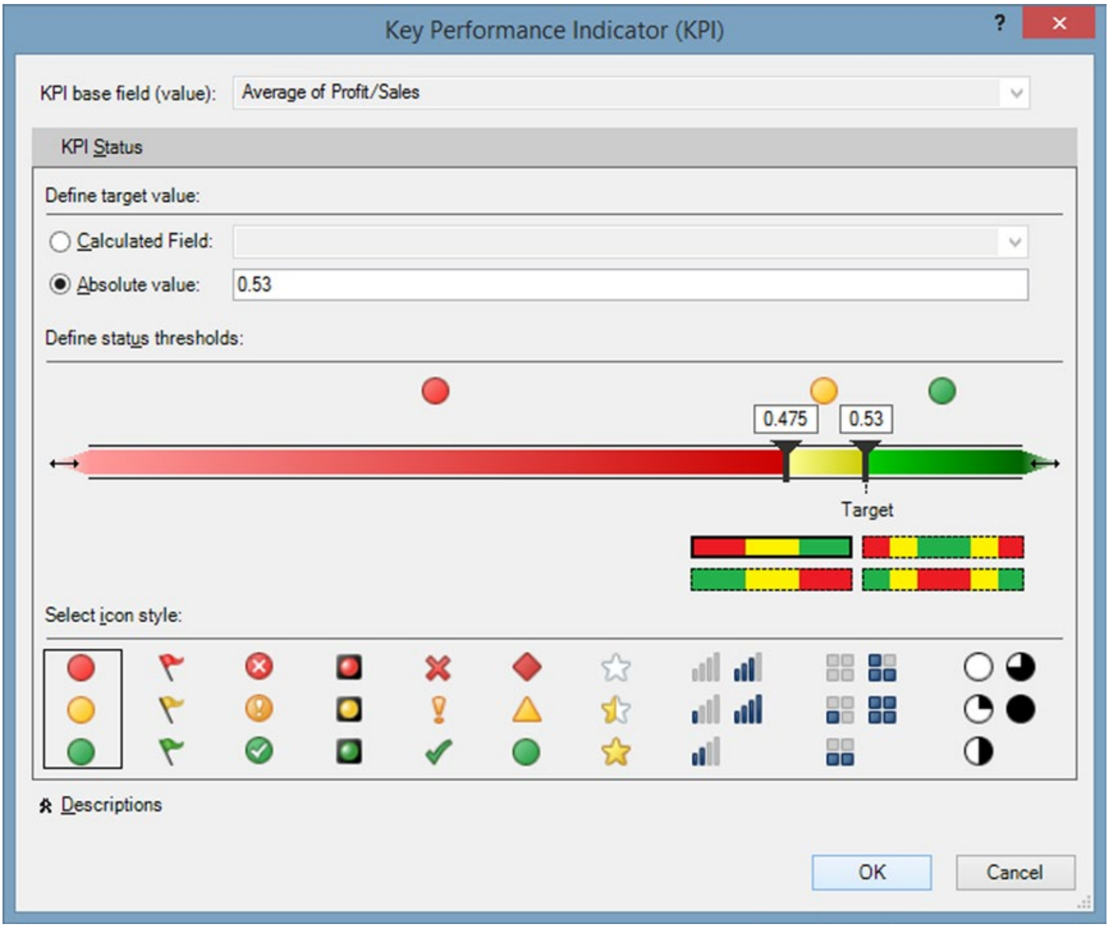


[Profit/Sales] Average of Profit/Sales:=AVERAGE([Profit/Sales])

ReturnAmount	DiscountQuantity	DiscountAmount	TotalCost	TotalSales	ETLLoadID	LoadDate	UpdateDate	TotalProfit	Profit/Sales	Add Co
$0	0	$0	$435.87	$854.91	6	1/1/2008 12...	1/1/2008 12:0...	$419.04	49.02 %	
$0	0	$0	$1,212.66	$2,637	6	1/1/2008 12...	1/1/2008 12:0...	$1,424.34	54.01 %	
$0	0	$0	$1,509.57	$2,961	6	1/1/2008 12...	1/1/2008 12:0...	$1,451.43	49.02 %	
$0	0	$0	$864.72	$2,609.91	6	1/1/2008 12...	1/1/2008 12:0...	$1,745.19	66.87 %	
$0	0	$0	$2,354.94	$5,121	6	1/1/2008 12...	1/1/2008 12:0...	$2,766.06	54.01 %	
$0	0	$0	$1,273.23	$3,843	6	1/2/2008 12...	1/2/2008 12:0...	$2,569.77	66.87 %	
$0	0	$0	$68.31	$148.5	6	1/2/2008 12...	1/2/2008 12:0...	$80.19	54.00 %	
$0	0	$0	$45.81	$89.91	6	1/2/2008 12...	1/2/2008 12:0...	$44.1	49.05 %	
$0	0	$0	$658.08	$1,431	6	1/2/2008 12...	1/2/2008 12:0...	$772.92	54.01 %	
$0	0	$0	$1,067.85	$2,322	6	1/2/2008 12...	1/2/2008 12:0...	$1,254.15	54.01 %	
$0	0	$0	$683.64	$1,341	6	1/3/2008 12...	1/3/2008 12:0...	$657.36	49.02 %	
$0	0	$0	$57.51	$125.01	6	1/3/2008 12...	1/3/2008 12:0...	$67.5	54.00 %	
$0	0	$0	$642.33	$1,259.91	6	1/3/2008 12...	1/3/2008 12:0...	$617.58	49.02 %	
$0	0	$0	$197.28	$387	6	1/4/2008 12...	1/4/2008 12:0...	$189.72	49.02 %	
$0	0	$0	$1,371.96	$2,691	6	1/4/2008 12...	1/4/2008 12:0...	$1,319.04	49.02 %	
$0	0	$0	$7,451.73	$22,491	6	1/4/2008 12...	1/4/2008 12:0...	$15,039.27	66.87 %	
$0	0	$0	$596.07	$1,169.1	6	1/5/2008 12...	1/5/2008 12:0...	$573.03	49.01 %	
$0	0	$0	$54.63	$107.1	6	1/5/2008 12...	1/5/2008 12:0...	$52.47	48.99 %	
								Sum of TotalProfit ...	Sum of Profit/Sales: 21123735...	
								Average of TotalPr...	Average of Profit/Sales: 53.31	

Figure 7-16. *Creating calculate field for Average of Profit/Sales*

2. Right-click the calculated field and select Create KPI. Enter an absolute value of .53, or 53%, and adjust the sliders so that green is displayed for values that meet the target, as shown in Figure 7-17, and click OK.



Key Performance Indicator (KPI)

KPI base field (value): Average of Profit/Sales

KPI Status

Define target value:

○ Calculated Field:

● Absolute value: 0.53

Define status thresholds:

0.475

0.53

Target

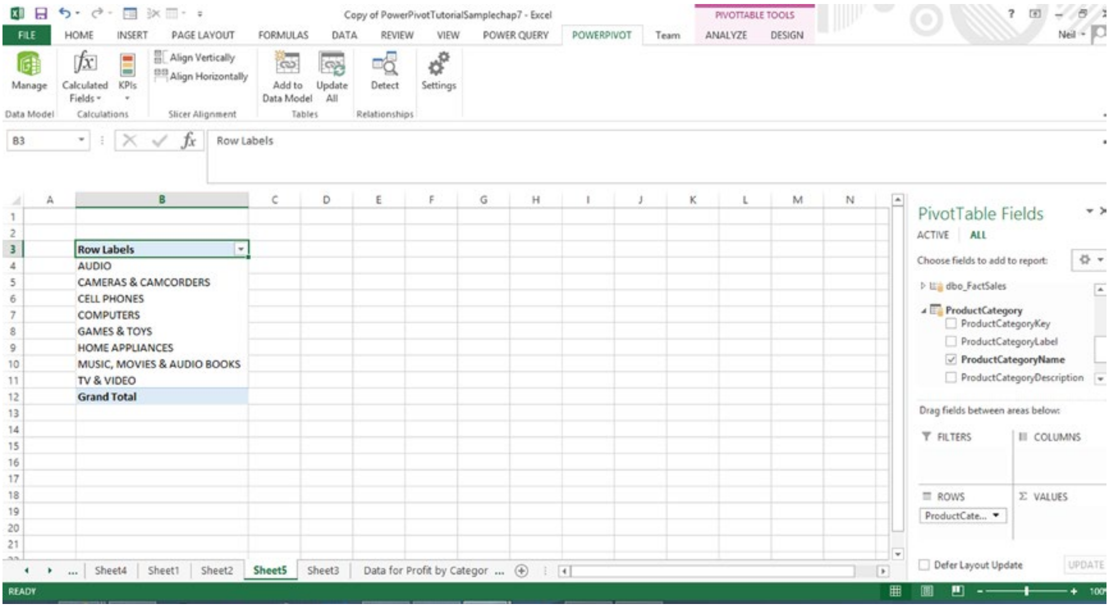
Select icon style:

Figure 7-17. *Defining the KPI*

Creating a Pivot Table Showing Profitability by Product Line

To create a Pivot Table showing profitability by product line, follow these steps:

1. Select the dbo_FactSales tab.
2. Click the Pivot Table icon on the ribbon and select Pivot Table.
3. Select New Worksheet in the Create Pivot Table dialog and click OK.
4. Select the Product Category Name field in the Product Category table. It will appear in the Rows box in the Pivot Table pane on the right of the screen, as shown in Figure 7-18.



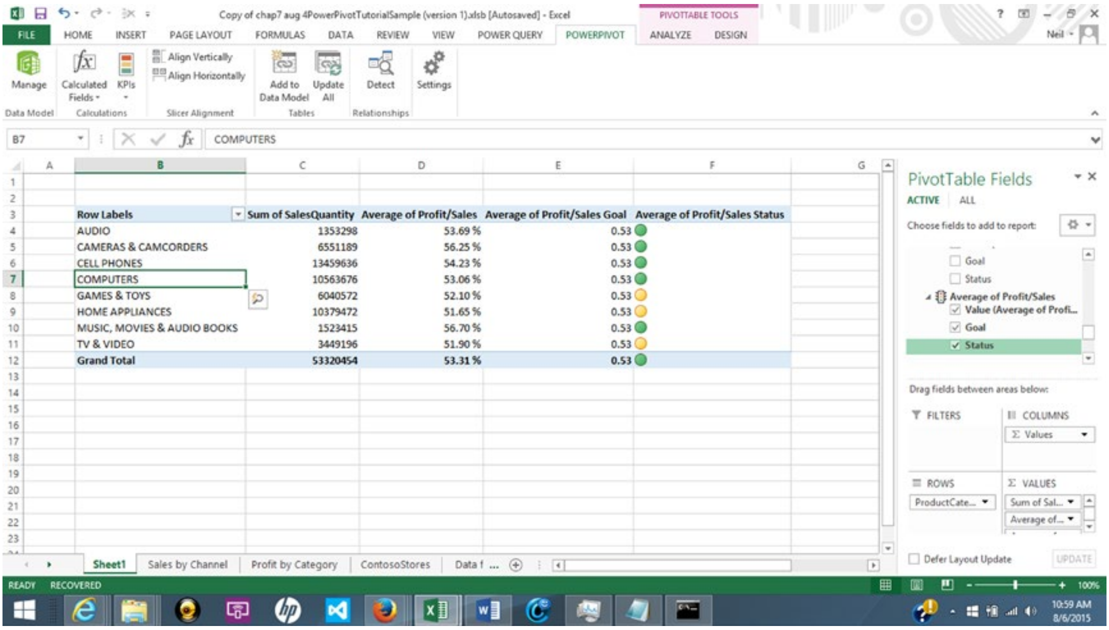
Row Labels
AUDIO
CAMERAS & CAMCORDERS
CELL PHONES
COMPUTERS
GAMES & TOYS
HOME APPLIANCES
MUSIC, MOVIES & AUDIO BOOKS
TV & VIDEO
Grand Total

dbo_FactSales
ProductCategory
□ ProductCategoryKey
□ ProductCategoryLabel
☑ ProductCategoryName
□ ProductCategoryDescription

ROWS: ProductCate...

Figure 7-18. *Inserting product category name into Pivot Table*

5. Next, select the Sales Quantity field in the dbo_FactSales table and the Average of Profit/Sales calculated field, which appears at the bottom of the fields list. Click the calculated field name and select values, goal, and status. This field will appear in the values box, and a Pivot Table will be created, as shown in Figure 7-19.



Row Labels	Sum of SalesQuantity	Average of Profit/Sales	Average of Profit/Sales Goal	Average of Profit/Sales Status
AUDIO	1353298	53.69 %	0.53	🟢
CAMERAS & CAMCORDERS	6551189	56.25 %	0.53	🟢
CELL PHONES	13459636	54.23 %	0.53	🟢
COMPUTERS	10563676	53.06 %	0.53	🟢
GAMES & TOYS	6040572	52.10 %	0.53	🟡
HOME APPLIANCES	10379472	51.65 %	0.53	🟡
MUSIC, MOVIES & AUDIO BOOKS	1523415	56.70 %	0.53	🟢
TV & VIDEO	3449196	51.90 %	0.53	🟡
Grand Total	53320454	53.31 %	0.53	🟢

□ Goal
□ Status
Average of Profit/Sales
☑ Value (Average of Profi...
☑ Goal
☑ Status

COLUMNS: Σ Values
ROWS: ProductCate...
VALUES: Sum of Sal... / Average of...

Figure 7-19. *Adding the KPI into Pivot Table*

Summary

This chapter showed how to use the DAX formula language to create calculated fields and calculated columns and how to create Key Performance Indicators to monitor business activity. In contrast to Excel formulas, which reference specific cells, DAX formulas reference columns, but the `CALCULATE()` function can be used to calculate an expression based on a filter.

CHAPTER 8

Power Query

Microsoft Power Query for Excel is a data-discovery tool for importing data from a wide variety of sources, including relational, semi-structured, and unstructured data available from sources such as OData, Hadoop, and Azure Marketplace. It is a self-service ETL (export, transform, load) tool for extracting, transforming, and loading data. It is more powerful than some of the approaches that have been covered previously. Microsoft is constantly updating Power Query, so some features may have changed by the time this book is published. This chapter demonstrates how to access data—from the Web, in table format, CSV format, and JSON format—and then shape it using the Power Query editor before importing it into Excel.

Installing Power Query

If the Power Query tab is not visible, you will have to install it. Power Query is available as a free download from Microsoft for Excel 2010 and 2013. The download link can be accessed by doing a search on "Power Query download." Be sure to install the 32-bit version if you have installed the 32-bit version of Excel and the 64-bit version if you have the 64-bit version of Excel. To enable Power Query after installation, follow these steps:

1. Click the File tab to see the Backstage View.
2. Click Options at the bottom of the left pane.
3. Select Add-Ins on the left pane.
4. At the bottom of the window, pull down the arrow after Manage and select Com Add-Ins and click Go.
5. Check Microsoft Office PowerPivot for Excel 2013, Microsoft Power Map for Excel, and Power View, and click OK.

After installation, the Power Query tab will be visible.

Key Options on Power Query Ribbon

This section will cover the most useful options on the Power Query ribbon, which is shown in Figure 8-1.

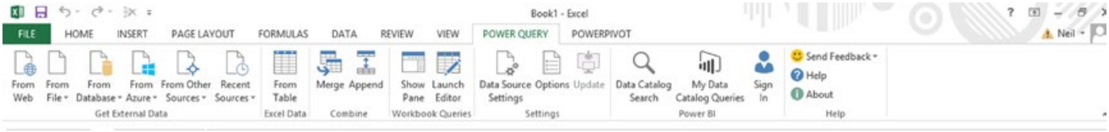


Figure 8-1. *Power Query ribbon*

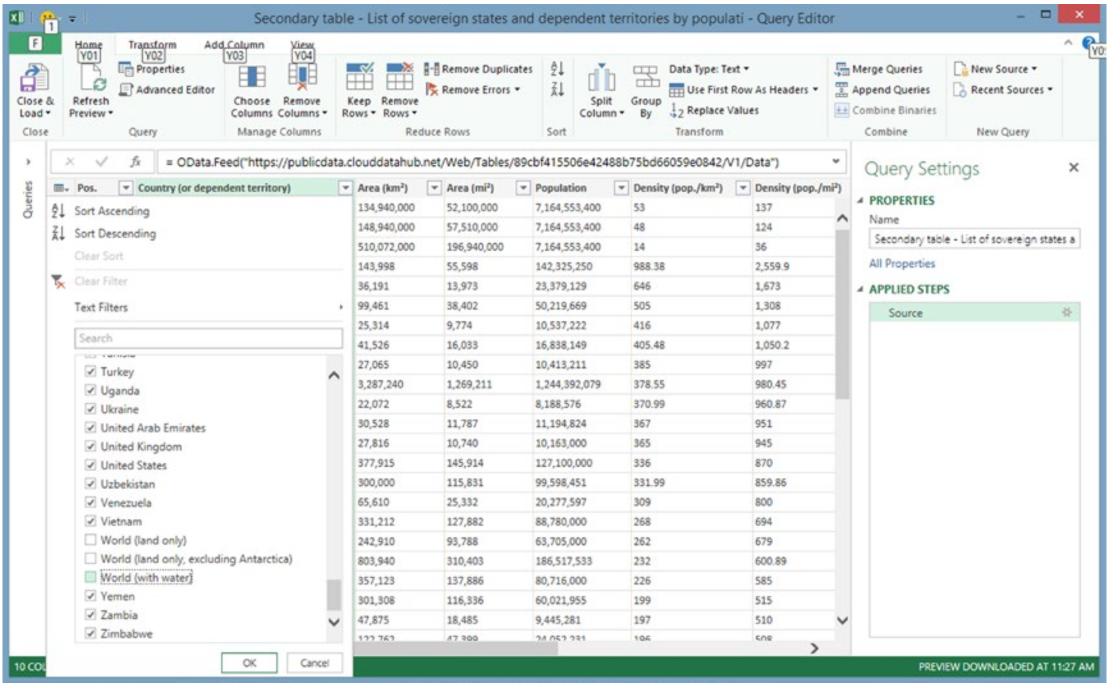
- *From Web*: Allows extracting tables from a specific web site
- *From File*: Imports from Excel, CSV, XML, text files, or from a group of files in a folder
- *From Database*: Imports from databases, such as SQL Server, Access, Oracle, and MySQL
- *From Azure*: Imports from Azure services, such as SQL Database, Market Place, HDInsight, Blob Storage, and Table Storage
- *From Other Sources*: Imports from sources including SharePoint Lists, OData feeds, Hadoop (HDFS), Facebook, Salesforce Objects and Reports, and ODBC
- *Recent Sources*: Shows the source of recent queries
- *From Table Excel Data*: Imports a range from an Excel spreadsheet
- *Merge*: Merges two queries to add columns
- *Append*: Appends one table to another with the same structure
- *Show Pane*: Toggles the display of the Workbook Query pane on the right side of the screen
- *Data Source Settings*: Manages setting for data sources that have been accessed through Power Query
- *Options*: Sets options for loading data
- *Update*: Checks online for Power Query updates
- *Data Catalog Search*: Searches a curated set of web sites and extracts tables
- *My Data Catalog Queries*: Allows sharing queries with other users

Working with the Query Editor

Power Query allows importing a subset of the data into the Query Editor, so that the data can be shaped by removing unneeded rows or columns or creating calculated columns before importing into Excel or into a data model. There are three tabs in Query Editor: Home, Transform, and Add Column.

Key Options on the Query Editor Home Ribbon

This section covers key options on the Query Editor Home ribbon, which is shown in Figure 8-2.



= OData.Feed("https://publicdata.clouddatahub.net/Web/Tables/89cbf415506e42488b75bd66059e0842/V1/Data")

- ☑ Turkey
- ☑ Uganda
- ☑ Ukraine
- ☑ United Arab Emirates
- ☑ United Kingdom
- ☑ United States
- ☑ Uzbekistan
- ☑ Venezuela
- ☑ Vietnam
- □ World (land only)
- □ World (land only, excluding Antarctica)
- □ World (with water)
- ☑ Yemen
- ☑ Zambia
- ☑ Zimbabwe

Pos.	Country (or dependent territory)	Area (km²)	Area (mi²)	Population	Density (pop./km²)	Density (pop./mi²)
		134,940,000	52,100,000	7,164,553,400	53	137
		148,940,000	57,510,000	7,164,553,400	48	124
		510,072,000	196,940,000	7,164,553,400	14	36
		143,998	55,598	142,325,250	988.38	2,559.9
		36,191	13,973	23,379,129	646	1,673
		99,461	38,402	50,219,669	505	1,308
		25,314	9,774	10,537,222	416	1,077
		41,526	16,033	16,838,149	405.48	1,050.2
		27,065	10,450	10,413,211	385	997
		3,287,240	1,269,211	1,244,392,079	378.55	980.45
		22,072	8,522	8,188,576	370.99	960.87
		30,528	11,787	11,194,824	367	951
		27,816	10,740	10,163,000	365	945
		377,915	145,914	127,100,000	336	870
		300,000	115,831	99,598,451	331.99	859.86
		65,610	25,332	20,277,597	309	800
		331,212	127,882	88,780,000	268	694
		242,910	93,788	63,705,000	262	679
		803,940	310,403	186,517,533	232	600.89
		357,123	137,886	80,716,000	226	585
		301,308	116,336	60,021,955	199	515
		47,875	18,485	9,445,281	197	510

Query Settings

PROPERTIES

Name: Secondary table - List of sovereign states a

All Properties

APPLIED STEPS

Source

Figure 8-2. *Query Editor screen*

- *Close & Load*: Closes the editor and loads the data either into an Excel worksheet or into the data model
- *Refresh Preview*: Refreshes the query, reprocessing all steps, and previewing the results
- *Advanced Editor*: Shows the code used to extract the data in the M query language
- *Choose Columns/Remove Columns*: Allows keeping or removing selected columns. Clicking the Choose Columns icon will show a list of columns that can be unchecked to remove, as shown in Figure 8-3.

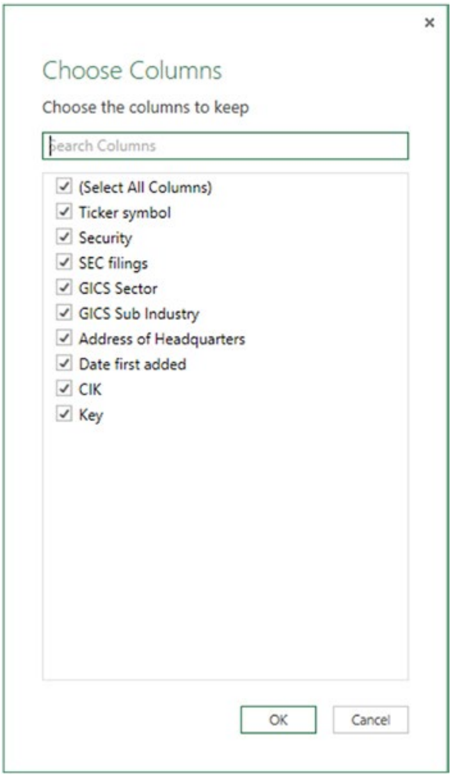


Figure 8-3. *Choose Columns dialog*

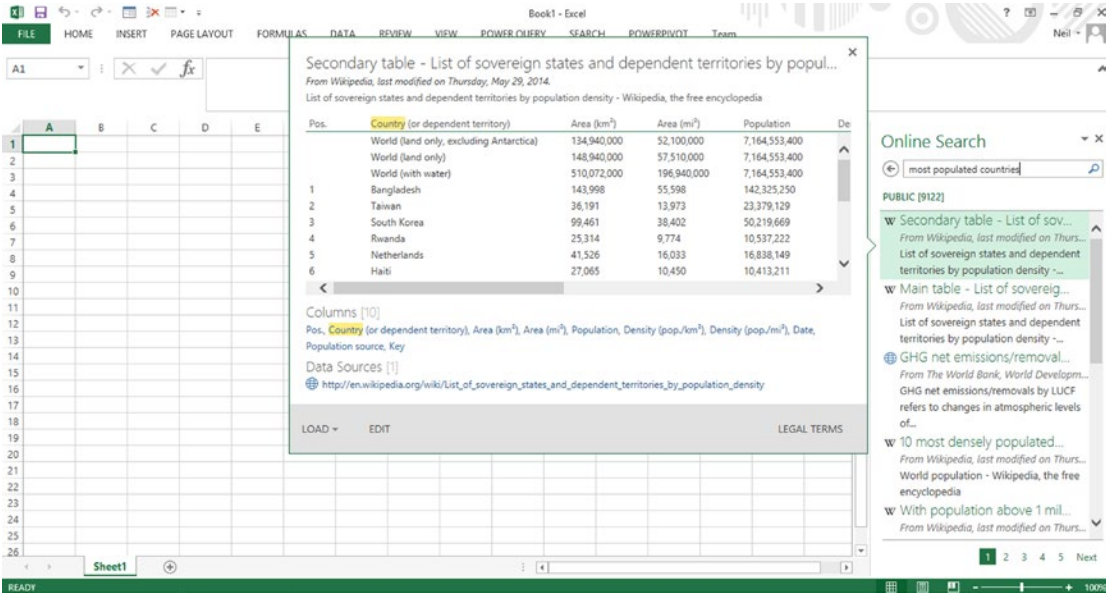
- *Keep Rows/Remove Rows*: Allows keeping or removing selected rows
- *Remove Duplicates*: Removes duplicates. Be careful about defining the criteria for duplicates. For example, in a list of stock prices by day, removing duplicates based only on the stock symbol would leave only one unique row for each stock.
- *Sort*: Sorts columns in ascending or descending order. Remember that the Query Editor is only working a subset of the data. It might be better to wait until the data is loaded into a worksheet or data model before sorting.
- *Split Column*: Splits columns based on a delimiter, such as a comma or space
- *Group By*: Groups rows based on a field or fields

Note that another way to remove or filter out rows is by clicking the arrow to the right of the column heading and de-selecting values, as shown in Figure 8-2.

A Simple Population

This example will show how to use the Data Catalog Search option to retrieve population data in a tabular format for analysis. The Data Catalog Search option searches a curated data catalog of public data web sites, such as Wikipedia and the Census Bureau web site, and allows tables to be easily extracted from those web sites. It is not a full-featured search engine. It seems to understand searches that start with words such as *largest* or *most*. It can also search corporate databases after being logged in to the corporate network. For this example, take the following steps.

1. On the Power Query tab, click Data Catalog Search.
2. In the Search pane to the right, enter "most populated countries." Hover the mouse pointer over the results to get a preview of the data. Then hover the mouse over the item in the list entitled "Secondary table—List of sovereign states and dependent territories by population density" from Wikipedia. The results are shown in Figure 8-4. Note the prompts at the bottom for Load and Edit.



Secondary table - List of sovereign states and dependent territories by popul...

From Wikipedia, last modified on Thursday, May 29, 2014.

List of sovereign states and dependent territories by population density - Wikipedia, the free encyclopedia

Pos.	Country (or dependent territory)	Area (km²)	Area (mi²)	Population	De
	World (land only, excluding Antarctica)	134,940,000	52,100,000	7,164,553,400	
	World (land only)	148,940,000	57,510,000	7,164,553,400	
	World (with water)	510,072,000	196,940,000	7,164,553,400	
1	Bangladesh	143,998	55,598	142,325,250	
2	Taiwan	36,191	13,973	23,379,129	
3	South Korea	99,461	38,402	50,219,669	
4	Rwanda	25,314	9,774	10,537,222	
5	Netherlands	41,526	16,033	16,838,149	
6	Haiti	27,065	10,450	10,413,211	

Columns [10]

Pos., Country (or dependent territory), Area (km²), Area (mi²), Population, Density (pop./km²), Density (pop./mi²), Date, Population source, Key

Data Sources [1]

http://en.wikipedia.org/wiki/List_of_sovereign_states_and_dependent_territories_by_population_density

LOAD ▾ EDIT LEGAL TERMS

Online Search

most populated countries

PUBLIC [9122]

Secondary table - List of sov...
From Wikipedia, last modified on Thurs...
List of sovereign states and dependent territories by population density -...

Main table - List of sovereig...
From Wikipedia, last modified on Thurs...
List of sovereign states and dependent territories by population density -...

GHG net emissions/removal...
From The World Bank, World Developm...
GHG net emissions/removals by LUCF refers to changes in atmospheric levels of...

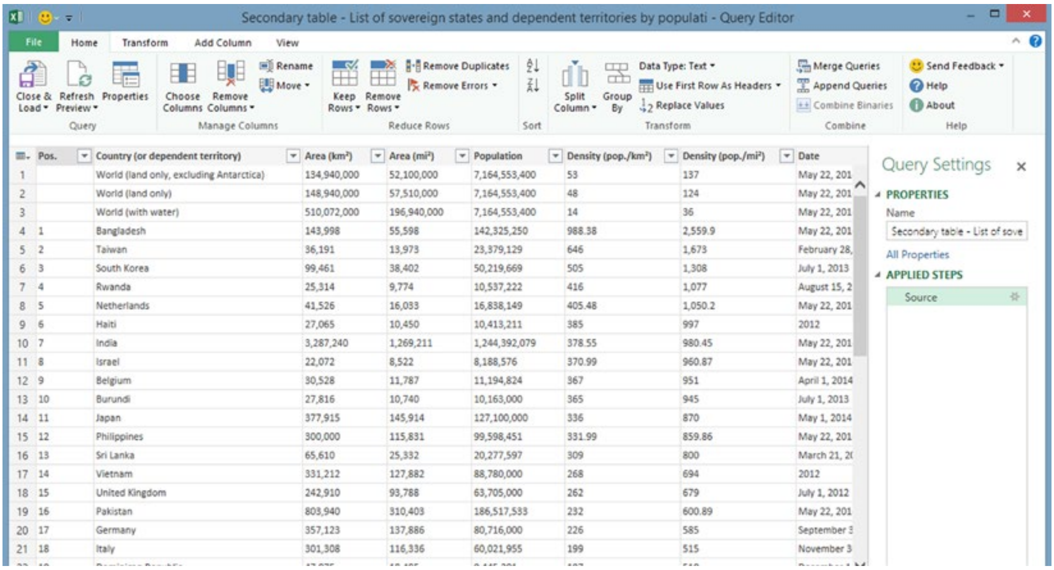
10 most densely populated...
From Wikipedia, last modified on Thurs...
World population - Wikipedia, the free encyclopedia

With population above 1 mil...
From Wikipedia, last modified on Thurs...

1 2 3 4 5 Next

***Figure 8-4.** Preview of population data*

3. Click Edit on the lower left of the preview to load a subset of data from the table into the Query Editor, as shown in Figure 8-5. The table lists countries with their population and areas in square miles or square kilometers and shows their population density per square mile or square kilometer.

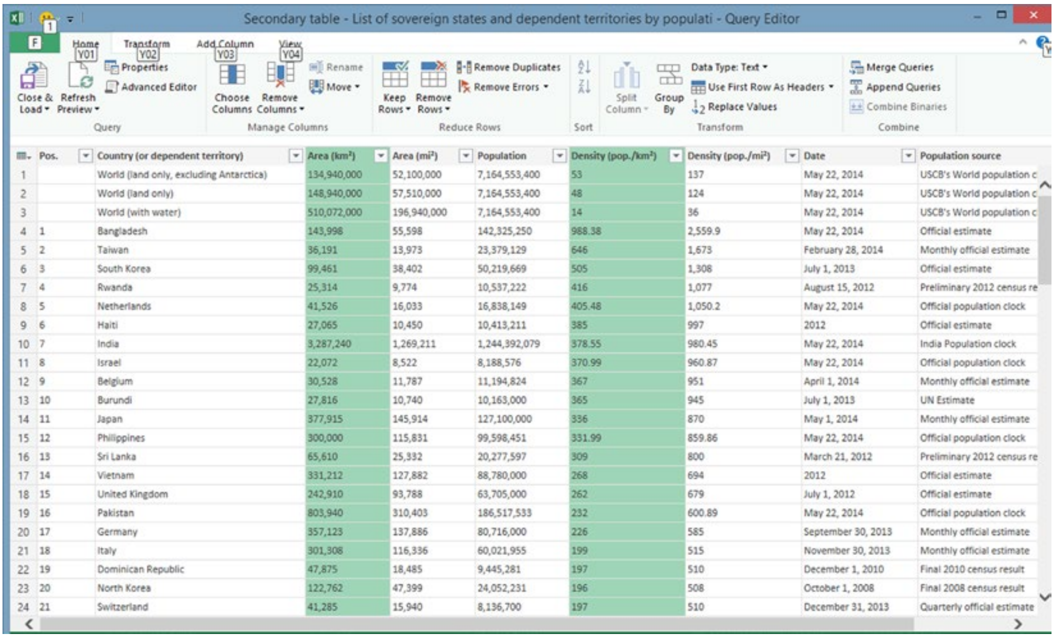


Secondary table - List of sovereign states and dependent territories by populati - Query Editor

	Pos.	Country (or dependent territory)	Area (km²)	Area (mi²)	Population	Density (pop./km²)	Density (pop./mi²)	Date
1		World (land only, excluding Antarctica)	134,940,000	52,100,000	7,164,553,400	53	137	May 22, 201
2		World (land only)	148,940,000	57,510,000	7,164,553,400	48	124	May 22, 201
3		World (with water)	510,072,000	196,940,000	7,164,553,400	14	36	May 22, 201
4	1	Bangladesh	143,998	55,598	142,325,250	988.38	2,559.9	May 22, 201
5	2	Taiwan	36,191	13,973	23,379,129	646	1,673	February 28,
6	3	South Korea	99,461	38,402	50,219,669	505	1,308	July 1, 2013
7	4	Rwanda	25,314	9,774	10,537,222	416	1,077	August 15, 2
8	5	Netherlands	41,526	16,033	16,838,149	405.48	1,050.2	May 22, 201
9	6	Haiti	27,065	10,450	10,413,211	385	997	2012
10	7	India	3,287,240	1,269,211	1,244,392,079	378.55	980.45	May 22, 201
11	8	Israel	22,072	8,522	8,188,576	370.99	960.87	May 22, 201
12	9	Belgium	30,528	11,787	11,194,824	367	951	April 1, 2014
13	10	Burundi	27,816	10,740	10,163,000	365	945	July 1, 2013
14	11	Japan	377,915	145,914	127,100,000	336	870	May 1, 2014
15	12	Philippines	300,000	115,831	99,598,451	331.99	859.86	May 22, 201
16	13	Sri Lanka	65,610	25,332	20,277,597	309	800	March 21, 2(
17	14	Vietnam	331,212	127,882	88,780,000	268	694	2012
18	15	United Kingdom	242,910	93,788	63,705,000	262	679	July 1, 2012
19	16	Pakistan	803,940	310,403	186,517,533	232	600.89	May 22, 201
20	17	Germany	357,123	137,886	80,716,000	226	585	September 3
21	18	Italy	301,308	116,336	60,021,955	199	515	November 3

Figure 8-5. *Population data in Query Editor*

4. In the Query Editor, data can be manipulated by deleting rows or columns, splitting or merging columns, or removing duplicates. For example, to delete the columns for area or density in kilometers, select both columns by clicking the header of the first column to be deleted and Ctrl-click the header of the second column, as shown in Figure 8-6.



Secondary table - List of sovereign states and dependent territories by populati - Query Editor

	Pos.	Country (or dependent territory)	Area (km²)	Area (mi²)	Population	Density (pop./km²)	Density (pop./mi²)	Date	Population source
1		World (land only, excluding Antarctica)	134,940,000	52,100,000	7,164,553,400	53	137	May 22, 2014	USCB's World population c
2		World (land only)	148,940,000	57,510,000	7,164,553,400	48	124	May 22, 2014	USCB's World population c
3		World (with water)	510,072,000	196,940,000	7,164,553,400	14	36	May 22, 2014	USCB's World population c
4	1	Bangladesh	143,998	55,598	142,325,250	988.38	2,559.9	May 22, 2014	Official estimate
5	2	Taiwan	36,191	13,973	23,379,129	646	1,673	February 28, 2014	Monthly official estimate
6	3	South Korea	99,461	38,402	50,219,669	505	1,308	July 1, 2013	Official estimate
7	4	Rwanda	25,314	9,774	10,537,222	416	1,077	August 15, 2012	Preliminary 2012 census re
8	5	Netherlands	41,526	16,033	16,838,149	405.48	1,050.2	May 22, 2014	Official population clock
9	6	Haiti	27,065	10,450	10,413,211	385	997	2012	Official estimate
10	7	India	3,287,240	1,269,211	1,244,392,079	378.55	980.45	May 22, 2014	India Population clock
11	8	Israel	22,072	8,522	8,188,576	370.99	960.87	May 22, 2014	Official population clock
12	9	Belgium	30,528	11,787	11,194,824	367	951	April 1, 2014	Monthly official estimate
13	10	Burundi	27,816	10,740	10,163,000	365	945	July 1, 2013	UN Estimate
14	11	Japan	377,915	145,914	127,100,000	336	870	May 1, 2014	Monthly official estimate
15	12	Philippines	300,000	115,831	99,598,451	331.99	859.86	May 22, 2014	Official population clock
16	13	Sri Lanka	65,610	25,332	20,277,597	309	800	March 21, 2012	Preliminary 2012 census re
17	14	Vietnam	331,212	127,882	88,780,000	268	694	2012	Official estimate
18	15	United Kingdom	242,910	93,788	63,705,000	262	679	July 1, 2012	Official estimate
19	16	Pakistan	803,940	310,403	186,517,533	232	600.89	May 22, 2014	Official population clock
20	17	Germany	357,123	137,886	80,716,000	226	585	September 30, 2013	Monthly official estimate
21	18	Italy	301,308	116,336	60,021,955	199	515	November 30, 2013	Monthly official estimate
22	19	Dominican Republic	47,875	18,485	9,445,281	197	510	December 1, 2010	Final 2010 census result
23	20	North Korea	122,762	47,399	24,052,231	196	508	October 1, 2008	Final 2008 census result
24	21	Switzerland	41,285	15,940	8,136,700	197	510	December 31, 2013	Quarterly official estimate

Figure 8-6. *Highlighting columns for deletion*

5. Then click Remove Columns under Remove Columns on the tab, to remove the selected columns.

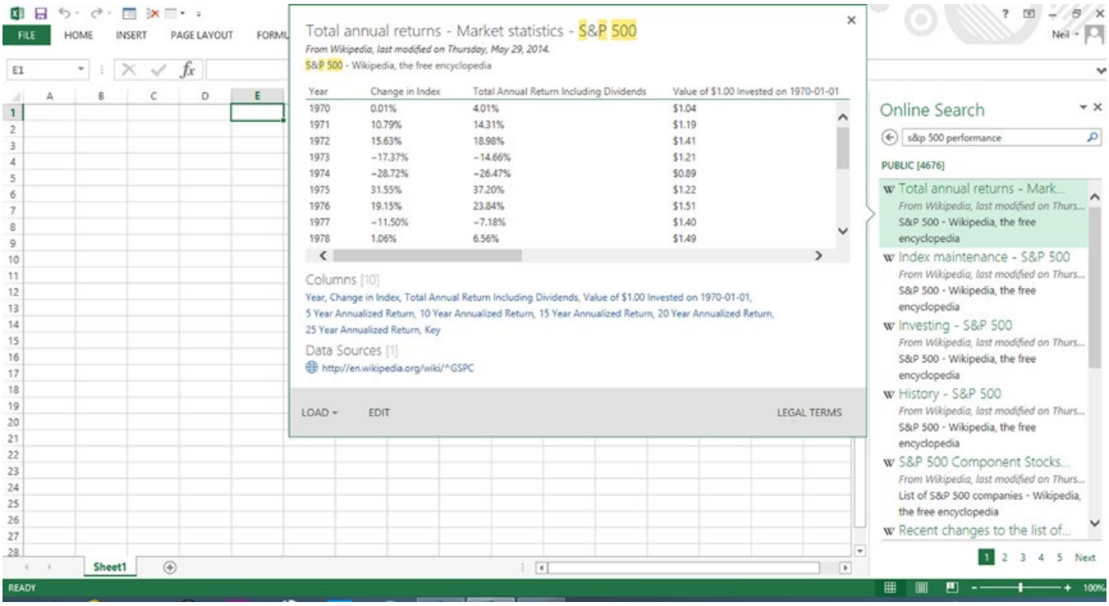
6. After the data is shaped the way you want, click Close & Load, to load the data into an Excel spreadsheet.

Performance of S&P 500 Stock Index

This example will show how to retrieve S&P 500 performance data, by taking the following steps:

1. On the Power Query ribbon, click Data Catalog Search.

2. In the search box, type "S&P 500 performance." Hover the mouse over the first link, labeled "Total annual returns...," as shown in Figure 8-7.



Total annual returns - Market statistics - S&P 500

From Wikipedia, last modified on Thursday, May 29, 2014.

S&P 500 - Wikipedia, the free encyclopedia

Year	Change in Index	Total Annual Return Including Dividends	Value of $1.00 Invested on 1970-01-01
1970	0.01%	4.01%	$1.04
1971	10.79%	14.31%	$1.19
1972	15.63%	18.98%	$1.41
1973	-17.37%	-14.66%	$1.21
1974	-28.72%	-26.47%	$0.89
1975	31.55%	37.20%	$1.22
1976	19.15%	23.84%	$1.51
1977	-11.50%	-7.18%	$1.40
1978	1.06%	6.56%	$1.49

Columns [10]

Year, Change in Index, Total Annual Return Including Dividends, Value of $1.00 Invested on 1970-01-01, 5 Year Annualized Return, 10 Year Annualized Return, 15 Year Annualized Return, 20 Year Annualized Return, 25 Year Annualized Return, Key

Data Sources [1]

http://en.wikipedia.org/wiki/^GSPC

LOAD ▾ EDIT LEGAL TERMS

Online Search

s&p 500 performance

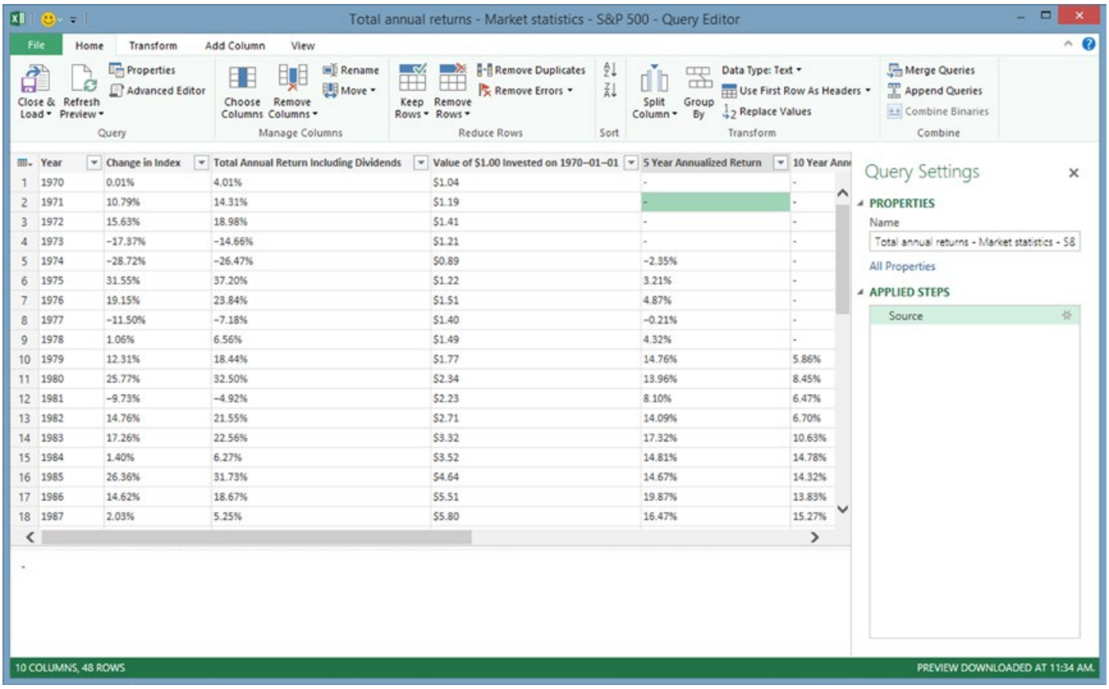
PUBLIC [4676]

- Total annual returns - Mark...
  From Wikipedia, last modified on Thurs...
  S&P 500 - Wikipedia, the free encyclopedia
- Index maintenance - S&P 500
  From Wikipedia, last modified on Thurs...
  S&P 500 - Wikipedia, the free encyclopedia
- Investing - S&P 500
  From Wikipedia, last modified on Thurs...
  S&P 500 - Wikipedia, the free encyclopedia
- History - S&P 500
  From Wikipedia, last modified on Thurs...
  S&P 500 - Wikipedia, the free encyclopedia
- S&P 500 Component Stocks...
  From Wikipedia, last modified on Thurs...
  List of S&P 500 companies - Wikipedia, the free encyclopedia
- Recent changes to the list of...

1 2 3 4 5 Next

***Figure 8-7.** Data preview*

3. Click Edit in the lower left to load the data showing S&P 500 returns for every year from 1970 to 2013 into the Query Editor, as shown in Figure 8-8.



Total annual returns - Market statistics - S&P 500 - Query Editor

Name: Total annual returns - Market statistics - S8

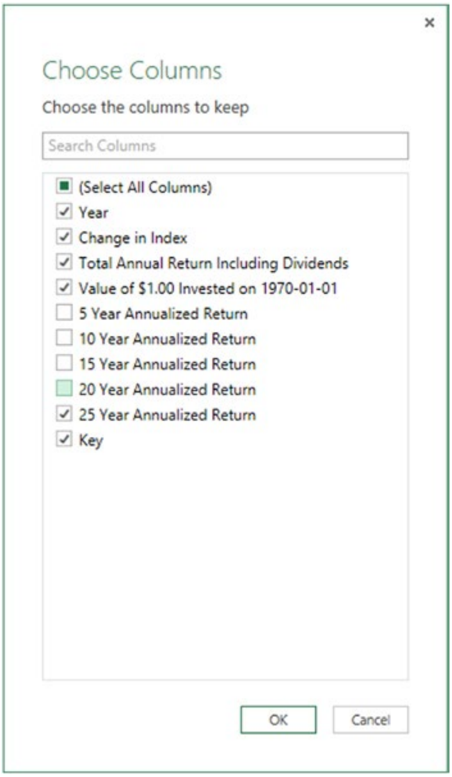
	Year	Change in Index	Total Annual Return Including Dividends	Value of $1.00 Invested on 1970-01-01	5 Year Annualized Return	10 Year Ann
1	1970	0.01%	4.01%	$1.04	-	-
2	1971	10.79%	14.31%	$1.19	-	-
3	1972	15.63%	18.98%	$1.41	-	-
4	1973	-17.37%	-14.66%	$1.21	-	-
5	1974	-28.72%	-26.47%	$0.89	-2.35%	-
6	1975	31.55%	37.20%	$1.22	3.21%	-
7	1976	19.15%	23.84%	$1.51	4.87%	-
8	1977	-11.50%	-7.18%	$1.40	-0.21%	-
9	1978	1.06%	6.56%	$1.49	4.32%	-
10	1979	12.31%	18.44%	$1.77	14.76%	5.86%
11	1980	25.77%	32.50%	$2.34	13.96%	8.45%
12	1981	-9.73%	-4.92%	$2.23	8.10%	6.47%
13	1982	14.76%	21.55%	$2.71	14.09%	6.70%
14	1983	17.26%	22.56%	$3.32	17.32%	10.63%
15	1984	1.40%	6.27%	$3.52	14.81%	14.78%
16	1985	26.36%	31.73%	$4.64	14.67%	14.32%
17	1986	14.62%	18.67%	$5.51	19.87%	13.83%
18	1987	2.03%	5.25%	$5.80	16.47%	15.27%

10 COLUMNS, 48 ROWS

PREVIEW DOWNLOADED AT 11:34 AM.

Figure 8-8. *Data in Query Editor*

4. Select the columns by clicking Choose Columns and unchecking columns that will not be included. For this example, the 5-, 10-, 15-, and 20-year return columns will be removed, as shown in Figure 8-9. Click OK.



Choose Columns

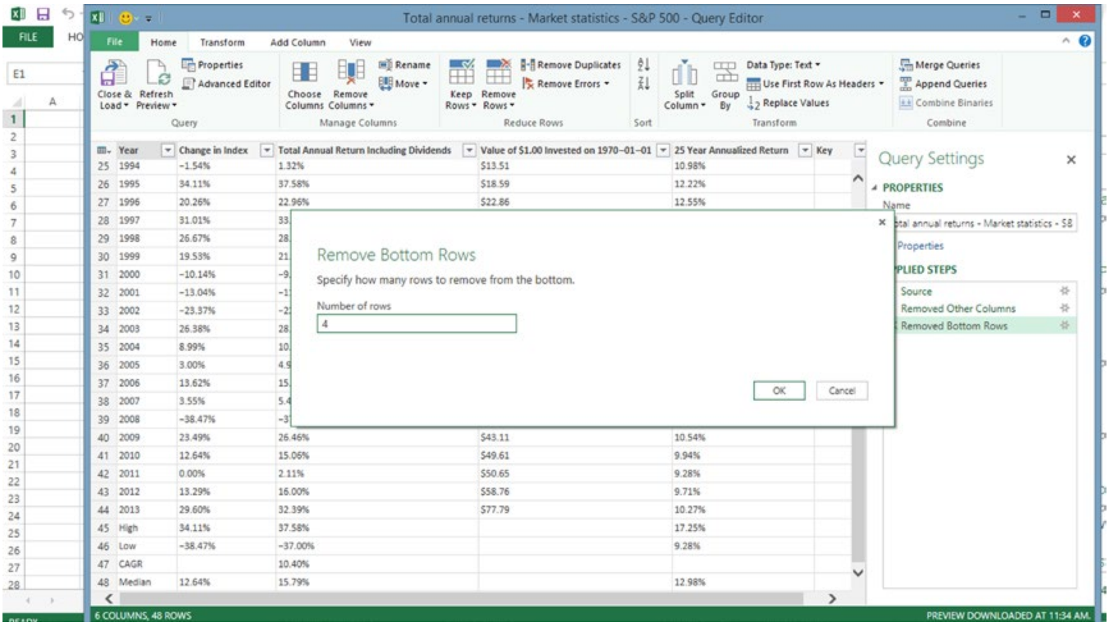
Choose the columns to keep

Search Columns

■ (Select All Columns)
☑ Year
☑ Change in Index
☑ Total Annual Return Including Dividends
☑ Value of $1.00 Invested on 1970-01-01
□ 5 Year Annualized Return
□ 10 Year Annualized Return
□ 15 Year Annualized Return
□ 20 Year Annualized Return
☑ 25 Year Annualized Return
☑ Key

Figure 8-9. *Choose Columns dialog*

5. To remove the four bottom rows, click Remove Rows and then Remove Bottom Rows and enter 4 as the number of rows to be removed, as shown in Figure 8-10, and click OK.



	Year	Change in Index	Total Annual Return Including Dividends	Value of $1.00 Invested on 1970-01-01	25 Year Annualized Return	Key
25	1994	-1.54%	1.32%	$13.51	10.98%	
26	1995	34.11%	37.58%	$18.59	12.22%	
27	1996	20.26%	22.96%	$22.86	12.55%	
28	1997	31.01%	33			
29	1998	26.67%	28			
30	1999	19.53%	21			
31	2000	-10.14%	-9			
32	2001	-13.04%	-1			
33	2002	-23.37%	-2			
34	2003	26.38%	28			
35	2004	8.99%	10			
36	2005	3.00%	4.9			
37	2006	13.62%	15			
38	2007	3.55%	5.4			
39	2008	-38.47%	-3			
40	2009	23.49%	26.46%	$43.11	10.54%	
41	2010	12.64%	15.06%	$49.61	9.94%	
42	2011	0.00%	2.11%	$50.65	9.28%	
43	2012	13.29%	16.00%	$58.76	9.71%	
44	2013	29.60%	32.39%	$77.79	10.27%	
45	High	34.11%	37.58%		17.25%	
46	Low	-38.47%	-37.00%		9.28%	
47	CAGR		10.40%			
48	Median	12.64%	15.79%		12.98%	

Remove Bottom Rows

Specify how many rows to remove from the bottom.

Number of rows

4

OK Cancel

Query Settings

PROPERTIES

Name

otal annual returns - Market statistics - S8

Properties

PLIED STEPS

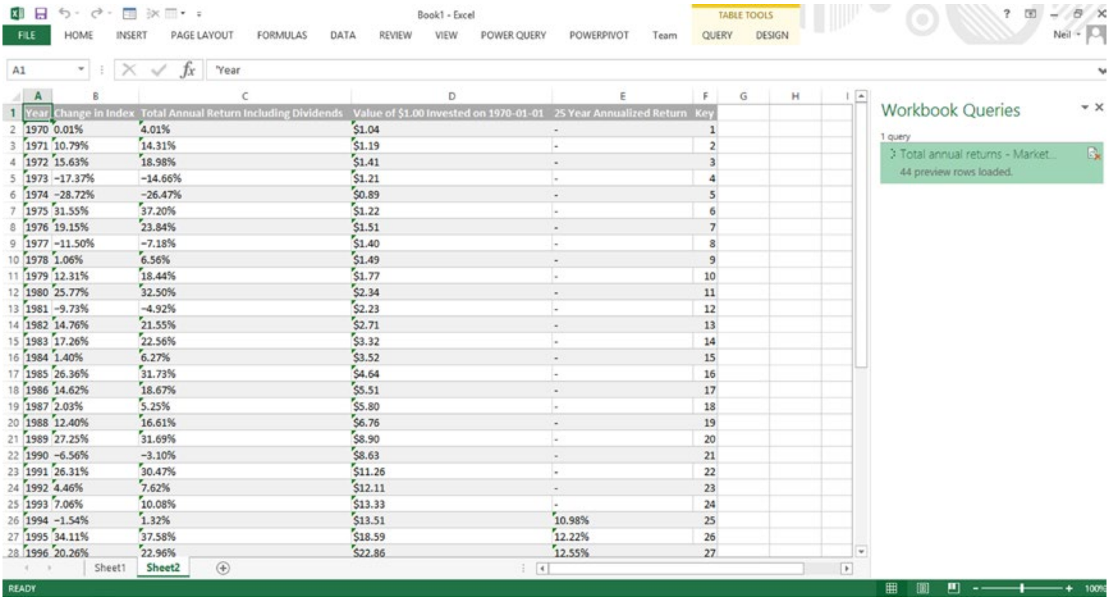
Source

Removed Other Columns

Removed Bottom Rows

Figure 8-10. *Remove Rows dialog*

6. Then click Close & Load on the left side of the ribbon to import the data into a spreadsheet, to get the results shown in Figure 8-11.



'Year

	A	B	C	D	E	F
1	Year	Change in Index	Total Annual Return Including Dividends	Value of $1.00 Invested on 1970-01-01	25 Year Annualized Return	Key
2	1970	0.01%	4.01%	$1.04	-	1
3	1971	10.79%	14.31%	$1.19	-	2
4	1972	15.63%	18.98%	$1.41	-	3
5	1973	-17.37%	-14.66%	$1.21	-	4
6	1974	-28.72%	-26.47%	$0.89	-	5
7	1975	31.55%	37.20%	$1.22	-	6
8	1976	19.15%	23.84%	$1.51	-	7
9	1977	-11.50%	-7.18%	$1.40	-	8
10	1978	1.06%	6.56%	$1.49	-	9
11	1979	12.31%	18.44%	$1.77	-	10
12	1980	25.77%	32.50%	$2.34	-	11
13	1981	-9.73%	-4.92%	$2.23	-	12
14	1982	14.76%	21.55%	$2.71	-	13
15	1983	17.26%	22.56%	$3.32	-	14
16	1984	1.40%	6.27%	$3.52	-	15
17	1985	26.36%	31.73%	$4.64	-	16
18	1986	14.62%	18.67%	$5.51	-	17
19	1987	2.03%	5.25%	$5.80	-	18
20	1988	12.40%	16.61%	$6.76	-	19
21	1989	27.25%	31.69%	$8.90	-	20
22	1990	-6.56%	-3.10%	$8.63	-	21
23	1991	26.31%	30.47%	$11.26	-	22
24	1992	4.46%	7.62%	$12.11	-	23
25	1993	7.06%	10.08%	$13.33	-	24
26	1994	-1.54%	1.32%	$13.51	10.98%	25
27	1995	34.11%	37.58%	$18.59	12.22%	26
28	1996	20.26%	22.96%	$22.86	12.55%	27

Workbook Queries

1 query

Total annual returns - Market...

44 preview rows loaded.

Figure 8-11. *Data imported into a spreadsheet*

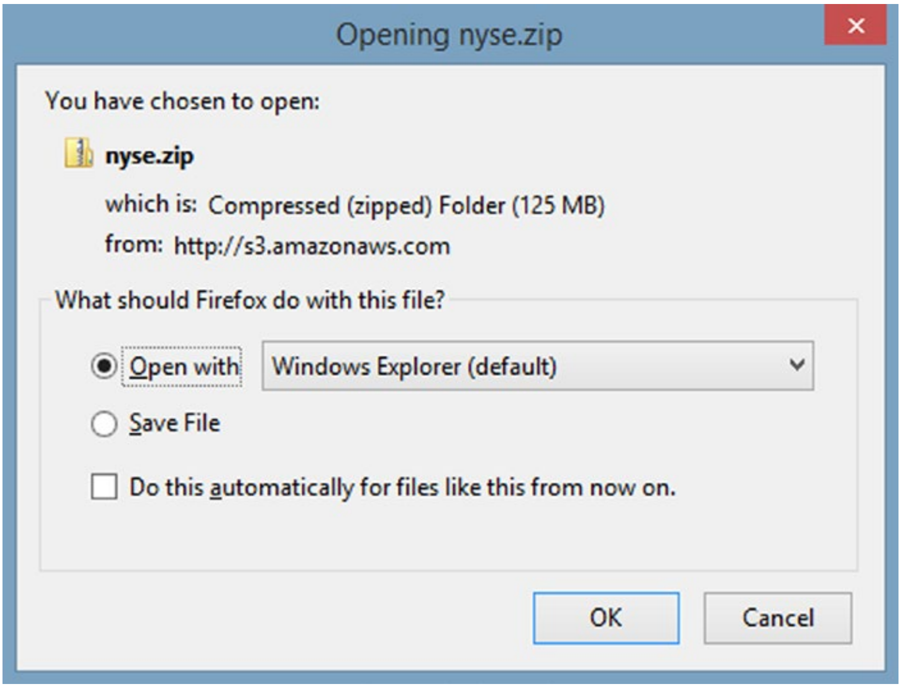
Importing CSV Files from a Folder

Sometimes Hadoop data will be stored in files with comma-separated values. Rather than loading it into Hortonworks Sandbox or some other product to be manipulated as a Hadoop, the files with comma-separated values can be loaded directly into Excel and PowerPivot, using Power Query. The following example demonstrates how to do this.

1. First download the stock market zipped file from the following URL:

   `s3.amazonaws.com/hortonassets/mstut/nyse.zip`

2. After the download is complete, double-click the file in your browsers download window to open it, as shown in Figure 8-12.



Opening nyse.zip

You have chosen to open:

nyse.zip

which is: Compressed (zipped) Folder (125 MB)

from: http://s3.amazonaws.com

What should Firefox do with this file?

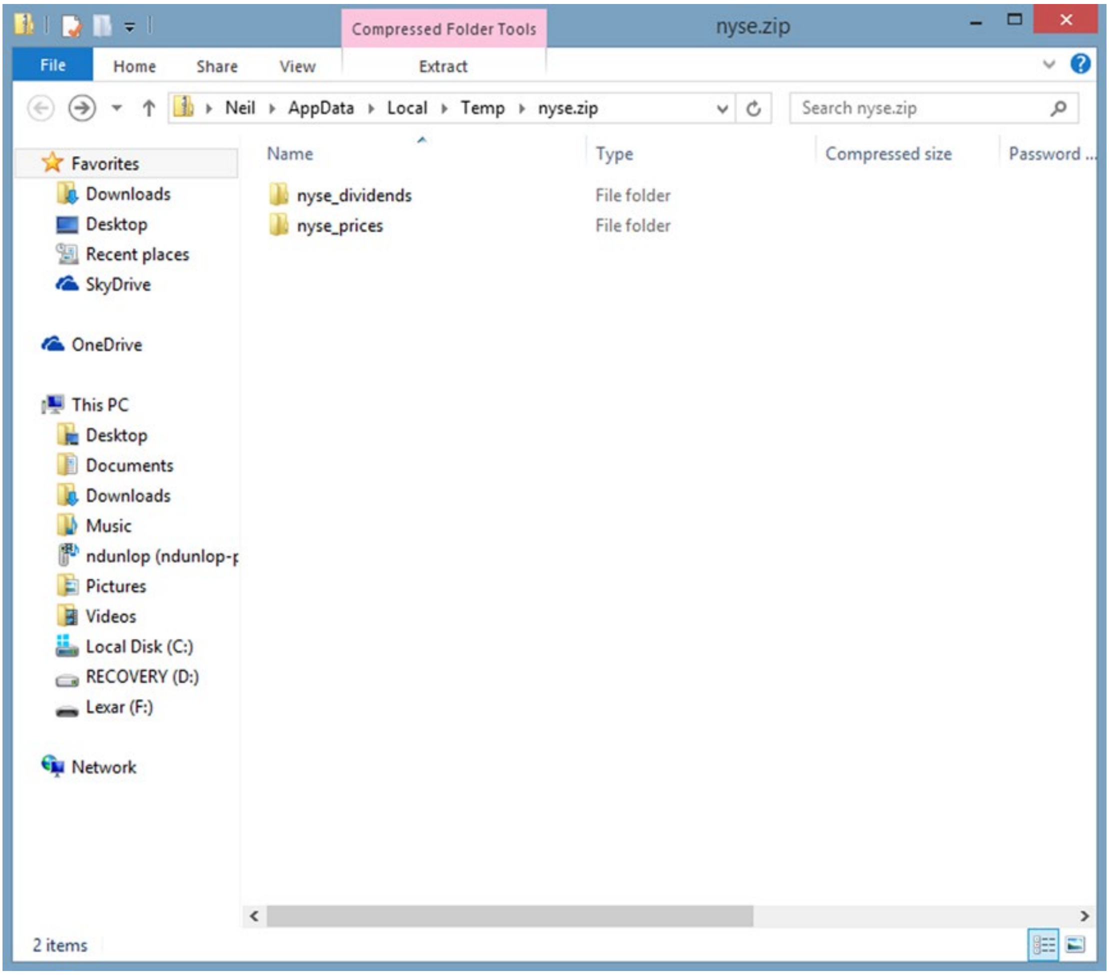
● Open with Windows Explorer (default)

○ Save File

□ Do this automatically for files like this from now on.

Figure 8-12. *Download window*

3. Two folders of `.csv` files will be downloaded, as shown in Figure 8-13.



Name	Type	Compressed size	Password ...
nyse_dividends	File folder		
nyse_prices	File folder		

Figure 8-13. *Windows showing file folders*

4. Drag the folder `nyse_prices` to the desktop, to make it easier to access.
5. Open Excel and click the Power Query tab. Select From File and From Folder, as shown in Figure 8-14.

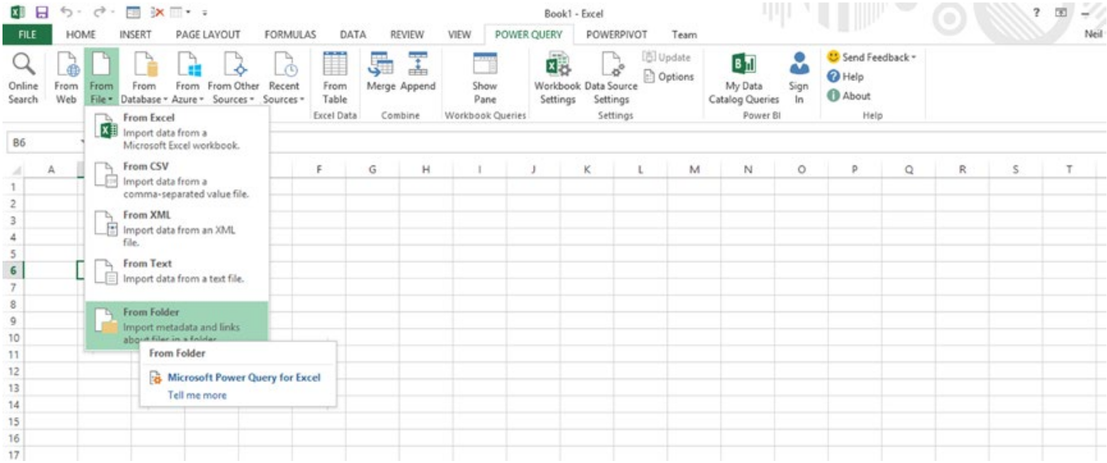
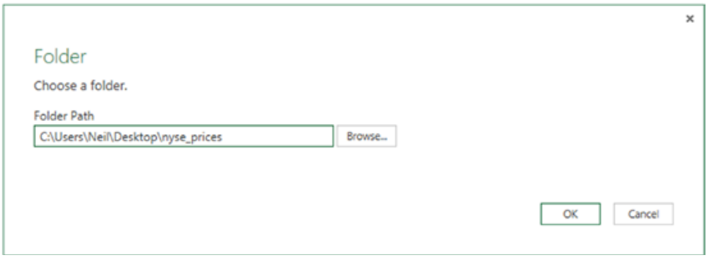


Figure 8-14. *Power Query screen to import from File Folder*

6. Click Browse and select the `nyse_prices` folder from the desktop, as shown in Figure 8-15. Click OK.



Folder

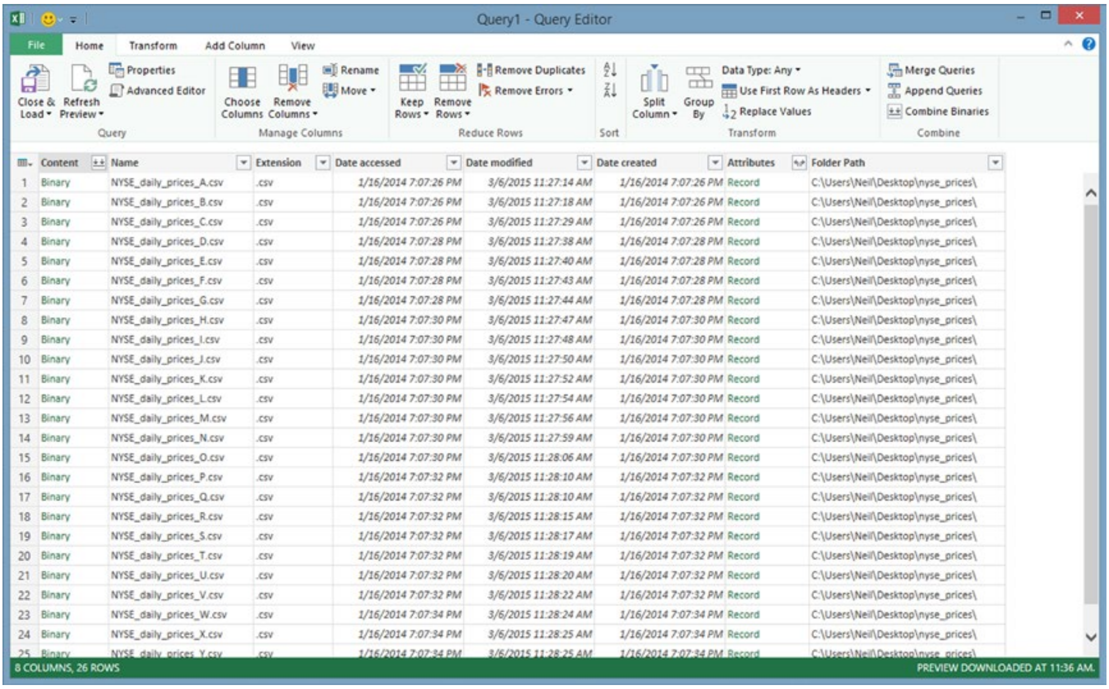
Choose a folder.

Folder Path

C:\Users\Neil\Desktop\nyse_prices

Figure 8-15. *Folder screen*

The result is a list of `.csv` files, as shown in Figure 8-16.



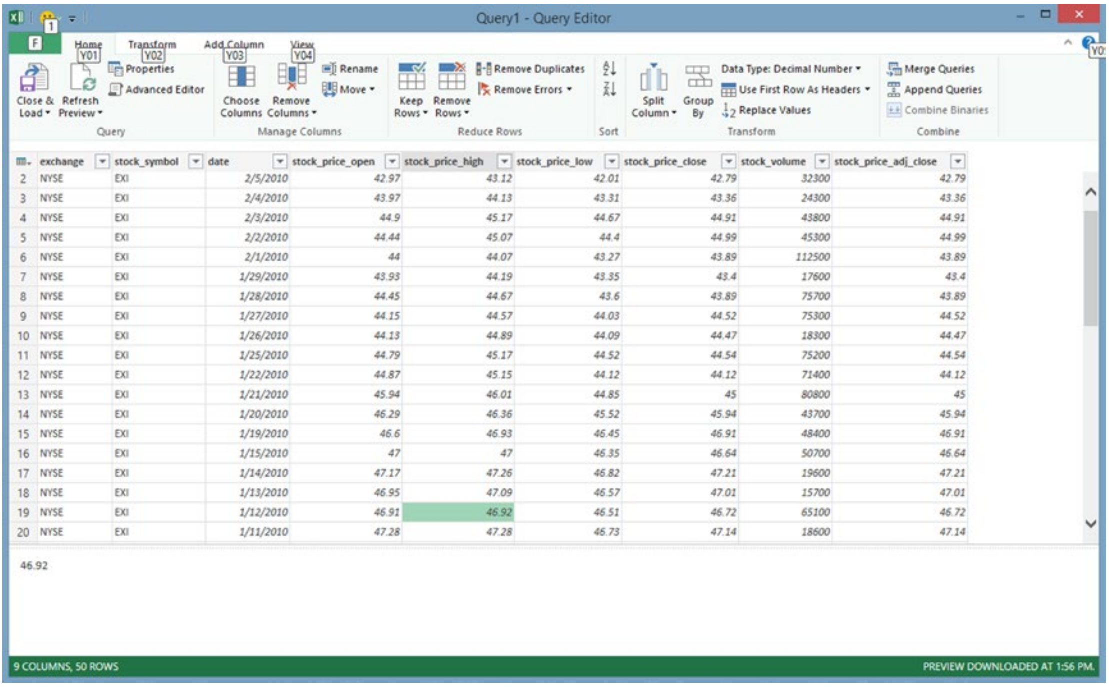
	Content	Name	Extension	Date accessed	Date modified	Date created	Attributes	Folder Path
1	Binary	NYSE_daily_prices_A.csv	.csv	1/16/2014 7:07:26 PM	3/6/2015 11:27:14 AM	1/16/2014 7:07:26 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
2	Binary	NYSE_daily_prices_B.csv	.csv	1/16/2014 7:07:26 PM	3/6/2015 11:27:18 AM	1/16/2014 7:07:26 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
3	Binary	NYSE_daily_prices_C.csv	.csv	1/16/2014 7:07:26 PM	3/6/2015 11:27:29 AM	1/16/2014 7:07:26 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
4	Binary	NYSE_daily_prices_D.csv	.csv	1/16/2014 7:07:28 PM	3/6/2015 11:27:38 AM	1/16/2014 7:07:28 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
5	Binary	NYSE_daily_prices_E.csv	.csv	1/16/2014 7:07:28 PM	3/6/2015 11:27:40 AM	1/16/2014 7:07:28 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
6	Binary	NYSE_daily_prices_F.csv	.csv	1/16/2014 7:07:28 PM	3/6/2015 11:27:43 AM	1/16/2014 7:07:28 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
7	Binary	NYSE_daily_prices_G.csv	.csv	1/16/2014 7:07:28 PM	3/6/2015 11:27:44 AM	1/16/2014 7:07:28 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
8	Binary	NYSE_daily_prices_H.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:47 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
9	Binary	NYSE_daily_prices_I.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:48 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
10	Binary	NYSE_daily_prices_J.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:50 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
11	Binary	NYSE_daily_prices_K.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:52 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
12	Binary	NYSE_daily_prices_L.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:54 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
13	Binary	NYSE_daily_prices_M.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:56 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
14	Binary	NYSE_daily_prices_N.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:27:59 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
15	Binary	NYSE_daily_prices_O.csv	.csv	1/16/2014 7:07:30 PM	3/6/2015 11:28:06 AM	1/16/2014 7:07:30 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
16	Binary	NYSE_daily_prices_P.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:10 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
17	Binary	NYSE_daily_prices_Q.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:10 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
18	Binary	NYSE_daily_prices_R.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:15 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
19	Binary	NYSE_daily_prices_S.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:17 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
20	Binary	NYSE_daily_prices_T.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:19 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
21	Binary	NYSE_daily_prices_U.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:20 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
22	Binary	NYSE_daily_prices_V.csv	.csv	1/16/2014 7:07:32 PM	3/6/2015 11:28:22 AM	1/16/2014 7:07:32 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
23	Binary	NYSE_daily_prices_W.csv	.csv	1/16/2014 7:07:34 PM	3/6/2015 11:28:24 AM	1/16/2014 7:07:34 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
24	Binary	NYSE_daily_prices_X.csv	.csv	1/16/2014 7:07:34 PM	3/6/2015 11:28:25 AM	1/16/2014 7:07:34 PM	Record	C:\Users\Neil\Desktop\nyse_prices\
25	Binary	NYSE_daily_prices_Y.csv	.csv	1/16/2014 7:07:34 PM	3/6/2015 11:28:25 AM	1/16/2014 7:07:34 PM	Record	C:\Users\Neil\Desktop\nyse_prices\

8 COLUMNS, 26 ROWS

PREVIEW DOWNLOADED AT 11:36 AM.

Figure 8-16. *List of* .csv *files*

7. To open a file, click Binary in the leftmost column. For this example, select the file in the fifth row. The file is opened in the QueryEditor, and results are shown in Figure 8-17. Remember that the Query Editor can only contain a subset of the total number of records.



	exchange	stock_symbol	date	stock_price_open	stock_price_high	stock_price_low	stock_price_close	stock_volume	stock_price_adj_close
2	NYSE	EXI	2/5/2010	42.97	43.12	42.01	42.79	32300	42.79
3	NYSE	EXI	2/4/2010	43.97	44.13	43.31	43.36	24300	43.36
4	NYSE	EXI	2/3/2010	44.9	45.17	44.67	44.91	43800	44.91
5	NYSE	EXI	2/2/2010	44.44	45.07	44.4	44.99	45300	44.99
6	NYSE	EXI	2/1/2010	44	44.07	43.27	43.89	112500	43.89
7	NYSE	EXI	1/29/2010	43.93	44.19	43.35	43.4	17600	43.4
8	NYSE	EXI	1/28/2010	44.45	44.67	43.6	43.89	75700	43.89
9	NYSE	EXI	1/27/2010	44.15	44.57	44.03	44.52	75300	44.52
10	NYSE	EXI	1/26/2010	44.13	44.89	44.09	44.47	18300	44.47
11	NYSE	EXI	1/25/2010	44.79	45.17	44.52	44.54	75200	44.54
12	NYSE	EXI	1/22/2010	44.87	45.15	44.12	44.12	71400	44.12
13	NYSE	EXI	1/21/2010	45.94	46.01	44.85	45	80800	45
14	NYSE	EXI	1/20/2010	46.29	46.36	45.52	45.94	43700	45.94
15	NYSE	EXI	1/19/2010	46.6	46.93	46.45	46.91	48400	46.91
16	NYSE	EXI	1/15/2010	47	47	46.35	46.64	50700	46.64
17	NYSE	EXI	1/14/2010	47.17	47.26	46.82	47.21	19600	47.21
18	NYSE	EXI	1/13/2010	46.95	47.09	46.57	47.01	15700	47.01
19	NYSE	EXI	1/12/2010	46.91	46.92	46.51	46.72	65100	46.72
20	NYSE	EXI	1/11/2010	47.28	47.28	46.73	47.14	18600	47.14

46.92

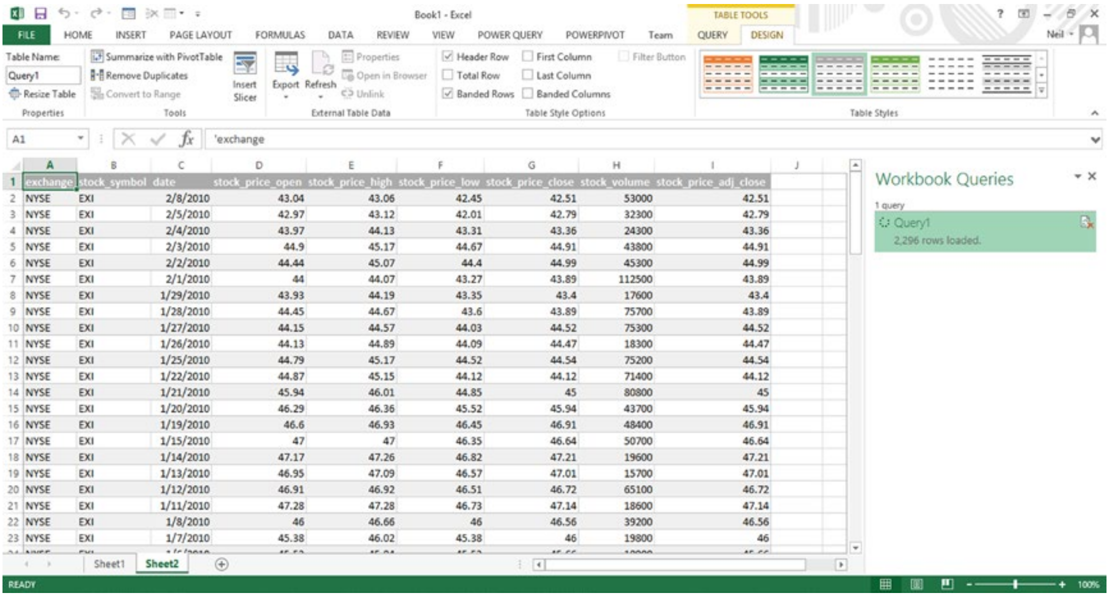
9 COLUMNS, 50 ROWS

PREVIEW DOWNLOADED AT 1:56 PM.

Figure 8-17. *CSV file imported into Query Editor*

8. Note that this file contains the opening, high, low, and closing stock price and volume for each stock on a given day. For this example, all rows and columns will be retained.

9. Click Close & Load to load the records from the Query Editor into a spreadsheet. The results are shown in Figure 8-18.



A1 'exchange

	exchange	stock_symbol	date	stock_price_open	stock_price_high	stock_price_low	stock_price_close	stock_volume	stock_price_adj_close
2	NYSE	EXI	2/8/2010	43.04	43.06	42.45	42.51	53000	42.51
3	NYSE	EXI	2/5/2010	42.97	43.12	42.01	42.79	32300	42.79
4	NYSE	EXI	2/4/2010	43.97	44.13	43.31	43.36	24300	43.36
5	NYSE	EXI	2/3/2010	44.9	45.17	44.67	44.91	43800	44.91
6	NYSE	EXI	2/2/2010	44.44	45.07	44.4	44.99	45300	44.99
7	NYSE	EXI	2/1/2010	44	44.07	43.27	43.89	112500	43.89
8	NYSE	EXI	1/29/2010	43.93	44.19	43.35	43.4	17600	43.4
9	NYSE	EXI	1/28/2010	44.45	44.67	43.6	43.89	75700	43.89
10	NYSE	EXI	1/27/2010	44.15	44.57	44.03	44.52	75300	44.52
11	NYSE	EXI	1/26/2010	44.13	44.89	44.09	44.47	18300	44.47
12	NYSE	EXI	1/25/2010	44.79	45.17	44.52	44.54	75200	44.54
13	NYSE	EXI	1/22/2010	44.87	45.15	44.12	44.12	71400	44.12
14	NYSE	EXI	1/21/2010	45.94	46.01	44.85	45	80800	45
15	NYSE	EXI	1/20/2010	46.29	46.36	45.52	45.94	43700	45.94
16	NYSE	EXI	1/19/2010	46.6	46.93	46.45	46.91	48400	46.91
17	NYSE	EXI	1/15/2010	47	47	46.35	46.64	50700	46.64
18	NYSE	EXI	1/14/2010	47.17	47.26	46.82	47.21	19600	47.21
19	NYSE	EXI	1/13/2010	46.95	47.09	46.57	47.01	15700	47.01
20	NYSE	EXI	1/12/2010	46.91	46.92	46.51	46.72	65100	46.72
21	NYSE	EXI	1/11/2010	47.28	47.28	46.73	47.14	18600	47.14
22	NYSE	EXI	1/8/2010	46	46.66	46	46.56	39200	46.56
23	NYSE	EXI	1/7/2010	45.38	46.02	45.38	46	19800	46

Workbook Queries

1 query

Query1

2,296 rows loaded.

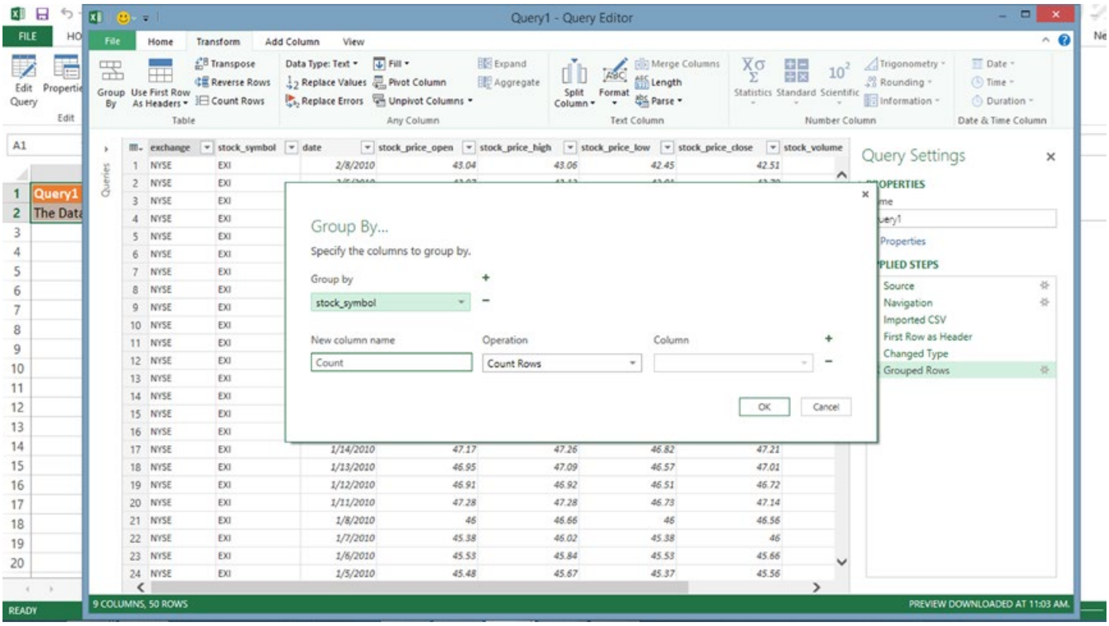
Figure 8-18. *Data loaded into spreadsheet*

Group By

To group by a specific category, go into the Query Editor and follow these steps:

1. Reopen the Query Editor, by clicking Launch Editor on the Power Query tab. Then click Transform and Select Group By at the left end of the ribbon.

2. In the Group By dialog, select the stock_symbol column as the Group By criteria and leave the default as Count, as shown in Figure 8-19.



Group By...

Specify the columns to group by.

Group by: stock_symbol

New column name	Operation	Column
Count	Count Rows	

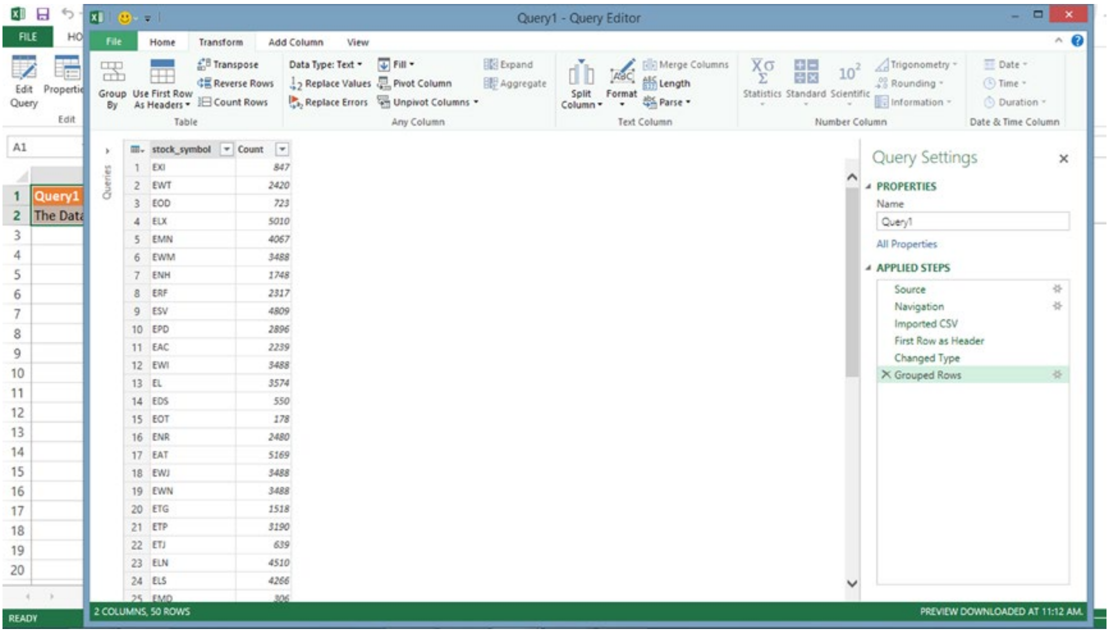
OK Cancel

	exchange	stock_symbol	date	stock_price_open	stock_price_high	stock_price_low	stock_price_close
1	NYSE	EXI	2/8/2010	43.04	43.06	42.45	42.51
2	NYSE	EXI					
3	NYSE	EXI					
4	NYSE	EXI					
5	NYSE	EXI					
6	NYSE	EXI					
7	NYSE	EXI					
8	NYSE	EXI					
9	NYSE	EXI					
10	NYSE	EXI					
11	NYSE	EXI					
12	NYSE	EXI					
13	NYSE	EXI					
14	NYSE	EXI					
15	NYSE	EXI					
16	NYSE	EXI					
17	NYSE	EXI	1/14/2010	47.17	47.26	46.82	47.21
18	NYSE	EXI	1/13/2010	46.95	47.09	46.57	47.01
19	NYSE	EXI	1/12/2010	46.91	46.92	46.51	46.72
20	NYSE	EXI	1/11/2010	47.28	47.28	46.73	47.14
21	NYSE	EXI	1/8/2010	46	46.66	46	46.56
22	NYSE	EXI	1/7/2010	45.38	46.02	45.38	46
23	NYSE	EXI	1/6/2010	45.53	45.84	45.53	45.66
24	NYSE	EXI	1/5/2010	45.48	45.67	45.37	45.56

9 COLUMNS, 50 ROWS

Figure 8-19. *Group By dialog*

3. Click OK, and the results shown in Figure 8-20 will appear.



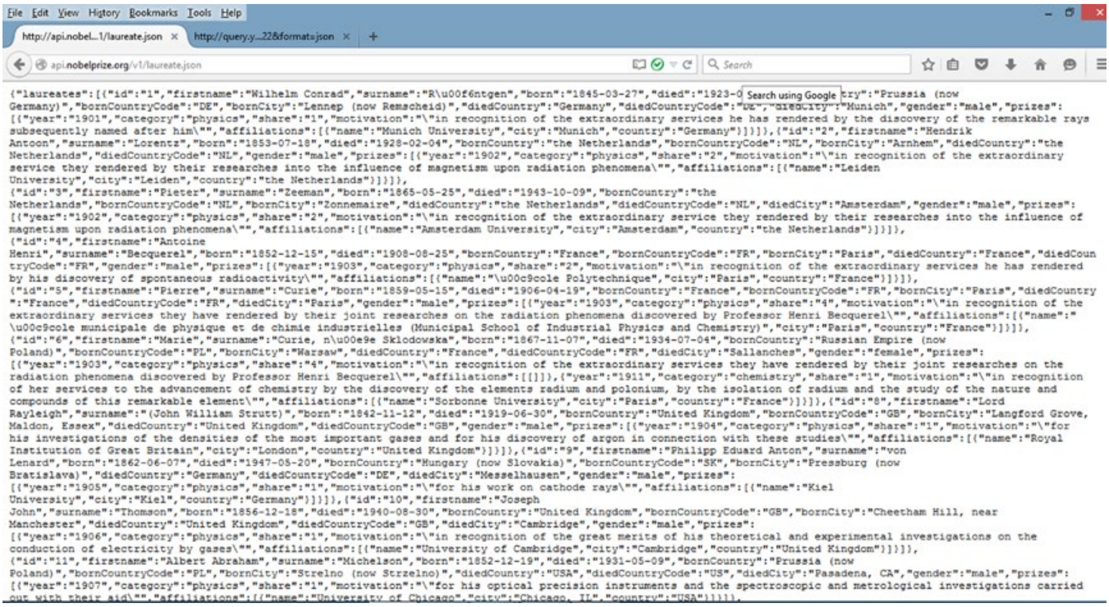
	stock_symbol	Count
1	EXI	847
2	EWT	2420
3	EOD	723
4	ELX	5010
5	EMN	4067
6	EWM	3488
7	ENH	1748
8	ERF	2317
9	ESV	4809
10	EPD	2896
11	EAC	2239
12	EWI	3488
13	EL	3574
14	EDS	550
15	EOT	178
16	ENR	2480
17	EAT	5169
18	EWJ	3488
19	EWN	3488
20	ETG	1518
21	ETP	3190
22	ETJ	639
23	ELN	4510
24	ELS	4266
25	EMD	306

2 COLUMNS, 50 ROWS

Figure 8-20. *Results after doing a Group By on stock_symbol*

Importing JSON

This example shows how to use Power Query to extract JSON data from a web site. Figure 8-21 shows the raw JSON data on Nobel Prize winners.


File Edit View History Bookmarks Tools Help
http://api.nobel...1/laureate.json
http://query.y...22&format=json
api.nobelprize.org/v1/laureate.json
Search
Search using Google

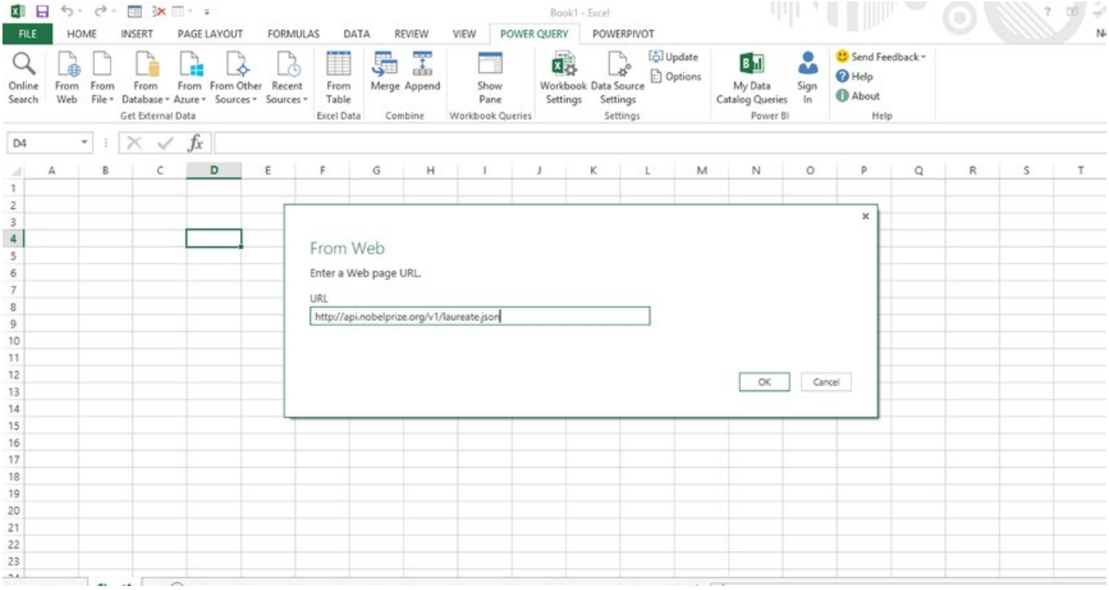
```
{"laureates":[{"id":"1","firstname":"Wilhelm Conrad","surname":"R\u00f6ntgen","born":"1845-03-27","died":"1923-0 Search using Google try":"Prussia (now
Germany)","bornCountryCode":"DE","bornCity":"Lennep (now Remscheid)","diedCountry":"Germany","diedCountryCode":"DE","diedCity":"Munich","gender":"male","prizes":
[{"year":"1901","category":"physics","share":"1","motivation":"\"in recognition of the extraordinary services he has rendered by the discovery of the remarkable rays
subsequently named after him\"","affiliations":[{"name":"Munich University","city":"Munich","country":"Germany"}]}]},{"id":"2","firstname":"Hendrik
Antoon","surname":"Lorentz","born":"1853-07-18","died":"1928-02-04","bornCountry":"the Netherlands","bornCountryCode":"NL","bornCity":"Arnhem","diedCountry":"the
Netherlands","diedCountryCode":"NL","gender":"male","prizes":[{"year":"1902","category":"physics","share":"2","motivation":"\"in recognition of the extraordinary
service they rendered by their researches into the influence of magnetism upon radiation phenomena\"","affiliations":[{"name":"Leiden
University","city":"Leiden","country":"the Netherlands"}]}]},
{"id":"3","firstname":"Pieter","surname":"Zeeman","born":"1865-05-25","died":"1943-10-09","bornCountry":"the
Netherlands","bornCountryCode":"NL","bornCity":"Zonnemaire","diedCountry":"the Netherlands","diedCountryCode":"NL","diedCity":"Amsterdam","gender":"male","prizes":
[{"year":"1902","category":"physics","share":"2","motivation":"\"in recognition of the extraordinary service they rendered by their researches into the influence of
magnetism upon radiation phenomena\"","affiliations":[{"name":"Amsterdam University","city":"Amsterdam","country":"the Netherlands"}]}]},
{"id":"4","firstname":"Antoine
Henri","surname":"Becquerel","born":"1852-12-15","died":"1908-08-25","bornCountry":"France","bornCountryCode":"FR","bornCity":"Paris","diedCountry":"France","diedCoun
tryCode":"FR","gender":"male","prizes":[{"year":"1903","category":"physics","share":"2","motivation":"\"in recognition of the extraordinary services he has rendered
by his discovery of spontaneous radioactivity\"","affiliations":[{"name":"\u00c9cole Polytechnique","city":"Paris","country":"France"}]}]},
{"id":"5","firstname":"Pierre","surname":"Curie","born":"1859-05-15","died":"1906-04-19","bornCountry":"France","bornCountryCode":"FR","bornCity":"Paris","diedCountry
":"France","diedCountryCode":"FR","diedCity":"Paris","gender":"male","prizes":[{"year":"1903","category":"physics","share":"4","motivation":"\"in recognition of the
extraordinary services they have rendered by their joint researches on the radiation phenomena discovered by Professor Henri Becquerel\"","affiliations":[{"name":"
\u00c9cole municipale de physique et de chimie industrielles (Municipal School of Industrial Physics and Chemistry)","city":"Paris","country":"France"}]}]},
{"id":"6","firstname":"Marie","surname":"Curie, n\u00e9e Sklodowska","born":"1867-11-07","died":"1934-07-04","bornCountry":"Russian Empire (now
Poland)","bornCountryCode":"PL","bornCity":"Warsaw","diedCountry":"France","diedCountryCode":"FR","diedCity":"Sallanches","gender":"female","prizes":
[{"year":"1903","category":"physics","share":"4","motivation":"\"in recognition of the extraordinary services they have rendered by their joint researches on the
radiation phenomena discovered by Professor Henri Becquerel\"","affiliations":[[]]},{"year":"1911","category":"chemistry","share":"1","motivation":"\"in recognition
of her services to the advancement of chemistry by the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and
compounds of this remarkable element\"","affiliations":[{"name":"Sorbonne University","city":"Paris","country":"France"}]}]},{"id":"8","firstname":"Lord
Rayleigh","surname":"(John William Strutt)","born":"1842-11-12","died":"1919-06-30","bornCountry":"United Kingdom","bornCountryCode":"GB","bornCity":"Langford Grove,
Maldon, Essex","diedCountry":"United Kingdom","diedCountryCode":"GB","gender":"male","prizes":[{"year":"1904","category":"physics","share":"1","motivation":"\"for
his investigations of the densities of the most important gases and for his discovery of argon in connection with these studies\"","affiliations":[{"name":"Royal
Institution of Great Britain","city":"London","country":"United Kingdom"}]}]},{"id":"9","firstname":"Philipp Eduard Anton","surname":"von
Lenard","born":"1862-06-07","died":"1947-05-20","bornCountry":"Hungary (now Slovakia)","bornCountryCode":"SK","bornCity":"Pressburg (now
Bratislava)","diedCountry":"Germany","diedCountryCode":"DE","diedCity":"Messelhausen","gender":"male","prizes":
[{"year":"1905","category":"physics","share":"1","motivation":"\"for his work on cathode rays\"","affiliations":[{"name":"Kiel
University","city":"Kiel","country":"Germany"}]}]},{"id":"10","firstname":"Joseph
John","surname":"Thomson","born":"1856-12-18","died":"1940-08-30","bornCountry":"United Kingdom","bornCountryCode":"GB","bornCity":"Cheetham Hill, near
Manchester","diedCountry":"United Kingdom","diedCountryCode":"GB","diedCity":"Cambridge","gender":"male","prizes":
[{"year":"1906","category":"physics","share":"1","motivation":"\"in recognition of the great merits of his theoretical and experimental investigations on the
conduction of electricity by gases\"","affiliations":[{"name":"University of Cambridge","city":"Cambridge","country":"United Kingdom"}]}]},
{"id":"11","firstname":"Albert Abraham","surname":"Michelson","born":"1852-12-19","died":"1931-05-09","bornCountry":"Prussia (now
Poland)","bornCountryCode":"PL","bornCity":"Strelno (now Strzelno)","diedCountry":"USA","diedCountryCode":"US","diedCity":"Pasadena, CA","gender":"male","prizes":
[{"year":"1907","category":"physics","share":"1","motivation":"\"for his optical precision instruments and the spectroscopic and metrological investigations carried
out with their aid\"","affiliations":[{"name":"University of Chicago","city":"Chicago, IL","country":"USA"}]}]},
```

Figure 8-21. *Raw JSON data*

To import the data using Power Query, follow these steps:

1. Click the Power Query tab.
2. Click From Web and enter the following URL, as shown in Figure 8-22, and click OK:

   http://api.nobelprize.org/v1/laureate.json



From Web

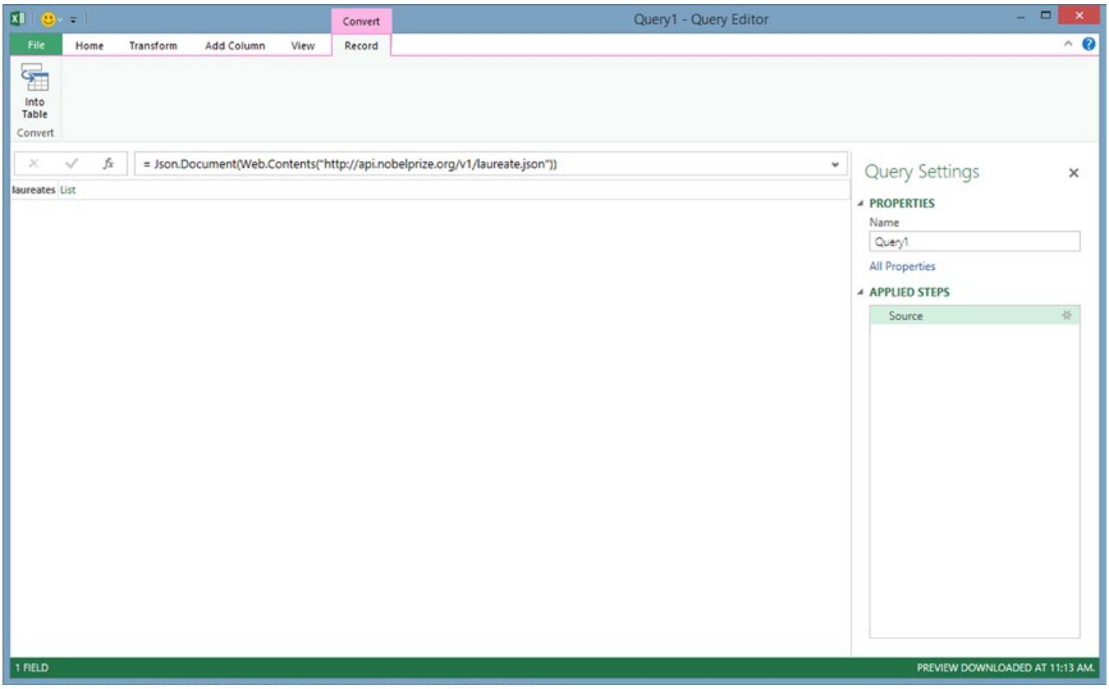
Enter a Web page URL.

URL

http://api.nobelprize.org/v1/laureate.json

Figure 8-22. *Importing using the From Web option*

3. The Query Editor will open. Click the Into Table icon at the upper left of the ribbon, as shown in Figure 8-23.



= Json.Document(Web.Contents("http://api.nobelprize.org/v1/laureate.json"))

laureates List

Name

Query1

Source

1 FIELD

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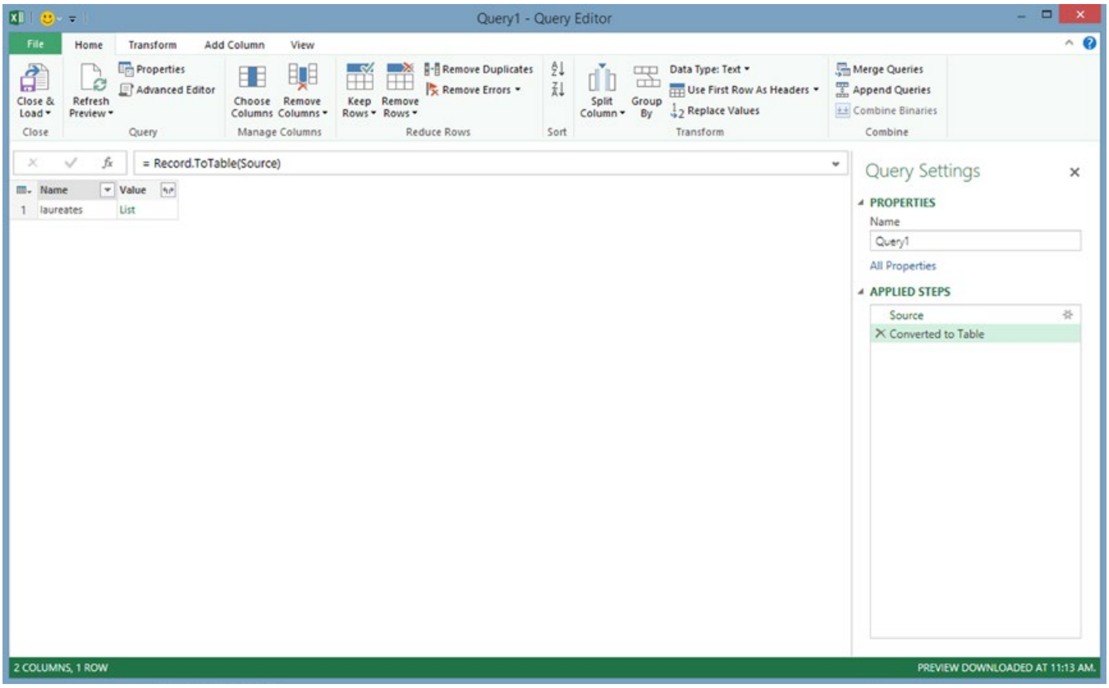
Figure 8-23. *The Convert screen for importing JSON*

4. The result, which displays only the column heading, is shown in Figure 8-24.



= Record.ToTable(Source)

	Name	Value
1	laureates	List

Name: Query1

Source
Converted to Table

2 COLUMNS, 1 ROW

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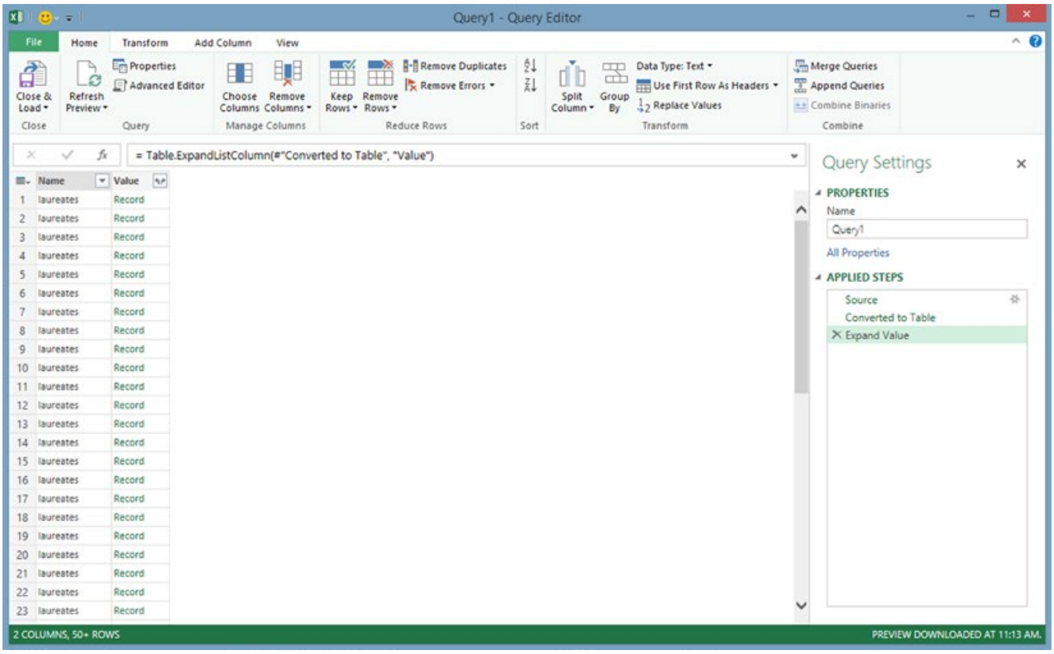
Figure 8-24. *Top-level JSON import*

5. Notice the expand button to the right of Value. Click that expand button. The results are shown in Figure 8-25.



```
= Table.ExpandListColumn(#"Converted to Table", "Value")
```

	Name	Value
1	laureates	Record
2	laureates	Record
3	laureates	Record
4	laureates	Record
5	laureates	Record
6	laureates	Record
7	laureates	Record
8	laureates	Record
9	laureates	Record
10	laureates	Record
11	laureates	Record
12	laureates	Record
13	laureates	Record
14	laureates	Record
15	laureates	Record
16	laureates	Record
17	laureates	Record
18	laureates	Record
19	laureates	Record
20	laureates	Record
21	laureates	Record
22	laureates	Record
23	laureates	Record

2 COLUMNS, 50+ ROWS

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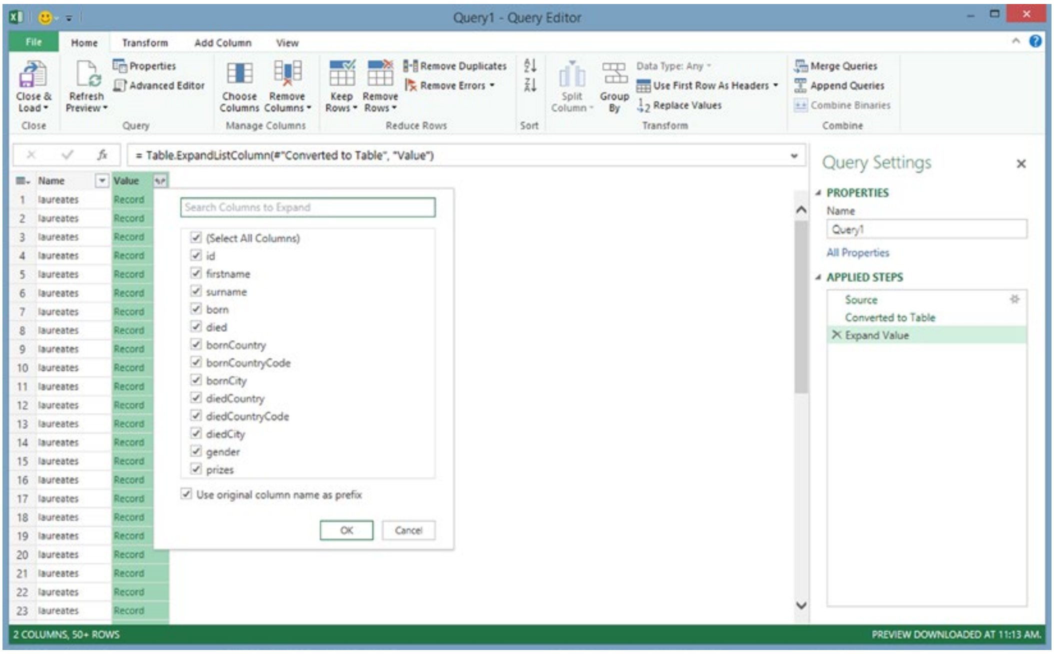
***Figure 8-25.** JSON column list*

6. Click the expand button again. The results are shown in Figure 8-26.



```
= Table.ExpandListColumn(#"Converted to Table", "Value")
```

	Name	Value
1	laureates	Record
2	laureates	Record
3	laureates	Record
4	laureates	Record
5	laureates	Record
6	laureates	Record
7	laureates	Record
8	laureates	Record
9	laureates	Record
10	laureates	Record
11	laureates	Record
12	laureates	Record
13	laureates	Record
14	laureates	Record
15	laureates	Record
16	laureates	Record
17	laureates	Record
18	laureates	Record
19	laureates	Record
20	laureates	Record
21	laureates	Record
22	laureates	Record
23	laureates	Record

☑ (Select All Columns)
☑ id
☑ firstname
☑ surname
☑ born
☑ died
☑ bornCountry
☑ bornCountryCode
☑ bornCity
☑ diedCountry
☑ diedCountryCode
☑ diedCity
☑ gender
☑ prizes

☑ Use original column name as prefix

2 COLUMNS, 50+ ROWS

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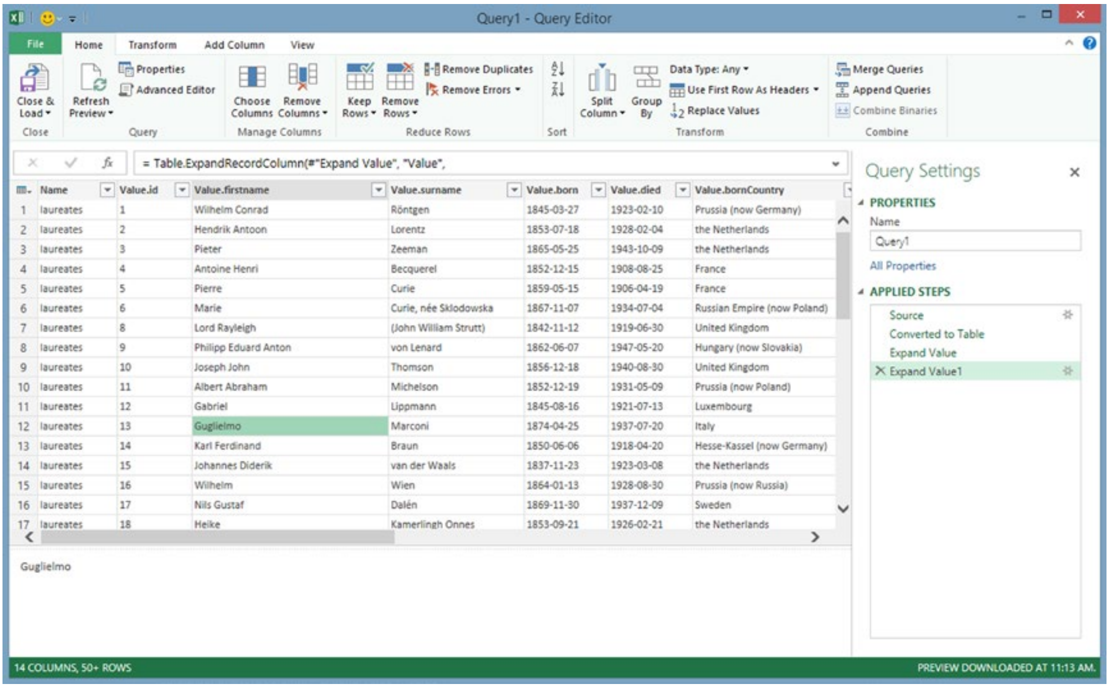
***Figure 8-26.** Select columns dialog box*

7. Accept the defaults and click OK to get the results shown in Figure 8-27, which shows the actual records, with a single row for each Nobel laureate.



= Table.ExpandRecordColumn(#"Expand Value", "Value",

	Name	Value.id	Value.firstname	Value.surname	Value.born	Value.died	Value.bornCountry
1	laureates	1	Wilhelm Conrad	Röntgen	1845-03-27	1923-02-10	Prussia (now Germany)
2	laureates	2	Hendrik Antoon	Lorentz	1853-07-18	1928-02-04	the Netherlands
3	laureates	3	Pieter	Zeeman	1865-05-25	1943-10-09	the Netherlands
4	laureates	4	Antoine Henri	Becquerel	1852-12-15	1908-08-25	France
5	laureates	5	Pierre	Curie	1859-05-15	1906-04-19	France
6	laureates	6	Marie	Curie, née Sklodowska	1867-11-07	1934-07-04	Russian Empire (now Poland)
7	laureates	8	Lord Rayleigh	(John William Strutt)	1842-11-12	1919-06-30	United Kingdom
8	laureates	9	Philipp Eduard Anton	von Lenard	1862-06-07	1947-05-20	Hungary (now Slovakia)
9	laureates	10	Joseph John	Thomson	1856-12-18	1940-08-30	United Kingdom
10	laureates	11	Albert Abraham	Michelson	1852-12-19	1931-05-09	Prussia (now Poland)
11	laureates	12	Gabriel	Lippmann	1845-08-16	1921-07-13	Luxembourg
12	laureates	13	Guglielmo	Marconi	1874-04-25	1937-07-20	Italy
13	laureates	14	Karl Ferdinand	Braun	1850-06-06	1918-04-20	Hesse-Kassel (now Germany)
14	laureates	15	Johannes Diderik	van der Waals	1837-11-23	1923-03-08	the Netherlands
15	laureates	16	Wilhelm	Wien	1864-01-13	1928-08-30	Prussia (now Russia)
16	laureates	17	Nils Gustaf	Dalén	1869-11-30	1937-12-09	Sweden
17	laureates	18	Heike	Kamerlingh Onnes	1853-09-21	1926-02-21	the Netherlands

Guglielmo

Query Settings

PROPERTIES

Name

Query1

All Properties

APPLIED STEPS

Source

Converted to Table

Expand Value

Expand Value1

14 COLUMNS, 50+ ROWS

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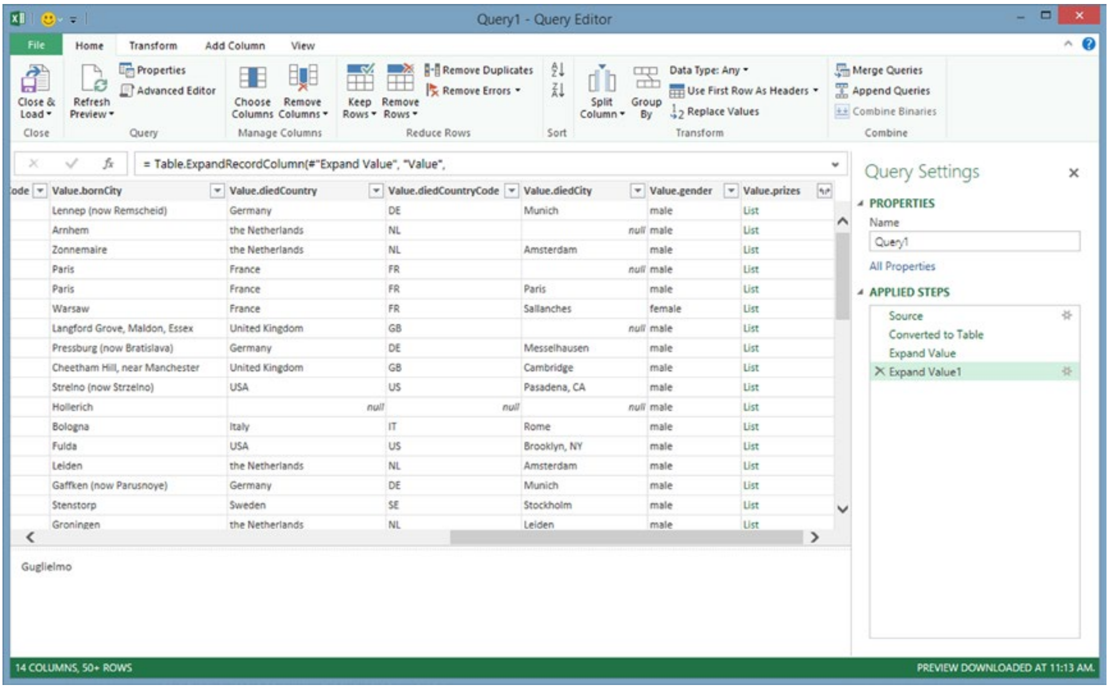
Figure 8-27. *JSON data in rows and columns.*

8. Scroll all the way to the right to find another expand button, as shown in Figure 8-28.



= Table.ExpandRecordColumn(#"Expand Value", "Value",

ode	Value.bornCity	Value.diedCountry	Value.diedCountryCode	Value.diedCity	Value.gender	Value.prizes
	Lennep (now Remscheid)	Germany	DE	Munich	male	List
	Arnhem	the Netherlands	NL	null	male	List
	Zonnemaire	the Netherlands	NL	Amsterdam	male	List
	Paris	France	FR	null	male	List
	Paris	France	FR	Paris	male	List
	Warsaw	France	FR	Sallanches	female	List
	Langford Grove, Maldon, Essex	United Kingdom	GB	null	male	List
	Pressburg (now Bratislava)	Germany	DE	Messelhausen	male	List
	Cheetham Hill, near Manchester	United Kingdom	GB	Cambridge	male	List
	Strelno (now Strzelno)	USA	US	Pasadena, CA	male	List
	Hollerich	null	null	null	male	List
	Bologna	Italy	IT	Rome	male	List
	Fulda	USA	US	Brooklyn, NY	male	List
	Leiden	the Netherlands	NL	Amsterdam	male	List
	Gaffken (now Parusnoye)	Germany	DE	Munich	male	List
	Stenstorp	Sweden	SE	Stockholm	male	List
	Groningen	the Netherlands	NL	Leiden	male	List

Guglielmo

14 COLUMNS, 50+ ROWS

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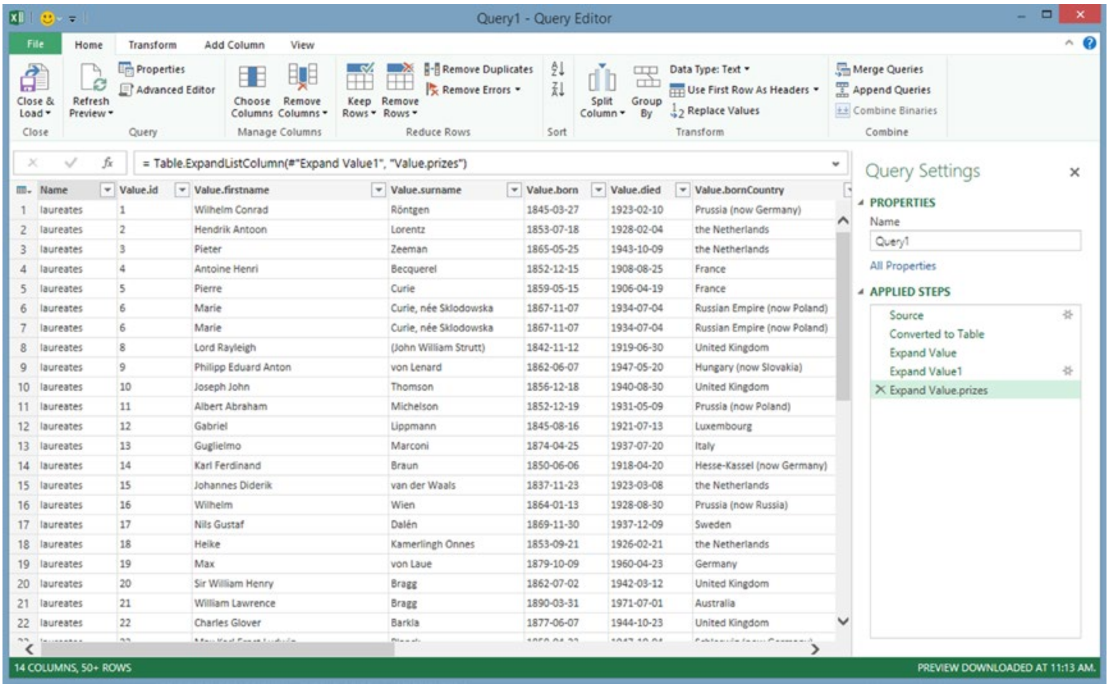
Figure 8-28. *Additonal columns*

9. Clicking this expand button will generate multiple rows for persons who won the Nobel Prize more than once, as shown in Figure 8-29.



= Table.ExpandListColumn(#"Expand Value1", "Value.prizes")

	Name	Value.id	Value.firstname	Value.surname	Value.born	Value.died	Value.bornCountry
1	laureates	1	Wilhelm Conrad	Röntgen	1845-03-27	1923-02-10	Prussia (now Germany)
2	laureates	2	Hendrik Antoon	Lorentz	1853-07-18	1928-02-04	the Netherlands
3	laureates	3	Pieter	Zeeman	1865-05-25	1943-10-09	the Netherlands
4	laureates	4	Antoine Henri	Becquerel	1852-12-15	1908-08-25	France
5	laureates	5	Pierre	Curie	1859-05-15	1906-04-19	France
6	laureates	6	Marie	Curie, née Sklodowska	1867-11-07	1934-07-04	Russian Empire (now Poland)
7	laureates	6	Marie	Curie, née Sklodowska	1867-11-07	1934-07-04	Russian Empire (now Poland)
8	laureates	8	Lord Rayleigh	(John William Strutt)	1842-11-12	1919-06-30	United Kingdom
9	laureates	9	Philipp Eduard Anton	von Lenard	1862-06-07	1947-05-20	Hungary (now Slovakia)
10	laureates	10	Joseph John	Thomson	1856-12-18	1940-08-30	United Kingdom
11	laureates	11	Albert Abraham	Michelson	1852-12-19	1931-05-09	Prussia (now Poland)
12	laureates	12	Gabriel	Lippmann	1845-08-16	1921-07-13	Luxembourg
13	laureates	13	Guglielmo	Marconi	1874-04-25	1937-07-20	Italy
14	laureates	14	Karl Ferdinand	Braun	1850-06-06	1918-04-20	Hesse-Kassel (now Germany)
15	laureates	15	Johannes Diderik	van der Waals	1837-11-23	1923-03-08	the Netherlands
16	laureates	16	Wilhelm	Wien	1864-01-13	1928-08-30	Prussia (now Russia)
17	laureates	17	Nils Gustaf	Dalén	1869-11-30	1937-12-09	Sweden
18	laureates	18	Heike	Kamerlingh Onnes	1853-09-21	1926-02-21	the Netherlands
19	laureates	19	Max	von Laue	1879-10-09	1960-04-23	Germany
20	laureates	20	Sir William Henry	Bragg	1862-07-02	1942-03-12	United Kingdom
21	laureates	21	William Lawrence	Bragg	1890-03-31	1971-07-01	Australia
22	laureates	22	Charles Glover	Barkla	1877-06-07	1944-10-23	United Kingdom

Name: Query1

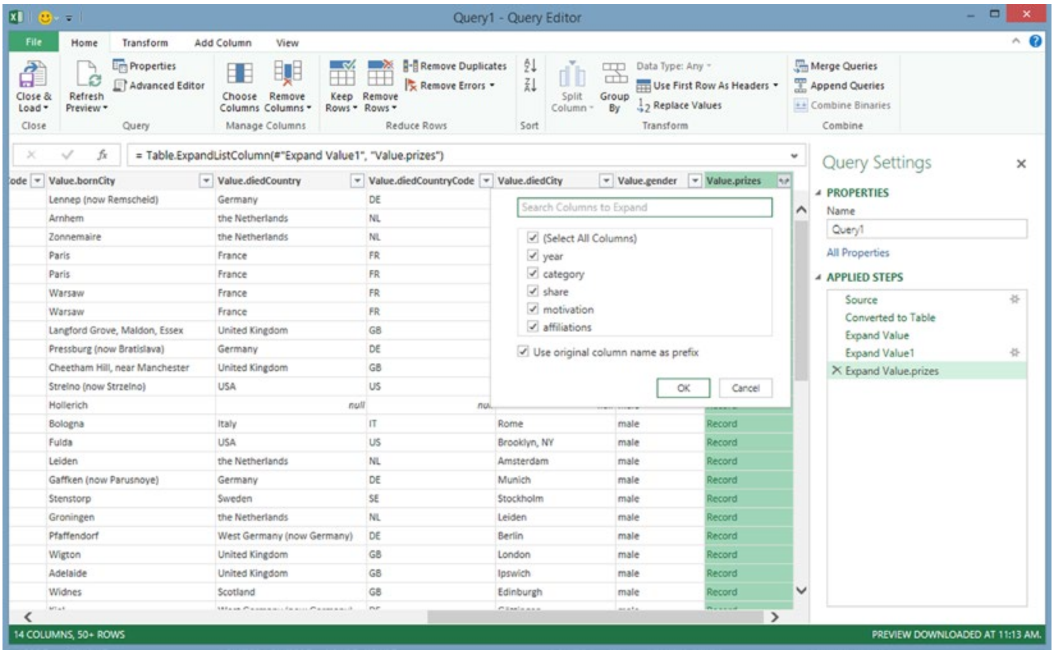
Applied steps:
- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes

14 COLUMNS, 50+ ROWS

PREVIEW DOWNLOADED AT 11:13 AM.

Figure 8-29. *Expanded view with multiple rows for recipients of multiple Nobel Prizes*

10. Scrolling to the right, clicking the expand button again, and accepting the defaults, as shown in Figure 8-30, will expand some of the fields that were not shown before, such as the reason for the prize.



= Table.ExpandListColumn(#"Expand Value1", "Value.prizes")

ode	Value.bornCity	Value.diedCountry	Value.diedCountryCode	Value.diedCity	Value.gender	Value.prizes
	Lennep (now Remscheid)	Germany	DE			
	Arnhem	the Netherlands	NL			
	Zonnemaire	the Netherlands	NL			
	Paris	France	FR			
	Paris	France	FR			
	Warsaw	France	FR			
	Warsaw	France	FR			
	Langford Grove, Maldon, Essex	United Kingdom	GB			
	Pressburg (now Bratislava)	Germany	DE			
	Cheetham Hill, near Manchester	United Kingdom	GB			
	Strelno (now Strzelno)	USA	US			
	Hollerich	null	nu			
	Bologna	Italy	IT	Rome	male	Record
	Fulda	USA	US	Brooklyn, NY	male	Record
	Leiden	the Netherlands	NL	Amsterdam	male	Record
	Gaffken (now Parusnoye)	Germany	DE	Munich	male	Record
	Stenstorp	Sweden	SE	Stockholm	male	Record
	Groningen	the Netherlands	NL	Leiden	male	Record
	Pfaffendorf	West Germany (now Germany)	DE	Berlin	male	Record
	Wigton	United Kingdom	GB	London	male	Record
	Adelaide	United Kingdom	GB	Ipswich	male	Record
	Widnes	Scotland	GB	Edinburgh	male	Record

Search Columns to Expand

☑ (Select All Columns)
☑ year
☑ category
☑ share
☑ motivation
☑ affiliations

☑ Use original column name as prefix

OK Cancel

Query Settings

PROPERTIES

Name: Query1

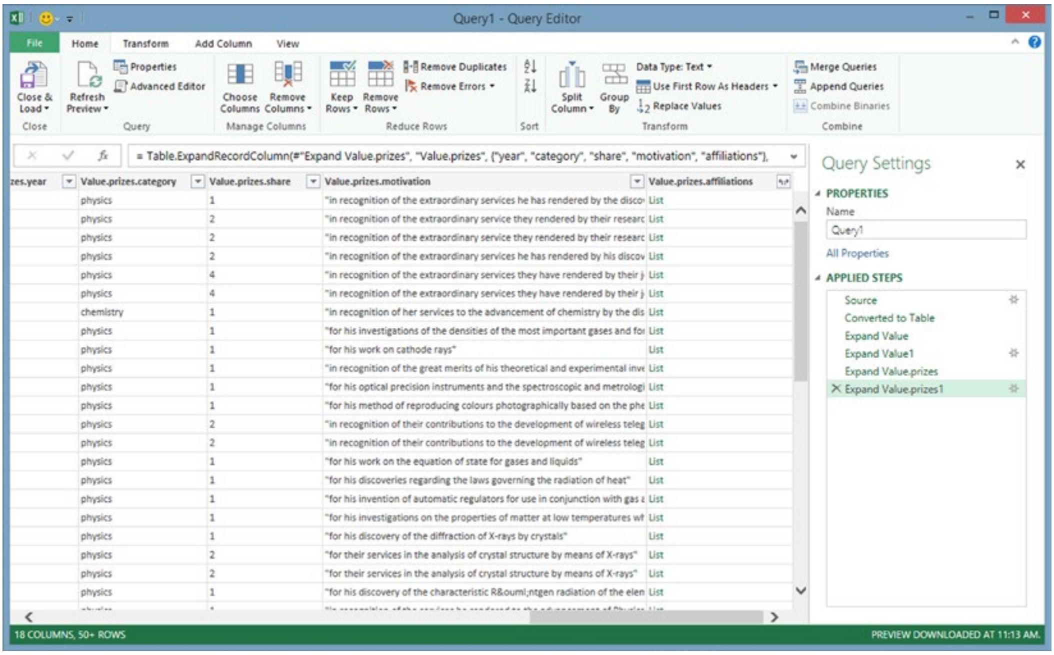
All Properties

APPLIED STEPS

- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes

Figure 8-30. *Further expanding the rows*

11. The results are shown in Figure 8-31.



= Table.ExpandRecordColumn(#"Expand Value.prizes", "Value.prizes", {"year", "category", "share", "motivation", "affiliations"},

zes.year	Value.prizes.category	Value.prizes.share	Value.prizes.motivation	Value.prizes.affiliations
	physics	1	"in recognition of the extraordinary services he has rendered by the disco	List
	physics	2	"in recognition of the extraordinary service they rendered by their researc	List
	physics	2	"in recognition of the extraordinary service they rendered by their researc	List
	physics	2	"in recognition of the extraordinary services he has rendered by his discov	List
	physics	4	"in recognition of the extraordinary services they have rendered by their j	List
	physics	4	"in recognition of the extraordinary services they have rendered by their j	List
	chemistry	1	"in recognition of her services to the advancement of chemistry by the dis	List
	physics	1	"for his investigations of the densities of the most important gases and fo	List
	physics	1	"for his work on cathode rays"	List
	physics	1	"in recognition of the great merits of his theoretical and experimental inv	List
	physics	1	"for his optical precision instruments and the spectroscopic and metrologi	List
	physics	1	"for his method of reproducing colours photographically based on the phe	List
	physics	2	"in recognition of their contributions to the development of wireless teleg	List
	physics	2	"in recognition of their contributions to the development of wireless teleg	List
	physics	1	"for his work on the equation of state for gases and liquids"	List
	physics	1	"for his discoveries regarding the laws governing the radiation of heat"	List
	physics	1	"for his invention of automatic regulators for use in conjunction with gas a	List
	physics	1	"for his investigations on the properties of matter at low temperatures wh	List
	physics	1	"for his discovery of the diffraction of X-rays by crystals"	List
	physics	2	"for their services in the analysis of crystal structure by means of X-rays"	List
	physics	2	"for their services in the analysis of crystal structure by means of X-rays"	List
	physics	1	"for his discovery of the characteristic R&ouml;ntgen radiation of the elen	List

Query Settings

PROPERTIES

Name: Query1

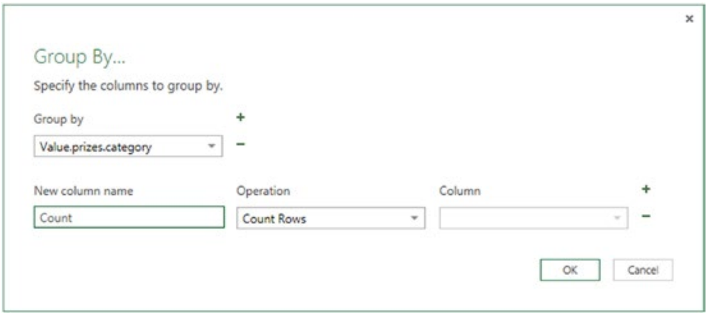
All Properties

APPLIED STEPS

- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes
- Expand Value.prizes1

Figure 8-31. *Display showing reason (motivation) for Nobel Prize*

12. Decisions can be made about how to group the data. For example, to group the data by category, click the heading of the category column to select the desired category, then right-click and select Group By to see the Group By... dialog, as shown in Figure 8-32.



Group By...

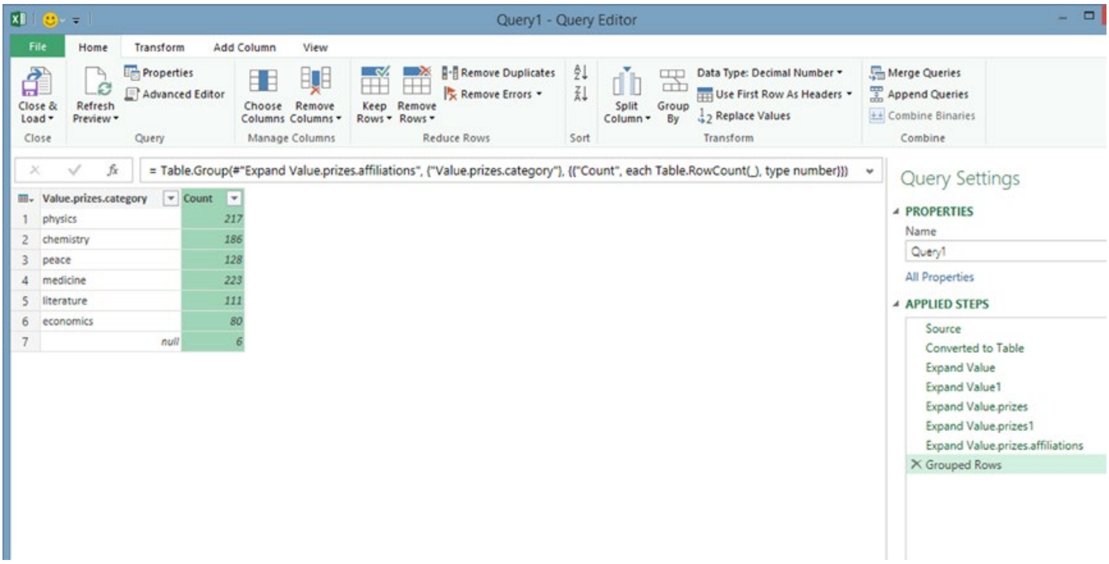
Specify the columns to group by.

Group by: Value.prizes.category

New column name	Operation	Column
Count	Count Rows	

Figure 8-32. Group By... dialog with single field

13. Clicking OK will show a count of the prizes by category, as in Figure 8-33.



= Table.Group(#"Expand Value.prizes.affiliations", {"Value.prizes.category"}, {{"Count", each Table.RowCount(_), type number}})

	Value.prizes.category	Count
1	physics	217
2	chemistry	186
3	peace	128
4	medicine	223
5	literature	111
6	economics	80
7	null	6

Query Settings

PROPERTIES

Name: Query1

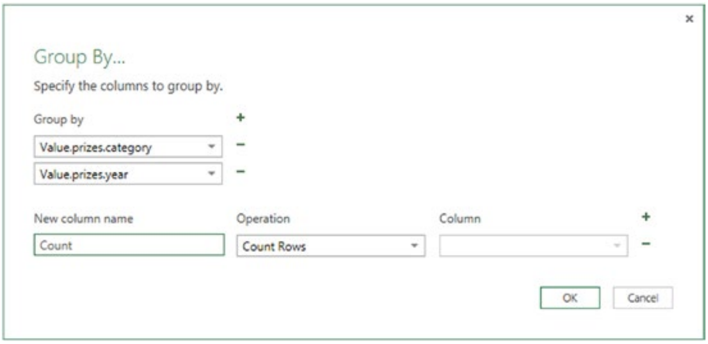
All Properties

APPLIED STEPS

- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes
- Expand Value.prizes1
- Expand Value.prizes.affiliations
- Grouped Rows

Figure 8-33. Count of Nobel Prizes by category

14. It is possible to group by two fields, such as category and year, by clicking the plus sign in the Group By... dialog box to select a second field, as shown in Figure 8-34. The Group By... dialog box can be accessed again by clicking the gear icon after Group Rows at the bottom of the Applied Steps list in the Query Setting pane on the right side of the screen.



Group By...

Specify the columns to group by.

Group by: Value.prizes.category; Value.prizes.year

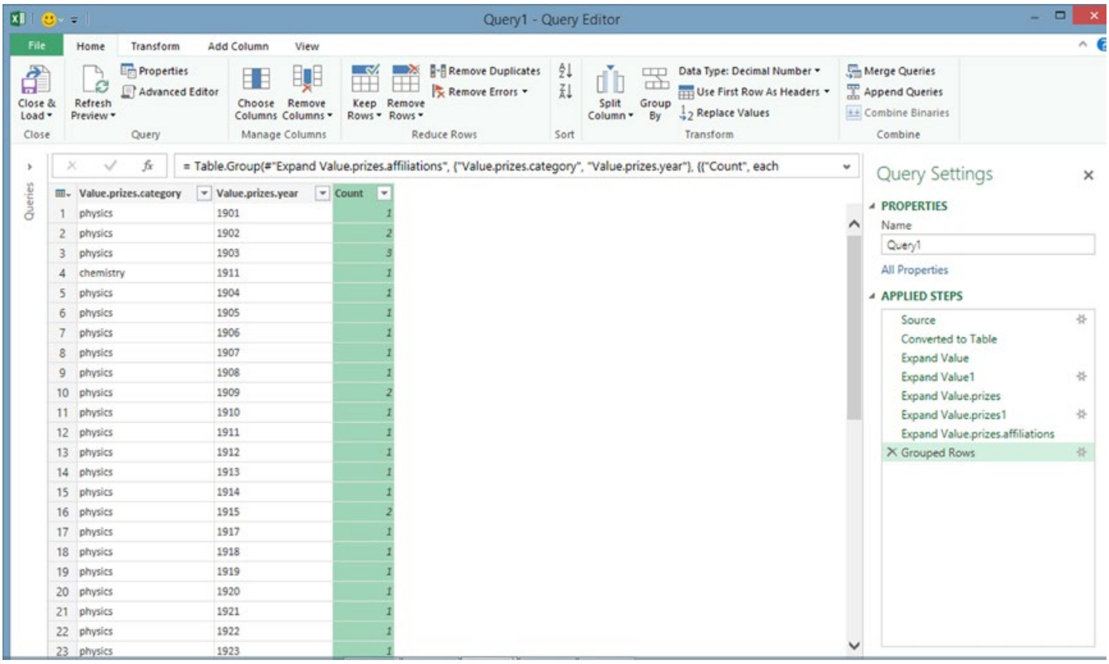
New column name: Count

Operation: Count Rows

Column:

Figure 8-34. *Group By dialog with two fields*

15. The results are shown in Figure 8-35.



= Table.Group(#"Expand Value.prizes.affiliations", {"Value.prizes.category", "Value.prizes.year"}, {{"Count", each

	Value.prizes.category	Value.prizes.year	Count
1	physics	1901	1
2	physics	1902	2
3	physics	1903	3
4	chemistry	1911	1
5	physics	1904	1
6	physics	1905	1
7	physics	1906	1
8	physics	1907	1
9	physics	1908	1
10	physics	1909	2
11	physics	1910	1
12	physics	1911	1
13	physics	1912	1
14	physics	1913	1
15	physics	1914	1
16	physics	1915	2
17	physics	1917	1
18	physics	1918	1
19	physics	1919	1
20	physics	1920	1
21	physics	1921	1
22	physics	1922	1
23	physics	1923	1

Query Settings

PROPERTIES

Name: Query1

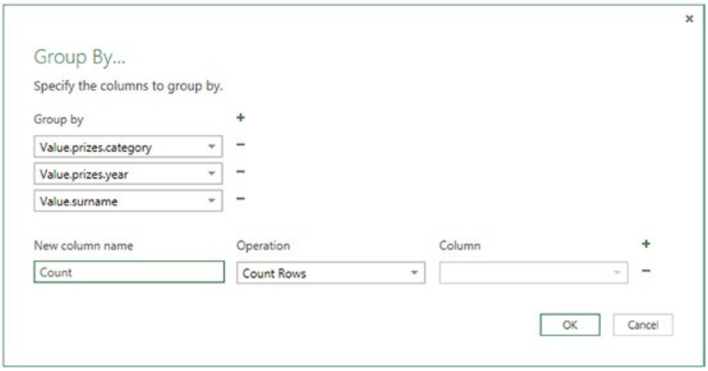
All Properties

APPLIED STEPS

- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes
- Expand Value.prizes1
- Expand Value.prizes.affiliations
- Grouped Rows

Figure 8-35. *Count of Nobel Prizes by category and year*

16. To add a third field to show the name of the prize winner, select + again in the Group By... dialog and add the surname of the winner, as shown in Figure 8-36.



Group By...

Specify the columns to group by.

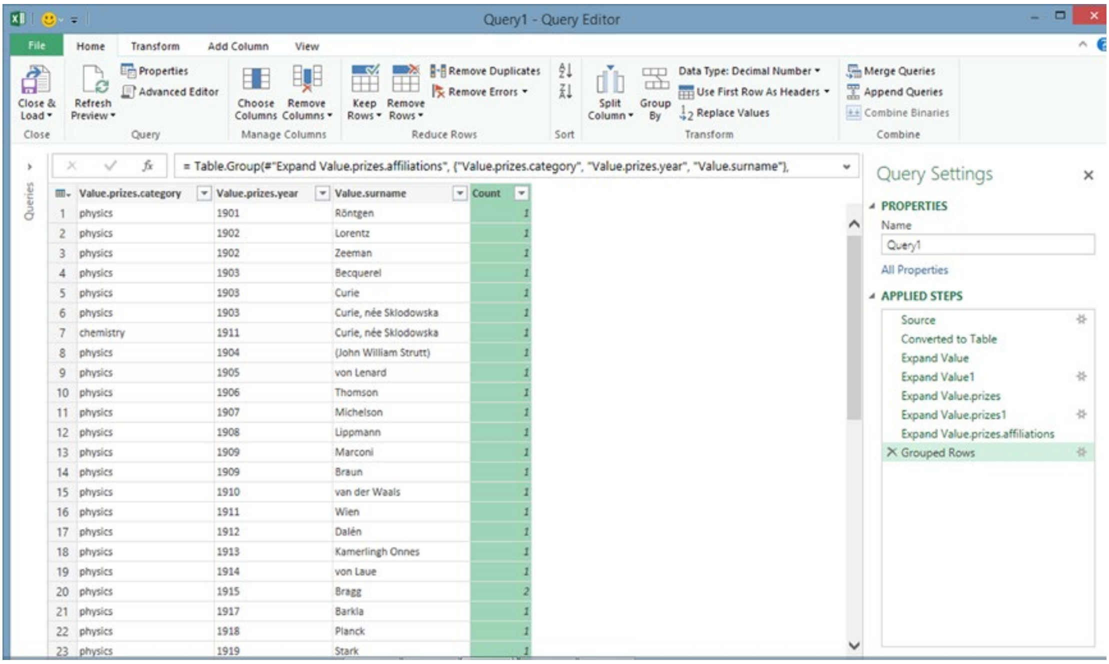
Group by

- Value.prizes.category
- Value.prizes.year
- Value.surname

New column name	Operation	Column
Count	Count Rows	

Figure 8-36. *Group By... dialog with three fields*

17. The results are shown in Figure 8-37.



```
= Table.Group(#"Expand Value.prizes.affiliations", {"Value.prizes.category", "Value.prizes.year", "Value.surname"},
```

	Value.prizes.category	Value.prizes.year	Value.surname	Count
1	physics	1901	Röntgen	1
2	physics	1902	Lorentz	1
3	physics	1902	Zeeman	1
4	physics	1903	Becquerel	1
5	physics	1903	Curie	1
6	physics	1903	Curie, née Sklodowska	1
7	chemistry	1911	Curie, née Sklodowska	1
8	physics	1904	(John William Strutt)	1
9	physics	1905	von Lenard	1
10	physics	1906	Thomson	1
11	physics	1907	Michelson	1
12	physics	1908	Lippmann	1
13	physics	1909	Marconi	1
14	physics	1909	Braun	1
15	physics	1910	van der Waals	1
16	physics	1911	Wien	1
17	physics	1912	Dalén	1
18	physics	1913	Kamerlingh Onnes	1
19	physics	1914	von Laue	1
20	physics	1915	Bragg	2
21	physics	1917	Barkla	1
22	physics	1918	Planck	1
23	physics	1919	Stark	1

Query Settings

PROPERTIES

Name: Query1

All Properties

APPLIED STEPS

- Source
- Converted to Table
- Expand Value
- Expand Value1
- Expand Value.prizes
- Expand Value.prizes1
- Expand Value.prizes.affiliations
- Grouped Rows

Figure 8-37. *Display of Nobel Prizes by category and year, with surname of recipient*

Summary

This chapter has demonstrated how to use Power Query to import tables from web sites, multiple CSV files from a folder, and JSON data. The examples have shown how to use Power Query to extract, transform, and load data. More examples of using Power Query will be provided in later chapters.

CHAPTER 9

Power Map

Power Map is a powerful visualization tool that allows the creation of 2D and 3D visualizations by plotting Excel-based geospatial data on a map, using Bing Map technology. This chapter demonstrates how to import data using Power Query and then how to plot it using Power Map.

Installing Power Map

Power Map is accessed through an icon on the Excel Insert tab. If that icon is not displayed, it may mean that you do not have the current version of Power Map installed. If that is the case, do a search on “download Power Map” and download the latest version from Microsoft. Then, to enable Power Map, follow these steps:

1. Click the File tab to see the Backstage View.
2. Click Options at the bottom of the left pane.
3. Select Add-Ins on the left pane.
4. At the bottom of the window, pull down the arrow after Manage, select Com Add-Ins, and click Go.
5. Check Microsoft Office PowerPivot for Excel 2013, Microsoft Power Map for Excel and Power View, and click OK.

Plotting a Map

The steps to plotting a map include the following:

1. Open a data source, which may be a spreadsheet or a data model that includes geographic descriptors, such as city and state or geographic coordinates.
2. Select the Insert tab and click Map and Load Power Map.
3. In the Fields list pane on the right side of the screen, select geographic fields to map to, such as city and state or geographic coordinates, and then select a data metric, such as population. Power Map calls Bing Map services to locate the geographic locations on a map, and then the metric value is plotted.
4. By default, a column chart is displayed. This can be changed to a bubble chart or heat map by clicking the appropriate icon.

A Power Map video tour is an animation that tells a story about data by linking individual maps. A video can be created to tell a story based on the data. A video is a collection of tours, and a tour is a collection of scenes.

Key Power Map Ribbon Options

This section highlights some of the key options on the Power Map ribbon, which is shown in Figure 9-1.

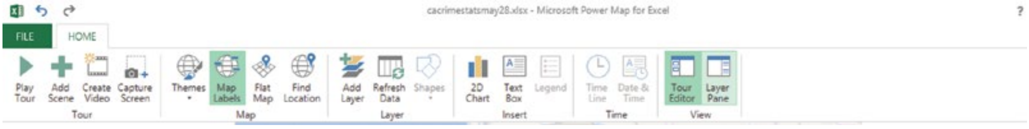


Figure 9-1. *Power Map ribbon*

- Tour Section
    - Play Tour. Plays a tour already created
    - Add Scene. Adds a scene to a tour
    - Create Video. Creates a video from tours
- Map Section
    - Themes. Changes the map style
    - Map Labels. Adds country or city names
    - Flat Map. Switches between 2D and 3D views
- Layer Section
    - Add Layer. Adds a new layer
    - Refresh Data. Refreshes data from the source
    - Shapes. Selects the shape of the bar chart
- Insert Section
    - 2D Chart. Adds a 2D chart
    - Text Box. Adds a text box on the map
    - Legend. Adds a legend to the map
- Time Section
    - Time Line. Shows or hides the time line in a time animation
    - Date & Time. Shows or adds the date and time in a time animation
- View Section
    - Tour Editor. Displays or hides the Tour Editor pane (left side of screen)
    - Layer Pane. Displays or hides the Layer Pane (right side of screen)

Troubleshooting

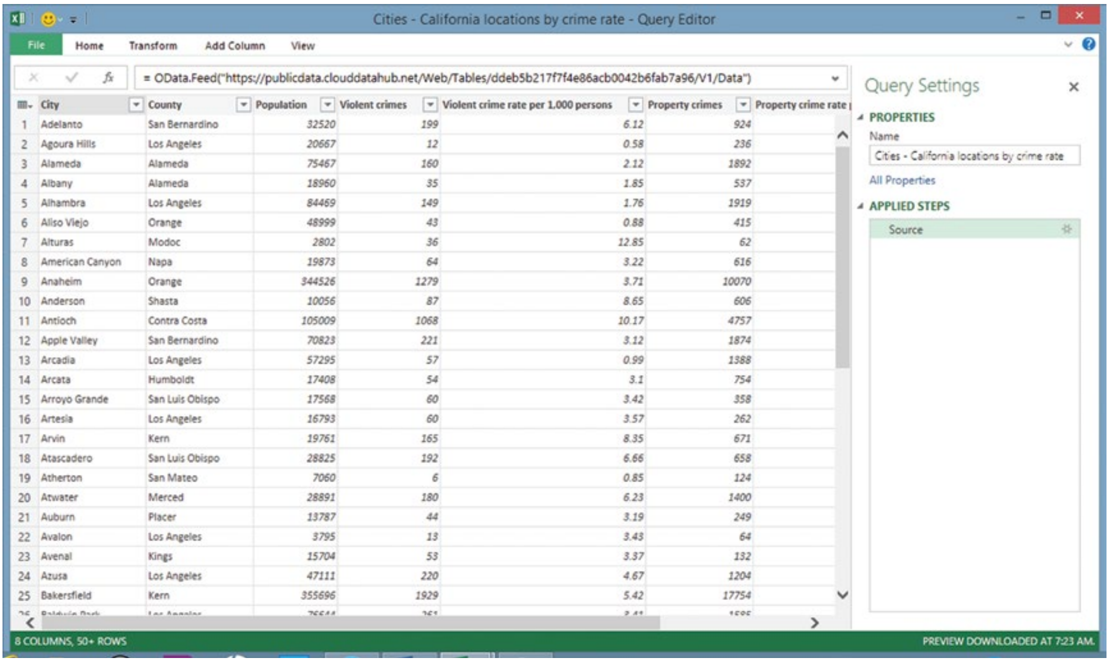
Power Map is very particular about data types. If numeric data that you want to plot is not treated as numeric data, as evidenced by only showing a count aggregation, or if time data is not recognized, follow these steps:

1. Check for any extraneous string data in the column and delete the row containing string data.
2. Make sure that a numeric data column is formatted as a number and that a date column is formatted as date.
3. After changing the format, click Refresh Data on the Power Map ribbon.

EXERCISE 9-1. MAPPING CALIFORNIA CRIME STATISTICS EXAMPLE

This example shows how to use Power Query to import California crime statistics by city and how to use Power Map to plot the data.

1. Go to Power Query and do a Data Catalog search on "California Cities by Population and Crime Rate." Hover your mouse over "Cities—California locations by crime rate" and select Edit to load into the Query Editor. The screen shown in Figure 9-2 will appear.



= OData.Feed("https://publicdata.clouddatahub.net/Web/Tables/ddeb5b217f7f4e86acb0042b6fab7a96/V1/Data")

Name: Cities - California locations by crime rate

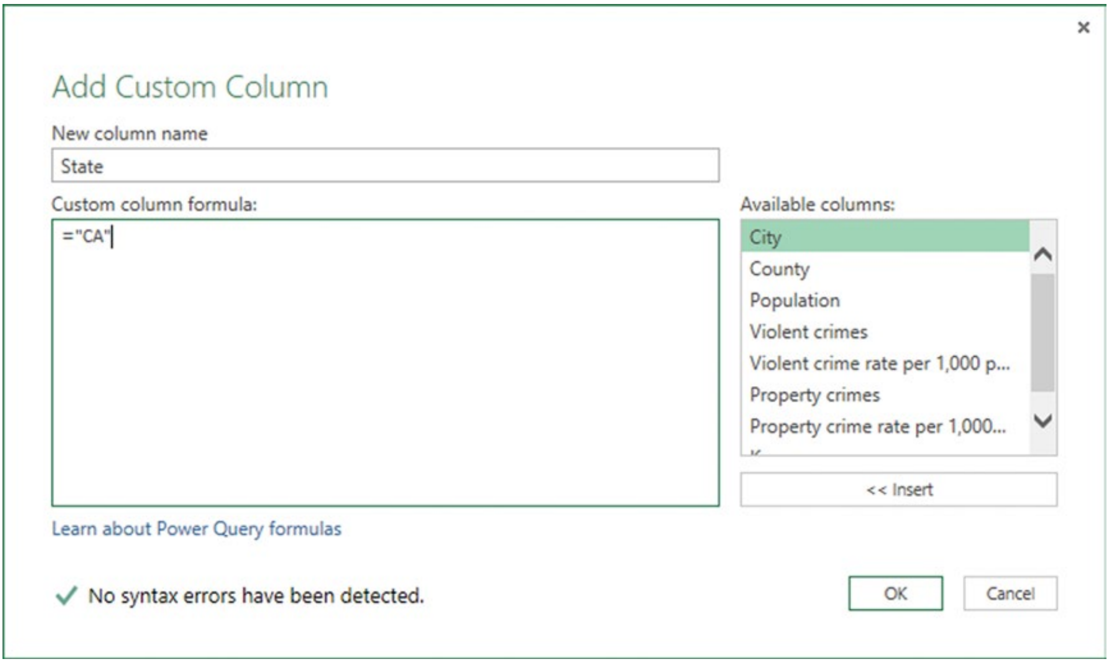
	City	County	Population	Violent crimes	Violent crime rate per 1,000 persons	Property crimes	Property crime rate
1	Adelanto	San Bernardino	32520	199	6.12	924	
2	Agoura Hills	Los Angeles	20667	12	0.58	236	
3	Alameda	Alameda	75467	160	2.12	1892	
4	Albany	Alameda	18960	35	1.85	537	
5	Alhambra	Los Angeles	84469	149	1.76	1919	
6	Aliso Viejo	Orange	48999	43	0.88	415	
7	Alturas	Modoc	2802	36	12.85	62	
8	American Canyon	Napa	19873	64	3.22	616	
9	Anaheim	Orange	344526	1279	3.71	10070	
10	Anderson	Shasta	10056	87	8.65	606	
11	Antioch	Contra Costa	105009	1068	10.17	4757	
12	Apple Valley	San Bernardino	70823	221	3.12	1874	
13	Arcadia	Los Angeles	57295	57	0.99	1388	
14	Arcata	Humboldt	17408	54	3.1	754	
15	Arroyo Grande	San Luis Obispo	17568	60	3.42	358	
16	Artesia	Los Angeles	16793	60	3.57	262	
17	Arvin	Kern	19761	165	8.35	671	
18	Atascadero	San Luis Obispo	28825	192	6.66	658	
19	Atherton	San Mateo	7060	6	0.85	124	
20	Atwater	Merced	28891	180	6.23	1400	
21	Auburn	Placer	13787	44	3.19	249	
22	Avalon	Los Angeles	3795	13	3.43	64	
23	Avenal	Kings	15704	53	3.37	132	
24	Azusa	Los Angeles	47111	220	4.67	1204	
25	Bakersfield	Kern	355696	1929	5.42	17754	
26	Baldwin Park	Los Angeles	75544	261	3.41	1585	

8 COLUMNS, 50+ ROWS

PREVIEW DOWNLOADED AT 7:23 AM

Figure 9-2. Crime Statistics in Query Editor

2. In Query Editor, click the Add Column tab. On the left end of the tab, click Add Custom Column. Create a new column for state. Set the contents `="CA"`, as shown in Figure 9-3.



Add Custom Column

New column name: State

Custom column formula:

```
="CA"
```

Available columns:

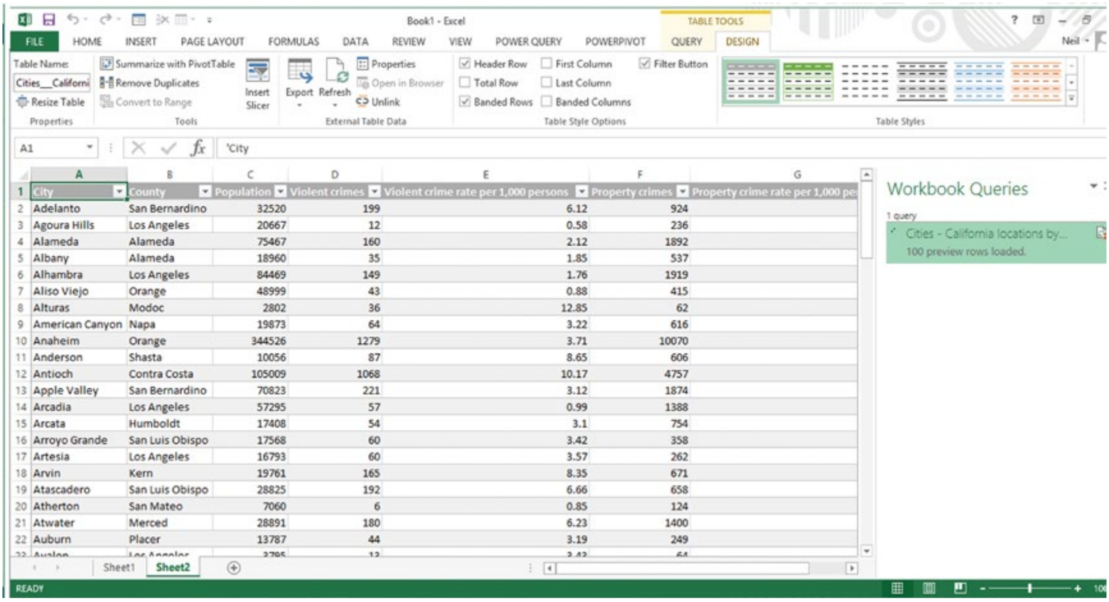
- City
- County
- Population
- Violent crimes
- Violent crime rate per 1,000 p...
- Property crimes
- Property crime rate per 1,000...

Learn about Power Query formulas

✓ No syntax errors have been detected.

Figure 9-3. *Adding a State column*

3. Check that the data type of all the numeric columns is a decimal number by right-clicking the column heading, selecting Change Type, and selecting Decimal Number. Also, check that there are no non-numeric values in numeric columns. When the data is the way you want it, click Close & Load on the ribbon, to load to a spreadsheet. The spreadsheet should appear as shown in Figure 9-4.



Workbook Queries

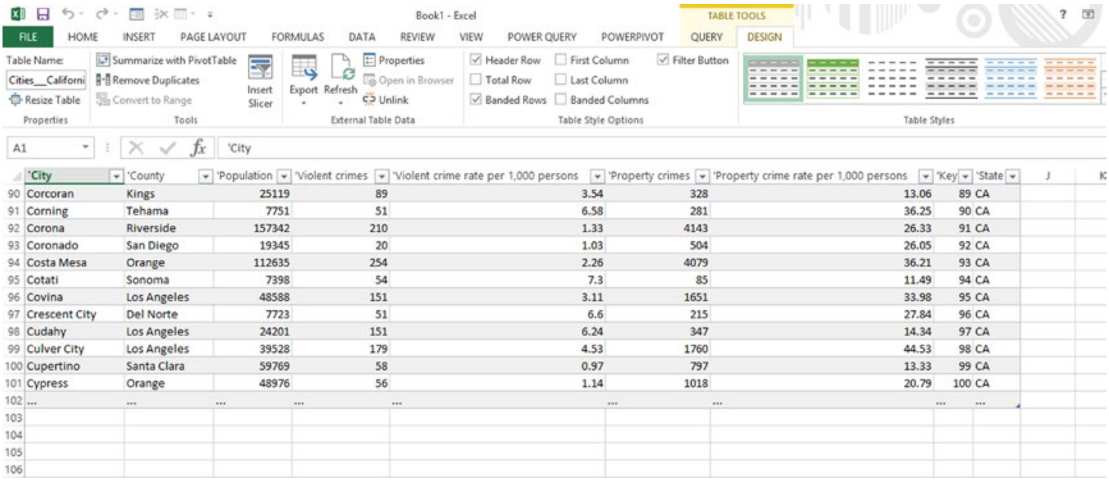
1 query

Cities - California locations by...
100 preview rows loaded.

	A	B	C	D	E	F	G
1	City	County	Population	Violent crimes	Violent crime rate per 1,000 persons	Property crimes	Property crime rate per 1,000 pe
2	Adelanto	San Bernardino	32520	199	6.12	924	
3	Agoura Hills	Los Angeles	20667	12	0.58	236	
4	Alameda	Alameda	75467	160	2.12	1892	
5	Albany	Alameda	18960	35	1.85	537	
6	Alhambra	Los Angeles	84469	149	1.76	1919	
7	Aliso Viejo	Orange	48999	43	0.88	415	
8	Alturas	Modoc	2802	36	12.85	62	
9	American Canyon	Napa	19873	64	3.22	616	
10	Anaheim	Orange	344526	1279	3.71	10070	
11	Anderson	Shasta	10056	87	8.65	606	
12	Antioch	Contra Costa	105009	1068	10.17	4757	
13	Apple Valley	San Bernardino	70823	221	3.12	1874	
14	Arcadia	Los Angeles	57295	57	0.99	1388	
15	Arcata	Humboldt	17408	54	3.1	754	
16	Arroyo Grande	San Luis Obispo	17568	60	3.42	358	
17	Artesia	Los Angeles	16793	60	3.57	262	
18	Arvin	Kern	19761	165	8.35	671	
19	Atascadero	San Luis Obispo	28825	192	6.66	658	
20	Atherton	San Mateo	7060	6	0.85	124	
21	Atwater	Merced	28891	180	6.23	1400	
22	Auburn	Placer	13787	44	3.19	249	
23	Avalon	Los Angeles	3795	13	3.43	64	

Figure 9-4. *Crime data loaded into spreadsheet*

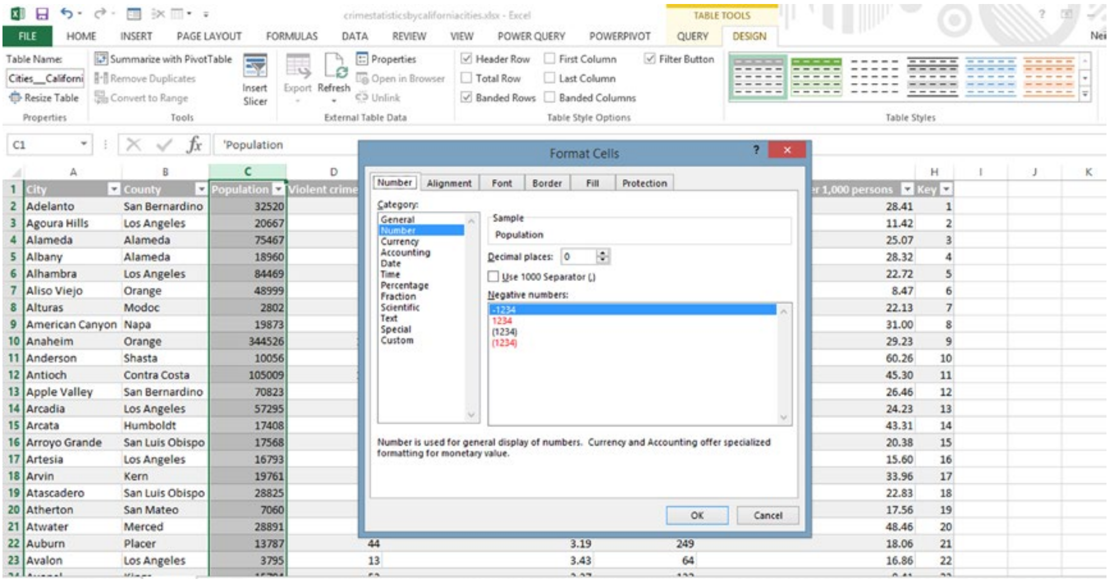
Again, check for non-numeric values in number fields that could keep Power Map from interpreting the contents correctly. Because not all the rows are displayed in the Query Editor, for larger datasets, this has to be checked after loading the data into Excel. As shown in Figure 9-5, the last row of data may contain ellipses. If this is the case, delete that last row by right-clicking the row and selecting Delete Table Row.



	'City	'County	'Population	'Violent crimes	'Violent crime rate per 1,000 persons	'Property crimes	'Property crime rate per 1,000 persons	'Key	'State
90	Corcoran	Kings	25119	89	3.54	328	13.06	89	CA
91	Corning	Tehama	7751	51	6.58	281	36.25	90	CA
92	Corona	Riverside	157342	210	1.33	4143	26.33	91	CA
93	Coronado	San Diego	19345	20	1.03	504	26.05	92	CA
94	Costa Mesa	Orange	112635	254	2.26	4079	36.21	93	CA
95	Cotati	Sonoma	7398	54	7.3	85	11.49	94	CA
96	Covina	Los Angeles	48588	151	3.11	1651	33.98	95	CA
97	Crescent City	Del Norte	7723	51	6.6	215	27.84	96	CA
98	Cudahy	Los Angeles	24201	151	6.24	347	14.34	97	CA
99	Culver City	Los Angeles	39528	179	4.53	1760	44.53	98	CA
100	Cupertino	Santa Clara	59769	58	0.97	797	13.33	99	CA
101	Cypress	Orange	48976	56	1.14	1018	20.79	100	CA
102	...	...	...	...	...	...	...	...	...
103									
104									
105									
106									

Figure 9-5. *Ellipsis in the last row that has to be deleted*

4. Check the formatting of each column by highlighting the column, by clicking the letter at the top of the column. Right-click the selected column and select Format Cells from the Context menu. For the population, violent crimes, and property crimes columns, set the format to Number, with 0 places to the right of the point, as shown in Figure 9-6. For the violent crimes and property crimes per 1,000 persons, set the format to Number, with 2 places to the right of the point.



Format Cells

Number | Alignment | Font | Border | Fill | Protection

Category: General, **Number**, Currency, Accounting, Date, Time, Percentage, Fraction, Scientific, Text, Special, Custom

Sample: Population

Decimal places: 0

□ Use 1000 Separator (,)

Negative numbers: **-1234**, 1234, (1234), (1234)

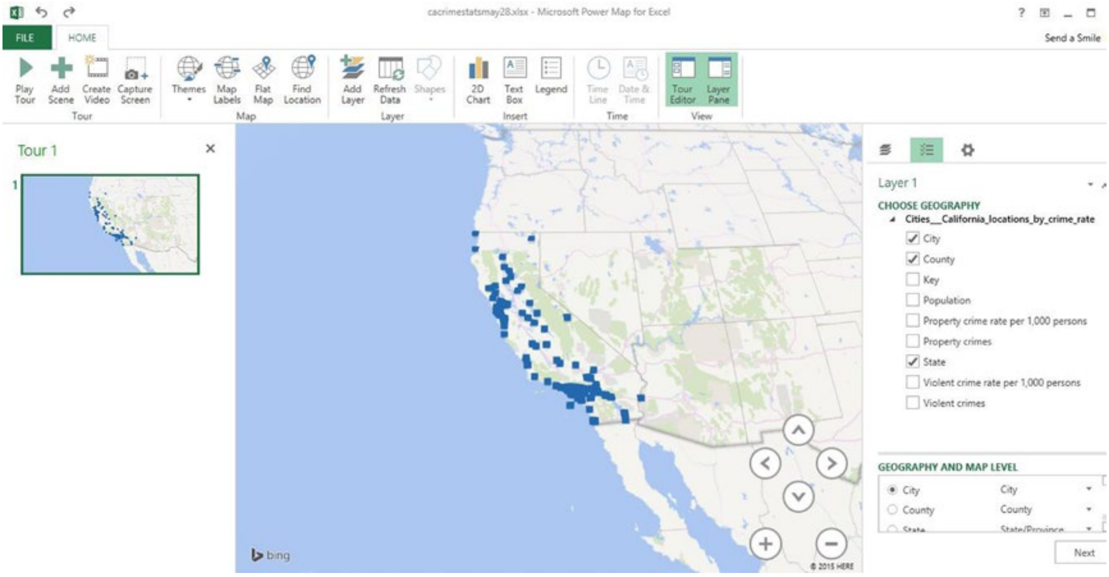
Number is used for general display of numbers. Currency and Accounting offer specialized formatting for monetary value.

OK | Cancel

	City	County	Population	Violent crime			er 1,000 persons	Key
2	Adelanto	San Bernardino	32520				28.41	1
3	Agoura Hills	Los Angeles	20667				11.42	2
4	Alameda	Alameda	75467				25.07	3
5	Albany	Alameda	18960				28.32	4
6	Alhambra	Los Angeles	84469				22.72	5
7	Aliso Viejo	Orange	48999				8.47	6
8	Alturas	Modoc	2802				22.13	7
9	American Canyon	Napa	19873				31.00	8
10	Anaheim	Orange	344526				29.23	9
11	Anderson	Shasta	10056				60.26	10
12	Antioch	Contra Costa	105009				45.30	11
13	Apple Valley	San Bernardino	70823				26.46	12
14	Arcadia	Los Angeles	57295				24.23	13
15	Arcata	Humboldt	17408				43.31	14
16	Arroyo Grande	San Luis Obispo	17568				20.38	15
17	Artesia	Los Angeles	16793				15.60	16
18	Arvin	Kern	19761				33.96	17
19	Atascadero	San Luis Obispo	28825				22.83	18
20	Atherton	San Mateo	7060				17.56	19
21	Atwater	Merced	28891				48.46	20
22	Auburn	Placer	13787	44	3.19	249	18.06	21
23	Avalon	Los Angeles	3795	13	3.43	64	16.86	22

Figure 9-6. *Formatting column as number*

5. Click the Insert tab and select Launch Power Map under Map. If you have previously created a map, you may be prompted to create a New Tour. Accept the default of City, County, and State as the geographic fields, as shown in Figure 9-7. Click Next.



Layer 1

CHOOSE GEOGRAPHY

Cities__California_locations_by_crime_rate

☑ City
☑ County
☐ Key
☐ Population
☐ Property crime rate per 1,000 persons
☐ Property crimes
☑ State
☐ Violent crime rate per 1,000 persons
☐ Violent crimes

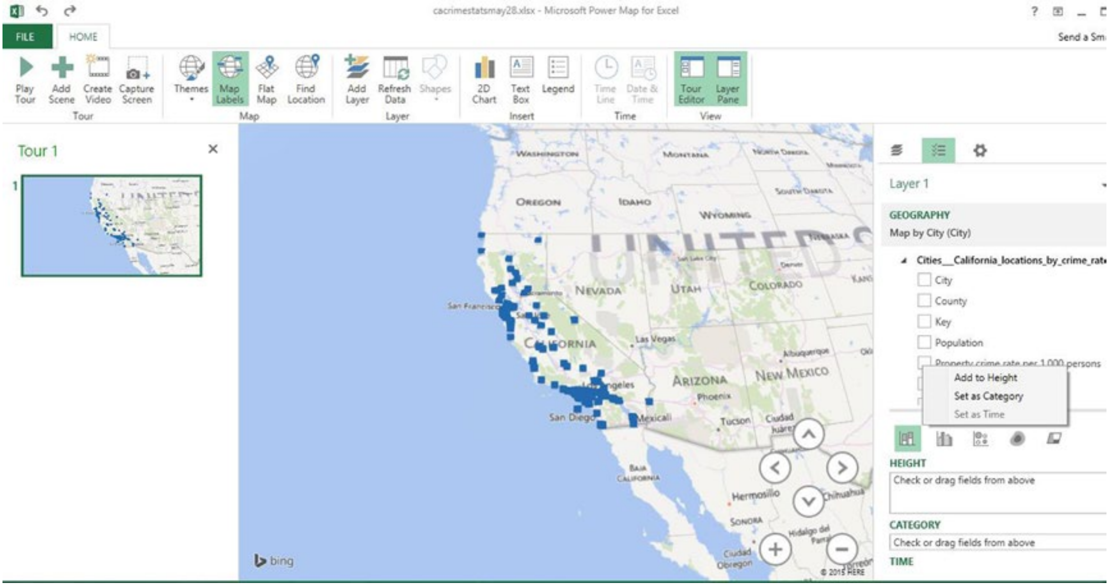
GEOGRAPHY AND MAP LEVEL

● City — City
○ County — County
○ State — State/Province

Next

Figure 9-7. *Setting the geogrpahic fields*

6. Click Map Labels on the ribbon to display city names. In the Layer pane, right-click Property Crimes per 1,000 persons and then click Add to Height, as shown in Figure 9-8. Note that the Bing Mapping service is showing a certainty of 94% for the geographic mapping in the upper right corner. If you want to go back and edit the geographic fields, click the icon above the 94%.



Layer 1

GEOGRAPHY

Map by City (City)

Cities__California_locations_by_crime_rat

☐ City
☐ County
☐ Key
☐ Population
☐ Property crime rate per 1,000 persons

Add to Height
Set as Category
Set as Time

HEIGHT

Check or drag fields from above

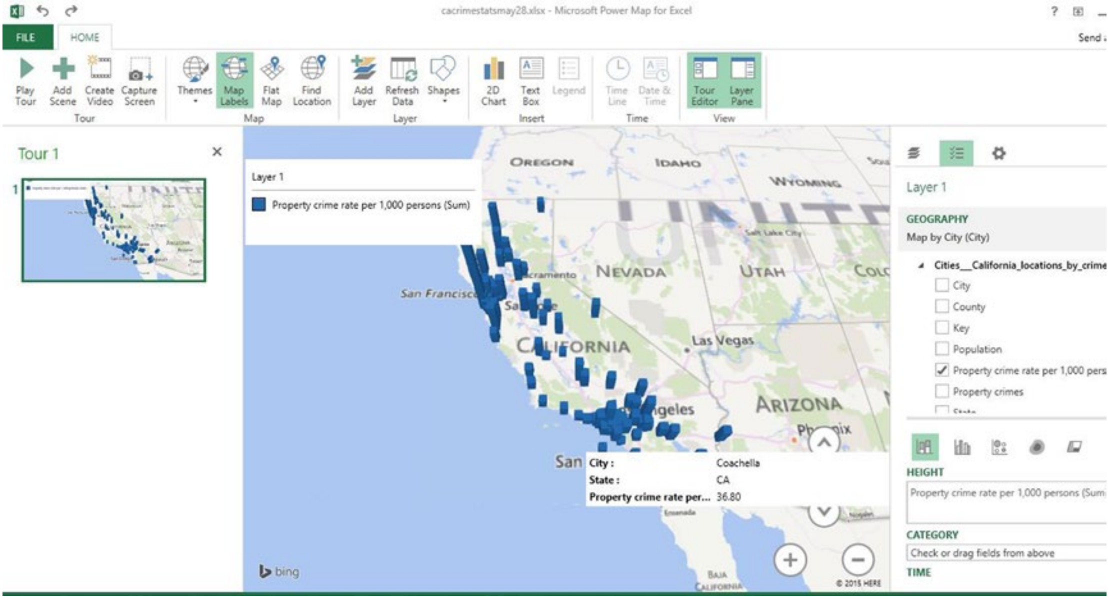
CATEGORY

Check or drag fields from above

TIME

Figure 9-8. *Setting field for height of plot*

7. Click the legend box and resize it to be smaller, then drag it to the upper left part of the map. Click the large + on the lower right side of the map several times to zoom in. The results are shown in Figure 9-9. Note that it is possible to point the mouse at any graphic, to see the details about that city crime rate. It is also possible to double-click any location, to zoom in.



Layer 1
■ Property crime rate per 1,000 persons (Sum)

City : Coachella
State : CA
Property crime rate per... 36.80

Layer 1

GEOGRAPHY
Map by City (City)

Cities__California_locations_by_crime
- ☐ City
- ☐ County
- ☐ Key
- ☐ Population
- ☑ Property crime rate per 1,000 pers
- ☐ Property crimes
- ☐ State

HEIGHT
Property crime rate per 1,000 persons (Sum

CATEGORY
Check or drag fields from above

TIME

Figure 9-9. *Map with legend and detailed crime statistics*

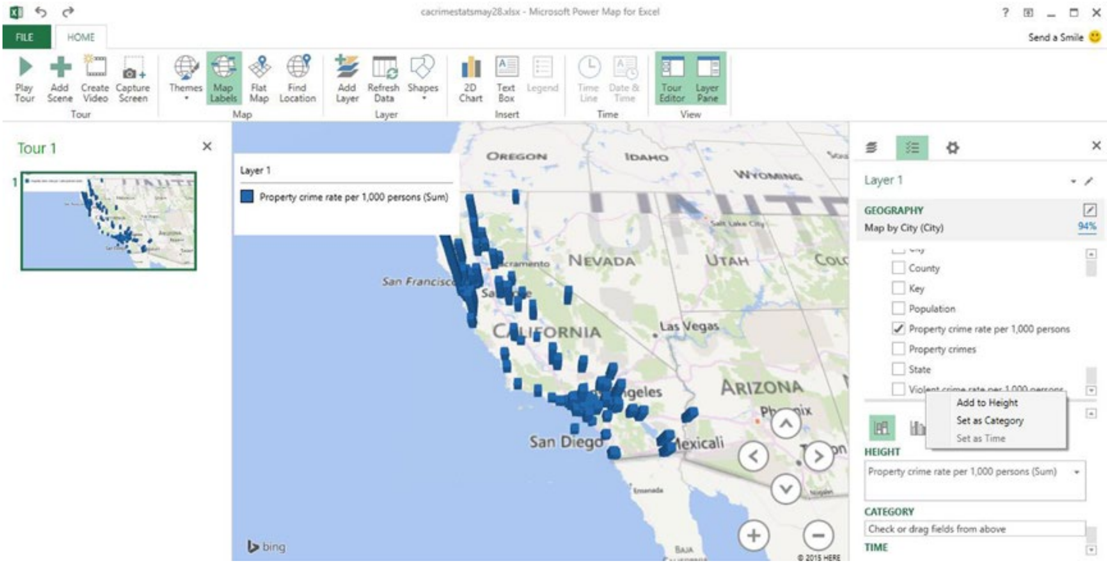
Plotting Multiple Statistics

It is possible to plot multiple metrics—both property crime and violent crime statistics. To do this, let's continue with the example from the preceding section.

EXERCISE 9-2. MAPPING CALIFORNIA CRIME STATISTICS, PART 2

You can plot the property crime and violent crime statistics by following these steps:

1. In the Layer pane, right-click Property crime rate per 1,000 persons and select Add to Height, as shown in Figure 9-10.



Layer 1

■ Property crime rate per 1,000 persons (Sum)

Layer 1

GEOGRAPHY

Map by City (City) 94%

□ County

□ Key

□ Population

☑ Property crime rate per 1,000 persons

□ Property crimes

□ State

□ Violent crime rate per 1,000 persons

HEIGHT

Property crime rate per 1,000 persons (Sum)

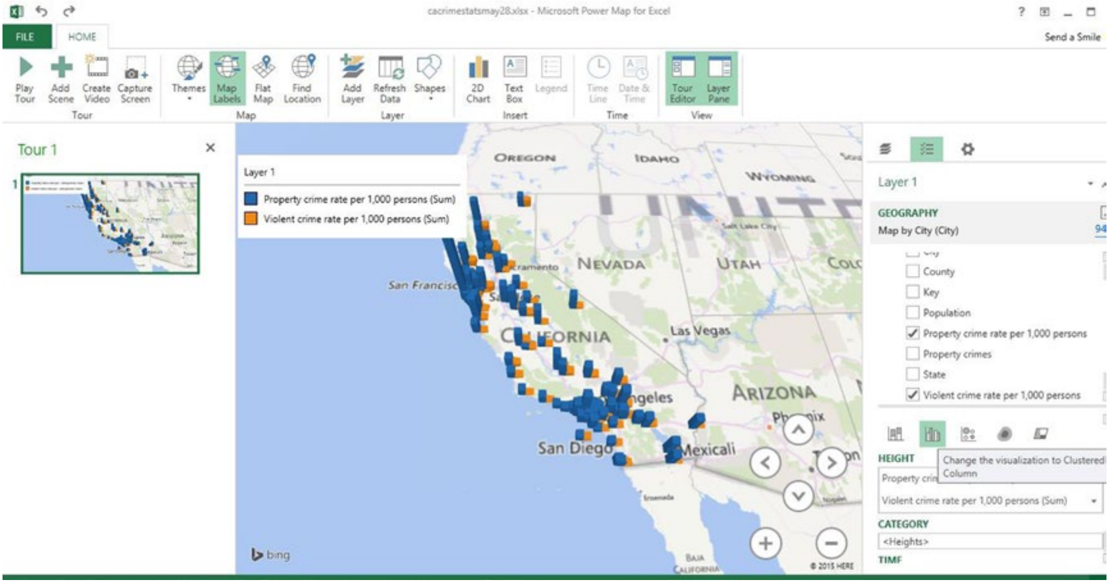
CATEGORY

Check or drag fields from above

TIME

Figure 9-10. *Adding violent crimes metric*

2. Note that the default view is stacked column. This can be changed to clustered column by clicking the icon to the right of stacked column, as shown in Figure 9-11. The property crime rate is shown in blue, and the violent crime rate in orange.



Layer 1

■ Property crime rate per 1,000 persons (Sum)

■ Violent crime rate per 1,000 persons (Sum)

Layer 1

GEOGRAPHY

Map by City (City) 94

□ County

□ Key

□ Population

☑ Property crime rate per 1,000 persons

□ Property crimes

□ State

☑ Violent crime rate per 1,000 persons

HEIGHT

Property crim

Violent crime rate per 1,000 persons (Sum)

CATEGORY

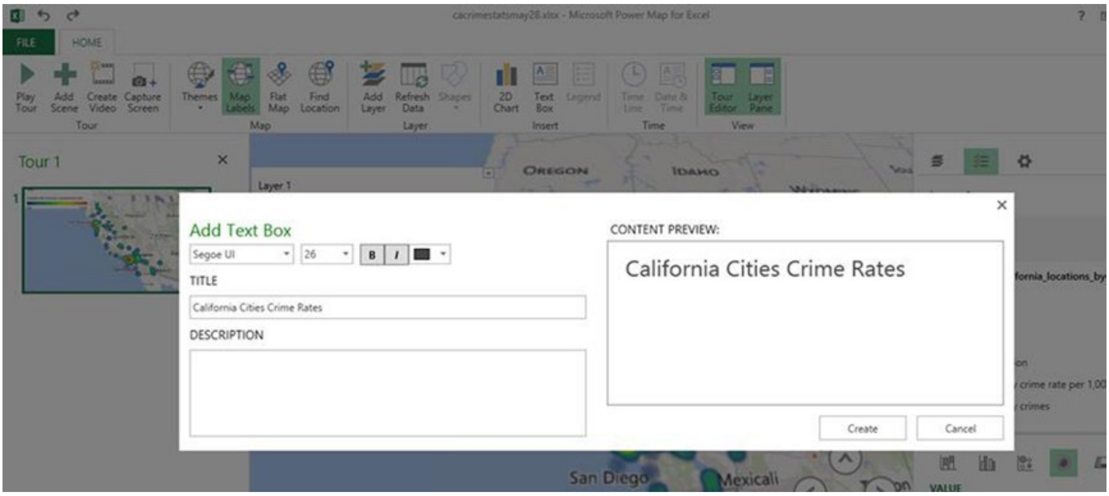
<Heights>

TIME

Figure 9-11. *Display of both property crime and violent crime metric*

3. Click Add Scene on the left end of the ribbon.

4. Click the Text Box icon on the ribbon and add the title “California Cities Crime Rates,” as shown in Figure 9-12.



cacrimestatsmay28.xlsx - Microsoft Power Map for Excel

Add Text Box

Segoe UI · 26

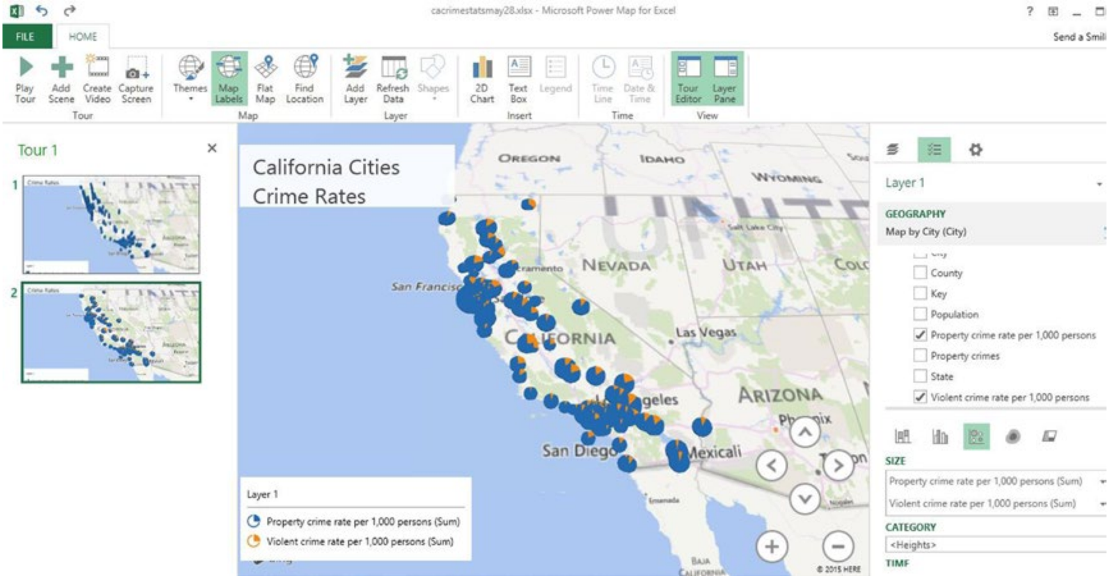
TITLE: California Cities Crime Rates

DESCRIPTION:

CONTENT PREVIEW: California Cities Crime Rates

Figure 9-12. *Adding a title to the map*

5. Change the view to the bubble view, which is like a pie chart. The text box can be resized and dragged to the appropriate location on the map, as shown in Figure 9-13.



cacrimestatsmay28.xlsx - Microsoft Power Map for Excel

California Cities Crime Rates

Layer 1
- Property crime rate per 1,000 persons (Sum)
- Violent crime rate per 1,000 persons (Sum)

Layer 1

GEOGRAPHY
Map by City (City)

□ County
□ Key
□ Population
☑ Property crime rate per 1,000 persons
□ Property crimes
□ State
☑ Violent crime rate per 1,000 persons

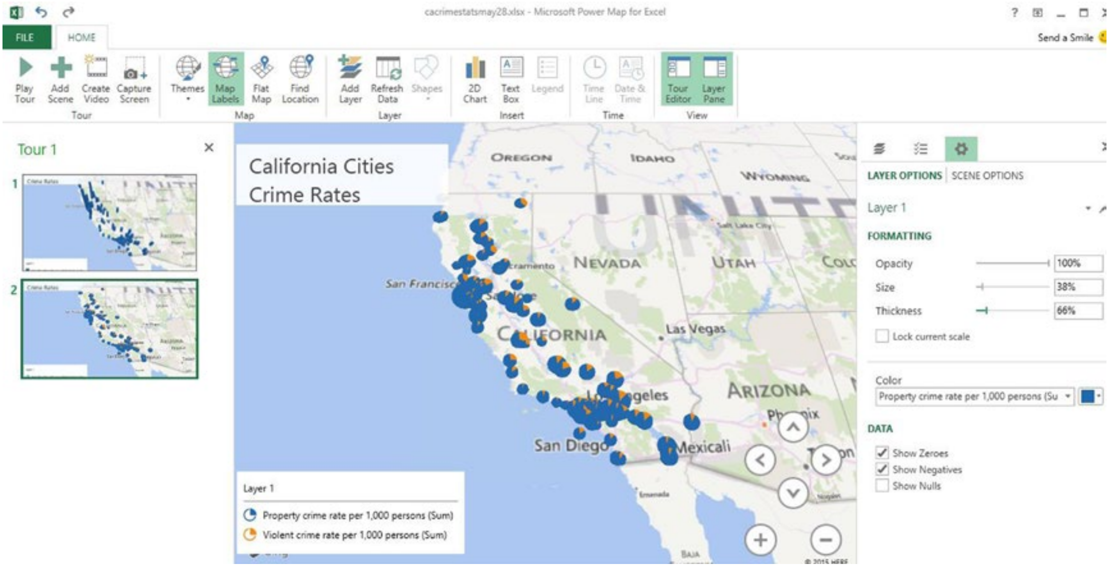
SIZE
Property crime rate per 1,000 persons (Sum)
Violent crime rate per 1,000 persons (Sum)

CATEGORY
<Heights>

TIME

Figure 9-13. *Bubble view of data*

6. The size of the bubbles can be adjusted by clicking the gear icon at the top right of the Layer pane, selecting Layer Options, and adjusting the size slider, as shown in Figure 9-14.



cacrimestatsmay28.xlsx - Microsoft Power Map for Excel

California Cities Crime Rates

Layer 1
- ● Property crime rate per 1,000 persons (Sum)
- ● Violent crime rate per 1,000 persons (Sum)

LAYER OPTIONS | SCENE OPTIONS

Layer 1

FORMATTING

Opacity 100%

Size 38%

Thickness 66%

☐ Lock current scale

Color: Property crime rate per 1,000 persons (Su

DATA

☑ Show Zeroes

☑ Show Negatives

☐ Show Nulls

Figure 9-14. *Adusting bubble size*

7. Click the Add Scene on the left end of the ribbon.

8. Another view is the heat map view shown in Figure 9-15. Note that San Francisco and Los Angeles, the two largest cities in California, have the most crime.

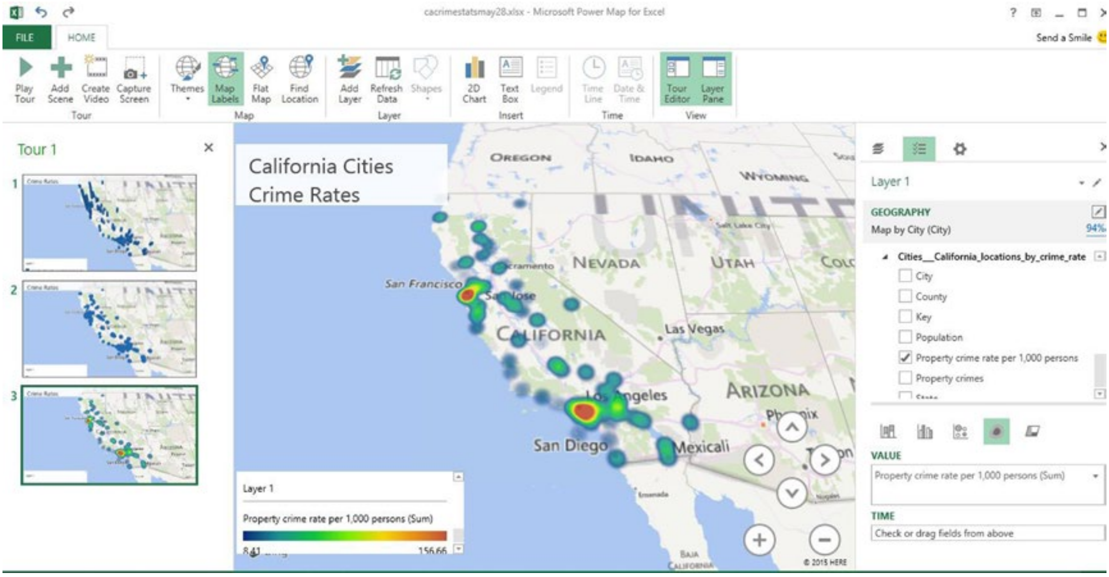


***Figure 9-15.** Heat map view of data*

Adding a 2D Chart

A two dimensional chart for Property crime rate per 1,000 persons can be added by clicking 2D Chart on the ribbon. The results are shown in Figure 9-16.

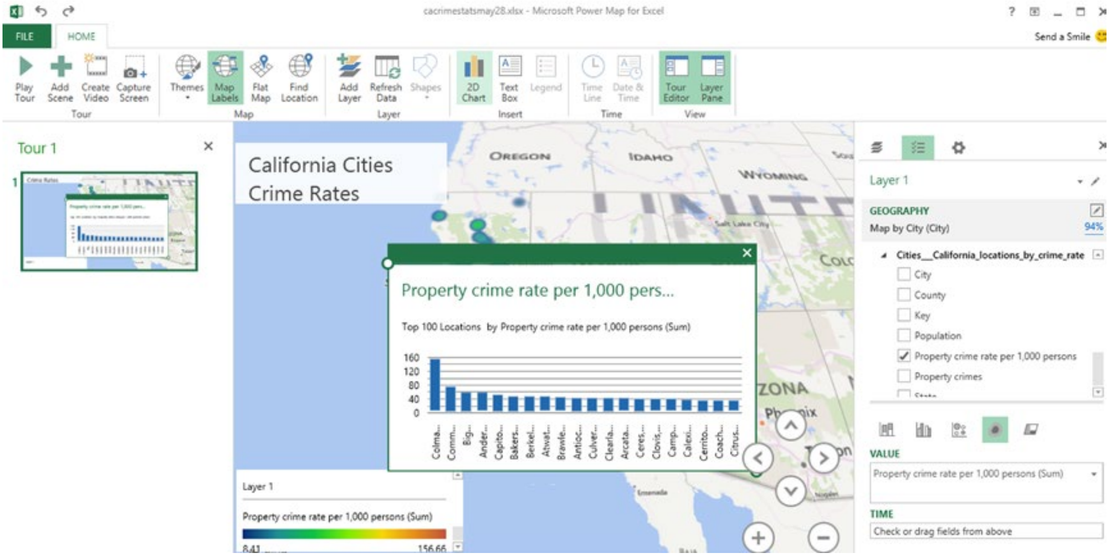
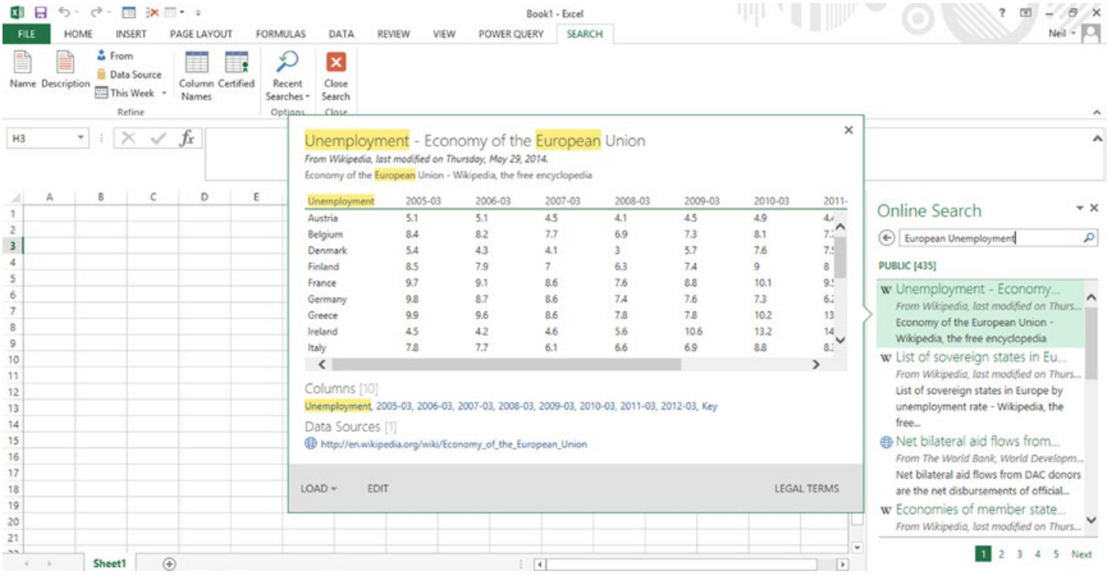


***Figure 9-16.** 2D chart*

EXERCISE 9-3. PLOTTING EUROPEAN UNEMPLOYMENT RATES EXAMPLE

This example will show how to load data about European unemployment rates into Power Query and how to plot it using Power Map. It will also show how to unpivot data in order to add a time animation. Follow these steps:

1. Click the Power Query tab and select Data Catalog Search.
2. Type "European Unemployment" into the search box. Hover the mouse over each of the results to get a preview of the data, as shown in Figure 9-17.



Unemployment - Economy of the European Union

From Wikipedia, last modified on Thursday, May 29, 2014.

Economy of the European Union - Wikipedia, the free encyclopedia

Unemployment	2005-03	2006-03	2007-03	2008-03	2009-03	2010-03	2011-
Austria	5.1	5.1	4.5	4.1	4.5	4.9	4.
Belgium	8.4	8.2	7.7	6.9	7.3	8.1	7.
Denmark	5.4	4.3	4.1	3	5.7	7.6	7.
Finland	8.5	7.9	7	6.3	7.4	9	8
France	9.7	9.1	8.6	7.6	8.8	10.1	9.
Germany	9.8	8.7	8.6	7.4	7.6	7.3	6.
Greece	9.9	9.6	8.6	7.8	7.8	10.2	13
Ireland	4.5	4.2	4.6	5.6	10.6	13.2	14
Italy	7.8	7.7	6.1	6.6	6.9	8.8	8.

Columns [10]

Unemployment, 2005-03, 2006-03, 2007-03, 2008-03, 2009-03, 2010-03, 2011-03, 2012-03, Key

Data Sources [1]

http://en.wikipedia.org/wiki/Economy_of_the_European_Union

Online Search

European Unemployment

PUBLIC [435]

Unemployment - Economy...
From Wikipedia, last modified on Thurs...
Economy of the European Union - Wikipedia, the free encyclopedia

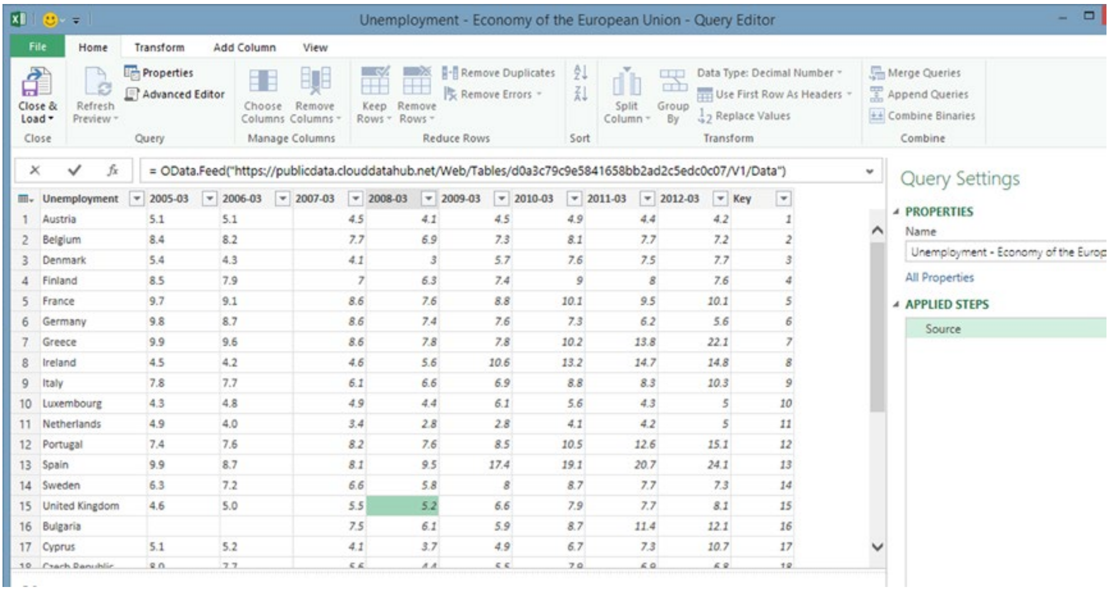
List of sovereign states in Eu...
From Wikipedia, last modified on Thurs...
List of sovereign states in Europe by unemployment rate - Wikipedia, the free...

Net bilateral aid flows from...
From The World Bank, World Developm...
Net bilateral aid flows from DAC donors are the net disbursements of official...

Economies of member state...
From Wikipedia, last modified on Thurs...

***Figure 9-17.** Preview of European unemployment data*

3. Select Edit, at the bottom of the preview screen, to load the data into the Query Editor, as shown in Figure 9-18.



= OData.Feed("https://publicdata.clouddatahub.net/Web/Tables/d0a3c79c9e5841658bb2ad2c5edc0c07/V1/Data")

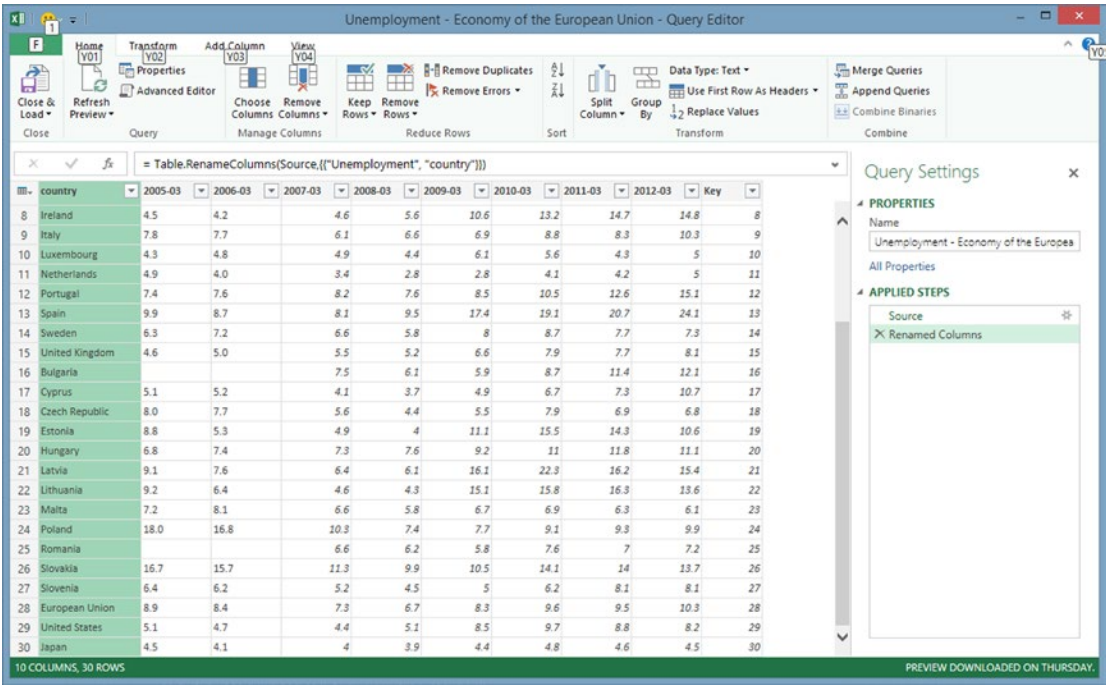
	Unemployment	2005-03	2006-03	2007-03	2008-03	2009-03	2010-03	2011-03	2012-03	Key
1	Austria	5.1	5.1	4.5	4.1	4.5	4.9	4.4	4.2	1
2	Belgium	8.4	8.2	7.7	6.9	7.3	8.1	7.7	7.2	2
3	Denmark	5.4	4.3	4.1	3	5.7	7.6	7.5	7.7	3
4	Finland	8.5	7.9	7	6.3	7.4	9	8	7.6	4
5	France	9.7	9.1	8.6	7.6	8.8	10.1	9.5	10.1	5
6	Germany	9.8	8.7	8.6	7.4	7.6	7.3	6.2	5.6	6
7	Greece	9.9	9.6	8.6	7.8	7.8	10.2	13.8	22.1	7
8	Ireland	4.5	4.2	4.6	5.6	10.6	13.2	14.7	14.8	8
9	Italy	7.8	7.7	6.1	6.6	6.9	8.8	8.3	10.3	9
10	Luxembourg	4.3	4.8	4.9	4.4	6.1	5.6	4.3	5	10
11	Netherlands	4.9	4.0	3.4	2.8	2.8	4.1	4.2	5	11
12	Portugal	7.4	7.6	8.2	7.6	8.5	10.5	12.6	15.1	12
13	Spain	9.9	8.7	8.1	9.5	17.4	19.1	20.7	24.1	13
14	Sweden	6.3	7.2	6.6	5.8	8	8.7	7.7	7.3	14
15	United Kingdom	4.6	5.0	5.5	5.2	6.6	7.9	7.7	8.1	15
16	Bulgaria			7.5	6.1	5.9	8.7	11.4	12.1	16
17	Cyprus	5.1	5.2	4.1	3.7	4.9	6.7	7.3	10.7	17
18	Czech Republic	8.0	7.7	5.6	4.4	5.5	7.0	6.9	6.8	18

Figure 9-18. *Unemployment data in Query Editor*

4. Check the shape of the data to see if there any extraneous columns. In this case, the columns include the country names and the unemployment rate by year and a key column that uses sequential numbering. Also, check the rows. Notice that there are rows for US and Japanese unemployment, as well as European.

5. Also, check the data type for each column to see if it is the correct type. To check the data type, select the column by clicking the heading and note the data type shown in the upper right section of the ribbon. To change the data type, select a column, click the arrow after Data Type on the ribbon, and select the correct data type. Notice that the data type for 2005 and 2006 is text and that for the other years is Decimal Number. Use this approach to change the type of all numeric columns to Decimal Number.

6. Check the column headings. Notice that the heading for the column with the country names is Unemployment, which is not descriptive. To change the column name, right-click the column heading and select Rename. Rename it to country, as shown in Figure 9-19. Notice that the column rename is listed under Applied Steps in the Query Settings pane on the right side of the screen.



= Table.RenameColumns(Source,{{"Unemployment", "country"}})

	country	2005-03	2006-03	2007-03	2008-03	2009-03	2010-03	2011-03	2012-03	Key
8	Ireland	4.5	4.2	4.6	5.6	10.6	13.2	14.7	14.8	8
9	Italy	7.8	7.7	6.1	6.6	6.9	8.8	8.3	10.3	9
10	Luxembourg	4.3	4.8	4.9	4.4	6.1	5.6	4.3	5	10
11	Netherlands	4.9	4.0	3.4	2.8	2.8	4.1	4.2	5	11
12	Portugal	7.4	7.6	8.2	7.6	8.5	10.5	12.6	15.1	12
13	Spain	9.9	8.7	8.1	9.5	17.4	19.1	20.7	24.1	13
14	Sweden	6.3	7.2	6.6	5.8	8	8.7	7.7	7.3	14
15	United Kingdom	4.6	5.0	5.5	5.2	6.6	7.9	7.7	8.1	15
16	Bulgaria			7.5	6.1	5.9	8.7	11.4	12.1	16
17	Cyprus	5.1	5.2	4.1	3.7	4.9	6.7	7.3	10.7	17
18	Czech Republic	8.0	7.7	5.6	4.4	5.5	7.9	6.9	6.8	18
19	Estonia	8.8	5.3	4.9	4	11.1	15.5	14.3	10.6	19
20	Hungary	6.8	7.4	7.3	7.6	9.2	11	11.8	11.1	20
21	Latvia	9.1	7.6	6.4	6.1	16.1	22.3	16.2	15.4	21
22	Lithuania	9.2	6.4	4.6	4.3	15.1	15.8	16.3	13.6	22
23	Malta	7.2	8.1	6.6	5.8	6.7	6.9	6.3	6.1	23
24	Poland	18.0	16.8	10.3	7.4	7.7	9.1	9.3	9.9	24
25	Romania			6.6	6.2	5.8	7.6	7	7.2	25
26	Slovakia	16.7	15.7	11.3	9.9	10.5	14.1	14	13.7	26
27	Slovenia	6.4	6.2	5.2	4.5	5	6.2	8.1	8.1	27
28	European Union	8.9	8.4	7.3	6.7	8.3	9.6	9.5	10.3	28
29	United States	5.1	4.7	4.4	5.1	8.5	9.7	8.8	8.2	29
30	Japan	4.5	4.1	4	3.9	4.4	4.8	4.6	4.5	30

Query Settings

PROPERTIES

Name: Unemployment - Economy of the Europea

APPLIED STEPS: Source; Renamed Columns

10 COLUMNS, 30 ROWS

PREVIEW DOWNLOADED ON THURSDAY.

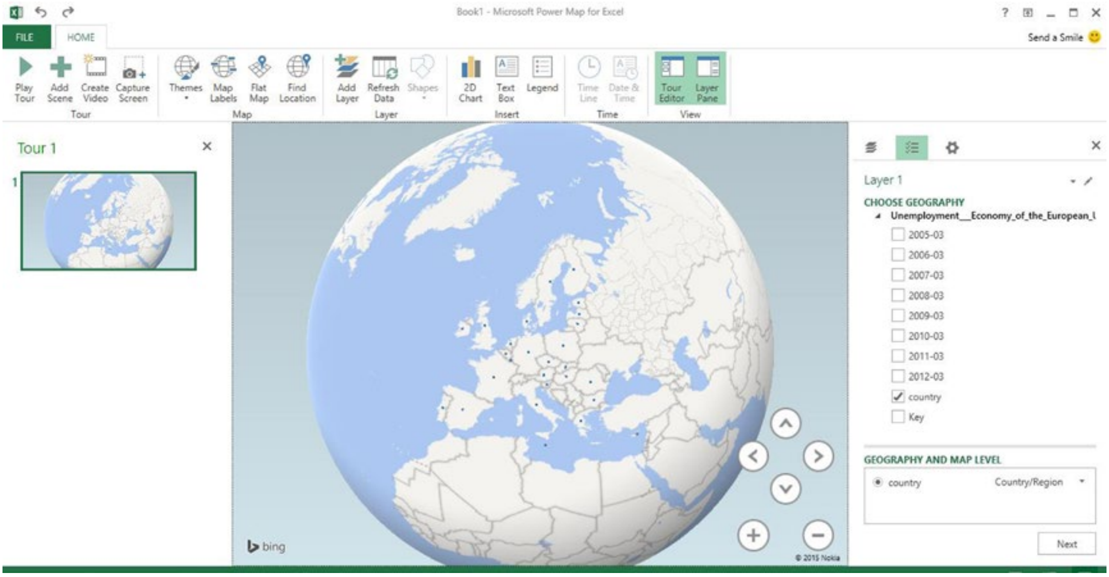
Figure 9-19. *Query Editor after renaming country column*

7. When the data is shaped the way you want it, select Close & Load at the leftmost side of the Query Editor ribbon to load the data into a spreadsheet. Note that data can also be loaded into a Data Model, but for this example, a spreadsheet will be used.

8. This would be a good time to save the spreadsheet and name it “European Unemployment.”

9. To start the mapping, select the Insert tab and Map and then Launch Power Map.

10. The screen shown in Figure 9-20 will appear. Note that in the Layer pane, on the right side of the screen, country is selected as the geographic field. Click Next.



Layer 1

CHOOSE GEOGRAPHY

Unemployment__Economy_of_the_European_l

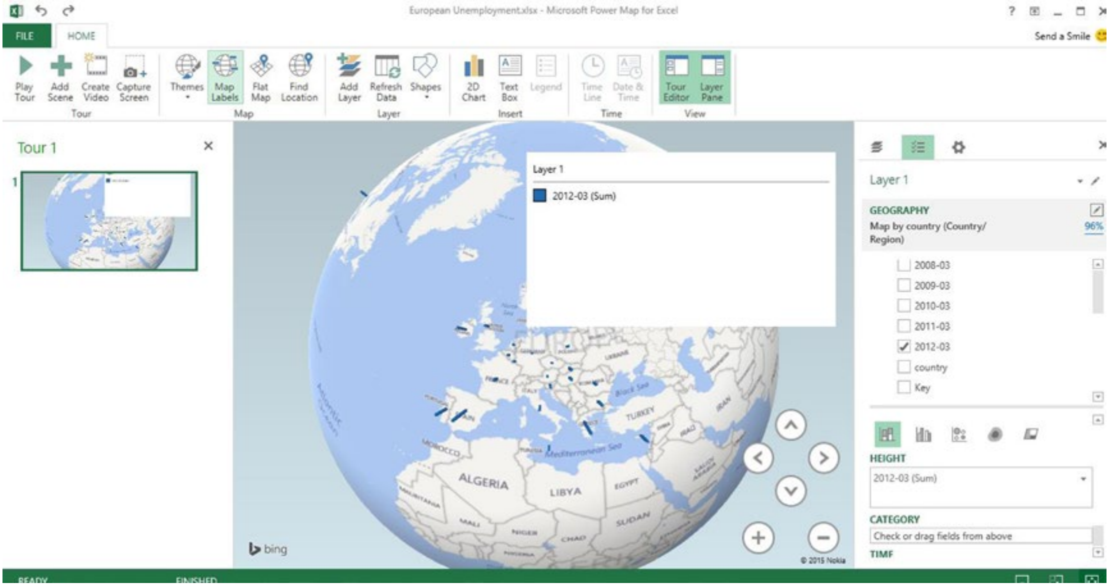
- □ 2005-03
- □ 2006-03
- □ 2007-03
- □ 2008-03
- □ 2009-03
- □ 2010-03
- □ 2011-03
- □ 2012-03
- ☑ country
- □ Key

GEOGRAPHY AND MAP LEVEL

● country Country/Region

Figure 9-20. *Country selected as geographic field*

11. Note that dots appear in each country that has data. Click Map Labels on the ribbon to display country names and select the numeric field that will be plotted. In this case, the 2012 unemployment rate will be checked, so that it can be plotted, as shown in Figure 9-21. Note that when the field is checked, it is added to the Height box. The default format is stacked column, and the default aggregation of the numeric values is sum. Pointing the mouse at a column on the map will display the unemployment rate for that country in 2012.



Layer 1
■ 2012-03 (Sum)

Layer 1

GEOGRAPHY
Map by country (Country/Region) 96%

- □ 2008-03
- □ 2009-03
- □ 2010-03
- □ 2011-03
- ☑ 2012-03
- □ country
- □ Key

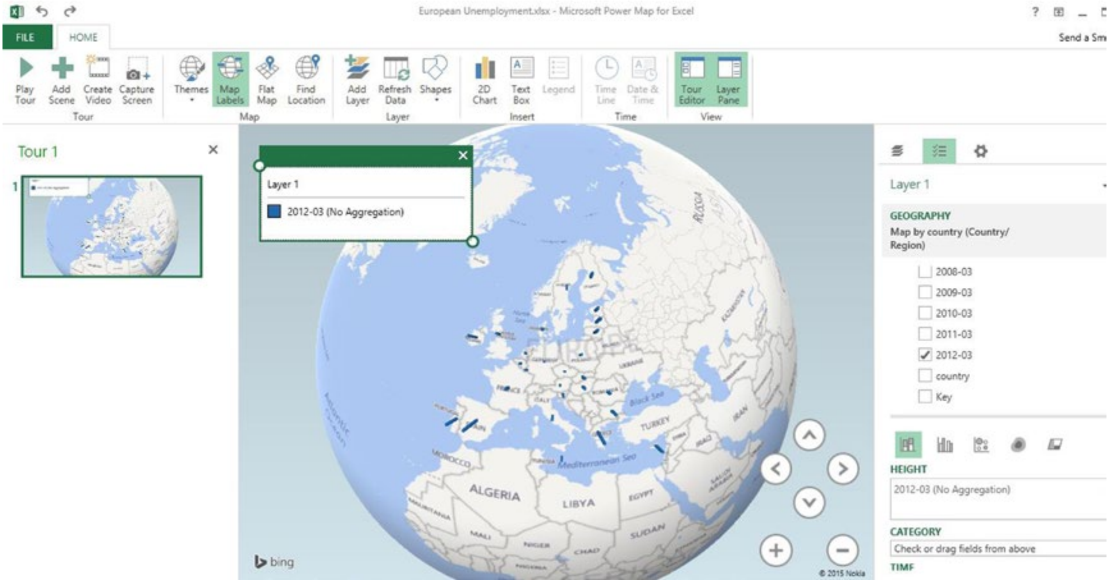
HEIGHT
2012-03 (Sum)

CATEGORY
Check or drag fields from above

TIME

__Figure 9-21.__ 2012 unemployment shown as a bar chart

12. Change the aggregation to none by clicking the arrow at the right side of the Height box and selecting No Aggregation. Resize the legend box by clicking it and using the handles, and drag it to reposition it on the left side of the map, as shown in Figure 9-22.



Layer 1
■ 2012-03 (No Aggregation)

Layer 1

GEOGRAPHY
Map by country (Country/Region)

- □ 2008-03
- □ 2009-03
- □ 2010-03
- □ 2011-03
- ☑ 2012-03
- □ country
- □ Key

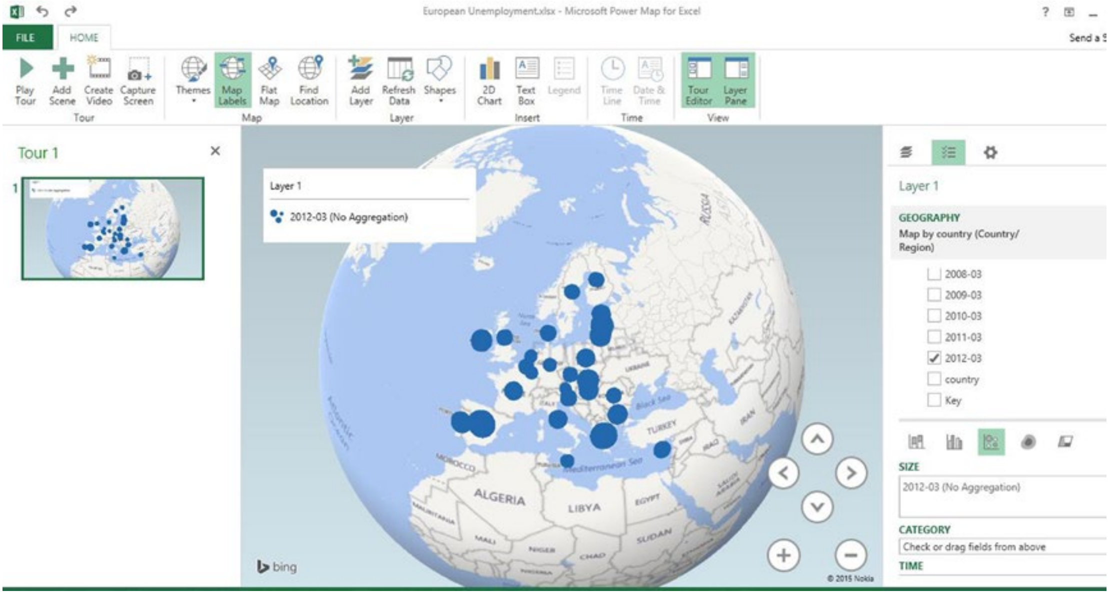
HEIGHT
2012-03 (No Aggregation)

CATEGORY
Check or drag fields from above

TIME

__Figure 9-22.__ Map after moving legend box and changing aggregation to none

13. Experiment with the different visualization formats by clicking the icons above the word *Height* in the Layer pane, to view the clustered column, bubble, heat map, and region. Note that because only one set of data is being shown, the clustered column and stacked column format are the same. A bubble view is shown in Figure 9-23.



Layer 1

2012-03 (No Aggregation)

Layer 1

GEOGRAPHY
Map by country (Country/Region)

□ 2008-03
□ 2009-03
□ 2010-03
□ 2011-03
☑ 2012-03
□ country
□ Key

SIZE
2012-03 (No Aggregation)

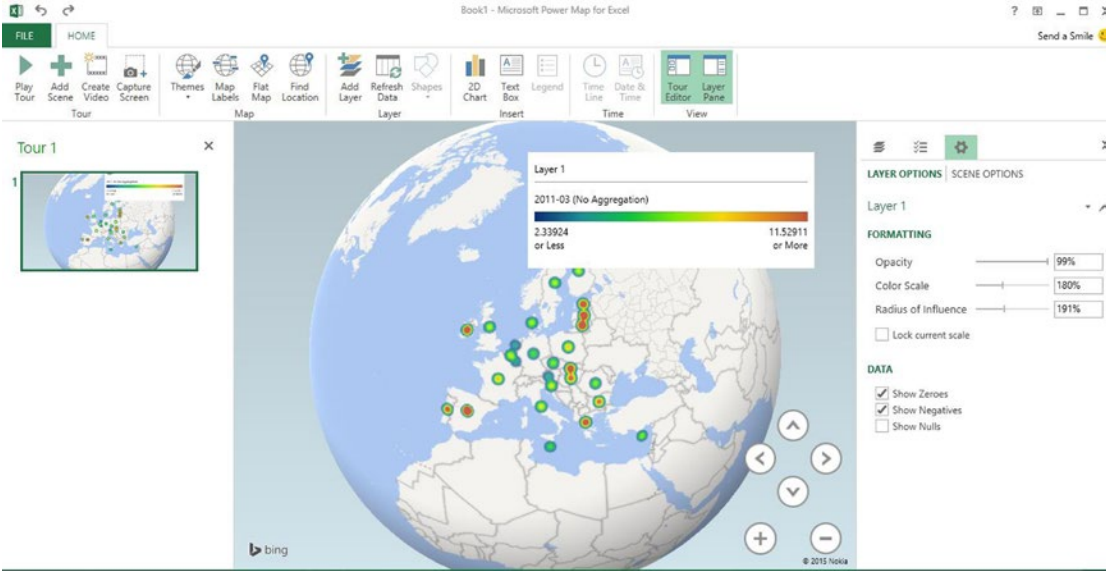
CATEGORY
Check or drag fields from above

TIME

Figure 9-23. *Bubble view*

14. To zoom in on a map, click the large + sign at the bottom right of the map or double-click an area of the map to zoom in.

15. To change the opacity, size, or thickness of the bubble, click the gear icon on the right, at the top of the Layer pane. Figure 9-24 shows a heat map view with the color scale set to 180%, the radius of the heat map to 191%, and opacity at 99%. The legend box for Layer 1 shows the color key based on the unemployment rate. Note that you can also decide whether to show zeroes, negatives, and nulls, by checking or unchecking the box.



Layer 1

2011-03 (No Aggregation)

2.33924 or Less — 11.52911 or More

LAYER OPTIONS | SCENE OPTIONS

Layer 1

FORMATTING

Opacity 99%

Color Scale 180%

Radius of Influence 191%

☐ Lock current scale

DATA

☑ Show Zeroes

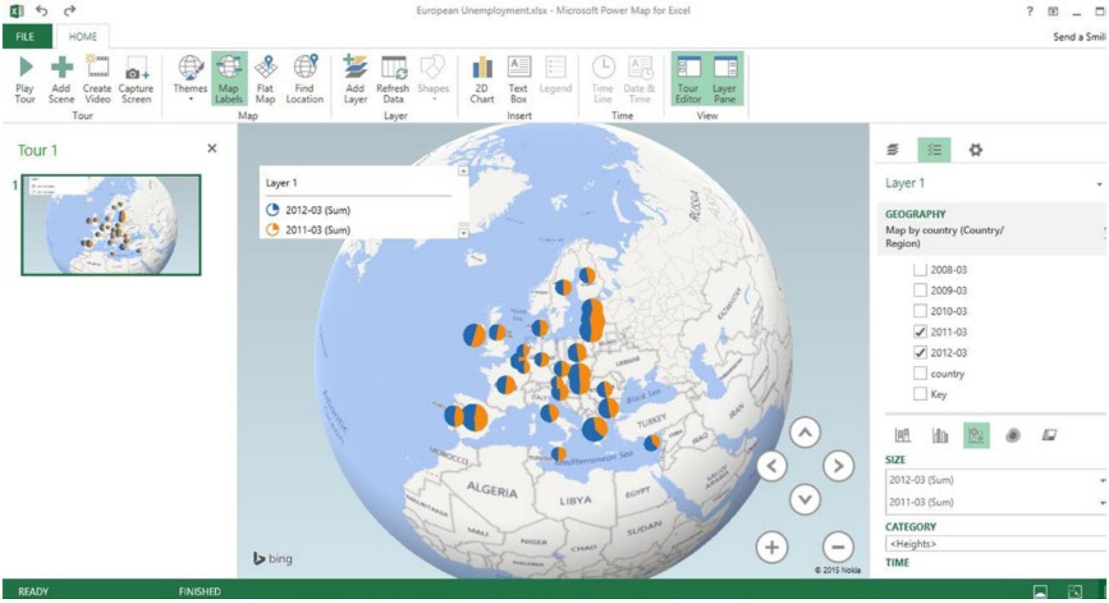
☑ Show Negatives

☐ Show Nulls

***Figure 9-24.** Heat map view*

Showing Two or More Values

Two or more values can be displayed, such as showing unemployment rates in two different years. Using the example from the preceding section, Figure 9-25 shows the employment rates for 2011 (orange) and 2012 (blue) as a bubble. Pointing the mouse at the color on the bubble will show the unemployment rate for that year.



Layer 1

2012-03 (Sum)

2011-03 (Sum)

Layer 1

GEOGRAPHY

Map by country (Country/Region)

☐ 2008-03

☐ 2009-03

☐ 2010-03

☑ 2011-03

☑ 2012-03

☐ country

☐ Key

SIZE

2012-03 (Sum)

2011-03 (Sum)

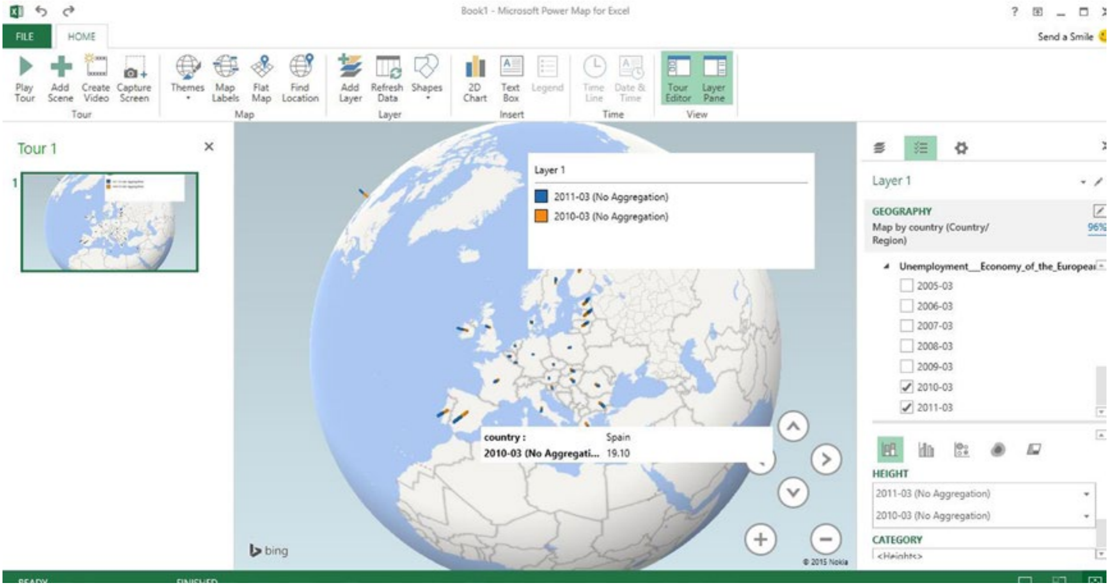
CATEGORY

<Heights>

TIME

***Figure 9-25.** Bubble view*

Figure 9-26 shows the unemployment rates for 2010 (orange) and 2011 (blue) as stacked bar columns. Pointing the mouse at the color on the stacked bar will show the unemployment rate for that year.



Layer 1

🟦 2011-03 (No Aggregation)

🟧 2010-03 (No Aggregation)

country : Spain

2010-03 (No Aggregati... 19.10

Layer 1

GEOGRAPHY

Map by country (Country/Region) 96%

Unemployment__Economy_of_the_Europear

□ 2005-03

□ 2006-03

□ 2007-03

□ 2008-03

□ 2009-03

☑ 2010-03

☑ 2011-03

HEIGHT

2011-03 (No Aggregation)

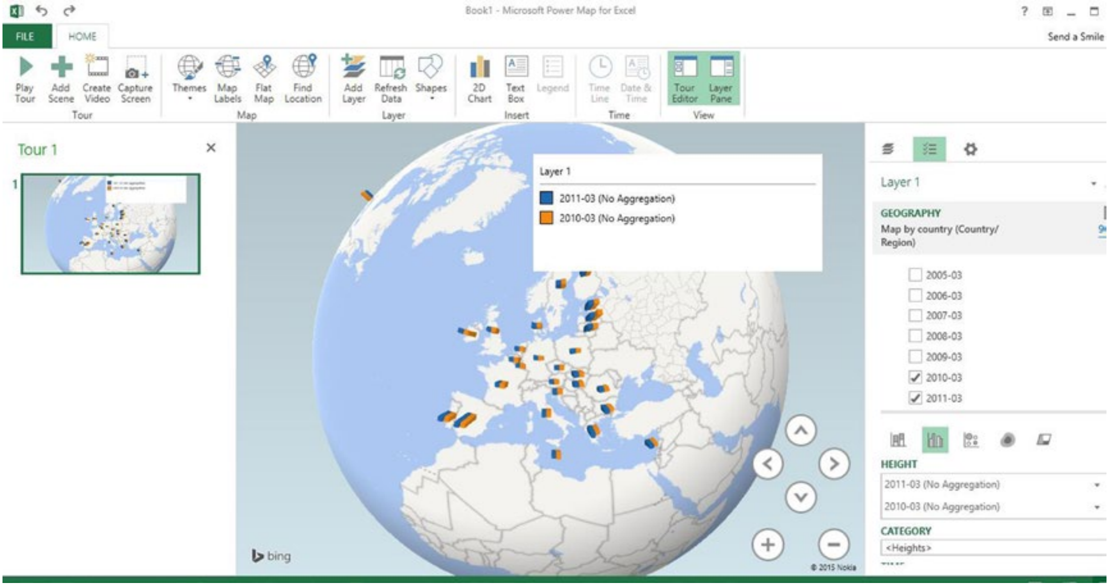
2010-03 (No Aggregation)

CATEGORY

<Heights>

Figure 9-26. *Stacked bar view*

The same data shown with clustered columns, where the columns are side-by-side, is shown in Figure 9-27.



Layer 1

🟦 2011-03 (No Aggregation)

🟧 2010-03 (No Aggregation)

Layer 1

GEOGRAPHY

Map by country (Country/Region)

□ 2005-03

□ 2006-03

□ 2007-03

□ 2008-03

□ 2009-03

☑ 2010-03

☑ 2011-03

HEIGHT

2011-03 (No Aggregation)

2010-03 (No Aggregation)

CATEGORY

<Heights>

Figure 9-27. *Clustered column view*

Creating a 2D Chart

A two-dimensional chart showing the progression over time can be plotted by checking a series of years and then clicking 2D Chart on the ribbon. The result is shown in Figure 9-28. Hovering the mouse over the 2D chart will bring up a box with a down arrow after the title, which allows changing the chart type.

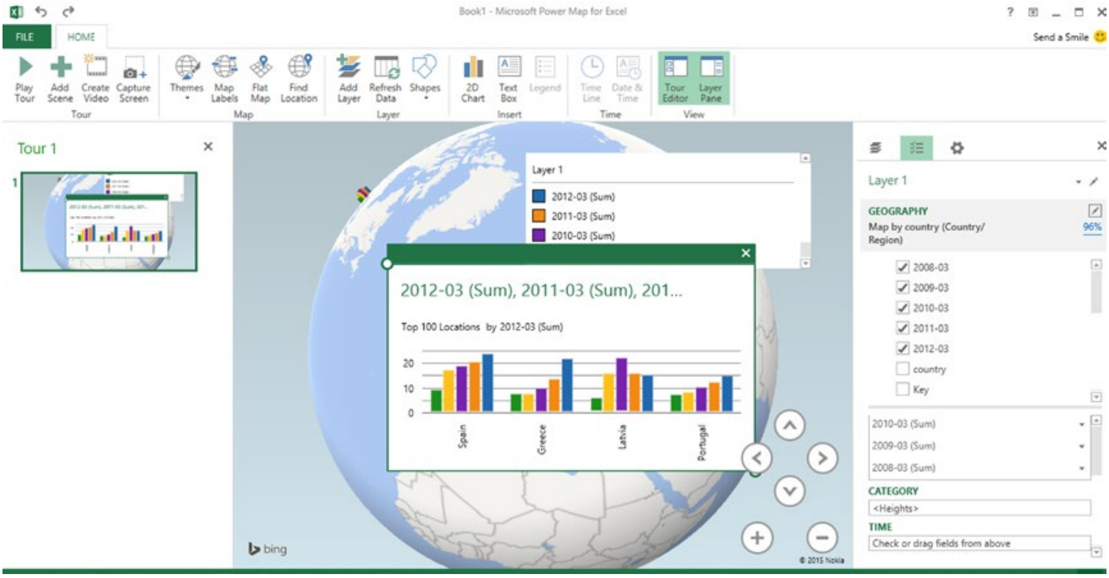
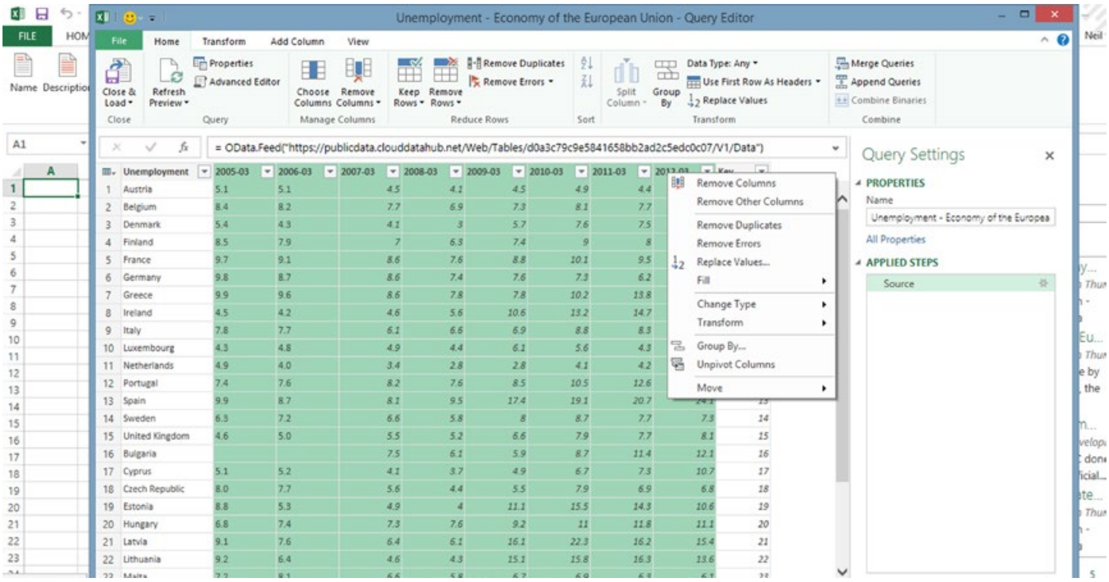


Figure 9-28. *2D chart*

EXERCISE 9-4. BUILDING A TIME ANIMATION EXERCISE

It is possible to animate a presentation to show the map values at different times. To do this, it is necessary to unpivot the data to indicate that a value is shown for each country for each year. To start from scratch, go back to steps 1–3 at the beginning of “Exercise 9-3. Plotting European Unemployment Rates Example” to load the data into the Query Editor, or click Recent Sources on the PowerPivot tab and select the data there.

1. In the Query Editor, click the first year column heading to select the column. Then Ctrl-click the other year column headings to select all year columns, or after selecting the first year column, Shift-click the last year column to select all year columns. Right-click one of the selected column headings and select Unpivot Columns, as shown in Figure 9-29.

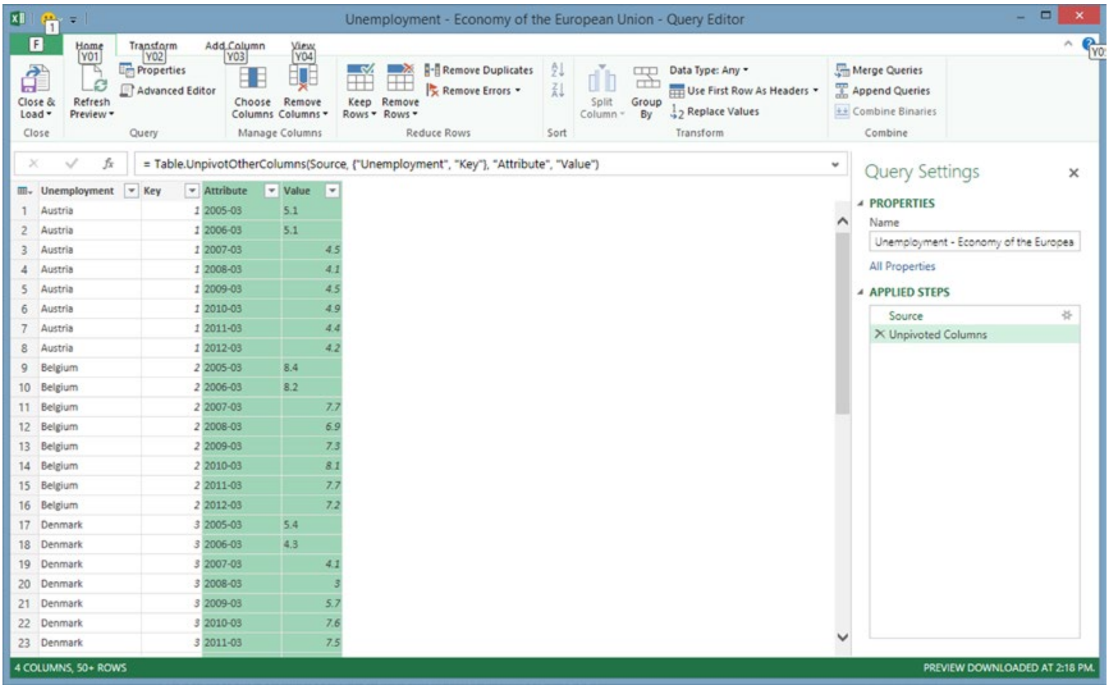


= OData.Feed("https://publicdata.clouddatahub.net/Web/Tables/d0a3c79c9e5841658bb2ad2c5edc0c07/V1/Data")

	Unemployment	2005-03	2006-03	2007-03	2008-03	2009-03	2010-03	2011-03	2012-03	Key
1	Austria	5.1	5.1	4.5	4.1	4.5	4.9	4.4		
2	Belgium	8.4	8.2	7.7	6.9	7.3	8.1	7.7		
3	Denmark	5.4	4.3	4.1	3	5.7	7.6	7.5		
4	Finland	8.5	7.9	7	6.3	7.4	9	8		
5	France	9.7	9.1	8.6	7.6	8.8	10.1	9.5		
6	Germany	9.8	8.7	8.6	7.4	7.6	7.3	6.2		
7	Greece	9.9	9.6	8.6	7.8	7.8	10.2	13.8		
8	Ireland	4.5	4.2	4.6	5.6	10.6	13.2	14.7		
9	Italy	7.8	7.7	6.1	6.6	6.9	8.8	8.3		
10	Luxembourg	4.3	4.8	4.9	4.4	6.1	5.6	4.3		
11	Netherlands	4.9	4.0	3.4	2.8	2.8	4.1	4.2		
12	Portugal	7.4	7.6	8.2	7.6	8.5	10.5	12.6		
13	Spain	9.9	8.7	8.1	9.5	17.4	19.1	20.7		
14	Sweden	6.3	7.2	6.6	5.8	8	8.7	7.7	7.3	14
15	United Kingdom	4.6	5.0	5.5	5.2	6.6	7.9	7.7	8.1	15
16	Bulgaria			7.5	6.1	5.9	8.7	11.4	12.1	16
17	Cyprus	5.1	5.2	4.1	3.7	4.9	6.7	7.3	10.7	17
18	Czech Republic	8.0	7.7	5.6	4.4	5.5	7.9	6.9	6.8	18
19	Estonia	8.8	5.3	4.9	4	11.1	15.5	14.3	10.6	19
20	Hungary	6.8	7.4	7.3	7.6	9.2	11	11.8	11.1	20
21	Latvia	9.1	7.6	6.4	6.1	16.1	22.3	16.2	15.4	21
22	Lithuania	9.2	6.4	4.6	4.3	15.1	15.8	16.3	13.6	22

***Figure 9-29.** Context menu showing the Unpivot Columns option*

2. The results are shown in Figure 9-30. One row has been created for each country and year.

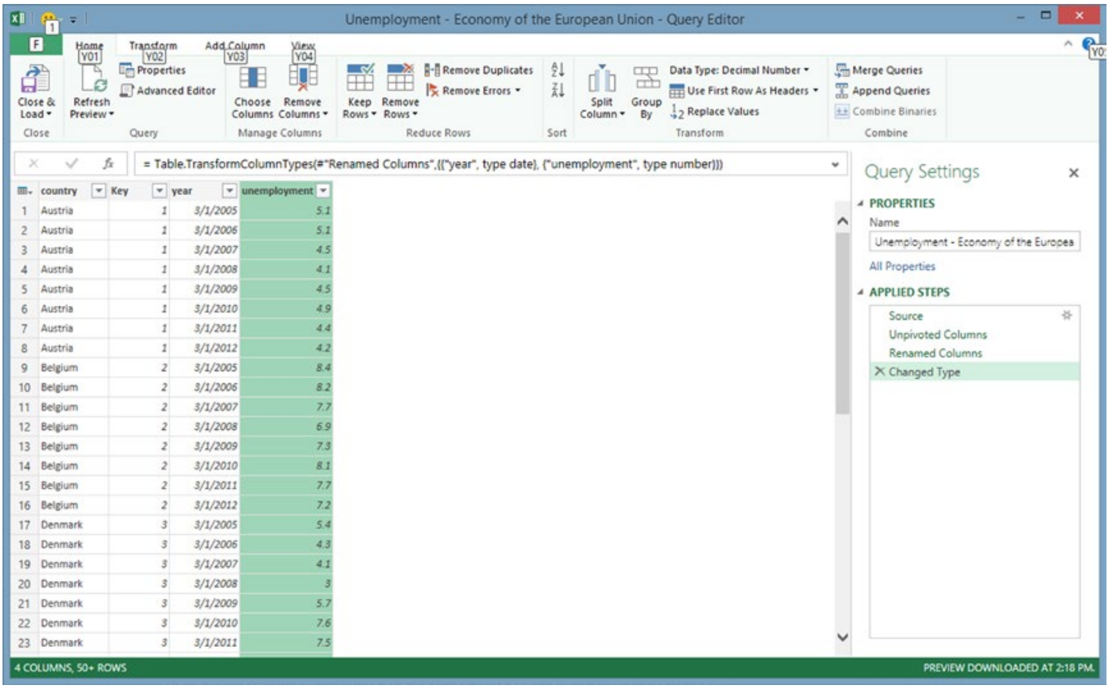


= Table.UnpivotOtherColumns(Source, {"Unemployment", "Key"}, "Attribute", "Value")

	Unemployment	Key	Attribute	Value
1	Austria	1	2005-03	5.1
2	Austria	1	2006-03	5.1
3	Austria	1	2007-03	4.5
4	Austria	1	2008-03	4.1
5	Austria	1	2009-03	4.5
6	Austria	1	2010-03	4.9
7	Austria	1	2011-03	4.4
8	Austria	1	2012-03	4.2
9	Belgium	2	2005-03	8.4
10	Belgium	2	2006-03	8.2
11	Belgium	2	2007-03	7.7
12	Belgium	2	2008-03	6.9
13	Belgium	2	2009-03	7.3
14	Belgium	2	2010-03	8.1
15	Belgium	2	2011-03	7.7
16	Belgium	2	2012-03	7.2
17	Denmark	3	2005-03	5.4
18	Denmark	3	2006-03	4.3
19	Denmark	3	2007-03	4.1
20	Denmark	3	2008-03	3
21	Denmark	3	2009-03	5.7
22	Denmark	3	2010-03	7.6
23	Denmark	3	2011-03	7.5

***Figure 9-30.** Unpivoted data*

3. Note that the column containing the year is labeled Attribute, which is not descriptive. Right-click the column heading and select Rename to change the name to year. Make sure that only the Attribute column is selected. Then change the data type to date, by selecting the column and clicking the down arrow after Data Type on the top-right side of the ribbon and selecting date. Change the name of the unemployment column to country, change the name of the value column to unemployment, and change the type of the column to decimal number. After changing the type of the unemployment column to decimal number, all data will be right-justified. The data should appear as shown in Figure 9-31. Note that the Applied Steps are shown in the Query Settings pane on the right side of the screen.



= Table.TransformColumnTypes(#"Renamed Columns",{{"year", type date}, {"unemployment", type number}})

	country	Key	year	unemployment
1	Austria	1	3/1/2005	5.1
2	Austria	1	3/1/2006	5.1
3	Austria	1	3/1/2007	4.5
4	Austria	1	3/1/2008	4.1
5	Austria	1	3/1/2009	4.5
6	Austria	1	3/1/2010	4.9
7	Austria	1	3/1/2011	4.4
8	Austria	1	3/1/2012	4.2
9	Belgium	2	3/1/2005	8.4
10	Belgium	2	3/1/2006	8.2
11	Belgium	2	3/1/2007	7.7
12	Belgium	2	3/1/2008	6.9
13	Belgium	2	3/1/2009	7.3
14	Belgium	2	3/1/2010	8.1
15	Belgium	2	3/1/2011	7.7
16	Belgium	2	3/1/2012	7.2
17	Denmark	3	3/1/2005	5.4
18	Denmark	3	3/1/2006	4.3
19	Denmark	3	3/1/2007	4.1
20	Denmark	3	3/1/2008	3
21	Denmark	3	3/1/2009	5.7
22	Denmark	3	3/1/2010	7.6
23	Denmark	3	3/1/2011	7.5

4 COLUMNS, 50+ ROWS

Query Settings

PROPERTIES

Name: Unemployment - Economy of the Europea

All Properties

APPLIED STEPS

- Source
- Unpivoted Columns
- Renamed Columns
- Changed Type

PREVIEW DOWNLOADED AT 2:18 PM.

Figure 9-31. *Spreadsheet after renaming columns*

4. Select Close & Load to save to a spreadsheet.

5. At this point, it is important to check the columns for any extraneous data types. For example, if a date column has non-date values, it will not map properly. The best way to check is to sort the columns from lowest to highest and highest to lowest, by pulling down the arrow at the top of each numeric and date column. This process may reveal a row containing only dots, as shown in Figure 9-32. If this is the case, delete this row by highlighting the row, right-clicking, and selecting delete and table rows.

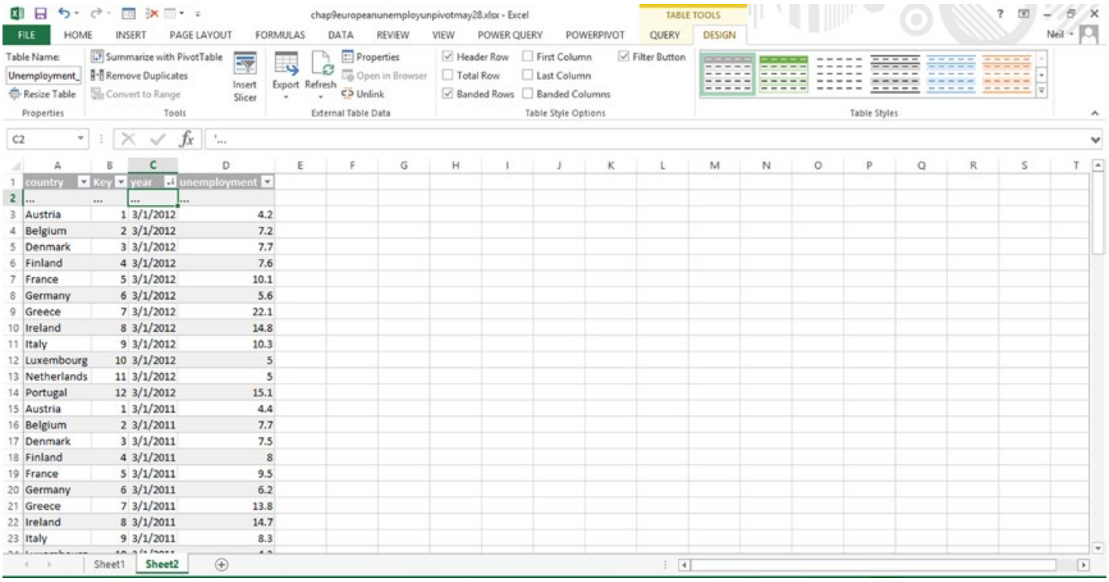

chap9europeanunemployunpivotmay28.xlsx - Excel
TABLE TOOLS
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWER QUERY POWERPIVOT QUERY DESIGN
Properties
Tools
External Table Data
Table Style Options
Table Styles

Table Name: Unemployment_

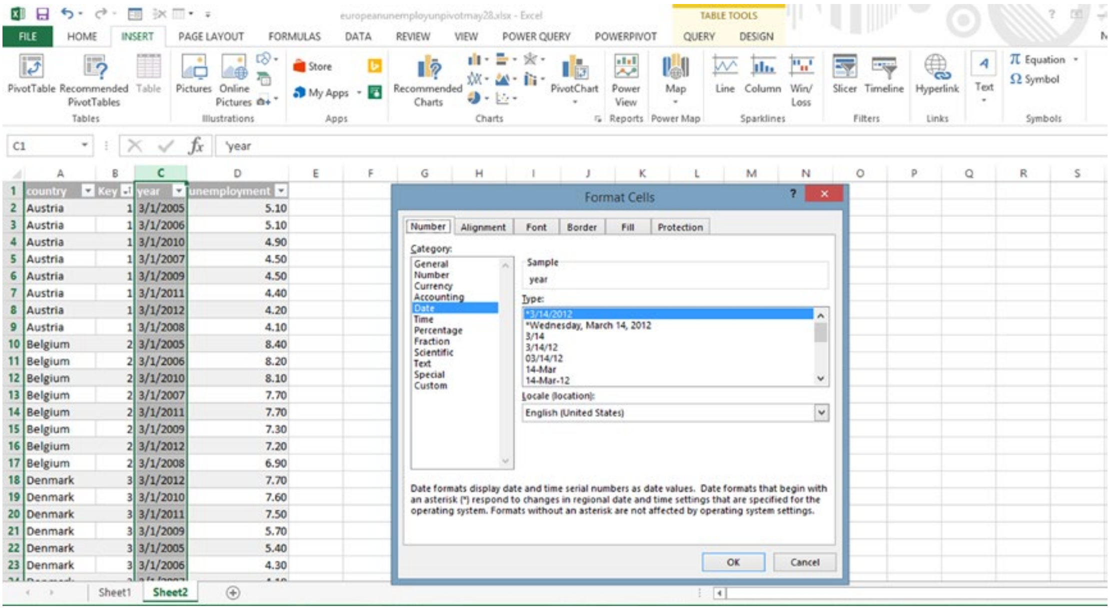
☑ Header Row ☐ First Column ☑ Filter Button
☐ Total Row ☐ Last Column
☑ Banded Rows ☐ Banded Columns

C2 '...

	A	B	C	D
1	country	Key	year	unemployment
2	...	...	...	...
3	Austria	1	3/1/2012	4.2
4	Belgium	2	3/1/2012	7.2
5	Denmark	3	3/1/2012	7.7
6	Finland	4	3/1/2012	7.6
7	France	5	3/1/2012	10.1
8	Germany	6	3/1/2012	5.6
9	Greece	7	3/1/2012	22.1
10	Ireland	8	3/1/2012	14.8
11	Italy	9	3/1/2012	10.3
12	Luxembourg	10	3/1/2012	5
13	Netherlands	11	3/1/2012	5
14	Portugal	12	3/1/2012	15.1
15	Austria	1	3/1/2011	4.4
16	Belgium	2	3/1/2011	7.7
17	Denmark	3	3/1/2011	7.5
18	Finland	4	3/1/2011	8
19	France	5	3/1/2011	9.5
20	Germany	6	3/1/2011	6.2
21	Greece	7	3/1/2011	13.8
22	Ireland	8	3/1/2011	14.7
23	Italy	9	3/1/2011	8.3

***Figure 9-32.** Extraneous row containing ellipses at top*

6. Check the formatting on the year column by selecting the column and right-clicking, making sure that a date format is selected, as shown in Figure 9-33.


europeanunemployunpivotmay28.xlsx - Excel
TABLE TOOLS
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWER QUERY POWERPIVOT QUERY DESIGN
PivotTable Recommended PivotTables Table
Pictures Online Pictures
Store My Apps
Recommended Charts PivotChart Power View Map Line Column Win/Loss Slicer Timeline Hyperlink Text Equation Symbol
Tables Illustrations Apps Charts Reports Power Map Sparklines Filters Links Symbols

C1 'year

	A	B	C	D
1	country	Key	year	unemployment
2	Austria	1	3/1/2005	5.10
3	Austria	1	3/1/2006	5.10
4	Austria	1	3/1/2010	4.90
5	Austria	1	3/1/2007	4.50
6	Austria	1	3/1/2009	4.50
7	Austria	1	3/1/2011	4.40
8	Austria	1	3/1/2012	4.20
9	Austria	1	3/1/2008	4.10
10	Belgium	2	3/1/2005	8.40
11	Belgium	2	3/1/2006	8.20
12	Belgium	2	3/1/2010	8.10
13	Belgium	2	3/1/2007	7.70
14	Belgium	2	3/1/2011	7.70
15	Belgium	2	3/1/2009	7.30
16	Belgium	2	3/1/2012	7.20
17	Belgium	2	3/1/2008	6.90
18	Denmark	3	3/1/2012	7.70
19	Denmark	3	3/1/2010	7.60
20	Denmark	3	3/1/2011	7.50
21	Denmark	3	3/1/2009	5.70
22	Denmark	3	3/1/2005	5.40
23	Denmark	3	3/1/2006	4.30

Format Cells

Category: Date

Sample: year

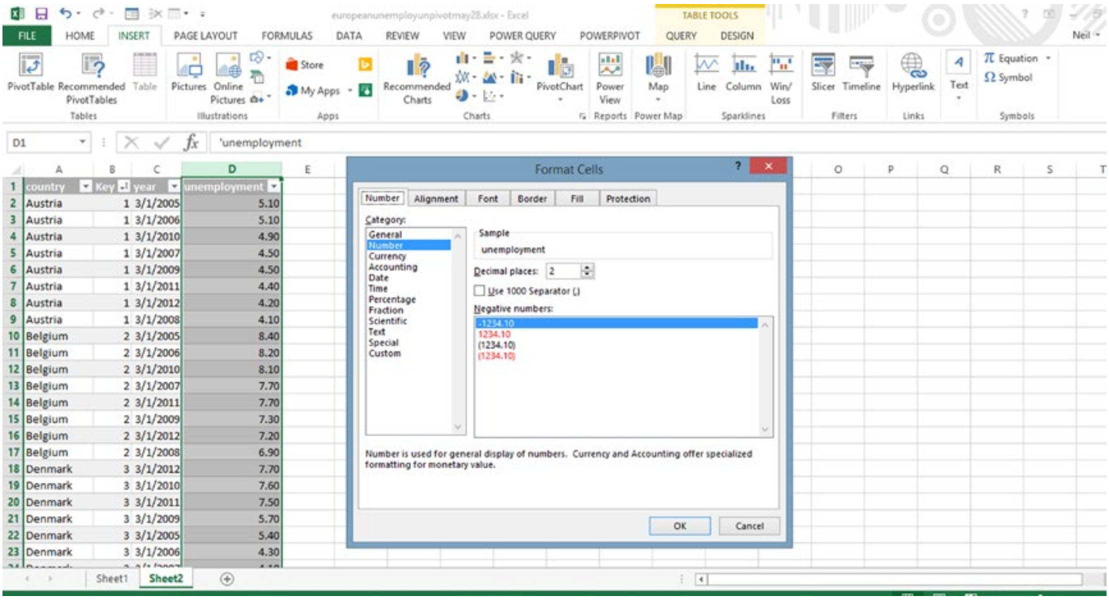
Type: *3/14/2012

Locale (location): English (United States)

Date formats display date and time serial numbers as date values. Date formats that begin with an asterisk (*) respond to changes in regional date and time settings that are specified for the operating system. Formats without an asterisk are not affected by operating system settings.

***Figure 9-33.** Applying date format to year column*

7. Also, check the format for the unemployment column, making sure that it has a number format with two places to the right of the decimal point, as shown in Figure 9-34.



D1 'unemployment

	A	B	C	D
1	country	Key	year	unemployment
2	Austria	1	3/1/2005	5.10
3	Austria	1	3/1/2006	5.10
4	Austria	1	3/1/2010	4.90
5	Austria	1	3/1/2007	4.50
6	Austria	1	3/1/2009	4.50
7	Austria	1	3/1/2011	4.40
8	Austria	1	3/1/2012	4.20
9	Austria	1	3/1/2008	4.10
10	Belgium	2	3/1/2005	8.40
11	Belgium	2	3/1/2006	8.20
12	Belgium	2	3/1/2010	8.10
13	Belgium	2	3/1/2007	7.70
14	Belgium	2	3/1/2011	7.70
15	Belgium	2	3/1/2009	7.30
16	Belgium	2	3/1/2012	7.20
17	Belgium	2	3/1/2008	6.90
18	Denmark	3	3/1/2012	7.70
19	Denmark	3	3/1/2010	7.60
20	Denmark	3	3/1/2011	7.50
21	Denmark	3	3/1/2009	5.70
22	Denmark	3	3/1/2005	5.40
23	Denmark	3	3/1/2006	4.30

Format Cells

Number | Alignment | Font | Border | Fill | Protection

Category: General, **Number**, Currency, Accounting, Date, Time, Percentage, Fraction, Scientific, Text, Special, Custom

Sample: unemployment

Decimal places: 2

□ Use 1000 Separator (,)

Negative numbers:
-1234.10
1234.10
(1234.10)
(1234.10)

Number is used for general display of numbers. Currency and Accounting offer specialized formatting for monetary value.

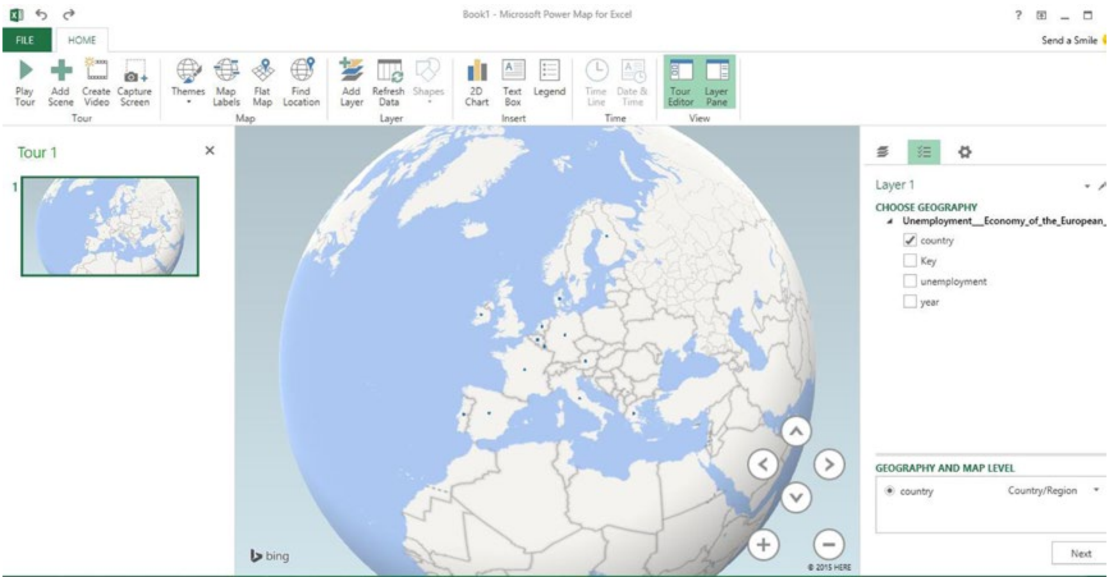
OK | Cancel

Figure 9-34. *Applying number format to unemployment column*

8. Then select the Insert tab and click Map and Launch Power Map.

9. Click the Refresh Data icon on the ribbon. This is important for applying the formatting changes.

10. Confirm that country is the geographic field by clicking Next, as shown in Figure 9-35.



Book1 - Microsoft Power Map for Excel

Tour 1

Layer 1

CHOOSE GEOGRAPHY

Unemployment__Economy_of_the_European_

☑ country

□ Key

□ unemployment

□ year

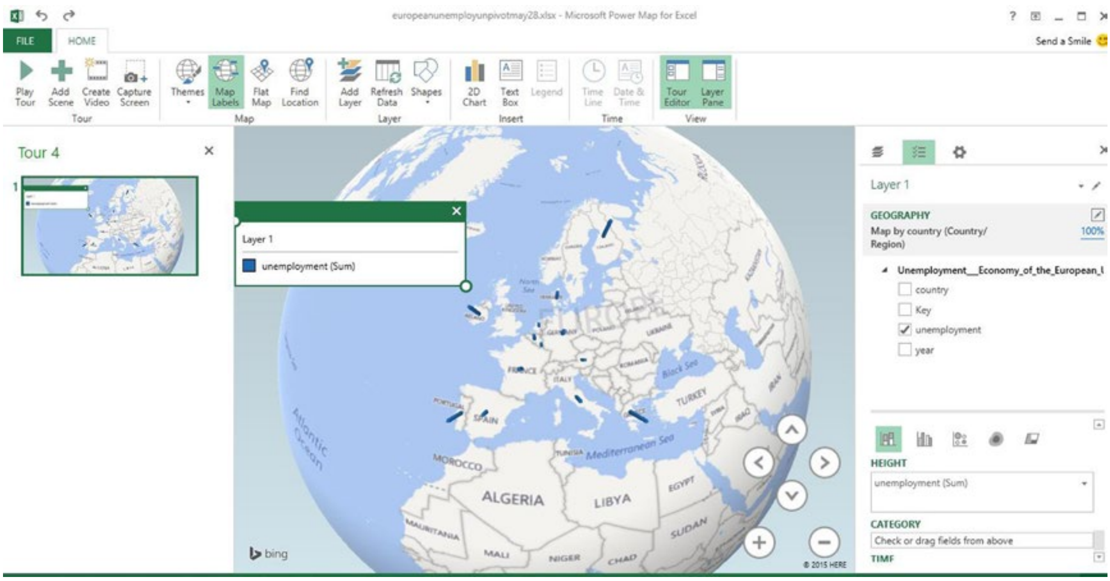
GEOGRAPHY AND MAP LEVEL

● country Country/Region

Next

Figure 9-35. *Defining geographic field*

11. Click Map Labels on the ribbon, then click the unemployment field to select the metric to be plotted and drag the legend box to the left, as shown in Figure 9-36.



europeanunemployunpivotmay28.xlsx - Microsoft Power Map for Excel

Tour 4

Layer 1

■ unemployment (Sum)

Layer 1

GEOGRAPHY

Map by country (Country/Region) 100%

Unemployment__Economy_of_the_European_I

□ country

□ Key

☑ unemployment

□ year

HEIGHT

unemployment (Sum)

CATEGORY

Check or drag fields from above

TIME

Figure 9-36. *Selecting unemployment metric*

12. Change the aggregation of the unemployment field to no aggregation by clicking the arrow after unemployment in the Height window and selecting No Aggregation, as shown in Figure 9-37.

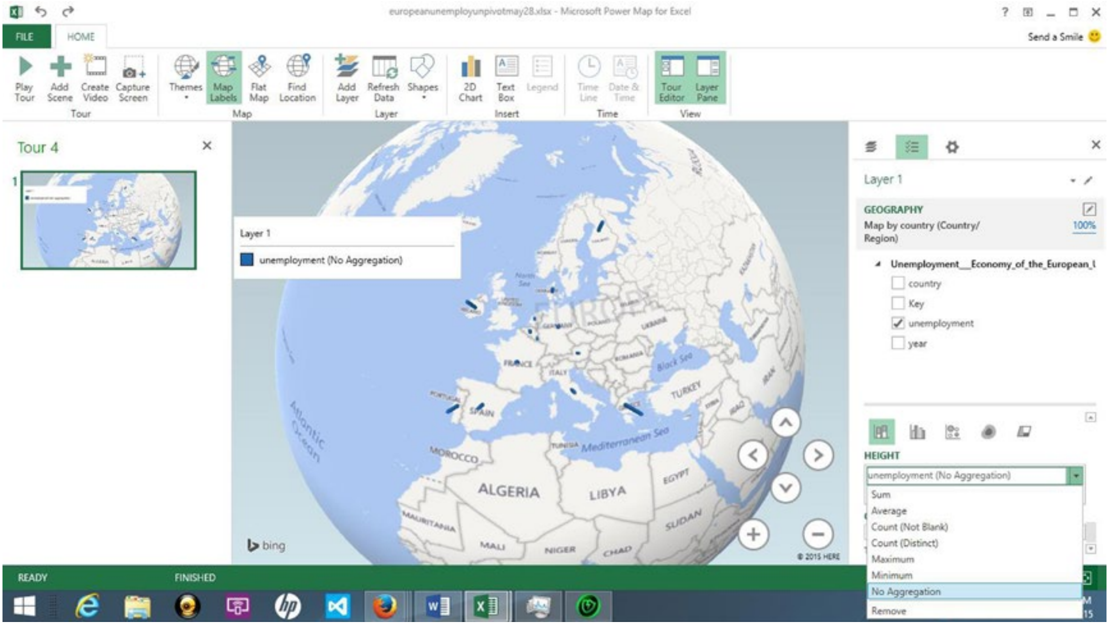


Figure 9-37. *Changing unemployment aggregation to no aggregation*

13. Right-click year and select Set as Time, as shown in Figure 9-38.

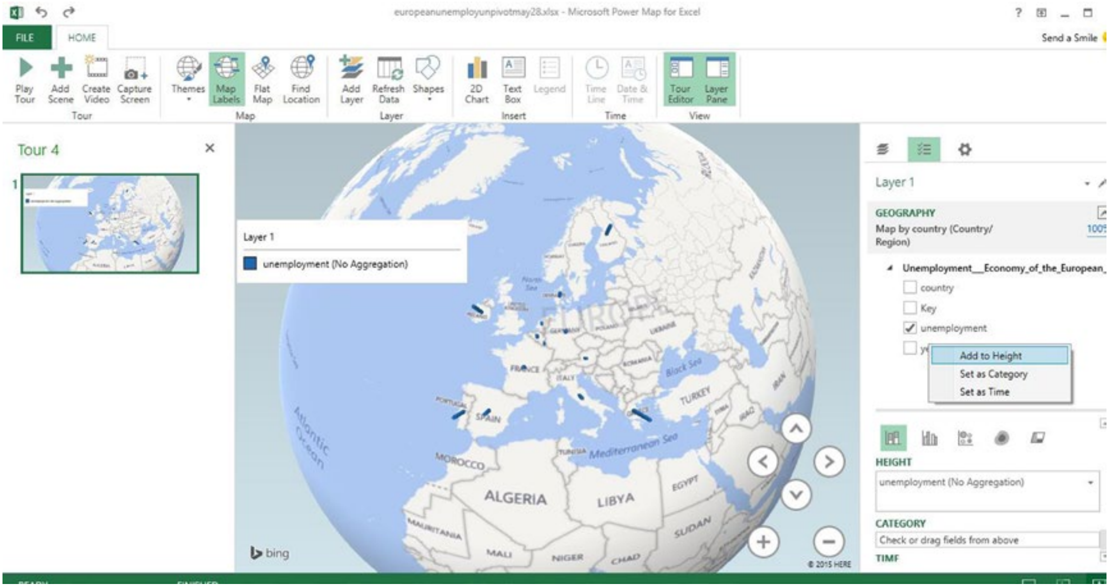


Figure 9-38. *Setting the year as time field*

Notice that a time control appears at the bottom of the map window, and the time appears in a box in the upper left, as shown in Figure 9-39. A time animation can be played by clicking the Play button on the time control at the bottom of the screen.

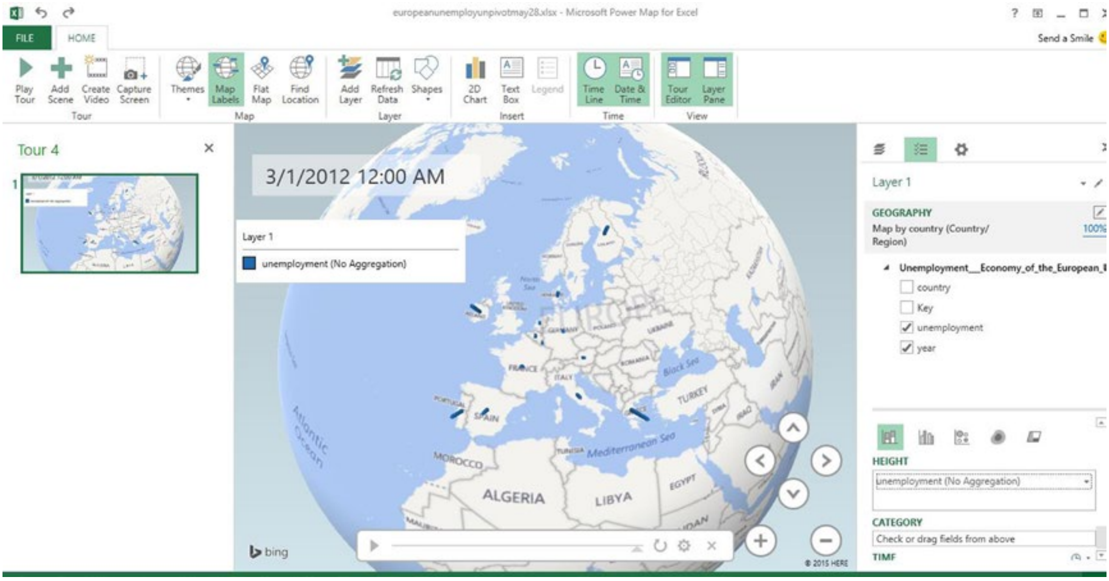
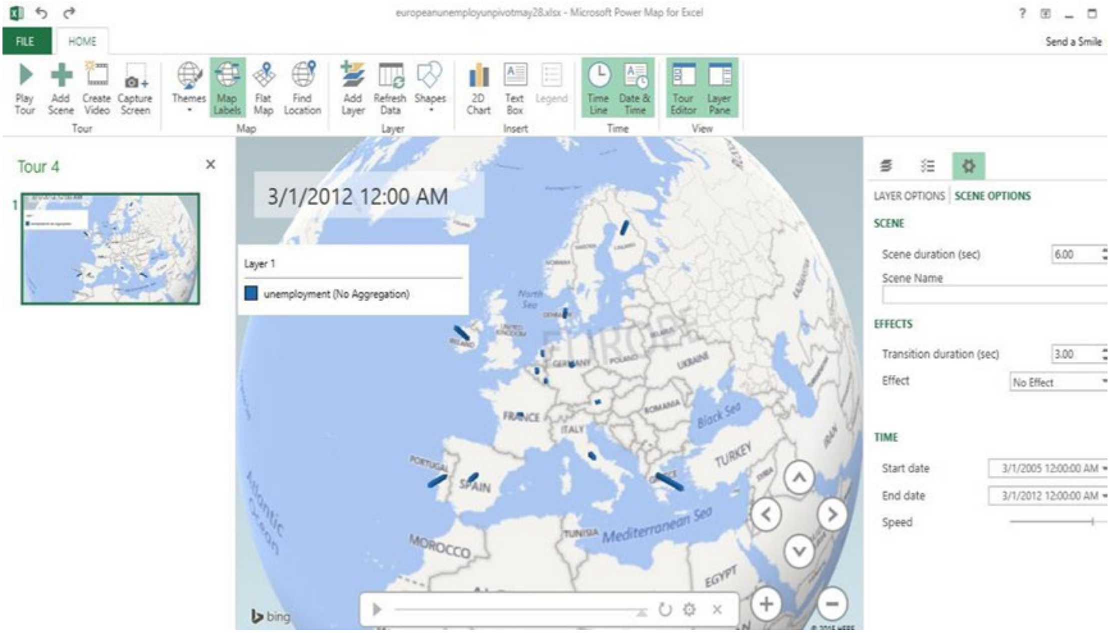


Figure 9-39. *Map set up for time animation*

The speed of play can be adjusted by clicking the gear icon on the upper right and clicking Scene Options to change the scene duration time and effects, as shown in Figure 9-40. The Speed slider at the bottom of the pane can be adjusted to slow down or speed up the transitions.



LAYER OPTIONS | SCENE OPTIONS

SCENE

Scene duration (sec) 6.00

Scene Name

EFFECTS

Transition duration (sec) 3.00

Effect No Effect

TIME

Start date 3/1/2005 12:00:00 AM

End date 3/1/2012 12:00:00 AM

Speed

Figure 9-40. *Setting scene duration*

Summary

This chapter has demonstrated how to load data into Power Query, how to shape the data in the Query Editor, and then how to load it in Power Map to create a visual story about the data. Some of the capabilities of Power Map were demonstrated, such as creating 2D and 3D visualizations, as well as creating animations to show variations over time.

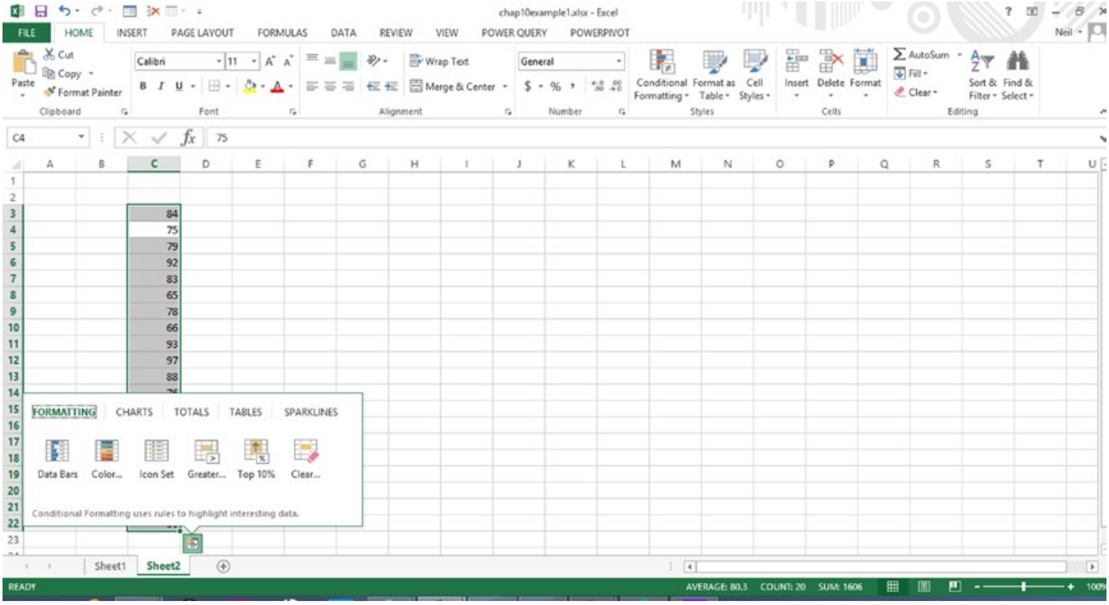
CHAPTER 10

Statistical Calculations

Excel provides a variety of built-in tools for performing statistical analysis. This chapter highlights some of those tools, including basic charting and the Excel Analysis ToolPak. The difference between descriptive and inferential statistics is discussed, and Excel statistical functions are introduced.

Recommended Analytical Tools in 2013

Excel 2013 tries to anticipate your needs by recommending conditional formatting, charts, tools, totals, and Pivot Tables. When data is highlighted, or when Ctrl+Q is pressed, with any cell in the data range selected, a pop-up window with various formatting options is displayed, as shown in Figure 10-1. Moving the cursor over the conditional formatting options will show a preview of that conditional formatting on the data.



C4 = 75

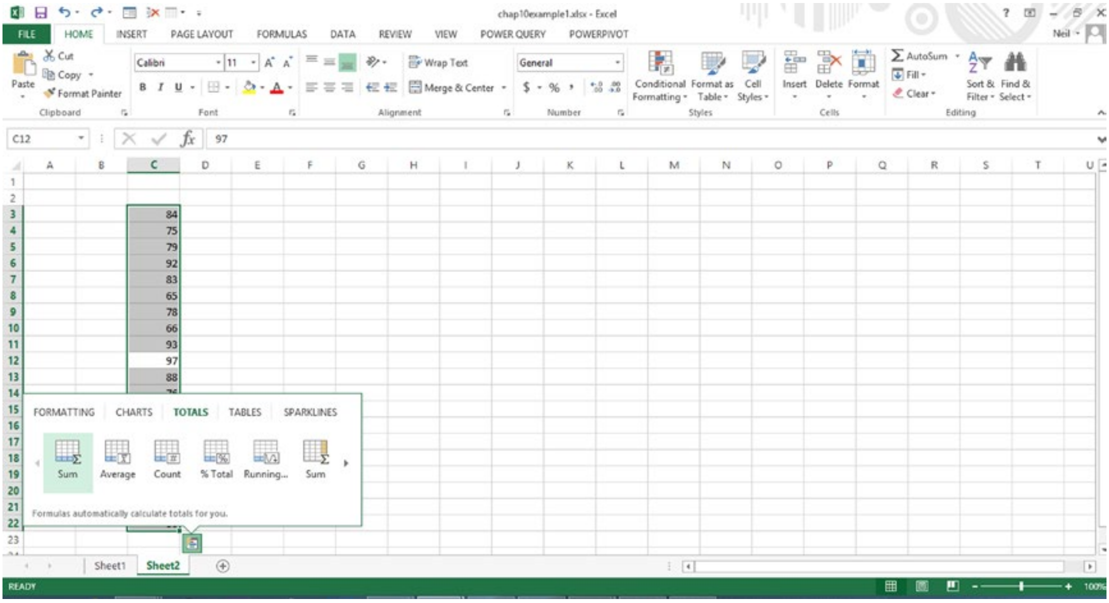
Row	C
3	84
4	75
5	79
6	92
7	83
8	65
9	78
10	66
11	93
12	97
13	88

Conditional Formatting uses rules to highlight interesting data.

AVERAGE: 80.3 COUNT: 20 SUM: 1606

Figure 10-1. *Recommended format and analytics options*

Clicking Totals in the pop-up window will cause the Totals menu to be displayed, which is shown in Figure 10-2.

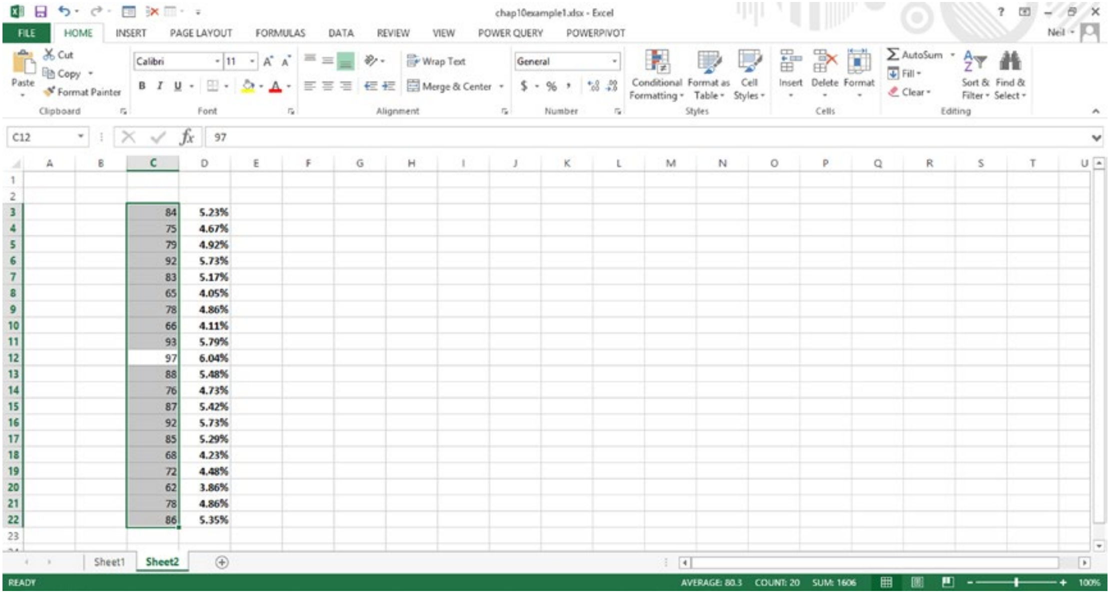


	C
3	84
4	75
5	79
6	92
7	83
8	65
9	78
10	66
11	93
12	97
13	88

Formulas automatically calculate totals for you.

Figure 10-2. *Totals and statistical options*

Scrolling right to highlight % Total will produce the results shown in Figure 10-3, in which the percent of the total is shown to the right of each item.



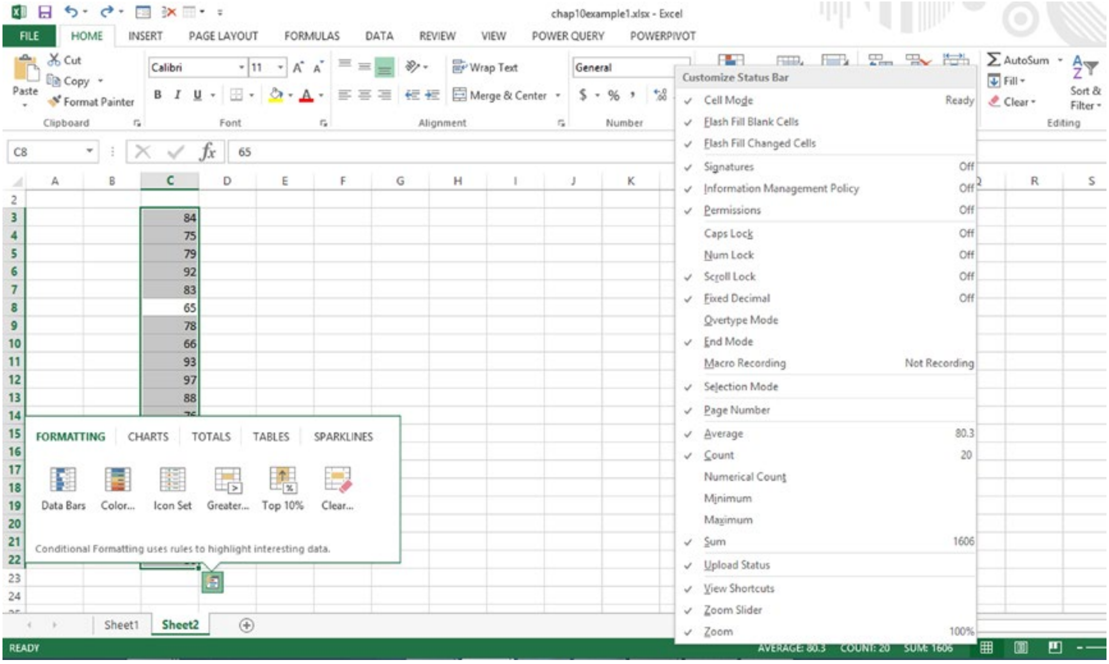
	C	D
3	84	5.23%
4	75	4.67%
5	79	4.92%
6	92	5.73%
7	83	5.17%
8	65	4.05%
9	78	4.86%
10	66	4.11%
11	93	5.79%
12	97	6.04%
13	88	5.48%
14	76	4.73%
15	87	5.42%
16	92	5.73%
17	85	5.29%
18	68	4.23%
19	72	4.48%
20	62	3.86%
21	78	4.86%
22	86	5.35%

AVERAGE: 80.3 COUNT: 20 SUM: 1606

Figure 10-3. *Percent totals*

Customizing the Status Bar

Notice that the status bar at the bottom of the Excel window shows statistics related to the highlighted data, such as the average, count, and sum. You can customize the values shown by right-clicking the status bar and selecting the items you want displayed, as shown in Figure 10-4.

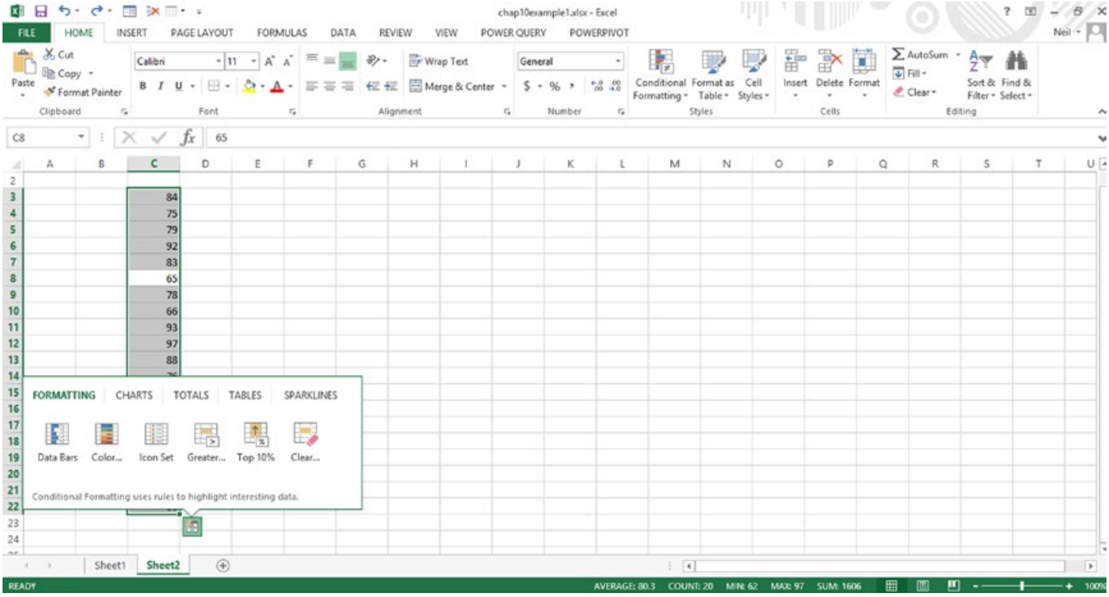


Customize Status Bar

✓	Cell Mode	Ready
✓	Flash Fill Blank Cells	
✓	Flash Fill Changed Cells	
✓	Signatures	Off
✓	Information Management Policy	Off
✓	Permissions	Off
	Caps Lock	Off
	Num Lock	Off
✓	Scroll Lock	Off
✓	Fixed Decimal	Off
	Overtype Mode	
✓	End Mode	
	Macro Recording	Not Recording
✓	Selection Mode	
✓	Page Number	
✓	Average	80.3
✓	Count	20
	Numerical Count	
	Minimum	
	Maximum	
✓	Sum	1606
✓	Upload Status	
✓	View Shortcuts	
✓	Zoom Slider	
✓	Zoom	100%

***Figure 10-4.** Customize Status Bar menu*

If Minimum and Maximum, for example, are selected on the Customize Status Bar menu, those values will be added to the status bar, as shown in Figure 10-5.



C
84
75
79
92
83
65
78
66
93
97
88

Conditional Formatting uses rules to highlight interesting data.

AVERAGE: 80.3 COUNT: 20 MIN: 62 MAX: 97 SUM: 1606

Figure 10-5. *Status bar with Min and Max added*

Inferential Statistics

Sampling involves examining a small portion of a large population in order to draw conclusions about the entire population. This is called inferential statistics. For a sample to be representative of the larger population, the members of the sample must be selected randomly, meaning that every member of the population has the same chance of being included as any other member. The objective is to draw reliable conclusions about the population from the sample. Determining the sample size is critical. The margin of error for a sample is calculated as one divided by the square root of the sample size. Thus, as the sample size increases, the margin of error decreases.

Generally, a sample is used because it is not economically feasible to survey an entire population. One of the promises of big data is that if the data is available, an entire population can be processed for more accurate results.

Review of Descriptive Statistics

Descriptive statistics summarize data with a few key calculated values. Figure 10-6 shows a normal distribution or, bell, curve. The frequency with which any value occurs is represented by the height of the curve. For example, if a coin is tossed ten times over multiple trials, the average number of heads will be five. This is the result that will occur most frequently and is represented by the highest point of the curve. The next most common occurrence will be six heads and four tails or six tails and four heads. Rarely would there be nine heads and one tail.

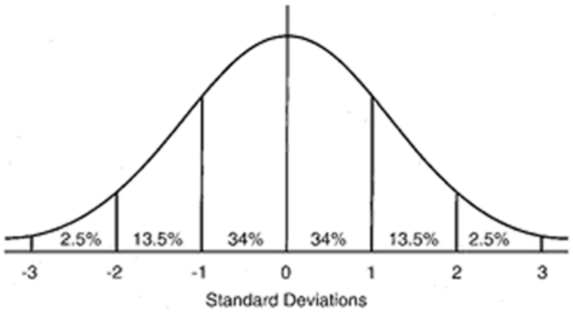


Figure 10-6. *Bell curve*

Calculating Descriptive Statistics

The most common calculated statistical values are mean, median, and mode.

> The mean, the average or arithmetic mean, is computed by adding all the values and dividing by the number of values.
>
> The middle value is called the median—the data point at which 50% of the values fall above it and 50% of the values fall below it.
>
> The most frequent value is called the mode. In a bell curve, the median, mode, and mean are equal.

Measures of Dispersion

Many distributions don't fit neatly into a bell curve, however, so we need measures of dispersion. The variance measures how far a set of numbers is spread out. A small variance indicates that the data points tend to be very close to the mean and, hence, to each other, while a high variance indicates that the data points are very spread out around the mean and from each other.

One measure of dispersion is the standard deviation, which is calculated by computing the deviation of each value from the arithmetic mean and squaring them. The arithmetic mean of these squared values is calculated, and the square root taken to calculate the standard deviation is represented by the Greek letter sigma.

The 68-95-99 rule is used to remember what percentage of values fall within a range around the mean of a normal distribution. In other words, 68.27% of the values are within the range of plus or minus one standard deviation; 95.45% of the values are in a range of plus or minus two standard deviations; and 99.73% of the values are within a range of plus or minus three standard deviations. This is sometimes called the Three Sigma Rule of Thumb. Remember that this rule only applies to a normal distribution. Notice the percentages shown in the illustration in Figure 10-6 that correspond to this rule.

For example, in an analysis of home values, if all home sales fall within a fairly narrow range, such as $400,000 to $600,000, there would be a relatively small variance and standard deviation. However, if a couple of high-end homes sell for more than $1,000,000, there would be a larger variance and standard deviation. That is why the graphical approaches described in the remainder of this chapter are useful for showing relationships among values.

Excel Statistical Functions

Excel provides numerous functions to calculate statistical values. Here are a few of the more common ones.

`Average(range)`: Calculates the arithmetic mean of a range of data or a list of discrete values. It ignores empty cells or cells containing text.

`Averagea(range)`: Same as average, except that it assigns a value of zero to cells containing text.

`Averageif(range, condition)`: Returns an arithmetic mean based on a conditional statement enclosed in quotes. It does not include empty cells or cells containing text in calculations.

`Averageifs(range,condition1,condition2)`: Returns an arithmetic mean based on multiple conditional statements. It does not include empty cells or cells containing text in calculations.

`Median(range)`: Calculates the media or middle value.

`Mode(range)`: Calculates the most frequent value, excluding empty cells and cells containing text not counted.

Charting Data

Excel provides several ways of viewing data graphically. It is important to select the best graphical tool to accurately portray the data, as described in the list below.

- Column and bar charts plot a category variable on one axis and a numeric variable on the other.
- An XY scatter chart shows the relationship between two numeric values.
- Frequency distributions deal with one variable only—it shows how many instances there are of each value. It groups individual measurements into classes or bins. In its most common form, the variable's values are on the horizontal, or x, axis and the frequency of instances on the vertical, or y, axis
- A histogram is a graphical representation of the distribution of numerical data.

Excel Analysis ToolPak

This section will cover how to use the Excel Analysis ToolPak, which is included with Excel. The Analysis ToolPak can be used to perform sophisticated statistical calculations that would be very time-consuming to program in by hand.

Enabling the Excel Analysis ToolPak

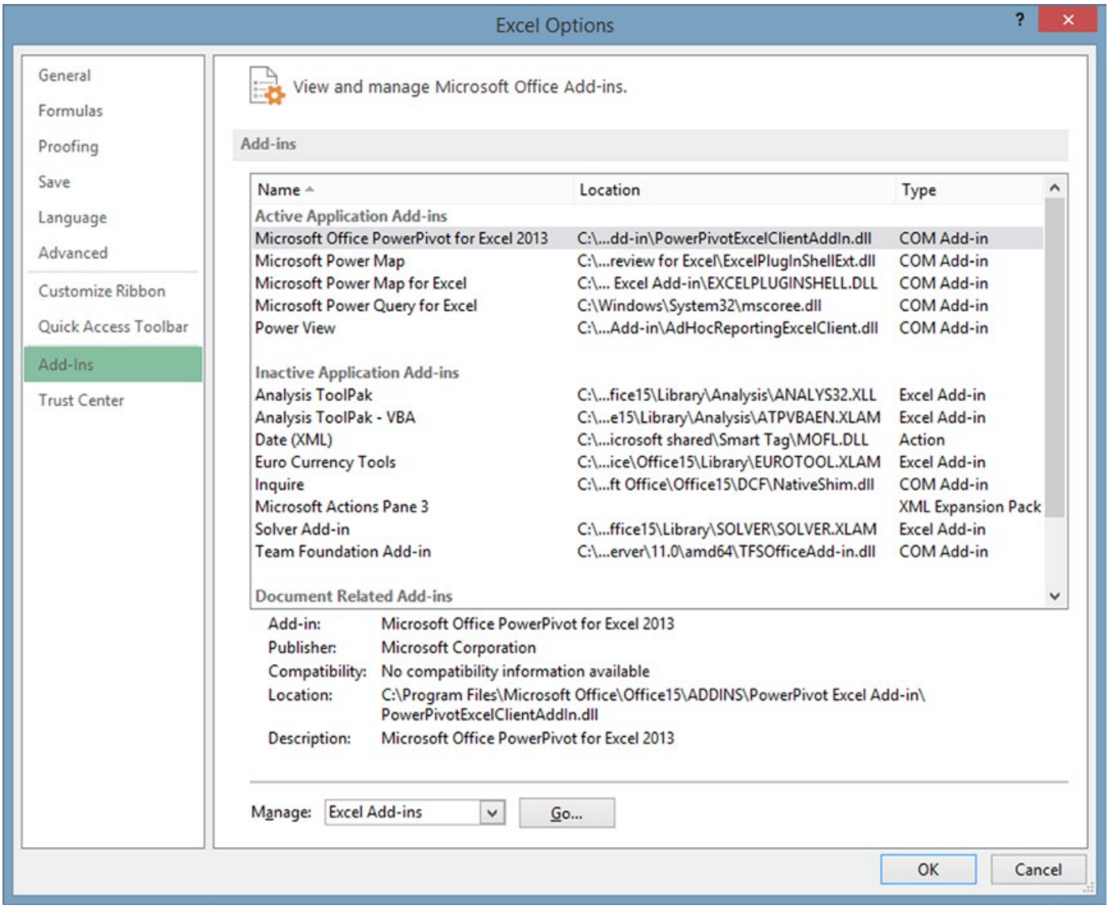
Before use, it must be activated.

To enable the Excel Analysis ToolPak, follow these steps:

1. Click the File tab to see the Backstage View.
2. Click Options at the bottom of the left pane.

3. Select Add-Ins on the left pane.

4. At the bottom of the window, select Excel Add-Ins and click Go, as shown in Figure 10-7.



View and manage Microsoft Office Add-ins.

Add-ins

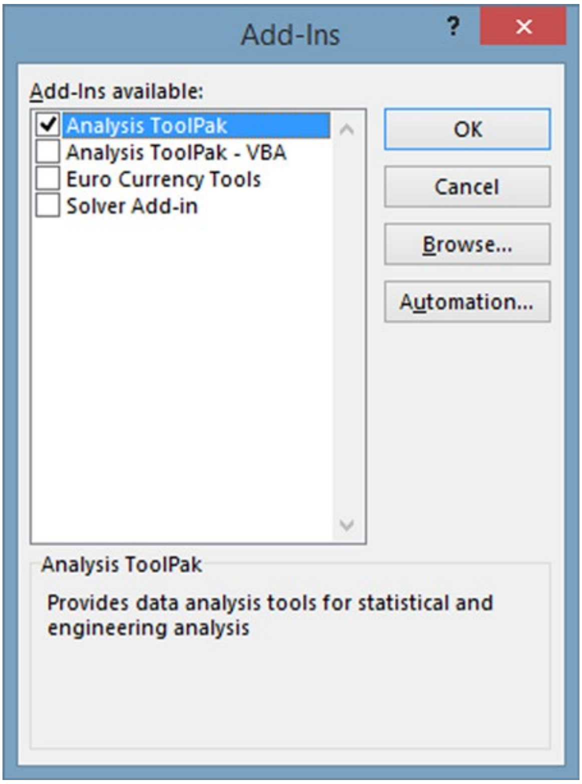
Name	Location	Type
Active Application Add-ins		
Microsoft Office PowerPivot for Excel 2013	C:\...dd-in\PowerPivotExcelClientAddIn.dll	COM Add-in
Microsoft Power Map	C:\...review for Excel\ExcelPlugInShellExt.dll	COM Add-in
Microsoft Power Map for Excel	C:\... Excel Add-in\EXCELPLUGINSHELL.DLL	COM Add-in
Microsoft Power Query for Excel	C:\Windows\System32\mscoree.dll	COM Add-in
Power View	C:\...Add-in\AdHocReportingExcelClient.dll	COM Add-in
Inactive Application Add-ins		
Analysis ToolPak	C:\...fice15\Library\Analysis\ANALYS32.XLL	Excel Add-in
Analysis ToolPak - VBA	C:\...e15\Library\Analysis\ATPVBAEN.XLAM	Excel Add-in
Date (XML)	C:\...icrosoft shared\Smart Tag\MOFL.DLL	Action
Euro Currency Tools	C:\...ice\Office15\Library\EUROTOOL.XLAM	Excel Add-in
Inquire	C:\...ft Office\Office15\DCF\NativeShim.dll	COM Add-in
Microsoft Actions Pane 3		XML Expansion Pack
Solver Add-in	C:\...ffice15\Library\SOLVER\SOLVER.XLAM	Excel Add-in
Team Foundation Add-in	C:\...erver\11.0\amd64\TFSOfficeAdd-in.dll	COM Add-in
Document Related Add-ins		

Add-in:	Microsoft Office PowerPivot for Excel 2013
Publisher:	Microsoft Corporation
Compatibility:	No compatibility information available
Location:	C:\Program Files\Microsoft Office\Office15\ADDINS\PowerPivot Excel Add-in\PowerPivotExcelClientAddIn.dll
Description:	Microsoft Office PowerPivot for Excel 2013

Manage: Excel Add-ins

Figure 10-7. *Excel Add-Ins screen*

5. Select Analysis TookPak, as shown in Figure 10-8, and click OK.



Add-Ins available:

- ☑ Analysis ToolPak
- □ Analysis ToolPak - VBA
- □ Euro Currency Tools
- □ Solver Add-in

Analysis ToolPak

Provides data analysis tools for statistical and engineering analysis

Figure 10-8. *Add-Ins pop-up*

After activation, the Analysis ToolPak can now be accessed by clicking Data Analysis on the right side of the Data tab in Excel.

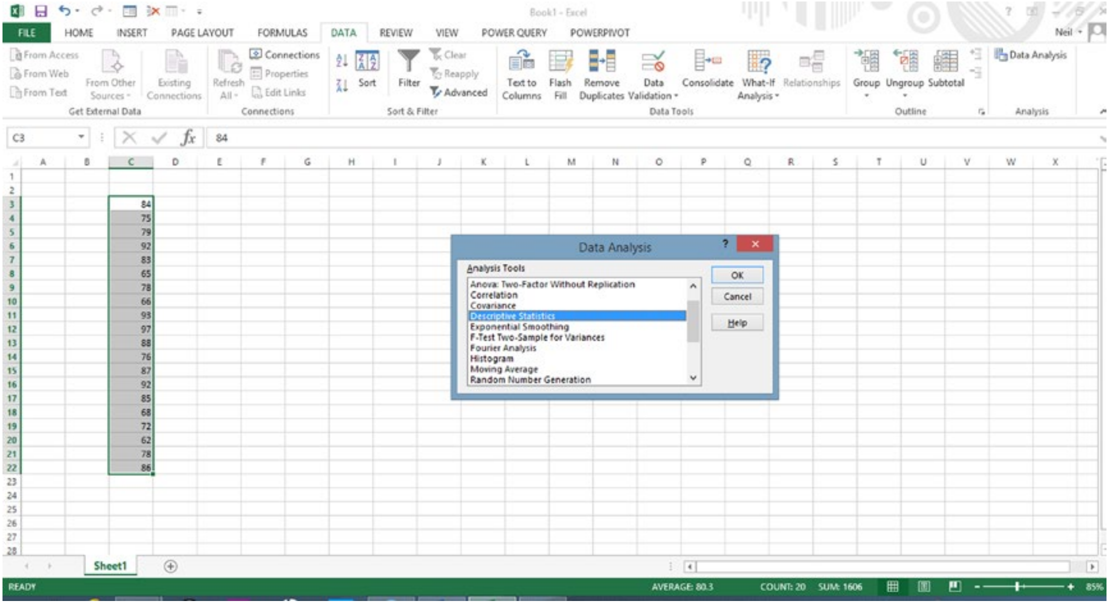
A Simple Example

The following example will show how to use the Excel Analysis ToolPak to analyze some sample test scores.

EXERCISE 10-1. USING THE ANALYSIS TOOLPAK

Follow these steps to analyze the test score:

1. Click Data Analysis on the right side of the Data tab. When the Data Analysis windows appears, select Descriptive Statistics, as shown in Figure 10-9.



C3 | 84

Row	C
3	84
4	75
5	79
6	92
7	83
8	65
9	78
10	66
11	93
12	97
13	88
14	76
15	87
16	92
17	85
18	68
19	72
20	62
21	78
22	86

Data Analysis

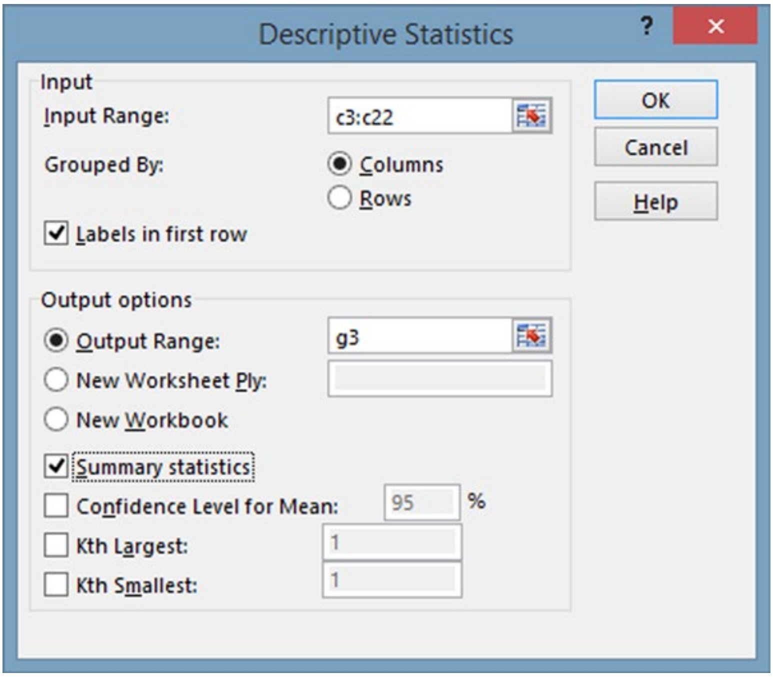
Analysis Tools

- Anova: Two-Factor Without Replication
- Correlation
- Covariance
- Descriptive Statistics
- Exponential Smoothing
- F-Test Two-Sample for Variances
- Fourier Analysis
- Histogram
- Moving Average
- Random Number Generation

OK | Cancel | Help

Figure 10-9. Data Analysis tools

2. Click OK. In the Descriptive Statistics dialog box, specify the input range and the output range and select summary statistics, as shown in Figure 10-10, and click OK.



Descriptive Statistics

Input

Input Range: c3:c22

Grouped By: ● Columns ○ Rows

☑ Labels in first row

Output options

● Output Range: g3

○ New Worksheet Ply:

○ New Workbook

☑ Summary statistics

□ Confidence Level for Mean: 95 %

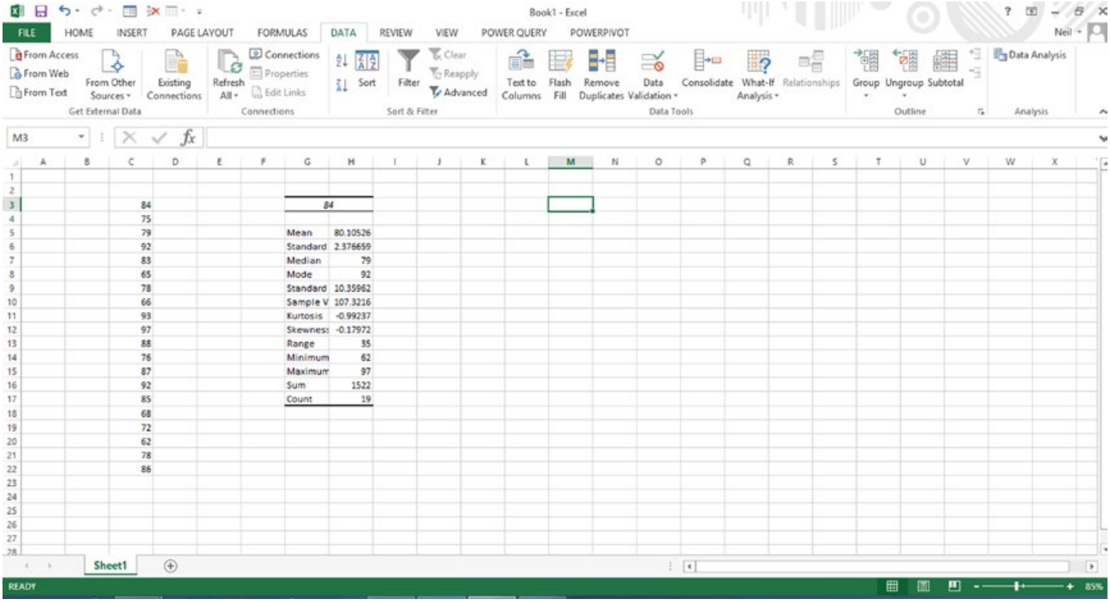
□ Kth Largest: 1

□ Kth Smallest: 1

OK | Cancel | Help

Figure 10-10. Descriptive Statistics dialog

The results are shown in Figure 10-11.



	C	G	H
1			
2			
3	84		*84*
4	75		
5	79	Mean	80.10526
6	92	Standard	2.376659
7	83	Median	79
8	65	Mode	92
9	78	Standard	10.35962
10	66	Sample V	107.3216
11	93	Kurtosis	-0.99237
12	97	Skewness	-0.17972
13	88	Range	35
14	76	Minimum	62
15	87	Maximum	97
16	92	Sum	1522
17	85	Count	19
18	68		
19	72		
20	62		
21	78		
22	86		

Figure 10-11. *Descriptive Statistics output*

3. To plot a histogram using the Data Analysis ToolPak, go to the Data tab and click Data Analytics. Select Histogram, as shown in Figure 10-12.

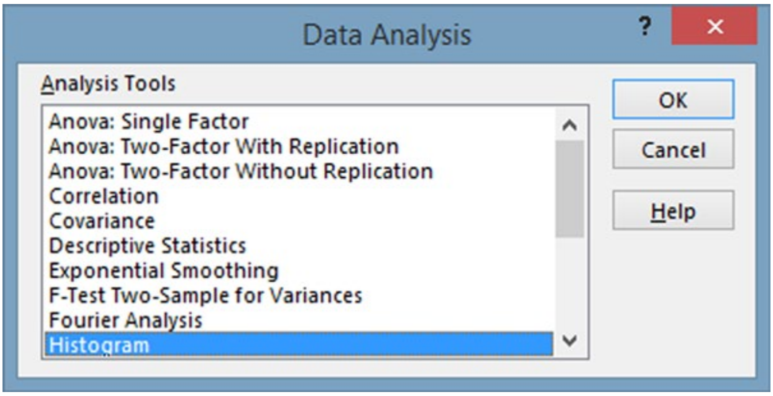
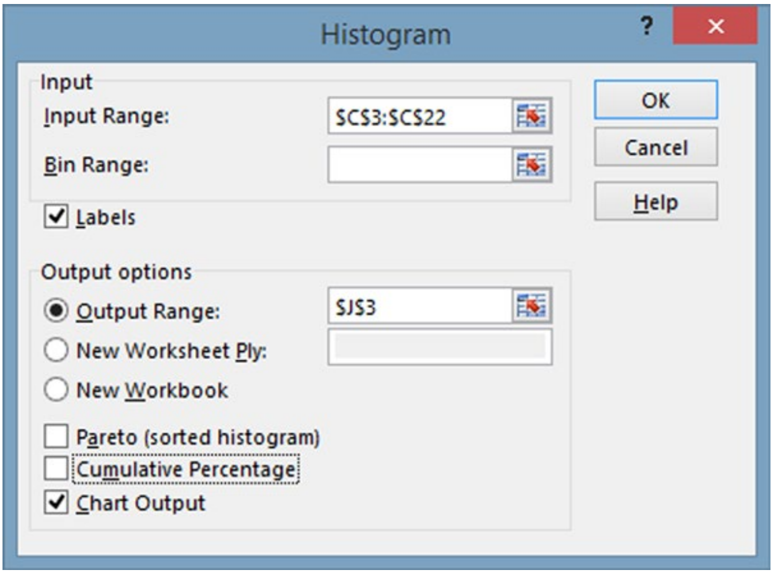


Figure 10-12. *Selecting Histogram from the Data Analysis dialog*

4. Define the range and select chart output, as shown in Figure 10-13, and click OK.



Histogram

Input

Input Range: $C$3:$C$22

Bin Range:

☑ Labels

Output options

● Output Range: $J$3

○ New Worksheet Ply:

○ New Workbook

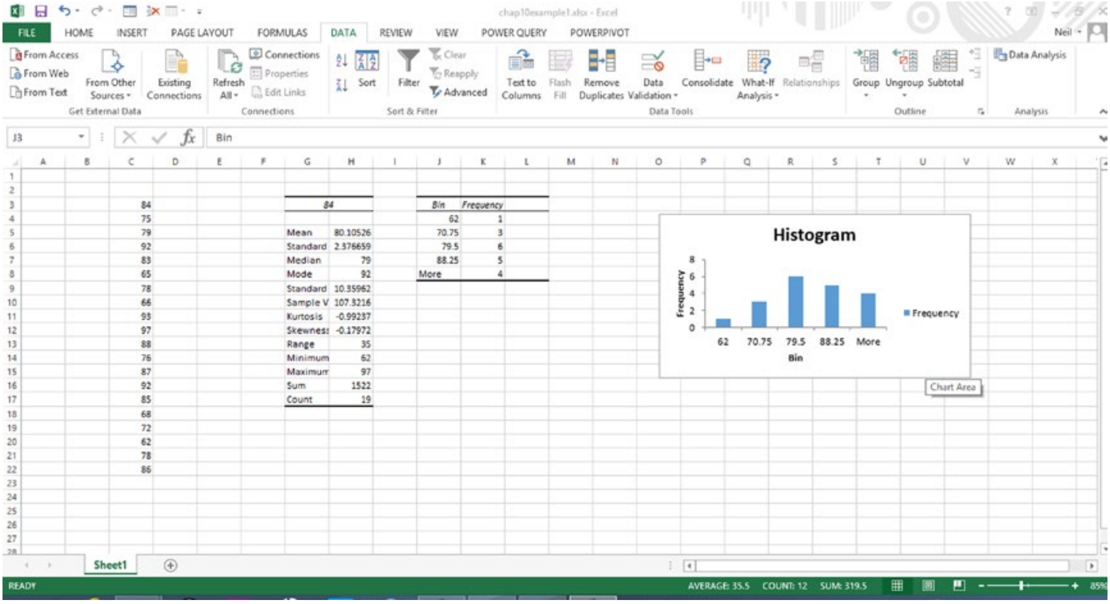
☐ Pareto (sorted histogram)

☐ Cumulative Percentage

☑ Chart Output

Figure 10-13. *Histogram dialog*

The results are shown in Figure 10-14. This operation sets up bins, or categories, for classifying the data, which are used for plotting the histogram.



J3 Bin

	C	G	H	J	K
3	84		84	Bin	Frequency
4	75			62	1
5	79	Mean	80.10526	70.75	3
6	92	Standard	2.376659	79.5	6
7	83	Median	79	88.25	5
8	65	Mode	92	More	4
9	78	Standard	10.35962		
10	66	Sample V	107.3216		
11	93	Kurtosis	-0.99237		
12	97	Skewness	-0.17972		
13	88	Range	35		
14	76	Minimum	62		
15	87	Maximum	97		
16	92	Sum	1522		
17	85	Count	19		
18	68				
19	72				
20	62				
21	78				
22	86				

Figure 10-14. *Histogram plot*

Other Analysis ToolPak Functions

The Analysis ToolPak includes other functions. Some of the most useful ones are listed following:

- The Anova tools provide different types of variance analysis. They test the randomness of the selection of two samples.
- The correlation coefficient is a value between -1 and +1 that measures how strongly two variables are related to each other. A +1 indicates a perfect positive correlation, meaning that the two variables move together. A -1 indicates a perfect negative correlation, meaning that the two variables move in opposition to each other. A positive correlation does not prove cause and effect. The Excel `CORREL` function can also be used to calculate correlation.
- Covariance is a measure of how much two random variables change together.
- Exponential smoothing is like a moving average used to forecast the next value in a time series.

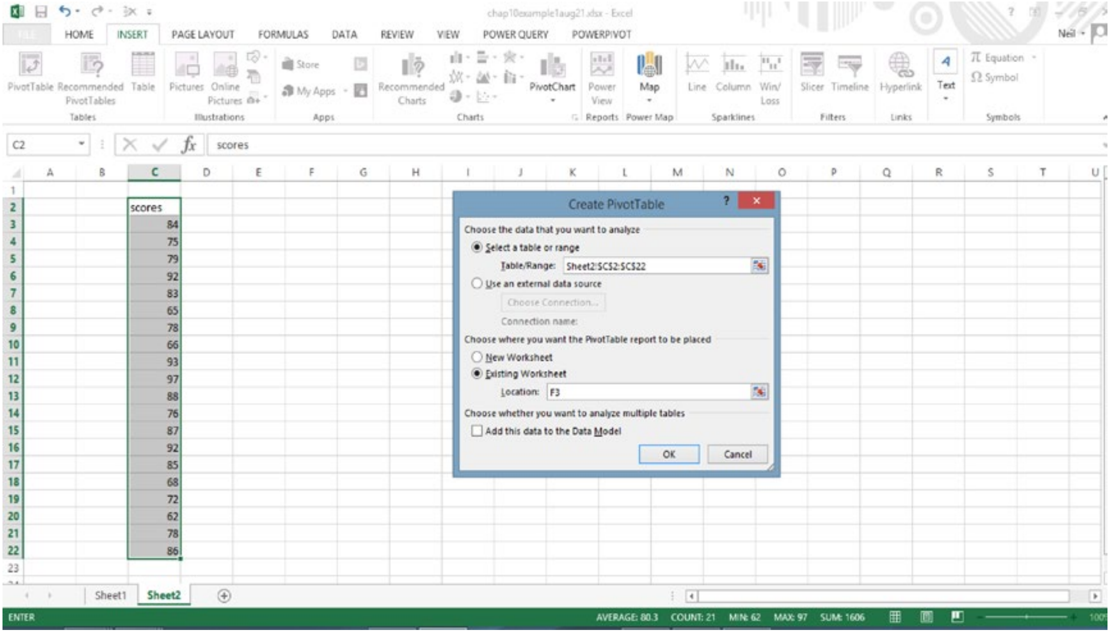
Using a Pivot Table to Create a Histogram

A Pivot Table can also be used to create a more customized histogram.

EXERCISE 10-2. A CUSTOMIZED TEST SCORE HISTOGRAM EXAMPLE

Create a histogram that shows test score distributions by following these steps:

1. Highlight the data to be plotted. Select the Insert tab and click PivotTable.
2. Confirm the range and put the Pivot Table in the same worksheet with the location of F3, as shown in Figure 10-15.


chap10example1aug21.xlsx - Excel
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWER QUERY POWERPIVOT
PivotTable Recommended PivotTables Table
Pictures Online Pictures
Store My Apps
Recommended Charts PivotChart Power View Map
Line Column Win/Loss
Slicer Timeline Hyperlink Text
Equation Symbol
Tables Illustrations Apps Charts Reports Power Map Sparklines Filters Links Symbols
Sheet1 Sheet2
ENTER

C2 fx scores

Row	C
2	scores
3	84
4	75
5	79
6	92
7	83
8	65
9	78
10	66
11	93
12	97
13	88
14	76
15	87
16	92
17	85
18	68
19	72
20	62
21	78
22	86

Create PivotTable

Choose the data that you want to analyze

● Select a table or range

Table/Range: Sheet2!$C$2:$C$22

○ Use an external data source

Choose Connection...

Connection name:

Choose where you want the PivotTable report to be placed

○ New Worksheet

● Existing Worksheet

Location: F3

Choose whether you want to analyze multiple tables

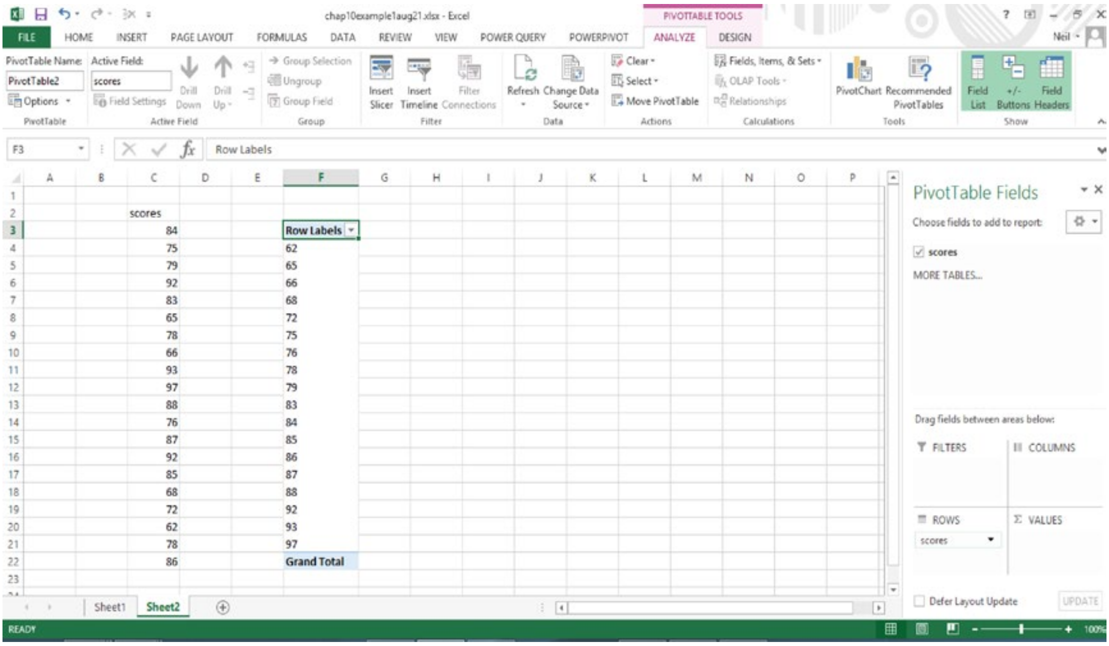
□ Add this data to the Data Model

OK Cancel

AVERAGE: 80.3 COUNT: 21 MIN: 62 MAX: 97 SUM: 1606

***Figure 10-15.** Create PivotTable dialog*

3. Drag scores to the Rows box, as shown in Figure 10-16.


chap10example1aug21.xlsx - Excel
PIVOTTABLE TOOLS
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW POWER QUERY POWERPIVOT ANALYZE DESIGN
Options Field Settings Drill Down Drill Up
Group Selection Ungroup Group Field
Insert Slicer Insert Timeline Filter Connections
Refresh Change Data Source
Clear Select Move PivotTable
Fields, Items, & Sets OLAP Tools Relationships
PivotChart Recommended PivotTables
Field List +/- Buttons Field Headers
PivotTable Active Field Group Filter Data Actions Calculations Tools Show
Sheet1 Sheet2
READY

PivotTable Name: PivotTable2

Active Field: scores

F3 fx Row Labels

Row	C	F
2	scores	
3	84	Row Labels
4	75	62
5	79	65
6	92	66
7	83	68
8	65	72
9	78	75
10	66	76
11	93	78
12	97	79
13	88	83
14	76	84
15	87	85
16	92	86
17	85	87
18	68	88
19	72	92
20	62	93
21	78	97
22	86	Grand Total

PivotTable Fields

Choose fields to add to report:

☑ scores

MORE TABLES...

Drag fields between areas below:

FILTERS COLUMNS

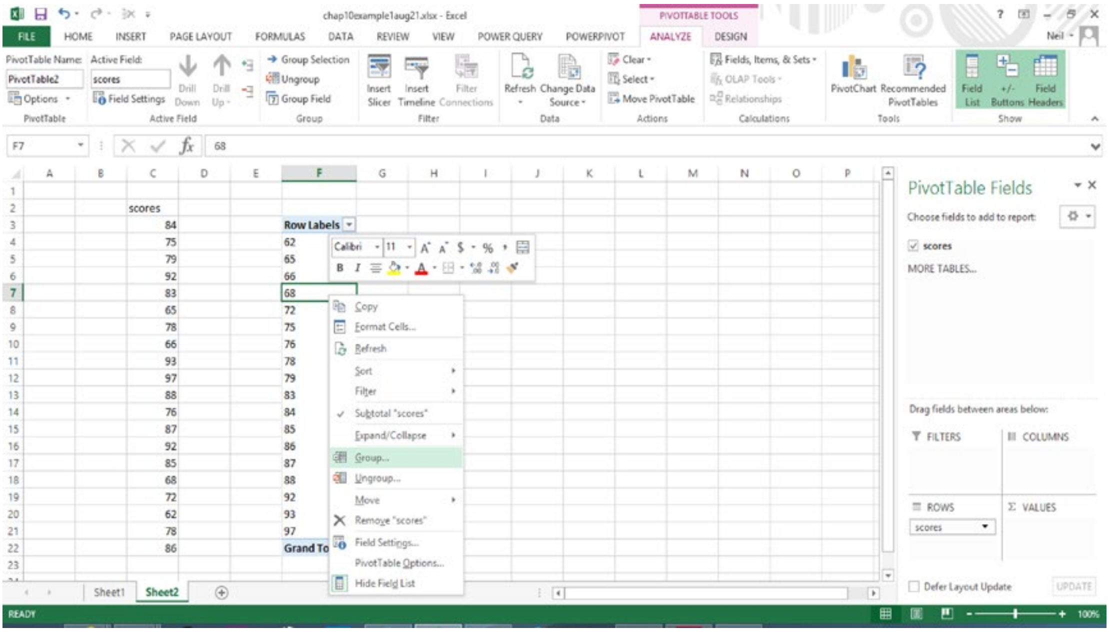
ROWS: scores

VALUES

□ Defer Layout Update UPDATE

***Figure 10-16.** Test scores as rows*

4. Right-click the PivotTable column and select Group, as shown in Figure 10-17.



F7: 68

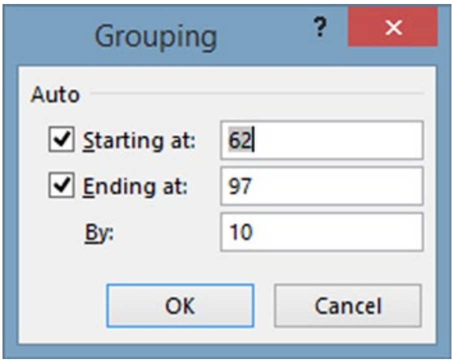
	C	F
2	scores	
3	84	Row Labels
4	75	62
5	79	65
6	92	66
7	83	68
8	65	72
9	78	75
10	66	76
11	93	78
12	97	79
13	88	83
14	76	84
15	87	85
16	92	86
17	85	87
18	68	88
19	72	92
20	62	93
21	78	97
22	86	Grand To

☑ scores

ROWS: scores

Figure 10-17. Selecting Group from the context menu

5. By default, the Grouping dialog box sets the lower range to the lowest score and the upper range to the highest score, with a default interval of 10, as shown in Figure 10-18. Click OK.



Auto

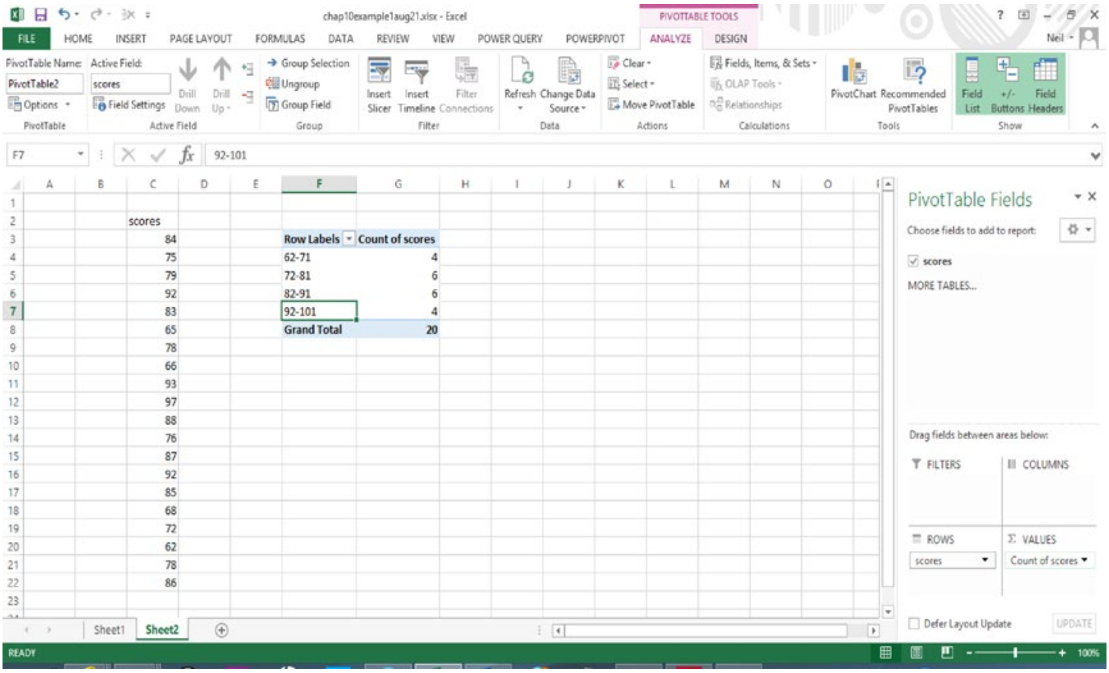
☑ Starting at: 62

☑ Ending at: 97

By: 10

Figure 10-18. Grouping dialog

6. Drag the scores to the Value box. The result indicating the frequency for each grouping category is shown in Figure 10-19. Notice that the categories are approximately what the grading categories would be: 92 to 100 would be an A, 82 to 91 would be a B, etc.

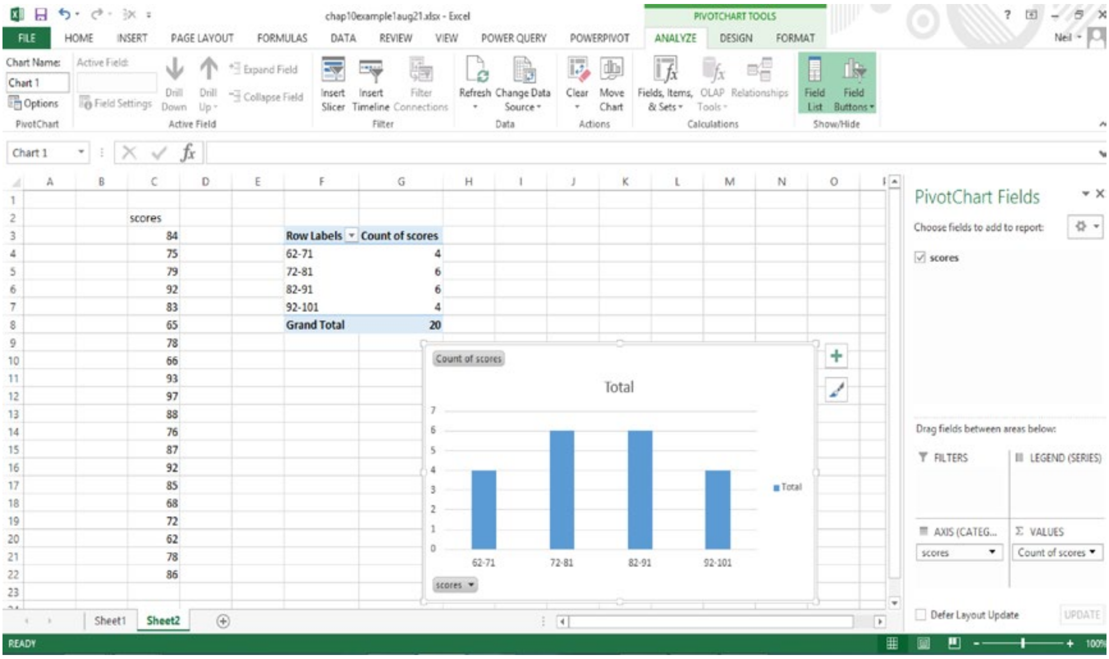


scores
84
75
79
92
83
65
78
66
93
97
88
76
87
92
85
68
72
62
78
86

Row Labels	Count of scores
62-71	4
72-81	6
82-91	6
92-101	4
Grand Total	20

Figure 10-19. *Grouping categories*

7. To plot a histogram, click the Insert tab and select Column Chart, 2D Column. The result, which plots the frequency for each category, is shown in Figure 10-20.



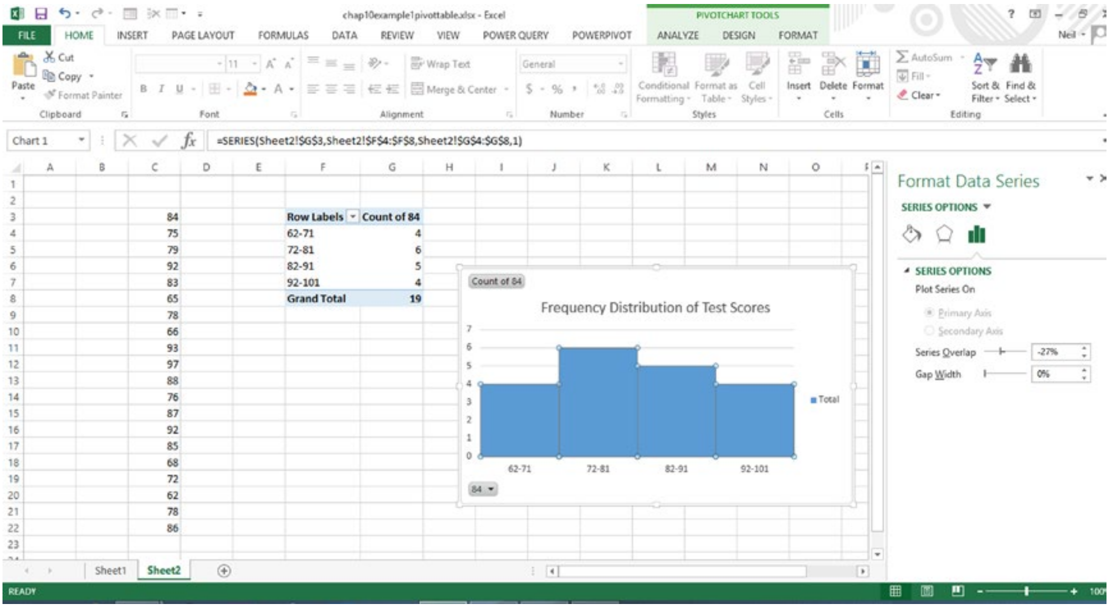
scores
84
75
79
92
83
65
78
66
93
97
88
76
87
92
85
68
72
62
78
86

Row Labels	Count of scores
62-71	4
72-81	6
82-91	6
92-101	4
Grand Total	20

Figure 10-20. *Histogram*

8. The chart can be tweaked by clicking a column and pressing Ctrl+1 to open the Format Data Series pane on the right side of the screen. Adjust the Gap Width slider to zero to remove the space between columns.

9. The title can be modified by clicking the title, which now says Total, and changing it to “Frequency Distribution of Test Scores,” as shown in Figure 10-21.



=SERIES(Sheet2!$G$3,Sheet2!$F$4:$F$8,Sheet2!$G$4:$G$8,1)

	C	F	G
1			
2			
3	84	Row Labels	Count of 84
4	75	62-71	4
5	79	72-81	6
6	92	82-91	5
7	83	92-101	4
8	65	Grand Total	19
9	78		
10	66		
11	93		
12	97		
13	88		
14	76		
15	87		
16	92		
17	85		
18	68		
19	72		
20	62		
21	78		
22	86		
23			

Format Data Series

SERIES OPTIONS

SERIES OPTIONS

Plot Series On

● Primary Axis

○ Secondary Axis

Series Overlap -27%

Gap Width 0%

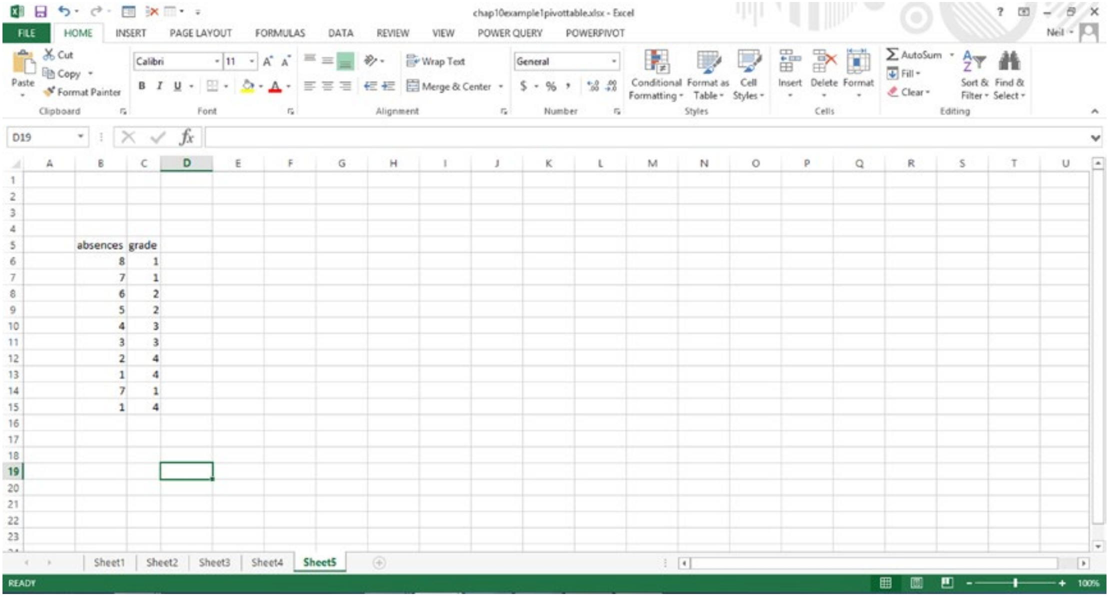
Figure 10-21. *Histogram with title*

Scatter Chart

It is possible to see the visual relationship between two variables by plotting a scatter chart and then allowing the program to calculate the R-squared value. R-squared is a statistical measure of how close the data are to the fitted regression line—the best-fitting straight line through the points. It is also known as the coefficient of determination. R-squared values range from 0 to 100. An R-squared value of 100 means that all movements of one value are completely explained by movements of the other variable. X is the independent variable, and y is the dependent variable.

EXERCISE 10-3. GRADE-ABSENCE RELATIONSHIP SCATTER CHART EXAMPLE

This example explores whether there is a relationship between class absences and numeric grades, with 1 being the lowest grade and 4 the highest. The grade data is shown in Figure 10-22.

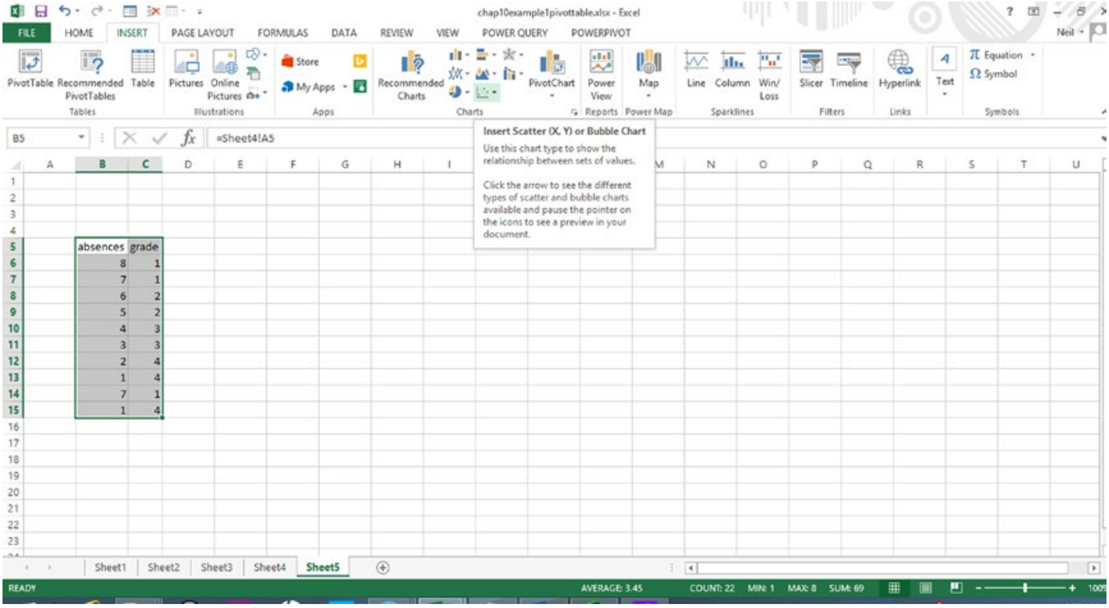


absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

Figure 10-22. *Grade and absence data*

Follow these steps:

1. Highlight the data, click the Insert tab, and select Scatter (X, Y), as shown in Figure 10-23.



=Sheet4!A5

Insert Scatter (X, Y) or Bubble Chart

Use this chart type to show the relationship between sets of values.

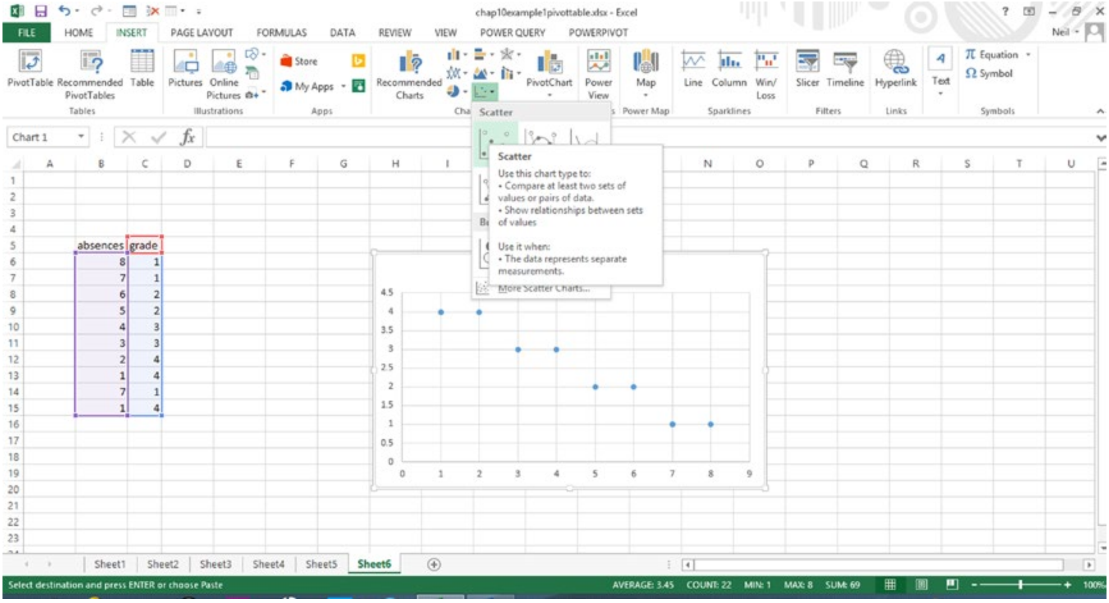
Click the arrow to see the different types of scatter and bubble charts available and pause the pointer on the icons to see a preview in your document.

absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

AVERAGE: 3.45 COUNT: 22 MIN: 1 MAX: 8 SUM: 69

Figure 10-23. *Insert Scatter (X, Y) or Bubble Chart option*

2. Select the Scatter option, as shown in Figure 10-24.



Scatter

Use this chart type to:
- Compare at least two sets of values or pairs of data.
- Show relationships between sets of values

Use it when:
- The data represents separate measurements.

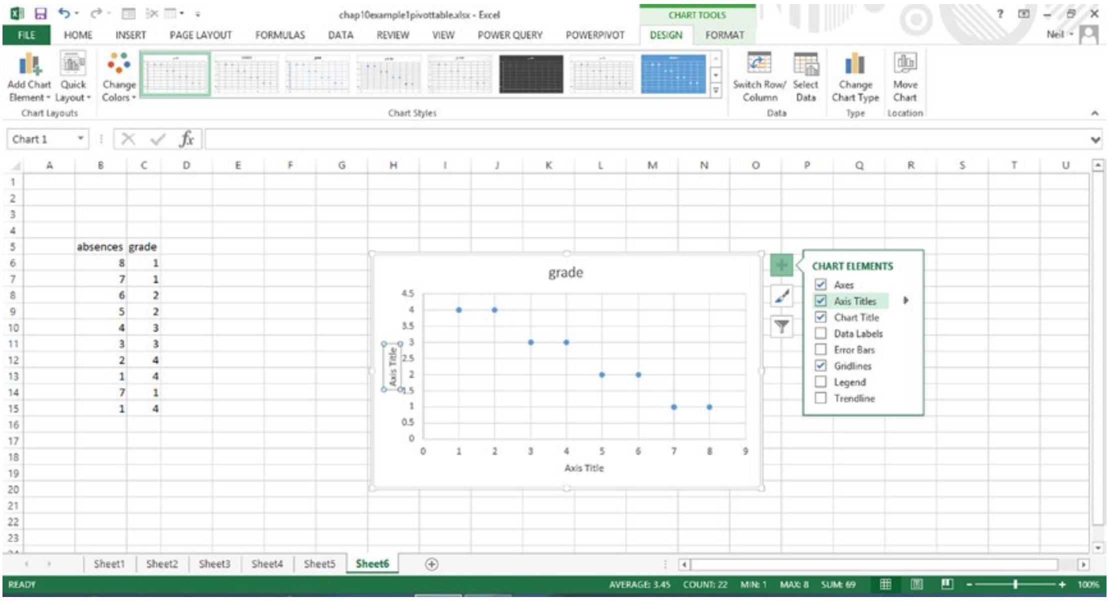
absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

Select destination and press ENTER or choose Paste

AVERAGE: 3.45 COUNT: 22 MIN: 1 MAX: 8 SUM: 69

Figure 10-24. *Select Scatter option*

3. Click the + sign at the upper right of the chart and select Axis Titles, as shown in Figure 10-25.

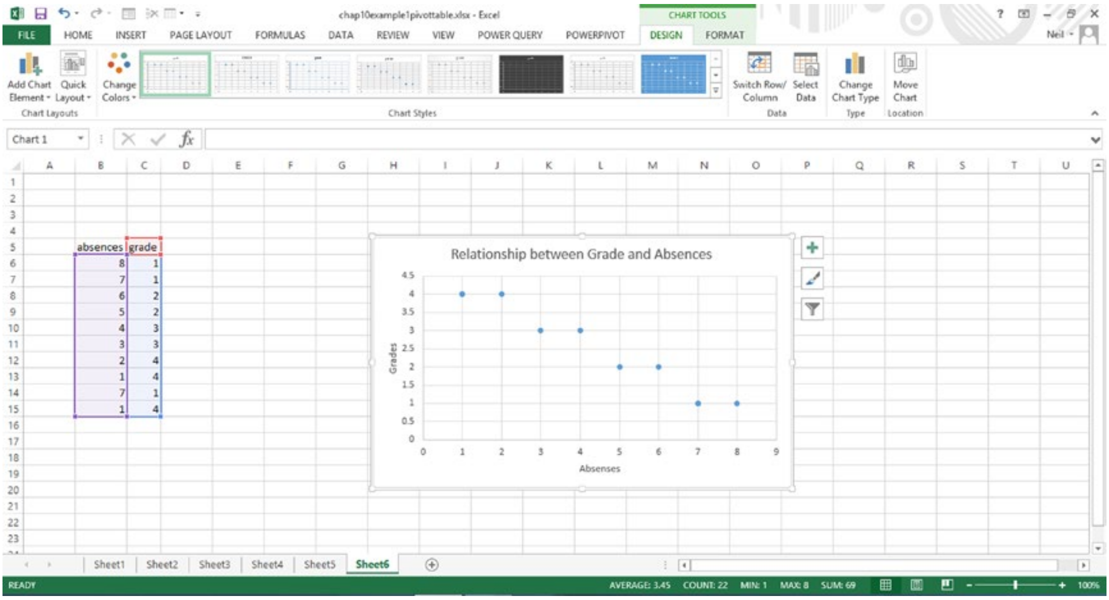


absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

CHART ELEMENTS
- ☑ Axes
- ☑ Axis Titles
- ☑ Chart Title
- □ Data Labels
- □ Error Bars
- ☑ Gridlines
- □ Legend
- □ Trendline

Figure 10-25. *Select Axis Titles*

4. Click the Axis Title on the horizontal or x axis and change it to Absences. Change the label on the vertical, or y, axis to Grades and change the chart title to “Relationship between Grade and Absences,” as shown in Figure 10-26.

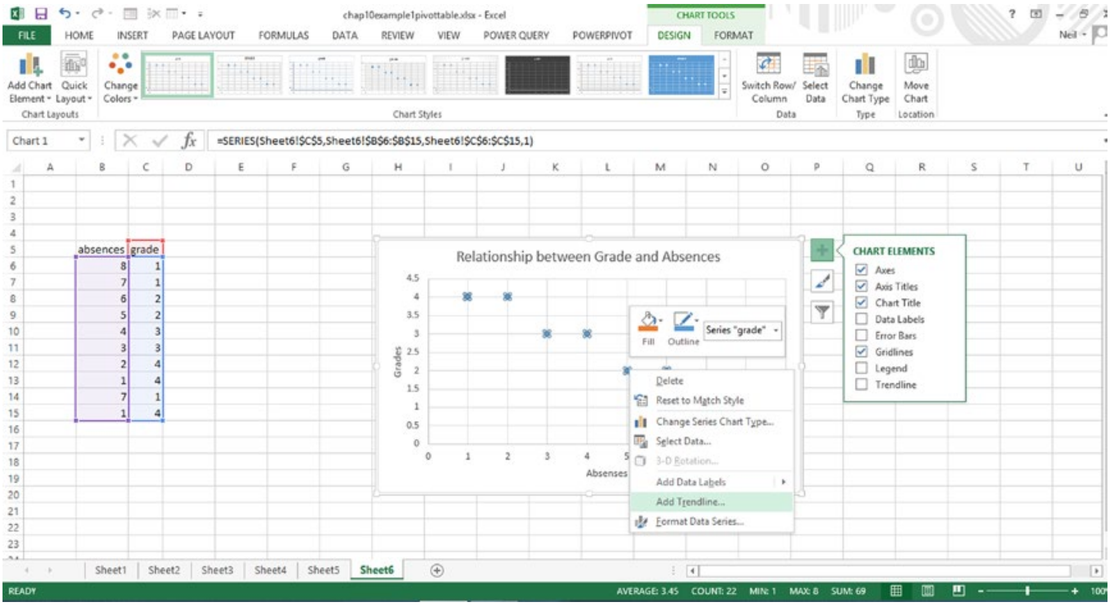


absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

AVERAGE: 3.45 COUNT: 22 MIN: 1 MAX: 8 SUM: 69

Figure 10-26. *Chart with title*

5. Right-click the plot area and select Add Trendline…, as shown in Figure 10-27.



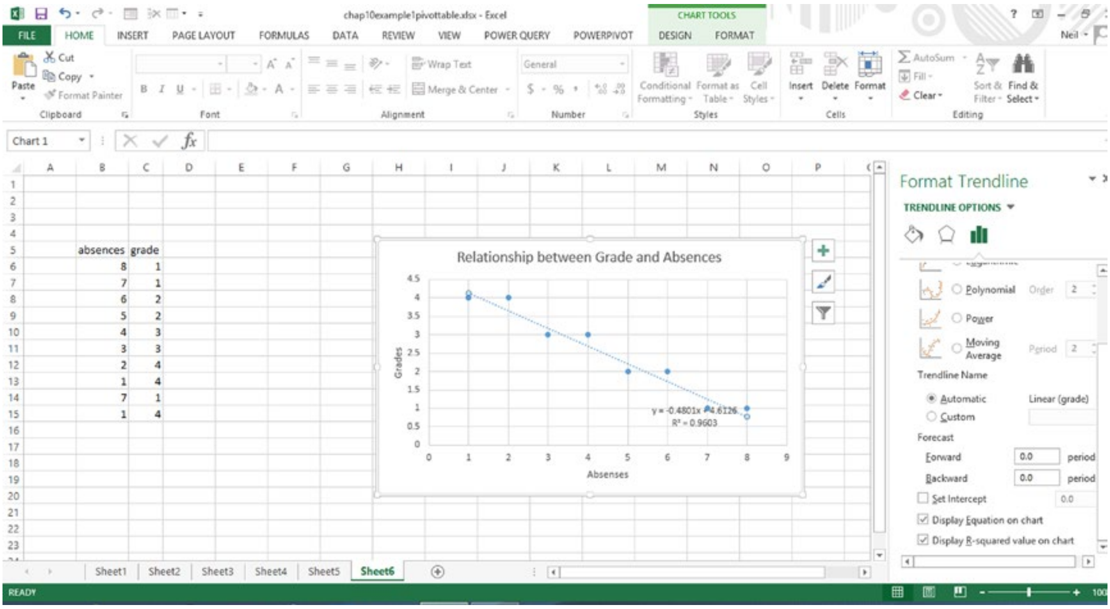
=SERIES(Sheet6!$C$5,Sheet6!$B$6:$B$15,Sheet6!$C$6:$C$15,1)

absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

AVERAGE: 3.45 COUNT: 22 MIN: 1 MAX: 8 SUM: 69

Figure 10-27. *Select Add Trendline…*

6. In the Format Trendline pane on the right, scroll down and select Display Equation on Chart and Display R squared value on chart, as shown in Figure 10-28. The formula for the line, including the slope and y intercept, is shown. Note that the R-squared value of 0.9603 (shown in decimal form) indicates a high correlation. This is an inverse relationship, which means the more absences, the lower the grade.



absences	grade
8	1
7	1
6	2
5	2
4	3
3	3
2	4
1	4
7	1
1	4

Format Trendline

TRENDLINE OPTIONS

○ Polynomial Order 2

○ Power

○ Moving Average Period 2

Trendline Name

● Automatic Linear (grade)

○ Custom

Forecast

Forward 0.0 period

Backward 0.0 period

□ Set Intercept 0.0

☑ Display Equation on chart

☑ Display R-squared value on chart

Figure 10-28. Chart showing the formula and R-squared value

Summary

This chapter has only begun to scratch the surface of the ability of Excel to calculate statistical values by using the Excel Analysis ToolPak. It has shown how to create visual displays of data, using the built-in charting tools. It has shown how to determine whether there is a relationship between two values. An entire book could be written on these topics.

CHAPTER 11

HDInsight

Chapter 1 described Hadoop as an open source distributed file system that allows processing of vast amounts of data. Microsoft's implementation of Hadoop on its Azure cloud platform is called HDInsight, which is designed to handle large amounts of data in the cloud. HDInsight uses Azure blob storage for storing the data, to make Hadoop available as a service in the cloud. Azure is useful for storing large datasets in the cloud in a cost-effective manner. Microsoft only charges for resources actually used.

Apache Hive supports analysis of large datasets stored in Hadoop. Hive is a data warehouse infrastructure built on top of Hadoop for providing data summarization, query, and analysis. Originally developed by Facebook, it is now an open source Apache project.

This chapter explores the easiest way to export data for analysis from Azure HDInsight into Excel.

Getting a Free Azure Account

Earlier chapters covered how to use the Azure Data Marketplace, which is essentially free for certain databases. The example in this chapter requires an Azure account. A 30-day trial account can be obtained by going to `https://azure.microsoft.com/en-us/pricing/free-trial/`.

The screen shown in Figure 11-1 will appear.

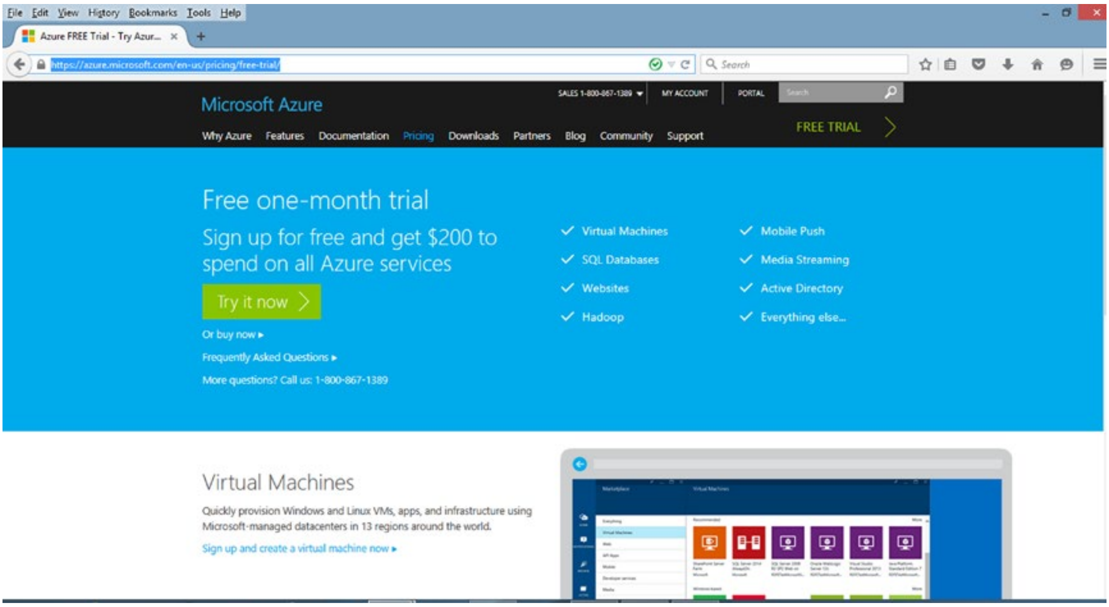

File Edit View History Bookmarks Tools Help
Azure FREE Trial - Try Azur...
https://azure.microsoft.com/en-us/pricing/free-trial/
Search
Microsoft Azure
SALES 1-800-867-1389
MY ACCOUNT
PORTAL
Search
Why Azure
Features
Documentation
Pricing
Downloads
Partners
Blog
Community
Support
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Figure 11-1. *Azure free trial screen as of July 2015*

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Importing Hadoop Files into Power Query

This example shows how to run a Hive query on a large dataset, using an HDInsight on Windows Azure Blob Storage. It then demonstrates how to use Power Query to import the data into Excel, so that it can be analyzed using Pivot Tables and Power Map.

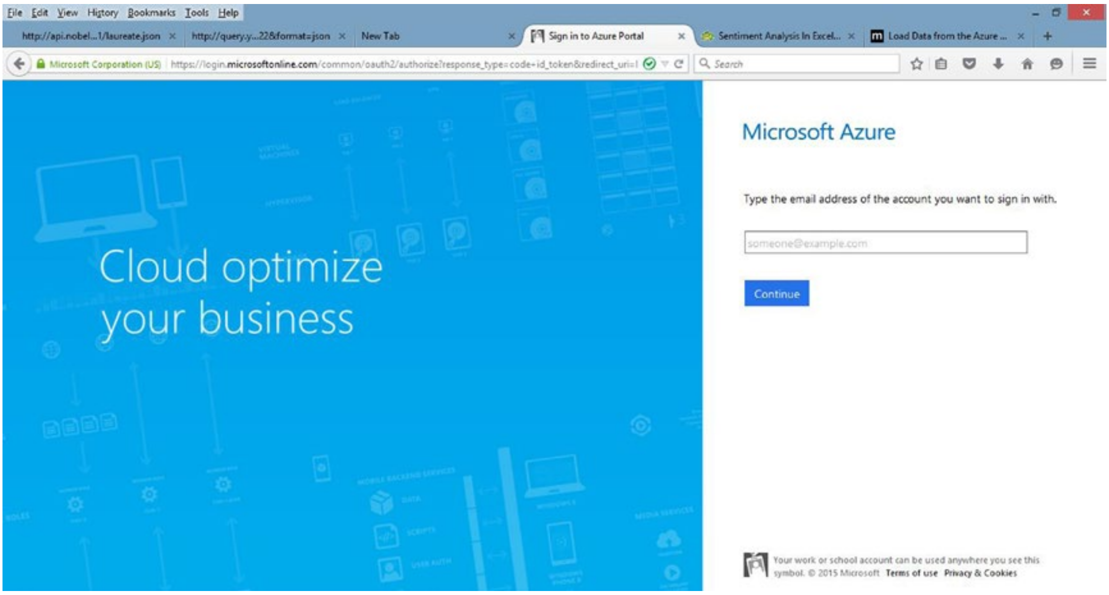
Creating an Azure Storage Account

To do this tutorial, you need the Windows Azure account just created.

1. Sign in to the Azure portal

   https://manage.windowsazure.com

   The screen shown in Figure 11-2 will appear. Log in with your Azure credentials.


File Edit View History Bookmarks Tools Help
http://api.nobel...1/laureate.json
http://query.y...22&format=json
New Tab
Sign in to Azure Portal
Sentiment Analysis In Excel...
Load Data from the Azure ...
Microsoft Corporation (US)
https://login.microsoftonline.com/common/oauth2/authorize?response_type=code+id_token&redirect_uri=
Search
Cloud optimize
your business
Continue

Microsoft Azure

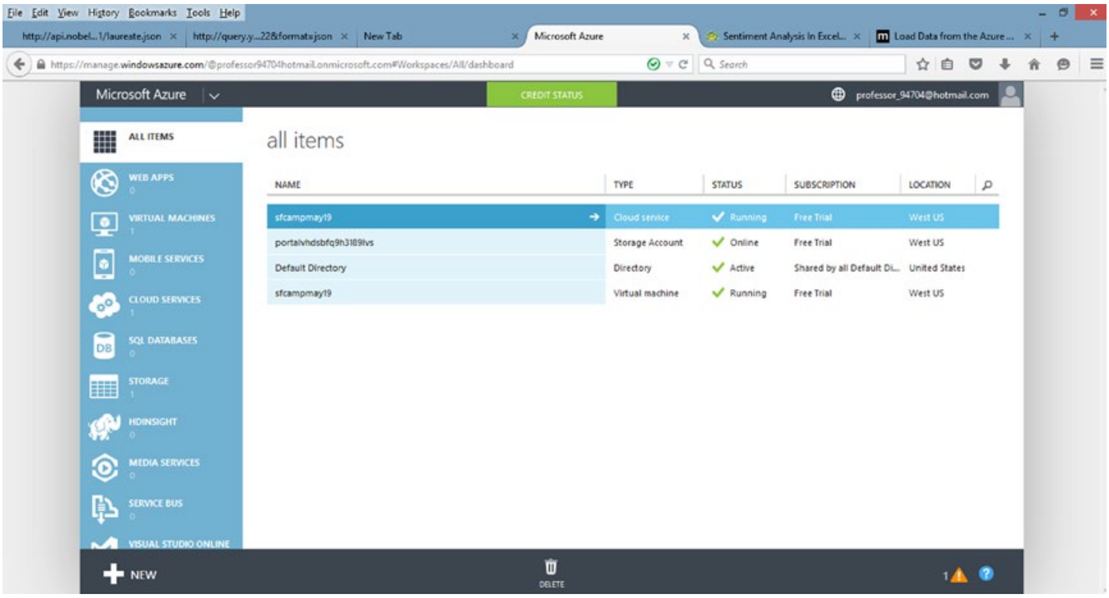
Type the email address of the account you want to sign in with.

someone@example.com

Your work or school account can be used anywhere you see this symbol. © 2015 Microsoft Terms of use Privacy & Cookies

Figure 11-2. *Microsoft Azure portal*

2. After logging in, click +NEW at the lower left-hand corner of the Azure portal screen, as shown in Figure 11-3.

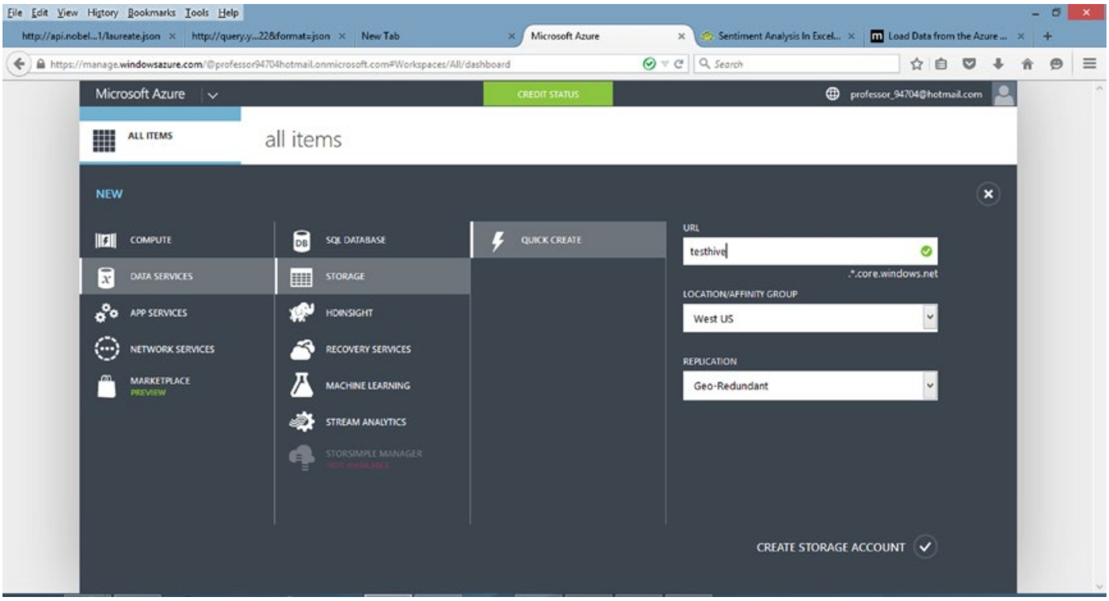


all items

NAME	TYPE	STATUS	SUBSCRIPTION	LOCATION
sfcampmay19	Cloud service	✓ Running	Free Trial	West US
portalvhdsbfq9h3189lvs	Storage Account	✓ Online	Free Trial	West US
Default Directory	Directory	✓ Active	Shared by all Default Di...	United States
sfcampmay19	Virtual machine	✓ Running	Free Trial	West US

Figure 11-3. *Azure portal screen*

3. Select Data Services ➤ Storage and Quick Create, as shown in Figure 11-4. Enter a unique name for the URL. This example will use `testhive`. Select a location closest to where you are.



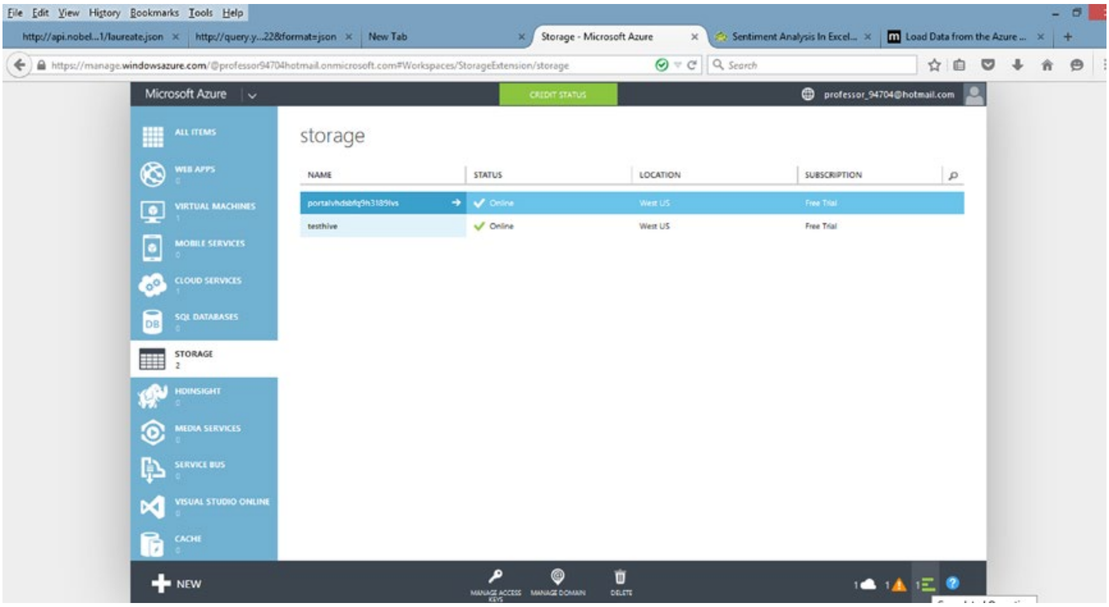
URL: testhive .core.windows.net

LOCATION/AFFINITY GROUP: West US

REPLICATION: Geo-Redundant

Figure 11-4. *Setting up a storage account in Azure*

4. Click Create Storage Account in the lower right and wait for the account to be created. The resulting screen will appear, as shown in Figure 11-5.

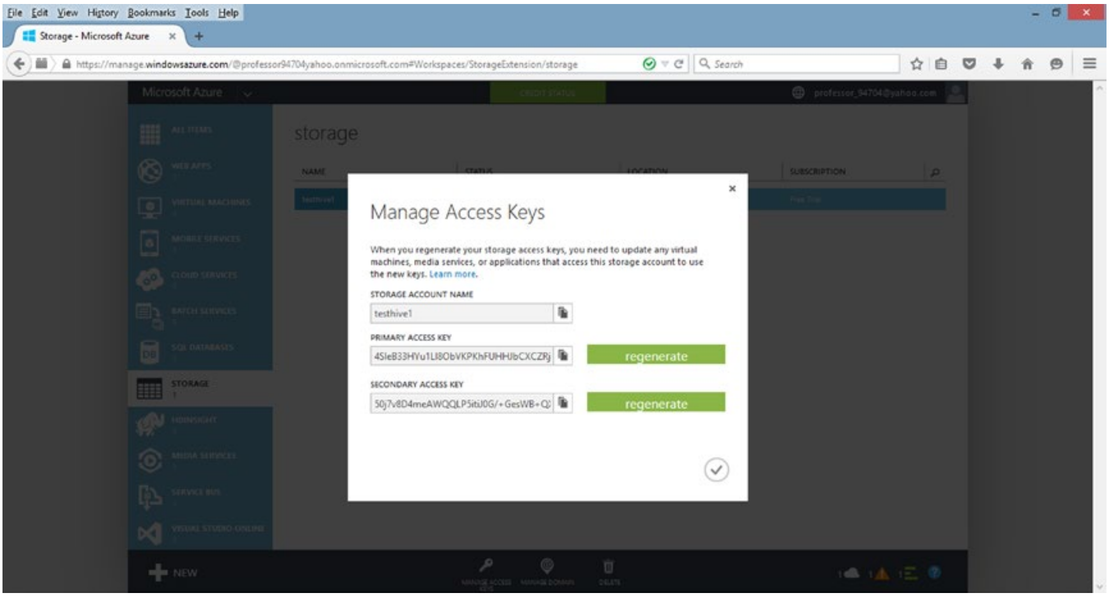


storage

NAME	STATUS	LOCATION	SUBSCRIPTION
portalvhdsbfq9h3189lvs	✓ Online	West US	Free Trial
testhive	✓ Online	West US	Free Trial

Figure 11-5. *New storage account*

5. Highlight the new account and click Manage Access Keys at the bottom of the screen. The Manage Access Keys pop-up will appear, as shown in Figure 11-6. Notice the primary and secondary access keys. Clicking the icon to the right of the key will copy it to the clipboard. Click the check mark at the bottom right of the screen, to close the window.



Manage Access Keys

When you regenerate your storage access keys, you need to update any virtual machines, media services, or applications that access this storage account to use the new keys. Learn more.

STORAGE ACCOUNT NAME

testhive1

PRIMARY ACCESS KEY

4SleB33HYu1LI8ObVKPKhFUHHJbCXCZRj

regenerate

SECONDARY ACCESS KEY

50j7v8D4meAWQQLP5itiJ0G/+GesWB+Q:

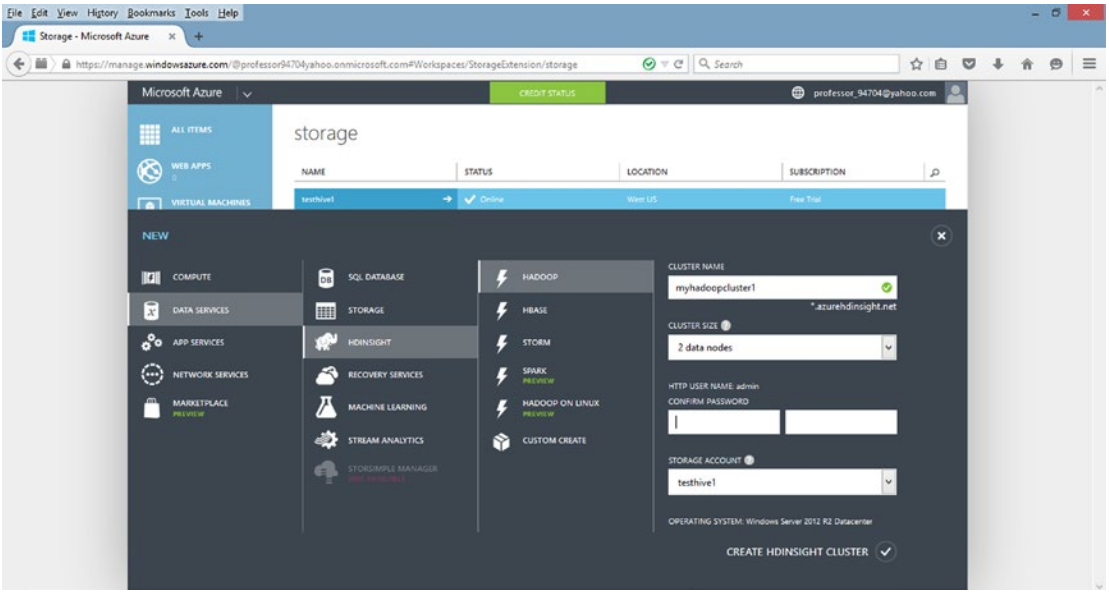
regenerate

Figure 11-6. Manage Access Keys

Provisioning a Hadoop Cluster

To provision a Hadoop Cluster, follow these steps:

1. Click +NEW in the lower left corner of the screen.
2. Select Data Services ➤ HDInsight ➤ Hadoop and fill in the values on the right side of the screen, as shown in Figure 11-7. Choose a cluster name. Two nodes should be sufficient for this example. Azure sets the default user name to `Admin`. You will need to create a password of at least ten characters, including at least one capital letter, one number, and one special character, and enter it twice, as prompted. Be sure to remember the password entered.



storage

NAME	STATUS	LOCATION	SUBSCRIPTION
testhive1	✓ Online	West US	Free Trial

CLUSTER NAME: myhadoopcluster1 .azurehdinsight.net

CLUSTER SIZE: 2 data nodes

HTTP USER NAME: admin

CONFIRM PASSWORD

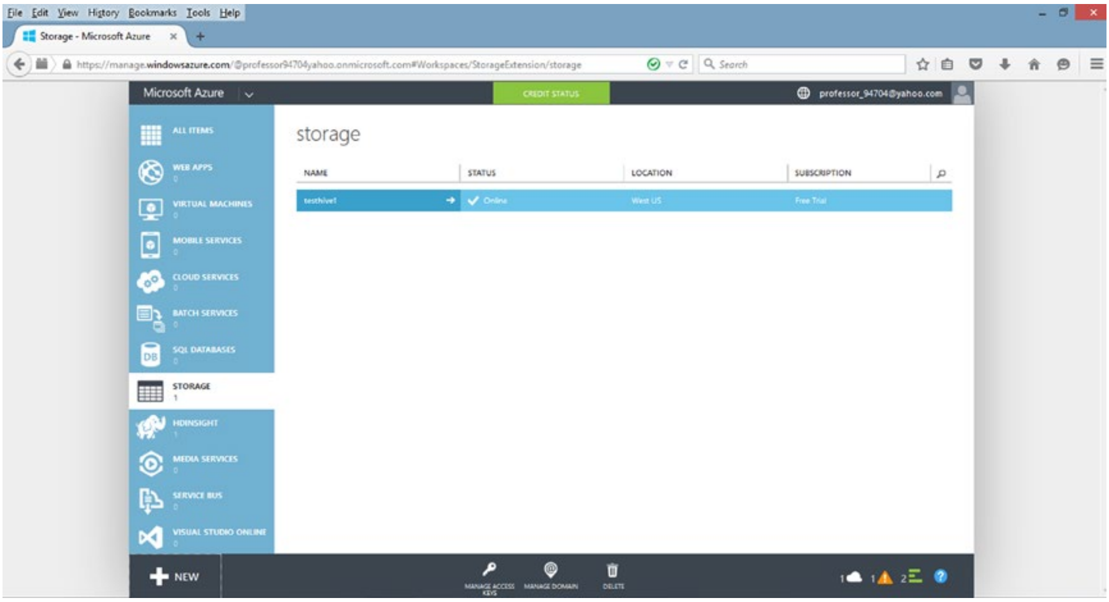
STORAGE ACCOUNT: testhive1

OPERATING SYSTEM: Windows Server 2012 R2 Datacenter

CREATE HDINSIGHT CLUSTER ✓

Figure 11-7. *Setting up the HDInsight cluster*

3. Click Create HDInsight Cluster at the bottom lower right of the screen. Then the screen shown in Figure 11-8 will appear after the cluster is created, which may take 20 minutes or more.

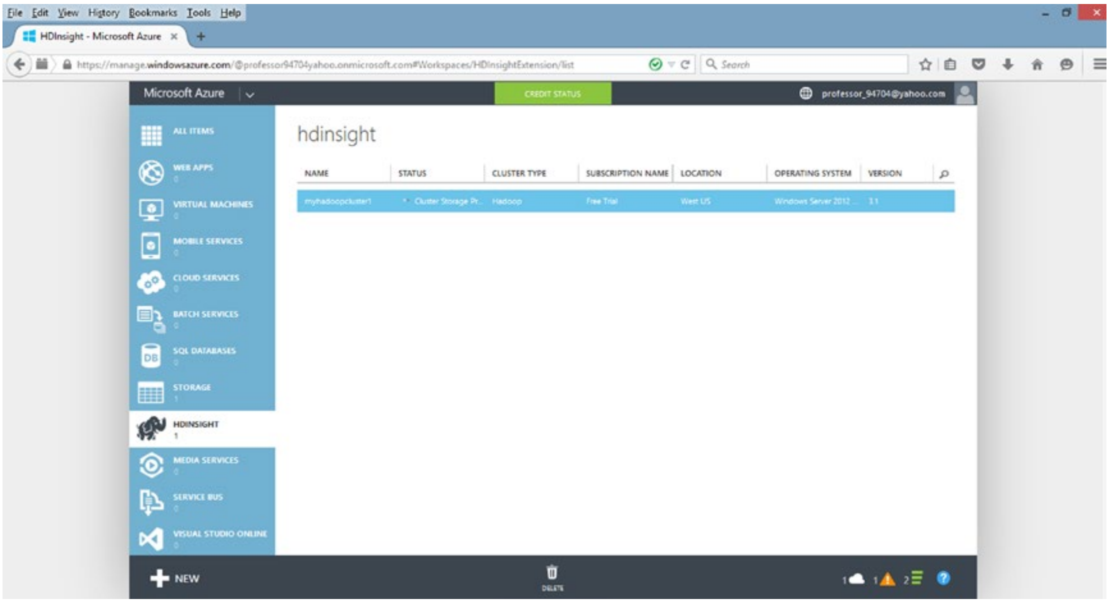


storage

NAME	STATUS	LOCATION	SUBSCRIPTION
testhive1	✓ Online	West US	Free Trial

Figure 11-8. *Showing new cluster*

4. Click HDInsight from the left pane to see the list of clusters, as shown in Figure 11-9. The cluster that was just created should be shown.

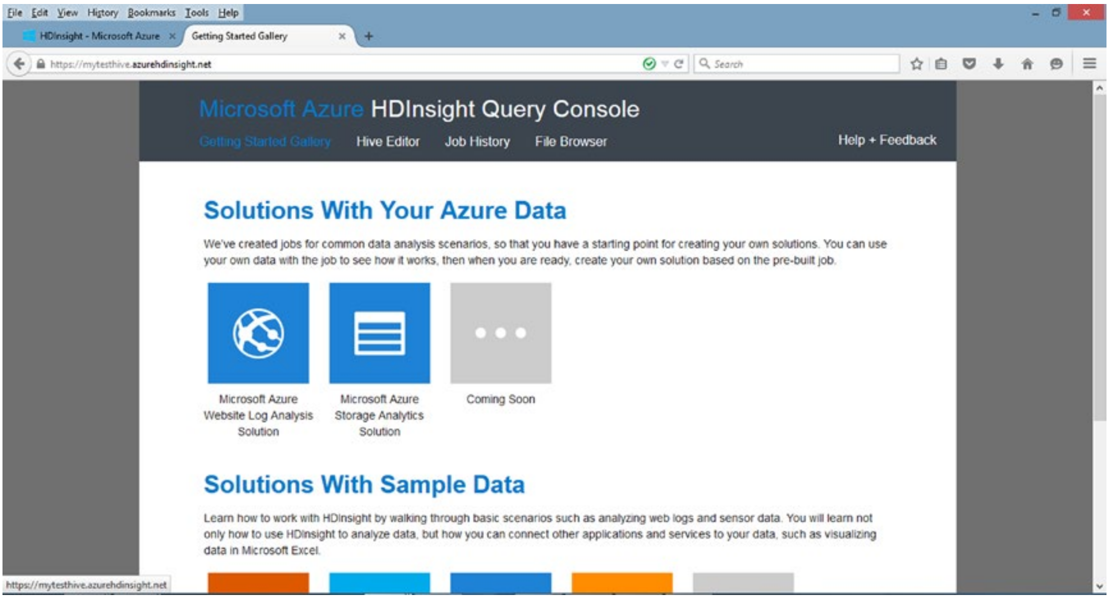

File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
https://manage.windowsazure.com/@professor94704yahoo.onmicrosoft.com#Workspaces/HDInsightExtension/list
Search
Microsoft Azure
CREDIT STATUS
professor_94704@yahoo.com
ALL ITEMS
WEB APPS
VIRTUAL MACHINES
MOBILE SERVICES
CLOUD SERVICES
BATCH SERVICES
SQL DATABASES
STORAGE
HDINSIGHT
MEDIA SERVICES
SERVICE BUS
VISUAL STUDIO ONLINE
NEW
DELETE

hdinsight

NAME	STATUS	CLUSTER TYPE	SUBSCRIPTION NAME	LOCATION	OPERATING SYSTEM	VERSION
myhadoopcluster1	Cluster Storage Pr...	Hadoop	Free Trial	West US	Windows Server 2012 ...	3.1

Figure 11-9. *List of HDInsight clusters*

5. Select the cluster that was just created and click Query Console at the bottom of the screen. If requested, enter your admin username and password. The screen shown in Figure 11-10 will appear.


File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
Getting Started Gallery
https://mytesthive.azurehdinsight.net
Search
Microsoft Azure HDInsight Query Console
Getting Started Gallery
Hive Editor
Job History
File Browser
Help + Feedback
Microsoft Azure Website Log Analysis Solution
Microsoft Azure Storage Analytics Solution
Coming Soon
https://mytesthive.azurehdinsight.net

Solutions With Your Azure Data

We've created jobs for common data analysis scenarios, so that you have a starting point for creating your own solutions. You can use your own data with the job to see how it works, then when you are ready, create your own solution based on the pre-built job.

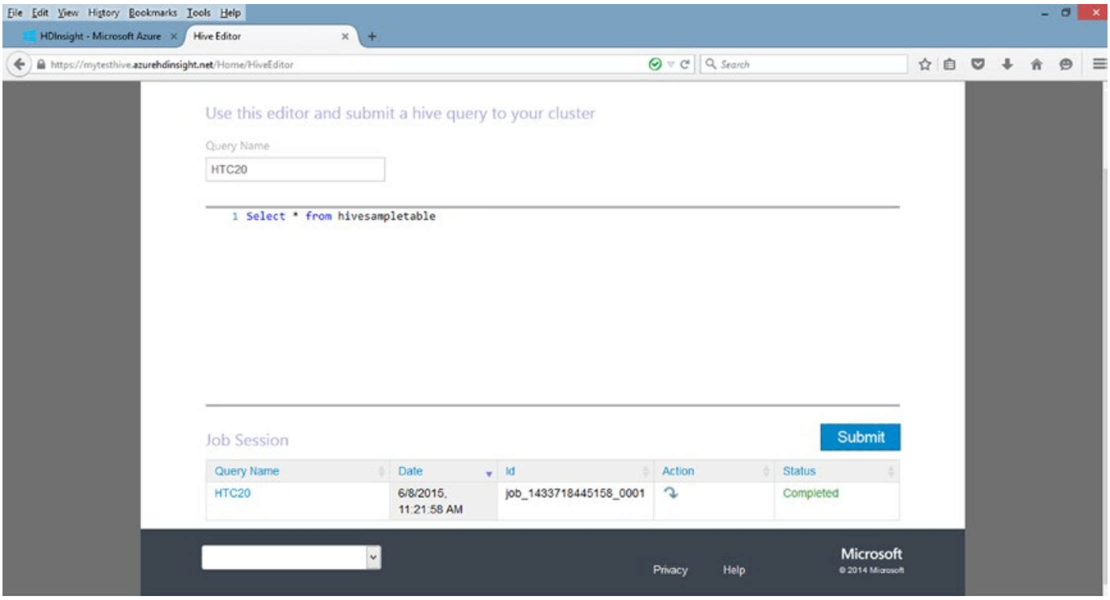
Solutions With Sample Data

Learn how to work with HDInsight by walking through basic scenarios such as analyzing web logs and sensor data. You will learn not only how to use HDInsight to analyze data, but how you can connect other applications and services to your data, such as visualizing data in Microsoft Excel.

Figure 11-10. *HDInsight Query Console*

6. Scroll down to see Solutions With Sample Data.

7. Click the Hive Editor tab at the top of the screen. In Hive Editor, enter a query name and accept the default SQL as `Select * from hivesampletable` to select all records as shown in Figure 11-11.


File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
Hive Editor
https://mytesthive.azurehdinsight.net/Home/HiveEditor
Search
Submit
Privacy
Help
Microsoft
© 2014 Microsoft

Use this editor and submit a hive query to your cluster

Query Name: HTC20

```
Select * from hivesampletable
```

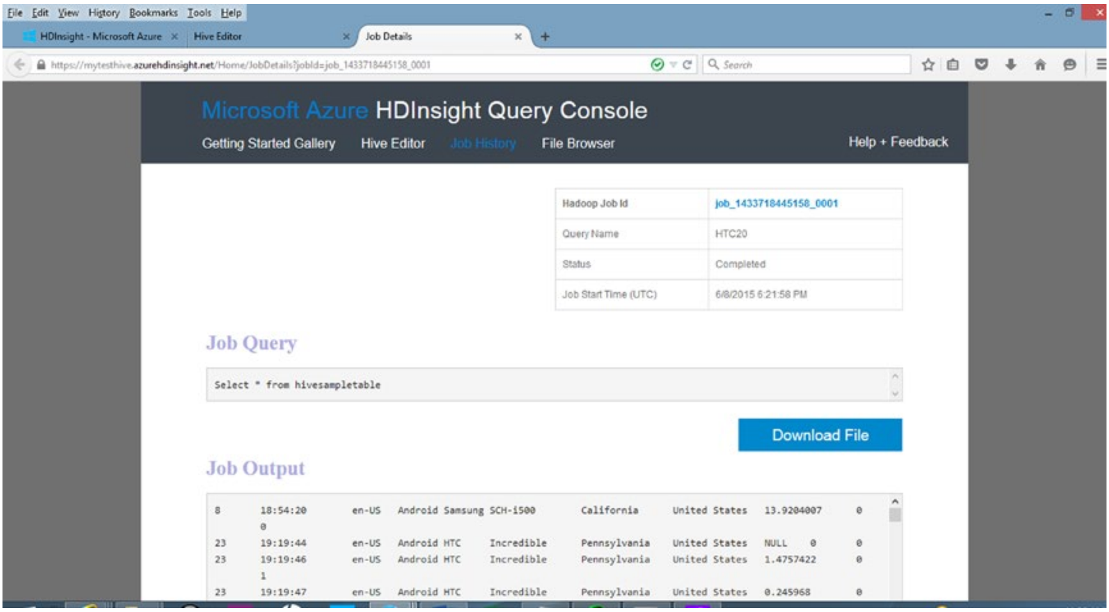
Job Session

Query Name	Date	Id	Action	Status
HTC20	6/8/2015, 11:21:58 AM	job_1433718445158_0001	↷	Completed

Figure 11-11. *SQL query to select all records*

8. Click Submit.

9. To see the query results, click the query name at the bottom left of the screen, as shown in Figure 11-12.



File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
Hive Editor
Job Details
https://mytesthive.azurehdinsight.net/Home/JobDetails?jobId=job_1433718445158_0001
Search
Microsoft Azure HDInsight Query Console
Getting Started Gallery
Hive Editor
Job History
File Browser
Help + Feedback
Download File

Hadoop Job Id	job_1433718445158_0001
Query Name	HTC20
Status	Completed
Job Start Time (UTC)	6/8/2015 6:21:58 PM

Job Query

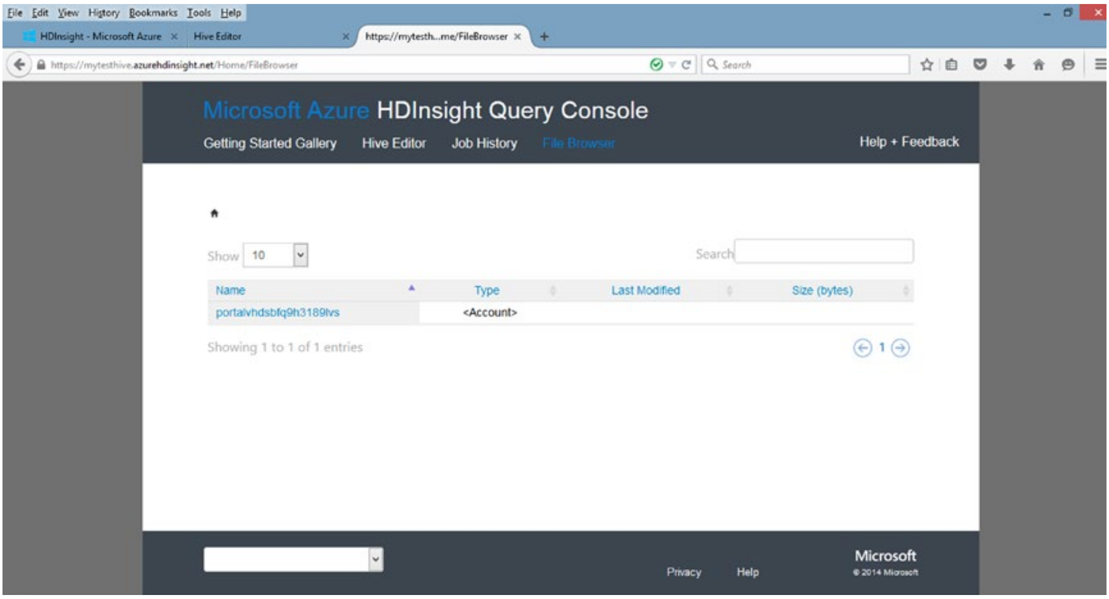
```
Select * from hivesampletable
```

Job Output

```
8       18:54:20        en-US   Android Samsung SCH-i500        California      United States   13.9204007      0
        0
23      19:19:44        en-US   Android HTC     Incredible      Pennsylvania    United States   NULL    0       0
23      19:19:46        en-US   Android HTC     Incredible      Pennsylvania    United States   1.4757422       0
        1
23      19:19:47        en-US   Android HTC     Incredible      Pennsylvania    United States   0.245968        0
```

Figure 11-12. *Query results*

10. On the HD Query Console screen, click File Browser at the top of the screen. The results are shown in Figure 11-13.



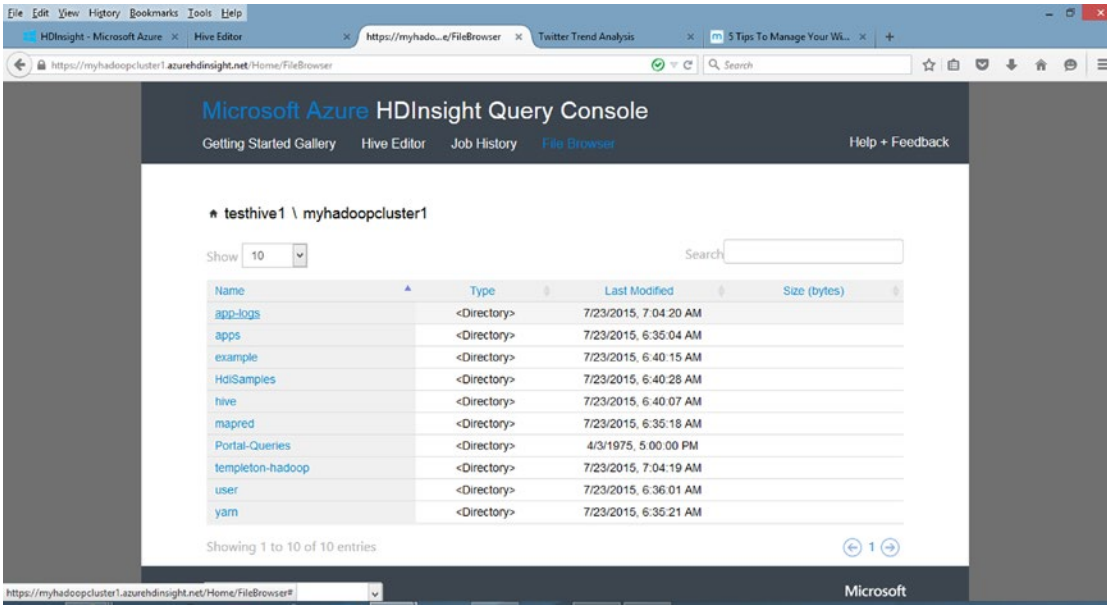
File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
Hive Editor
https://mytesth...me/FileBrowser
https://mytesthive.azurehdinsight.net/Home/FileBrowser
Search
Microsoft Azure HDInsight Query Console
Getting Started Gallery
Hive Editor
Job History
File Browser
Help + Feedback
Show 10
Search
1
Privacy
Help
Microsoft
© 2014 Microsoft

Name	Type	Last Modified	Size (bytes)
portalvhdsbfq9h3189lvs	<Account>		

Showing 1 to 1 of 1 entries

Figure 11-13. *List of clusters*

11. Click the first item in the Name column on the left and then on your cluster name, to get the results shown in Figure 11-14.



File Edit View History Bookmarks Tools Help
HDInsight - Microsoft Azure
Hive Editor
https://myhado...e/FileBrowser
Twitter Trend Analysis
5 Tips To Manage Your Wi...
https://myhadoopcluster1.azurehdinsight.net/Home/FileBrowser
Search
Microsoft Azure HDInsight Query Console
Getting Started Gallery
Hive Editor
Job History
File Browser
Help + Feedback
Microsoft
https://myhadoopcluster1.azurehdinsight.net/Home/FileBrowser#

testhive1 \ myhadoopcluster1

Show 10 Search

Name	Type	Last Modified	Size (bytes)
app-logs	<Directory>	7/23/2015, 7:04:20 AM	
apps	<Directory>	7/23/2015, 6:35:04 AM	
example	<Directory>	7/23/2015, 6:40:15 AM	
HdiSamples	<Directory>	7/23/2015, 6:40:28 AM	
hive	<Directory>	7/23/2015, 6:40:07 AM	
mapred	<Directory>	7/23/2015, 6:35:18 AM	
Portal-Queries	<Directory>	4/3/1975, 5:00:00 PM	
templeton-hadoop	<Directory>	7/23/2015, 7:04:19 AM	
user	<Directory>	7/23/2015, 6:36:01 AM	
yarn	<Directory>	7/23/2015, 6:35:21 AM	

Showing 1 to 10 of 10 entries

Figure 11-14. *List of files in cluster*

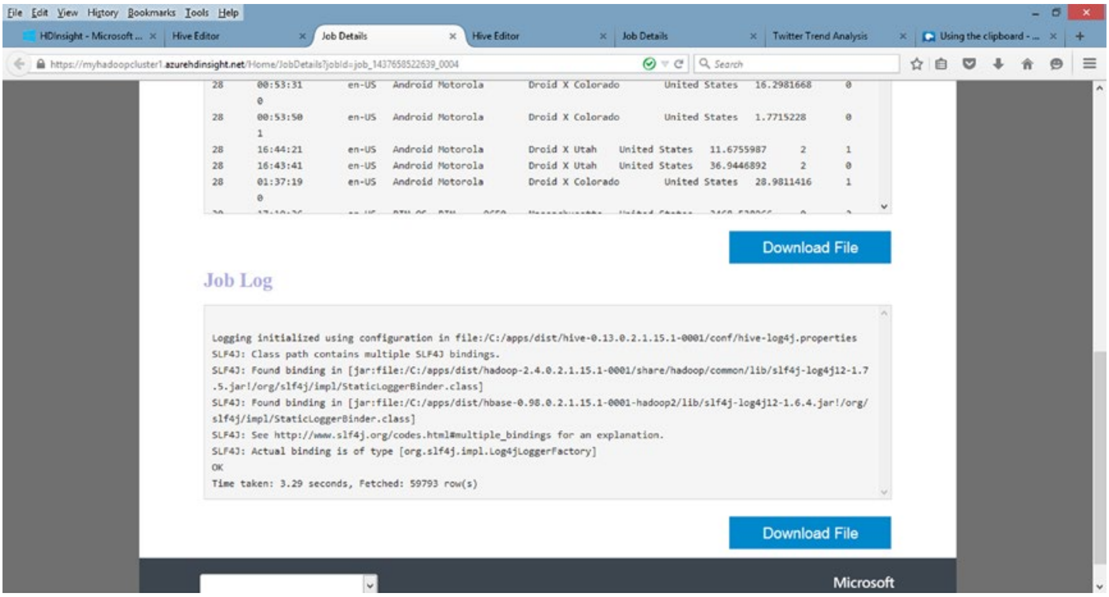
Importing into Excel

There are several ways to import this data into Excel. This section will demonstrate how to download the file to a text file with fixed-length fields.

Follow these steps:

1. Go back to the screen shown in Figure 11-12, by clicking Job History at the top of the screen and then clicking the query name. Then click Download File.

2. The Job Log for the download is shown in Figure 11-15, which reports that 59,793 rows were downloaded. The number you see may differ.


File Edit View History Bookmarks Tools Help
HDInsight - Microsoft ...
Hive Editor
Job Details
Hive Editor
Job Details
Twitter Trend Analysis
Using the clipboard - ...
https://myhadoopcluster1.azurehdinsight.net/Home/JobDetails?jobId=job_1437658522639_0004
Search
Download File
Download File
Microsoft

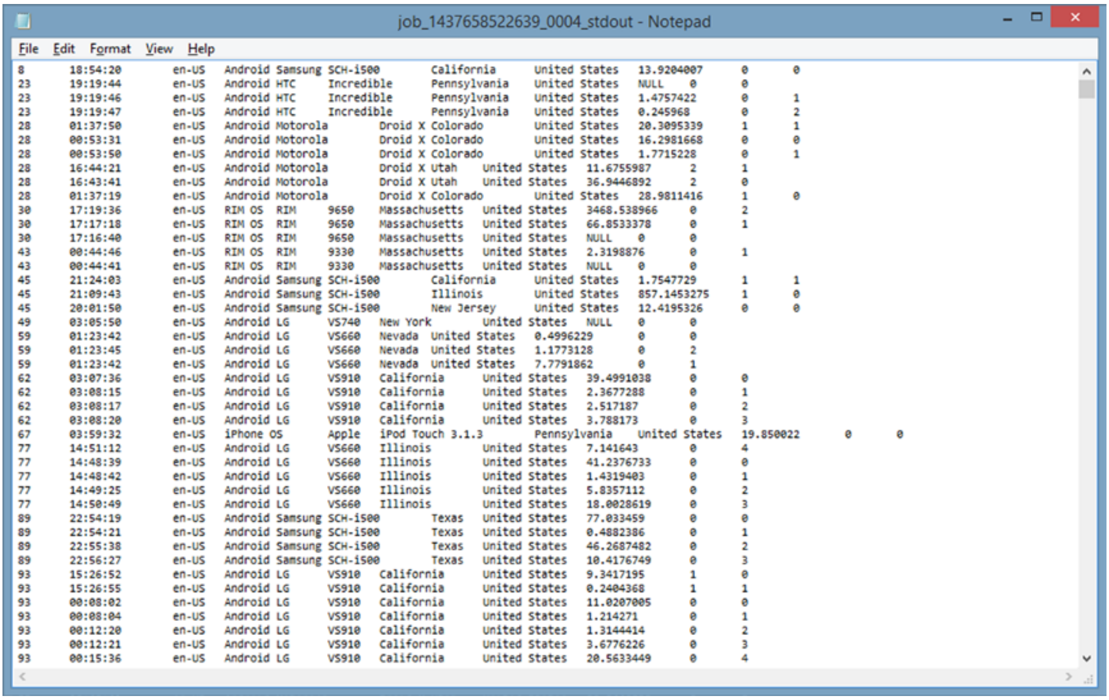
```
28      00:53:31        en-US   Android Motorola        Droid X Colorado        United States   16.2981668      0
        0
28      00:53:50        en-US   Android Motorola        Droid X Colorado        United States   1.7715228       0
        1
28      16:44:21        en-US   Android Motorola        Droid X Utah    United States   11.6755987      2       1
28      16:43:41        en-US   Android Motorola        Droid X Utah    United States   36.9446892      2       0
28      01:37:19        en-US   Android Motorola        Droid X Colorado        United States   28.9811416      1
        0
```

Job Log

```
Logging initialized using configuration in file:/C:/apps/dist/hive-0.13.0.2.1.15.1-0001/conf/hive-log4j.properties
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/C:/apps/dist/hadoop-2.4.0.2.1.15.1-0001/share/hadoop/common/lib/slf4j-log4j12-1.7
.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/C:/apps/dist/hbase-0.98.0.2.1.15.1-0001-hadoop2/lib/slf4j-log4j12-1.6.4.jar!/org/
slf4j/impl/StaticLoggerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [org.slf4j.impl.Log4jLoggerFactory]
OK
Time taken: 3.29 seconds, Fetched: 59793 row(s)
```

Figure 11-15. *Job Log for downloads*

3. Click the blue box at the bottom of the screen labeled Download File. When prompted for the program to use to open the file, select Notepad. The result will appear in Notepad, as shown in Figure 11-16. This appears to be a log file for web site accesses.


job_1437658522639_0004_stdout - Notepad
File Edit Format View Help

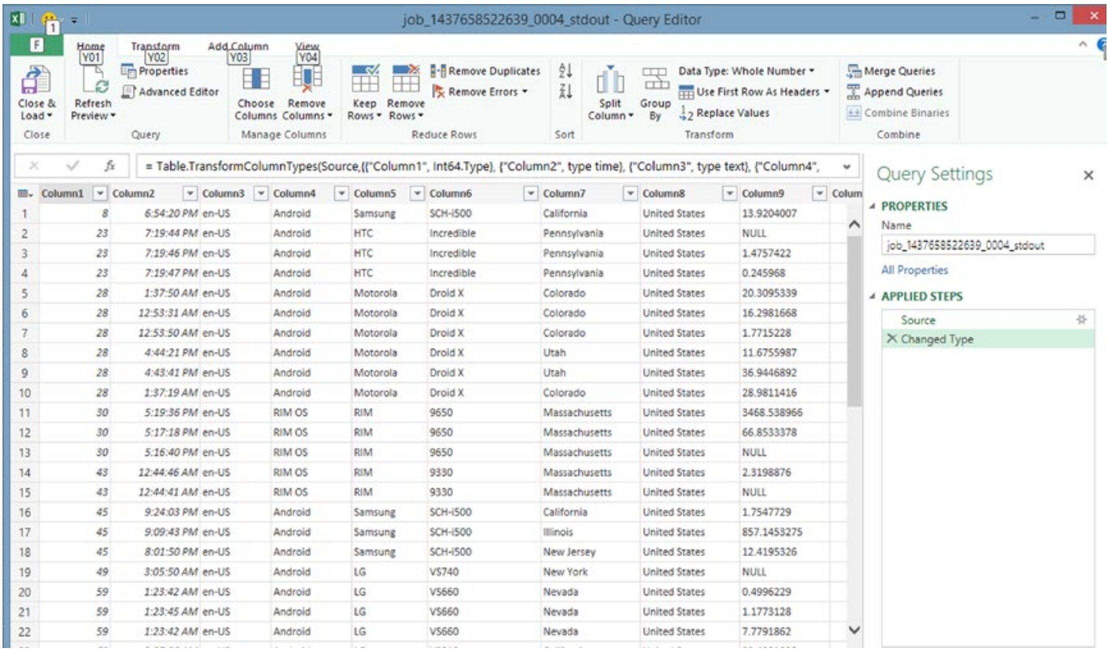
```
8       18:54:20        en-US   Android Samsung SCH-i500        California      United States   13.9204007      0       0
23      19:19:44        en-US   Android HTC     Incredible      Pennsylvania    United States   NULL    0       0
23      19:19:46        en-US   Android HTC     Incredible      Pennsylvania    United States   1.4757422       0       1
23      19:19:47        en-US   Android HTC     Incredible      Pennsylvania    United States   0.245968        0       2
28      01:37:50        en-US   Android Motorola        Droid X Colorado        United States   20.3095339      1       1
28      00:53:31        en-US   Android Motorola        Droid X Colorado        United States   16.2981668      0       0
28      00:53:50        en-US   Android Motorola        Droid X Colorado        United States   1.7715228       0       1
28      16:44:21        en-US   Android Motorola        Droid X Utah    United States   11.6755987      2       1
28      16:43:41        en-US   Android Motorola        Droid X Utah    United States   36.9446892      2       0
28      01:37:19        en-US   Android Motorola        Droid X Colorado        United States   28.9811416      1       0
30      17:19:36        en-US   RIM OS  RIM     9650    Massachusetts   United States   3468.538966     0       2
30      17:17:18        en-US   RIM OS  RIM     9650    Massachusetts   United States   66.8533378      0       1
30      17:16:40        en-US   RIM OS  RIM     9650    Massachusetts   United States   NULL    0       0
43      00:44:46        en-US   RIM OS  RIM     9330    Massachusetts   United States   2.3198876       0       1
43      00:44:41        en-US   RIM OS  RIM     9330    Massachusetts   United States   NULL    0       0
45      21:24:03        en-US   Android Samsung SCH-i500        California      United States   1.7547729       1       1
45      21:09:43        en-US   Android Samsung SCH-i500        Illinois        United States   857.1453275     1       0
45      20:01:50        en-US   Android Samsung SCH-i500        New Jersey      United States   12.4195326      0       0
49      03:05:50        en-US   Android LG      VS740   New York        United States   NULL    0       0
59      01:23:42        en-US   Android LG      VS660   Nevada  United States   0.4996229       0       0
59      01:23:45        en-US   Android LG      VS660   Nevada  United States   1.1773128       0       2
59      01:23:42        en-US   Android LG      VS660   Nevada  United States   7.7791862       0       1
62      03:07:36        en-US   Android LG      VS910   California      United States   39.4991038      0       0
62      03:08:15        en-US   Android LG      VS910   California      United States   2.3677288       0       1
62      03:08:17        en-US   Android LG      VS910   California      United States   2.517187        0       2
62      03:08:20        en-US   Android LG      VS910   California      United States   3.788173        0       3
67      03:59:32        en-US   iPhone OS       Apple   iPod Touch 3.1.3        Pennsylvania    United States   19.850022       0       0
77      14:51:12        en-US   Android LG      VS660   Illinois        United States   7.141643        0       4
77      14:48:39        en-US   Android LG      VS660   Illinois        United States   41.2376733      0       0
77      14:48:42        en-US   Android LG      VS660   Illinois        United States   1.4319403       0       1
77      14:49:25        en-US   Android LG      VS660   Illinois        United States   5.8357112       0       2
77      14:50:49        en-US   Android LG      VS660   Illinois        United States   18.0028619      0       3
89      22:54:19        en-US   Android Samsung SCH-i500        Texas   United States   77.033459       0       0
89      22:54:21        en-US   Android Samsung SCH-i500        Texas   United States   0.4882386       0       1
89      22:55:38        en-US   Android Samsung SCH-i500        Texas   United States   46.2687482      0       2
89      22:56:27        en-US   Android Samsung SCH-i500        Texas   United States   10.4176749      0       3
93      15:26:52        en-US   Android LG      VS910   California      United States   9.3417195       1       0
93      15:26:55        en-US   Android LG      VS910   California      United States   0.2404368       1       1
93      00:08:02        en-US   Android LG      VS910   California      United States   11.0207005      0       0
93      00:08:04        en-US   Android LG      VS910   California      United States   1.214271        0       1
93      00:12:20        en-US   Android LG      VS910   California      United States   1.3144414       0       2
93      00:12:21        en-US   Android LG      VS910   California      United States   3.6776226       0       3
93      00:15:36        en-US   Android LG      VS910   California      United States   20.5633449      0       4
```

Figure 11-16. *Log file for web site accesses*

4. Do a Save As to save the file to the desktop, to make it easier to access.

5. Open Excel and click the Power Query tab. Select from File and then From Text and Browse to find the downloaded file.

6. The file will be loaded into the Query Editor, as shown in Figure 11-17. Note that Power Query parsed the fixed-length fields to neatly put all the data in separate columns, but there are no descriptive column headings.



= Table.TransformColumnTypes(Source,{{"Column1", Int64.Type}, {"Column2", type time}, {"Column3", type text}, {"Column4",

	Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9
1	8	6:54:20 PM	en-US	Android	Samsung	SCH-i500	California	United States	13.9204007
2	23	7:19:44 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	NULL
3	23	7:19:46 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	1.4757422
4	23	7:19:47 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	0.245968
5	28	1:37:50 AM	en-US	Android	Motorola	Droid X	Colorado	United States	20.3095339
6	28	12:53:31 AM	en-US	Android	Motorola	Droid X	Colorado	United States	16.2981668
7	28	12:53:50 AM	en-US	Android	Motorola	Droid X	Colorado	United States	1.7715228
8	28	4:44:21 PM	en-US	Android	Motorola	Droid X	Utah	United States	11.6755987
9	28	4:43:41 PM	en-US	Android	Motorola	Droid X	Utah	United States	36.9446892
10	28	1:37:19 AM	en-US	Android	Motorola	Droid X	Colorado	United States	28.9811416
11	30	5:19:36 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	3468.538966
12	30	5:17:18 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	66.8533378
13	30	5:16:40 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	NULL
14	43	12:44:46 AM	en-US	RIM OS	RIM	9330	Massachusetts	United States	2.3198876
15	43	12:44:41 AM	en-US	RIM OS	RIM	9330	Massachusetts	United States	NULL
16	45	9:24:03 PM	en-US	Android	Samsung	SCH-i500	California	United States	1.7547729
17	45	9:09:43 PM	en-US	Android	Samsung	SCH-i500	Illinois	United States	857.1453275
18	45	8:01:50 PM	en-US	Android	Samsung	SCH-i500	New Jersey	United States	12.4195326
19	49	3:05:50 AM	en-US	Android	LG	VS740	New York	United States	NULL
20	59	1:23:42 AM	en-US	Android	LG	VS660	Nevada	United States	0.4996229
21	59	1:23:45 AM	en-US	Android	LG	VS660	Nevada	United States	1.1773128
22	59	1:23:42 AM	en-US	Android	LG	VS660	Nevada	United States	7.7791862

Name
job_1437658522639_0004_stdout

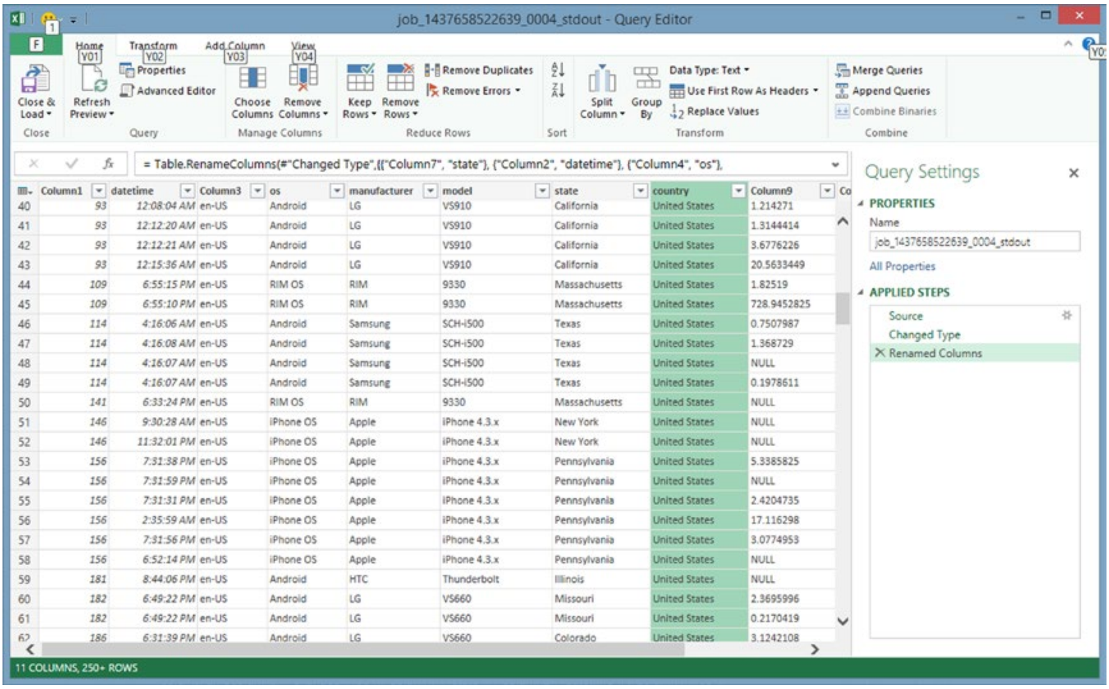
Source
Changed Type

Figure 11-17. File loaded into Power Query

7. To rename critical columns, right-click the column heading, select Rename, and enter a new descriptive name, as shown below.

Old Name	New Name
Column2	Datetime
Column4	OS
Column5	Manufacturer
Coluimn6	Model
Column7	State
Column 8	Country
Column10	Accesses

The result is shown in Figure 11-18.



job_1437658522639_0004_stdout - Query Editor

= Table.RenameColumns(#"Changed Type",{{"Column7", "state"}, {"Column2", "datetime"}, {"Column4", "os"},

	Column1	datetime	Column3	os	manufacturer	model	state	country	Column9	Co
40	93	12:08:04 AM	en-US	Android	LG	VS910	California	United States	1.214271	
41	93	12:12:20 AM	en-US	Android	LG	VS910	California	United States	1.3144414	
42	93	12:12:21 AM	en-US	Android	LG	VS910	California	United States	3.6776226	
43	93	12:15:36 AM	en-US	Android	LG	VS910	California	United States	20.5633449	
44	109	6:55:15 PM	en-US	RIM OS	RIM	9330	Massachusetts	United States	1.82519	
45	109	6:55:10 PM	en-US	RIM OS	RIM	9330	Massachusetts	United States	728.9452825	
46	114	4:16:06 AM	en-US	Android	Samsung	SCH-i500	Texas	United States	0.7507987	
47	114	4:16:08 AM	en-US	Android	Samsung	SCH-i500	Texas	United States	1.368729	
48	114	4:16:07 AM	en-US	Android	Samsung	SCH-i500	Texas	United States	NULL	
49	114	4:16:07 AM	en-US	Android	Samsung	SCH-i500	Texas	United States	0.1978611	
50	141	6:33:24 PM	en-US	RIM OS	RIM	9330	Massachusetts	United States	NULL	
51	146	9:30:28 AM	en-US	iPhone OS	Apple	iPhone 4.3.x	New York	United States	NULL	
52	146	11:32:01 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	New York	United States	NULL	
53	156	7:31:38 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	5.3385825	
54	156	7:31:59 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	NULL	
55	156	7:31:31 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	2.4204735	
56	156	2:35:59 AM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	17.116298	
57	156	7:31:56 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	3.0774953	
58	156	6:52:14 PM	en-US	iPhone OS	Apple	iPhone 4.3.x	Pennsylvania	United States	NULL	
59	181	8:44:06 PM	en-US	Android	HTC	Thunderbolt	Illinois	United States	NULL	
60	182	6:49:22 PM	en-US	Android	LG	VS660	Missouri	United States	2.3695996	
61	182	6:49:22 PM	en-US	Android	LG	VS660	Missouri	United States	0.2170419	
62	186	6:31:39 PM	en-US	Android	LG	VS660	Colorado	United States	3.1242108	

11 COLUMNS, 250+ ROWS

Query Settings

PROPERTIES

Name

job_1437658522639_0004_stdout

All Properties

APPLIED STEPS

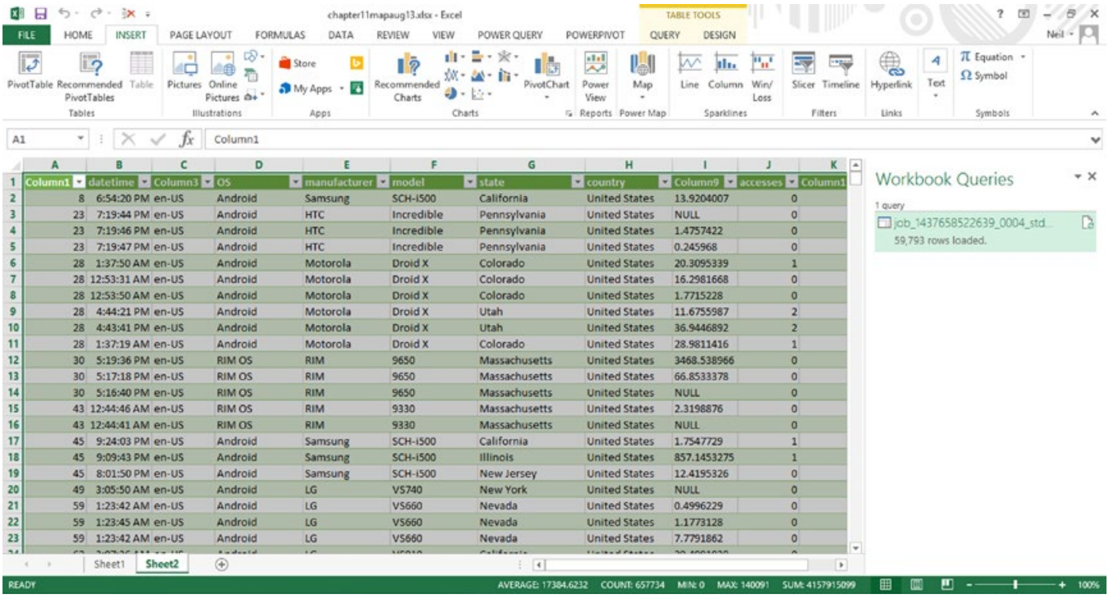
Source

Changed Type

Renamed Columns

***Figure 11-18.** Power Query Editor after columns are renamed*

8. To load the data into a spreadsheet, click Close & Load on the left end of the ribbon and select Close & Load. The data is loaded into a spreadsheet, as shown in Figure 11-19.



Column1	datetime	Column3	OS	manufacturer	model	state	country	Column9	accesses	Column1
8	6:54:20 PM	en-US	Android	Samsung	SCH-i500	California	United States	13.9204007	0	
23	7:19:44 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	NULL	0	
23	7:19:46 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	1.4757422	0	
23	7:19:47 PM	en-US	Android	HTC	Incredible	Pennsylvania	United States	0.245968	0	
28	1:37:50 AM	en-US	Android	Motorola	Droid X	Colorado	United States	20.3095339	1	
28	12:53:31 AM	en-US	Android	Motorola	Droid X	Colorado	United States	16.2981668	0	
28	12:53:50 AM	en-US	Android	Motorola	Droid X	Colorado	United States	1.7715228	0	
28	4:44:21 PM	en-US	Android	Motorola	Droid X	Utah	United States	11.6755987	2	
28	4:43:41 PM	en-US	Android	Motorola	Droid X	Utah	United States	36.9446892	2	
28	1:37:19 AM	en-US	Android	Motorola	Droid X	Colorado	United States	28.9811416	1	
30	5:19:36 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	3468.538966	0	
30	5:17:18 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	66.8533378	0	
30	5:16:40 PM	en-US	RIM OS	RIM	9650	Massachusetts	United States	NULL	0	
43	12:44:46 AM	en-US	RIM OS	RIM	9330	Massachusetts	United States	2.3198876	0	
43	12:44:41 AM	en-US	RIM OS	RIM	9330	Massachusetts	United States	NULL	0	
45	9:24:03 PM	en-US	Android	Samsung	SCH-i500	California	United States	1.7547729	1	
45	9:09:43 PM	en-US	Android	Samsung	SCH-i500	Illinois	United States	857.1453275	1	
45	8:01:50 PM	en-US	Android	Samsung	SCH-i500	New Jersey	United States	12.4195326	0	
49	3:05:50 AM	en-US	Android	LG	VS740	New York	United States	NULL	0	
59	1:23:42 AM	en-US	Android	LG	VS660	Nevada	United States	0.4996229	0	
59	1:23:45 AM	en-US	Android	LG	VS660	Nevada	United States	1.1773128	0	
59	1:23:42 AM	en-US	Android	LG	VS660	Nevada	United States	7.7791862	0	

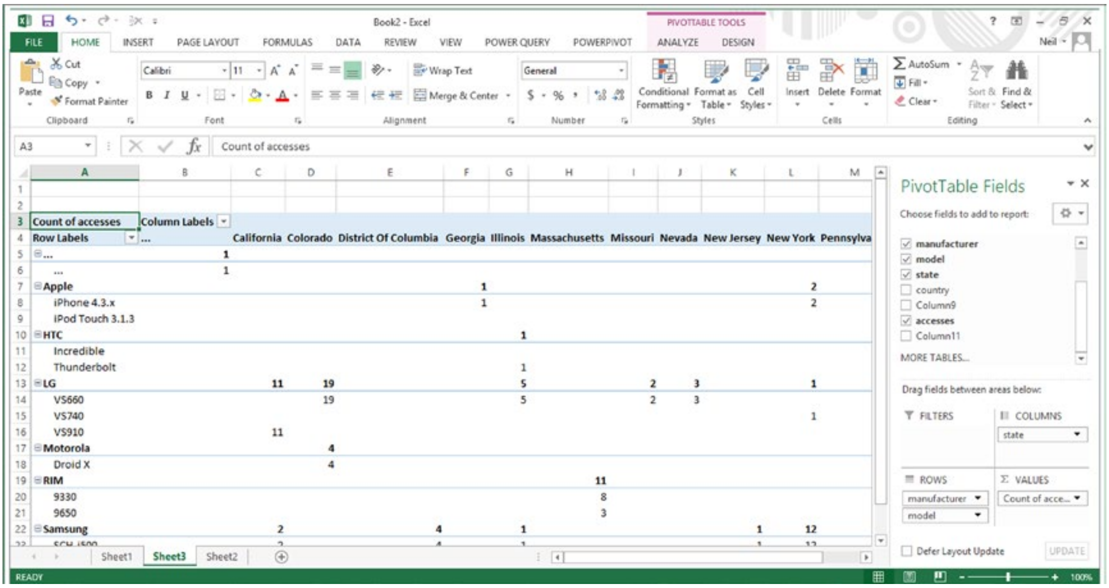
Figure 11-19. *Data loaded into spreadsheet*

Creating a Pivot Table

To create a Pivot Table to analyze accesses by state, manufacturer, and model, follow these steps:

1. Click Insert and Pivot Table. Accept the default of putting it in a new worksheet.

2. Drag state to the Columns box, manufacturer and model to the Rows box, and accesses to the Values box. The result, which shows accesses by manufacturer and model, is shown in Figure 11-20.



A3 | Count of accesses

Count of accesses	Column Labels										
Row Labels	...	California	Colorado	District Of Columbia	Georgia	Illinois	Massachusetts	Missouri	Nevada	New Jersey	New York	Pennsylva
⊟...	1											
...	1											
⊟Apple					1						2	
iPhone 4.3.x					1						2	
iPod Touch 3.1.3												
⊟HTC						1						
Incredible												
Thunderbolt						1						
⊟LG		11	19			5		2	3		1	
VS660			19			5		2	3			
VS740											1	
VS910		11										
⊟Motorola			4									
Droid X			4									
⊟RIM							11					
9330							8					
9650							3					
⊟Samsung		2		4		1				1	12	
SCH-i500		2		4		1				1	12	

PivotTable Fields

Choose fields to add to report:

- ☑ manufacturer
- ☑ model
- ☑ state
- □ country
- □ Column9
- ☑ accesses
- □ Column11

MORE TABLES...

Drag fields between areas below:

FILTERS	COLUMNS
	state

ROWS	VALUES
manufacturer model	Count of acce...

□ Defer Layout Update UPDATE

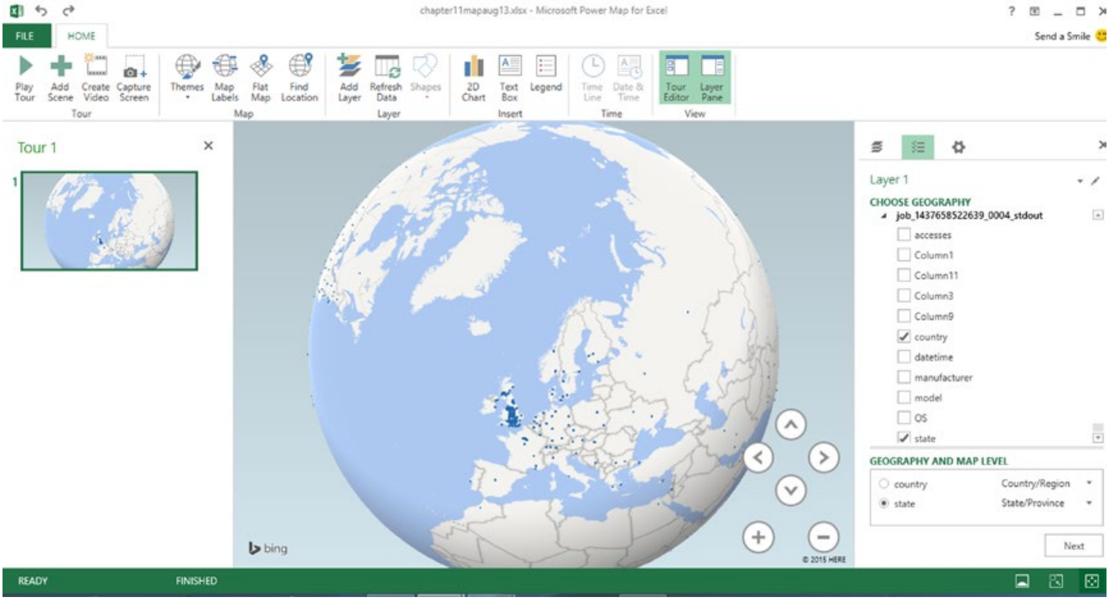
***Figure 11-20.** Pivot Table showing accesses by manufactuer and model*

Creating a Map in Power Map

This example shows how to map the data using Power Map. Follow these steps:

1. With the data loaded into the spreadsheet, click the Insert tab and then Map and Launch Power Map

2. Accept the default of country and state as the default geographic fields and click Next, as shown in Figure 11-21.



Layer 1

CHOOSE GEOGRAPHY

job_1437658522639_0004_stdout

☐ accesses
☐ Column1
☐ Column11
☐ Column3
☐ Column9
☑ country
☐ datetime
☐ manufacturer
☐ model
☐ OS
☑ state

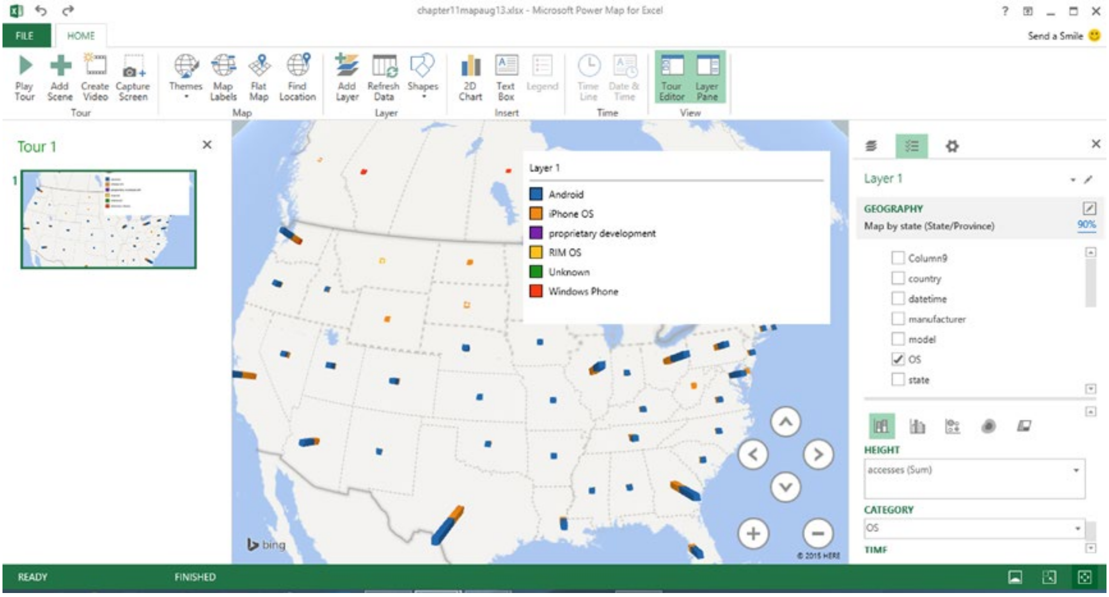
GEOGRAPHY AND MAP LEVEL

○ country Country/Region
● state State/Province

Next

Figure 11-21. *Selecting geographic fields*

3. Click Accesses for height and right-click OS and select Set as Category, as shown in Figure 11-22, which shows the map panned over to the United States.



Layer 1

🟦 Android
🟧 iPhone OS
🟪 proprietary development
🟨 RIM OS
🟩 Unknown
🟥 Windows Phone

Layer 1

GEOGRAPHY

Map by state (State/Province) 90%

☐ Column9
☐ country
☐ datetime
☐ manufacturer
☐ model
☑ OS
☐ state

HEIGHT

accesses (Sum)

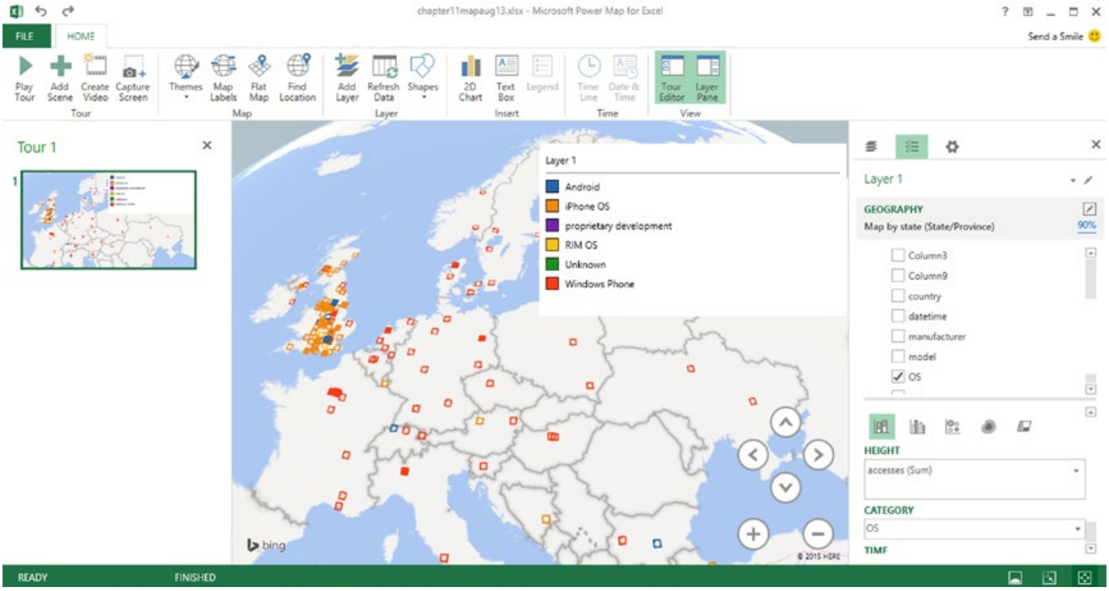
CATEGORY

OS

TIME

Figure 11-22. *Map showing accesses by OS in the United States*

A similar display for Europe is shown in Figure 11-23.



Layer 1

- 🟦 Android
- 🟧 iPhone OS
- 🟪 proprietary development
- 🟨 RIM OS
- 🟩 Unknown
- 🟥 Windows Phone

Layer 1

GEOGRAPHY
Map by state (State/Province) 90%

- □ Column3
- □ Column9
- □ country
- □ datetime
- □ manufacturer
- □ model
- ☑ OS

HEIGHT
accesses (Sum)

CATEGORY
OS

TIME

__Figure 11-23.__ Map showing access by OS in Europe

If you are finished with the HDInsight cluster you just created, delete it, so that you will not be charged for it.

Summary

This chapter has just scratched the surface of the power of creating and accessing Hadoop clusters in Azure and moving the data into Excel and Power Query for analysis using Pivot Tables and Power Map to provide a graphic display of the data broken out by OS.

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