PBI365

Data Analytics and Reporting with Power BI and Office 365

Power BI for Business Analyists and Power Users

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Course Manual Version 1.0

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About This Training Course

Course Title:	Data Analytics and Reporting with Power BI and Office 365
Course Code:	PBI365
Audience:	Business Analysts, Technical Specialists and BI Enthusiasts
Format:	Instructor-led training with hands-on labs
Length	3 Days

Course Description

Data Analytics and Reporting with Power BI is 3-day, hands-on training course for business analysts, technical specialist and BI enthusiasts who want to learn about the fundamental concepts and tools used to create custom business solutions using the Business Intelligence (BI) features of Power BI, Office 365, Excel Online, SharePoint Online, Microsoft Excel 2016.

Students will learn about the architecture of the Power BI platform as well as how to get up and running with Power BI Desktop. The course focuses on teaching techniques and a methodology for creating and implementing BI projects containing datasets, reports and dashboards. Students will learn how to use the Power Query features of Power BI Desktop to import and reshape data as it's loaded into the data model of a project. The course also teaches students how to use the Power Pivot features of Power BI Desktop and DAX (Data Analysis Expression language) to implement a project with a data model that has been designed to support rich data analytics and reporting.

After teaching students how to design and implement a rich data model in a Power BI Desktop project using Power Query and Power Pivot, the course then focuses on creating dashboard and reports. Students will learn about the rich set of visualization types that are built into the Power BI reporting platform as well as how to design Power BI reports and dashboards using tables, matrices, graphs, charts and maps.

Along the way, students will learn how to create reports and dashboards for mobile devices. Students will also learn how to design and deploy a custom BI solution to an Office 365 tenancy using Organization Content Packs. The third day of the course introduces the new BI features that have been added to Microsoft Excel 2016 and Excel Online and compares the relative strengths and weaknesses of Excel 2016 when compared to Power BI Desktop as a tool for creating custom BI solutions. The course concludes by examining common approaches for designing and implementing real-world BI solutions using the Power BI service.

Student Prerequisites

Students should have prior experience working with Microsoft Excel and be familiar with navigating around within the Office 365 and Excel Online environment. It is recommended that students also have prior experience working with relational databases, tabular databases and other related BI technologies.

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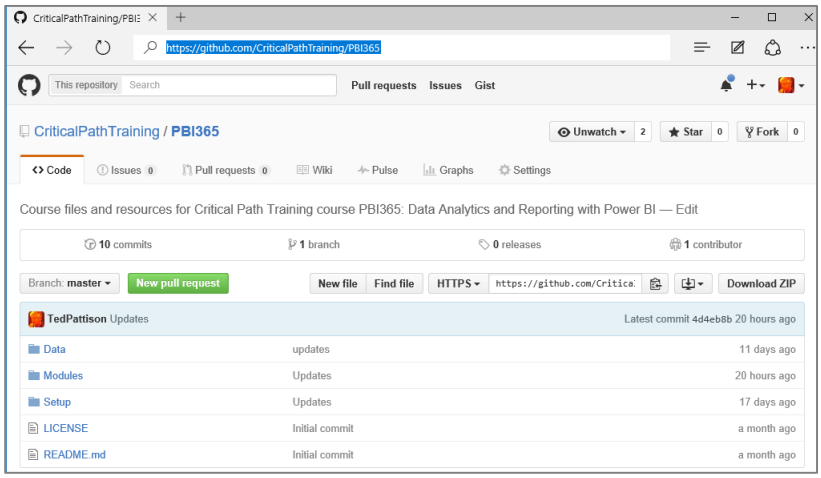
About the Hands-on Labs

The courseware for PBI365 includes a rich set of hands-on lab exercises that are designed to complement the learning material that is presented in the lectures. The lab exercises were designed to run on a student workstation running a modern version of Windows such as Windows 8.1 or Windows 10. The student workstation requires the installation or prerequisite software which is listed below on this page. As a student, you may be supplied with a virtual machine running a pre-configured build of the student workstation by the training company that is hosting this training class. Alternatively, you can configure your own computer with the prerequisite software if you are running Windows 8.1 or Windows 10 if you would rather complete the lab exercises on your own computer.

GitHub Repository for this course

Student files for this course are maintained in a GitHub fil repository at https://github.com/CriticalPathTraining/PBI365.



Student Workstation Prerequisites

All lab exercises should be completed on a student workstation that has the following software.

1. Windows 8.1 or Windows 10.
2. One or more Internet browsers (Chrome, Edge, IE, etc.)
3. Microsoft Office 2016 Professional including Microsoft Excel 2016
4. Power BI Desktop – which is installed during lab 2.

Copying the Student Lab Files to the Student VM

There is a set of student lab files that must be copied to our student VM before you can begin to work on the student lab exercises. These student files are distributed in a single ZIP archive known as the **"student.zip"** file which will have a file name that also contains the course code and the version (e.g. **CPT_PBI365_Student_v1.0.zip**). Make sure the version number (e.g. v1.0, v1.1, v2.0, etc.) of the student.zip file matches the version number of this manual.

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Module 01: Introduction to the Power BI Platform

Module Description

This module introduces the basic terminology and Business Intelligence features supported by Office 365 and the Power BI platform. Students will learn about the enhanced BI features offered by the Power BI service and the self-service BI tools including Power BI Desktop, Power Query, PowerPivot and Data Analysis Expressions (DAX) Language. The module also discusses Microsoft's strategic vision for BI which includes support for traditional BI as well as new support for the self-service BI model where power users are able to complete BI projects involving data analysis and reporting in a more timely fashion. The module concludes by demonstrating how to get a BI project up and running by creating a Power BI group, a dataset, a report and a dashboard.

Module Agenda

- Introduction to Power BI
- Creating a Power BI Test Environment
- Importing Datasets
- Creating Reports and Dashboards

Topics Covered

What is Business Intelligence?
Brief History of Microsoft's BI Platform
Microsoft BI Technology Winners
Microsoft BI Technology Losers
New BI Features in Excel 2013
The Excel Data Model
The Power Query Add-in for Excel 2013
The PowerPivot Add-in for Excel 2013
What is Power BI?
Power BI Workspaces
Central Power BI Concepts
Power BI Tools
RTFM: Moving Through Our Setup Guide
Your First Stop - Office 365 admin center
Enabling The Power BI Pro Trial
License Assignment
Add a Secondary User for Testing
Uploading Data Files to OneDrive for Office 365
Do I Have Power BI License?
What is a Dataset?
Getting Started with the Power BI Service
Importing a Dataset
Designing Reports
Creating Dashboards
Sharing Dashboards
Dashboard Consumer Experience

Instructor Demos

- Working in the Power BI Service
- Sharing a Dashboard in Power BI

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What is Business Intelligence?

- BI focuses on business health and performance
  - Gather insights into health of business processes
  - Take corrective actions in a timely fashion
- BI projects typically involve the following…
  - Integrate data from multiple sources
  - Perform data transformation and complex calculations
  - Analyze large data sets with rapid query response
  - Create insightful reports and visualizations

"Business Intelligence" is a widely used term that can different things to different people. However, BI generally refers to the practice of monitoring business health and performance. BI who perform BI roles in an organization have the job of gathering insights into health of business processes and helping the organization take corrective actions in a timely fashion.

Many BI projects share a common set of chores. There include importing and integrate data from multiple sources and performing data transformation and complex calculations on that data. Once the data has been imported and transformed, there is then the need to analyze large data sets with rapid query response and to create insightful reports and visualizations for business executives and managers.

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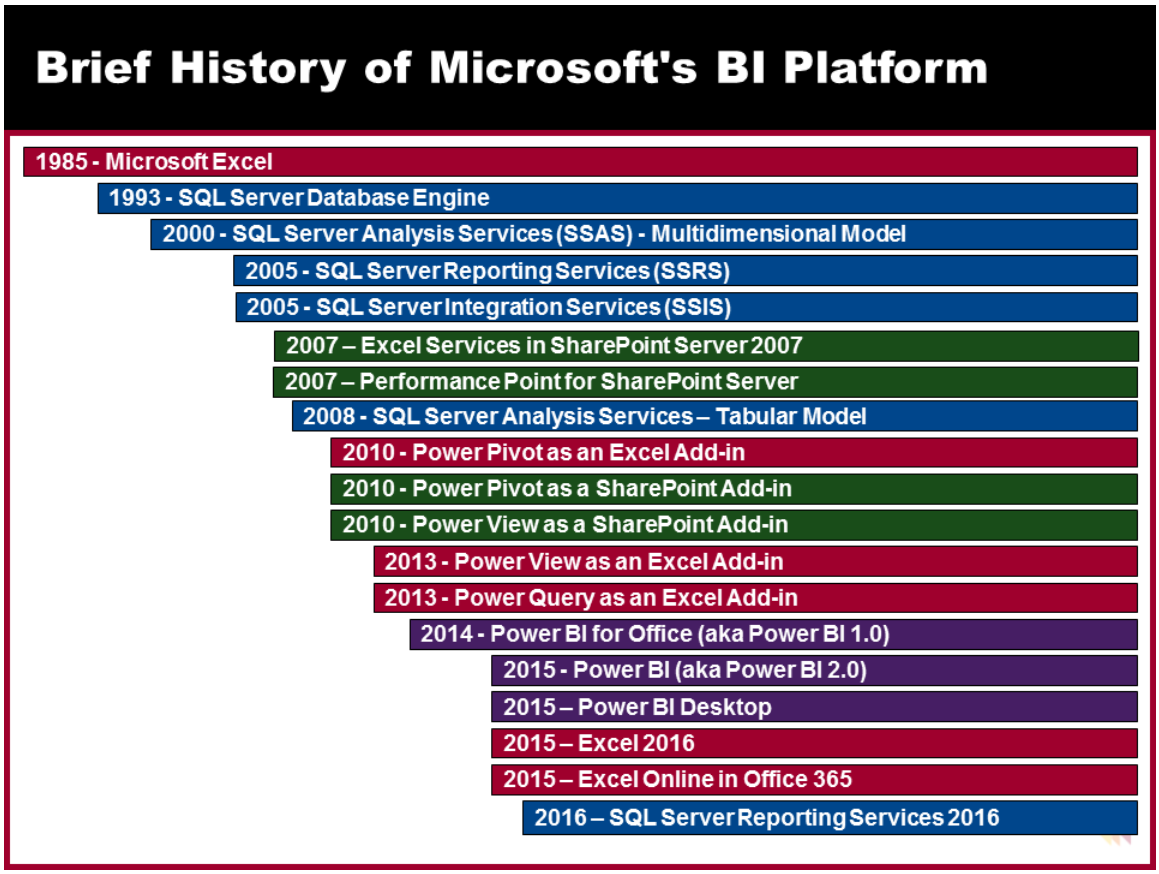

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Microsoft BI Technology Winners

- Which BI products are strategic moving forward?
  - Microsoft Excel
  - SQL Server, SSAS, SSIS, SSRS
  - Tabular Database Model
  - Power Pivot and DAX language
  - Power Query
  - Power BI Service (aka Power BI 2.0 or what they call the "New Experience")
  - Power BI Desktop
  - Excel Online (no longer considered part of SharePoint)
  - SQL Server Reporting Services 2016

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Microsoft BI Technology Losers

- Technologies in which Microsoft is no longer investing
  - Power BI for Office 365 (aka Power BI v1.0)
  - Power View
  - Performance Point Services
  - Excel Services in SharePoint Server
  - SharePoint as place to surface reports & dashboards

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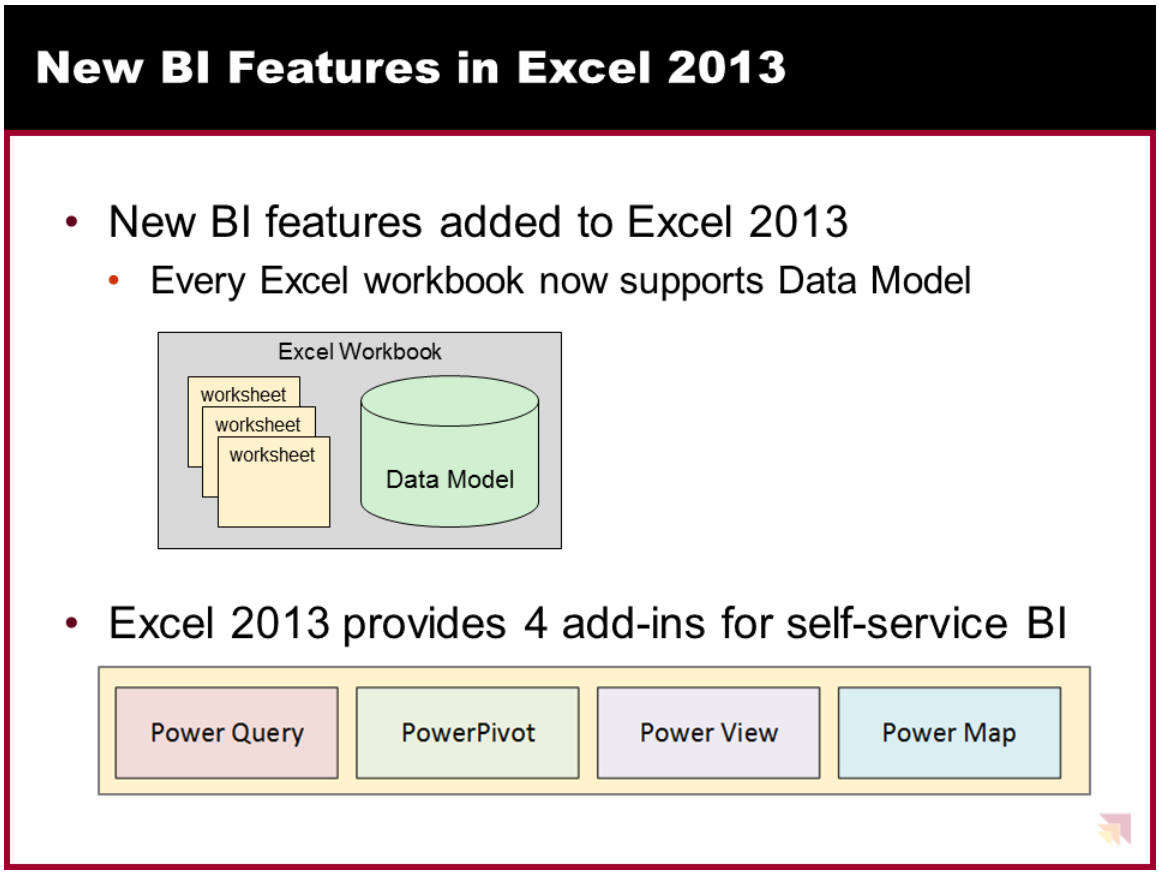

While early versions of Excel provide valuable BI support, the new BI features added to Excel 2013 add a significant number of new features that are really changing the way that Excel is being used as a BI tool. First, every Excel workbook now supports a Data Model which acts as an OLAP database embedded inside the Excel .xlsx file format. Also, Microsoft has created several important add-ins for working with the Data Model including PowerPivot, Power View and Power Query.

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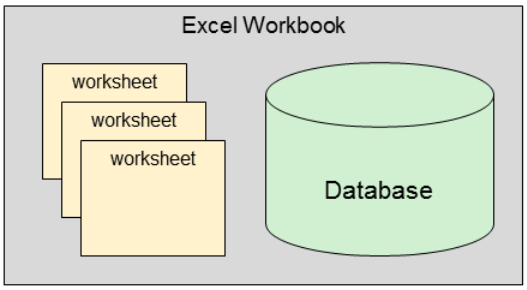
The Excel Data Model

- Excel 2013 introduces the data model
  - Data model stored as OLAP database inside Excel workbook file
  - Data model is separate from tables created in worksheets
  - Data model contains tables and table relationships
  - Tables in data model loaded into memory for query execution
  - Tables stored in highly-compressed, column-based format
  - This type of OLAP database known as a "Tabular" database



A very significant enhancement to the BI support for Excel 2013 is the introduction of the data model. This changes everything about the Excel BI story because you no longer have to rely on tables stored in worksheets.

The data model is a separate OLAP database that is separate from anything stored in a worksheet such as a classic Excel table. The data model contains two primary things: tables and table relationships. Data which has been imported into tables inside the data model is stored in a highly-compressed, column-based format which is often referred to as the "tabular format" or a '"tabular database". A key factor of this tabular data model is that it can accommodate data sets that have tens of millions (10,000,000) of rows.

All the data contained within the data model is stored in the Excel workbook file and is loaded into memory the first time the data model is used. It is important to note that query execution only works with data which has been loaded into memory. Therefore, the query engine never needs to read anything from persistent storage such as a hard drive which would slow performance.

Microsoft implementation of the tabular data model in Excel is based on a query execution engine known as the **xVelocity engine**. You might also hear some people refer to the tabular database engine as "Vertipaq". That's because Vertipaq is the name of the company that Microsoft acquired to obtain the code base which implements the tabular database model.

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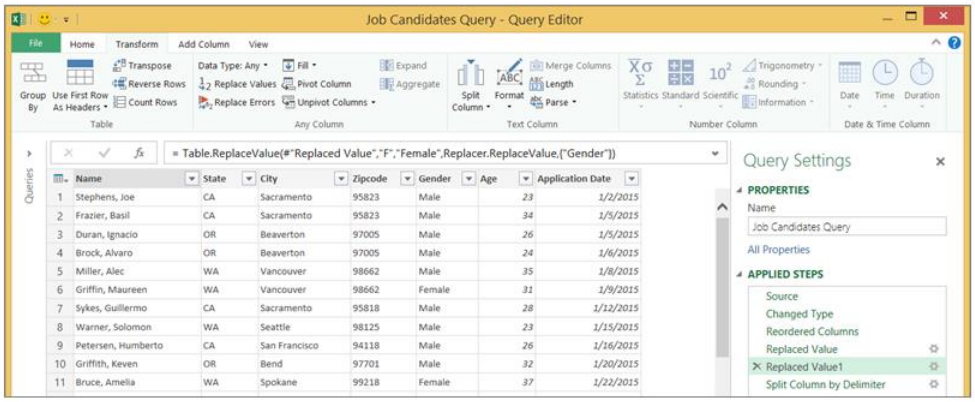
The Power Query Add-in for Excel 2013

- Used to perform ETL operations on data
  - ETL = Extract, Transform and Load
  - Queries can be saved inside Excel workbook
  - Saved query can be run on demand to refresh data



Power Query is a SSBI tool for discovering data and extracting it from a wide variety of data sources on a local network or from across the Internet. A key point is that you use Power Query to import data from external source into a worksheet or into the data model of an Excel workbook. Importing data is typically the first step in a BI project because importing data is how you create tables inside the data model.

Power Query supports extracting data directly from common file types such as Excel workbooks, Access databases and CSV files as well as database systems such as SQL Server, Oracle and DB2. It also offers capabilities to extract data from HTML tables in web pages and from public datasets that have been published on the Internet. Power Query provides a valuable productivity layer when it comes to importing data from SharePoint lists. Behind the scenes, Power Query figures out how to extract SharePoint lists by creating OData queries that are executed against the SharePoint REST API.

When extracting data from external data sources, Power Query provides the ability to perform transformation operations to shape the data as it is being loaded into Excel. For example, you can split a column with delimited values into multiple columns. You can combine multiple columns into a single column using string parsing or mathematical operations. You can perform table operations such as merging columns and appending rows from multiple data sources. You can also perform powerful transform operations such as transposing, pivoting and un-pivoting the rows and columns in a source table.

When you work with Power Query, you work with a Query Editor to extract the data and to shape it as you import into Excel. A query in Power Query represents a set of steps (i.e. extract and transform operations) that are applied on data that has been extracted from an external data source. A query is saved inside the Excel workbook and can be executed to import data and then to refresh that data on demand. The screenshot shows an example of working with the Query Editor and demonstrates how this tools allows you to see the data are you are shaping before you import it into the data model.

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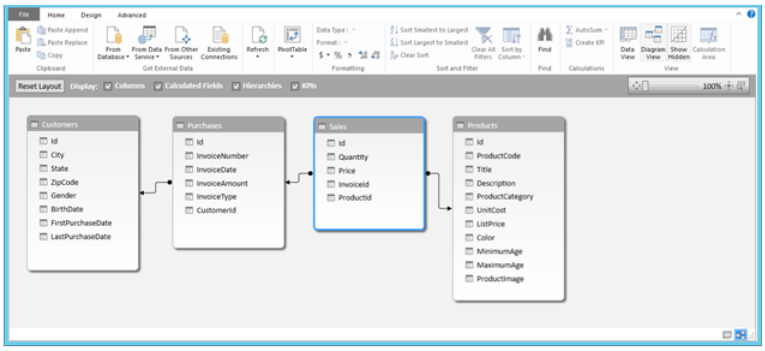
The PowerPivot Add-in for Excel 2013

- Adds support for designing data model
  - Importing data from external sources to create tables
  - Defining relationships between tables
  - Creating calculated columns, calculated fields and KPIs
  - Provides data modeling capabilities to business users



The main purpose of using the PowerPivot add-in in Excel 2013 is to create and enhance the data model within a specific Excel workbook. First, PowerPivot makes it possible to import data from a large variety of external sources such as Excel workbooks, Access databases, CSV files and SharePoint lists. Once you have imported data and created tables in the data model, PowerPivot allows you to define relationships between tables and to create BI calculations such calculated columns, calculated fields and Key Performance Indicators (KPIs).

PowerPivot is an add-in that is automatically installed along with Excel 2013. While this add-in is part of Excel 2013, it is not activated by default. Therefore, you must activate it before you can use it.

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What is Power BI?

- What is Power BI?
  - Collection of online services and features
  - Environment created to promote self-service BI *to the end user*
  - Environment created to support Power Query and Power Pivot
  - Something to assists with data import, analysis and visualization
- The Power BI service
  - accessible to subscribed users through https://app.powerbi.com
  - user has access to personal workspace and group workspaces
  - workspaces contain datasets, reports and dashboards
  - supports Power Query features for data import and transformation
  - supports Power Pivot and DAX used for data modeling
  - provides authoring environment for reports and dashboards

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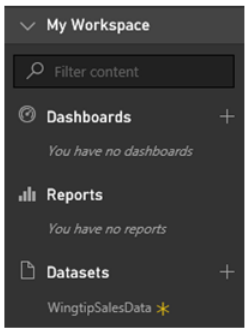
Power BI Workspaces

- Power BI provides user context using workspaces
  - Personal workspace created for each Power BI user
  - Group workspaces created with Unified Groups
- Workspace is container with three collections
  - Dashboards
  - Reports
  - Datasets



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Central Power BI Concepts

- Workspace
  - Provides user context (personal workspaces & group workspaces)
- Datasets
  - Dataset contains data model with one or more tables
  - Data model based on tabular database model
- Reports
  - Report is a collection of one or more pages of visualizations
- Dashboard
  - Dashboard consolidates datasets and reports to single entry point
  - Dashboard is a collection of one or more tiles
  - Tiles created from report visualizations

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Power BI Tools

- The Browser
  - Import datasets
  - Design reports and dashboards
- Power BI Desktop
  - Create complex data import processing using Power Query
  - Model data sets using Power Pivot and DAX
  - Publish PBIX files from local desktop to Power BI service
- Microsoft Excel 2016
  - Contains similar feature set for Power Query and Power Pivot
  - Can support data model in Excel file without Power BI service
  - Contains extra features and charts not in Power BI

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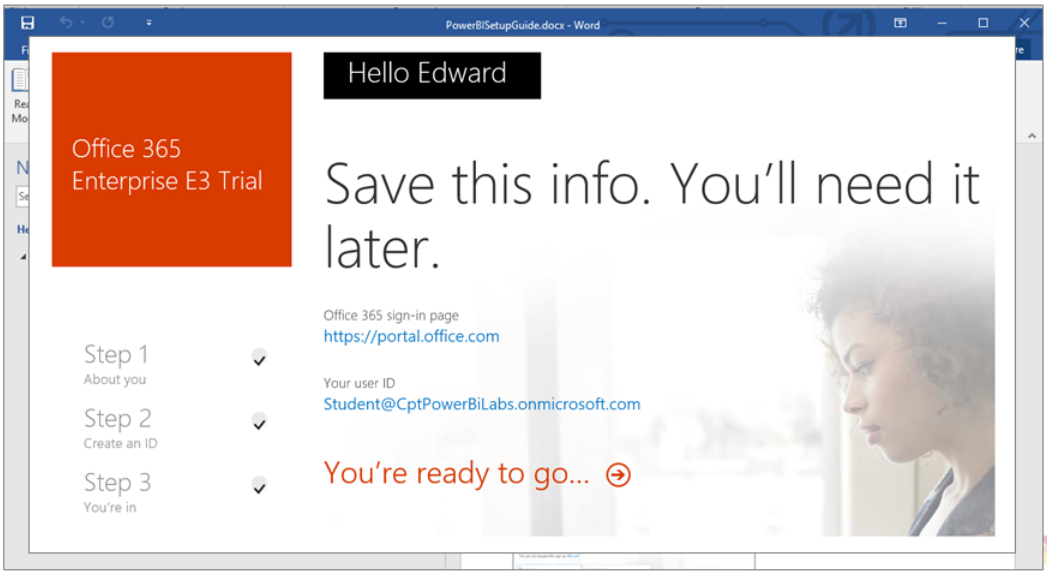
RTFM: Moving Through Our Setup Guide

- Find it here
  - https://github.com/CriticalPathTraining/PBI365



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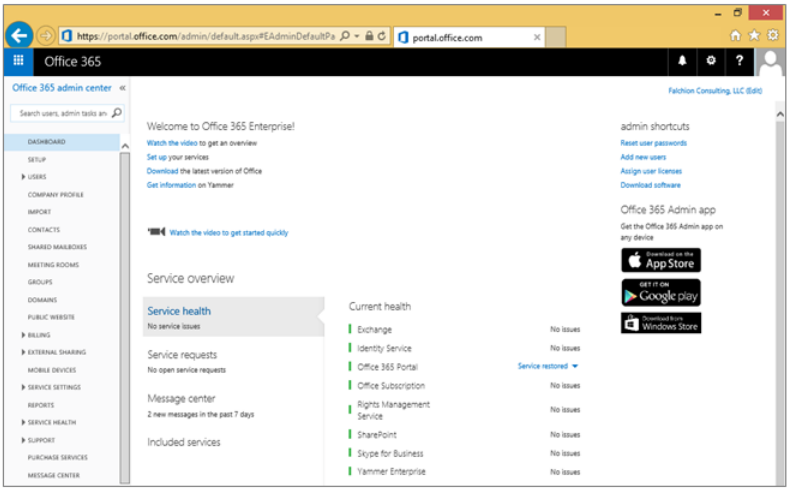
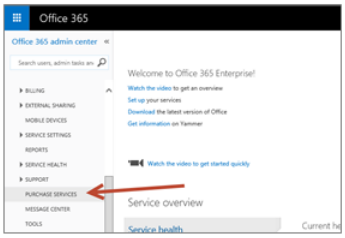
Your First Stop - Office 365 admin center

- What will you need to do in Office 365 admin center?
  - Purchase 30 trial for Power BI Pro
  - Configure your Power BI License
  - Add a secondary user account for testing

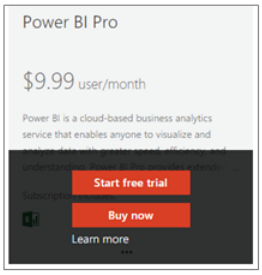


Enabling The Power BI Pro Trial

- Navigate to PURCHASE SERVICES



- Select Power BI Pro Trial



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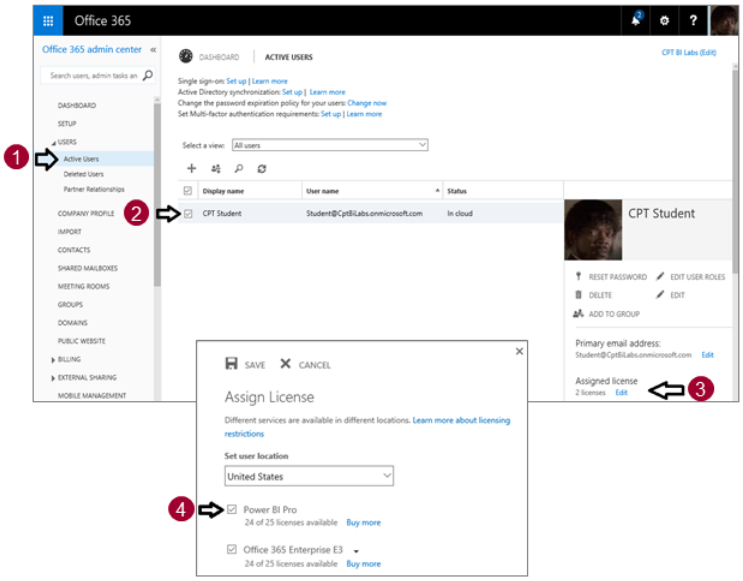
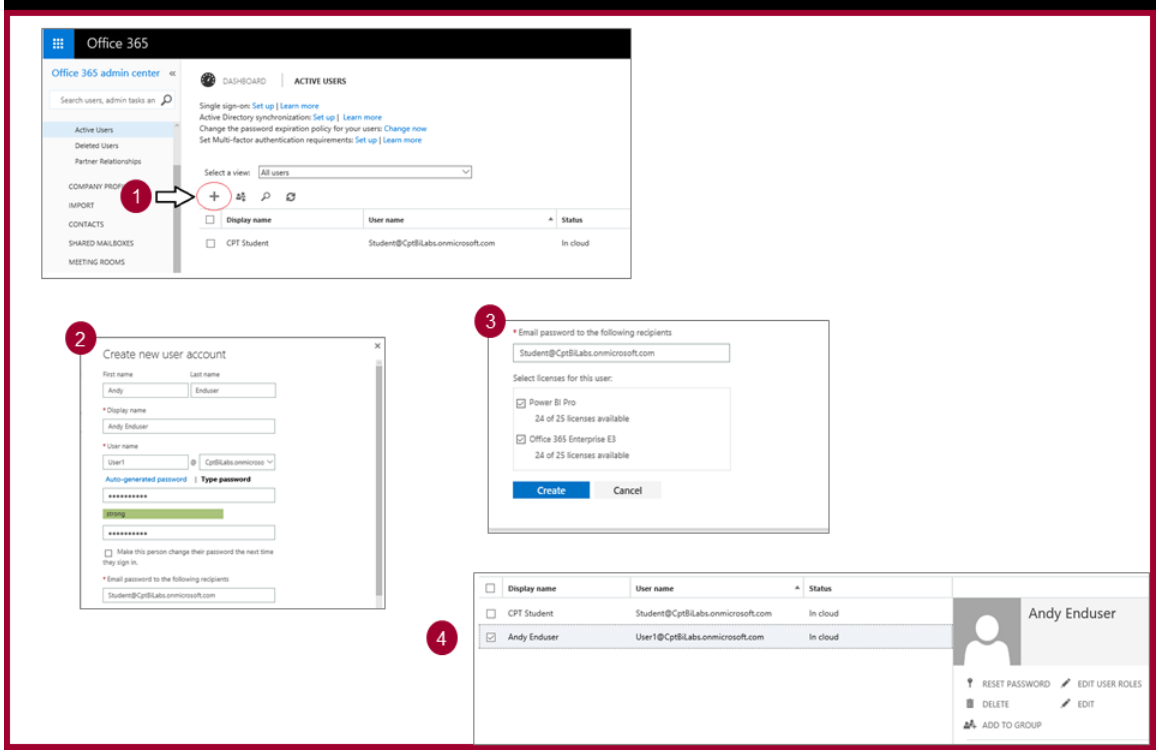
License Assignment

- It's as easy as 1, 2, 3, 4

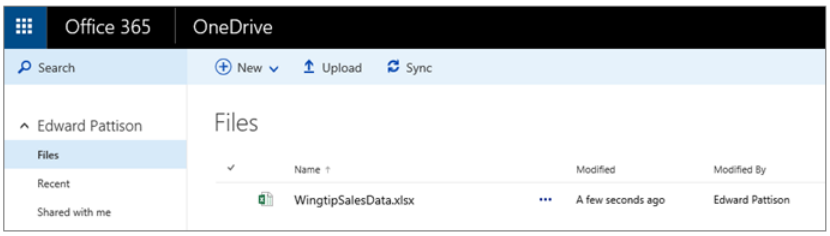


Add a Secondary User for Testing



Uploading Data Files to OneDrive for Office 365

- Preferred location for data files consumed by Power BI service
  - Excel workbooks
  - CSV files
  - PBIX files created using Power BI Desktop



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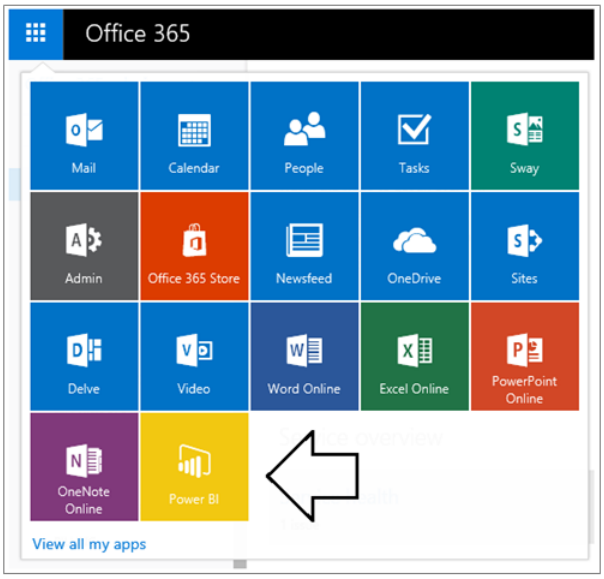
Do I Have Power BI License?

- Just ask Mr. Waffle (aka the Office 365 App Launcher)



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What is a Dataset?

- A data model containing one or more tables
  - Dataset represents a tabular database
  - Dataset can contain a single table
  - Dataset can contain many tables with relationships
  - Dataset can be imported data or connected data

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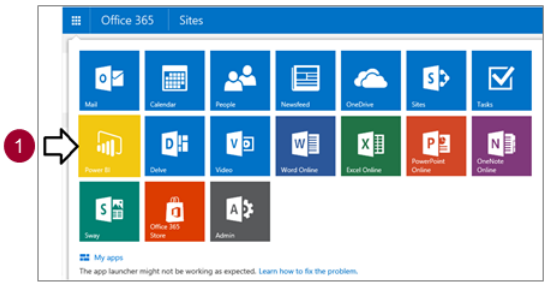
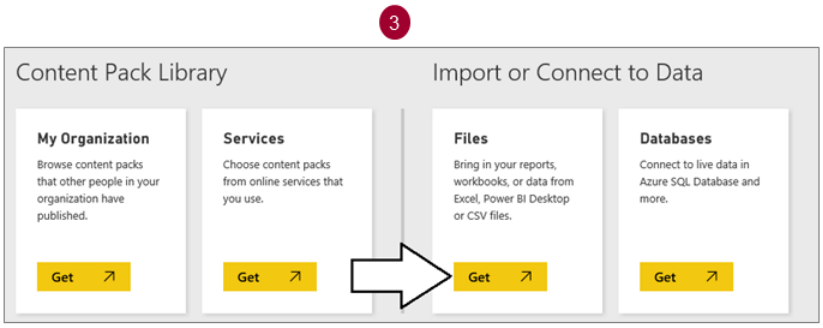
Getting Started with the Power BI Service





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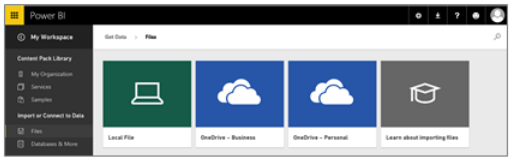
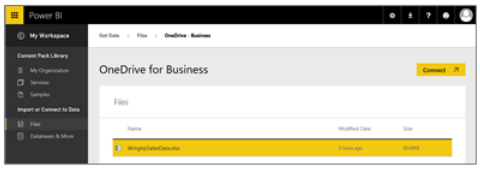
Importing a Dataset

- Connect to files in OneDrive



- Select the file and click Connect



- Choose between Import or Connect

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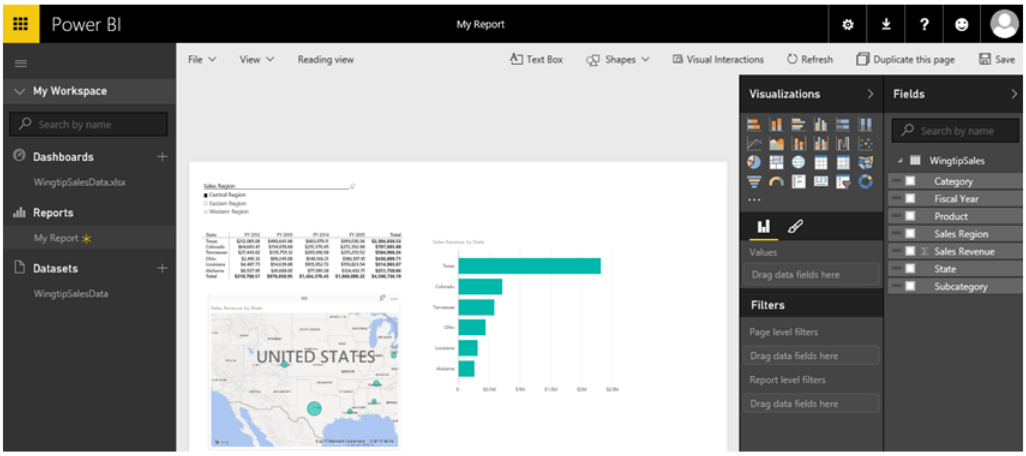
Designing Reports

- Power BI service provides browser-based report designer
  - Report contains one o more pages
  - Pages contain visuals (aka visualizations)
  - Visuals display fields from underling data model



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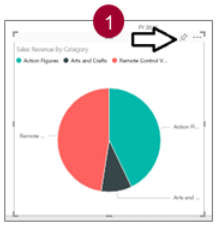
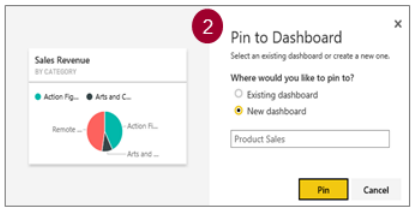
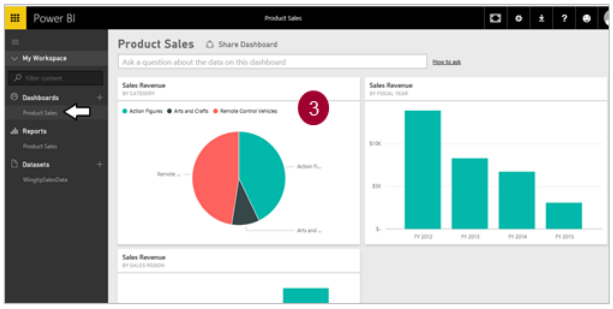
Creating Dashboards

- Dashboards contain tiles
  - Tiles created from visuals on report pages







Sharing Dashboards

- There are two types of Power BI workspaces
  - Personal workspaces
  - Group Workspaces
- To deploy reports and dashboards from a personal workspace
  - Create one or more reports in your personal workspace
  - Create a dashboard and pin report tiles to it
  - Share dashboard with other users
  - Dashboard sharing involves accepting invitation
  - Dashboard owner can see who has accepted invitation
- Deploying reports and dashboards from group workspace
  - Group workspace created using Unified Group in Office 365 tenant
  - Allows team of authors to work on a single BI project
  - Users can be added with authoring permission or read-only permissions

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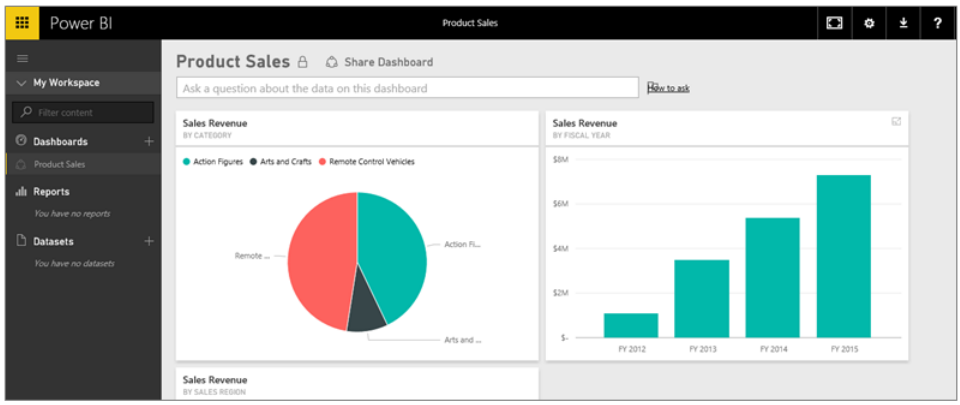
Dashboard Consumer Experience

- Dashboard consumer can only see dashboard
  - Dashboard reports not shown in left navigation
  - Reports and datasets only available through dashboard links



Module 01 Lab: Getting Up and Running with the Power BI Service

Setup Time: 45-60 minutes

Overview: This lab covers how to get up and running with Power BI by creating a new Office 365 tenant with trial subscriptions to Office 365 and Power BI Pro. The act of creating and configuring this new Office 365 tenant will yield an isolated testing and development environment for working on projects with the Power BI service and using Microsoft's latest self-service BI tools such as Power BI Desktop and Microsoft Excel 2016. One valuable aspect of creating a new and isolated Office 365 tenant is that you will have tenant-level administrative permissions allowing you to configure the tenant with multiple user accounts for testing your Power BI projects in isolation from any existing Office 365 tenancy.

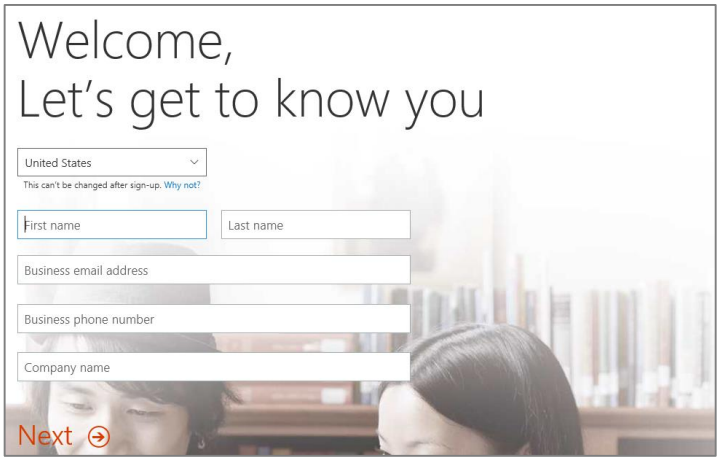
Exercise 1: Create a new Office 365 Trial Tenant

In this exercise, you will create a new Office 365 tenant which allows you to create up to 25 user accounts with Enterprise E3 trial licenses. Being able to create multiple Office 365 user accounts in your Power BI testing environment will be important so that you can test the effects of sharing Power BI dashboards between users.

1. Navigate to the following URL:

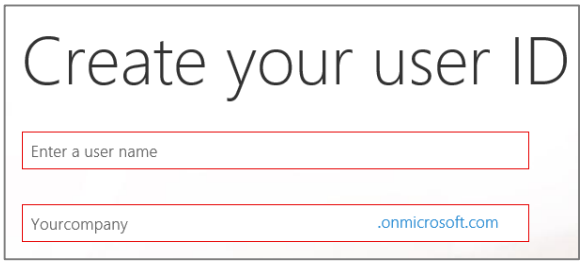
   https://go.microsoft.com/fwlink/p/?LinkID=403802&culture=en-US&country=US

2. Fill out the form with your personal information and click **Next**.



The information you provide here will be used throughout your tenant so if you do not wish to use your actual company name then provide humorous and fictitious company name.

3. On the next page, you are prompted to provide a user ID, company name and password.



Note that the company name you enter on this page will be used to create the domain name for your new Office 365 trial tenant. For example, if you were to enter a company name of **CptBiLabs**, it would result in the creation of a new Office 365 tenant within a domain of **CptBiLabs.onMicrosoft.com**. The user name you enter will be used to create the first user account which will be given administrative rights within the trial tenant. If you enter a user name of **Student**, then the email address as well as user principal name for this account will be **Student@CptBiLabs.onMicrosoft.com**.

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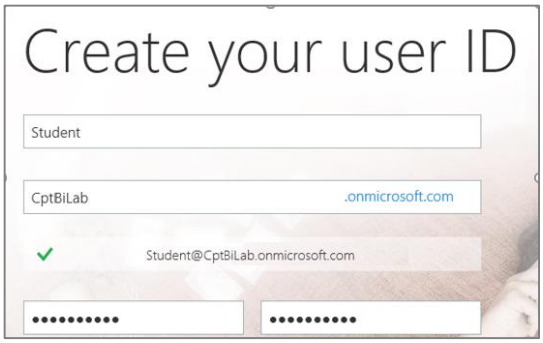
4. Enter a user name and a company name for your new Office 365 trial tenant. For the company name, you may wish to simply use your first and/or last name with a number which you can increment each time you have to create a new trial account (e.g. EricClapton1.onmicrosoft.com).



Don't use your actual company name as that may cause some conflict when your company decides to create their own official tenant. Throughout the remainder of this guide you will see a company domain name of **CptBiLab** which you should replace with the value specified for your company name.

5. Click **Next** to continue to step 3.
6. Complete the validation form in step 3 by proving you are not a robot.
   a) Select the **Text me** option and provide the number of your mobile phone.
   b) When you go through this process, a Microsoft service will send you a text message that contains an access code.
   c) You retrieve the access code form your mobile device and use it to complete the validation process.

7. Once you have completed the validation process, click the **You're ready to go…** link to navigate to the portal welcome page for your new Office 365 trial tenant. Note that you should already be logged on using the user account that was created during the sign up process.

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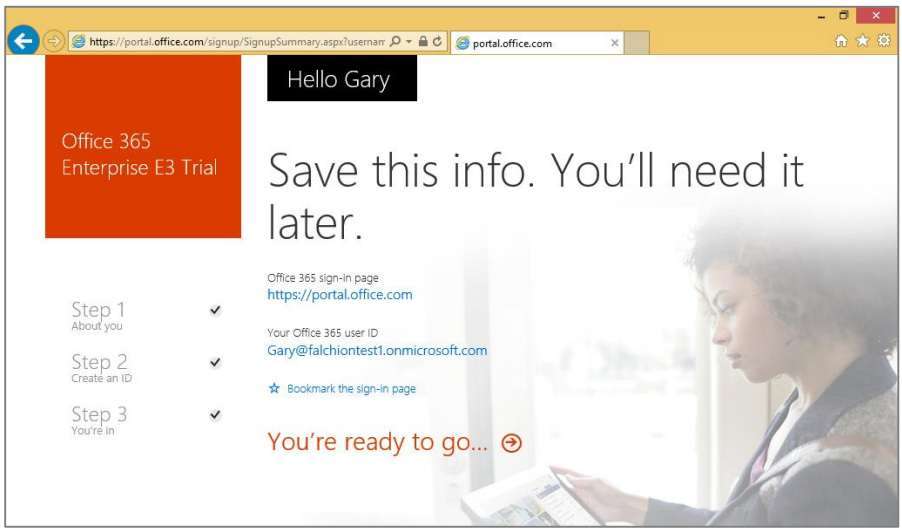
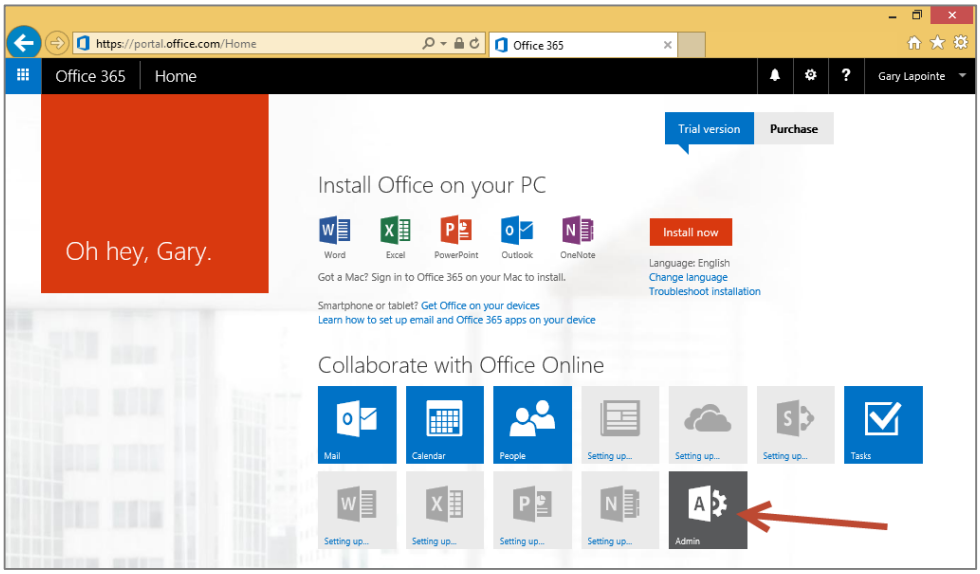


At this point, you have already created your new Office 365 tenant which can support creating up to 25 user accounts with Office 365 Enterprise E3 trial licenses. Note that some Office 365 services within your new Office 365 tenant such as the Office 365 admin center can be accessed immediately. Other services within your Office 365 tenant such as SharePoint Online are not ready immediately and will take some time to provision.

8. At this point, you should be located on the portal welcome page of Office 365. You will notice that this page shows the progress of the Office 365 environment in setting up each of the individual services that make up your new Office 365 tenant. Click the **Admin** tile to proceed to the Office **365 admin center**.



9. Verify that you are able to access the home page of the **Office 365 admin** center.

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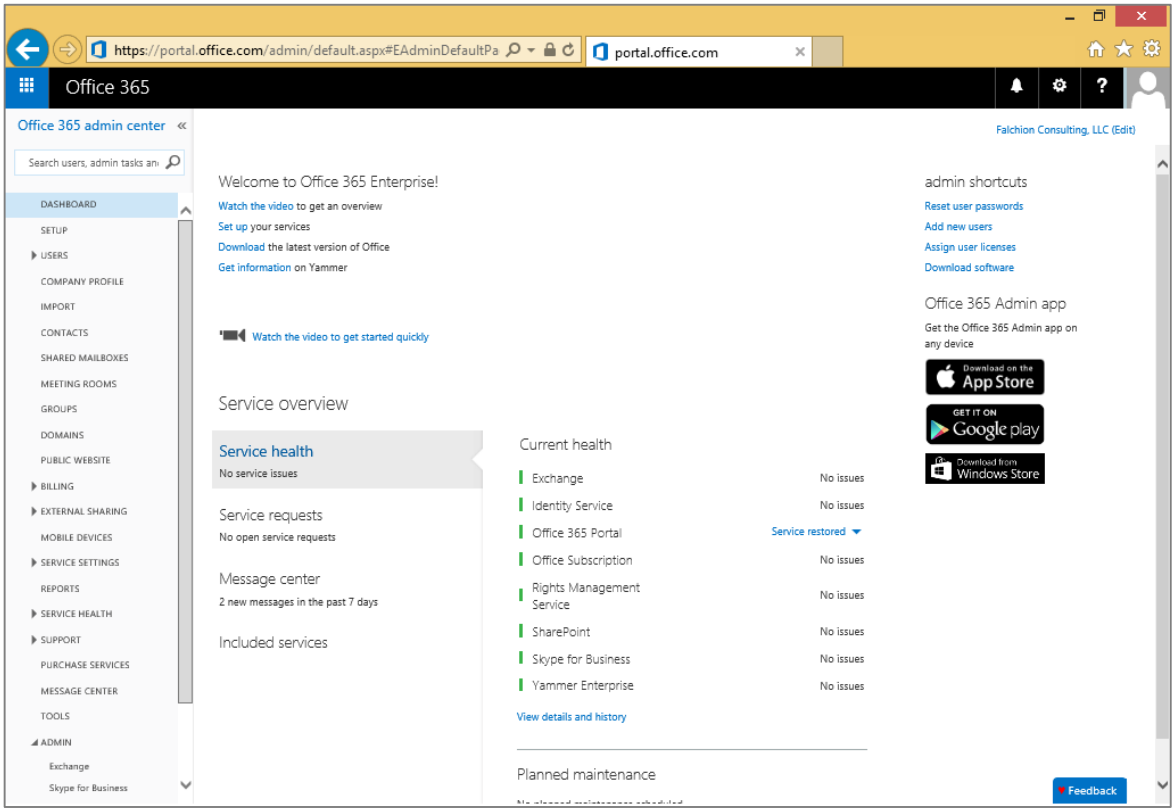
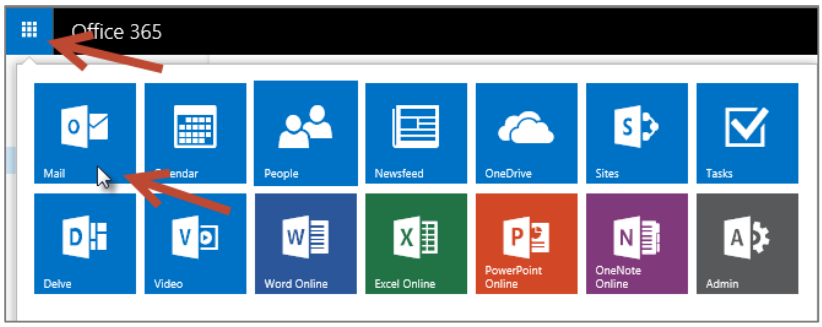


If you are interested in getting more familiar with the **Office 365 admin center**, take a minute to explore the administrative pages behind each of the links in the Office 365 admin center navigation menu on the left-hand side of the page.

10. Make sure you can access mail and your Office 365 inbox.
    a) Open the Outlook web access client by navigating to **https://outlook.office365.com** or clicking the **Mail** icon in the Application Launcher accessible via the **Waffle Button**.



    b) If prompted, specify your language and time zone for Outlook.

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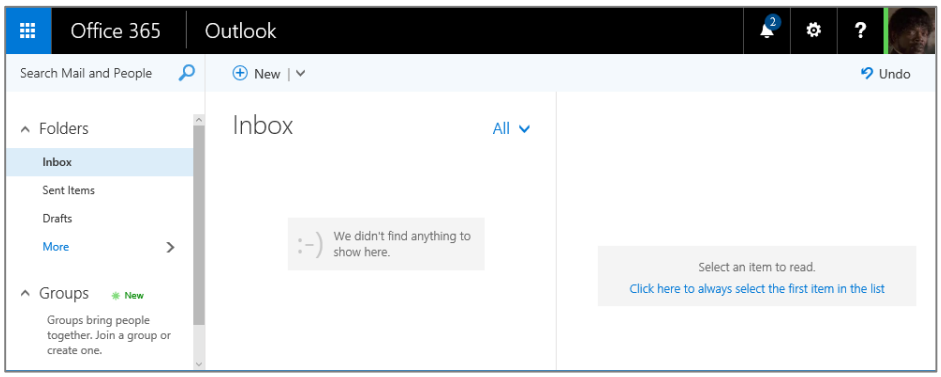
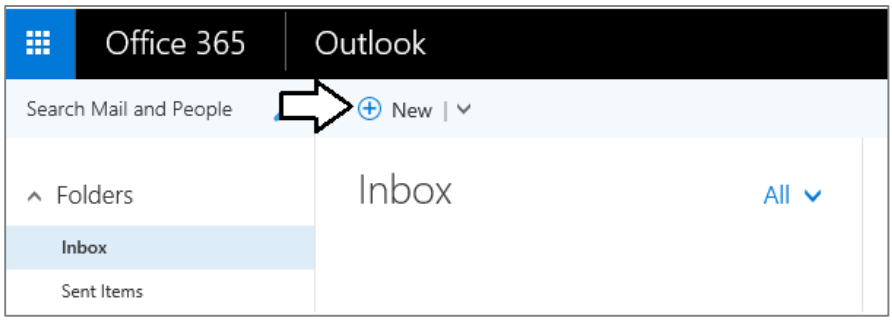
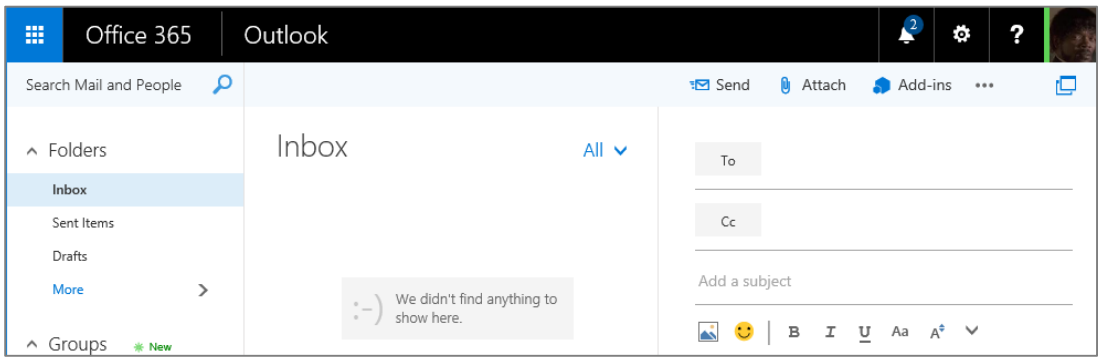
c) You should now see a web page with the Office 365 Outlook web access client and a view the Exchange inbox that is associated with the primary user account that was created when you created the Office 365 tenancy.



d) Test email by sending a message to one of your other email addresses, Display the form to create a new email clicking the **New** button. If the **New** button is not showing, it's probably because the form to create a new email is already showing.



e) At this point, you should see the Outlook form to create new email on the right side of the page.



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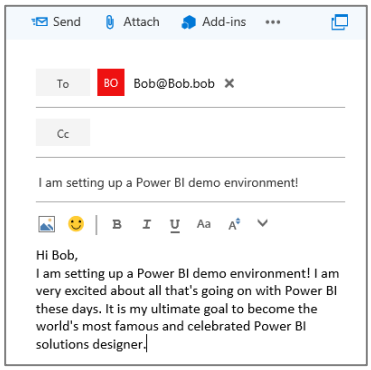
f) Fill out the new email form using sample data (see example below) to send a test message. Be sure to send the test message to an email address that is yours. Click **Send** when it's ready to go.

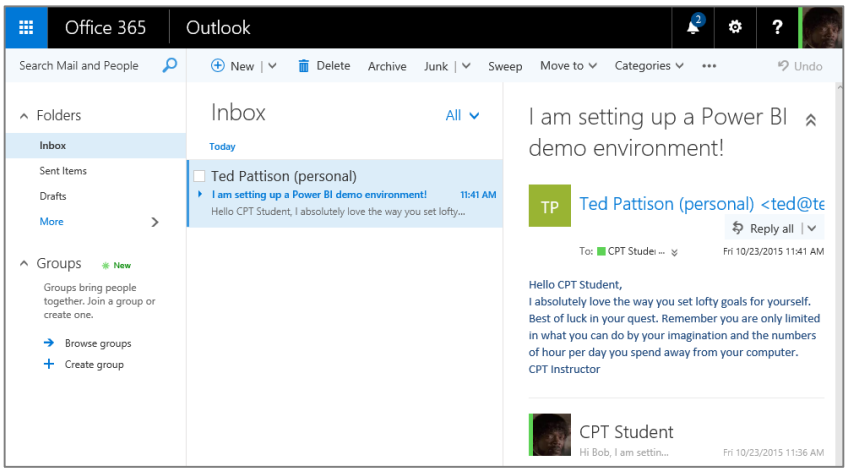


g) Click **Send** to send the email.

h) Check the email account you sent the email to and verify that you received the email.

i) Reply to the email to verify that you can send an email to your new account.

j) Return to the Outlook Web Client and verify receipt of your reply.



Having access to mail is valuable when you are working with Power BI. That's because the Office 365 and the Power BI service use email messages to send invitations and notification to users is response to user actions such as creating a new group workspace or sharing a dashboard.

Exercise 2: Upload a Workbook with Sample Data to OneDrive for Business

In this exercise, you will upload an Excel workbook file containing sample data to OneDrive for Business. However, the first step will to download a copy of the sample Excel workbook to your local hard drive.

1. Download the sample Excel workbook file from Critical Path Training's GitHub repository.
   a) In the browser, use the URL below to access and download the Excel workbook named **WingtipSalesData.xlsx** to the Downloads folder in your local machine.

   https://github.com/CriticalPathTraining/PBI365/raw/master/Data/WingtipSalesData.xlsx

   b) Ensure that the Excel workbook file has been saved to your local hard drive.
2. Open OneDrive for Business by clicking the **OneDrive** icon in the Application Launcher accessible via the **Waffle Button**.

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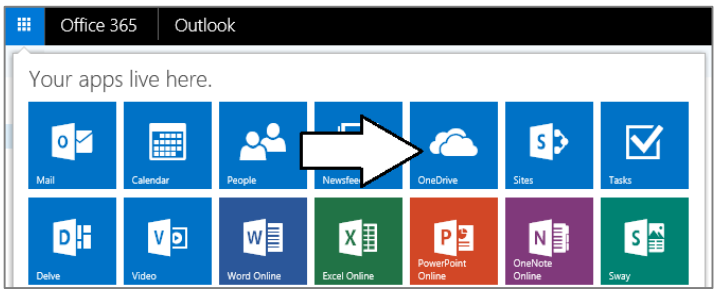
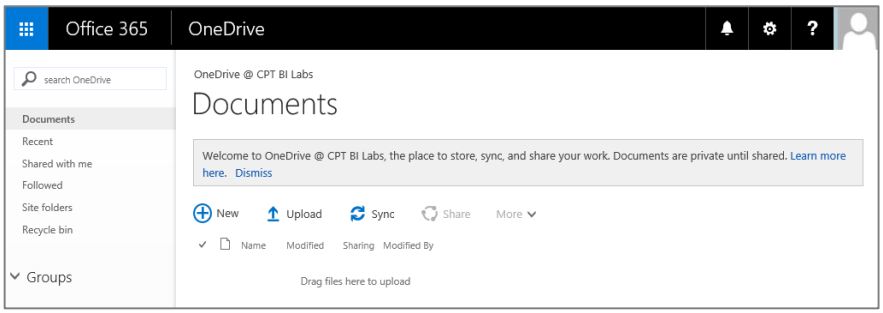
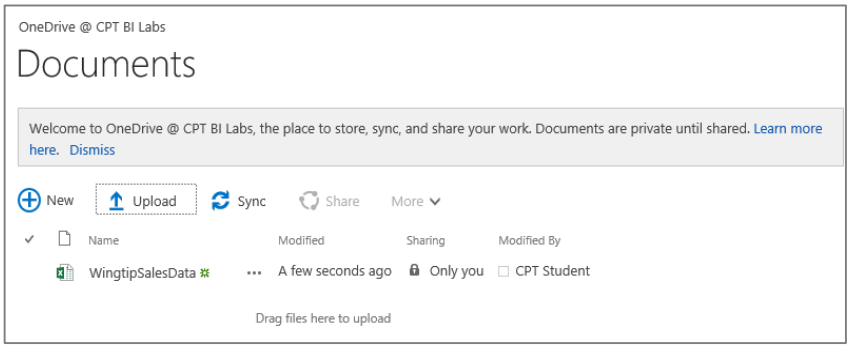


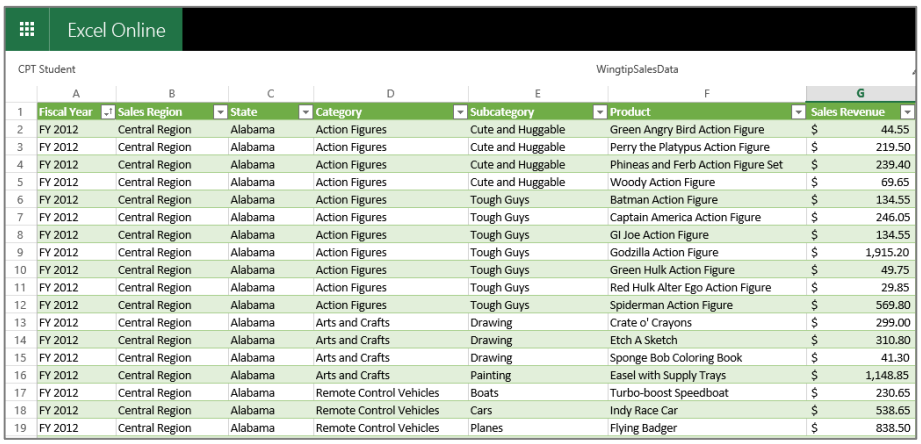
3. You should now be at the main landing page for **OneDrive for Business** which displays the **Documents** library.



4. Click the **Upload** button and go through the steps to upload the local copy of **WingtipSalesData.xlsx** to the **Documents** library. Once you have completed this step, you should be able to verify that the **Documents** library contains **WingtipSalesData.xlsx**.



5. Inside the **Documents** library, locate and click on the **WingtipSalesData** link to open the workbook in Excel Online. As you can see, the workbook contains a sample set of tabular data that will be used in a later exercise.



	A	B	C	D	E	F	G
1	Fiscal Year	Sales Region	State	Category	Subcategory	Product	Sales Revenue
2	FY 2012	Central Region	Alabama	Action Figures	Cute and Huggable	Green Angry Bird Action Figure	$ 44.55
3	FY 2012	Central Region	Alabama	Action Figures	Cute and Huggable	Perry the Platypus Action Figure	$ 219.50
4	FY 2012	Central Region	Alabama	Action Figures	Cute and Huggable	Phineas and Ferb Action Figure Set	$ 239.40
5	FY 2012	Central Region	Alabama	Action Figures	Cute and Huggable	Woody Action Figure	$ 69.65
6	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Batman Action Figure	$ 134.55
7	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Captain America Action Figure	$ 246.05
8	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	GI Joe Action Figure	$ 134.55
9	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Godzilla Action Figure	$ 1,915.20
10	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Green Hulk Action Figure	$ 49.75
11	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Red Hulk Alter Ego Action Figure	$ 29.85
12	FY 2012	Central Region	Alabama	Action Figures	Tough Guys	Spiderman Action Figure	$ 569.80
13	FY 2012	Central Region	Alabama	Arts and Crafts	Drawing	Crate o' Crayons	$ 299.00
14	FY 2012	Central Region	Alabama	Arts and Crafts	Drawing	Etch A Sketch	$ 310.80
15	FY 2012	Central Region	Alabama	Arts and Crafts	Drawing	Sponge Bob Coloring Book	$ 41.30
16	FY 2012	Central Region	Alabama	Arts and Crafts	Painting	Easel with Supply Trays	$ 1,148.85
17	FY 2012	Central Region	Alabama	Remote Control Vehicles	Boats	Turbo-boost Speedboat	$ 230.65
18	FY 2012	Central Region	Alabama	Remote Control Vehicles	Cars	Indy Race Car	$ 538.65
19	FY 2012	Central Region	Alabama	Remote Control Vehicles	Planes	Flying Badger	$ 838.50

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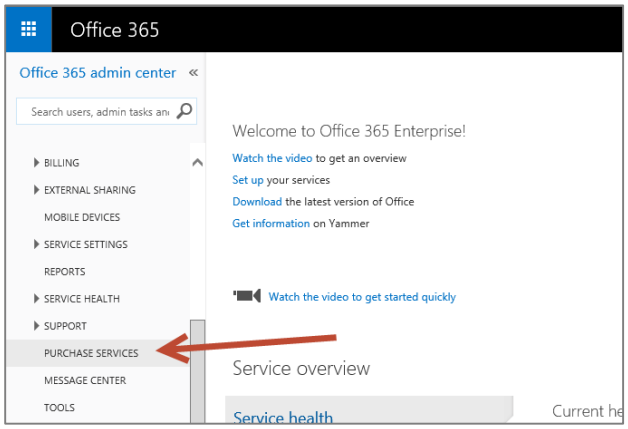
At this point, you have now uploaded an Excel workbook with sample data that you will use in later steps to create a dataset, a report and a dashboard.

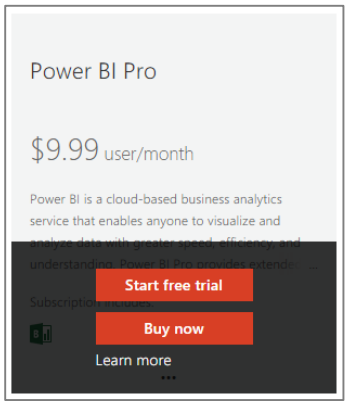
Exercise 3: Configure Multiple Users with Power BI Pro Licenses

In this exercise, you will configure your new Office 365 tenant by adding trial subscriptions for Power BI Pro. Once you have completed this task, you will be able to begin working with the Power BI service.

1. Return to Office 365 admin center by clicking the **Admin** icon in the Application Launcher accessible via the **Waffle Button**.
2. Start a free trial of Power BI Pro.
   a) In the **Office 365 admin center**, click the **Purchase Services** link in the left column.



   b) Scroll down the page of available services and locate the **Power BI Pro** tile. Hover over the ellipses (…) in the bottom of the tile and click **Start free trial**.



   c) On the **Check out** page, click **try now** to add the subscription to your tenant.

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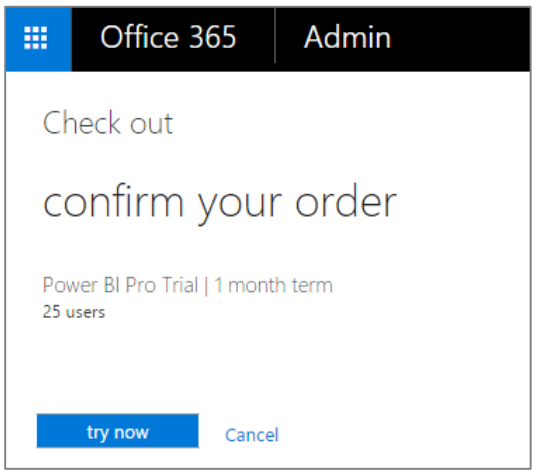
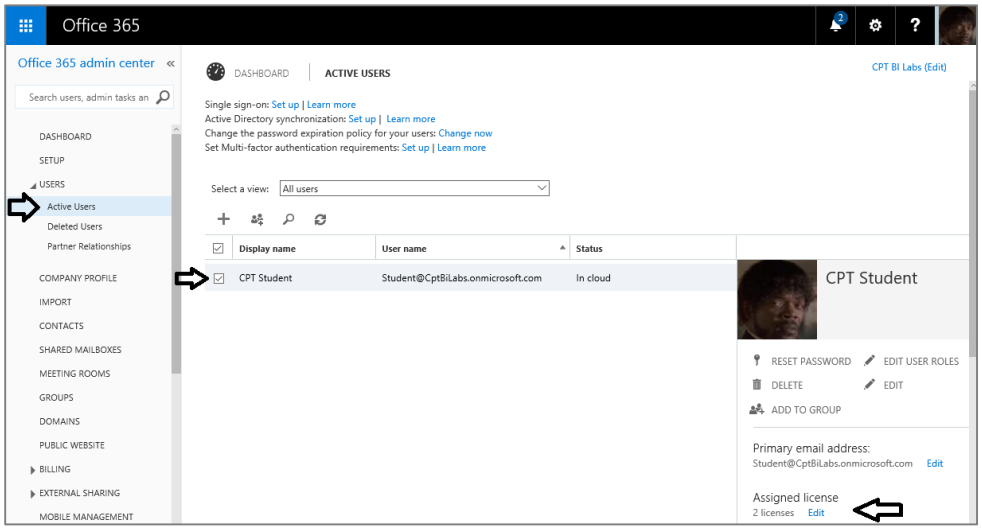


d) Click continue on the order receipt page.

While you have just started the Power BI Pro trial, you cannot use it yet because no trial license has been assigned to a user account. The next step is to configure your user account with a trial license for Power BI Pro.

3. Assign the Power BI license to your account.
   a) In the Office 365 admin center, expand the **Users** node in the left column and click **Active Users**.
   b) Check the box next to your account and click **Edit** next to **Office 365 Enterprise E3** in the tool pane on the right.



c) Expand **Microsoft Power BI for Office 365** and select the checkbox for the Power Bi pro license.

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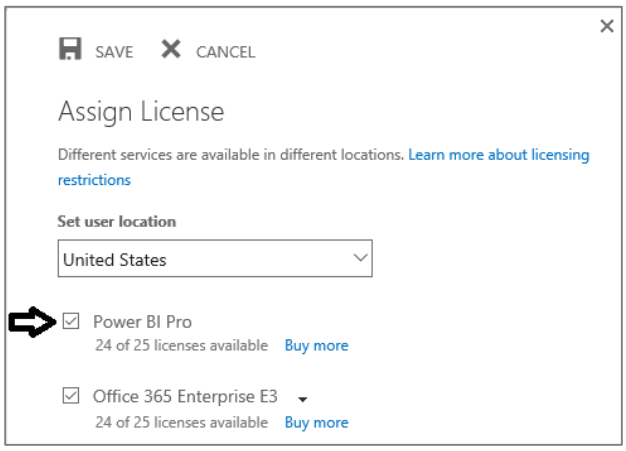
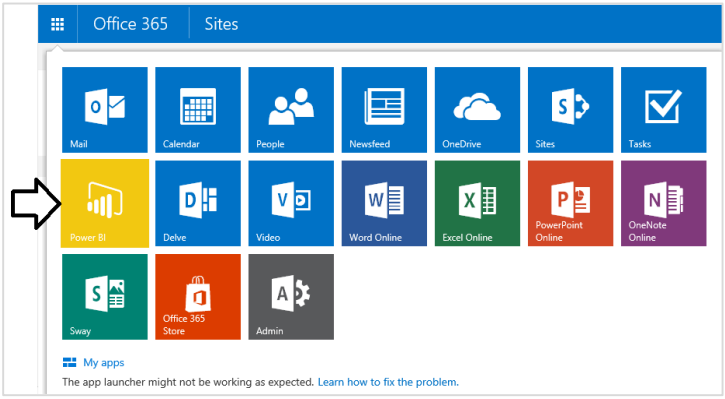


d) Click **Save** to complete the assignment.

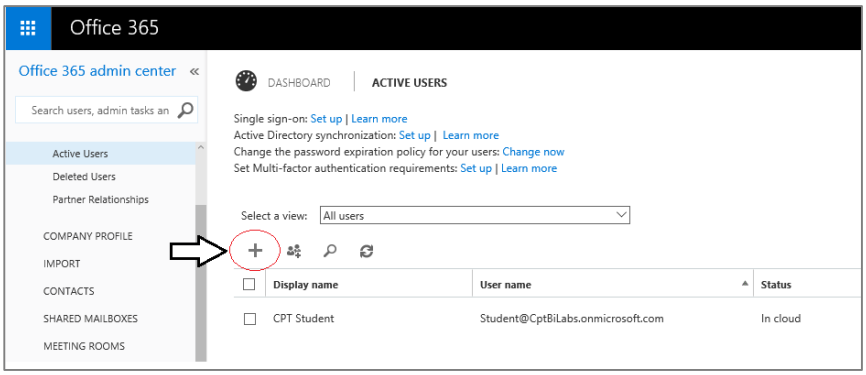
4. Check the Application Launcher accessible via the **Waffle** button and verify you can see a tile for **Power BI**.



Don't click on the tile for **Power BI** just yet. You will get to the Power BI environment in just a few more minutes. There is just one more setup task you must first complete in the Office 365 admin center which is to create a second user account. This second user account will be needed when you begin to test the effects of dashboard sharing.

5. In the Office 365 admin center, expand the **Users** node in the left column and click **Active Users**.

6. Click the button with the plus sign (**+**) to create a new user account



7. Fill in the **Create new user account** form with information for a new user account.

   a) When creating this account, you can use any name you would like.

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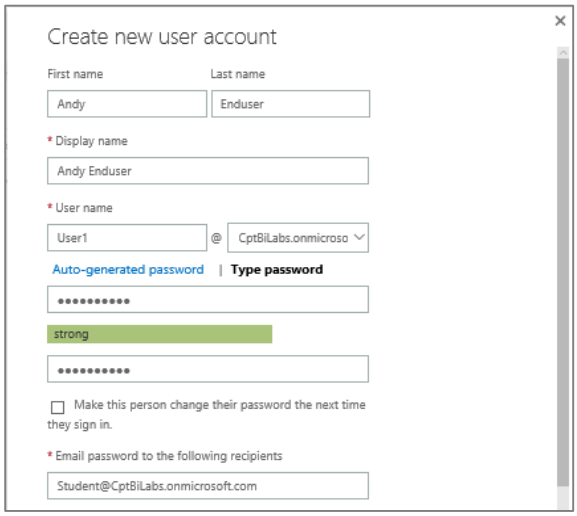
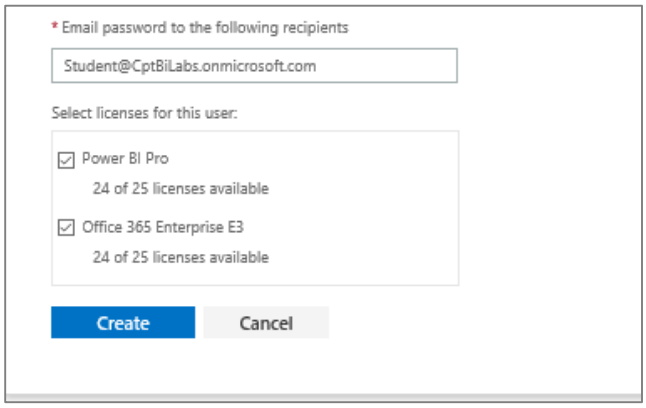
b) Click **Type password** and enter a password that you will remember such as **pass@word1**.

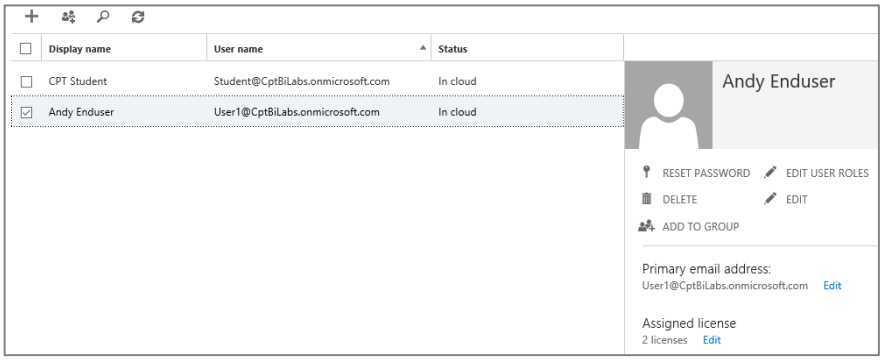
c) For your convenience, uncheck the option to Make this person change their password the next time they sign in.



d) Make sure to create the new user with trial licenses for **Office 365 Enterprise E3** and **Power BI Pro**. Click the **Create** button to create the new user account.



8. Verify that the new user account has been created.



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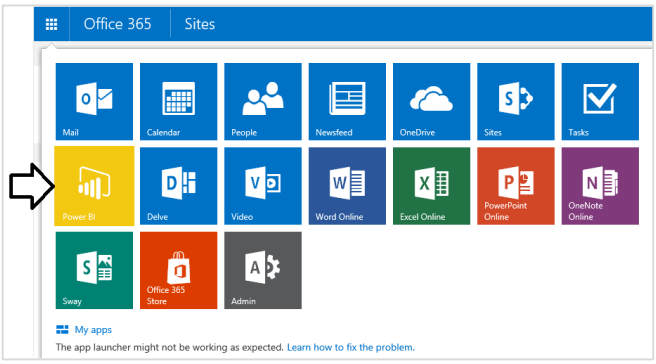
Exercise 4: Use the Power BI Service to Import a New Dataset

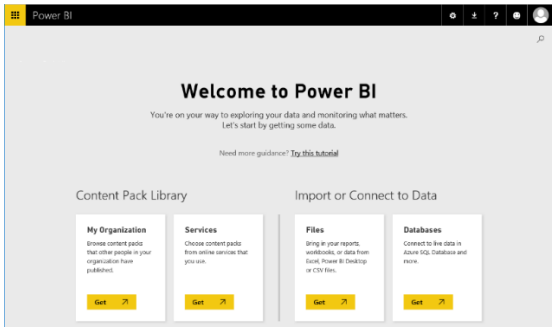
Now, after all that busy work you are finally ready to begin working with Power BI. In this setup task you will import data from an Excel workbook to create a new dataset. In the setup tasks that follow, you will create a report and a dashboard.

1. Navigate to the Power BI environment by clicking the **Power BI** icon in the Application Launcher accessible via the **Waffle Button**.

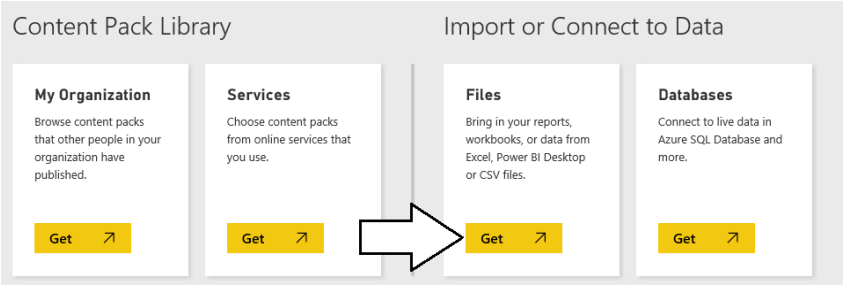


What usually happens when you click the **Power BI** tile in the Office 365 Application Launcher is that you will navigate to the page that shows the dashboards, reports and datasets in your personal workspace. However, your personal workspace is initially empty so it doesn't contain any dashboards, reports or datasets yet. Therefore, the Power BI service display a special welcome page that allows you to get started by linking to or importing data.

2. At this point, you should be at the Welcome to Power BI page as seen in the following screenshot.



3. Click in the **Get** button in the **Files** tile under the **Import or Connect to Data** section header.



4. On the next page you should see several tiles which indicate your choices for the location of the file you would like to connect to or import. Click on the tile with the caption **OneDrive – Business** so you can import data from the Excel workbook you uploaded to your OneDrive site in a previous setup task.

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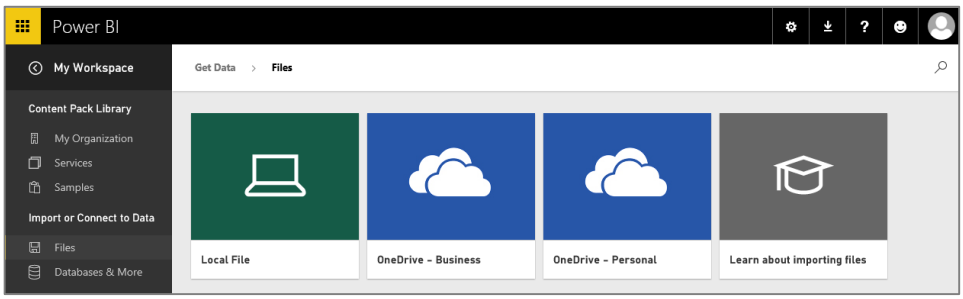
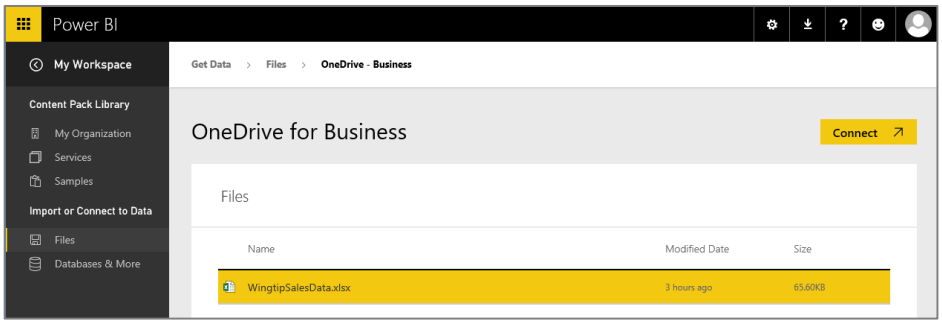
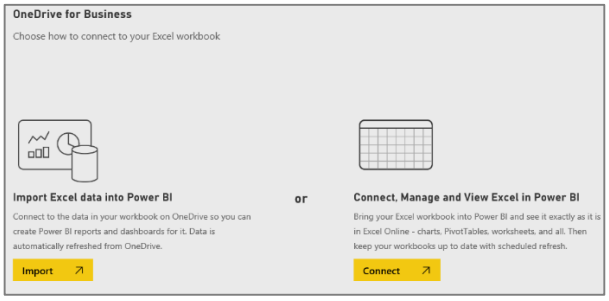


5. One the **OneDrive for Business** page, select the workbook named **WingtipSalesData.xslx** and then click the **Connect** button on the top right-hand side of the page.

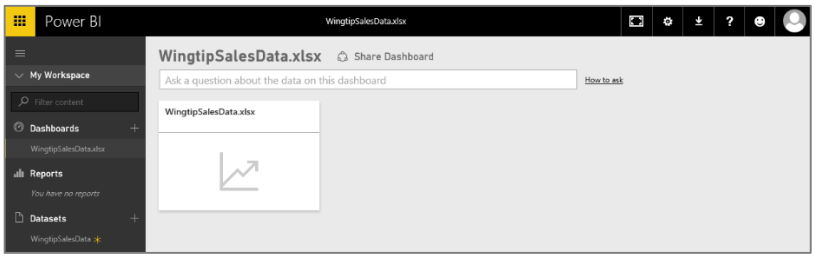


6. After clicking the **Connect** button in the previous step, you are taken to a page which prompts you to **Choose how to connect to your Excel workbook**. Click the **Import** button on the bottom left-hand side of the page to import data from the Excel workbook into the Power BI service to create a new dataset.



At this point you might make the observation that Microsoft has invested to streamline the user experience in Power BI of working with data files that have been uploaded to OneDrive sites. Once you upload your data files to a OneDrive site, they are very easy to access and integrate into your Power BI workspaces.

7. After the import process has completed, the Power BI service will display the main page that shows the Personal workspace named **My Workspace** for the current user. You should be able to verify that the import process has created a dataset named **WingtipSalesData** and a dashboard named **WingtipSalesData.xslx**.



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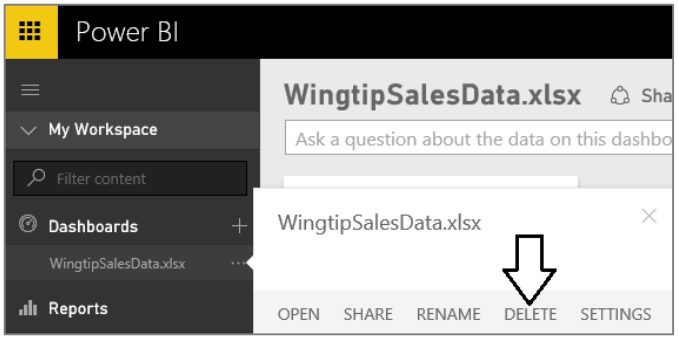
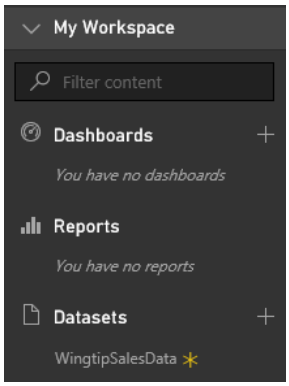
Note that when importing data from an Excel workbook that the Power BI service creates both a new dataset and a new dashboard. However, you might want just the dataset but not the dashboard. Feel free to delete the dashboard if you do not need it.

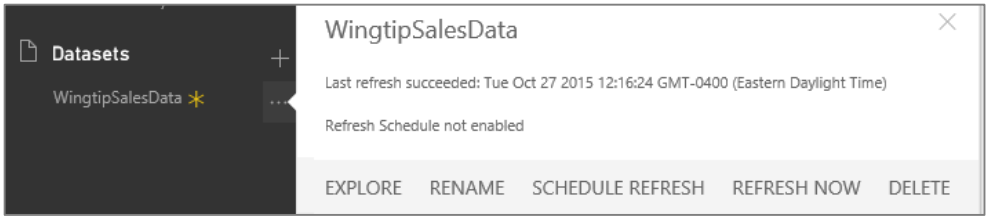
8. Delete the dashboard named **WingtipSalesData.xslx**. Accomplish this by expanding the ellipse menu to the right of the **WingtipSalesData.xlsx** dashboard and selecting the **DELETE** command.



9. Now your Power BI workspace should contain the **WingtipSalesData** dataset but there should not be any dashboards or reports.



10. Expand the ellipse menu (**…**) to the right of the **WingtipSalesData** dataset link. There is no need to execute any of the commands at this time. However, you should observe the set of commands that you can execute on a dataset that's been created by importing data from an excel workbook. For example, you have the ability to rename the dataset or to refresh its underlying data in a scenario in which the data in the underlying Excel workbook has changed.



Exercise 5: Create a New Power BI Report with Multiple Pages

Now that you have created a dataset, the next setup step involves creating a new report with two pages of visualizations.

1. Click the **WingtipSalesData** link in the **Datasets** section of the navigation menu.

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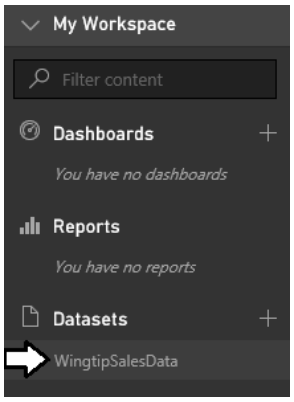
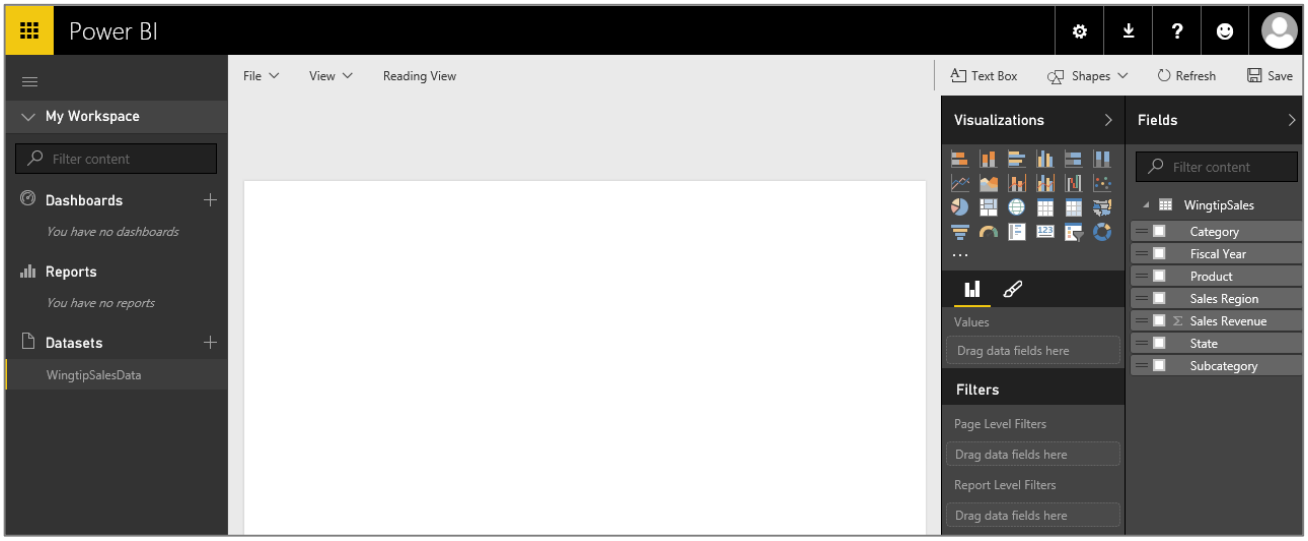
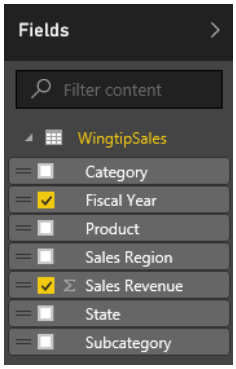


2. When you navigate to a dataset such as **WingtipSalesData**, the Power BI service display a page in report design mode as shown in the following screenshot. Locate the **Fields** list for the dataset on the right-hand side of the page.



3. In the **Fields** list on the right-hand side of the page, click the checkbox beside **Fiscal Year** and then select the checkbox beside **Sales Revenue**.



4. This should create a table visualization in the new report as shown in the following screenshot.

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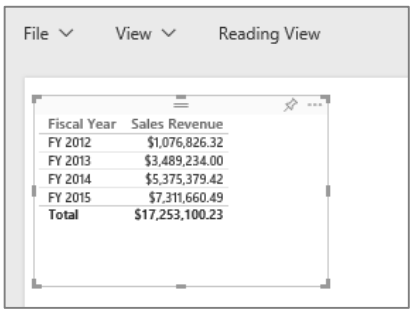
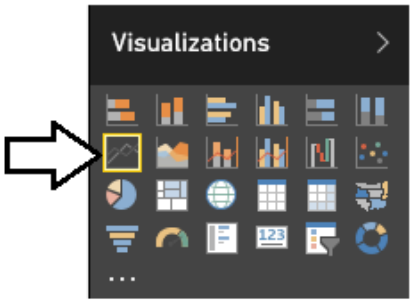
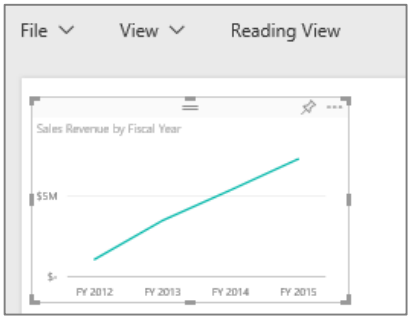


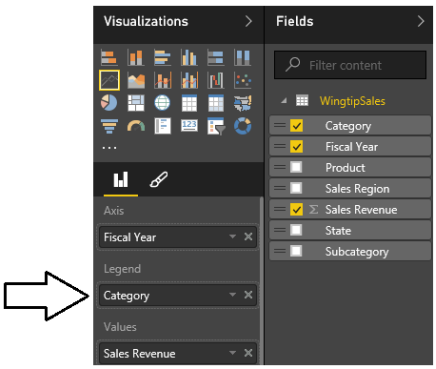
5. Change the visualization from a table to a line chart by clicking the line chart button in the **Visualizations** list.



6. At this point, you should see that the visualization on the report should now display a line chart.



7. Next, you will add a new dimension to your visualization to show how sales revenue is distributed across product categories. First, make sure the visualization with the line chart is selected and then drag-and-drop the **Category** field from the **Fields** list into the **Legend** well in the **Visualizations** pane as shown in the following screenshot.



8. At this point, your visualization should match the one shown in the following screenshot.

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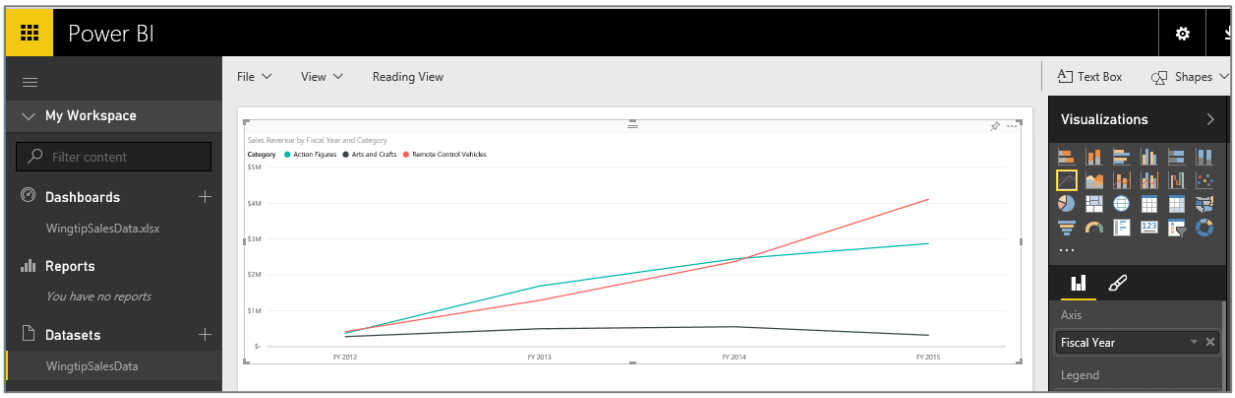
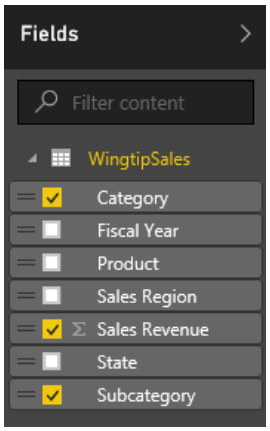
9. Select the handle at the bottom-right corner of the visualization and resize it so it takes up the width of the current report page.



10. Now you will add a second visualization to the current report page. Begin by clicking the white space under the visualization so that the visualization is no longer selected. Next, return to the **Fields** list and select the checkbox beside the **Category** field. Next, select the checkbox beside the **Subcategory** field and then select the checkbox beside the **Sales Revenue** field.



11. Now, the current report page should display a second visualization like the one shown in the following screenshot.

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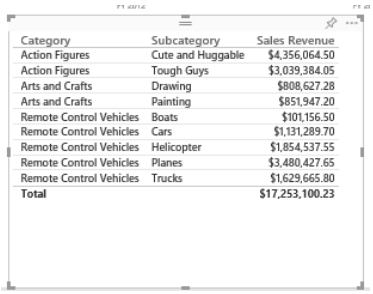
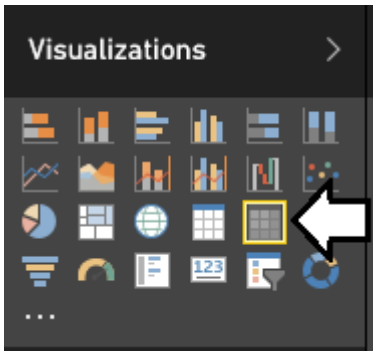
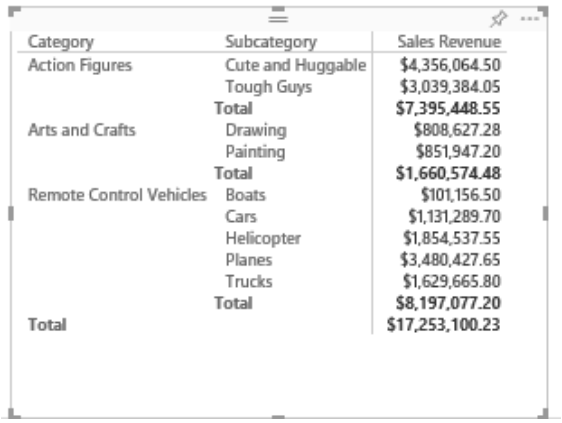


Category	Subcategory	Sales Revenue
Action Figures	Cute and Huggable	$4,356,064.50
Action Figures	Tough Guys	$3,039,384.05
Arts and Crafts	Drawing	$808,627.28
Arts and Crafts	Painting	$851,947.20
Remote Control Vehicles	Boats	$101,156.50
Remote Control Vehicles	Cars	$1,131,289.70
Remote Control Vehicles	Helicopter	$1,854,537.55
Remote Control Vehicles	Planes	$3,480,427.65
Remote Control Vehicles	Trucks	$1,629,665.80
Total		**$17,253,100.23**

12. Change the type of visualization from table to matrix by clicking the **Matrix** button in the **Visualizations** list.



13. Now, the second visualization should display as a matrix instead of a standard table.



Category	Subcategory	Sales Revenue
Action Figures	Cute and Huggable	$4,356,064.50
	Tough Guys	$3,039,384.05
	Total	**$7,395,448.55**
Arts and Crafts	Drawing	$808,627.28
	Painting	$851,947.20
	Total	**$1,660,574.48**
Remote Control Vehicles	Boats	$101,156.50
	Cars	$1,131,289.70
	Helicopter	$1,854,537.55
	Planes	$3,480,427.65
	Trucks	$1,629,665.80
	Total	**$8,197,077.20**
Total		**$17,253,100.23**

14. Inside the matrix, click on the **Sales Revenue** column header to resort the data in the matrix so that the product categories and subcategories with the highest amounts of sales revenue are sorted to the top of the matrix.

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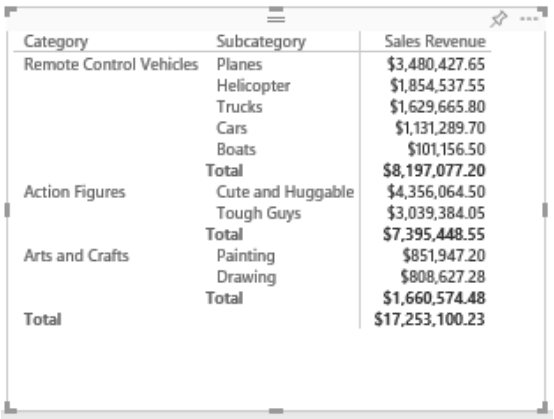
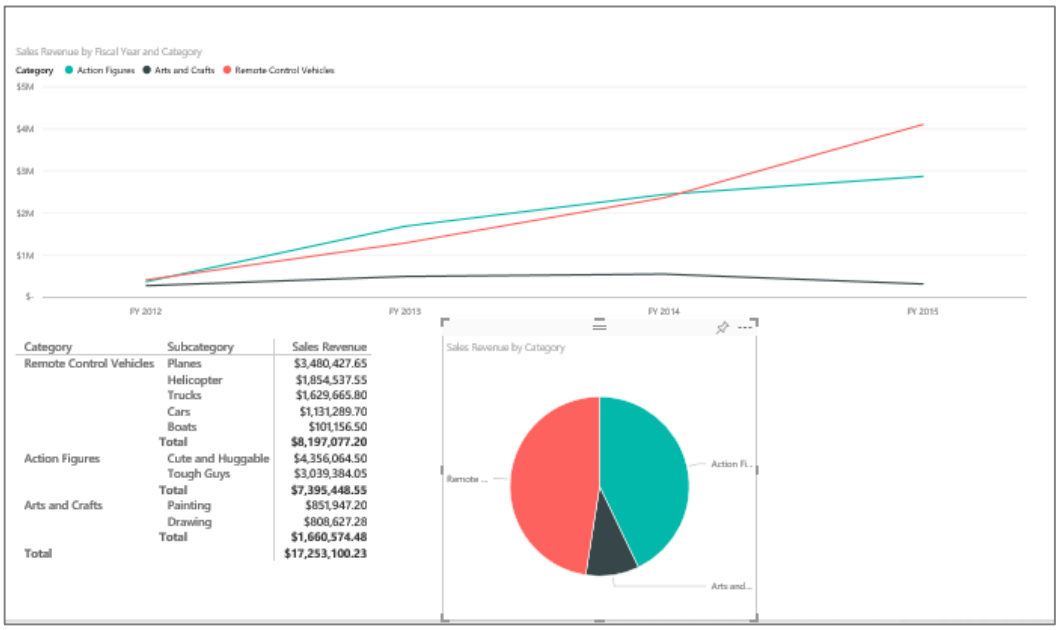


Category	Subcategory	Sales Revenue
Remote Control Vehicles	Planes	$3,480,427.65
	Helicopter	$1,854,537.55
	Trucks	$1,629,665.80
	Cars	$1,131,289.70
	Boats	$101,156.50
	Total	**$8,197,077.20**
Action Figures	Cute and Huggable	$4,356,064.50
	Tough Guys	$3,039,384.05
	Total	**$7,395,448.55**
Arts and Crafts	Painting	$851,947.20
	Drawing	$808,627.28
	Total	**$1,660,574.48**
Total		**$17,253,100.23**

15. Now you will add a third visualization to the current report page. Begin by clicking the white space on the report page outside of the two existing visualizations so that neither visualization is selected. Next, return to the **Fields** list and select the checkbox beside the **Category** field. Next, select the checkbox beside the **Sales Revenue** field. After creating the visualization, change it to a pie chart by clicking the Pie chart button in the **Visualizations** list.



16. With the pie chart visualization selected, click on the pen icon in the **Visualizations** task pane so you can edit the visual properties of the new pie chart visualization.

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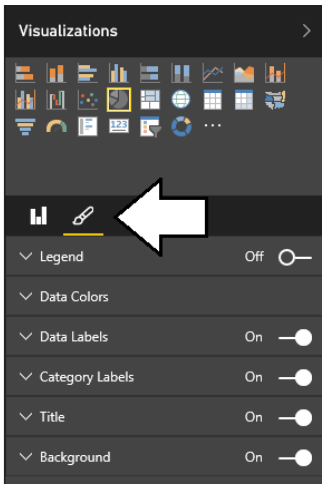
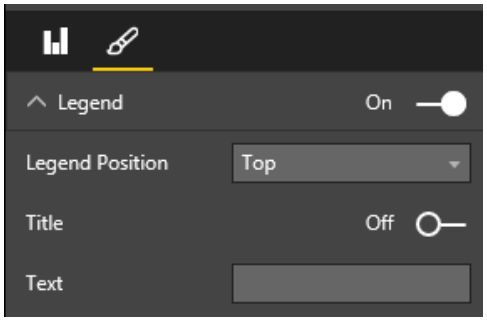
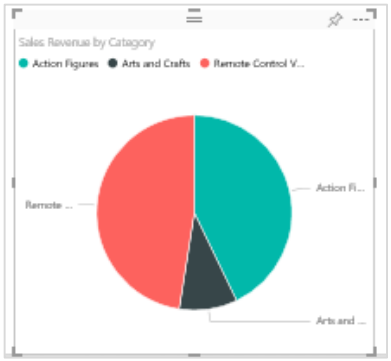


17. Turn on the **Legend** option and then expand the **Legend** section. Set the **Legend Position** to **Top** and turn off the **Title** option as shown in the following screenshot.



18. At this point, you should see the visual changes you have made to the pie chart.



If you have time, you might explore the other options available for editing the appearance of a visualization by examining the other options that are available on the Visualizations task pane when a visualization is selected. Note that the set of available options change depending on what type of visualization is selected.

19. Now it is time to save the report. Begin by changing the name of the current page. Locate the report page name section at the bottom left of the current page and observe that the page has been given an initial name of **Page 1**.

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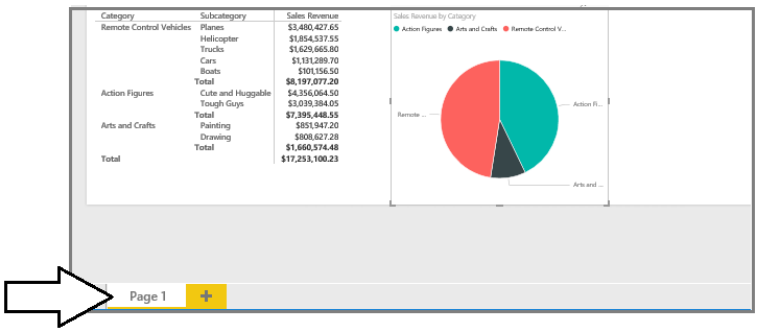
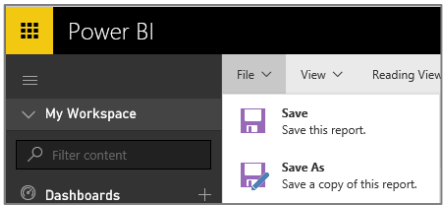


20. Double click on the page name of **Page 1** to enter edit mode and then update the page name to **Sales by Product Category**,

21. Save the report by dropping down the reports **File** menu and selecting the **Save As** menu command.



22. When prompted, enter a report name of **Product Sales** and click the **Save** button.

23. After saving the **Product Sales** report, you should be able to see a link for it in the **Reports** section of the left-hand navigation.

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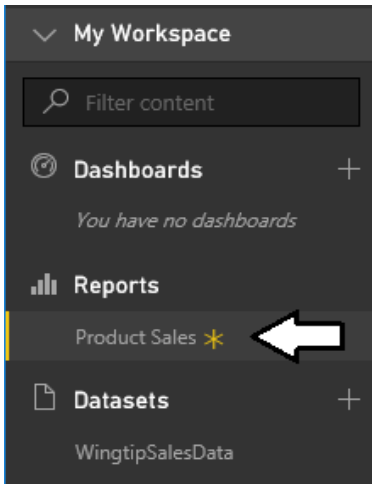
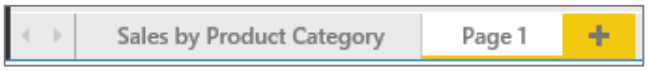
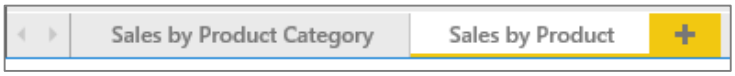


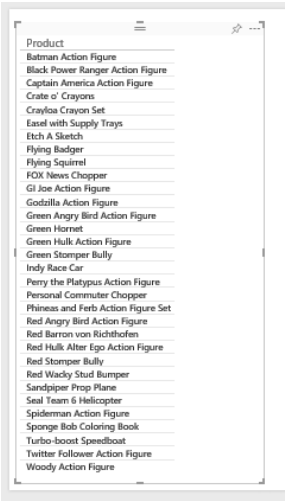
24. Now, add a second page to the **Product Sales** report. Accomplish this by clicking the button with the plus (+) sign to the right of the page name. The Power BI service will respond by creating a second page named **Page 1**.



25. Change the name of the second page from **Page 1** to **Sales by Product**.



26. On the new **Sales by Product** page, add a new visualization by selecting the checkbox beside the **Product** field from the **Fields** list. This should create a simple table visualization with a list of products. Resize the height of the visualization to display all products at once without the need for a scrollbar.



27. Change the type of visualization from a table to a slicer by clicking the Slicer button in the **Visualizations** list.

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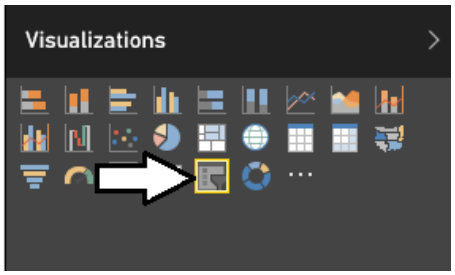
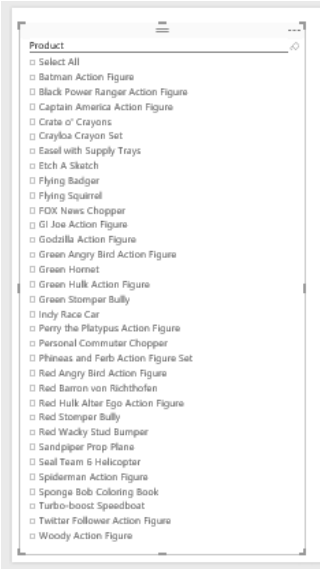
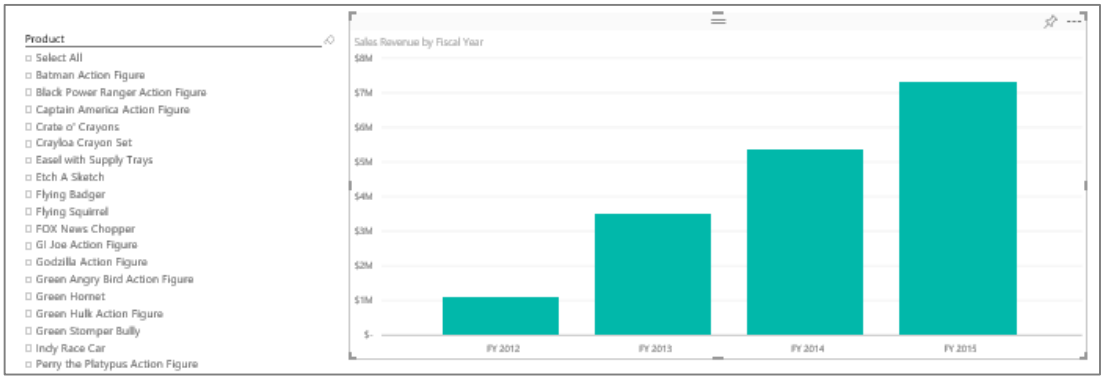


28. Now that the visualization has been changed to a slicer, you should see that each product has an associated checkbox.



Keep in mind that this slicer visualization adds the ability for the current user to intact with this report by selecting one or more products using these checkboxes. When a user changes the selection of products, the Power BI service will automatically refresh the other visualizations on the page by filtering the results using the selected product or products. Learning how to make reports interactive is a key to creating effective BI solutions with Power BI.

29. Next, you will add a second visualization to **Sales by Product** page. Click whitespace in the report to ensure the first visualization is not selected. Next, create a new visualization by selecting the checkbox for the **Sales Revenue** field and then selecting the checkbox for the **Fiscal Year** field. This should create the second visualization on the page as a bar chart as shown in the following screenshot.



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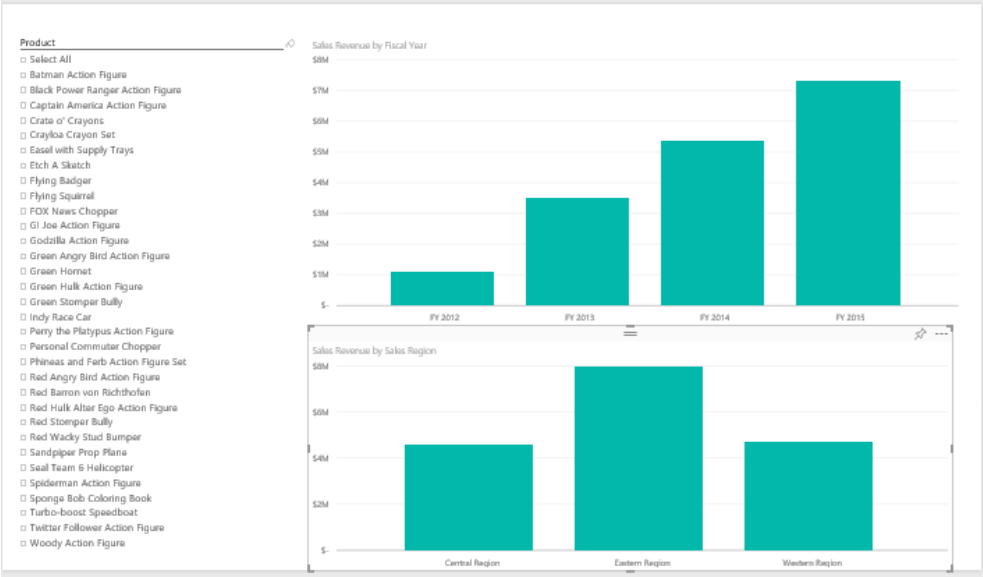
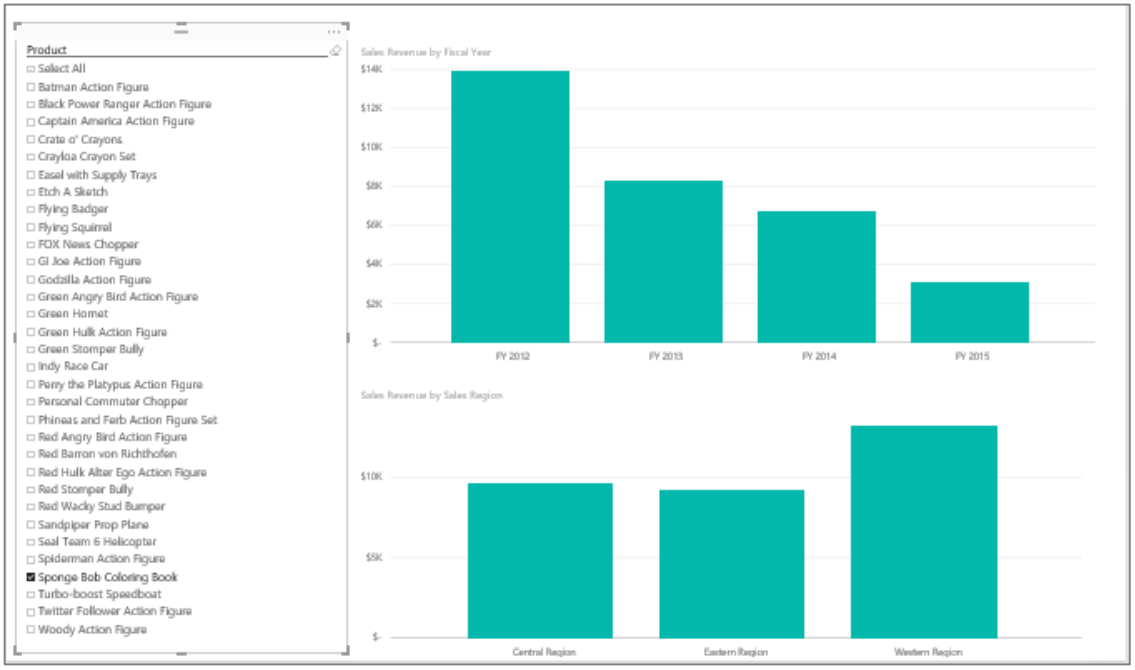
30. Now you will add a third visualization. Click whitespace in the report to ensure the neither of the two visualizations are currently selected. Next, create a third visualization by selecting the checkbox for the **Sales Revenue** field and then selecting the checkbox for the **Sales Region** field. This should create the third visualization as a bar chart as shown in the following screenshot.



31. Test out the slicer by selecting one product at a time and observing how the two other visualizations on the page automatically refresh to show sales data for one product at a time. Play the role of a business analyst and determine which products have the most positive increases in sales revenue from year to year. Also, find the products with downward trending sales. If you examine the sales data for the **Sponge Bob Coloring Book**, you can sales revenue is trending in the wrong direction over the last four years.



32. Now you are done authoring the report. Save the work you have done authoring the report by dropping down the **File** menu and selecting to **Save** menu command.

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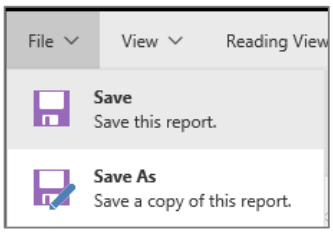
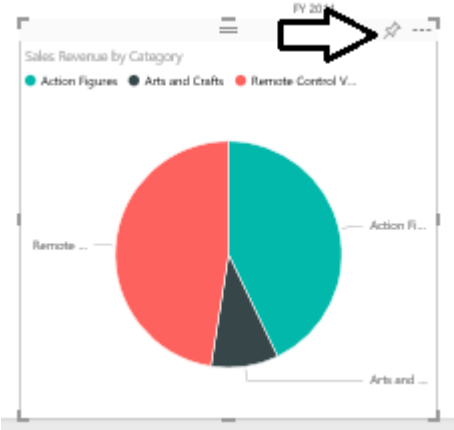


Now that you have created a report with multiple pages, it is time to move on to the last setup task where you will create a new dashboard and test sharing it with another user.

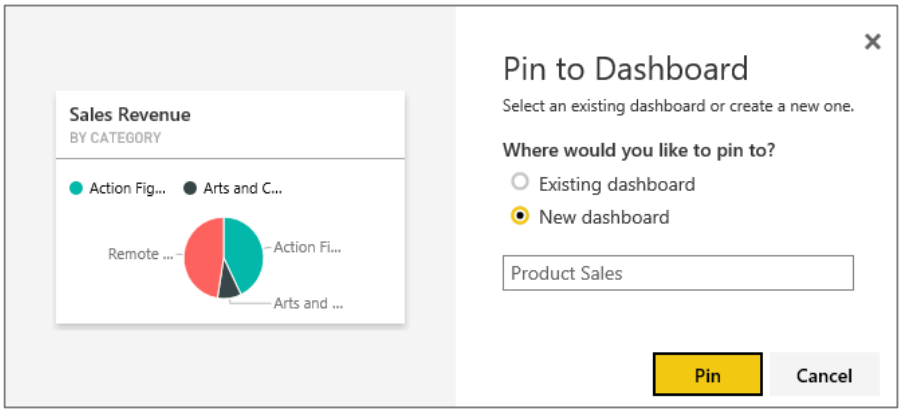
Exercise 6: Create and Share a Power BI Dashboard

While you have already created a dataset and a report, you must create a dashboard to effectively share a customized BI solution with other users. This final setup task will walk you through the steps of creating and sharing a Power BI dashboard.

1. Navigate to the **Sales by Product Category** page of the **Product Sales** report.
2. Inspect the pie chart with product categories. Locate and click the button with the thumbtack icon which is used to pin a report visualization to a dashboard.



3. When you click the button with the thumbtack icon, you will be prompted with the dialog which asks you where to pin the visualization. Select the option to pin the visualization to a **New Dashboard** and give the new dashboard a name of **Product Sales**. When the **Pin to Dashboard** form is filled out like the one shown in the following screenshot, click the **Pin** button.



4. At this point, the new **Product Sales** dashboard should be created and a link to it should appear in the left navigation menu.

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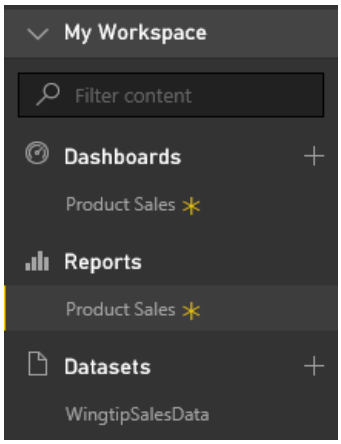
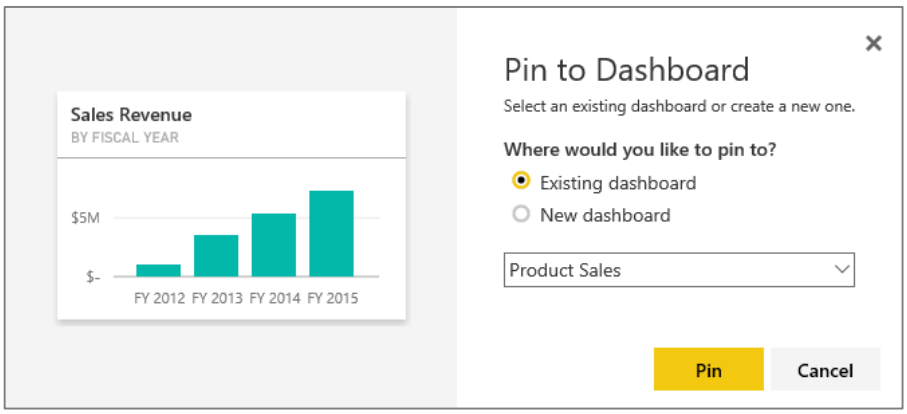
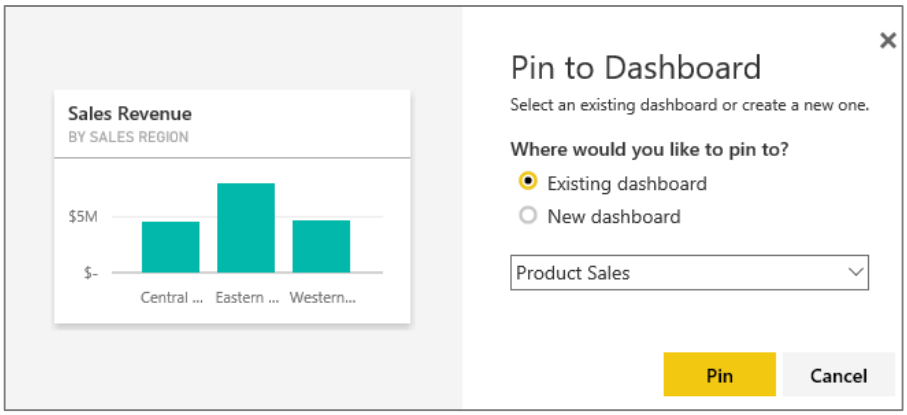


5. Navigate to the **Sales by Product** page of **Product Sales** report and follow the same steps to pin the bar chart visualization showing sales revenue by fiscal year to the **Product Sales** dashboard.



6. Remain on the **Sales by Product** page of **Product Sales** report and follow the same steps to pin the bar chart visualization showing sales revenue by sales region to the **Product Sales** dashboard.



7. Click on the **Product Sales** link in the **Dashboards** section of the left navigation menu to display the **Product Sales** dashboard. You should be able to verify that you see three tiles that have been created from the three report visualization that you pinned to this dashboard.

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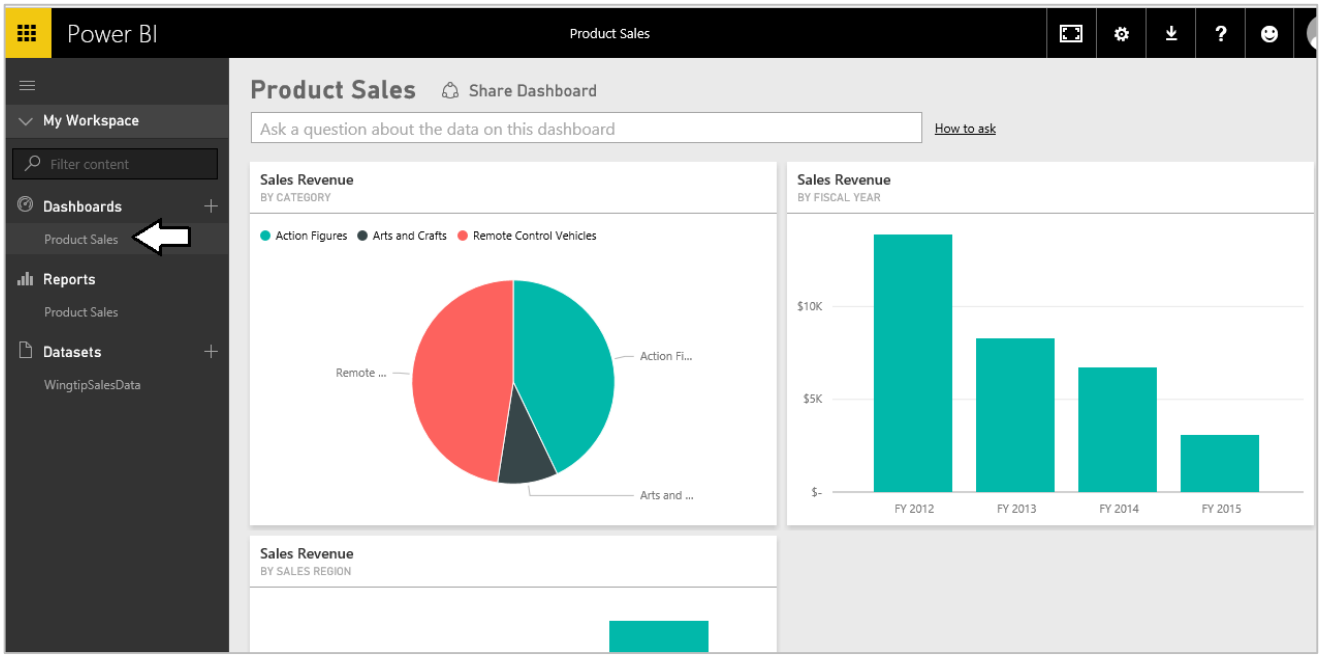
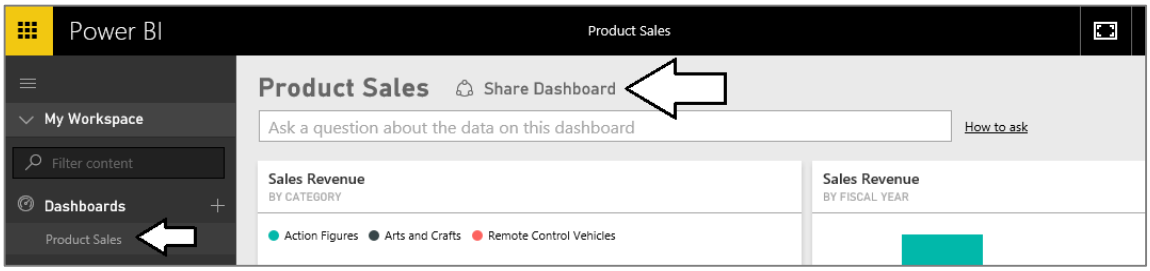


8. Note that you can move or resize the tiles inside the dashboard. This is due to the fact that you are the dashboard author and you are in dashboard edit mode.
9. Experiment by clicking on the tiles in the dashboard. You will find that clicking a tile will navigate the user to the report and page that contains the visualization which was pinned to the dashboard.
10. Now, it is time to test sharing a Power BI dashboard. Start by navigating to the **Product Sale** dashboard and clicking the **Share Dashboard** link at the top of the page.



11. At this point, you are prompted with the **Share Dashboard** page where you can enter information about the users and/or groups with which you want to share your new dashboard. Enter the email address of the secondary user account that you created earlier in setup task five. After you have entered the email address, click the **Share** button at the bottom of the page.

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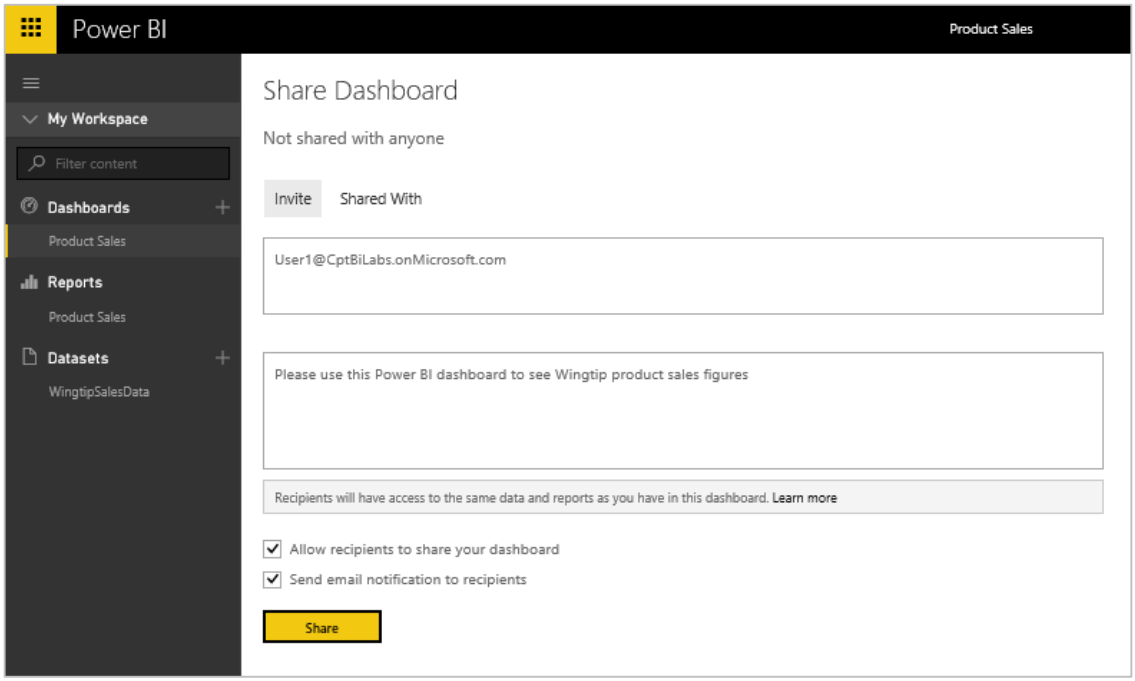
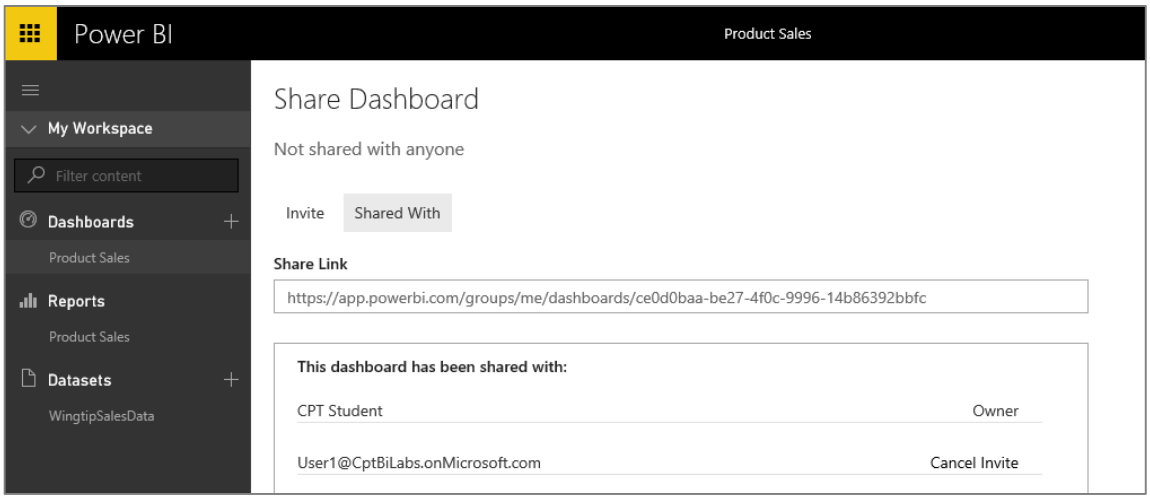
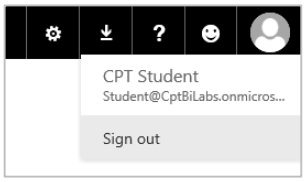


12. Once the dashboard has been successfully shared, you should be able to confirm that the secondary user has access to this dashboard by examining the **Shared With** tab of the **Share Dashboard** page as shown in the following screenshot.



Now you have completed the steps to share the dashboard. The final step is to test the experience of a user who is not the dashboard author, but instead a dashboard consumer. This will require that you sign out of the Power BI service and then sign back in under the identity of the secondary user account. By accessing the shared dashboard in this fashion, you will be able to observe the typical experience of a dashboard consumer when accessing a dashboard that has been shared by another user.

13. Drop down the user menu from the top, right-hand corner of the page and click the Sign out command.



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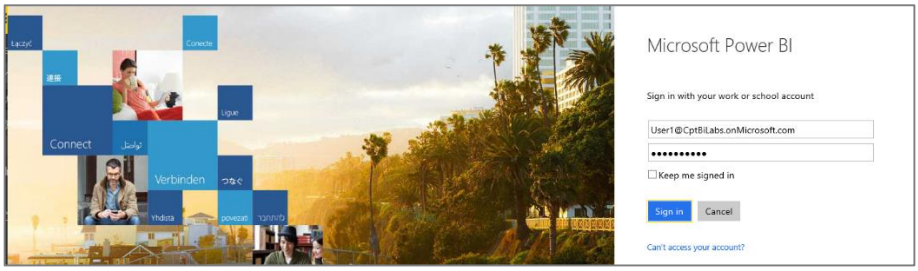
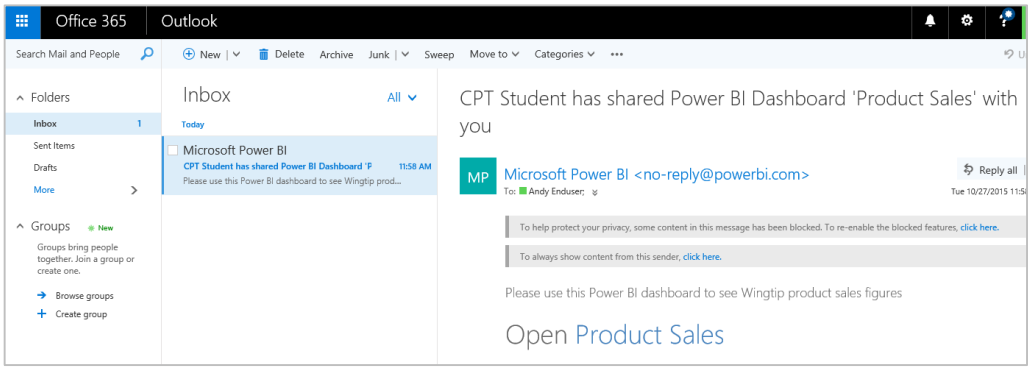
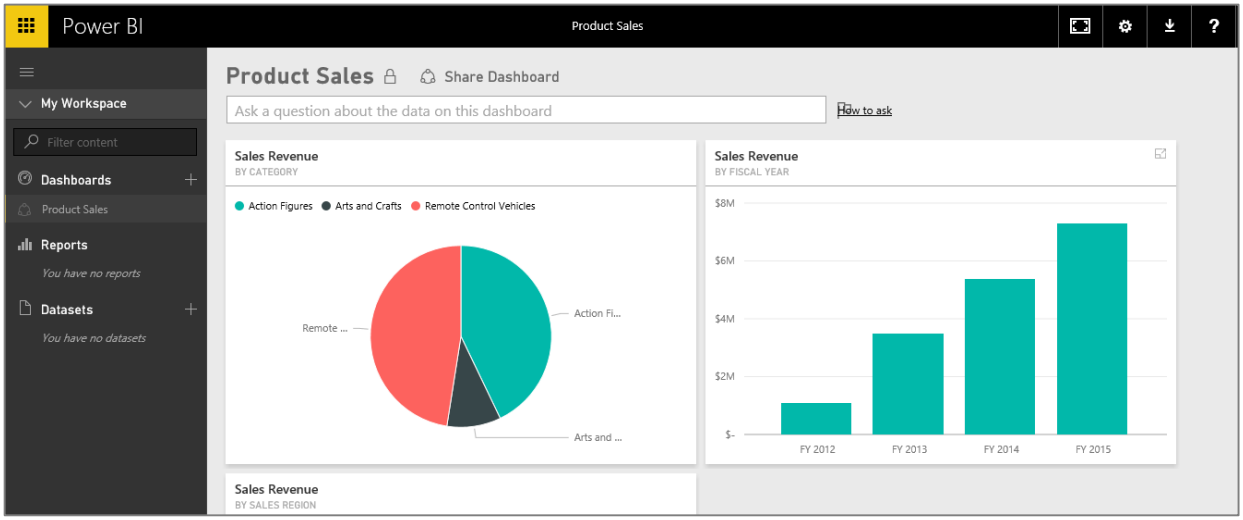
14. Now, sign back in using the account name and the password of the secondary user account you created earlier.



15. Once you have signed in, click the **Mail** tile in the Application Launcher accessible via the **Waffle Button**.
16. Once you are able to access the inbox for the secondary user, you should be able to verify that the Power BI service has sent this user a notification email message informing the user that the Product Sales dashboard that has been shared. In the body of the email message, click the **Open Product Sales** link to navigate to the new dashboard.



17. At this point, you will be taken to a page which shows the personal workspace for the current user and displays the page for the Product Sale dashboard.



18. Take note that this user can see the **Product Sales** dashboard link in the left navigation menu but there are not links for any reports or datasets.

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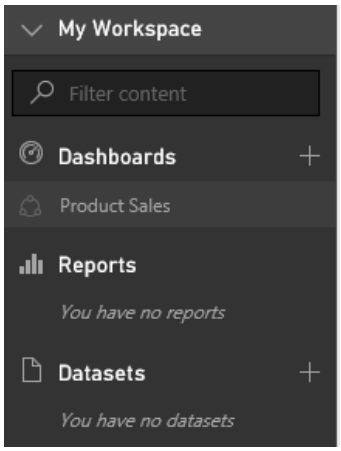
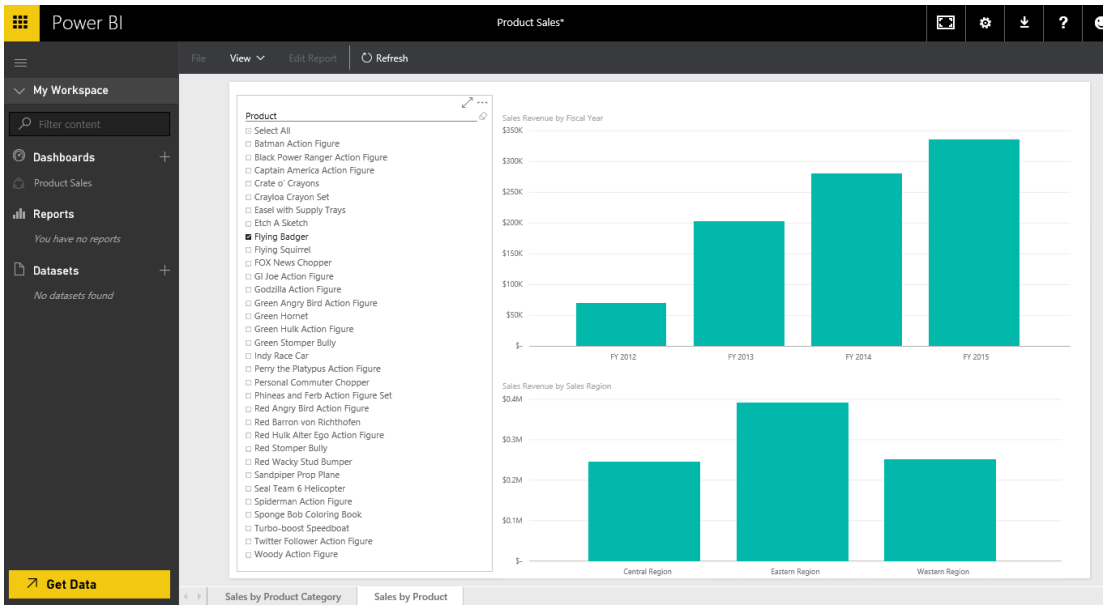


Note that Power BI does not include links to provide the dashboard consumer with direct access to the report or the dataset behind the dashboard. However, Power BI does supply the dashboard consumer with indirect access to the report and the dataset behind the dashboard. It's just that the dashboard consumer can only access the report and dataset by interacting with the dashboard. One key benefit is that this approach keeps the left navigation less cluttered when the user is accessing many different shared dashboards.

19. Navigate to the **Product Sales** dashboard and observe that the dashboard page is in read-only view. The user is not able to delete, move or resize any of the tiles. Only the dashboard author is able to edit this dashboard page.
20. On the **Product Sales** dashboard, experiment by clicking on the dashboard tile showing sales revenue by fiscal year. This will allow you to navigate to the **Sales by Product** page of the **Product Sales** report. Interact with the report page by using the slicer to filter and analyze the underlying data and see how individual products are selling from year to year..



Congratulations. You have made it to the end of this setup guide and you have now created and configured a test environment in which you can begin to create and implement custom BI solutions using the Power BI platform.

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Module 02: Getting Started with Power BI Desktop

Module Description

This module provides an overview of Power BI Desktop, Microsoft's primary tool for creating custom BI solutions using the Power BI service. Students will learn how to install and configure Power BI Desktop as well as how to import data and create datasets. The module provides students with an introductory tour of how to get around in Power BI Desktop as well as how to import data and to create datasets. Students will learn about the PBIX file format used by Power BI Desktop as well as the process used to create dashboards and reports and to publish them to the Power BI service.

Module Agenda

- Project Lifecycle with Power BI Desktop
- Getting Started with Power BI Desktop
- Using Power Query to Import Data
- Using Power Pivot to Model Data
- Publishing Power BI Desktop Projects

Topics Covered

Project Lifecycle in Power BI
Working with Power BI Desktop
Installing Power BI Desktop
Launching Power BI Desktop
Projects and PBIX Files
Getting Around in Power BI Desktop
Relationship View
Data View
Report View
Creating Queries with Power Query
Query Editor Window
Example Query Step: Choose Columns
The Project's Data Model
Creating Calculated Columns
Creating Measures
Publishing a Power BI Desktop Project
A Published Power BI Desktop Project

Instructor Demos

- Getting Up and Running with Power BI Desktop
- Importing Data using Power Query
- Modeling Data using Power Pivot
- Publishing a Data Analysis Project using Power BI Desktop

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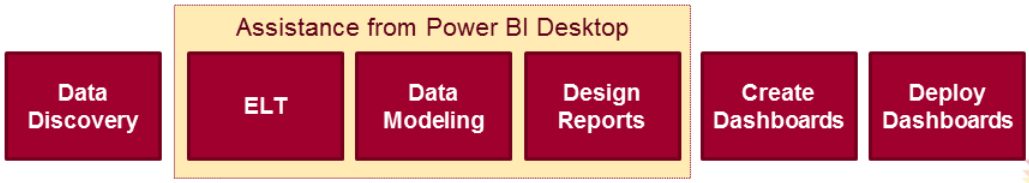
Project Lifecycle in Power BI

- What's the lifecycle of a typical BI project
  - Discover where the data lives
  - Extract, transform and load the data (ELT)
  - Model data to create project's main dataset
  - Design and implement reports on top of dataset
  - Consolidate reports to one or more dashboards
  - Package efforts into custom Power BI content pack
  - Deploy content package to production tenant



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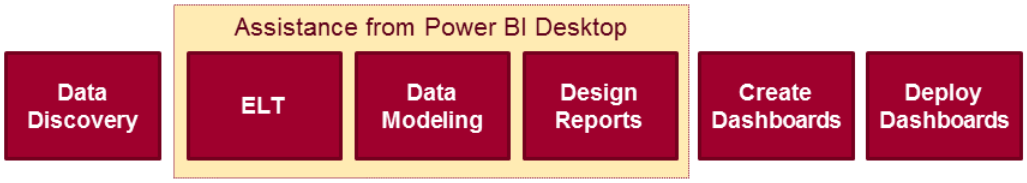
Working with Power BI Desktop

- Power BI Desktop focuses on three phases
  - ELT using Power Query features
  - Data modeling using Power Pivot and DAX
  - Report creation using the Power BI report designer



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Installing Power BI Desktop

- Power BI Desktop installs as click-once application
  - Can be installed when logged into Power BI service

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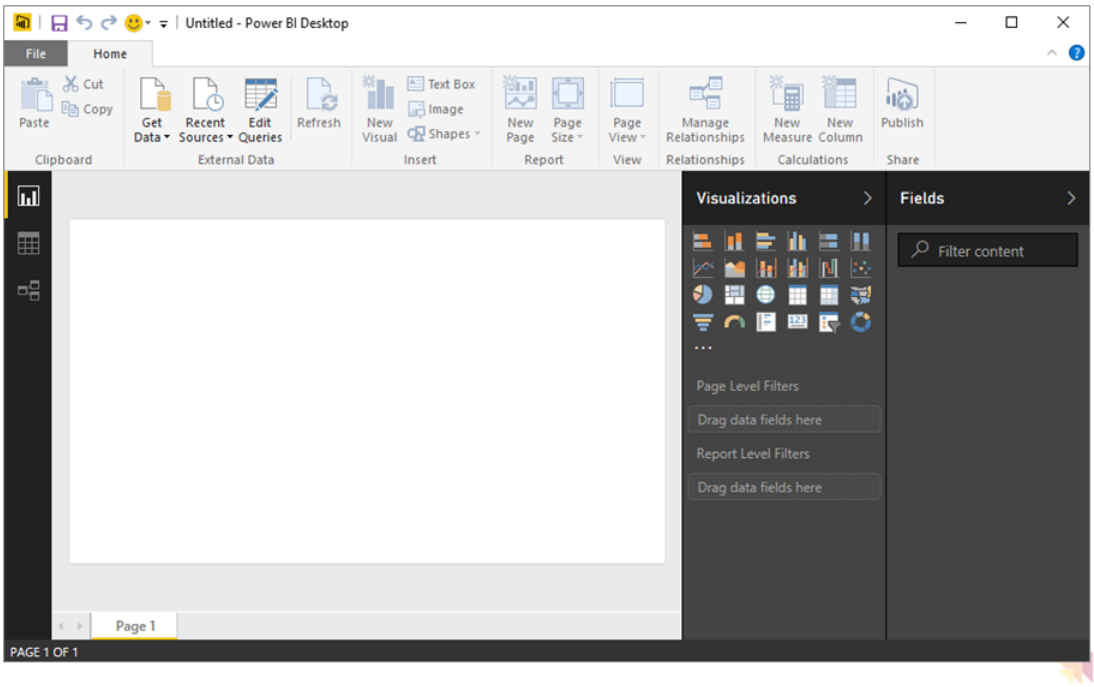
Launching Power BI Desktop



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Projects and PBIX Files

- Power BI Desktop projects saved using PBIX files
  - PBIX file contains queries created with Power Query
  - PBIX file contains data imported using queries
  - PBIX file contains data modeling definitions
  - PBIX file contains reports

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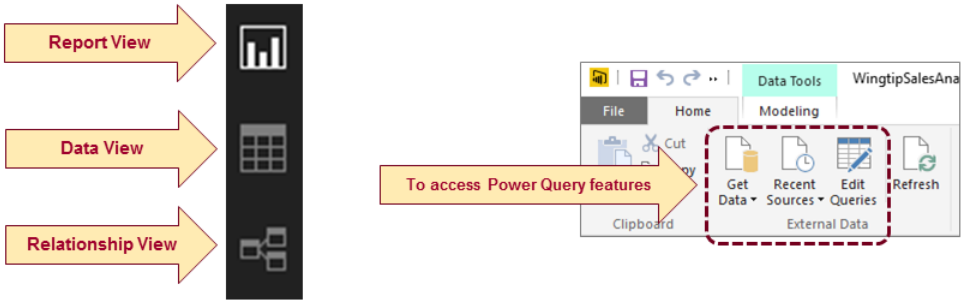
Getting Around in Power BI Desktop

- Understanding the features for Power BI Desktop
  - Power query features for importing data
  - Power Pivot features for modeling data
  - Report designer for creating reports
  - No current support for creating dashboards
- Navigating between view modes



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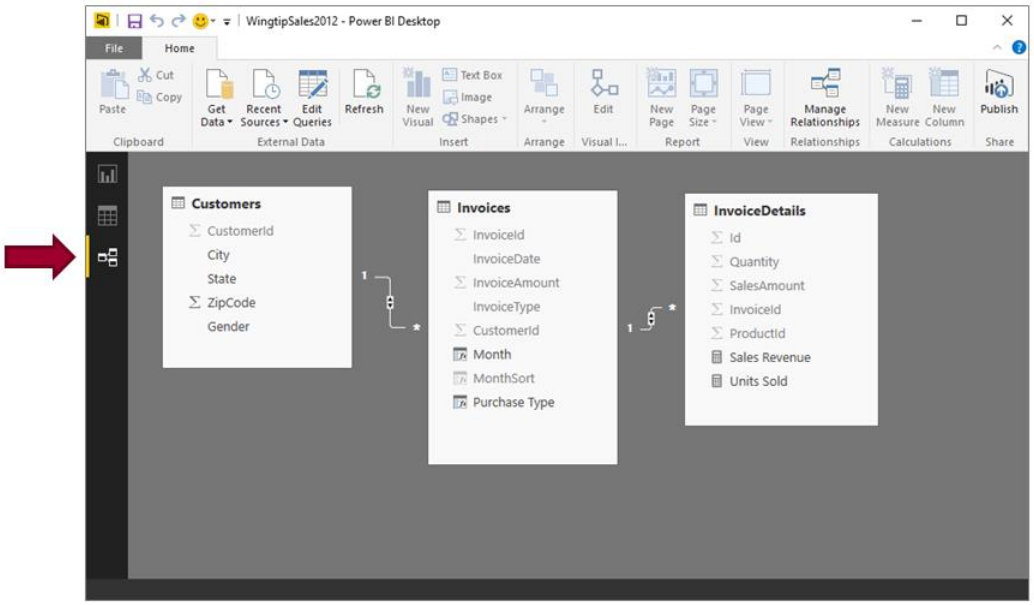
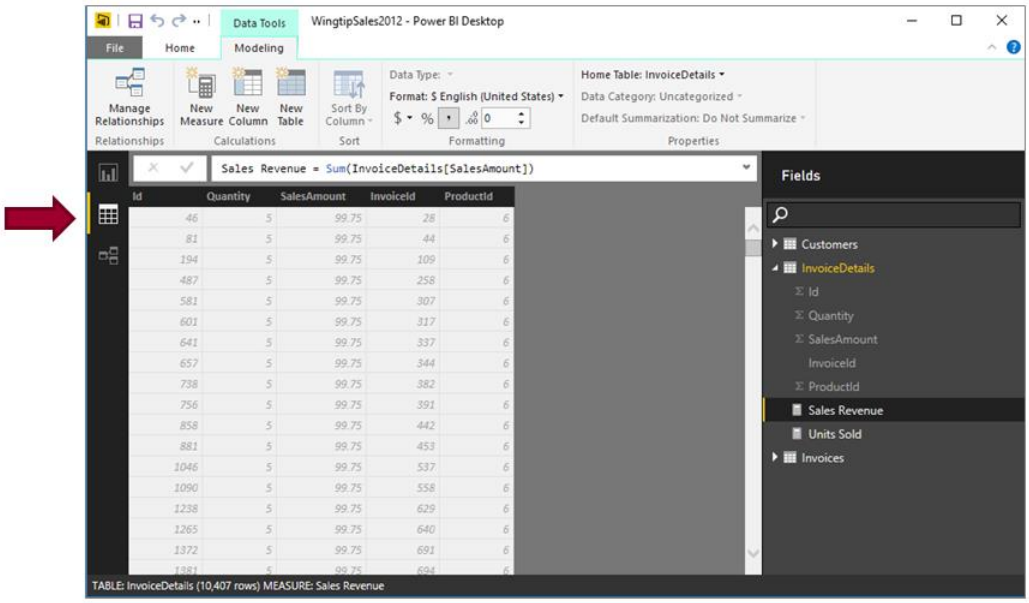
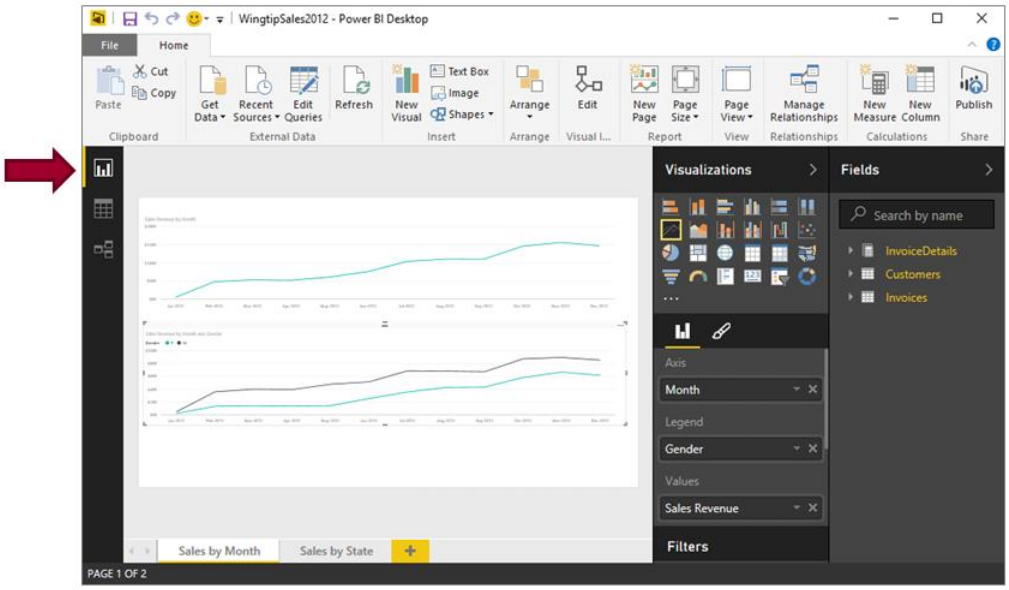
Relationship View



Data View

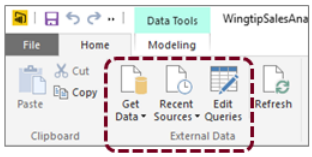

Data Tools
WingtipSales2012 - Power BI Desktop
File
Home
Modeling
Manage Relationships
Relationships
New Measure
New Column
New Table
Calculations
Sort By Column
Sort
Data Type:
Format: $ English (United States)
Formatting
Home Table: InvoiceDetails
Data Category: Uncategorized
Default Summarization: Do Not Summarize
Properties
Sales Revenue = Sum(InvoiceDetails[SalesAmount])
Id
Quantity
SalesAmount
InvoiceId
ProductId
Fields
Customers
InvoiceDetails
Id
Quantity
SalesAmount
InvoiceId
ProductId
Sales Revenue
Units Sold
Invoices
TABLE: InvoiceDetails (10,407 rows) MEASURE: Sales Revenue

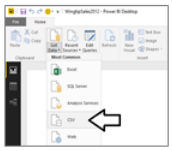
Report View


WingtipSales2012 - Power BI Desktop
File
Home
Paste
Cut
Copy
Clipboard
Get Data
Recent Sources
Edit Queries
Refresh
External Data
New Visual
Text Box
Image
Shapes
Insert
Arrange
Edit
New Page
Page Size
Report
Page View
View
Manage Relationships
Relationships
New Measure
New Column
Calculations
Publish
Share
Visualizations
Fields
Search by name
InvoiceDetails
Customers
Invoices
Axis
Month
Legend
Gender
Values
Sales Revenue
Filters
Sales by Month
Sales by State
PAGE 1 OF 2

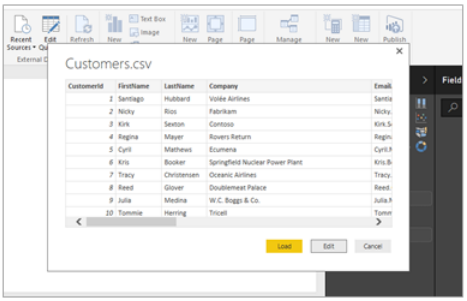
Creating Queries with Power Query

- Power BI Desktop support Power Query features
  - Creating a new query





  - Working in the Query Editor window



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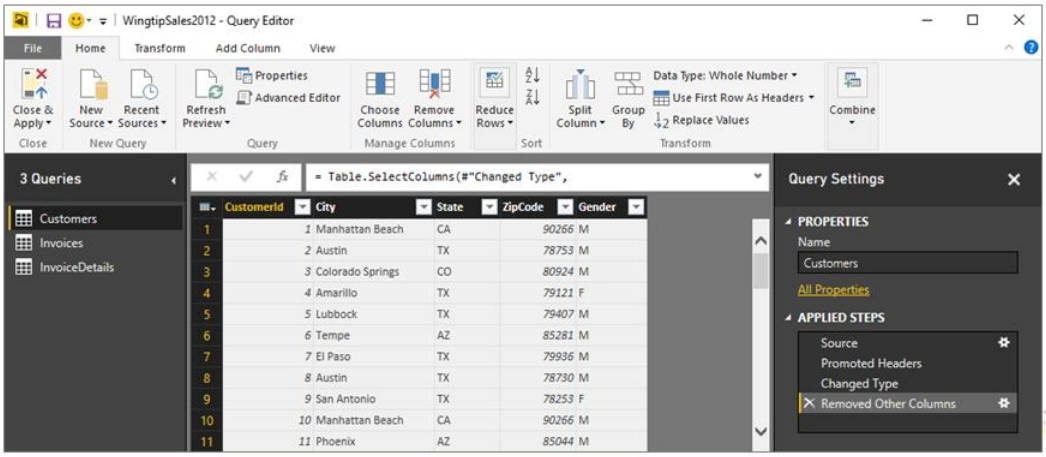
Query Editor Window

- Power BI Desktop provides Query Editor window
  - This is where you create and modify queries
  - Queries are created using query steps



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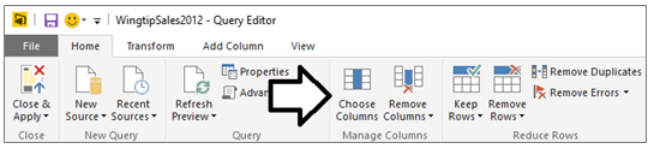
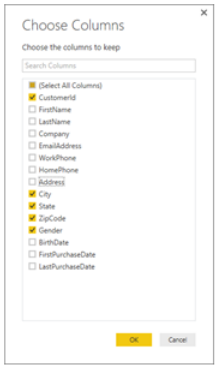
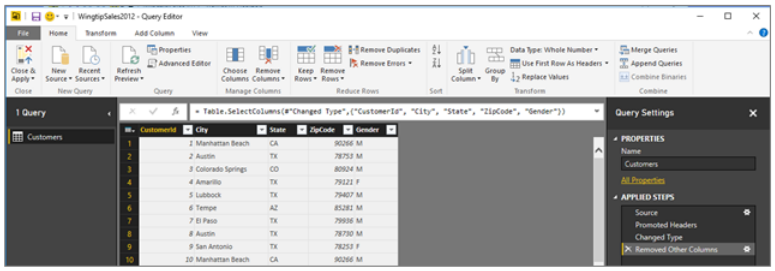
Example Query Step: Choose Columns

- Select which columns to include in query output







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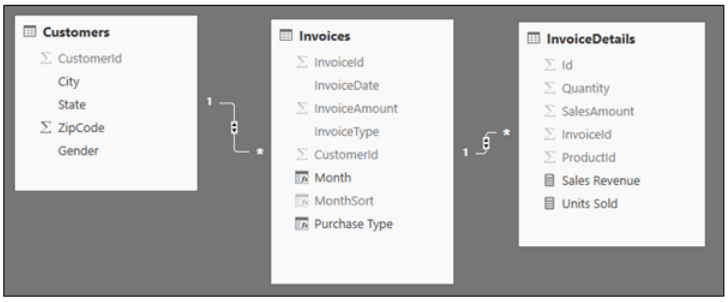
The Project's Data Model

- Each PBIX project has a data model
  - Data model contains tables and relationships
  - Tables contain three different types of fields
    - Native columns
    - Calculated columns
    - Measures



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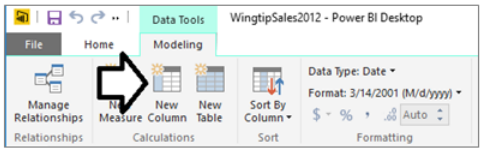
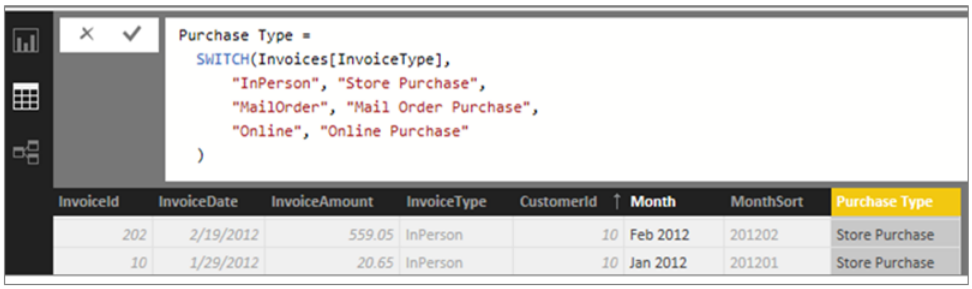
Creating Calculated Columns

- Calculated column can be added to table



- Calculated columns created with DAX expressions



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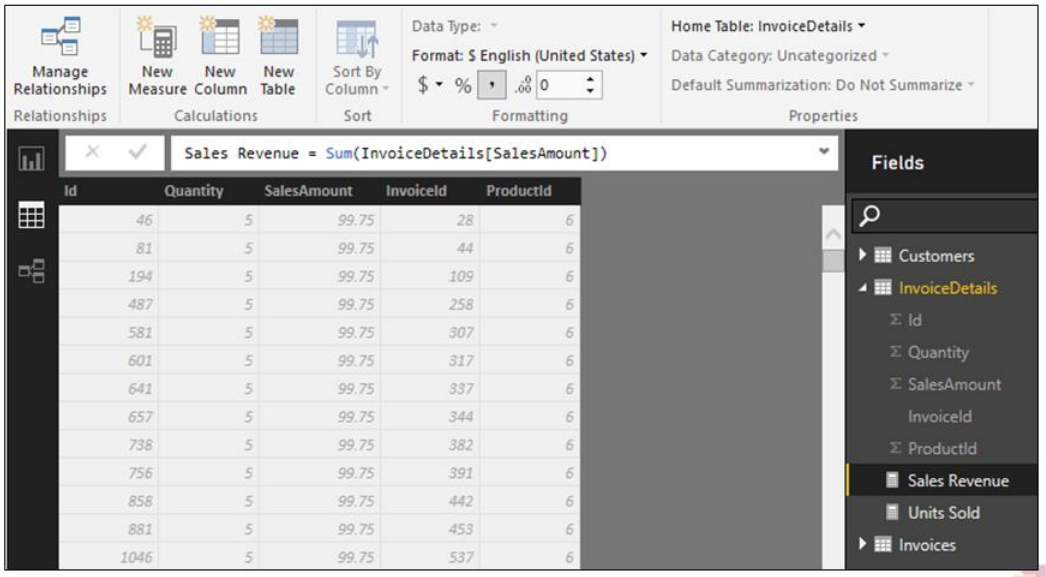
Creating Measures

- Measure defined as DAX expression with format settings



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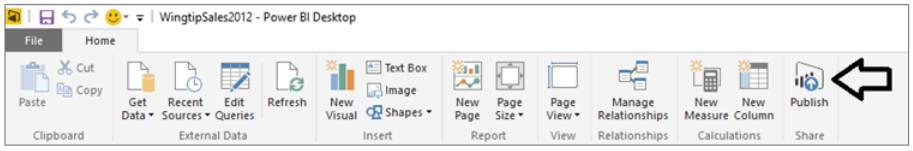
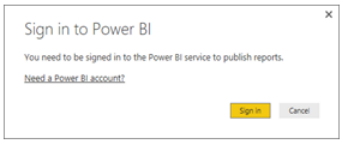
Publishing a Power BI Desktop Project

- Power BI Desktop provides **Publish** command
  - Used to publish project to Power BI service



  - Requires logging into your Office 365 account



  - Published articles added to your personal workspace

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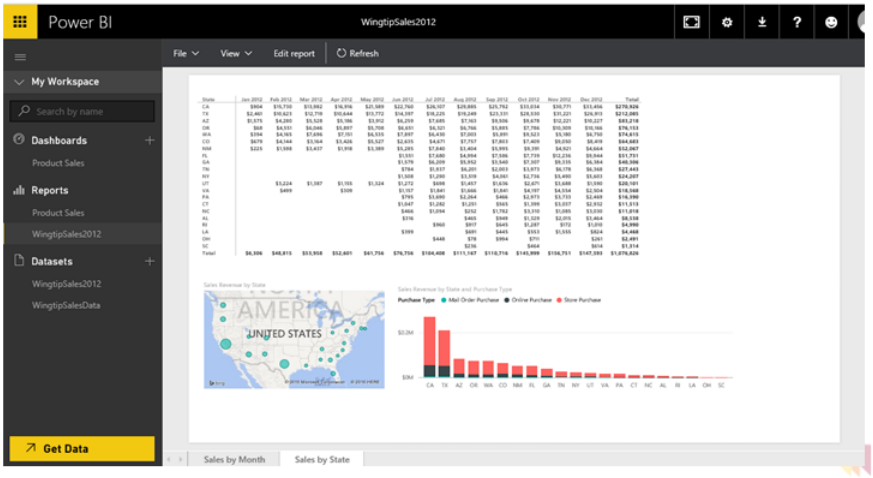
A Published Power BI Desktop Project



Module 02 Lab: Working with Power BI Desktop

Lab Time: 60 minutes

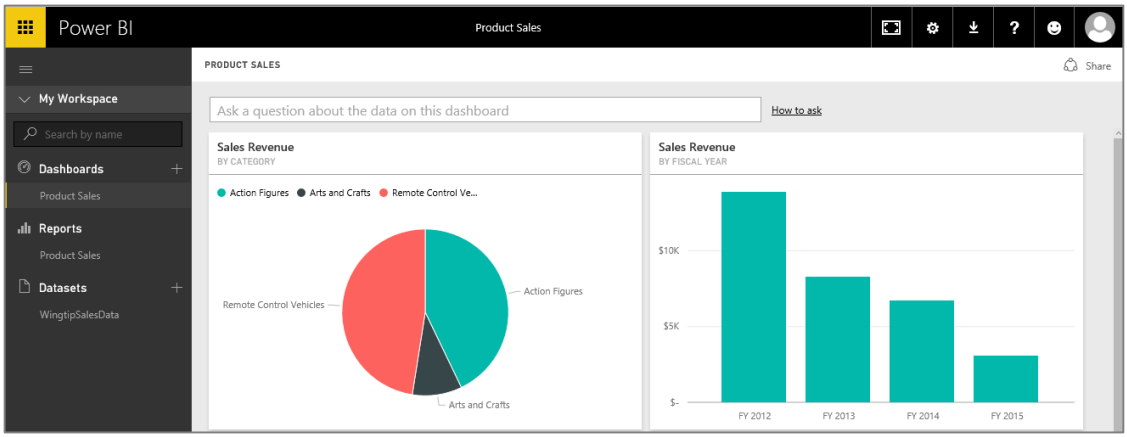
Lab Folder: C:\Student\Modules\PowerBIDesktop\Lab

Lab Overview: In this module you will learn how to install and begin working with Power BI Desktop. You will learn how to import data using Power Query to create a dataset and you will also learn how model the data within the dataset using Power Pivot. After modeling the data to make it better suited for analysis, you will create a report and publish it to the Power BI service.

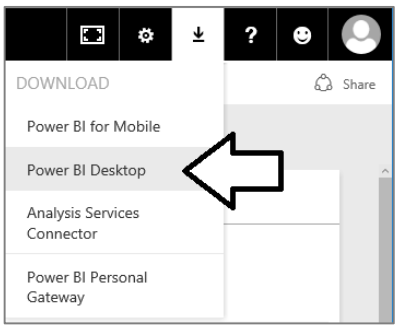
Exercise 1: Installing and Configuring Power BI Desktop

In this exercise you will download and install Power BI Desktop. Note that if Power BI desktop is already installed on your student workstation, you can move ahead to exercise 2.

1. Launch the browser and navigate to the landing page of the Power BI service at https://app.powerbi.com. Make sure you log on to the Power BI service using the primary Office 365 account you used to create the Office 365 tenancy and not the secondary user account you used at the end of the previous lab to test dashboard sharing. Inside your personal workspace, you should see the dataset, report and dashboard you created in the previous lab.



2. On the top right of the Power BI service window, drop down the **Downloads** menu and click the **Power BI Desktop** menu command to begin the download of the installation file.



3. Wait for the MSI file to download.

4. Once the file has downloaded, click the **Run** button to begin the installation of Power BI Desktop.

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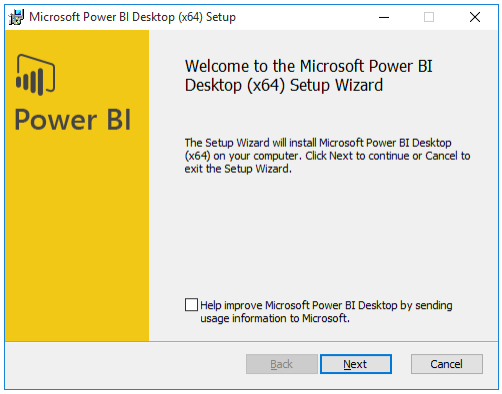
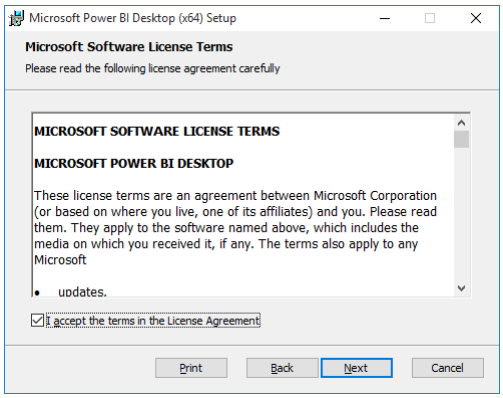
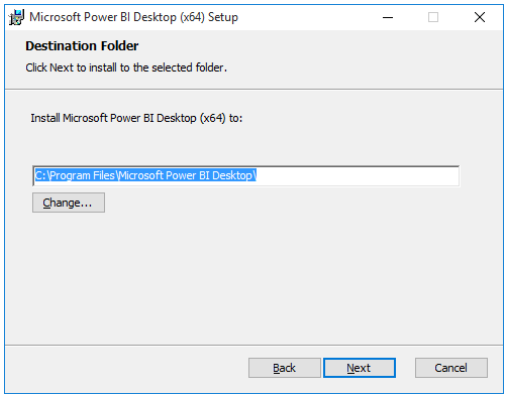
5. When you see the Welcome screen, click **Next** to continue with the installation.



6. Click the checkbox to accept the license agreement and click **Next**.



7. Accept the default location for the installation and click **Next**.



8. On the next screen, click **Install**.

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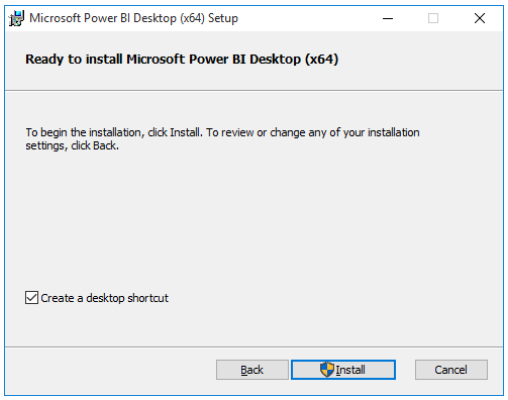
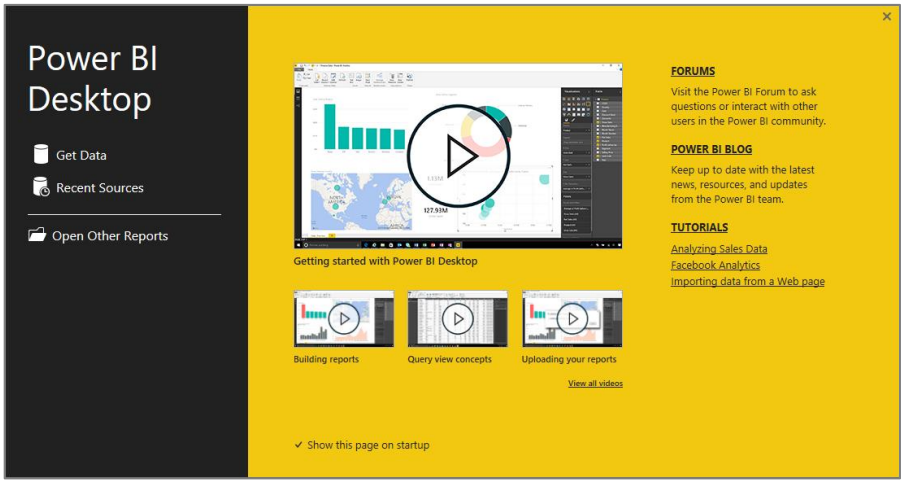


9. When you see the **Completed the Microsoft Power BI Desktop Setup Wizard** screen, click **Finish** to launch Power BI Desktop.

10. When Power BI Desktop launches for the first time, it displays a Welcome screen as shown in the following desktop. Click the (**X**) button in the upper right corner to close this window.



11. At this point, you should have Power BI Desktop running as shown in the following screenshot. You are now ready to move ahead to the next exercise.

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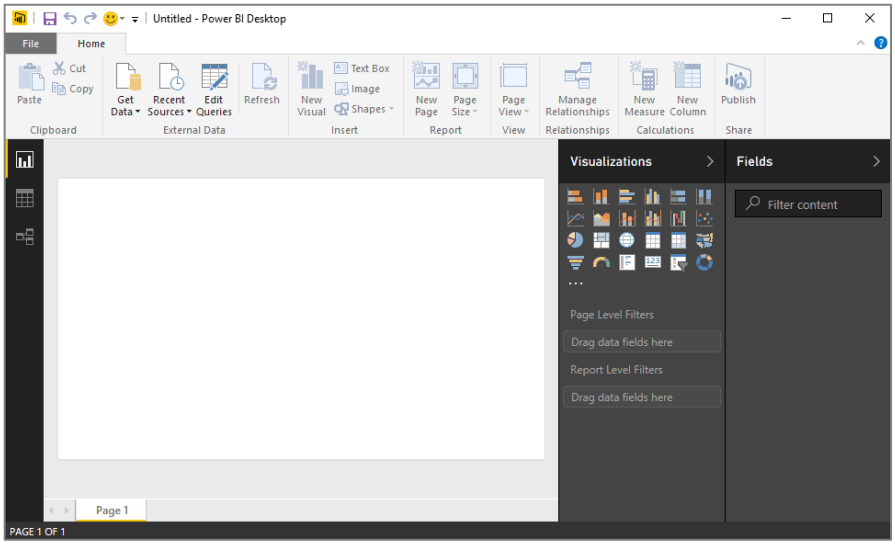
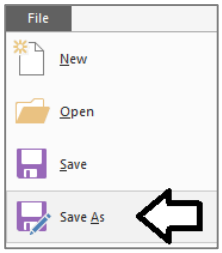


Exercise 2: Importing Data into Power BI Desktop using Power Query

In this exercise you will use Power BI Desktop to import sales data from three separate CSV files. Moving through the steps of this exercise will give you a chance to begin working with the Power Query features that are built into Power BI Desktop.

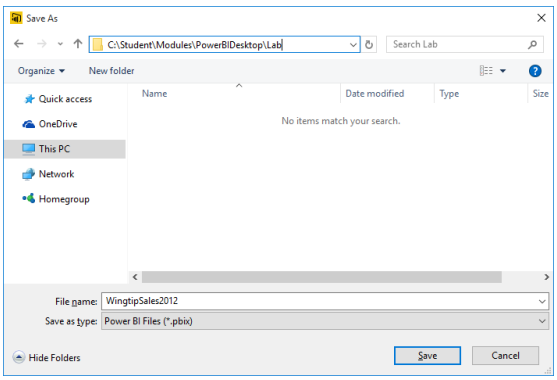
1. Open Power BI Desktop if it is not already open.
2. Power BI Desktop should now be open with a new and empty project.
3. Before beginning your work, save the empty project as a PBIX file.
   a) Drop down the **File** menu and click the **Save As** command.



   b) Save the PBIX file as **WingtipSales2012.pbix** using the following path location.

```
C:\Student\Modules\PowerBIDesktop\Lab\WingtipSales2012.pbix
```

   c) Click the **Save** button on the **Save As** dialog to save the PBIX file.



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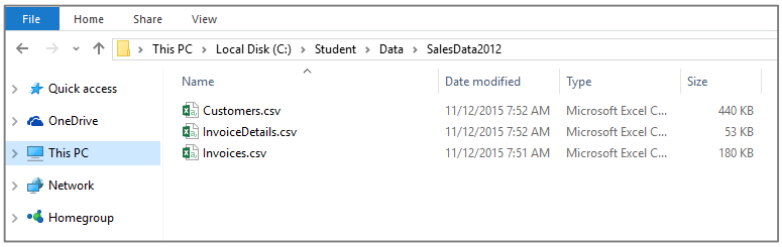
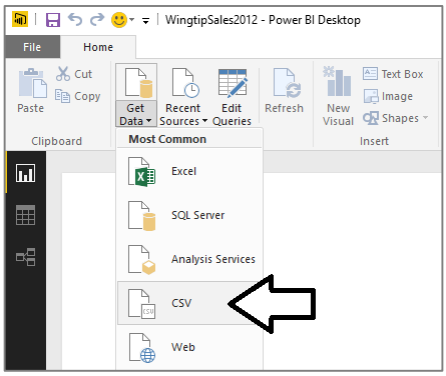
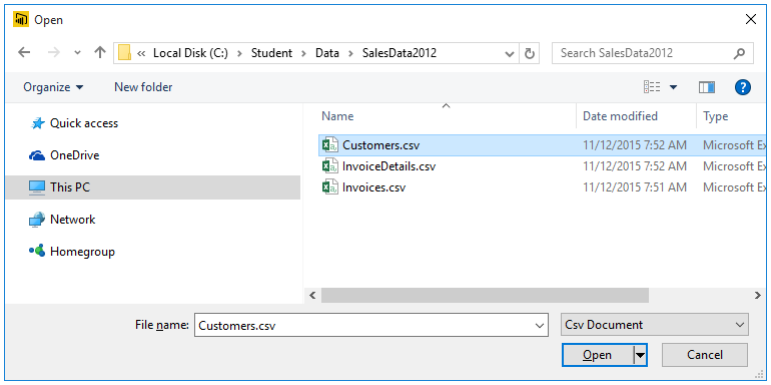
4. Using Windows Explorer, open the folder at **C:\Student\Data\SalesData2012** and examine what's inside. You should observe that there are three CSV files named **Customers.csv**, **Invoices.csv** and **InvoiceDetails.csv**. Over the next few steps, you will use these three files to import data into Power BI Desktop to create a new dataset.



5. Return to Power BI Desktop and examine the ribbon. Drop down the **Get Data** menu button and select the **CSV** command.



6. In the **Open** dialog, navigate to the folder at **C:\Student\Data\SalesData2012** and select the file named **Customers.csv**. Click the **Open** button in the bottom right of the dialog to begin the import process.



7. At this point you are presented with the **Customers.csv** dialog which displays a **Load** button, an **Edit** button and a **Cancel** button. Click the **Edit** button to view the data from **Customers.csv** in the Power Query Editor window.

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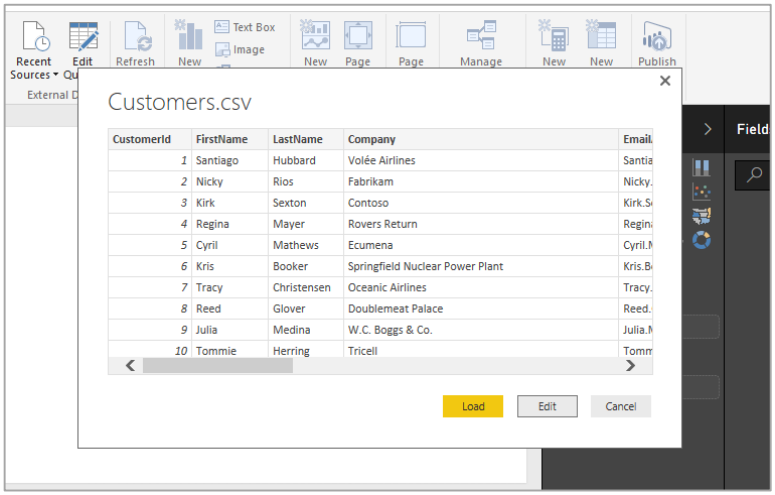
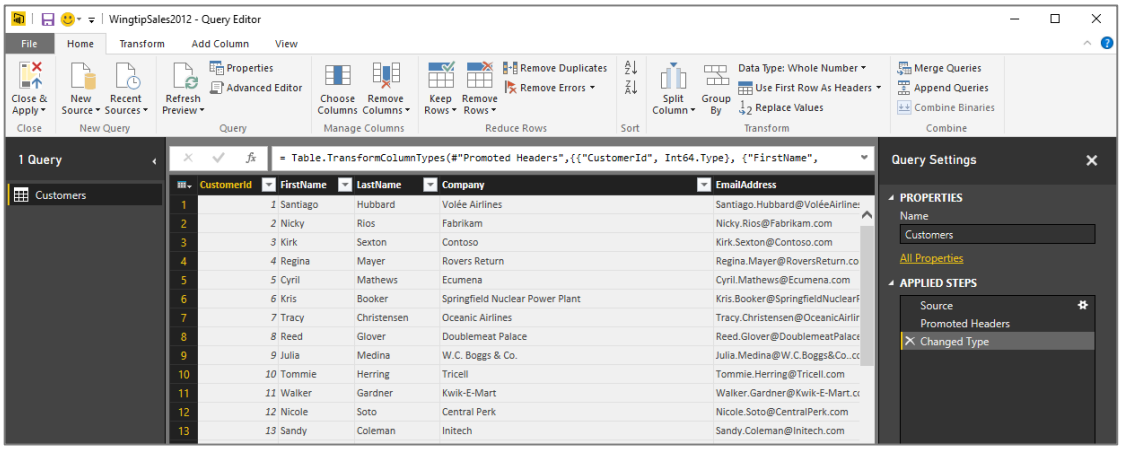
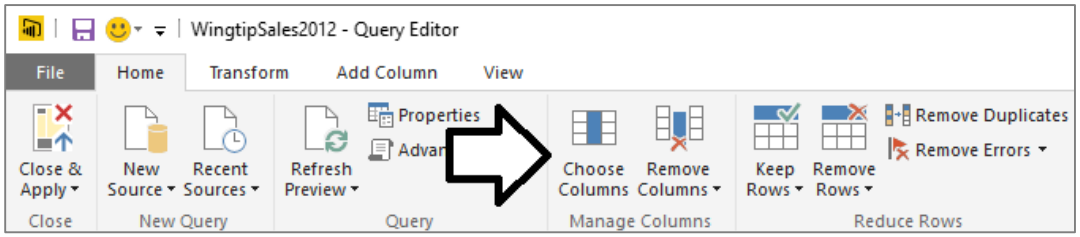


8. You should now be looking at the data from **Customers.csv** in the Query Editor window as shown in the following screenshot. If you examine the **Query Settings** task pane on the right-hand side, you can see that the query is named **Customers** and there are three steps in the **Applied Steps** list.



9. The **Customers** query contains several unneeded columns that will not be used to analyze sales data. In this step you will remove these unneeded columns to reduce the amount of data that is loaded into the data model.

   a) In the ribbon of the **Query Editor** window, click the **Choose Columns** button.



   b) In the **Choose Columns** dialog, begin be unselecting all columns.

   c) Select the columns named **CustomerId**, **City**, **State**, **ZipCode** and **Gender** as shown in the following dialog.

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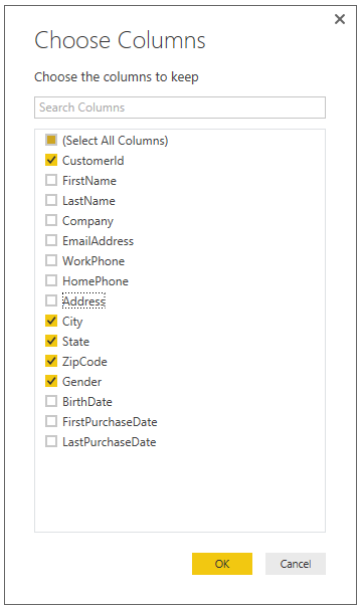
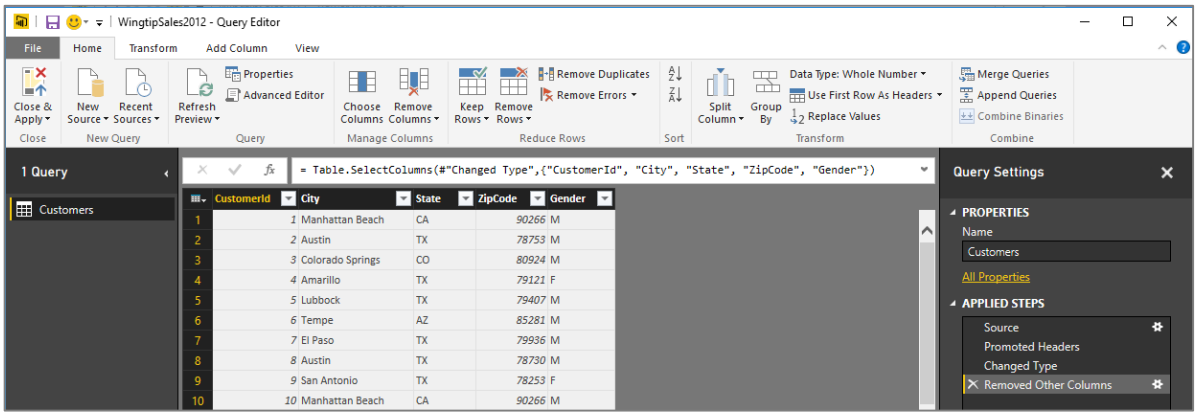
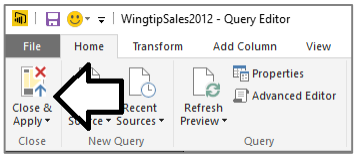


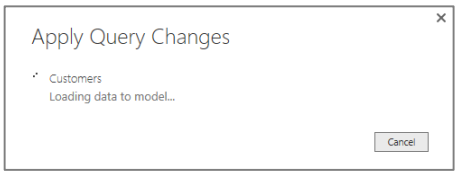
10. Once you have selected the desired columns, click the **OK** button to close the **Choose Columns** dialog. You should be able to observe that the Query Editor window now displays data for the columns you selected.



11. Now it's time to load the data from **Customer.csv** into the data model. Accomplish this by clicking the **Close & Apply** button in the ribbon of the Query Editor window to close the Query Editor window and import the data.



12. Power BI Desktop displays the **Apply Query Changes** dialog while it's executing the query and importing the data. Note that the **Apply Query Changes** dialog will close automatically after the data has been imported.



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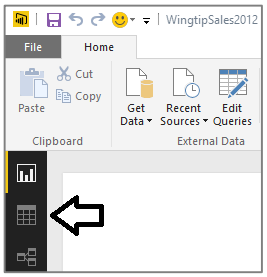
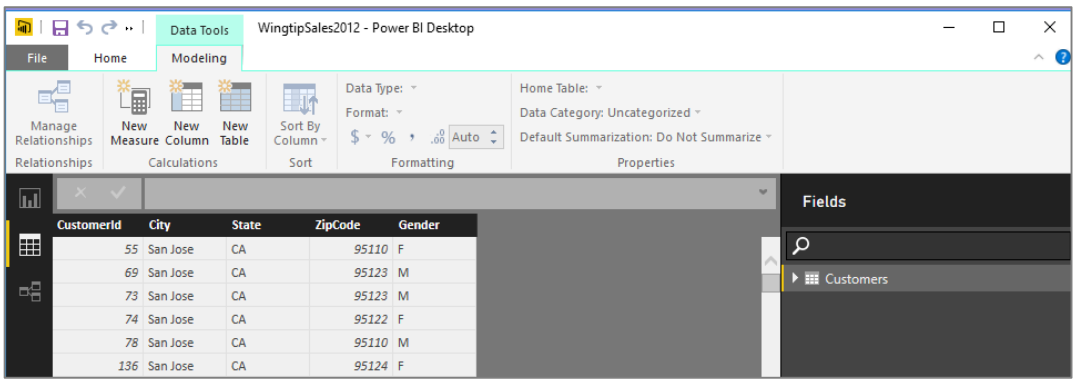
13. You should now be looking at the main window of Power BI Desktop in report view which displays a new and empty report. Locate the three buttons on the sidebar on the left-hand side of the screen. Click the button in the middle to move from report view to data view.

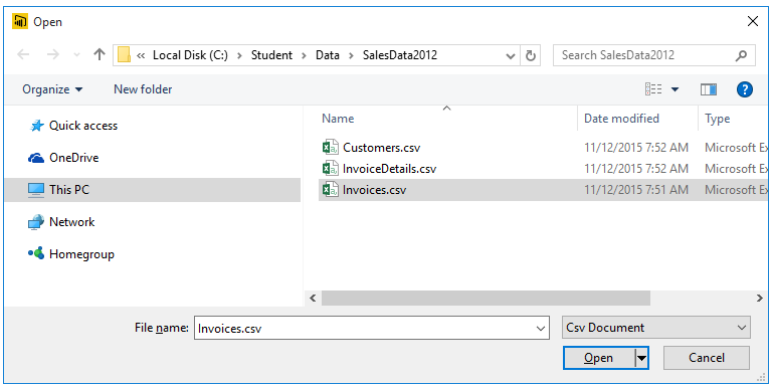


14. Once you have moved over to data view, you should be able to verify that the **Customers** table has been created. On the right side of the window, the **Fields** list shows the **Customers** table which is selected. The data from the **Customers** table is shown in a grid view in the middle of the screen.



You might observe that the data from the **Customers** table is not sorted in an intuitive fashion. For example, you might expect the default sort order to be the same as the underlying CSV file which orders customers by **CustomerId**. Instead, the table has a seemingly random sort order which is a side effect of the way data is stored in memory given the column-based nature of the tabular model. You can right-click the column header for the **CustomerId** column and run a command to sort the data in the table if it makes you feel better, but this action will not really have any effect because changes to the sort order are only temporary and they are not saved as part of the underlying data model.

15. You have imported one table into the data model. Now you will import a second table to get additional data on invoices.
    a) In the Ribbon of the Power BI Desktop window, select the **Home** tab.
    b) Drop down the **Get Data** menu button and select the **CSV** command.
    c) In the **Open** dialog, navigate to the folder at **C:\Student\Data\SalesData2012** and select the file named **Invoices.csv**.



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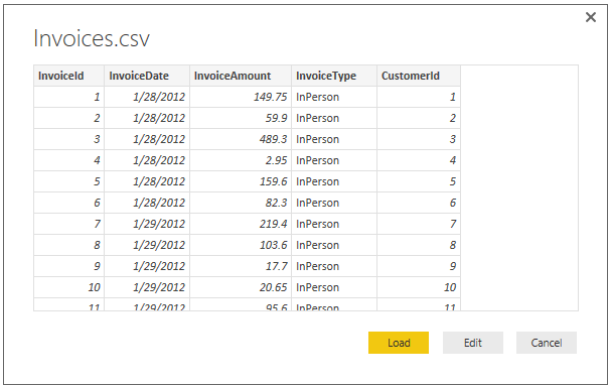
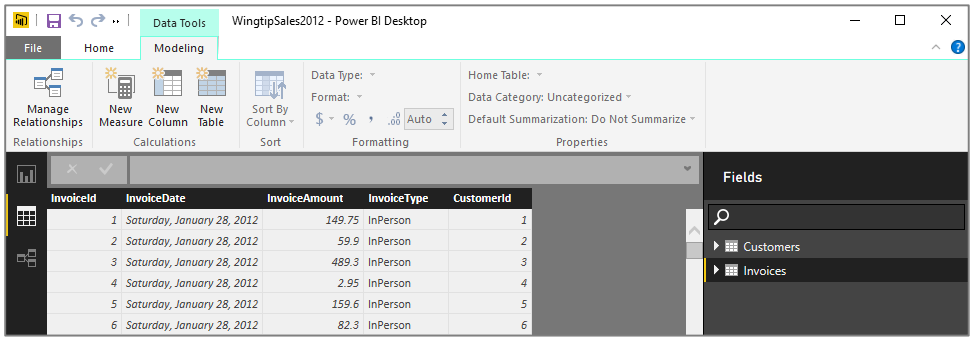
d) Click the **Open** button in the bottom right of the dialog to begin the import process.

e) In the **Invoices.csv** dialog, click the **Load** button to execute the query and import data to create the **Invoices** table.



InvoiceId	InvoiceDate	InvoiceAmount	InvoiceType	CustomerId
1	1/28/2012	149.75	InPerson	1
2	1/28/2012	59.9	InPerson	2
3	1/28/2012	489.3	InPerson	3
4	1/28/2012	2.95	InPerson	4
5	1/28/2012	159.6	InPerson	5
6	1/28/2012	82.3	InPerson	6
7	1/29/2012	219.4	InPerson	7
8	1/29/2012	103.6	InPerson	8
9	1/29/2012	17.7	InPerson	9
10	1/29/2012	20.65	InPerson	10
11	1/29/2012	95.6	InPerson	11

f) Make sure Power BI Desktop is in data view. You should be able to verify that the **Invoices** table has been created.



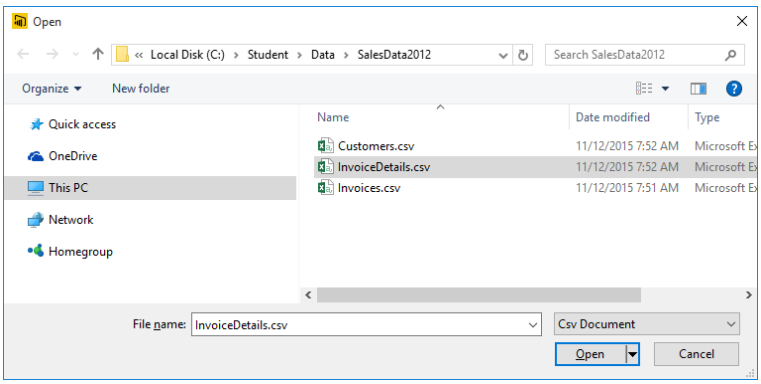
InvoiceId	InvoiceDate	InvoiceAmount	InvoiceType	CustomerId
1	Saturday, January 28, 2012	149.75	InPerson	1
2	Saturday, January 28, 2012	59.9	InPerson	2
3	Saturday, January 28, 2012	489.3	InPerson	3
4	Saturday, January 28, 2012	2.95	InPerson	4
5	Saturday, January 28, 2012	159.6	InPerson	5
6	Saturday, January 28, 2012	82.3	InPerson	6

16. Now, you will import one more table into the data model.

a) In the ribbon of the Power BI Desktop window, select the **Home** tab.

b) Drop down the **Get Data** menu button and select the **CSV** command.

c) In the **Open** dialog, navigate to the folder at **C:\Student\Data\SalesData2012** and select the file named **InvoiceDetails.csv**.



d) Click the **Open** button in the bottom right of the dialog to begin the import process.

e) In the **InvoiceDetails.csv** dialog, click **Load** to execute the query and import data to create the **InvoiceDetails** table.

f) After the import process completes, you should be able to verify that the **InvoiceDetails** table has been created.

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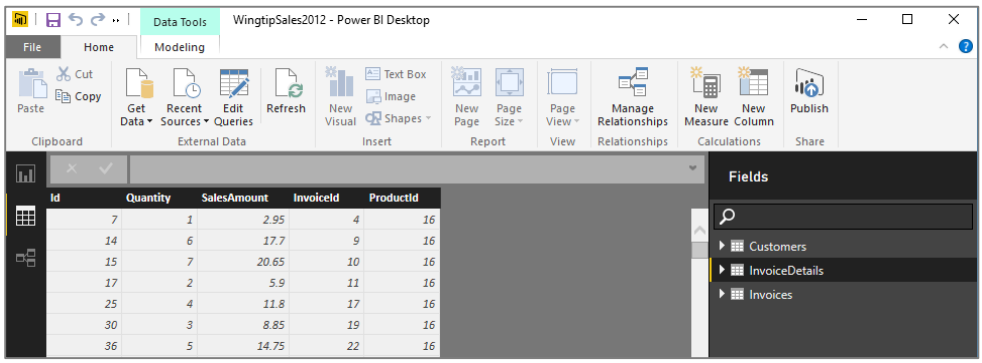
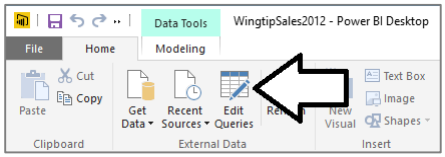
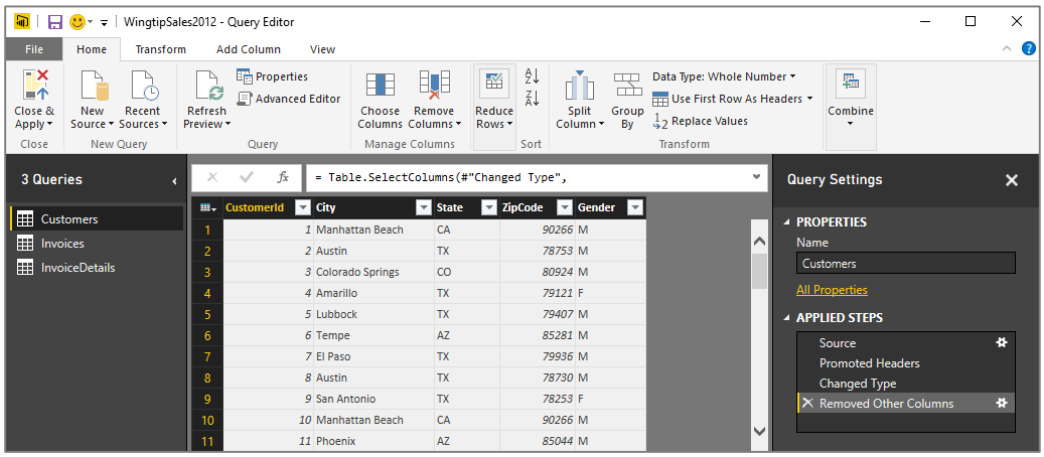


17. While you are done working with the query and data import aspects of Power BI Desktop for this particular lab exercise, it's still important that you know how to open and edit queries whenever it is required. You will now go through the steps to open the Query Editor window to see how to get back to query editing mode.

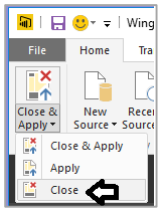
    a) In the ribbon of the Power BI Desktop window, click the **Edit Queries** button to open the Query Editor window.



    b) You should now see the Query Editor window displaying queries named **Customers**, **Invoices** and **InvoiceDetails** in the **Queries** list in the right-hand side of the screen. You can select any of these queries and continue to edit them if required. However, in this case there is no need to edit the queries any more.



    c) Close the Query Editor window by dropping down the **Close and Apply** menu button and clicking the **Close** command.



18. Save your work by clicking the Save button on the top left of the Power BI Desktop window.

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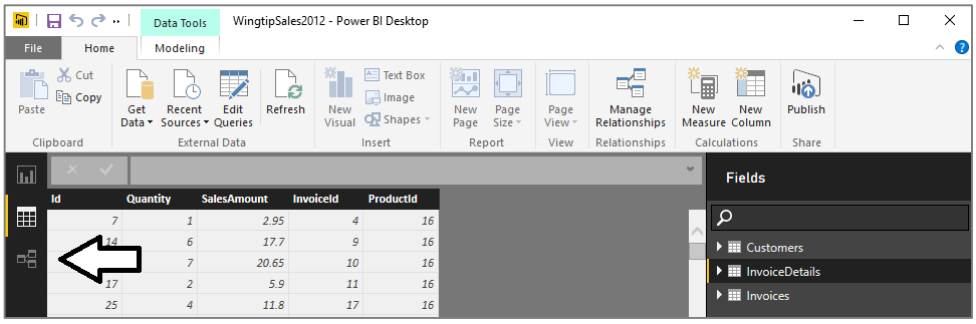
You have now finished importing data into your data model using Power Query. The next step is to begin modeling the data using the Power Pivot features of Power BI Desktop.

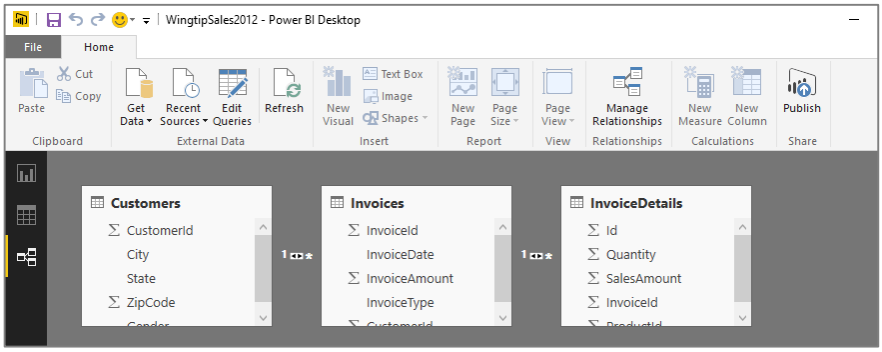
Exercise 3: Modeling Tables in a Dataset using Power Pivot

In this exercise you will begin to model the data in the dataset you have created using the Power Pivot features of Power BI Desktop. You will begin by ensuring the appropriate relationships have been created between the three tables in the data model. After that, you will extend the tables within the data model by adding calculated columns and measures.

1. Currently, the Power BI Desktop window should be displaying in data view. Click on the bottom button in the sidebar on the left-hand side of the screen to move to relationship view.

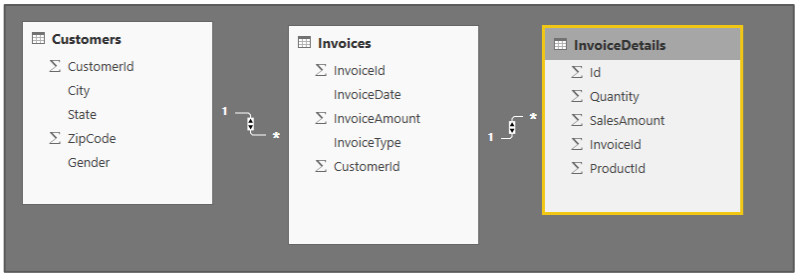


2. Once you navigate to relationship view, you should be able to see all three tables as shown in the following screenshot.



Note that Power BI desktop automatically created relationships between these tables because it determined that the **Customers** table and **Invoices** table both contain a common field named **CustomerId** and also that the **Invoices** tables and the **InvoicesDetails** table both contain a common field named **InvoiceId**.

3. Using the mouse, resize each of the three tables in relationship view so you can see all the fields in each one. Also space the tables out a bit so it is easier to see the relationships between them. You can see that these relationship are displayed using a line that starts with a **1** and end with a (*****) to indicate a one-to-many relationship.



4. Take a moment to inspect the relationships that have been created.

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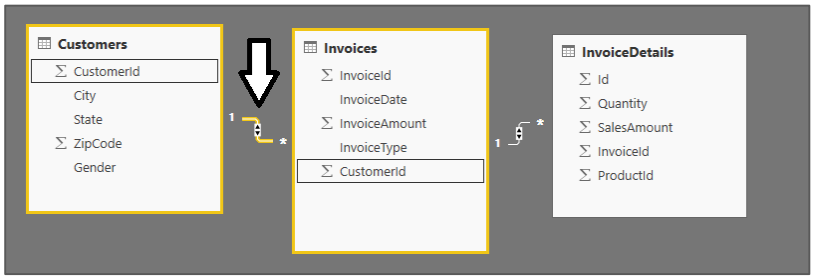
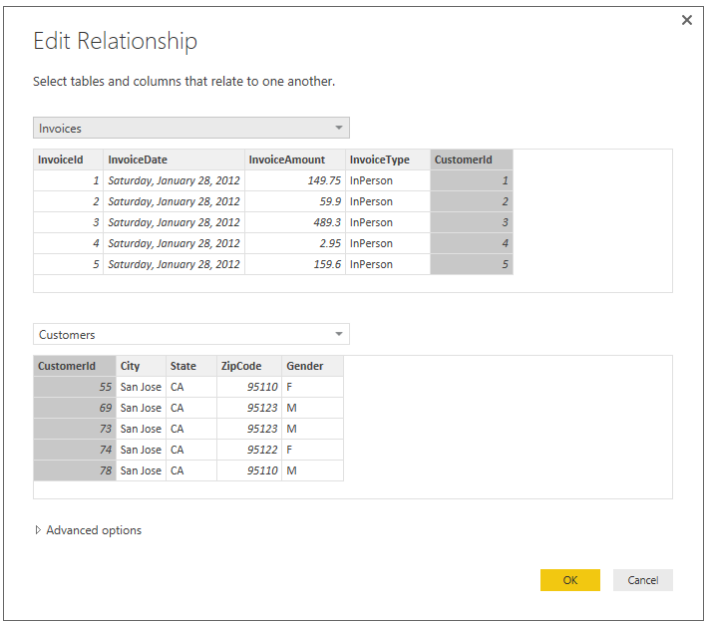
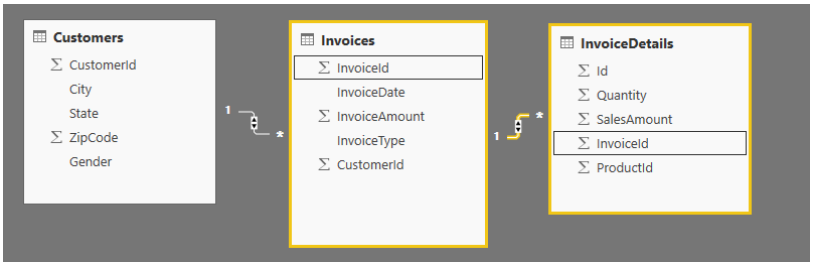
a) Click on the line that represents the relationship between the **Customers** table and the **Invoices** table. Once the relationship has been selected, you can see that the **CustomerId** field in each table becomes highlighted to indicate that those are the two fields used to define the one-to-many relationship.



b) Now, double-click on the line that represents the relationship between the **Customers** table and the **Invoices** table to display the **Edit Relationship** dialog. There is no need to change anything as you are just observing. Once you have seen what's inside this dialog, click the **OK** button to close it.



c) Click on the line that represents the relationship between the **Invoices** table and the **InvoiceDetails** table. When you do, you can see that the **InvoiceId** field in each table becomes highlighted to indicate that those are the two fields used to define the one-to-many relationship.



d) Now, double-click on the line that represents the relationship between the **Invoices** table and the **InvoiceDetails** table to display the **Edit Relationship** dialog. Once you have seen the dialog, click the **OK** button to close the dialog.

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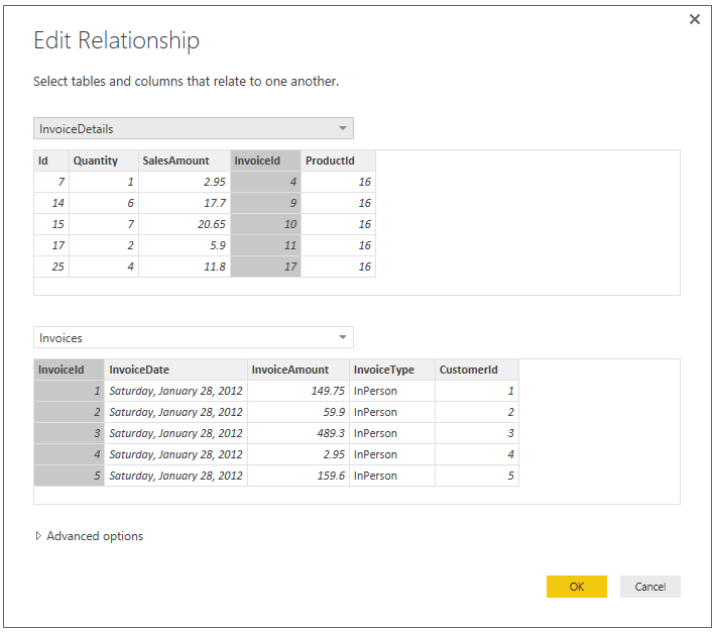
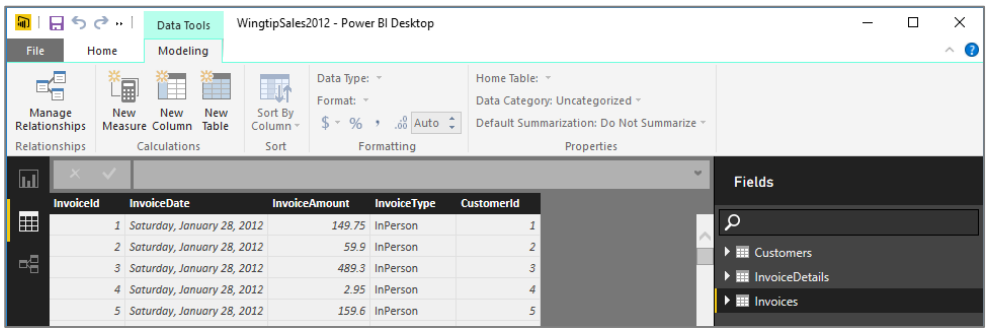
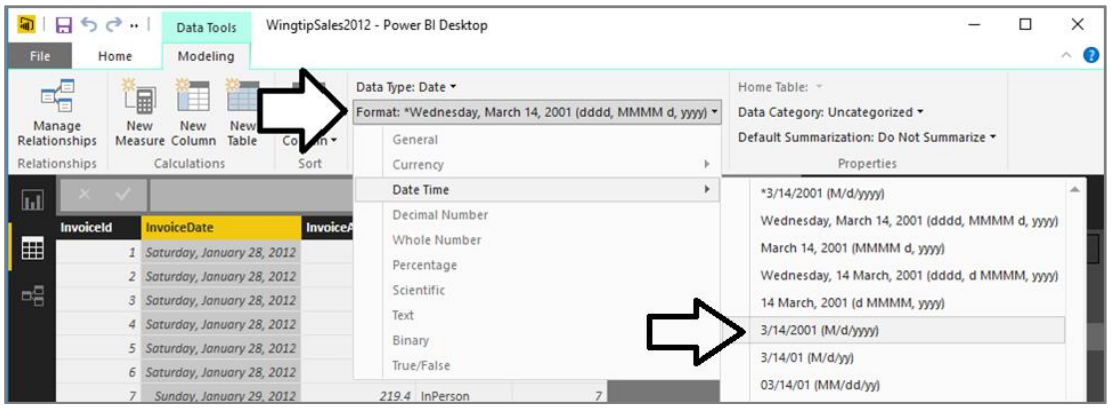


5. Modify the formatting on the **InvoiceDate** field of the **Invoices** table.
   a) Navigate back to data view and select the **Invoices** table from the **Fields** list.



   b) Select the **InvoiceDate** column by clicking its column header.
   c) Drop down the **Format** menu in the ribbon and select the date format of **3/14/2001 (M/d/yyyy)**.



   d) The data in the **InvoiceDate** field should now be display in the new format.

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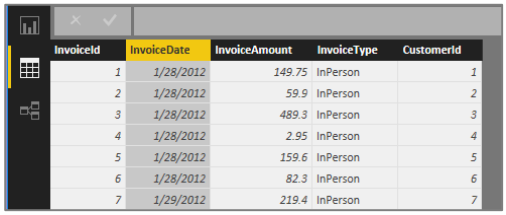
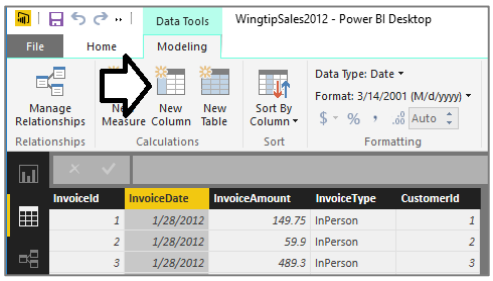
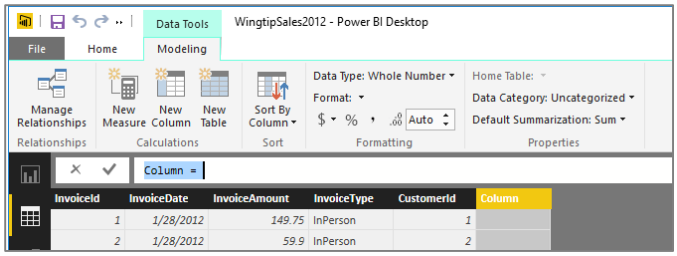


6. Add a new calculated column to the **Invoice** table to display the current month.
   a) Click the **New Column** button in the ribbon to create a new column.



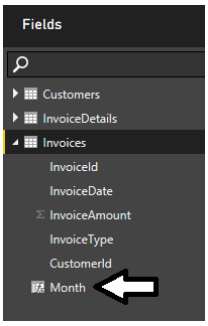
   b) The column is initially created with a generic name of **Column** and it has no formula in the formula bar.



   c) Give the new column a name of **Month** and provide a DAX formula for determining the month from the **InvoiceDate** column by replacing what's inside the formula bar with the following text. When you are done typing the formula, press the **Enter** key.

```
Month = FORMAT(Invoices[InvoiceDate], "MMM yyyy")
```

   d) At this point, you should be able to see the **Month** column in the **Fields** list. Note that the **Month** column is displayed with a special function icon (i.e. **Fx**) to indicate that it is a calculated column.



Now that you have created the **Month** column, you will be able to use it to display data on reports that is broken out by month. However, this can cause a sorting issue because month names will be sorted alphabetically by default. For example, February will be sorted before January which will cause confusion and produce strange results. In the next step you will create an extra column that will be used assist in sorting the Month column in a chronologic fashion which is what people expect.

7. Create an additional calculated column named **MonthSort** to supply the proper sorting behavior for the **Month** column.

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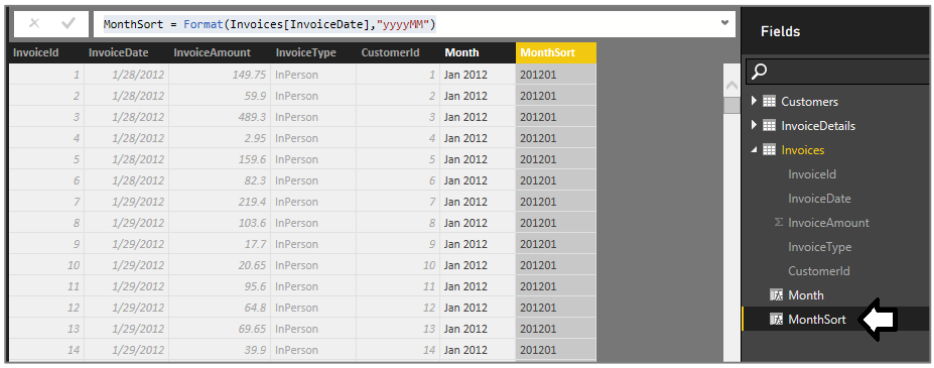
a) Click the **New Column** button in the ribbon to create a new column.

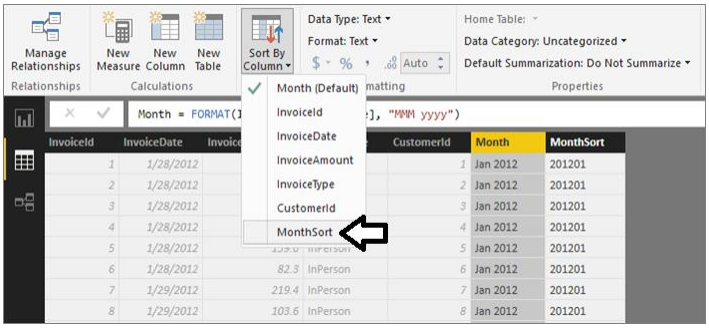
b) Give the new column a name of **MonthSort** and use the following DAX formula.

```
MonthSort = Format(Invoices[InvoiceDate],"yyyyMM")
```

c) Once you add the **MonthSort** column, you should be able to see it on the **Fields** list. You should also be able to see that the data in the **MonthSort** column contains a sortable text value which concatenates a 4-digit year value together with the 2-digit month value.



d) Now it is time to configure the **Month** column to use **MonthSort** as its sort column. Begin by clicking on the column header of the **Month** column to select it. Next, drop down the **Sort By Column** button and select the **MonthSort** column.



8. Create a calculated column named **Purchase Type** to provide a more human readable value for the **InvoiceType** column.

a) Click the **New Column** button in the ribbon to create a new column.

b) Given the new column a name of **Purchase Type** using the following formula.

```
Purchase Type =
  SWITCH(Invoices[InvoiceType],
   "InPerson", "Store Purchase",
   "MailOrder", "Mail Order Purchase",
   "Online", "Online Purchase"
  )
```

c) Note that you can expand the height of the formula bar by clicking the downward facing button on the right-hand side. This will make it much easier to write multi-line DAX expressions which are far more readable and also more maintainable. Also remember that you can add a line break into a DAX formula by holding down the **SHIFT** key and then pressing the **ENTER** key. Once you have typed in the DAX formula for the **Purchase Type** field, press the **Enter** key.

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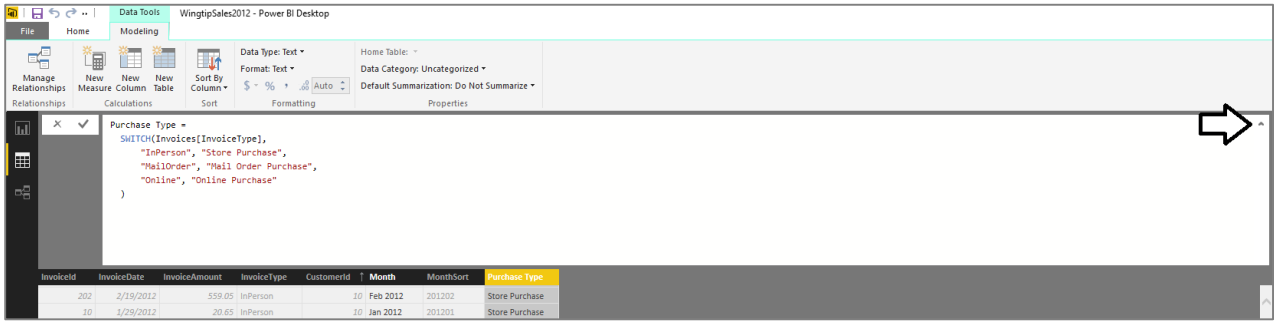
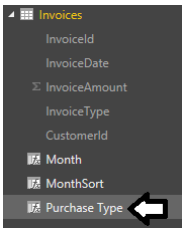


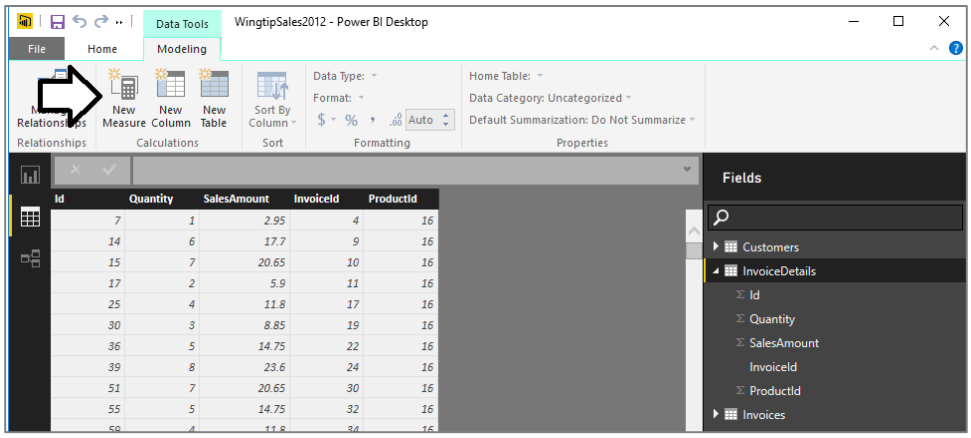
d) At this point, you should be able to see the **Purchase Type** column in the **Fields** list.



e) Inspect the values in the **Purchase Type** column to see the effect of the DAX formula you have written.

InvoiceId	InvoiceDate	InvoiceAmount	InvoiceType	CustomerId	Month	MonthSort	Purchase Type
5220	12/31/2012	25.85	InPerson	2653	Dec 2012	201212	Store Purchase
5219	12/31/2012	319.3	InPerson	2652	Dec 2012	201212	Store Purchase
5218	12/31/2012	162.6	InPerson	2651	Dec 2012	201212	Store Purchase
5217	12/31/2012	183.6	InPerson	2650	Dec 2012	201212	Store Purchase
5216	12/31/2012	114.6	InPerson	2649	Dec 2012	201212	Store Purchase
5215	12/31/2012	59.8	InPerson	2648	Dec 2012	201212	Store Purchase
5214	12/31/2012	41.8	InPerson	2647	Dec 2012	201212	Store Purchase

9. Add a measure to the **InvoiceDetails** table to calculate total sales revenue.
   a) Select the **InvoiceDetails** table by clicking on it in the **Fields** list.
   b) Click the **New Measure** button in the ribbon to create a new measure.



c) Create a new measure named **Sales Revenue** using the following DAX formula. Once you have typed the formula into the formula bar, press the **Enter** key to create the new measure.

```
Sales Revenue = Sum(InvoiceDetails[SalesAmount])
```

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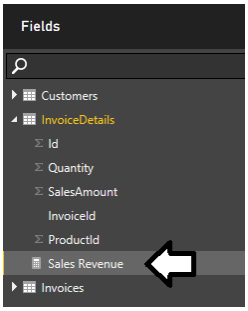
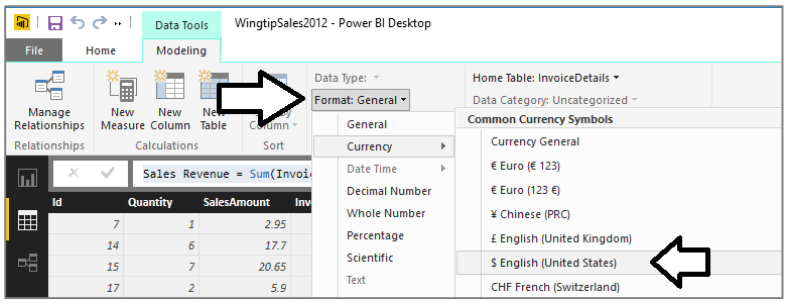
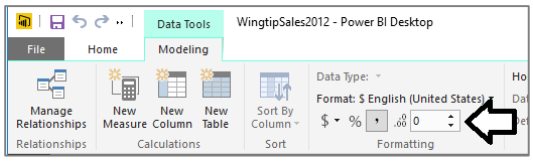
d) At this point you should be able to see the **Sales Revenue** measure in the **InvoiceDetails** table in the **Fields** list. Note that the **Sales Revenue** field is displayed with a special calculator icon to indicate that it is a measure.



e) Make sure the **Sales Revenue** measure is still selected in the **Fields** list. Modify the formatting of this measure by dropping down the **Format** menu on the ribbon and selecting a format type of **Currency > English (United States)**.



f) Enhance the formatting of the **Sales Revenue** column by reducing the number of decimal places shown from **2** to **0**.



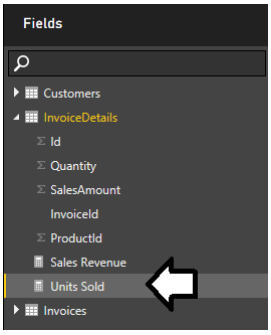
10. Create a second measure in the **InvoiceDetails** table to calculate the total number of units sold.

a) Click the **New Measure** button in the ribbon to create a new measure.

b) Create a new measure named **Units Sold** using the following DAX formula. Once you have type the formula into the formula bar, press the **Enter** key to create the new measure.

```
Units Sold = SUM(InvoiceDetails[Quantity])
```

c) You should be able to see the new **Units Sold** measure in the **Fields** list.



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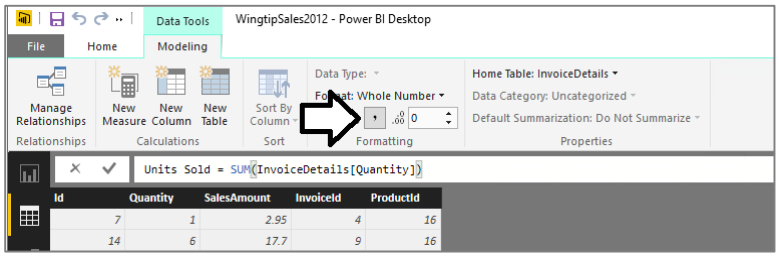
d) Make sure the **Units Sold** measure is selected in the **Fields** list and modify the formatting by clicking and selecting the button on the ribbon with the comma which adds a thousands separator so larger numbers are formatted with commas (e.g. 2,500).

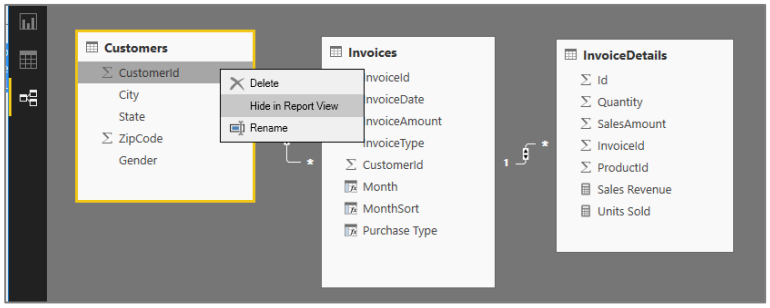


You are now done adding calculated columns and measures. You will now complete you modeling work by hiding fields that do not need to be seen when designing reports.

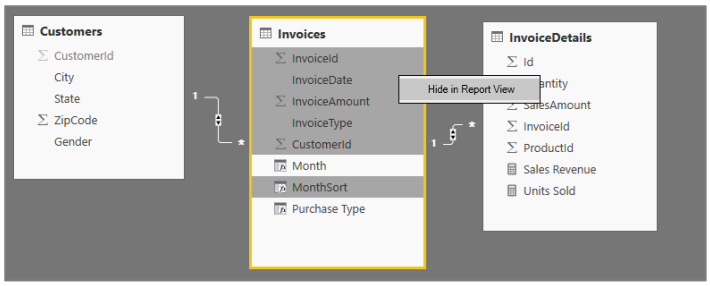
11. Hide all the fields that are not needed when designing reports.

a) Navigate to relationship view.

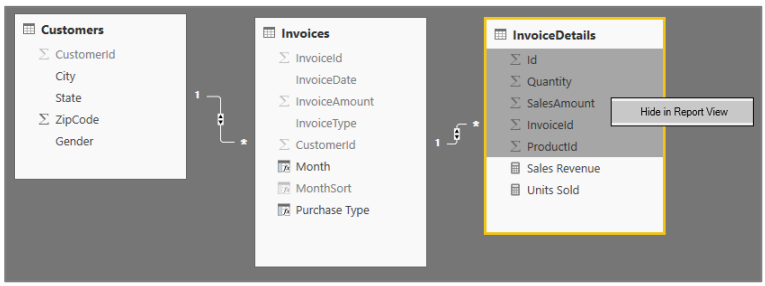
b) Right-click on the **CustomerId** field in the **Customers** table and click the **Hide in Report View** command.



c) Hold down the **Ctrl** key and select all the fields in the **Invoices** table except for the **Month** column and the **Purchase Type** column. Once you have the correct fields selected, right-click the selection and then click the **Hide in Report View** command.



d) Hold down the **Ctrl** key and select all the fields in the **InvoiceDetails** table except for the **Sales Revenue** measure and the **Units Sold** measure. Once you have the correct fields selected, right-click the selection and then click the **Hide in Report View** command.



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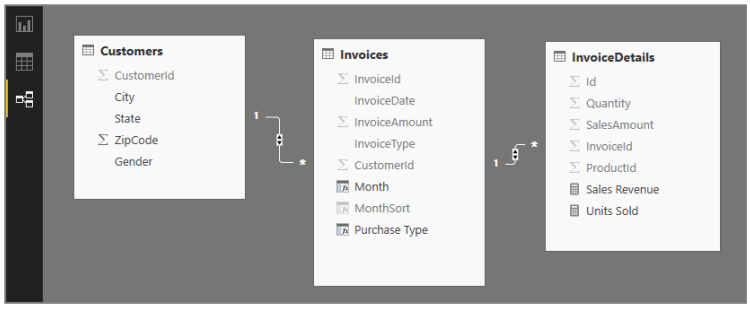
e) The tables in relationship view should appear as they do in the following screenshot. You are now done modeling the data.

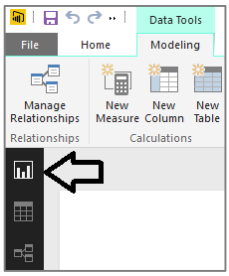


12. Save your work by clicking the **Save** button on the top left of the Power BI Desktop window.

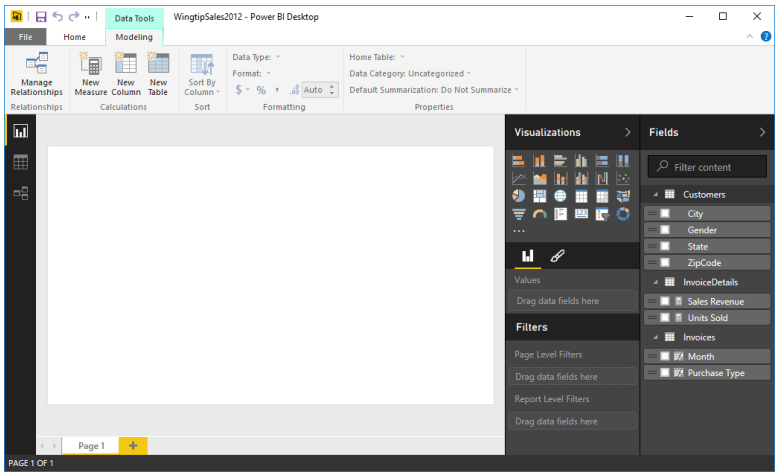
Exercise 4: Create a Report using Power BI Desktop

In this exercise you will design a report with two pages of visualizations using the data model you created in the previous exercise.

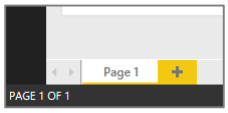
1. Make sure you still have the **Wingtipsales2012.pbix** file open that you created in the previous exercise.
2. Click on the top bottom in the sidebar to place Power BI Desktop into report view.



3. At this point, you should see the default report which contain an empty page named **Page 1**.



4. Change the title of the report's one and only page.
   a) Locate page title with a default value of **Page 1** on the bottom left corner of the report and double-click on it to edit its value.



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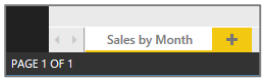
b) Modify the page title to **Sales by Month** and press the **Enter** key to enter your changes

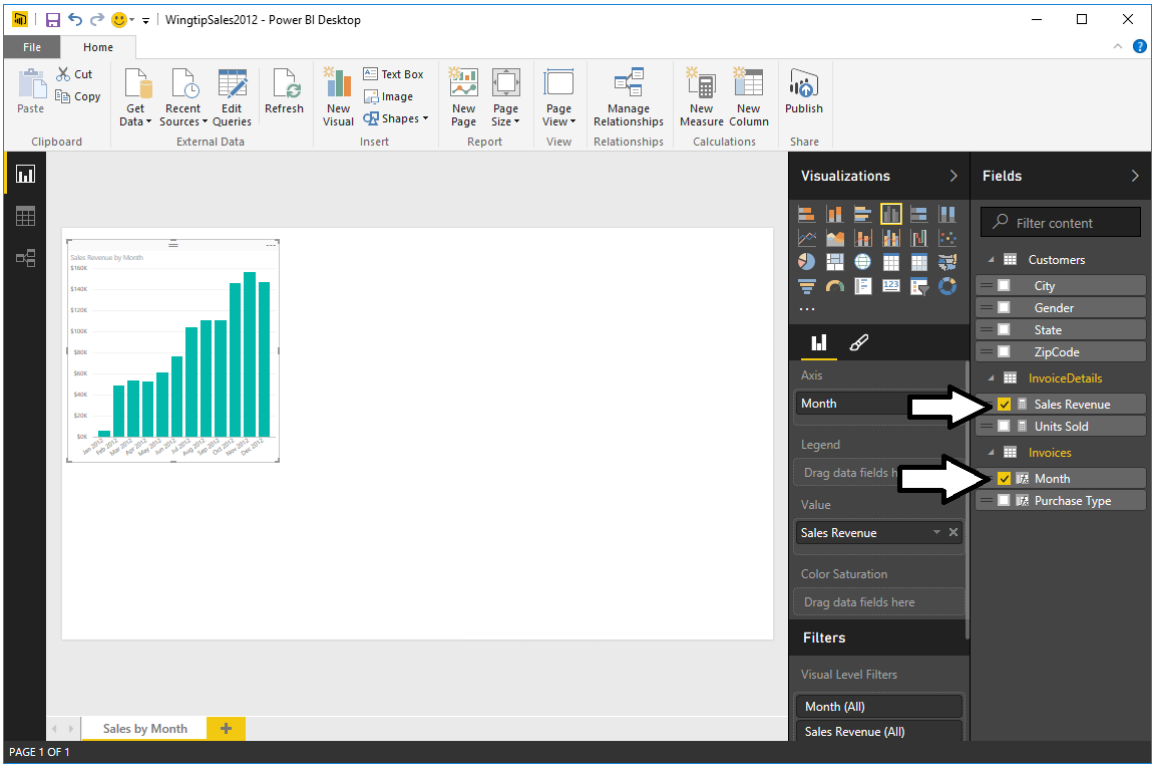


5. Add a new visualization to display sales revenue by month.

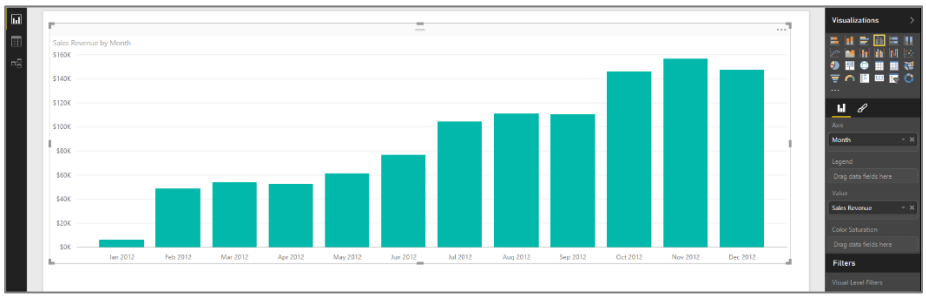
a) At this point the **Sales by Month** page should be empty without any visualizations.

b) In the **Fields** list, click the checkbox to select the **Sales Revenue** measure. Note that this action will add a new visualization to the page based on a clustered bar chart.

c) Next, click the checkbox to select the **Month** column which will automatically add that column into the **Axis** well and produce a bar chart like the one shown in the following screenshot.



d) Use the mouse to grab the lower right corner of the visualization and resize it so it takes up the full width of the page.



e) Ensure that the visualization is still selected. Click the **Line Chart** button in the **Visualizations** list to change the visualization type to display it as a line chart.

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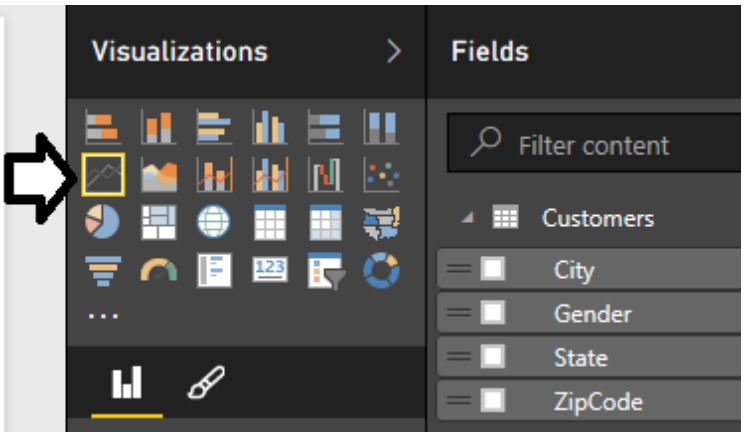
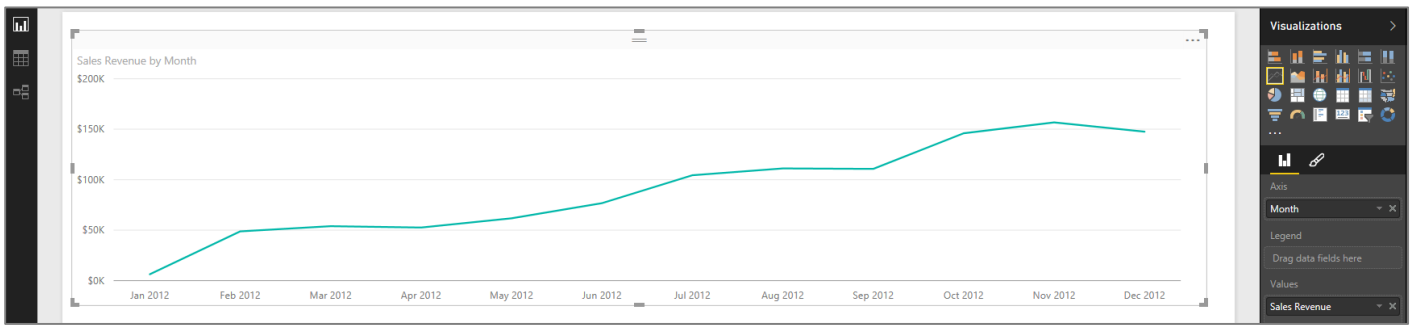
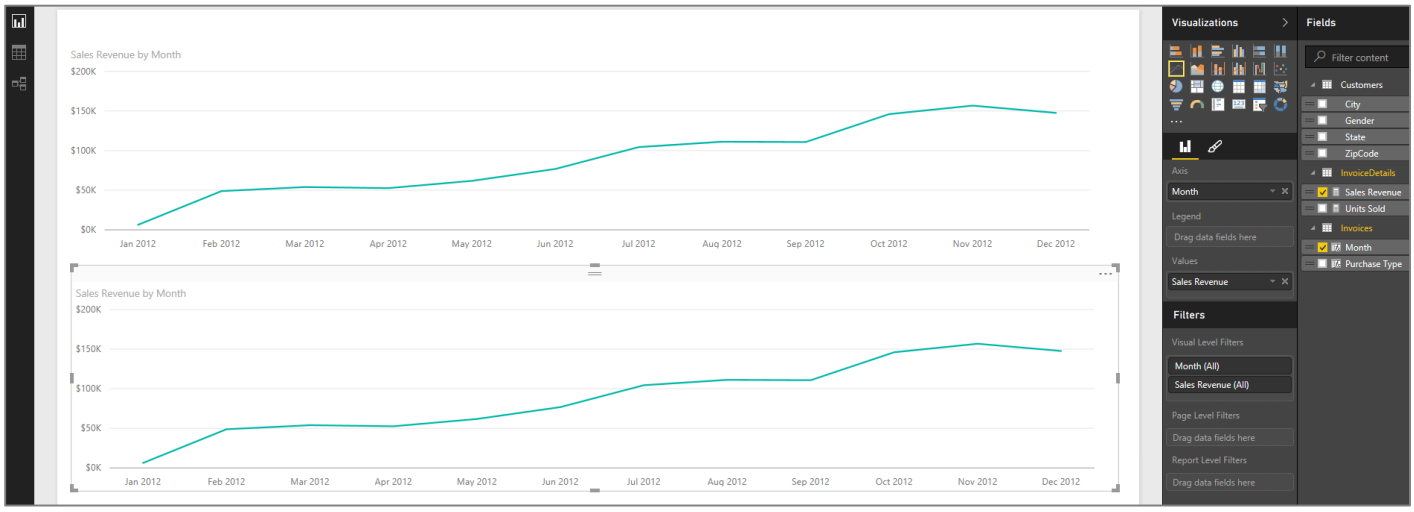


f) The visualization should now appear as a line chart like the one shown in the following screenshot.



6. Create a second visualization to display sales revenue by month and gender.
   a) Select the visualization you created in the previous step and copy it to the Windows clpipboard.
   b) Use the Paste command to clone a copy of the first visualization.
   c) Use the mouse to move the second visualization so it appears under the first visualization.



   d) Make sure the bottom visualization is selected.
   e) Locate the **Gender** field in the **Fields** list.

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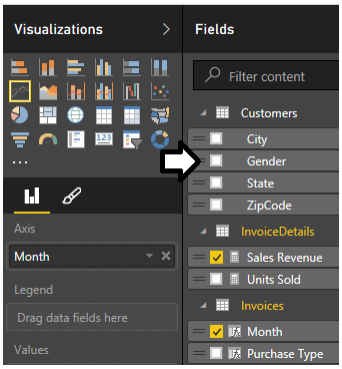
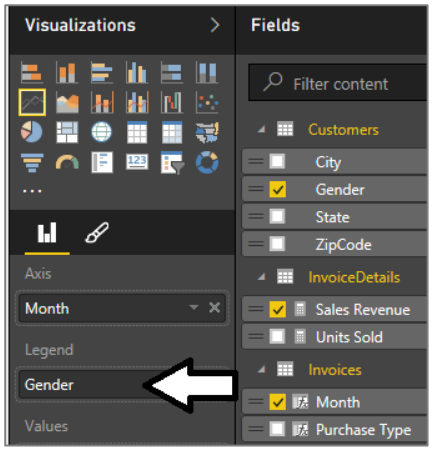
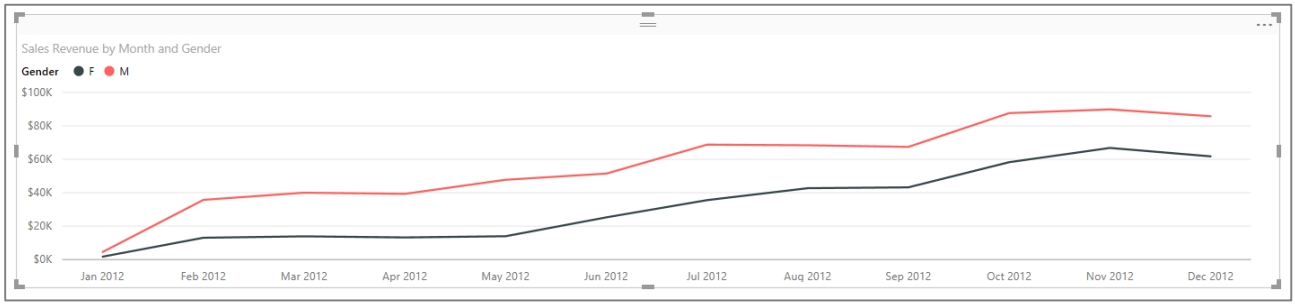


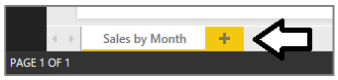
f) Using the mouse, drag the **Gender** field from the **Fields** list and drop it into the **Axis** well in the **Visualizations** pane.



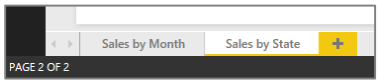
g) The bottom visualization should now appear as the one shown in the following screenshot.



7. Save your work by clicking the **Save** button on the top left of the Power BI Desktop window.
8. Add a second page to the report.
   a) Click the (**+**) button in the bottom left corner of report view to add a second page to the report.



   b) Once the page has been created, modify its title to **Sales by States**.



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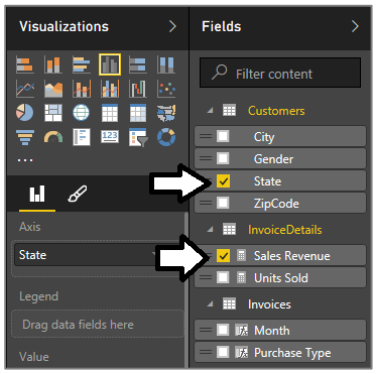
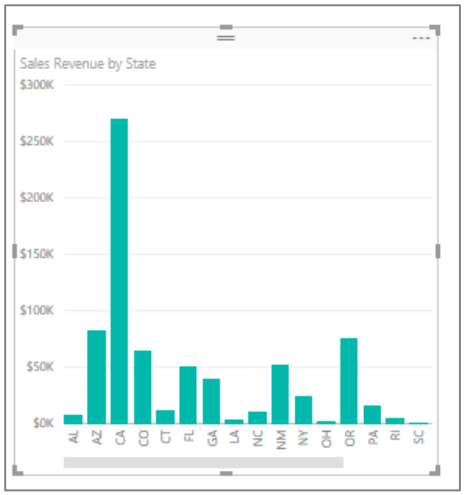
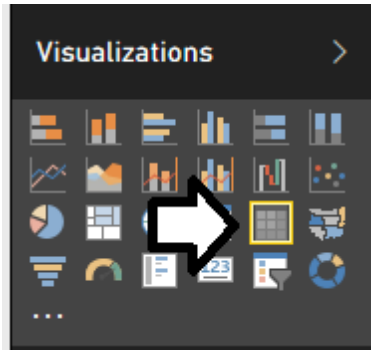
9. Add a new visualization to the **Sales by States** page to display numeric data in a matrix.
   a) In the **Fields** list, select the **Sales Revenue** measure to create a new clustered bar chart visualization.
   b) Next, select the **State** column.



   c) At this point, your visualization should appear like the one shown in the following screenshot.



   d) Change the visualization type by clicking the **Matrix** button in the **Visualizations** list.



   e) The visualization should now display numeric data in a tabular format as shown in the following screenshot.

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State	Sales Revenue
AL	$8,538
AZ	$83,218
CA	$270,926
CO	$64,683
CT	$11,513
FL	$51,731
GA	$40,306
LA	$4,468
NC	$11,018
NM	$52,067
NY	$24,207
OH	$2,491
OR	$76,153
PA	$16,390
RI	$4,990
SC	$1,314
TN	$27,443
TX	$212,085
UT	$20,101

f) Click on the column header of the **Sales Revenue** column to resort the rows within the visualization so that the states with the largest amounts of sales revenue are sorted towards the top.

State	Sales Revenue
CA	$270,926
TX	$212,085
AZ	$83,218
OR	$76,153
WA	$74,615
CO	$64,683
NM	$52,067
FL	$51,731
GA	$40,306
TN	$27,443
NY	$24,207
UT	$20,101
VA	$18,568
PA	$16,390
CT	$11,513
NC	$11,018
AL	$8,538
RI	$4,990
LA	$4,468
OH	$2,491
SC	$1,314
Total	**$1,076,826**

g) In the **Fields** list, locate the **Month** column.

h) Using the mouse, drag the **Month** field from the **Fields** list and drop it into the **Columns** well in the **Visualizations** pane.

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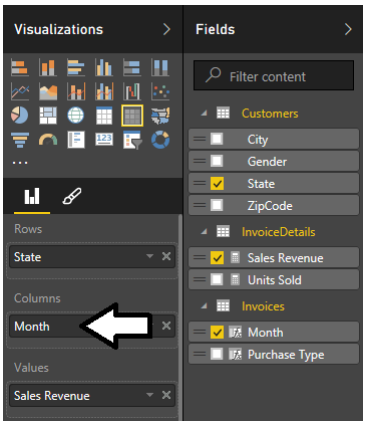


i) You should now see the visualization expand to the right to display a column for each month.

j) Using the mouse, resize the visualization to display all of its contents.

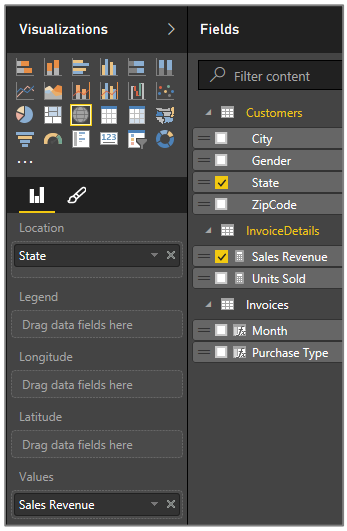
State	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	Oct 2012	Nov 2012	Dec 2012	Total
CA	$904	$15,730	$13,982	$16,916	$21,589	$22,760	$26,107	$29,885	$25,792	$33,034	$30,771	$33,456	**$270,926**
TX	$2,461	$10,623	$12,719	$10,644	$13,772	$14,397	$18,225	$19,249	$23,331	$28,530	$31,221	$26,913	**$212,085**
AZ	$1,575	$4,280	$5,528	$5,186	$3,912	$6,259	$7,685	$7,163	$9,506	$9,678	$12,221	$10,227	**$83,218**
OR	$68	$4,551	$6,046	$5,897	$5,708	$6,651	$6,321	$6,766	$5,885	$7,786	$10,309	$10,166	**$76,153**
WA	$394	$4,165	$7,696	$7,151	$6,535	$7,897	$6,430	$7,003	$5,891	$9,523	$5,180	$6,750	**$74,615**
CO	$679	$4,144	$3,164	$3,426	$5,527	$2,635	$4,671	$7,757	$7,803	$7,409	$9,050	$8,419	**$64,683**
NM	$225	$1,598	$3,437	$1,918	$3,389	$5,285	$7,840	$3,404	$5,995	$9,391	$4,921	$4,664	**$52,067**
FL						$1,551	$7,680	$4,994	$7,586	$7,739	$12,236	$9,944	**$51,731**
GA						$1,579	$6,209	$5,952	$3,540	$7,307	$9,335	$6,384	**$40,306**
TN						$784	$1,937	$6,201	$2,003	$3,973	$6,178	$6,368	**$27,443**
NY						$1,508	$1,290	$3,519	$4,061	$2,736	$5,490	$5,603	**$24,207**
UT		$3,224	$1,387	$1,155	$1,324	$1,272	$698	$1,457	$1,636	$2,671	$3,688	$1,590	**$20,101**
VA		$499		$309		$1,157	$1,841	$1,666	$1,841	$4,197	$4,554	$2,504	**$18,568**
PA						$795	$3,690	$2,264	$466	$2,973	$3,733	$2,469	**$16,390**
CT						$1,047	$1,282	$1,251	$565	$1,399	$3,037	$2,932	**$11,513**
NC						$466	$1,094	$252	$1,782	$3,310	$1,085	$3,030	**$11,018**
AL						$316		$465	$949	$1,329	$2,015	$3,464	**$8,538**
RI							$960	$917	$645	$1,287	$172	$1,010	**$4,990**
LA						$399		$691	$445	$553	$1,555	$824	**$4,468**
OH							$448	$78	$994	$711		$261	**$2,491**
SC								$236		$464		$614	**$1,314**
Total	**$6,306**	**$48,815**	**$53,958**	**$52,601**	**$61,756**	**$76,756**	**$104,408**	**$111,167**	**$110,716**	**$145,999**	**$156,751**	**$147,593**	**$1,076,826**

10. Add a second visualization to display a map visualization which shows how sales revenue is distributed across states.

a) Click on the white space below the matrix visualization to make sure no visualization is selected.

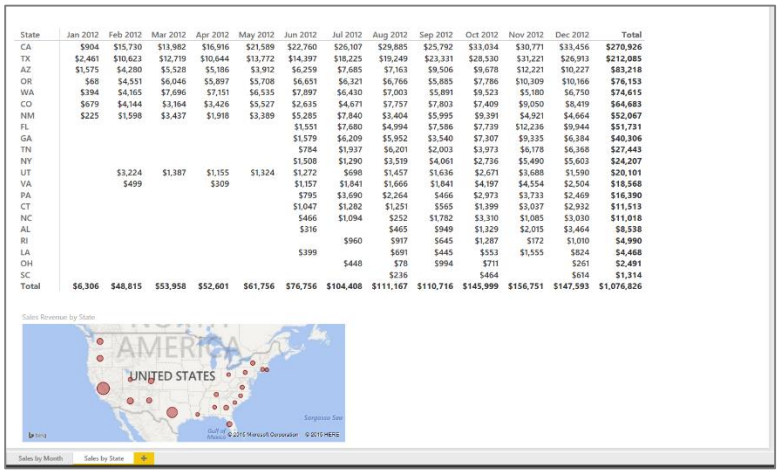
b) Select the **State** column in the **Fields** list to create a new visualization. Note that Power BI Desktop recognizes the **State** column as a geographic field so it creates the new visualization using the **Map** visualization type.

c) Using the mouse, drag the **Sales Revenue** measure from the **Fields** list into the **Values** well in the **Visualization** pane.



d) The Map visualization should now show dots of different sizes to visually depict how sales revenue is distributed across states.

e) Using the mouse, rearrange the visualizations on the page to match the following screenshot.



State	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	Oct 2012	Nov 2012	Dec 2012	Total
CA	$904	$15,730	$13,982	$16,916	$21,589	$22,760	$26,107	$29,885	$25,792	$33,034	$30,771	$33,456	**$270,926**
TX	$2,461	$10,623	$12,719	$10,644	$13,772	$14,397	$18,225	$19,249	$23,331	$28,530	$31,221	$26,913	**$212,085**
AZ	$1,575	$4,280	$5,528	$5,186	$3,912	$6,259	$7,685	$7,163	$9,506	$9,678	$12,221	$10,227	**$83,218**
OR	$68	$4,551	$6,046	$5,897	$5,708	$6,651	$6,321	$6,766	$5,885	$7,786	$10,309	$10,166	**$76,153**
WA	$394	$4,165	$7,696	$7,151	$6,535	$7,897	$6,430	$7,003	$5,891	$9,523	$5,180	$6,750	**$74,615**
CO	$679	$4,144	$3,164	$3,426	$5,527	$2,635	$4,671	$7,757	$7,803	$7,409	$9,050	$8,419	**$64,683**
NM	$225	$1,598	$3,437	$1,918	$3,389	$5,285	$7,840	$3,404	$5,995	$9,391	$4,921	$4,664	**$52,067**
FL						$1,551	$7,680	$4,994	$7,586	$7,739	$12,236	$9,944	**$51,731**
GA						$1,579	$6,209	$5,952	$3,540	$7,307	$9,335	$6,384	**$40,306**
TN						$784	$1,937	$6,201	$2,003	$3,973	$6,178	$6,368	**$27,443**
NY						$1,508	$1,290	$3,519	$4,061	$2,736	$5,490	$5,603	**$24,207**
UT		$3,224	$1,387	$1,155	$1,324	$1,272	$698	$1,457	$1,636	$2,671	$3,688	$1,590	**$20,101**
VA		$499		$309		$1,157	$1,841	$1,666	$1,841	$4,197	$4,554	$2,504	**$18,568**
PA						$795	$3,690	$2,264	$466	$2,973	$3,733	$2,469	**$16,390**
CT						$1,047	$1,282	$1,251	$565	$1,399	$3,037	$2,932	**$11,513**
NC						$466	$1,094	$252	$1,782	$3,310	$1,085	$3,030	**$11,018**
AL						$316		$465	$949	$1,329	$2,015	$3,464	**$8,538**
RI							$960	$917	$645	$1,287	$172	$1,010	**$4,990**
LA						$399		$691	$445	$553	$1,555	$824	**$4,468**
OH							$448	$78	$994	$711		$261	**$2,491**
SC								$236		$464		$614	**$1,314**
Total	**$6,306**	**$48,815**	**$53,958**	**$52,601**	**$61,756**	**$76,756**	**$104,408**	**$111,167**	**$110,716**	**$145,999**	**$156,751**	**$147,593**	**$1,076,826**

11. Add a third visualization to the page to display sales revenue by state and purchase type.

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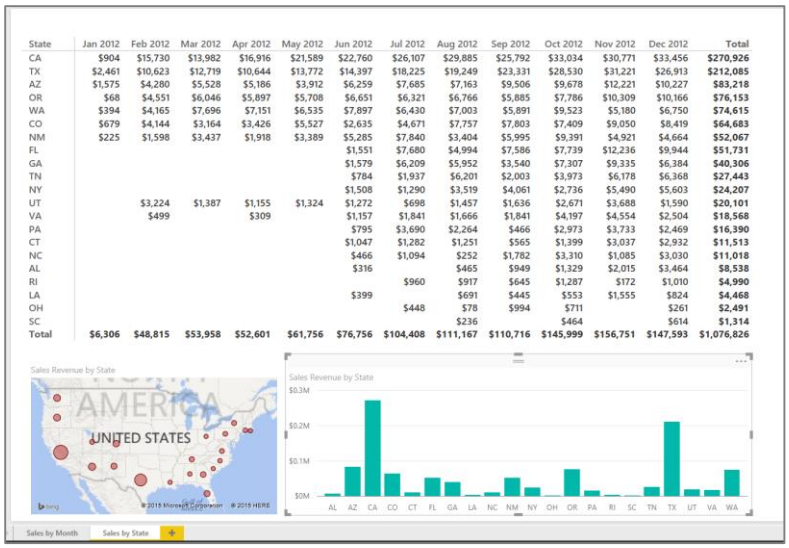
a) Click on the white space in the bottom right corner of the page to make sure no visualization is selected.

b) Select the **Sales Revenue** measure in the **Fields** list to create a new bar chart visualization.

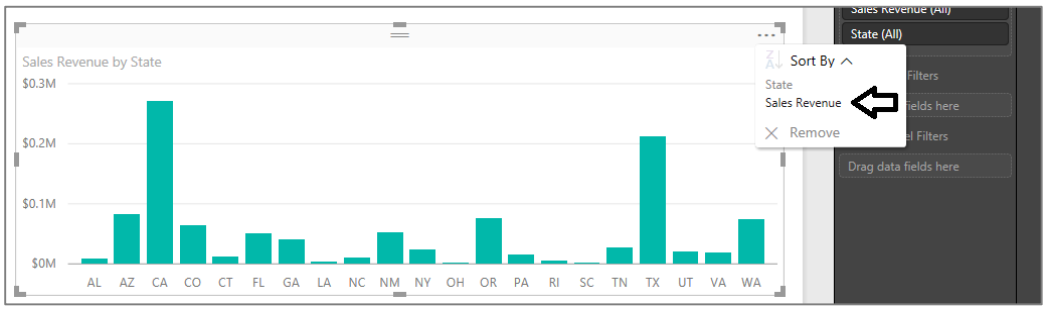
c) Select the **State** column in the **Fields** list to add a legend to the bar chart.

d) Using the mouse, rearrange the visualizations on the page to match the following screenshot.

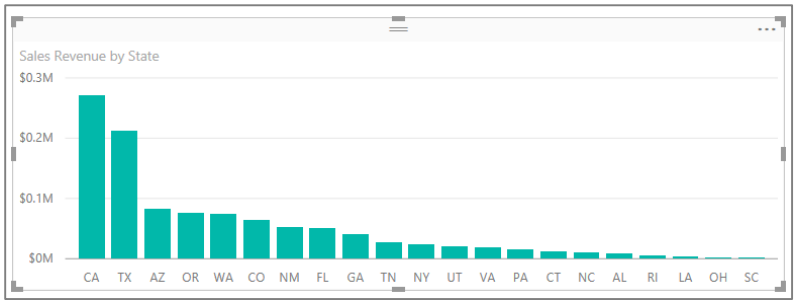


State	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	Oct 2012	Nov 2012	Dec 2012	Total
CA	$904	$15,730	$13,982	$16,916	$21,589	$22,760	$26,107	$29,885	$25,792	$33,034	$30,771	$33,456	$270,926
TX	$2,461	$10,623	$12,719	$10,644	$13,772	$14,397	$18,225	$19,249	$23,331	$28,530	$31,221	$26,913	$212,085
AZ	$1,575	$4,280	$5,528	$5,186	$3,912	$6,259	$7,685	$7,163	$9,506	$9,678	$12,221	$10,227	$83,218
OR	$68	$4,551	$6,046	$5,897	$5,708	$6,651	$6,321	$6,766	$5,885	$7,786	$10,309	$10,166	$76,153
WA	$394	$4,165	$7,696	$7,151	$6,535	$7,897	$6,430	$7,003	$5,891	$9,523	$5,180	$6,750	$74,615
CO	$679	$4,144	$3,164	$3,426	$5,527	$2,635	$4,671	$7,757	$7,803	$7,409	$9,050	$8,419	$64,683
NM	$225	$1,598	$3,437	$1,918	$3,389	$5,285	$7,840	$3,404	$5,995	$9,391	$4,921	$4,664	$52,067
FL						$1,551	$7,680	$4,994	$7,586	$7,739	$12,236	$9,944	$51,731
GA						$1,579	$6,209	$5,952	$3,540	$7,307	$9,335	$6,384	$40,306
TN						$784	$1,937	$6,201	$2,003	$3,973	$6,178	$6,368	$27,443
NY						$1,508	$1,290	$3,519	$4,061	$2,736	$5,490	$5,603	$24,207
UT		$3,224	$1,387	$1,155	$1,324	$1,272	$698	$1,457	$1,636	$2,671	$3,688	$1,590	$20,101
VA		$499		$309		$1,157	$1,841	$1,666	$1,841	$4,197	$4,554	$2,504	$18,568
PA						$795	$3,690	$2,264	$466	$2,973	$3,733	$2,469	$16,390
CT						$1,047	$1,282	$1,251	$565	$1,399	$3,037	$2,932	$11,513
NC						$466	$1,094	$252	$1,782	$3,310	$1,085	$3,030	$11,018
AL						$316		$465	$949	$1,329	$2,015	$3,464	$8,538
RI							$960	$917	$645	$1,287	$172	$1,010	$4,990
LA						$399		$691	$445	$553	$1,555	$824	$4,468
OH							$448	$78	$994	$711		$261	$2,491
SC								$236		$464		$614	$1,314
Total	$6,306	$48,815	$53,958	$52,601	$61,756	$76,756	$104,408	$111,167	$110,716	$145,999	$156,751	$147,593	$1,076,826

e) Click the (**…**) menu in the top left corner of the new visualization and click **Sort By > Sales Revenue**.



f) The visualization should now display states sorted by sales revenue.



While the visualization appears to be a simple bar chart, it has actually been created as a clustered bar chart. You must modify the visualization type from a clustered bar chart to a standard bar chart to achieve the desired layout for this particular scenario.

g) Change the visualization type by clicking the **Bar chart** button in the **Visualizations** list. Note that you will not see the effects of this change until the next step.

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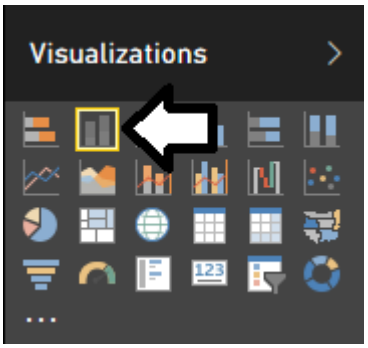
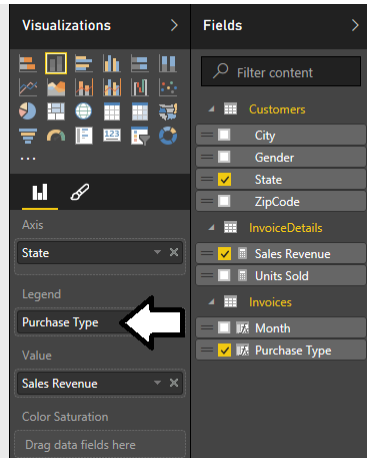
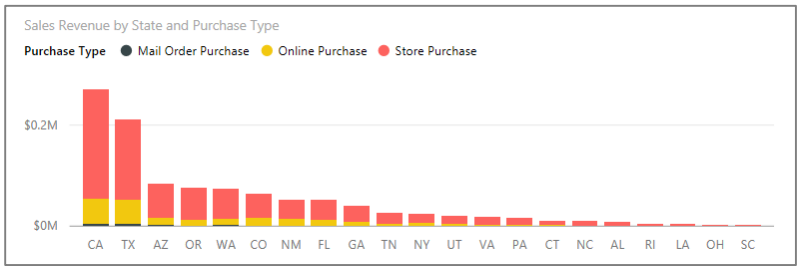


h) Using the mouse, drag the **Purchase Type** column from the **Fields** list to the **Legend** well in the **Visualization** pane.



i) Your visualization should now show the per-state breakdown of sales revenue by purchase type.



12. At this point, you have now finished designing the **Sales by State** page.

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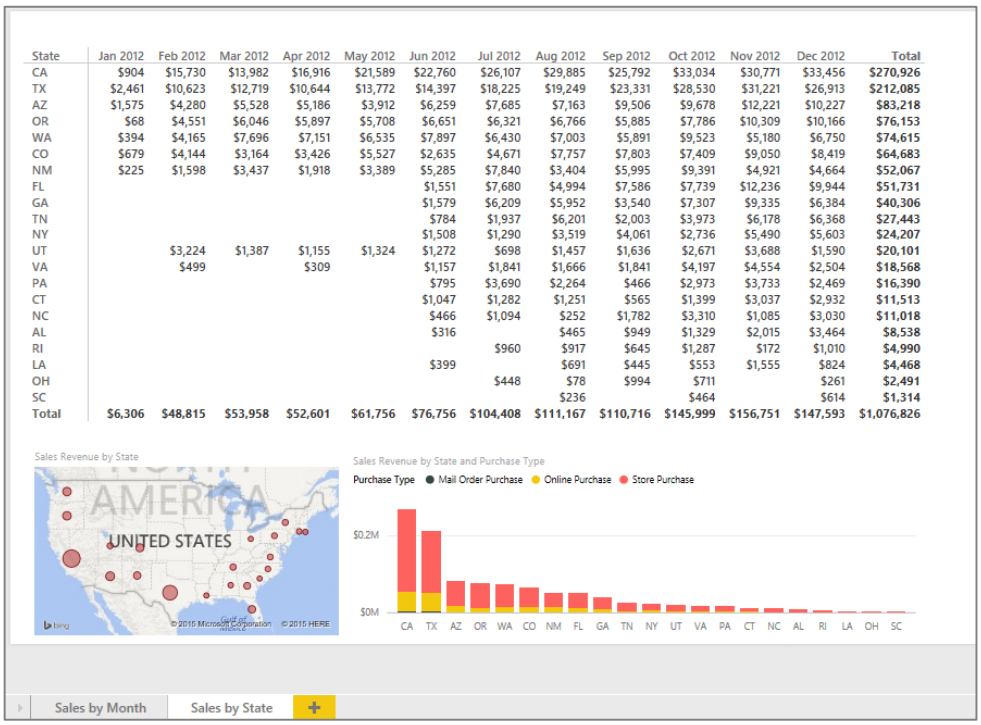


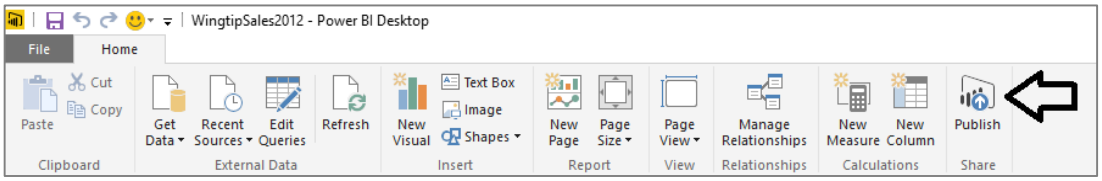
State	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012	Aug 2012	Sep 2012	Oct 2012	Nov 2012	Dec 2012	Total
CA	$904	$15,730	$13,982	$16,916	$21,589	$22,760	$26,107	$29,885	$25,792	$33,034	$30,771	$33,456	$270,926
TX	$2,461	$10,623	$12,719	$10,644	$13,772	$14,397	$18,225	$19,249	$23,331	$28,530	$31,221	$26,913	$212,085
AZ	$1,575	$4,280	$5,528	$5,186	$3,912	$6,259	$7,685	$7,163	$9,506	$9,678	$12,221	$10,227	$83,218
OR	$68	$4,551	$6,046	$5,897	$5,708	$6,651	$6,321	$6,766	$5,885	$7,786	$10,309	$10,166	$76,153
WA	$394	$4,165	$7,696	$7,151	$6,535	$7,897	$6,430	$7,003	$5,891	$9,523	$5,180	$6,750	$74,615
CO	$679	$4,144	$3,164	$3,426	$5,527	$2,635	$4,671	$7,757	$7,803	$7,409	$9,050	$8,419	$64,683
NM	$225	$1,598	$3,437	$1,918	$3,389	$5,285	$7,840	$3,404	$5,995	$9,391	$4,921	$4,664	$52,067
FL						$1,551	$7,680	$4,994	$7,586	$7,739	$12,236	$9,944	$51,731
GA						$1,579	$6,209	$5,952	$3,540	$7,307	$9,335	$6,384	$40,306
TN						$784	$1,937	$6,201	$2,003	$3,973	$6,178	$6,368	$27,443
NY						$1,508	$1,290	$3,519	$4,061	$2,736	$5,490	$5,603	$24,207
UT		$3,224	$1,387	$1,155	$1,324	$1,272	$698	$1,457	$1,636	$2,671	$3,688	$1,590	$20,101
VA		$499		$309		$1,157	$1,841	$1,666	$1,841	$4,197	$4,554	$2,504	$18,568
PA						$795	$3,690	$2,264	$466	$2,973	$3,733	$2,469	$16,390
CT						$1,047	$1,282	$1,251	$565	$1,399	$3,037	$2,932	$11,513
NC						$466	$1,094	$252	$1,782	$3,310	$1,085	$3,030	$11,018
AL						$316		$465	$949	$1,329	$2,015	$3,464	$8,538
RI							$960	$917	$645	$1,287	$172	$1,010	$4,990
LA						$399		$691	$445	$553	$1,555	$824	$4,468
OH							$448	$78	$994	$711		$261	$2,491
SC								$236		$464		$614	$1,314
Total	$6,306	$48,815	$53,958	$52,601	$61,756	$76,756	$104,408	$111,167	$110,716	$145,999	$156,751	$147,593	$1,076,826

13. Save your work by clicking the Save button on the top left of the Power BI Desktop window.

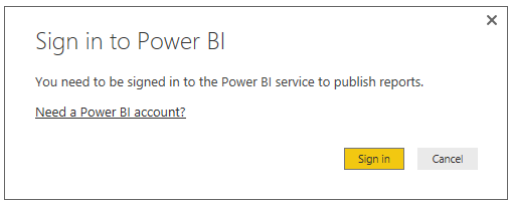
Exercise 5: Publishing a PBIX File to the Power BI Service

In this exercise you will complete your work by publishing the PBIX file to your personal workspace in the Power BI service.

1. Make sure you still have the **Wingtipsales2012.pbix** file open that you created in the previous exercise.
2. Click the **Publish** button on the far right-hand side of the ribbon..



3. When promoted with the **Sign in to Power BI** dialog, click the **Sign In** button



4. Sign into the Power BI service using your primary Office 365 account to give Power BI Desktop the access to publish the PBIX file.

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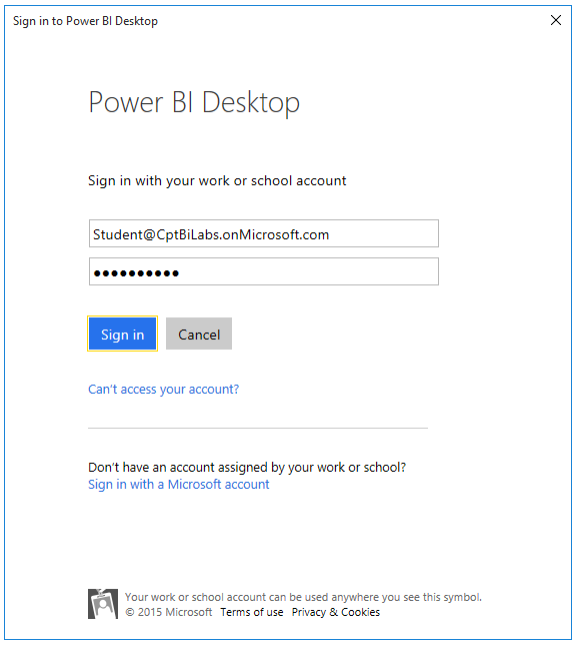
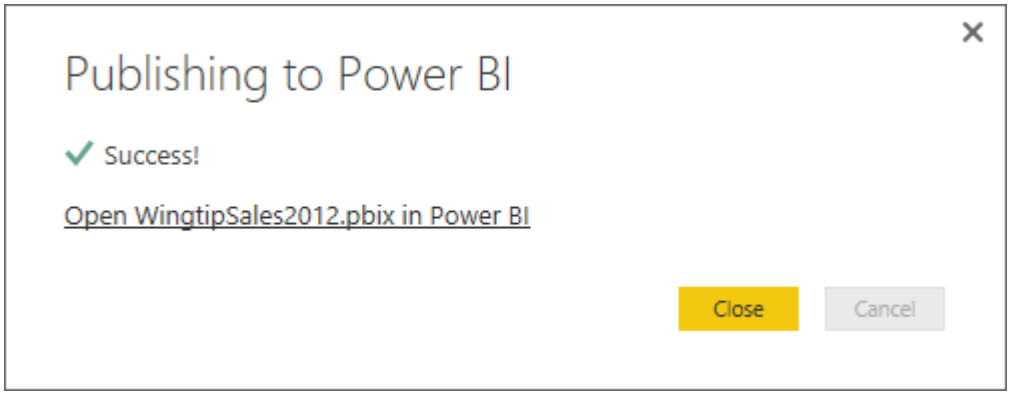


5. After you have signed in, Power BI Desktop will display the **Publishing to Power BI** dialog showing you that the publishing process is underway.

6. Once the publishing process has completed, the **Publishing to Power BI** dialog will display a success message and provide you with a link to **Open WingtipSales2012.pbix in Power BI**. Click on that link to navigate to the Power BI service using the browser.



7. You should now be able to see the **Sales by Month** page of the report you just created.

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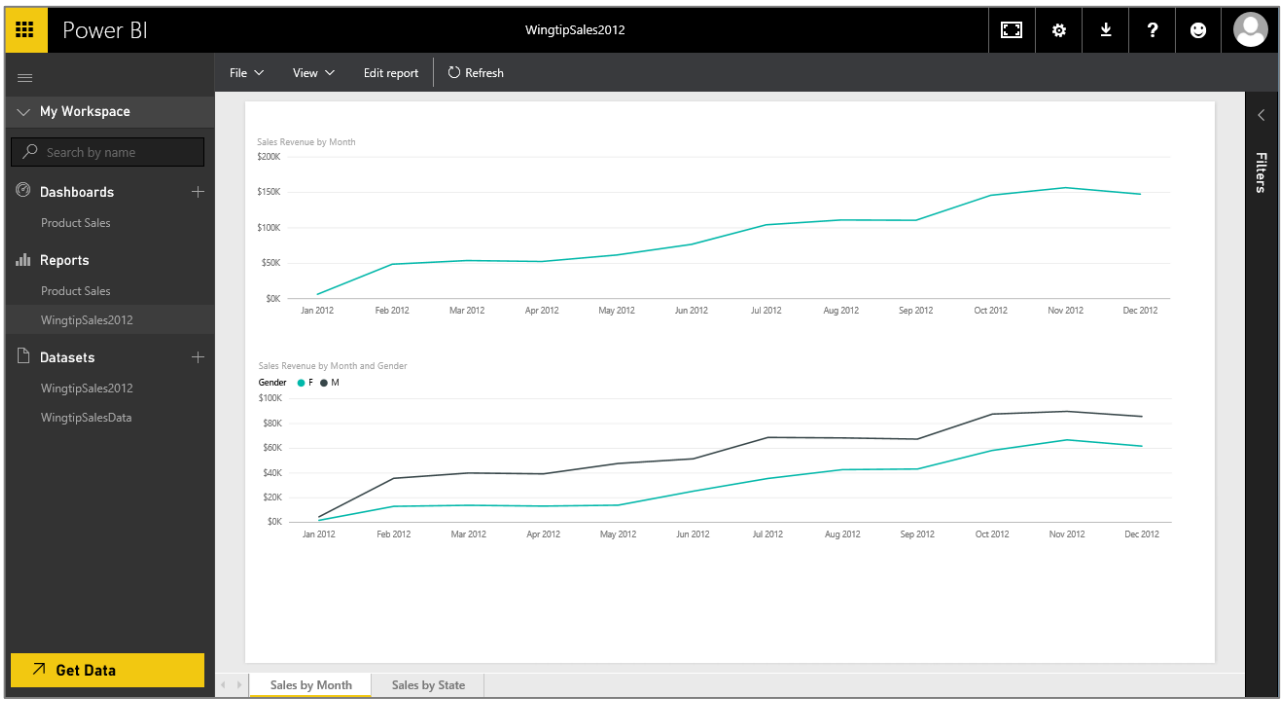
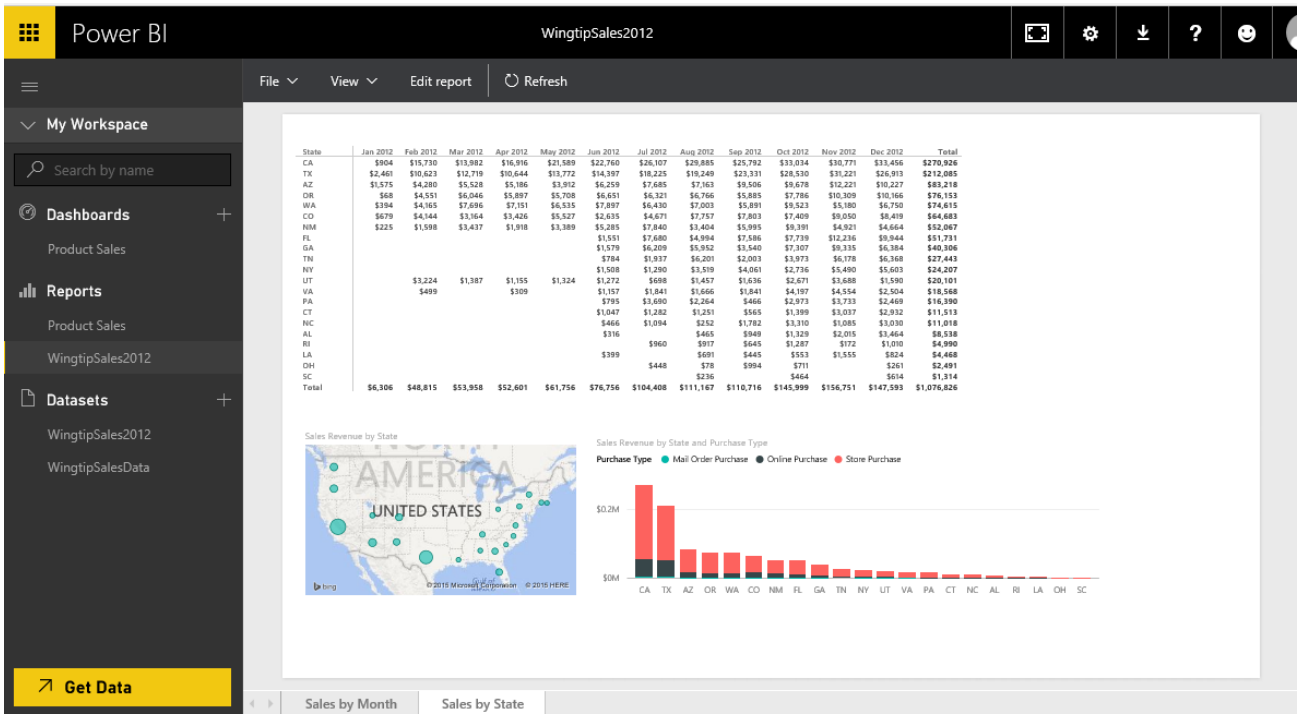


8. Click on the **Sales by State** link at the bottom of the screen to see the second page of the report.



9. You have now successfully created and published a simple BI solution using Power BI Desktop.
10. If you finish early and have extra time, experiment by clicking the Edit report button and seeing how you can continue to modify the pages of the report using the browser.

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Module 03: Using the Power Query Features of Power BI Desktop

Module Description

This module introduces the core concepts of creating and designing queries in Power BI Desktop using the features of Power Query. You will learn how to use Power Query to import data from a variety of sources including databases, Excel spreadsheets, web pages and SharePoint lists. You will also learn how Power Query can be used to reshape data during the import process by splitting a column with delimited values and combining multiple columns into a single column. You will also learn to perform powerful table operations such as merging columns and appending rows from multiple data sources as well as transposing, pivoting and un-pivoting the rows and columns in a source table.

Module Agenda

- Data Sources and Data Discovery
- Power Query Fundamentals
- Working with the Query Editor Window
- Importing Data Into a Star Schema

Topics Covered

Where's the Data?
OLTP Systems
OLAP Systems
What is a Spreadmart?
Deciding What To Measure
Defining Grain Statements
Understanding ETL
Query Steps
Advanced Editor
Understanding Query Input and Output
Query Composition
Combining Queries
Merging Columns
Appending Rows
Pivoting Columns
Unpivoting Columns
Creating a New Query
File-based Data Sources
Supported Databases
Azure Data Sources
Other Supported Data Sources
Selecting Tables from a Data Source
Examples of Basic Power Query Steps
Replacing Values
Converting Column Types
Expanding Related Columns
Merging Columns
Splitting Columns
Adding a Custom Column
Query Editor Ribbon Tabs
Data Modeling using a Star Schema
Building a Star Schema with Power Query

Instructor Demos

- Creating a Query using a Web Page
- Using Power Query to Import Data from a SQL Azure Database
- Using Power Query to Transform Data During the Load Process
- Using Power Query to Import Data into a Star Schema

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Where's the Data?

- Data can live in a variety of sources
  - OLTP Databases
  - OLAP Databases
  - LOB Systems
  - Web services
  - Spreadmarts

As this slide shows, the data you want to analyze can live in many different places and can exist in many different formats. We will explore each of these types of data source in more detail over the next few slides.

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OLTP Systems

- Online Transaction Processing (OLTP) System
  - Used for real-time data access and transaction-based data entry
  - Optimized for faster transactions (e.g. inserts, updates & deletes)
  - Tables normalized to reduce/eliminate redundancies
  - OLTP systems do not prioritize keeping historical data
- Problems with OLTP System for Business Intelligence
  - Not built for running complex queries
  - Fewer indexes and informational queries require more joins
  - Joins often required when querying data
  - Reporting can be confusing for business users

Online Transaction Processing (OLTP) databases are used for databases that have high transaction rates. The data model of tables in this type of database is optimized to speed up transactions for operation such as inserting, updating and deleting records. Tables in an OLTP database are usually normalized to reduce or eliminate any redundancies.

Another noteworthy issue is that OLTP systems are often not designed to track historical data. For example, imagine a customer living in California makes a number of purchases over a 5 year period and then the customer moves to Florida. If you run a query to determine sales revenue by state, you will likely find that all the historic purchases for the customer are attributed to the new state Florida and not the state where the purchases were made which is California.

In a nutshell, there are several common issues that you deal with when try to build BI projects on top of an OLTP database. First, they are not designed for complex queries so you will have to join more tables together and performance might be poor since it will not have indexes to optimize these queries. Also, the table schema is often more complicated and not intuitive for the average business user.

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OLAP Systems

- Online Analytical Processing (OLAP) System
  - Used for analysis and data drilldown on online or historical data
  - Data in OLAP system is read-only database.
  - Optimized for performance and details in querying the data.
  - Relaxes database normalization rules.
  - Relatively more indexes and fewer joins.
- OLAP Systems often built using a Data Warehouse
  - Data must be gathered from multiple sources
  - Often this data must be cleaned up, formatted or transformed
  - Data model is de-normalized resulting in fewer tables
  - Fewer tables results in fewer joins
  - Tables are categorized as fact tables and dimension tables

OLAP systems are inherently different than OLTP system because they are not designed to support data entry. Instead, OLAP systems are based on the idea of bulk-loading pre-existing data for the sole purpose of data analysis. This means that OLAP systems data drilldown on online or historical data in an environment where the data has been optimized for read-only performance and low-level detail in querying the data.

OLAP Systems in larger projects are often built using a Data Warehouse. However, a simple OLAP system can be created using nothing more than Excel 2013. However, the data must be typically be gathered from multiple sources and this data often requires some type of clean up, formatting or transformation. The data model can be de-normalized resulting in fewer tables and a data model which is much easier to business users to understand.

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What is a Spreadmart?

- An analysis system running on desktop database
  - Spreadsheets
  - Access databases
  - Created and maintained by an individual or group
- What is the work involved with a spreadmart?
  - Extracting, transforming, and formatting data
  - Defining metrics for data
  - Submitting queries
  - Formatting and publishing reports to others

The term "spreadmart" is a general term which usually means that a business user has used desktop tools to build an ad hoc OLAP system. Common tools for building spreadmarts include Microsoft Access and/or Microsoft Excel. However, a key point is that the spreadmart has been created and maintained with little or no assistance from the IT department.

since a spreadmart is an OLAP system, creating one requires the same steps as creating a more sophisticated OLAP system. The creator of a spread mart must often locate and gain access to data that must be extracted, formatted and/or transformed. The spreadmart creator must also define metrics for data being analyzed to create a process for submitting queries and publishing reports to others business users.

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Deciding What To Measure

- You Must Determine Measurable Objectives
  - Financial (revenue, expenses, profit margin, etc.)
  - Business processes efficiency
  - Customer Satisfaction Levels

When you begin to create any type of BI system for monitoring the health and reporting on business processes, it is important to take a step back in the initial design phase and decide what your system is going to measure. This provides an opportunity to define what type of business analysis the results of the BI should provide. For example, one BI system might just need to track sales revenue in order to calculate commission for sales people. Another system with different requirements might need to analyze expenses and profit in addition to sales revenue. Determining high-level goals and capabilities is an important thing to do before getting into the nuts and bolts of beginning to extract and transform data.

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Defining Grain Statements

- Grain statements should be defined in initial design phase
  - Grain statements helps determine requirements for BI queries
  - Grain statements can be created & understood by business users
- Example grain statements for BI project at Wingtip Toys
  - What was the total sales revenue over the last 4 years?
  - What was the sales revenue by year, quarter and month?
  - What was the sales revenue by region, state, city and zip code?
  - What was the sales revenue by category, subcategory and product?
  - What was the growth in sales revenue from month to month in 2013?
  - What was profit margin for each product by year, quarter and month?
  - Have their been any products with significantly decreasing profit margin?

A popular technique for establishing the requirements for a BI system is to define a set of grain statements. What's valuable about grain statements is that they can easily be created by business users with little or no technical experience.

It's a good idea to create a set of grain statements when you begin a BI project. From a set of grain statements you can determine what data needs to be imported as well as what queries and reports need to be generated as well.

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Understanding ETL

- ETL process is essential part of any BI Project
  - **Extract** the data from wherever it lives
  - **Transform** the shape of the data for better analysis
  - **Load** the data into a dataset for analysis and reporting
- Power Query is an ETL tool for business users
  - Power Query can load data into an Excel worksheet
  - Power Query can load data into the Excel data model

Every BI projects work with data of some type. Early in the project, you must discover where this data lives and decide how you are going to import it into a dataset that can be used for reporting and analysis. This is the phase of a BI project that is often called the "ETL" phase because it involves extracting data, transforming data and then loading data.

Power Query is a self-service ETL tool for business users. It has the ability to extract data from a variety of data source and import it into an Excel workbook. When you execute a query from inside an Excel workbook, you have the option to load its output into a worksheet or into the data model. However, the real value of Power Query is that you can perform many types of transforms to better shape the data just before it's loaded.

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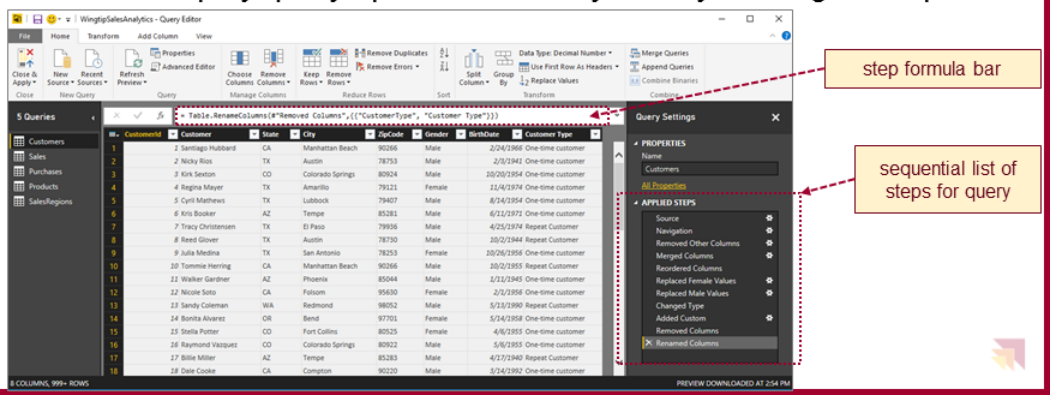
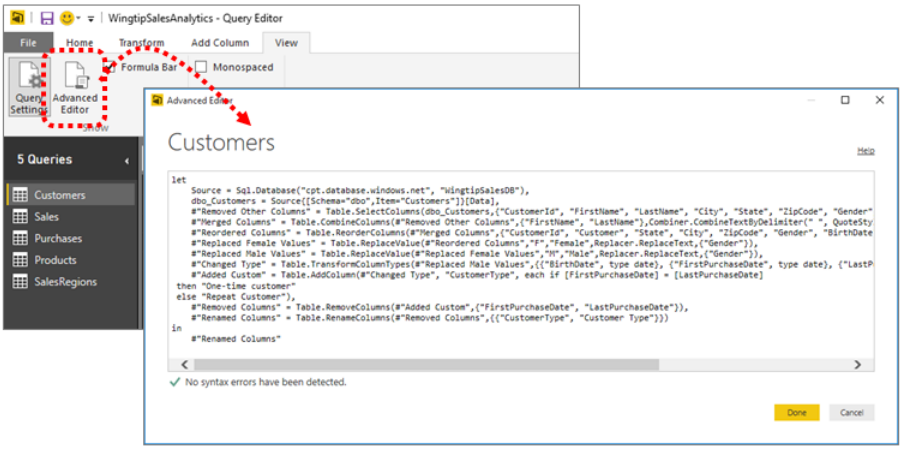
Query Steps

- A query is created as a sequence of steps
  - Each step is a parameterized operation on the data
  - Each step has formula which can be viewed/edited in formula bar
  - Query starts with Source step to extract data from a data source
  - Additional steps added to perform transform operations on data
  - You can replay query operations one by one by clicking on steps



Advanced Editor

- Power Query based on "M" functional language
  - Query in Power Query saved as a set of M statements in code
  - Query Editor generates code in M behind the scenes
  - Advanced users can view & modify query code in Advanced Editor



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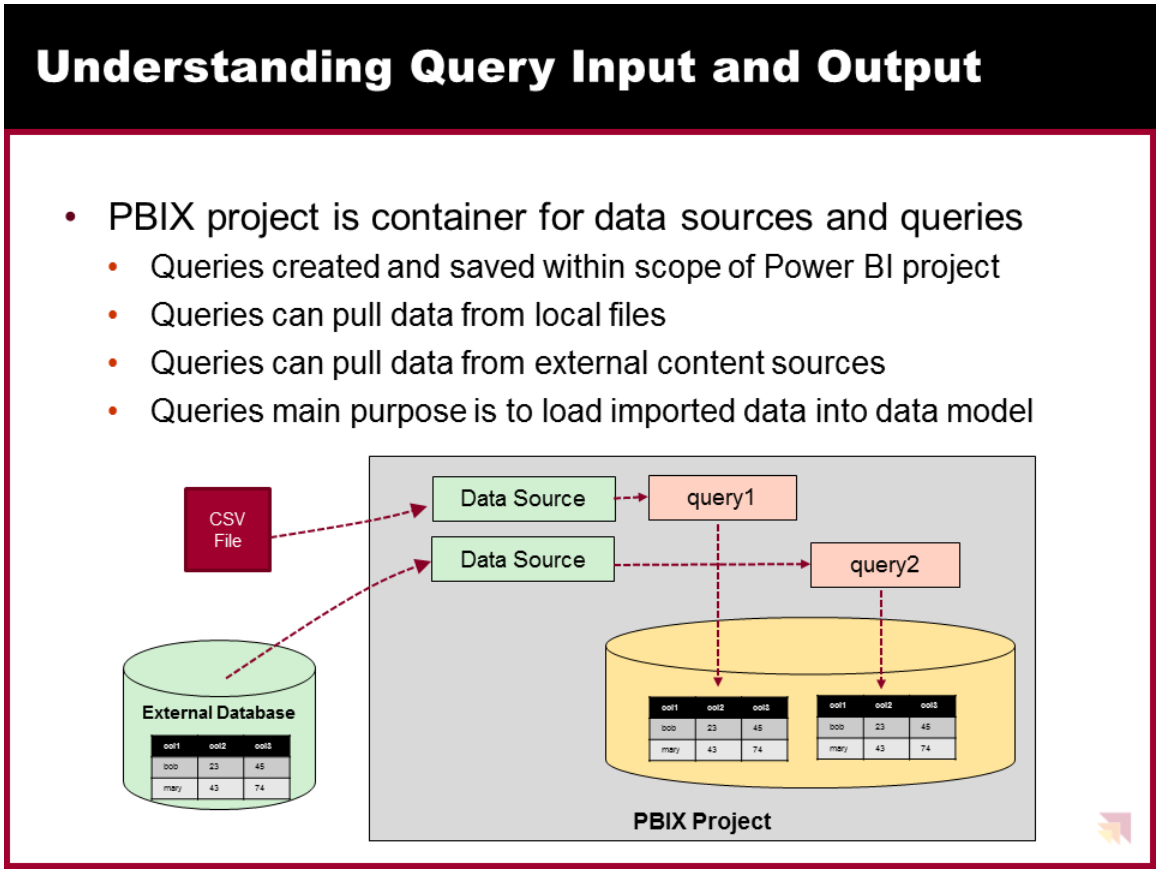

When working with Power Query in Excel 2013, you create and save queries within the scope of an Excel workbook. Each query must have at least one source of data to use as its input. To get started quickly, you can create a new query using a table in a worksheet inside the same workbook. Alternatively, you can create a query from an external data source such as an Access database, a SQL Server database or a SharePoint list.

A query can also be configure to load its output into the Excel workbook. You can configure a query to load its output into a new table in an Excel worksheet or into the data model. If you are creating a query whose sole purpose is to be used as a source for another query, you can disable loading and configure the query as a "connection-only" query.

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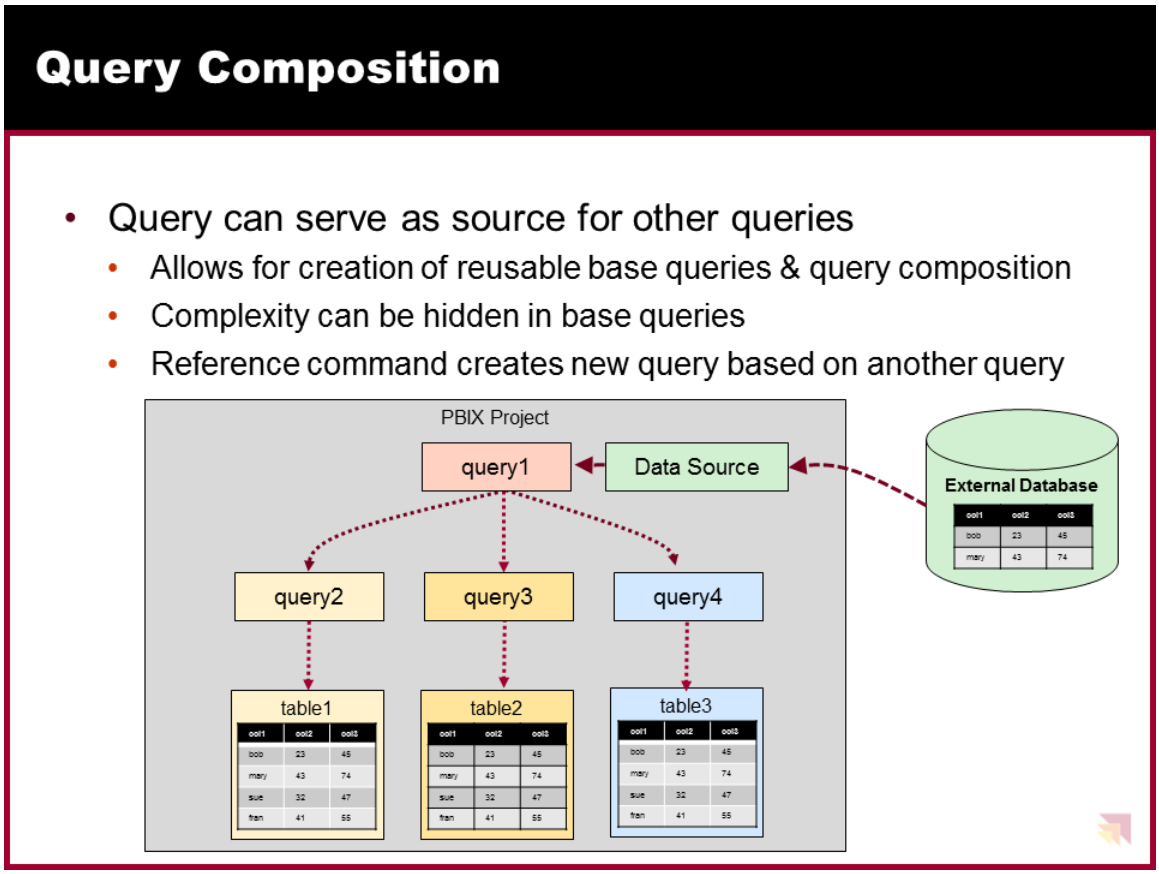

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A query can also be configure to load its output into the Excel workbook. You can configure a query to load its output into a new table in an Excel worksheet or into the data model. If you are creating a query whose sole purpose is to be used as a source for another query, you can disable loading and configure the query as a "connection-only" query.

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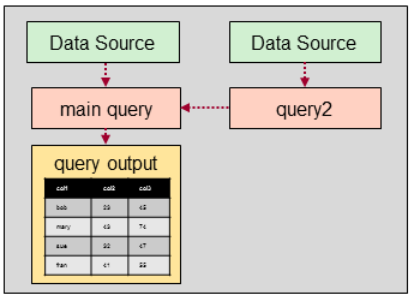
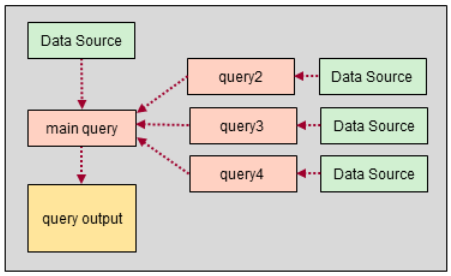
Combining Queries

- Query can be merged or appended with another query
  - Merge operation allows you combine columns from two tables
  - Append operation allows you to combine rows from two tables
- Two queries are combined into single output for loading
  - Load settings of main query determines where output is loaded
  - Secondary query acts as source for main query
  - Secondary query be can created with connection-only load setting





Power Query allows you to combine to queries. Combining queries means that you are combining two data sources into a single table as the queries output. Power Query supports two combine operations which are merge and append. A **merge** operation is used when you need to combine columns in from two tables into a single table. An append operation is used when you need to combine rows from two tables into a single table.

Consider that combining two queries produces a single output. Yet each of the queries involved has its own Power Query load setting. You configure the load setting of the main query to determine where to load the result of the merge/append operation. However, the secondary query which is only being used as the source in another query doesn't usually need to load its output anywhere in the workbook. When you are creating a query whose sole purpose is to be used as a source for a merge or append operation in another query, you can disable loading by configuring the load setting as a "connection-only" query.

What if you need to append together rows from more than one table? That's not a problem. A main query can include more than one append operation as shown in the diagram above on the right. This means a single query can append together rows from as many source tables as necessary.

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Merging Columns

Main Query Input

FirstName	LastName	JobTitle	Department	Email
Matthew	McDermott	IT Manager	Information Technology	matthewmcdermott@wingtip.com
Keith	Moon	System Administrator	Information Technology	keithmoon@wingtip.com
Spencer	Reed	Records Manager	Information Technology	spencerreed@wingtip.com
Paul	Schaeflein	Software Developer	Information Technology	paulschaeflein@wingtip.com
Scot	Hillier	CFO	Finance	scothillier@wingtip.com
Bernie	Madeoff	Accountant	Finance	berniemadeoff@wingtip.com
Andrew	Connell	Sales Director	Sales	andrewconnell@wingtip.com
Chandler	Bing	Sales Representitive	Sales	chandlerbing@wingtip.com
Wilson	Picket	Sales Representative	Sales	wilsonpicket@wingtip.com
Christina	Wheeler	Marketing Director	Marketing	christinawheeler@wingtip.com
Katie	Bowman	Web Designer	Marketing	katiebowman@wingtip.com
Asif	Rehmani	Vice President of Product Development	Product Development	asifrehmani@wingtip.com
Ted	Pattison	Senior Toy Scientist	Product Development	tedpattison@wingtip.com
David	Mann	Toy Scientist	Product Development	davidmann@wingtip.com
Gary	Lapointe	Toy Scientist	Product Development	garylapointe@wingtip.com

Join Column

Merge Query Input

Email	City	State
matthewmcdermott@wingtip.com	Austin	TX
keithmoon@wingtip.com	Hollywood	CA
spencerreed@wingtip.com	Washington	DC
paulschaeflein@wingtip.com	St Paul	MN
scothillier@wingtip.com	Hartford	CT
berniemadeoff@wingtip.com	NY	NY
andrewconnell@wingtip.com	Jacksonville	FL
chandlerbing@wingtip.com	NY	NY
wilsonpicket@wingtip.com	San Fransisco	CA
christinawheeler@wingtip.com	Atlanta	GE
katiebowman@wingtip.com	Autsin	TX
asifrehmani@wingtip.com	Chicago	IL
tedpattison@wingtip.com	Tampa	FL
davidmann@wingtip.com	Philidephia	PA
garylapointe@wingtip.com	Dever	CO

Join Column

Query Output

First Name	Last Name	Email	Job Title	Department	City	State
Matthew	McDermott	matthewmcdermott@wingtip.com	IT Manager	Information Technology	Austin	TX
Keith	Moon	keithmoon@wingtip.com	System Administrator	Information Technology	Hollywood	CA
Spencer	Reed	spencerreed@wingtip.com	Records Manager	Information Technology	Washington	DC
Paul	Schaeflein	paulschaeflein@wingtip.com	Software Developer	Information Technology	St Paul	MN
Scot	Hillier	scothillier@wingtip.com	CFO	Finance	Hartford	CT
Bernie	Madeoff	berniemadeoff@wingtip.com	Accountant	Finance	NY	NY
Andrew	Connell	andrewconnell@wingtip.com	Sales Director	Sales	Jacksonville	FL
Chandler	Bing	chandlerbing@wingtip.com	Sales Representitive	Sales	NY	NY
Wilson	Picket	wilsonpicket@wingtip.com	Sales Representative	Sales	San Fransisco	CA
Christina	Wheeler	christinawheeler@wingtip.com	Marketing Director	Marketing	Atlanta	GE
Katie	Bowman	katiebowman@wingtip.com	Web Designer	Marketing	Autsin	TX
Asif	Rehmani	asifrehmani@wingtip.com	Vice President of Product Development	Product Development	Chicago	IL
Ted	Pattison	tedpattison@wingtip.com	Senior Toy Scientist	Product Development	Tampa	FL
David	Mann	davidmann@wingtip.com	Toy Scientist	Product Development	Philidephia	PA
Gary	Lapointe	garylapointe@wingtip.com	Toy Scientist	Product Development	Dever	CO

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Appending Rows

Main Query Input

FirstName	LastName	Company	Email	City	State	ZipCode
Joe	Stephens	Initech	Joe.Stephens@Initech.com	Sacramento	CA	95823
Basil	Frazier	Nordyne Defense Dynamics	Basil.Frazier@NordyneDefenseDynamics.com	Sacramento	CA	95823
Ignacio	Duran	Yoyodyne Propulsion Systems	Ignacio.Duran@YoyodynePropulsionSystems.com	Beaverton	OR	97005
Alvaro	Brock	W.C. Boggs & Co.	Alvaro.Brock@W.C.Boggs&Co..com	Beaverton	OR	97005
Alec	Miller	Krusty Burger	Alec.Miller@KrustyBurger.com	Vancouver	WA	98662
Maureen	Griffin	VersaLife Corporation	Maureen.Griffin@VersaLifeCorporation.com	Vancouver	WA	98662
Guillermo	Sykes	Soar Airlines	Guillermo.Sykes@SoarAirlines.com	Sacramento	CA	95818
Solomon	Warner	Wayne Enterprises	Solomon.Warner@WayneEnterprises.com	Seattle	WA	98125
Humberto	Petersen	W.C. Boggs & Co.	Humberto.Petersen@W.C.Boggs&Co..com	San Francisco	CA	94118
Keven	Griffith	Fabrikam	Keven.Griffith@Fabrikam.com	Bend	OR	97701

Append Query Input

FirstName	LastName	Company	Email	City	State	ZipCode
Rich	Pierce	The Regal Beagle	Rich.Pierce@TheRegalBeagle.com	Portland	OR	97216
Ronnie	Donaldson	Union Aerospace Corporation	Ronnie.Donaldson@UnionAerospaceCorporation.com	Vancouver	WA	98684
Willard	Frazier	Benthic Petroleum	Willard.Frazier@BenthicPetroleum.com	Portland	OR	97220
Marina	Caldwell	Ewing Oil	Marina.Caldwell@EwingOil.com	Portland	OR	97205
Milagros	Mercer	Hishii Industries	Milagros.Mercer@HishiiIndustries.com	Salem	OR	97301
Kirsten	Little	Binford	Kirsten.Little@Binford.com	Ventura	CA	93003
Terri	Ferrell	Black Mesa Research Facility	Terri.Ferrell@BlackMesaResearchFacility.com	Portland	OR	97205
Francine	Doyle	Peach Pit	Francine.Doyle@PeachPit.com	Vancouver	WA	98662
Dannie	Powers	Deon International	Dannie.Powers@DeonInternational.com	Issaquah	WA	98027
Noah	Best	Shinra Electric Power Company	Noah.Best@ShinraElectricPowerCompany.com	Portland	OR	97217
Keenan	Holmes	Biffco	Keenan.Holmes@Biffco.com	Portland	OR	97220
Douglas	Maynard	Cyberdyne Systems	Douglas.Maynard@CyberdyneSystems.com	San Francisco	CA	94118
Gerald	Harrington	Yoyodyne Propulsion Systems	Gerald.Harrington@YoyodynePropulsionSystems.com	Portland	OR	97217
Josue	Robinson	North Western Railway	Josue.Robinson@NorthWesternRailway.com	Beaverton	OR	97005

Query Output

FirstName	LastName	Company	Email	City	State	ZipCode
Joe	Stephens	Initech	Joe.Stephens@Initech.com	Sacramento	CA	95823
Basil	Frazier	Nordyne Defense Dynamics	Basil.Frazier@NordyneDefenseDynamics.com	Sacramento	CA	95823
Ignacio	Duran	Yoyodyne Propulsion Systems	Ignacio.Duran@YoyodynePropulsionSystems.com	Beaverton	OR	97005
Alvaro	Brock	W.C. Boggs & Co.	Alvaro.Brock@W.C.Boggs&Co..com	Beaverton	OR	97005
Alec	Miller	Krusty Burger	Alec.Miller@KrustyBurger.com	Vancouver	WA	98662
Maureen	Griffin	VersaLife Corporation	Maureen.Griffin@VersaLifeCorporation.com	Vancouver	WA	98662
Guillermo	Sykes	Soar Airlines	Guillermo.Sykes@SoarAirlines.com	Sacramento	CA	95818
Solomon	Warner	Wayne Enterprises	Solomon.Warner@WayneEnterprises.com	Seattle	WA	98125
Humberto	Petersen	W.C. Boggs & Co.	Humberto.Petersen@W.C.Boggs&Co..com	San Francisco	CA	94118
Keven	Griffith	Fabrikam	Keven.Griffith@Fabrikam.com	Bend	OR	97701
Rich	Pierce	The Regal Beagle	Rich.Pierce@TheRegalBeagle.com	Portland	OR	97216
Ronnie	Donaldson	Union Aerospace Corporation	Ronnie.Donaldson@UnionAerospaceCorporation.com	Vancouver	WA	98684
Willard	Frazier	Benthic Petroleum	Willard.Frazier@BenthicPetroleum.com	Portland	OR	97220
Marina	Caldwell	Ewing Oil	Marina.Caldwell@EwingOil.com	Portland	OR	97205
Milagros	Mercer	Hishii Industries	Milagros.Mercer@HishiiIndustries.com	Salem	OR	97301
Kirsten	Little	Binford	Kirsten.Little@Binford.com	Ventura	CA	93003
Terri	Ferrell	Black Mesa Research Facility	Terri.Ferrell@BlackMesaResearchFacility.com	Portland	OR	97205
Francine	Doyle	Peach Pit	Francine.Doyle@PeachPit.com	Vancouver	WA	98662
Dannie	Powers	Deon International	Dannie.Powers@DeonInternational.com	Issaquah	WA	98027
Noah	Best	Shinra Electric Power Company	Noah.Best@ShinraElectricPowerCompany.com	Portland	OR	97217
Keenan	Holmes	Biffco	Keenan.Holmes@Biffco.com	Portland	OR	97220
Douglas	Maynard	Cyberdyne Systems	Douglas.Maynard@CyberdyneSystems.com	San Francisco	CA	94118
Gerald	Harrington	Yoyodyne Propulsion Systems	Gerald.Harrington@YoyodynePropulsionSystems.com	Portland	OR	97217
Josue	Robinson	North Western Railway	Josue.Robinson@NorthWesternRailway.com	Beaverton	OR	97005

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Pivoting Columns

- Pivot column adds its values are new columns
  - Create table layout like PivotTable

City	Year	Population
New York, NY	2010	8175133
New York, NY	2000	8008278
New York, NY	1990	7322564
Los Angeles, CA	2010	3792621
Los Angeles, CA	2000	3694820
Los Angeles, CA	1990	3485398
Chicago, IL	2010	2695598
Chicago, IL	2000	2896016
Chicago, IL	1990	2783726
Houston, TX	2010	2100263
Houston, TX	2000	1953631
Houston, TX	1990	1630553
Philadelphia, PA	2010	1526006
Philadelphia, PA	2000	1517550
Philadelphia, PA	1990	1585577
Phoenix, AZ	2010	1445632
Phoenix, AZ	2000	1321045
Phoenix, AZ	1990	983403

City	2010	2000	1990
New York, NY	8175133	8008278	7322564
Los Angeles, CA	3792621	3694820	3485398
Chicago, IL	2695598	2896016	2783726
Houston, TX	2100263	1953631	1630553
Philadelphia, PA	1526006	1517550	1585577
Phoenix, AZ	1445632	1321045	983403
San Antonio, TX	1327407	1144646	935933
San Diego, TX	1307402	1223400	1110549
Dallas, TX	1197816	1188580	1006877
San Jose, CA	945942	894943	782248

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Unpivoting Columns

- Unpivot columns to collapse them into single column
  - Removes PivotTable layout
  - Can be useful to prepare data for charting and analysis

City	2010	2000	1990
New York, NY	8175133	8008278	7322564
Los Angeles, CA	3792621	3694820	3485398
Chicago, IL	2695598	2896016	2783726
Houston, TX	2100263	1953631	1630553
Philadelphia, PA	1526006	1517550	1585577
Phoenix, AZ	1445632	1321045	983403
San Antonio, TX	1327407	1144646	935933
San Diego, TX	1307402	1223400	1110549
Dallas, TX	1197816	1188580	1006877
San Jose, CA	945942	894943	782248

City	Year	Population
New York, NY	2010	8175133
New York, NY	2000	8008278
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Los Angeles, CA	2010	3792621
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Los Angeles, CA	1990	3485398
Chicago, IL	2010	2695598
Chicago, IL	2000	2896016
Chicago, IL	1990	2783726
Houston, TX	2010	2100263
Houston, TX	2000	1953631
Houston, TX	1990	1630553
Philadelphia, PA	2010	1526006
Philadelphia, PA	2000	1517550
Philadelphia, PA	1990	1585577
Phoenix, AZ	2010	1445632
Phoenix, AZ	2000	1321045
Phoenix, AZ	1990	983403

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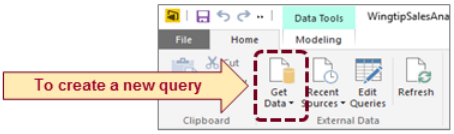
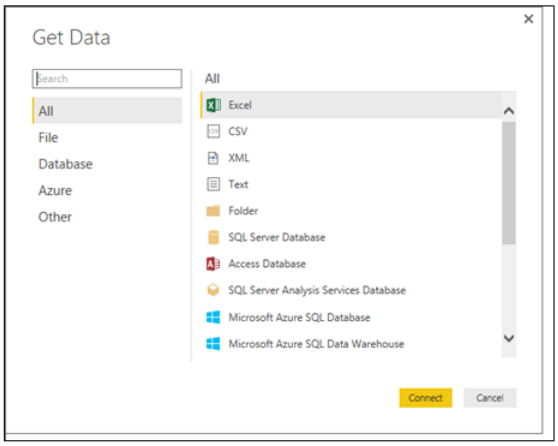
Creating a New Query

- New query created using **Get Data** menu on ribbon
  - **Get Data** menu has many commands for creating new queries
  - You can create new query based on large variety of data sources
  - New query is opened in Power Query's Query Editor window





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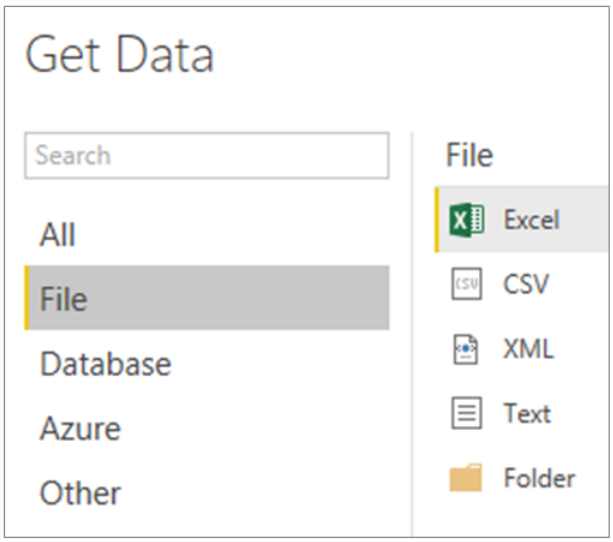
File-based Data Sources

- Power Query supports common file types
  - Excel workbooks
  - CSV files
  - XML files
  - Text files
  - Folder structure



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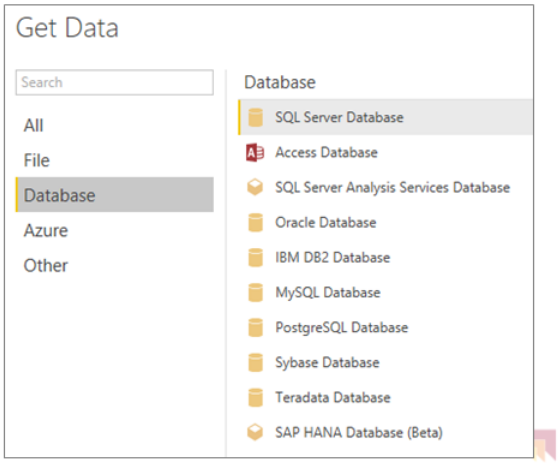
Supported Databases

- Power Query supports many database systems
  - SQL Server
  - SQL Server Analysis Services
  - Access
  - Oracle
  - DB2
  - MySQL
  - PostgreSQL
  - Sybase
  - Teradata



Access Databases

SQL Server Databases

Oracle Databases

DB2 Database

MySQL

PostgreSQL

Sybase

Teradata

SQL Server Analysis Services (SSAS)

Tabular Databases

Multidimensional Databases with Cubes

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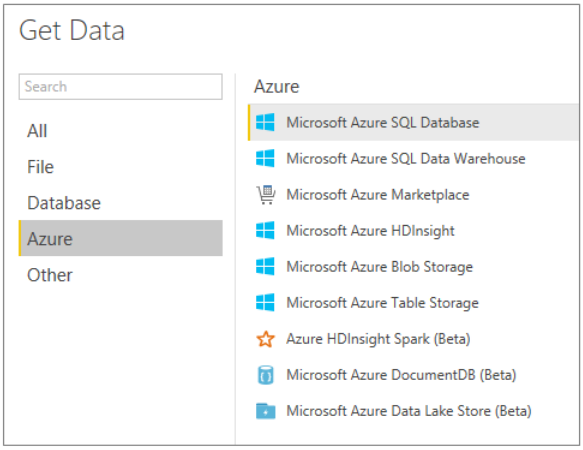
Azure Data Sources



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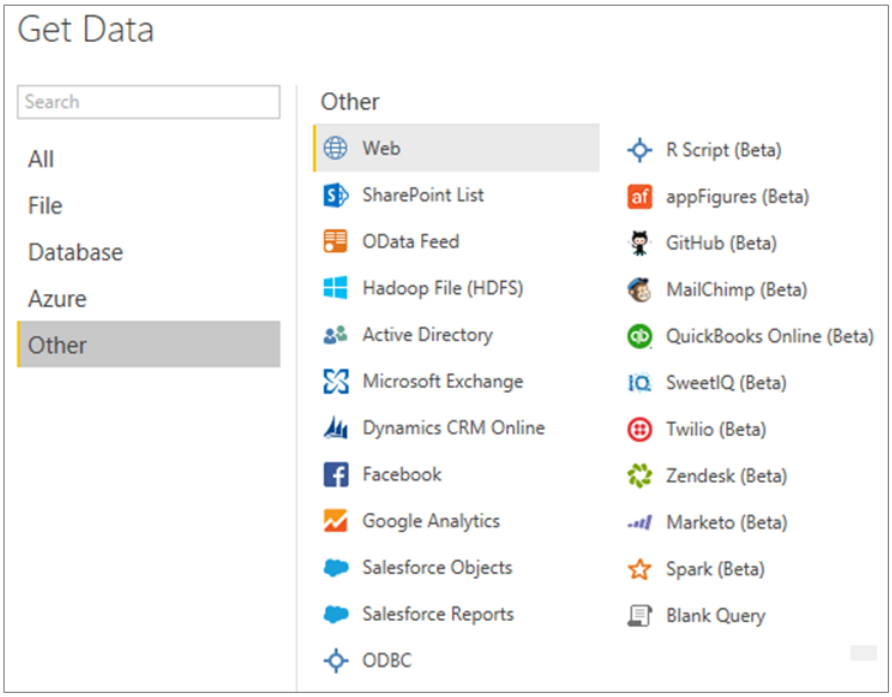
Other Supported Data Sources



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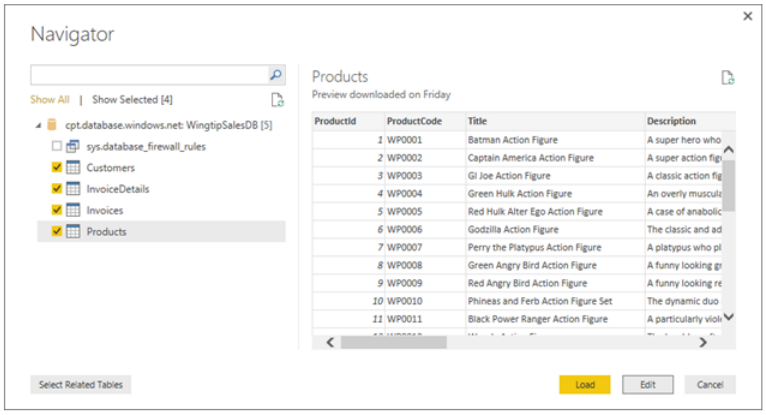
Selecting Tables from a Data Source

- Power Query provides Navigator dialog
  - Allows you to select tables
  - Navigator understands existing table relationships
  - Clicking **Load** will run query and import data
  - Clicking **Edit** will open queries in Query Editor window



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Examples of Basic Power Query Steps

- Rename column
- Convert column type
- Format column values
- Reorder columns
- Replace column values
- Expanding related column
- Merging columns
- Splitting columns
- Adding custom column

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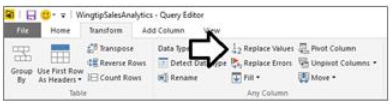
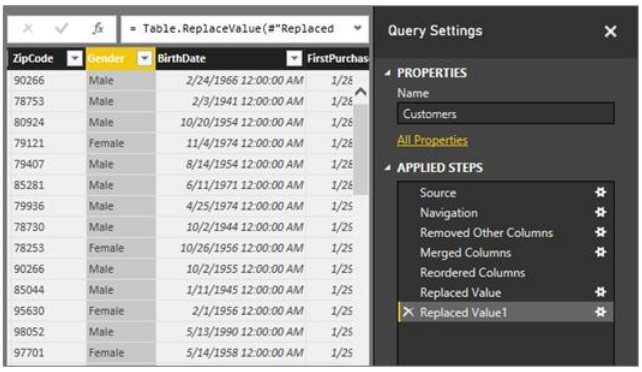
Replacing Values

- Used to substitute values during import





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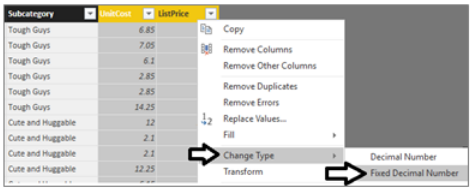
Converting Column Types

- Transform data to make it more reliable
  - Convert date-time column to date column
- Transform data to make it more efficient
  - Convert decimal to fixed decimal number for currency



- Beware: Conversion can have destructive effect on data

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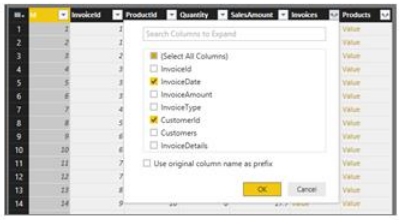
Expanding Related Columns

- Used to pull data from related tables
  - Saves you from performing SQL joins or VLOOKUP



	Id	InvoiceId	ProductId	Quantity	SalesAmount	InvoiceDate	CustomerId	Products
1	1	1	22	4	119.8	1/28/2012 12:00:00 AM	1	Value
2	2	1	22	1	29.95	1/28/2012 12:00:00 AM	1	Value
3	3	2	22	2	59.9	1/28/2012 12:00:00 AM	2	Value
4	4	3	17	8	399.6	1/28/2012 12:00:00 AM	3	Value
5	5	3	18	2	29.9	1/28/2012 12:00:00 AM	3	Value
6	6	3	18	4	59.8	1/28/2012 12:00:00 AM	3	Value
7	7	4	16	1	2.95	1/28/2012 12:00:00 AM	4	Value

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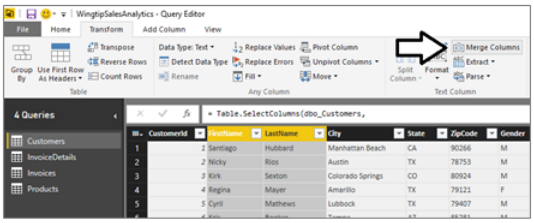
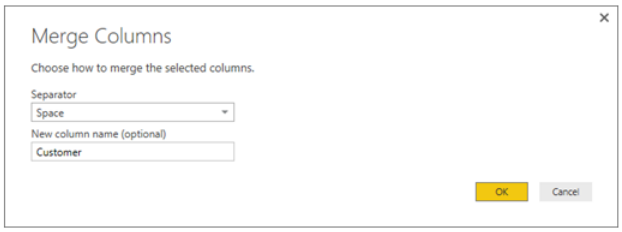
Merging Columns

- Merge two columns into a single column





	CustomerId	Customer
1	1	Santiago Hubbard
2	2	Nicky Rios
3	3	Kirk Sexton
4	4	Regina Mayer
5	5	Cyril Mathews
6	6	Kris Booker
7	7	Tracy Christensen
8	8	Reed Glover

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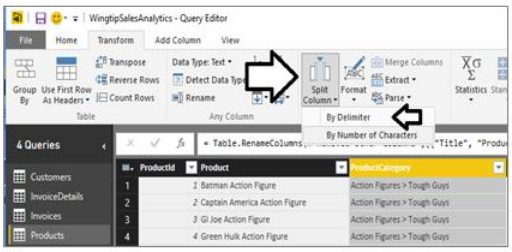
Splitting Columns

- Split a single column up into two columns



	ProductId	Product	Category	Subcategory
1	1	Batman Action Figure	Action Figures	Tough Guys
2	2	Captain America Action Figure	Action Figures	Tough Guys
3	3	GI Joe Action Figure	Action Figures	Tough Guys
4	4	Green Hulk Action Figure	Action Figures	Tough Guys
5	5	Red Hulk Alter Ego Action Figure	Action Figures	Tough Guys
6	6	Godzilla Action Figure	Action Figures	Tough Guys
7	7	Perry the Platypus Action Figure	Action Figures	Cute and Huggable
8	8	Green Angry Bird Action Figure	Action Figures	Cute and Huggable

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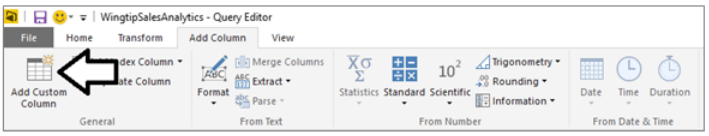
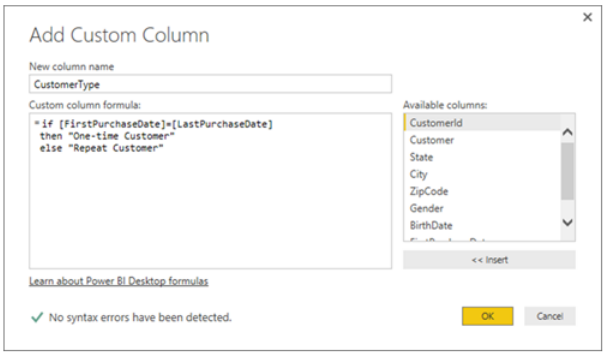
Adding a Custom Column

- Custom column provide custom logic
  - Logic must be written in M programming language





FirstPurchaseDate	LastPurchaseDate	CustomerType
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/29/2012	11/22/2015	Repeat Customer
1/29/2012	10/2/2015	Repeat Customer
1/29/2012	1/29/2012	One-time Customer
1/29/2012	5/6/2015	Repeat Customer
1/29/2012	1/29/2012	One-time Customer

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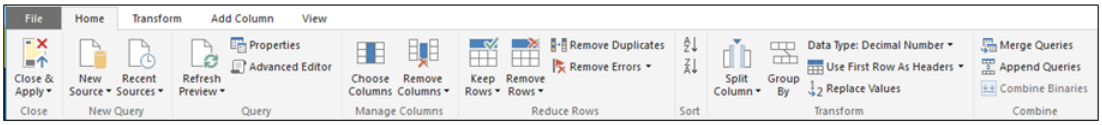
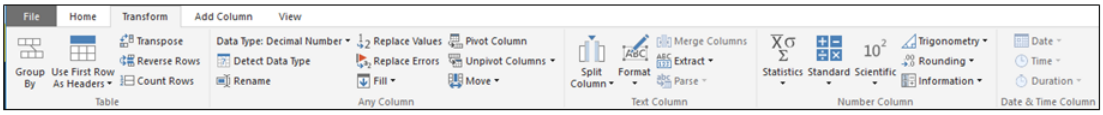
Query Editor Ribbon Tabs

Home tab



Transform tab



Add Columns tab

View tab

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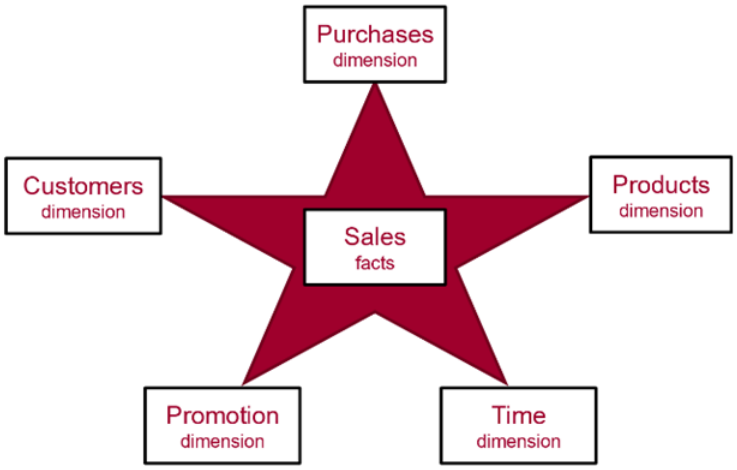
Data Modeling using a Star Schema

- OLAP Modeling often based on Star Schema
  - Tables defined as fact tables or dimension tables
  - Fact tables related to dimension table using 1-to-many relationships



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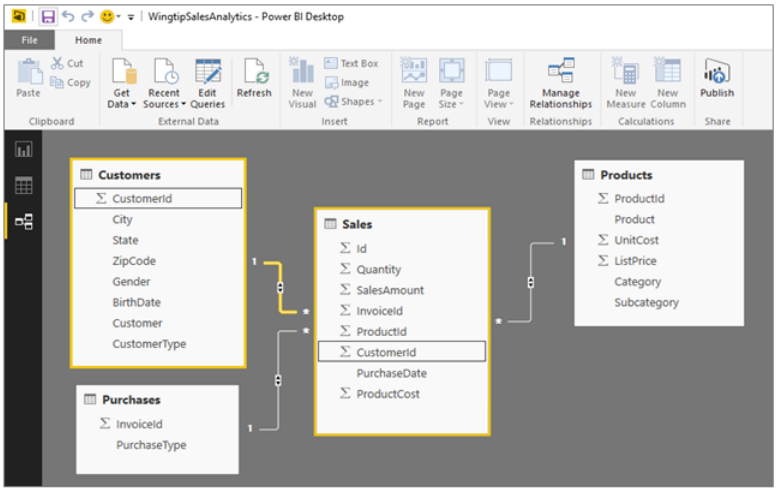
Building a Star Schema with Power Query

- Pull CustomerId column into Sales table



Module 03 Lab: Using the Power Query Features of Power BI Desktop

Lab Time: 40 minutes

Lab Folder: C:\Student\Modules\PowerQuery\Lab\

Lab Overview: In this lab you will begin by creating a new Power BI Desktop project and saving it as a PBIX file. Next, you will learn to work with the Power Query features of Power BI Desktop to extract data from a SQL Azure database and to transform the data as it is loaded into the data model. This is the first lab in a sequence of labs that continue with the same PBIX file. In other words, the labs that follow will build upon the work you do in this lab.

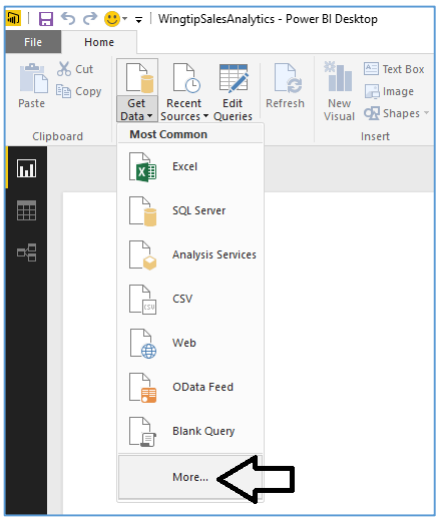
Exercise 1: Importing Data from a SQL Azure Database

In this exercise you will create and save a new Power BI Desktop project. After that, you will connect to a SQL Azure database and import data into Power BI Desktop using its Power Query features.

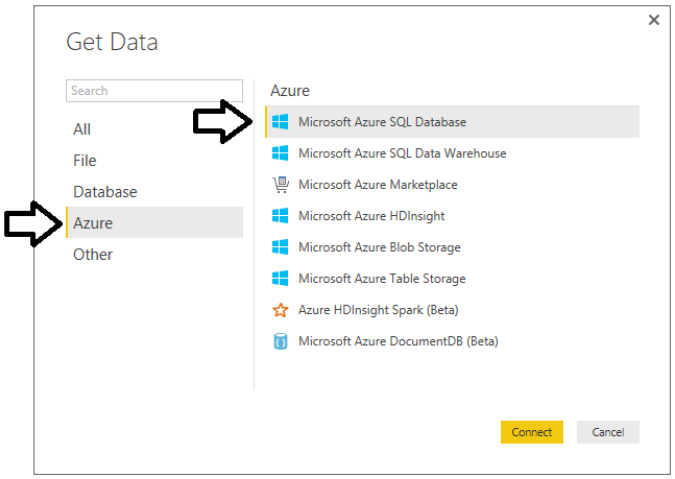
1. Launch Power BI Desktop to start a new project.
2. Save the new project as **WingtipSalesAnalytics.pbix** using the following path.

```
C:\Student\Projects\WingtipSalesAnalytics.pbix
```

3. Drop down the **Get Data** menu button on the ribbon and click **More…**.



4. On the **Get Data** dialog, select **Azure** in the list on the left. Next, select **Microsoft SQL Azure Database** on the right and then click the **Connect** button.



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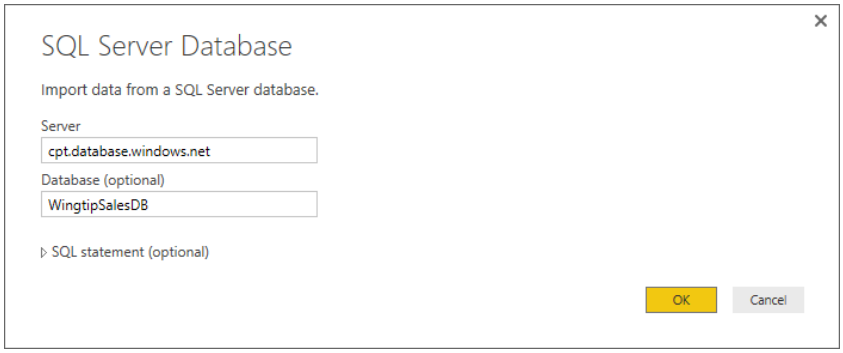
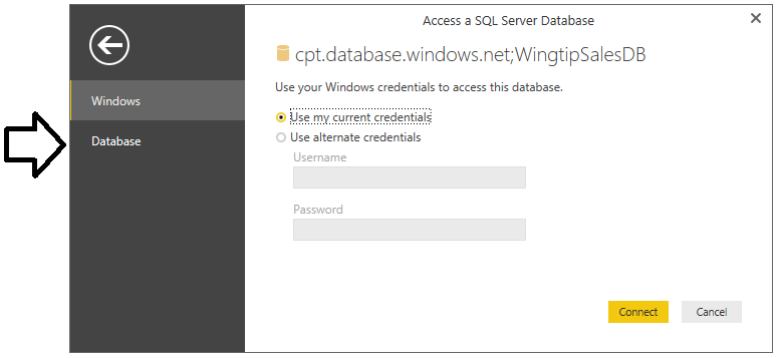
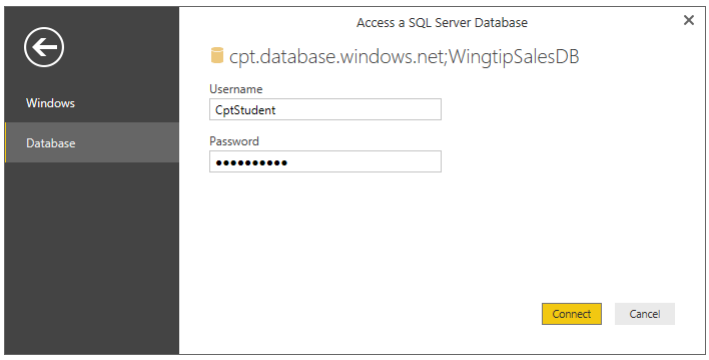
5. When you are prompted with the **SQL Server Database** dialog, enter the following values for the **Server** and **Database**.
   a) Server: cpt.database.windows.net
   b) Database: WingtipSalesDB
6. When the **SQL Server Database** dialog appears as it does in the following screenshot, click the **OK** button to continue.



7. At this point, you will be prompted by the **Access a SQL Server Database** dialog. Click on **Database** on the left side of the dialog so that you can enter the credentials for a standard SQL account instead of using Windows authentication.



8. Enter the following credentials for a SQL user account that has been configured with read access to the database.
   a) Username: **CptStudent**
   b) Password: **pass@word1**
9. Once you have entered the credentials the **Access a SQL Server Database** dialog, click the **Connect** button to continue.



10. At this point, Power BI Desktop should be able to establish a connection to the database and then prompt you with the **Navigator** dialog. The **Navigator** dialog allows you to select the tables you would like to import into your PBIX project.
11. In the **Navigator** dialog, select the **Customers** table, the **InvoiceDetails** table, the **Invoices** table and the **Products** table as shown in the following screenshot. Once you have selected these four tables, click the **Edit** button to create a query for each of these tables and to open the **Query Editor** dialog.

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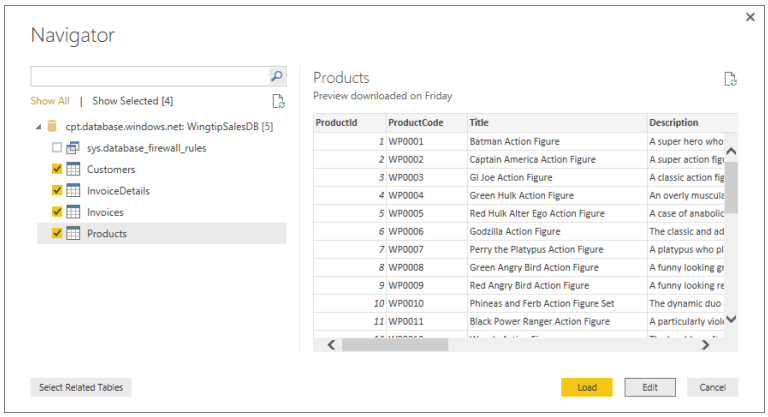
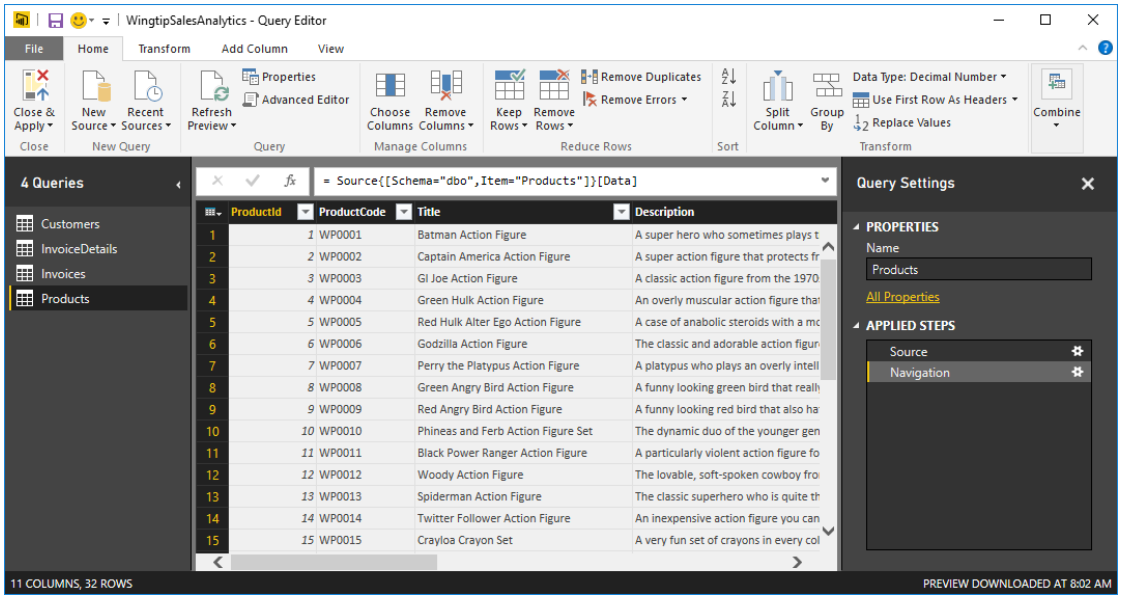
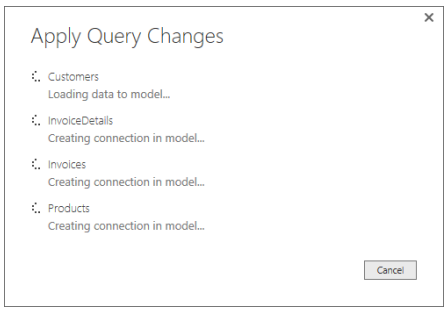


12. When you inspect the **Query Editor** window, you should now be able to observe that Power BI Desktop has created a new query for each of the four tables that you selected in the **Navigator** dialog. You will not begin to edit these queries until the next exercise. However, now you should take a moment to inspect each query by clicking on the query name in the **Queries** list on the left. You should be able to observe that each query is initially created to return the data just as it is defined in the underlying table.



13. Click the **Close and Apply** button in the **Query Editor** window. This will close the **Query Editor** window and start the process of extracting the data from the SQL Azure database and importing it into the current project's data model using a local cache on your student workstation. The **Apply Query Changes** dialog will be displayed with spinning icons as Power BI Desktop imports that data.



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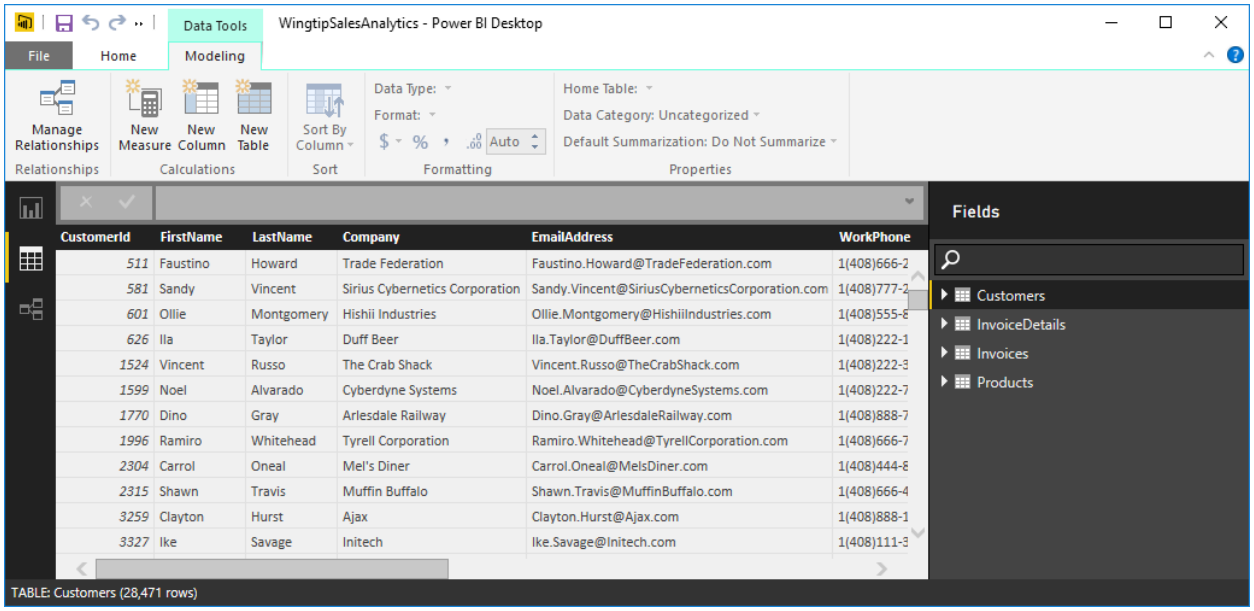
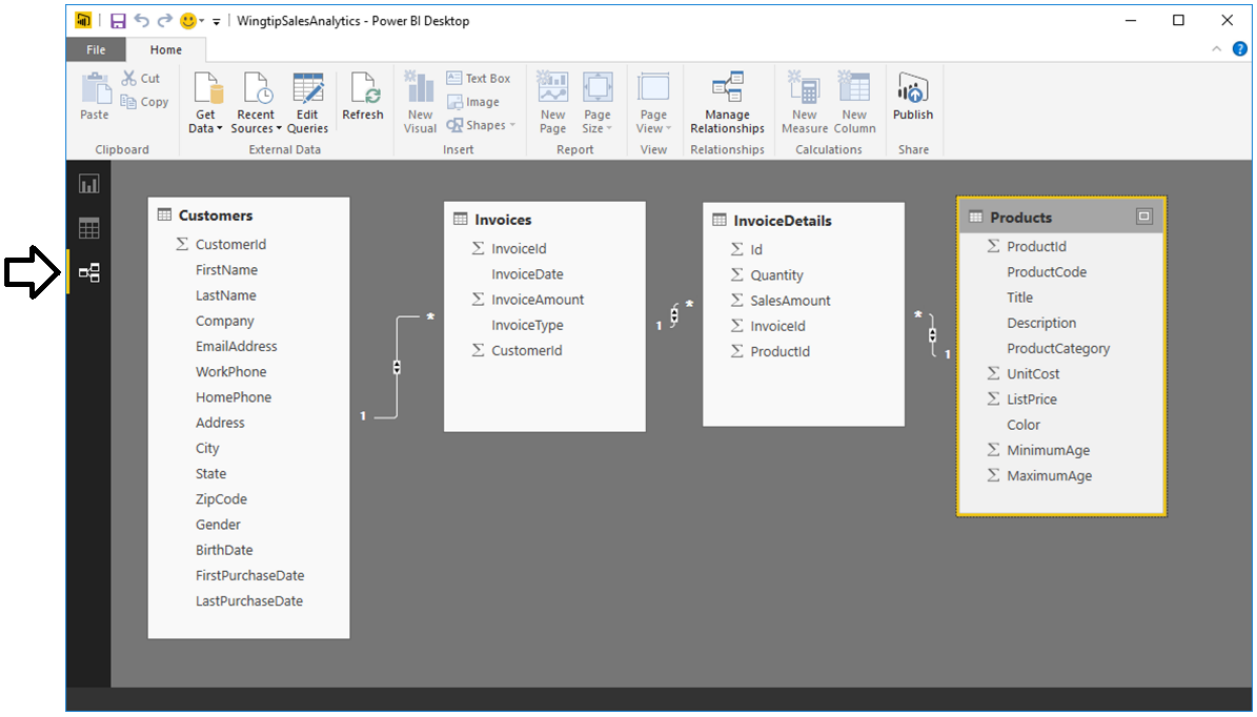
14. Once the data from all four queries has been imported, examine the **Fields** list on the right-hand side of the Power BI Desktop window. You should be able to see that four tables have been created from the four queries.



15. Click on the bottom icon in the sidebar to navigate to relationship view. You should be able to see each of the four tables. You should also be able to see that Power BI Desktop has automatically created relationships between the tables as they were imported into the data model. Use your mouse to move and resize the tables in relationship view so you can see all the fields in each table.



16. Save your work in the current project by clicking the Save button in the upper left corner of the Power BI Desktop window.

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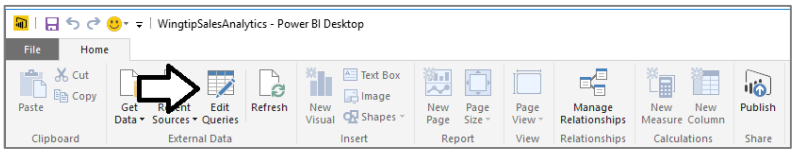
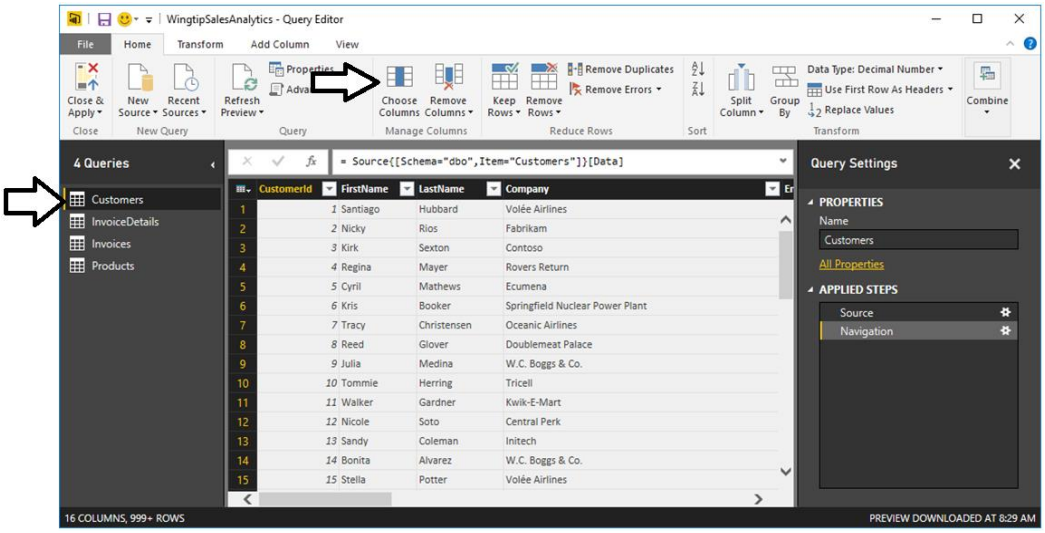
Exercise 2: Using Power Query to Transform and Reshape Customer Data

In the following exercise, you will use the **Query Editor** window to modify the **Customers** query to perform transforms on customer data as it is being loaded into the data model.

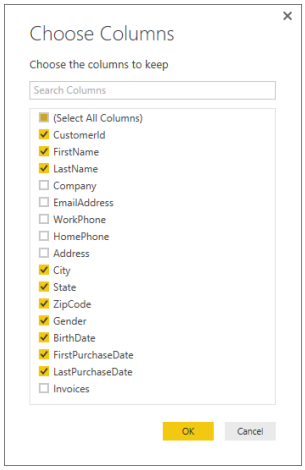
1. Make sure you have the **WingtipSalesAnalytics.pbix** project open that you started in the previous exercise.
2. Click on the **Edit Queries** button in the ribbon to display the Query Editor window.



3. Make sure the **Customers** query is selected in the **Queries** list on the left-hand side of the Query Editor window. Click the **Choose Columns** button in the ribbon to display the **Choose Columns** dialog.



4. In the **Choose Columns** dialog, begin by clicking on the **(Select all Columns)** checkbox at the top to unselect all column. Next, select the checkboxes for **CustomerId**, **FirstName**, **LastName**, **City**, **State**, **ZipCode**, **Gender**, **BirthDate**, **FirstPurchaseDate** and **LastPurchaseDate** as shown in the following screenshot. Once you have these columns selected, click the **OK** button to close the **Choose Columns** dialog and to modify the underlying query.



5. You should be able to see that the Query Editor window now only shows the columns that you selected.

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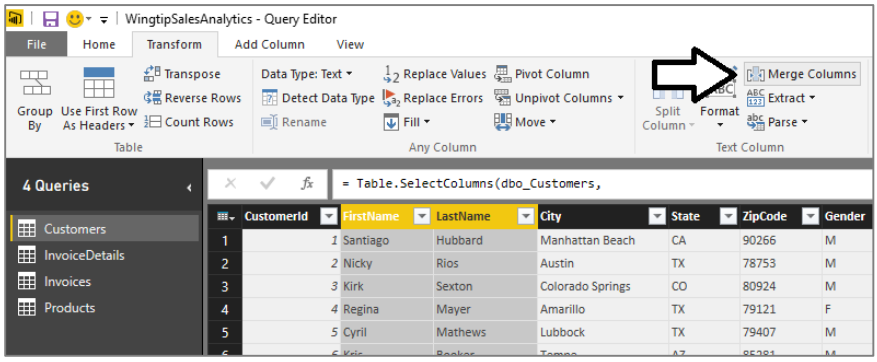
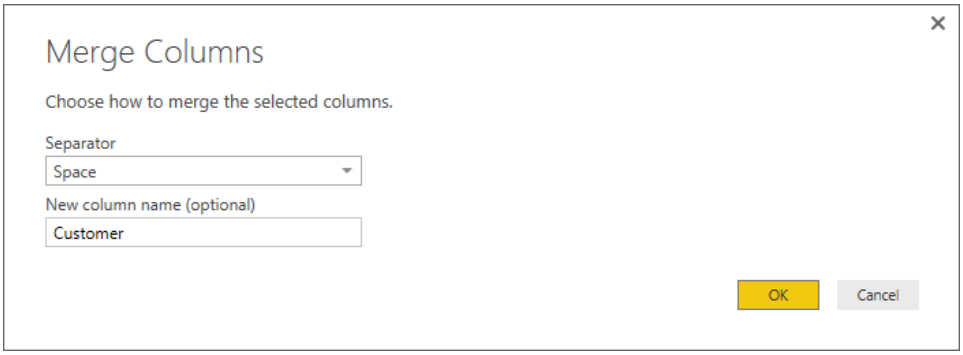
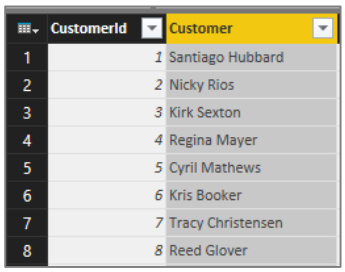
6. In this step you will merge the **FirstName** column and the **LastName** column together into a single column named **Customer**.
   a) Begin by clicking on the **Transform** tab in the ribbon.
   b) Next, select the **FirstName** column by clicking on its column header.
   c) Next, hold down the **SHIFT** key and select the **LastName** column by clicking on its column header.
   d) With both the **FirstName** column and the **LastName** column selected, click the **Merge Column** button in the ribbon to display the **Merge Column** dialog.



   e) In the **Merge Column** dialog, drop down the **Separator** control and select a value of **Space**. Add a **New column name** value of **Customer** and click the **OK** button to modify the underlying query with your changes.



   f) You should now be able to see that the **FirstName** column and the **LastName** column have been replaced with a single merged column named **Customer**.



7. The **State** column is currently to the right of the **City** column. Move the **State** column so that it is repositioned to the left of the **City** column. Accomplish this by clicking on the column header for the **State** column and leaving the mouse button down. Drag the **State** column to the left of the **City** column and release the mouse button.

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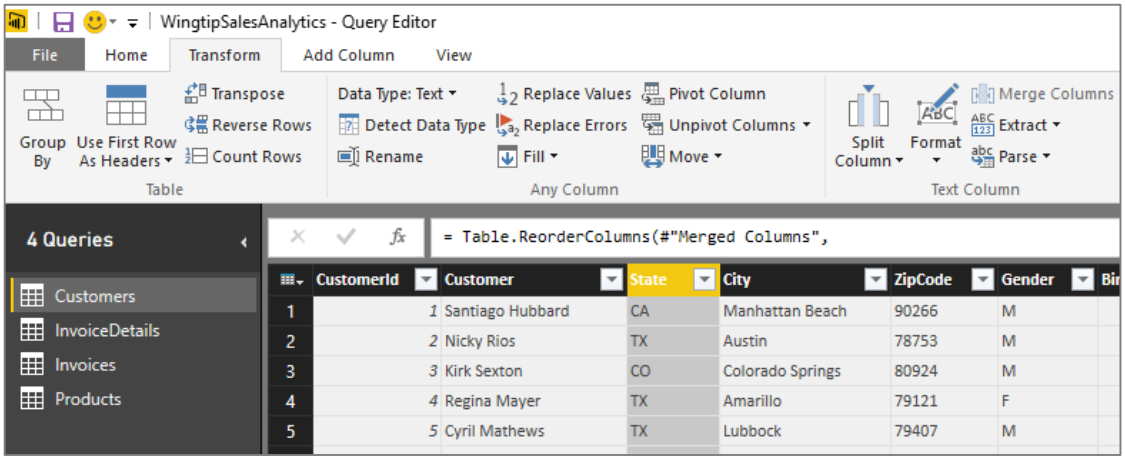
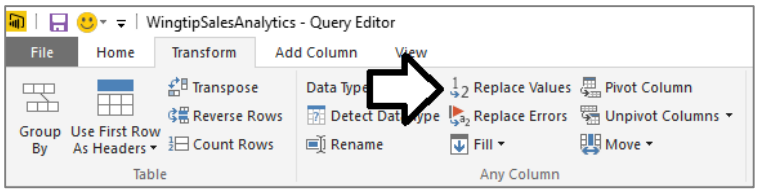
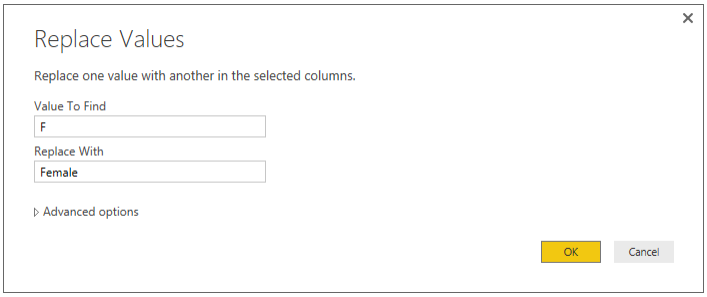


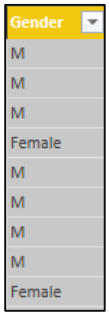
8. Modify the query so that the **Gender** column returns values of **Male** and **Female** instead of **M** and **F**.
   a) Make sure the **Transform** tab is the active tab in the ribbon.
   b) Select the **Gender** column by clicking its column header.
   c) Click the **Replace Values** button in the ribbon to display the **Replace Values** dialog.



   d) In the **Replace Value** dialog, enter a value of **F** in the **Value to Find** textbox and enter a value of **Female** in the **Replace With** textbox. Click to **OK** button add your changes to the underlying query.



   e) You should be able to see that all values of **F** in the **Gender** column have been replaced with a value of **Female**.



   f) Make sure the **Gender** column is still selected.

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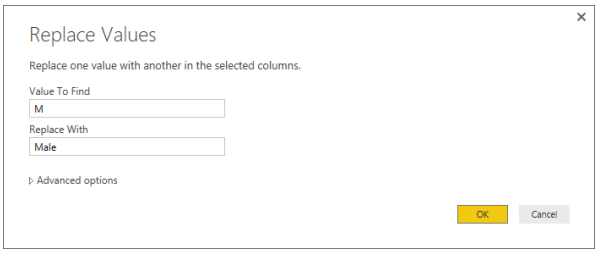
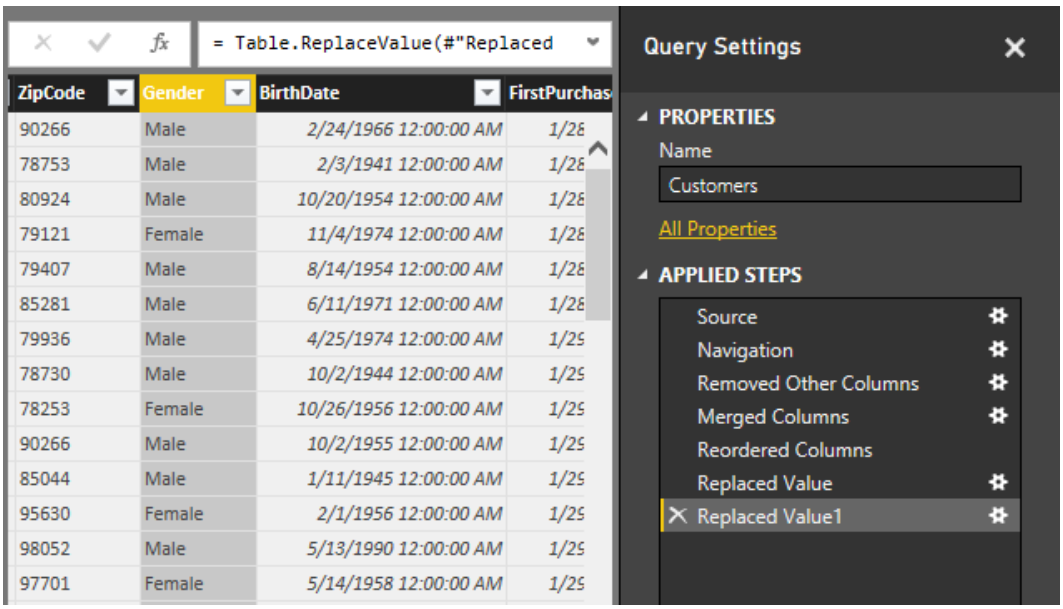
g) Click the **Replace Values** button in the ribbon to display the **Replace Values** dialog.

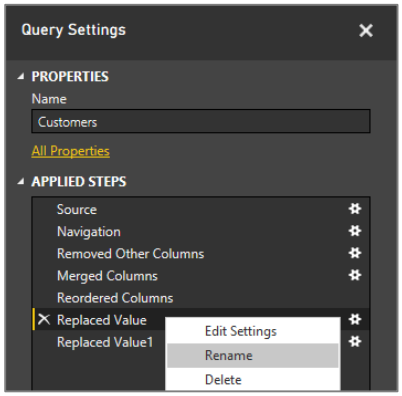
h) In the **Replace Value** dialog, enter a value of **M** in the **Value to Find** textbox and enter a value of **Male** in the **Replace With** textbox. Click to **OK** button add your changes to the underlying query.



i) You should be able to confirm that all values in the **Gender** column have been replaced with a value of either **Male** or **Female**. If you inspect the **APPLIED STEPS** list in the **Query Settings** pane, you should be able to see that there are two steps at the end that have been given the generic names of **Replaced Value** and **Replaced Value 1**.



j) In order to promote higher levels of maintainability, it's often a good idea to rename steps with names such as of **Replaced Value** and **Replaced Value 1**. Rename the **Replaced Values** step by right-clicking it and clicking the **Rename** command to place the step name in edit mode. Modify the name of this step to **Replaced Female Values**.



k) Using the same technique, rename the **Replaced Value 1** step to **Replaced Male Values**.

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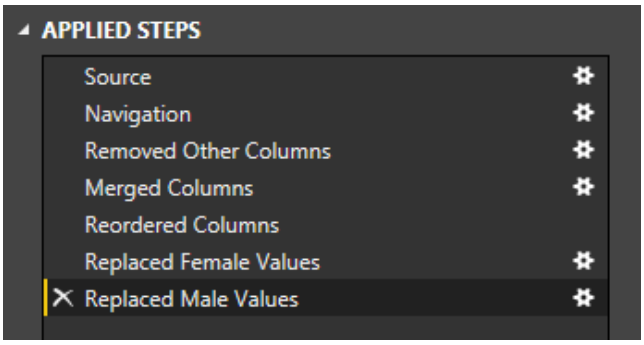
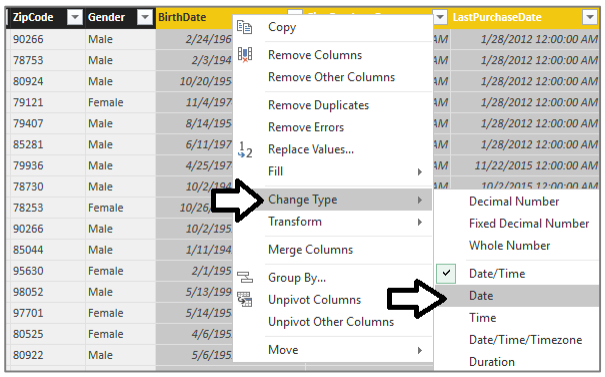


9. Change the column type of BirthDate, FirstPurchasedDate and LastPurchasedDate from Date/Time to Date.
   a) Select the **BirthDate** column by clicking its column header.
   b) Hold down the **SHIFT** key and click the column headers for **FirstPurchasedDate** and **LastPurchasedDate** so that all three columns are selected.
   c) Right-click on any one of the selected columns and select the **Change Type > Date** command.



   d) You should see that the three columns now show values with a date but without a time.

BirthDate	FirstPurchaseDate	LastPurchaseDate
2/24/1966	1/28/2012	1/28/2012
2/3/1941	1/28/2012	1/28/2012
10/20/1954	1/28/2012	1/28/2012
11/4/1974	1/28/2012	1/28/2012
8/14/1954	1/28/2012	1/28/2012
6/11/1971	1/28/2012	1/28/2012
4/25/1974	1/29/2012	11/22/2015
10/2/1944	1/29/2012	10/2/2015
10/26/1956	1/29/2012	1/29/2012
10/2/1955	1/29/2012	5/6/2015

10. Add a new custom column named **CustomerType** to indicates whether the customer is a repeat customer or not. You will accomplish by writing a DAX a formula which compares the **FirstPurchaseDate** column to **LastPurchaseDate** column.
   a) Begin by activating the **Add Column** tab in the ribbon.
   b) Click the **Add Custom Column** button in the ribbon to display the **Add Custom Column** dialog.

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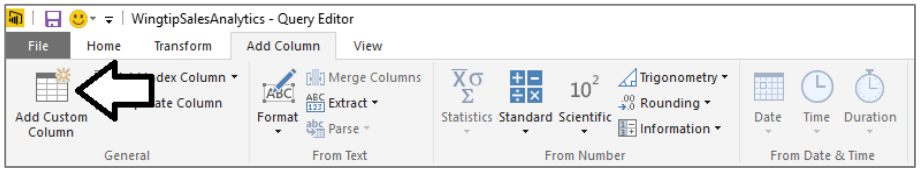


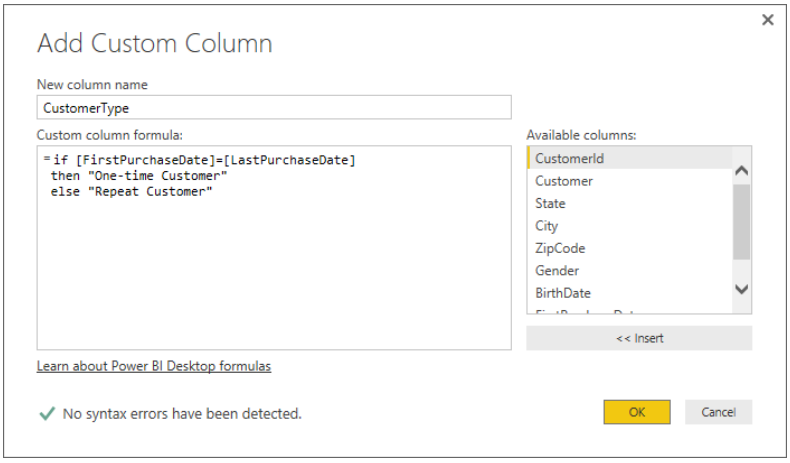
c) In the **Add Custom Column** dialog, add a value of **CustomerType** in the **New column name** textbox.

In this particular scenario, you are working under the assumption that the customer is a repeat customer when the **FirstPurchaseDate** column and the **LastPurchaseDate** column are not equal indicating the customer has made two or more purchases.

d) In the **Custom column formula** textbox, enter the following formula.

```
if [LastPurchaseDate]=[FirstPurchaseDate]
then "One-time Customer"
else "Repeat Customer"
```

e) When the **Add Custom Column** dialog appears as the following screenshot, click the **OK** button to add the new column.



f) You should be able to verify that the new **CustomerType** column has a value of **Repeat Customer** when the current customer has a **FirstPurchaseDate** column value that is not equal to the **LastPurchaseDate** column value. When these column values are equal, the **CustomerType** column has a value of **One-time Customer**.

FirstPurchaseDate	LastPurchaseDate	CustomerType
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/28/2012	1/28/2012	One-time Customer
1/29/2012	11/22/2015	Repeat Customer
1/29/2012	10/2/2015	Repeat Customer
1/29/2012	1/29/2012	One-time Customer
1/29/2012	5/6/2015	Repeat Customer
1/29/2012	1/29/2012	One-time Customer

11. Now, that you have used the **FirstPurchaseDate** column and the **LastPurchaseDate** column to calculate the value of the **CustomerType** column, you can delete them because they are no longer needed.

a) Activate the **Home** tab on the ribbon.

b) Select the **FirstPurchaseDate** column by clicking its column header.

c) Hold down the **SHIFT** key and click the column header for **LastPurchaseDate** so that both columns are selected.

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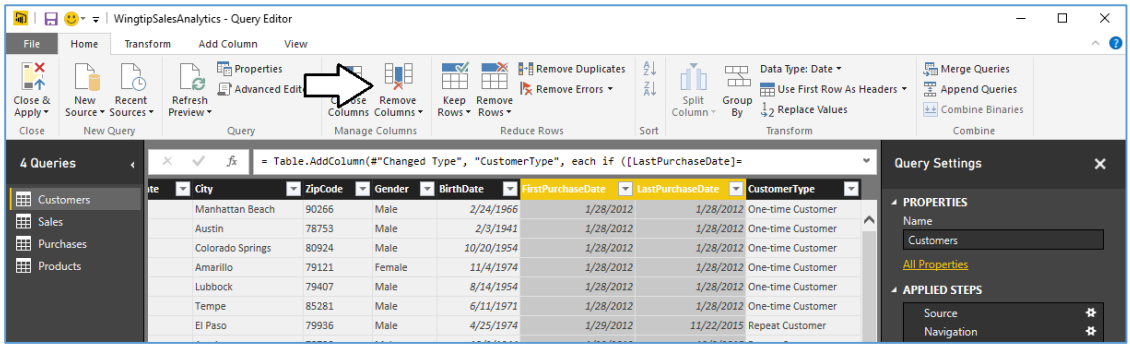
d) Click the **Remove Columns** button in the ribbon to remove both columns from the query results.

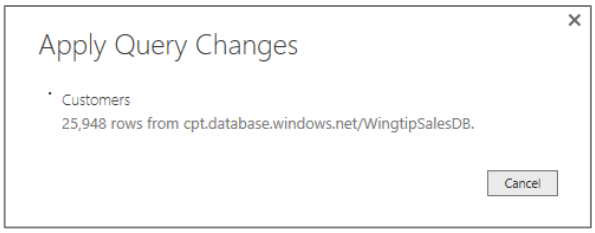


e) You should be able to confirm that the **FirstPurchaseDate** column and the **LastPurchaseDate** columns have been removed from the query results. However, the **CustomerType** column is still there.

	CustomerId	Customer	State	City	ZipCode	Gender	BirthDate	CustomerType
1	1	Santiago Hubbard	CA	Manhattan Beach	90266	Male	2/24/1966	One-time Customer
2	2	Nicky Rios	TX	Austin	78753	Male	2/3/1941	One-time Customer
3	3	Kirk Sexton	CO	Colorado Springs	80924	Male	10/20/1954	One-time Customer
4	4	Regina Mayer	TX	Amarillo	79121	Female	11/4/1974	One-time Customer
5	5	Cyril Mathews	TX	Lubbock	79407	Male	8/14/1954	One-time Customer
6	6	Kris Booker	AZ	Tempe	85281	Male	6/11/1971	One-time Customer
7	7	Tracy Christensen	TX	El Paso	79936	Male	4/25/1974	Repeat Customer
8	8	Reed Glover	TX	Austin	78730	Male	10/2/1944	Repeat Customer

You are now done working with the **Customers** query.

12. Click the **Close and Apply** button on the **Home** tab of the ribbon to execute the updated **Customers** query. Power BI Desktop will display the **Apply Query Changes** dialog while importing the data from the SQL Azure database and transforming it as it loads the customer data into the data model.



13. After the query changes have been applied, you should be able to see the results of your changes in the Customers table that has been loaded into the project's data model.

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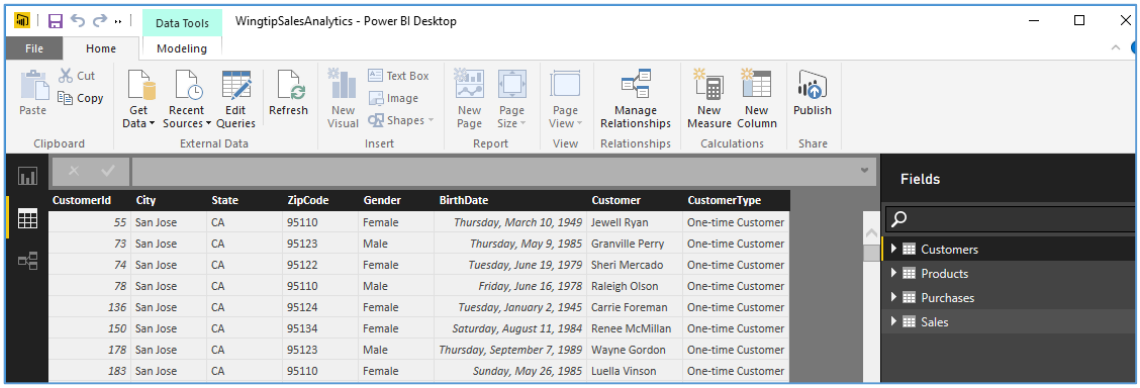


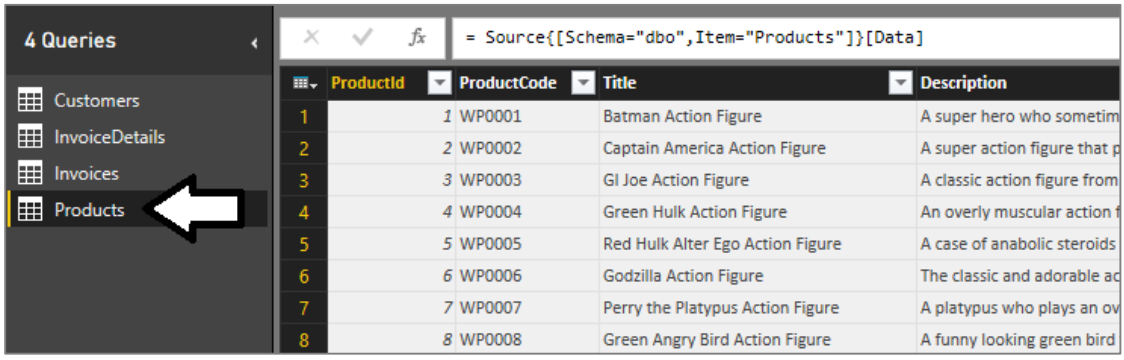
CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType
55	San Jose	CA	95110	Female	Thursday, March 10, 1949	Jewell Ryan	One-time Customer
73	San Jose	CA	95123	Male	Thursday, May 9, 1985	Granville Perry	One-time Customer
74	San Jose	CA	95122	Female	Tuesday, June 19, 1979	Sheri Mercado	One-time Customer
78	San Jose	CA	95110	Male	Friday, June 16, 1978	Raleigh Olson	One-time Customer
136	San Jose	CA	95124	Female	Tuesday, January 2, 1945	Carrie Foreman	One-time Customer
150	San Jose	CA	95134	Female	Saturday, August 11, 1984	Renee McMillan	One-time Customer
178	San Jose	CA	95123	Male	Thursday, September 7, 1989	Wayne Gordon	One-time Customer
183	San Jose	CA	95110	Female	Sunday, May 26, 1985	Luella Vinson	One-time Customer

14. Save the work you have done to **WingtipSalesAnalytics.pbix** by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 3: Using Power Query to Transform and Reshape Product Data

In the following exercise, you will use the **Query Editor** window to modify the **Products** query to perform transforms on product data as it is being loaded into the data model.

1. Make sure you have the **WingtipSalesAnalytics.pbix** project open that you started in the previous exercise.
2. Click on the **Edit Queries** button in the ribbon to display the **Query Editor** window.
3. Make sure the **Products** query is selected in the **Queries** list on the left-hand side of the **Query Editor** window.



	ProductId	ProductCode	Title	Description
1	1	WP0001	Batman Action Figure	A super hero who sometim
2	2	WP0002	Captain America Action Figure	A super action figure that p
3	3	WP0003	GI Joe Action Figure	A classic action figure from
4	4	WP0004	Green Hulk Action Figure	An overly muscular action f
5	5	WP0005	Red Hulk Alter Ego Action Figure	A case of anabolic steroids
6	6	WP0006	Godzilla Action Figure	The classic and adorable ac
7	7	WP0007	Perry the Platypus Action Figure	A platypus who plays an ov
8	8	WP0008	Green Angry Bird Action Figure	A funny looking green bird

4. Remove the columns that are not required in the **Products** query results.
   a) Click the **Choose Columns** button in the ribbon to display the **Choose Columns** dialog.
   b) In the **Choose Columns** dialog, begin by clicking on the **(Select all Columns)** checkbox at the top to unselect all columns. Next, select the checkboxes for **ProductId**, **Title**, **ProductCategory**, **UnitCost** and **ListPrice** as shown in the following screenshot. Once you have these columns selected, click the **OK** button to close the dialog and to modify the underlying query.

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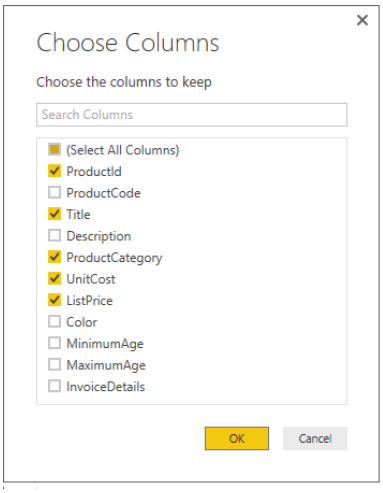
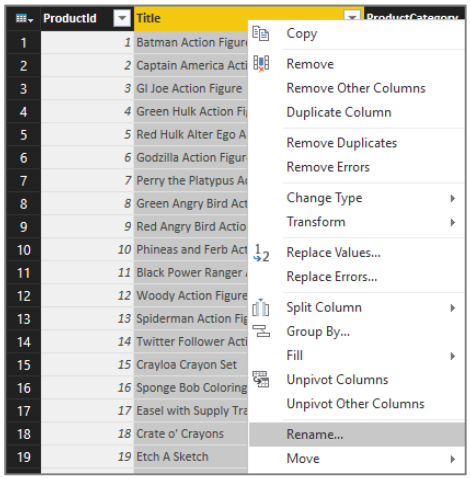
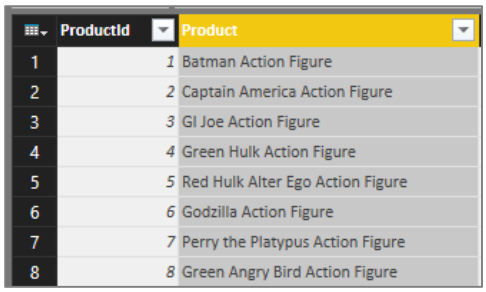


5. Rename the **Title** column to **Product**.
   a) Right-click on the **Title** column and click **Rename**.



   b) Modify the column name to **Product**.



	ProductId	Product
1	1	Batman Action Figure
2	2	Captain America Action Figure
3	3	GI Joe Action Figure
4	4	Green Hulk Action Figure
5	5	Red Hulk Alter Ego Action Figure
6	6	Godzilla Action Figure
7	7	Perry the Platypus Action Figure
8	8	Green Angry Bird Action Figure

6. Split the **ProductCategory** column up into two separate columns named **Category** and **Subcategory**.
   a) Activate the **Transform** tab on the ribbon.
   b) Select the **ProductCategory** by clicking its column header.
   c) Drop down the **Split Column** menu button and click by **By Delimiter** to display the **Split Column By Column** dialog.

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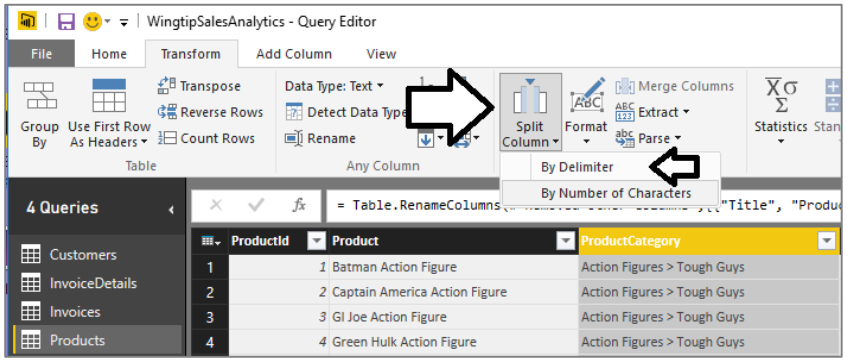
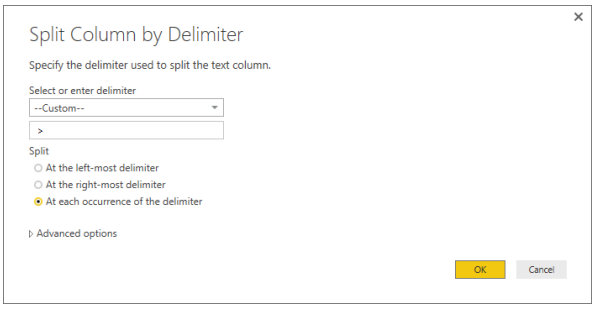


d) In the Split Column By Column dialog, drop down the Select or enter delimiter combo box and select --Custom--.

e) In the textbox below the combo box, enter a three-character text value which includes a space follow by the **>** character followed by another space.

f) When the **Split Column By Column** dialog appears as the one in the following screenshot, click the **OK** button to add the step to the **Products** query.



g) You should be able to confirm that Power BI Desktop has split the **ProductCategory** column into two separate columns named **ProductCategory.1** and **ProductCategory.2**.

	ProductId	Product	ProductCategory.1	ProductCategory.2
1	1	Batman Action Figure	Action Figures	Tough Guys
2	2	Captain America Action Figure	Action Figures	Tough Guys
3	3	GI Joe Action Figure	Action Figures	Tough Guys
4	4	Green Hulk Action Figure	Action Figures	Tough Guys
5	5	Red Hulk Alter Ego Action Figure	Action Figures	Tough Guys
6	6	Godzilla Action Figure	Action Figures	Tough Guys
7	7	Perry the Platypus Action Figure	Action Figures	Cute and Huggable
8	8	Green Angry Bird Action Figure	Action Figures	Cute and Huggable

h) Rename the **ProductCategory.1** column to **Category.** Also rename the **ProductCategory.2** column to **Subcategory** as shown in the following screenshot.

	ProductId	Product	Category	Subcategory
1	1	Batman Action Figure	Action Figures	Tough Guys
2	2	Captain America Action Figure	Action Figures	Tough Guys
3	3	GI Joe Action Figure	Action Figures	Tough Guys
4	4	Green Hulk Action Figure	Action Figures	Tough Guys
5	5	Red Hulk Alter Ego Action Figure	Action Figures	Tough Guys
6	6	Godzilla Action Figure	Action Figures	Tough Guys
7	7	Perry the Platypus Action Figure	Action Figures	Cute and Huggable
8	8	Green Angry Bird Action Figure	Action Figures	Cute and Huggable

When you have query columns based on numeric currency values, it is best to change their column type to **Fixed Decimal Number**.

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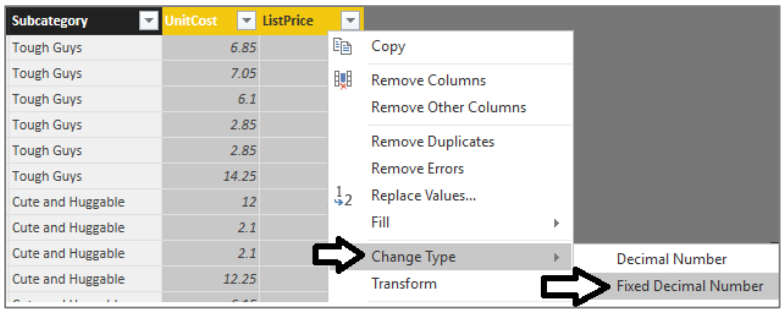
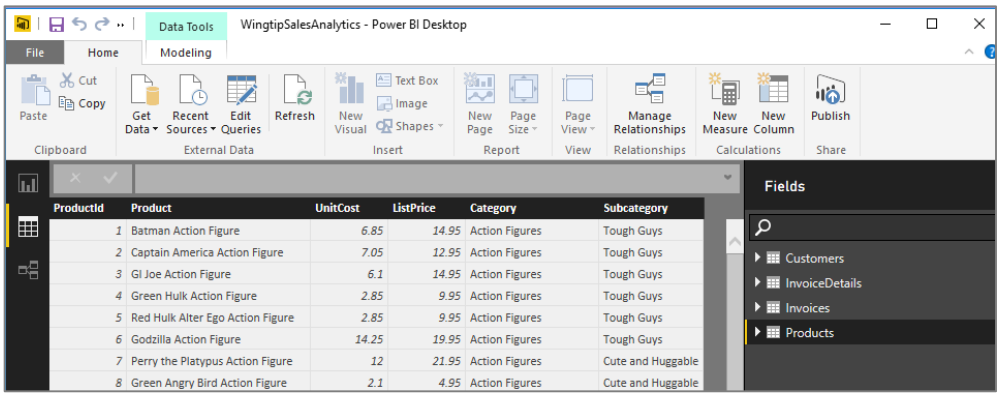
7. Modify the column type of the **UnitCost** column and the **ListPrice** column to the **Fixed Decimal Number** type.
   a) Select the **UnitCost** column by clicking its column header.
   b) Hold down the **SHIFT** key and click the ListPrice column so that both columns are selected.
   c) Right-click either one of the selected columns and click the **Change Type > Fixed Decimal Number** menu command.



You are now done working with the **Products** query.

8. Click the **Close and Apply** button on the **Home** tab of the ribbon to execute the updated **Products** query. Power BI Desktop will display the **Apply Query Changes** dialog while importing the data and transforming it to load it into the data model.
9. After the query changes have been applied, you should be able to see the results of your changes in the **Products** table that has been loaded into the project's data model.



You might have noticed that the columns that are displayed in the **Products** table do not appear in the same order as they appear in the **Products** query. As of the November 2015 updates, Power BI Desktop still does not provide any ability to control and change the order of columns or fields as they are defined in a table. Microsoft is expected to address this limitation soon in a future update to the Power BI Designer.

10. Save your work by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 4: Using Power Query to Transform and Reshape Product Data

In the following exercise, you will use the Query Editor to modify the **InvoiceDetails** query to transform data related to sales data before it is loaded into the data model.

1. Make sure you have the **WingtipSalesAnalytics.pbix** project open that you started in the previous exercise.
2. Click on the **Edit Queries** button in the ribbon to display the Query Editor window.
3. Make sure the **InvoiceDetails** query is selected in the **Queries** list on the left-hand side of the **Query Editor** window.

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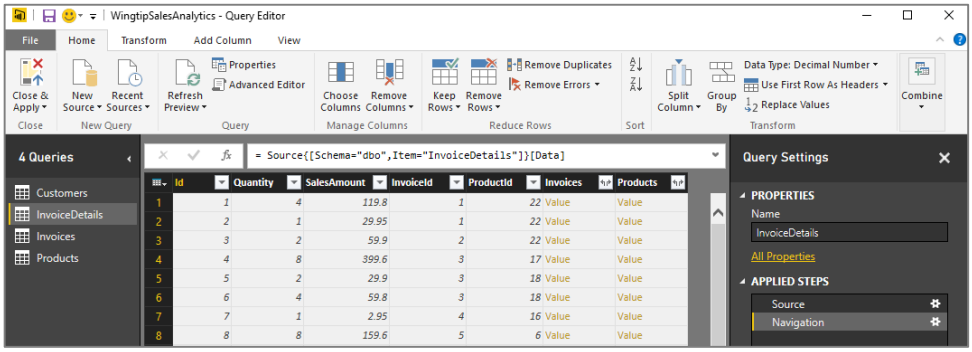
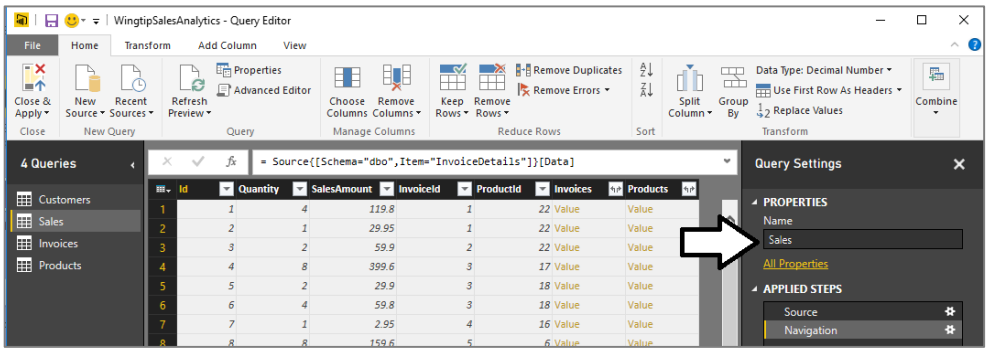
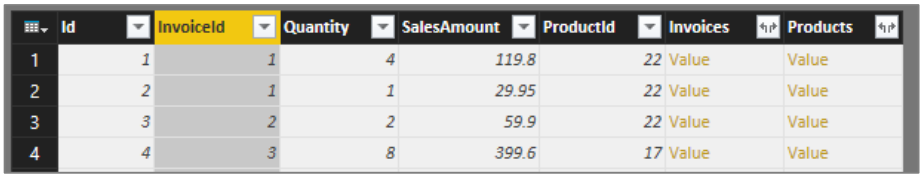


One important point of flexibility in the import process is that you can change the name of a query, and therefore the name of the resulting table to make the data model more intuitive and easier to understand. The **InvoiceDetails** query is returning data that will be used to calculate sales results at the most granular level. Therefore, the data model will be easier to understand if you change the name the name of the **InvoiceDetails** query to **Sales**. The will result in renaming the resulting table to the **Sales** table.

4. Update the name of the **InvoiceDetails** query to **Sales** by replacing the text in the **Name** textbox in the **Query Settings** pane.

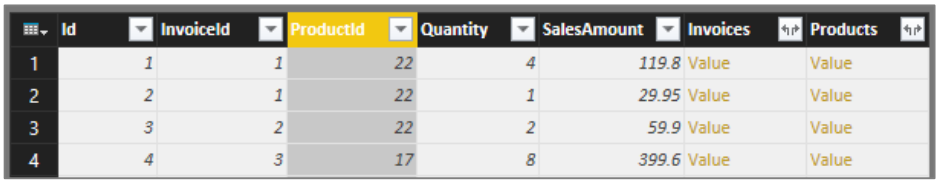


5. Using the mouse, drag and drop the column header for the **InvoiceId** column to move it to the immediate right of the **Id** column.



	Id	InvoiceId	Quantity	SalesAmount	ProductId	Invoices	Products
1	1	1	4	119.8	22	Value	Value
2	2	1	1	29.95	22	Value	Value
3	3	2	2	59.9	22	Value	Value
4	4	3	8	399.6	17	Value	Value

6. Using the mouse, drag and drop the column header for the **ProductId** column to move it to the right of the **InvoiceId** column.



	Id	InvoiceId	ProductId	Quantity	SalesAmount	Invoices	Products
1	1	1	22	4	119.8	Value	Value
2	2	1	22	1	29.95	Value	Value
3	3	2	22	2	59.9	Value	Value
4	4	3	17	8	399.6	Value	Value

7. Modify the column type of the **SalesAmount** column to the **Fixed Decimal Number** type.
   a) Select the **SalesAmoungt** column by clicking its column header.
   b) Right-click the selected column and click the **Change Type > Fixed Decimal Number** menu command.
8. Expand the **Invoices** column to add the **InvoiceDate** column and the **CustomerId** column to the **Sales** query.
   a) Click the Expand button inside the column header of the **Invoices** column to display the **Columns to Expand** dialog.

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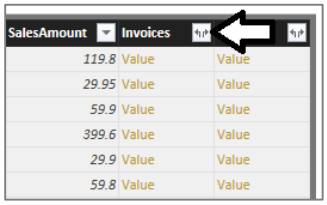
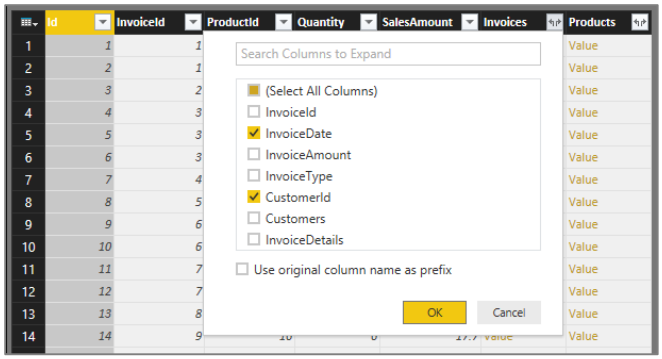


b) In the **Columns to Expand** dialog, begin by clicking on the **(Select all Columns)** checkbox at the top to unselect all columns. Next, select the checkboxes for the **InvoiceDate** column and the **CustomerId** column. Also make sure to uncheck the checkbox with the caption **Use original column name as prefix**. Once the **Columns to Expand** dialog looks like the one shown in the following screenshot, click the **OK** button to close the dialog and to modify the underlying query.



c) You should see that the **InvoiceDate** column and the **CustomerId** column have now been added to the **Sales** query results.

	Id	InvoiceId	ProductId	Quantity	SalesAmount	InvoiceDate	CustomerId	Products
1	1	1	22	4	119.8	1/28/2012 12:00:00 AM	1	Value
2	2	1	22	1	29.95	1/28/2012 12:00:00 AM	1	Value
3	3	2	22	2	59.9	1/28/2012 12:00:00 AM	2	Value
4	4	3	17	8	399.6	1/28/2012 12:00:00 AM	3	Value
5	5	3	18	2	29.9	1/28/2012 12:00:00 AM	3	Value
6	6	3	18	4	59.8	1/28/2012 12:00:00 AM	3	Value
7	7	4	16	1	2.95	1/28/2012 12:00:00 AM	4	Value

9. Use the mouse to drag and drop the **CustomerId** column to move it to the right of the **InvoiceId** column.

	Id	InvoiceId	CustomerId	ProductId	Quantity	SalesAmount	InvoiceDate	Products
1	1	1	1	22	4	119.8	1/28/2012 12:00:00 AM	Value
2	2	1	1	22	1	29.95	1/28/2012 12:00:00 AM	Value
3	3	2	2	22	2	59.9	1/28/2012 12:00:00 AM	Value
4	4	3	3	17	8	399.6	1/28/2012 12:00:00 AM	Value
5	5	3	3	18	2	29.9	1/28/2012 12:00:00 AM	Value
6	6	3	3	18	4	59.8	1/28/2012 12:00:00 AM	Value
7	7	4	4	16	1	2.95	1/28/2012 12:00:00 AM	Value

10. Use the mouse to drag and drop the **InvoiceDate** column to move it to the right of the **ProductId** column.

	Id	InvoiceId	CustomerId	ProductId	InvoiceDate	Quantity	SalesAmount	Products
1	1	1	1	22	1/28/2012 12:00:00 AM	4	119.8	Value
2	2	1	1	22	1/28/2012 12:00:00 AM	1	29.95	Value
3	3	2	2	22	1/28/2012 12:00:00 AM	2	59.9	Value
4	4	3	3	17	1/28/2012 12:00:00 AM	8	399.6	Value
5	5	3	3	18	1/28/2012 12:00:00 AM	2	29.9	Value
6	6	3	3	18	1/28/2012 12:00:00 AM	4	59.8	Value
7	7	4	4	16	1/28/2012 12:00:00 AM	1	2.95	Value

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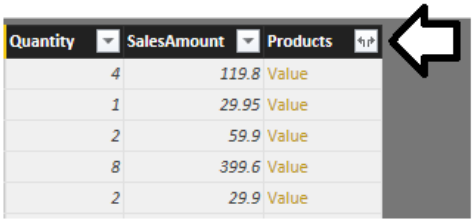
11. Change the column type of the **InvoiceDate** to the **Date** type by right-clicking its column header and selecting the **Change Type > Date** command. When you are done, the data in the column should show a date value without a time.

	Id	InvoiceId	CustomerId	ProductId	InvoiceDate	Quantity	SalesAmount	Products
1	1	1	1	22	1/28/2012	4	119.8	Value
2	2	1	1	22	1/28/2012	1	29.95	Value
3	3	2	2	22	1/28/2012	2	59.9	Value
4	4	3	3	17	1/28/2012	8	399.6	Value
5	5	3	3	18	1/28/2012	2	29.9	Value
6	6	3	3	18	1/28/2012	4	59.8	Value
7	7	4	4	16	1/28/2012	1	2.95	Value

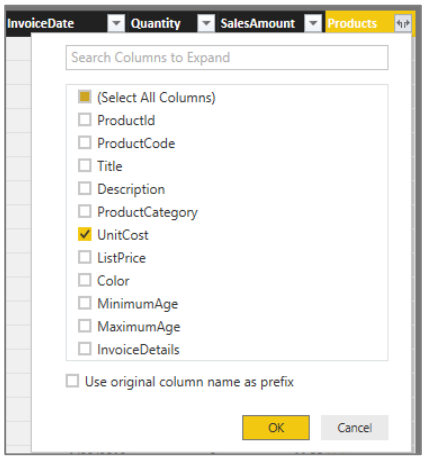
12. Change the name of the **InvoiceDate** column to **PurchaseDate**.

	Id	InvoiceId	CustomerId	ProductId	PurchaseDate	Quantity	SalesAmount	Products
1	1	1	1	22	1/28/2012	4	119.8	Value
2	2	1	1	22	1/28/2012	1	29.95	Value
3	3	2	2	22	1/28/2012	2	59.9	Value
4	4	3	3	17	1/28/2012	8	399.6	Value
5	5	3	3	18	1/28/2012	2	29.9	Value
6	6	3	3	18	1/28/2012	4	59.8	Value

13. Expand the **Products** column to add the **UnitCost** column to the **Sales** query.
    a) Click the Expand button inside the column header of the **Products** column to display the **Columns to Expand** dialog.



    b) In the **Columns to Expand** dialog, begin by clicking on the **(Select all Columns)** checkbox at the top to unselect all columns. Next, select the checkbox for the **UnitCost** column. Also make sure to uncheck the checkbox with the caption **Use original column name as prefix**. Once the **Columns to Expand** dialog looks like the one shown in the following screenshot, click the **OK** button to close the dialog and to modify the underlying query.



    c) You should see that the **UnitCost** column has now been added to the **Sales** query results.

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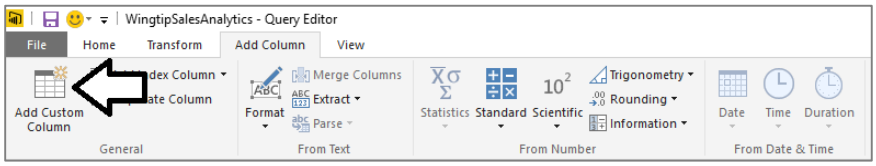
	Id	InvoiceId	CustomerId	ProductId	PurchaseDate	Quantity	SalesAmount	UnitCost
1	1	1	1	22	1/28/2012	4	119.8	21.5
2	2	1	1	22	1/28/2012	1	29.95	21.5
3	3	2	2	22	1/28/2012	2	59.9	21.5
4	4	3	3	17	1/28/2012	8	399.6	12.1
5	5	3	3	18	1/28/2012	2	29.9	10.5
6	6	3	3	18	1/28/2012	4	59.8	10.5

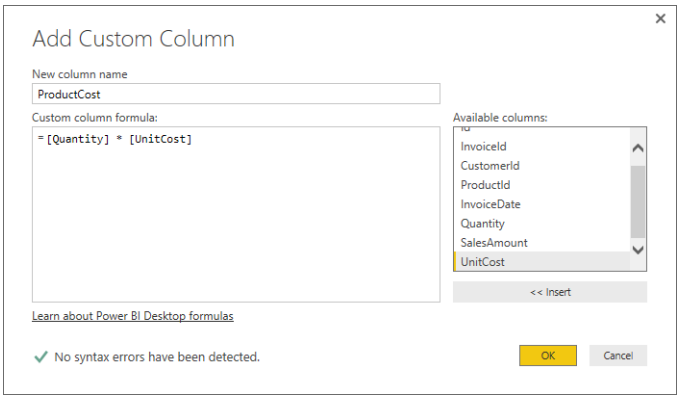
14. Add a new custom column named **ProductCost** to calculate the product of the **Quantity** field multiplied by the **UnitCost** field.
    a) Begin by activating the **Add Column** tab in the ribbon.
    b) Click the **Add Custom Column** button in the ribbon to display the **Add Custom Column** dialog.



    c) In the **Add Custom Column** dialog, add a value of **ProductCost** in the **New column name** textbox.
    d) In the **Custom column formula** textbox, enter the following formula.

```
[Quantity] * [UnitCost]
```

    e) When the **Add Custom Column** dialog appears as the following screenshot, click the **OK** button to add the new column.



    f) You should be able to verify that the new **ProductCost** column has a value calculated by multiplying the value of the **Quantity** column together with the value of the **UnitCost** column.

	Id	InvoiceId	CustomerId	ProductId	PurchaseDate	Quantity	SalesAmount	UnitCost	ProductCost
1	1	1	1	22	1/28/2012	4	119.8	21.5	86
2	2	1	1	22	1/28/2012	1	29.95	21.5	21.5
3	3	2	2	22	1/28/2012	2	59.9	21.5	43
4	4	3	3	17	1/28/2012	8	399.6	12.1	96.8
5	5	3	3	18	1/28/2012	2	29.9	10.5	21
6	6	3	3	18	1/28/2012	4	59.8	10.5	42

Once the **UnitCost** column has been used to calculate the value for the **ProductCost** value, this column is no longer needed and can be removed from the results of the **Sales** query.

15. Remove the **UnitCost** column by selecting its column header and pressing the DELETE key on the keyboard.

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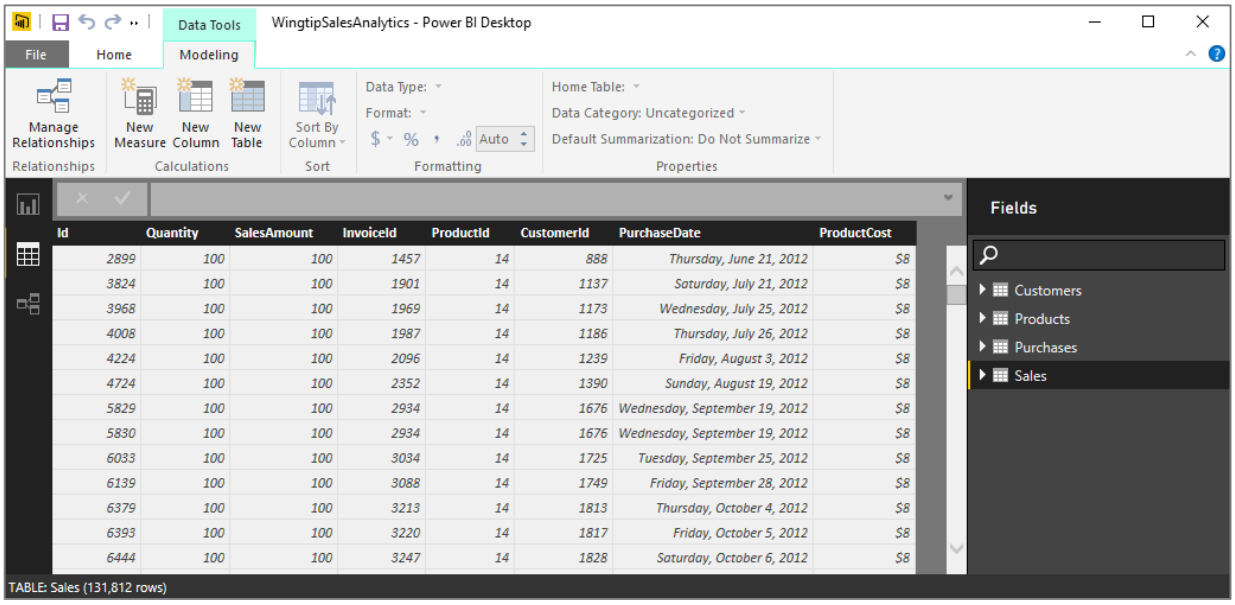
	Id	InvoiceId	CustomerId	ProductId	PurchaseDate	Quantity	SalesAmount	ProductCost
1	1	1	1	22	1/28/2012	4	119.8	86
2	2	1	1	22	1/28/2012	1	29.95	21.5
3	3	2	2	22	1/28/2012	2	59.9	43
4	4	3	3	17	1/28/2012	8	399.6	96.8
5	5	3	3	18	1/28/2012	2	29.9	21
6	6	3	3	18	1/28/2012	4	59.8	42

16. Modify the column type of the **SalesAmount** column and the **ProductCost** column to the **Fixed Decimal Number** type.
    a) Select the **SalesAmount** column by clicking its column header.
    b) Hold down the **SHIFT** key and click the **ProductCost** column so that both columns are selected.
    c) Right-click either one of the selected columns and click the **Change Type > Fixed Decimal Number** menu command.

You are now done working with the **Sales** query.

17. Click the **Close and Apply** button on the **Home** tab of the ribbon to execute the updated **Sales** query. Power BI Desktop will display the **Apply Query Changes** dialog while importing the data and transforming it to load it into the data model.
18. After the query changes have been applied, you should be able to see the results of your changes in the **Sales** table that has been loaded into the project's data model.



Id	Quantity	SalesAmount	InvoiceId	ProductId	CustomerId	PurchaseDate	ProductCost
2899	100	100	1457	14	888	Thursday, June 21, 2012	$8
3824	100	100	1901	14	1137	Saturday, July 21, 2012	$8
3968	100	100	1969	14	1173	Wednesday, July 25, 2012	$8
4008	100	100	1987	14	1186	Thursday, July 26, 2012	$8
4224	100	100	2096	14	1239	Friday, August 3, 2012	$8
4724	100	100	2352	14	1390	Sunday, August 19, 2012	$8
5829	100	100	2934	14	1676	Wednesday, September 19, 2012	$8
5830	100	100	2934	14	1676	Wednesday, September 19, 2012	$8
6033	100	100	3034	14	1725	Tuesday, September 25, 2012	$8
6139	100	100	3088	14	1749	Friday, September 28, 2012	$8
6379	100	100	3213	14	1813	Thursday, October 4, 2012	$8
6393	100	100	3220	14	1817	Friday, October 5, 2012	$8
6444	100	100	3247	14	1828	Saturday, October 6, 2012	$8

Unfortunately, the current version of Power BI Desktop does not retain the order of the columns that you configured in the **Sales** query.

19. Save your work by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 5: Using Power Query to Transform and Reshape Purchase Data

In the following exercise, you will use the **Query Editor** window to modify the **Invoices** query to transform invoice data as it is being loaded into the data model.

1. Make sure you have the **WingtipSalesAnalytics.pbix** project open that you started in the previous exercise.
2. Click on the **Edit Queries** button in the ribbon to display the **Query Editor** window.
3. Make sure the **Invoices** query is selected in the **Queries** list on the left-hand side of the Query Editor window.

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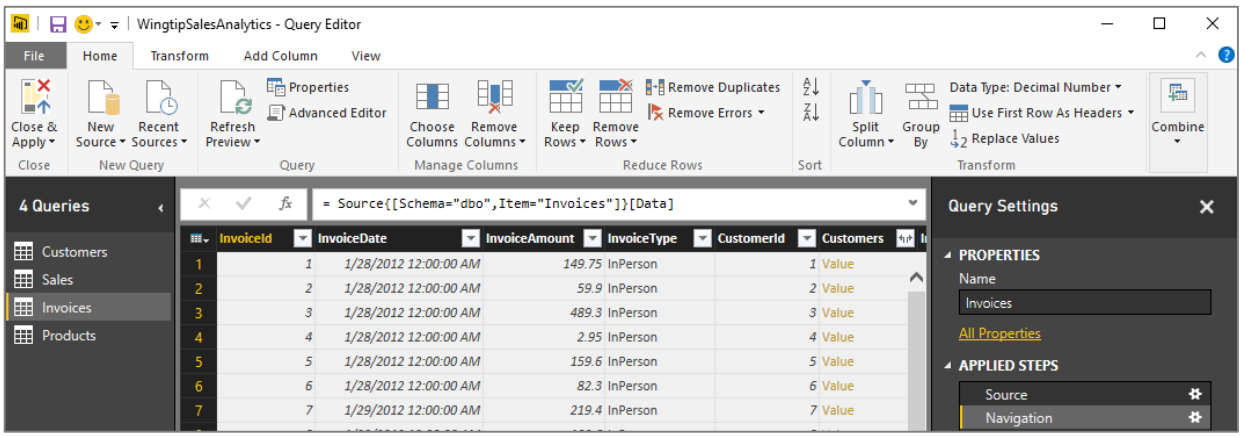
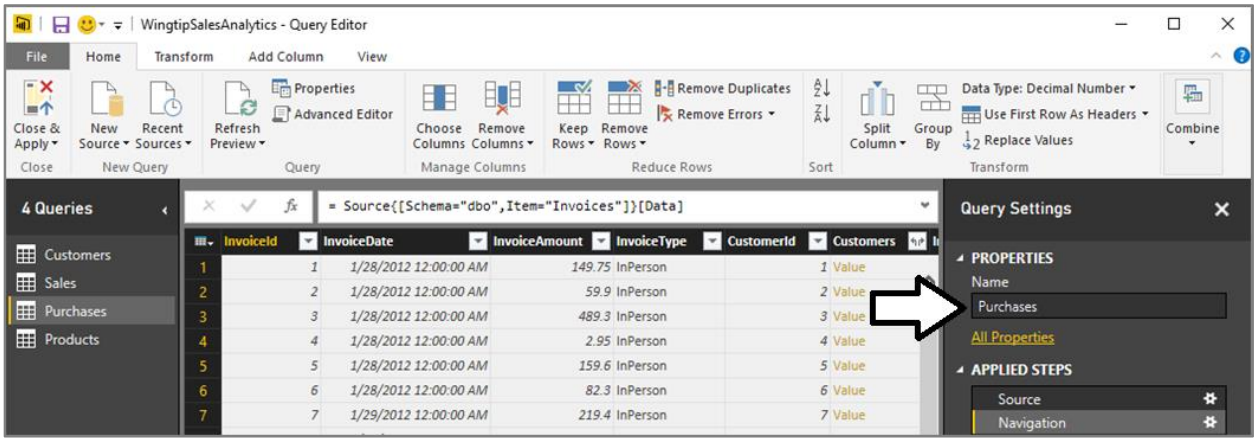


In the last exercise you changed the name of the **InvoiceDetails** to **Sales** to make the data model easier to understand. In this exercise you will change the name of the **Invoices** query to **Purchases** for the same reason.

4. Update the name of the **Invoices** query to **Purchases** by replacing the text in the **Name** textbox in the **Query Settings** pane.



5. Make sure the **Purchases** query is selected in the **Queries** list on the left-hand side of the Query Editor window. Click the **Choose Columns** button in the ribbon to display the **Choose Columns** dialog.
6. In the **Choose Columns** dialog, begin by clicking on the **(Select all Columns)** checkbox at the top to unselect all columns. Next, select the checkboxes for **InvoiceId** and **InvoiceType** as shown in the following screenshot. Once you have these columns selected, click the **OK** button to close the **Choose Columns** dialog and to modify the underlying query.

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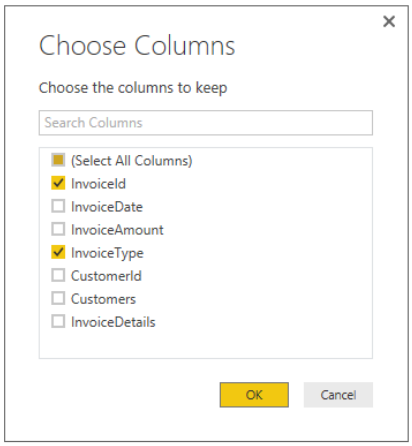
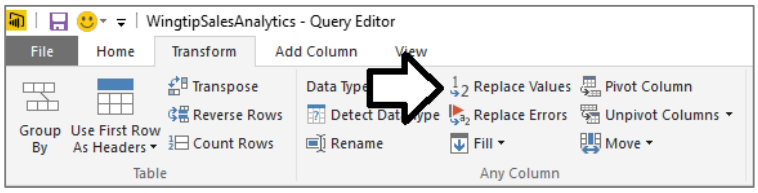


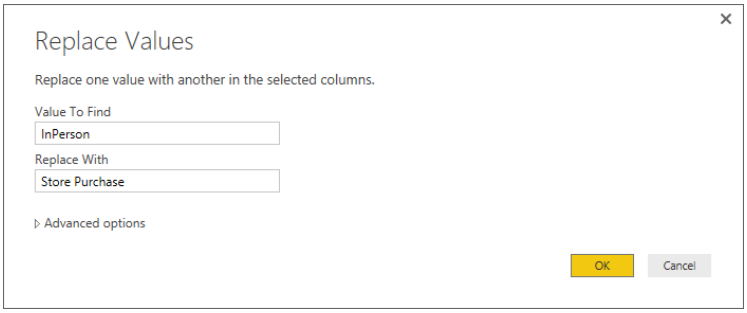
7. You should be able to see that the Query Editor window now only shows the columns that you selected.

	InvoiceId	InvoiceType
1	1	InPerson
2	2	InPerson
3	3	InPerson
4	4	InPerson
5	5	InPerson
6	6	InPerson

8. Modify the query so that the **InvoiceType** column returns values that are more human readable.
   a) Make sure the **Transform** tab is the active tab in the ribbon.
   b) Select the **InvoiceType** column by clicking its column header.
   c) Click the **Replace Values** button in the ribbon to display the **Replace Values** dialog.



   d) In the **Replace Value** dialog, enter a value of **InPerson** in the **Value to Find** textbox and enter a value of **Store Purchase** in the **Replace With** textbox. Click to **OK** button add your changes to the underlying query.



   e) Make sure the **InvoiceType** column is still selected.
   f) Click the **Replace Values** button in the ribbon to display the **Replace Values** dialog.

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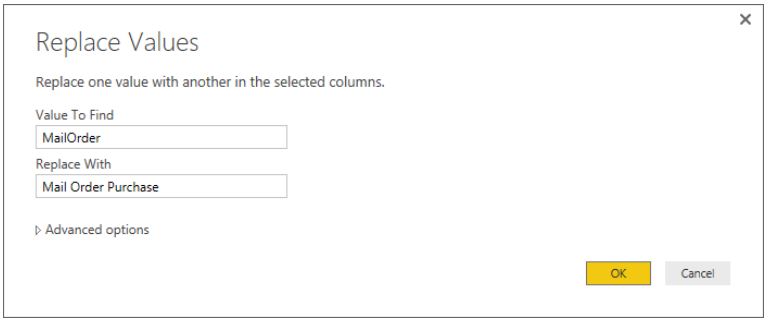
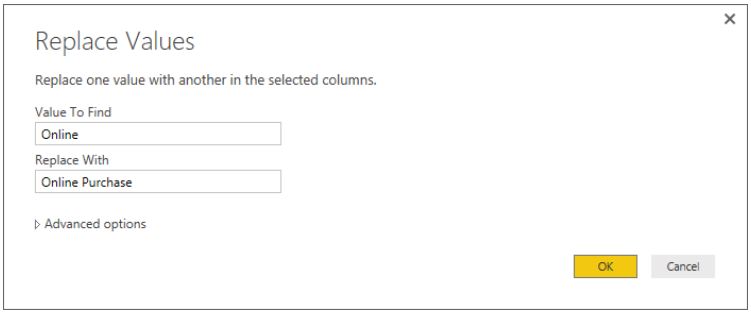
g) In the **Replace Value** dialog, enter a value of **MailOrder** in the **Value to Find** textbox and enter a value of **Mail Order Purchase** in the **Replace With** textbox. Click to **OK** button add your changes to the underlying query.



h) Make sure the **InvoiceType** column is still selected.

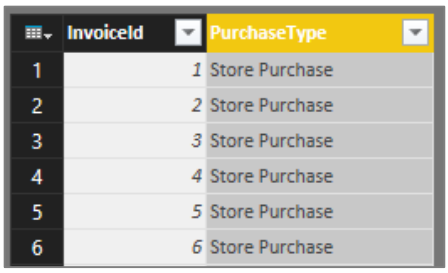
i) Click the **Replace Values** button in the ribbon to display the **Replace Values** dialog.

j) In the **Replace Value** dialog, enter a value of **Online** in the **Value to Find** textbox and enter a value of **Online Purchase** in the **Replace With** textbox. Click to **OK** button add your changes to the underlying query.



k) If you scroll down and look at all the rows within the **Purchases** table, you should be able to see that each row has a **InvoiceType** column value of either **Store Purchase**, **Mail Order Purchase** or **Online Purchase**.

9. Change the name of the **InvoiceType** column to **PurchaseType**.



	InvoiceId	PurchaseType
1	1	Store Purchase
2	2	Store Purchase
3	3	Store Purchase
4	4	Store Purchase
5	5	Store Purchase
6	6	Store Purchase

You are now done working with the **Purchase** query.

10. Click the **Close and Apply** button on the **Home** tab of the ribbon to execute the updated **Purchases** query. Power BI Desktop will display the **Apply Query Changes** dialog while importing the data and transforming it to load it into the data model.

11. After the query changes have been applied, you should be able to see the results of your changes in the **Purchase** table that has been loaded into the project's data model.

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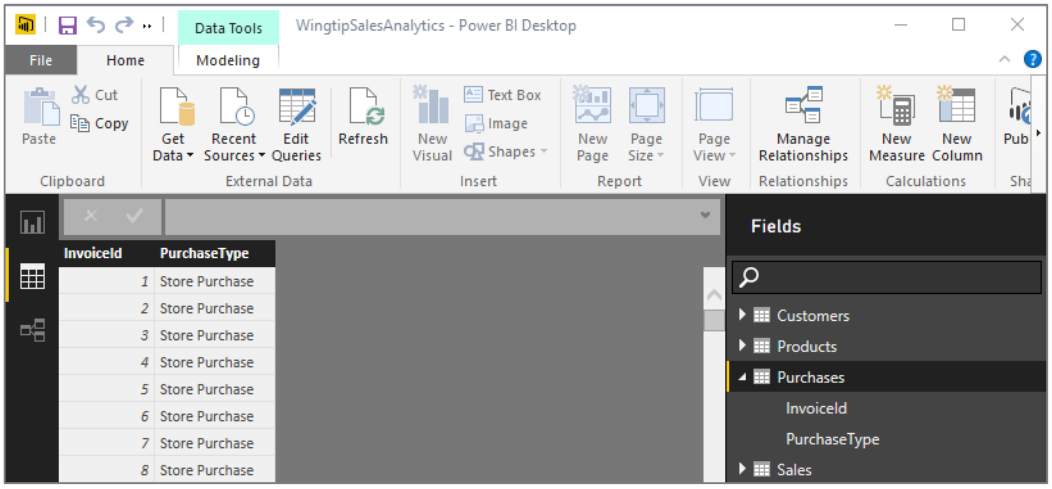
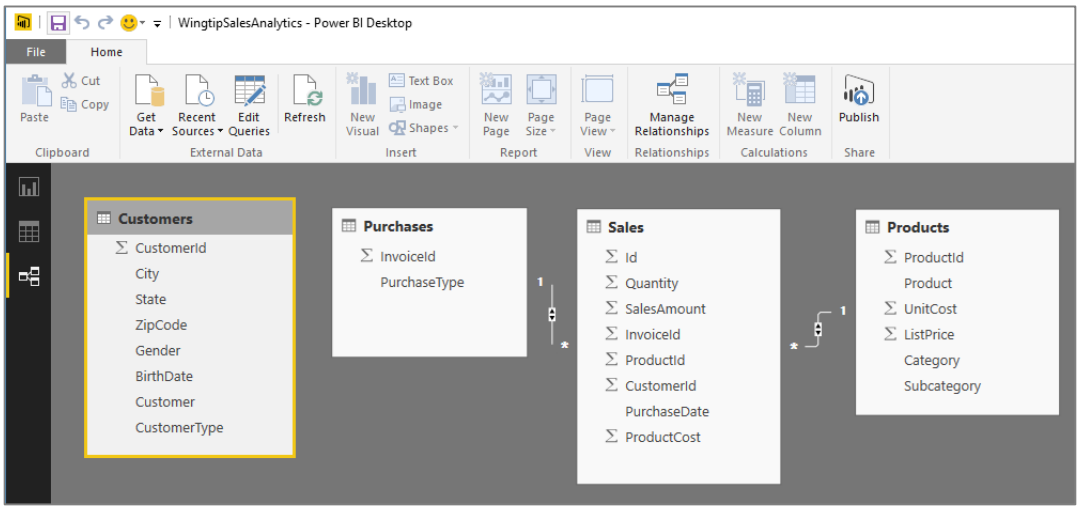


12. Navigate to relationship view to see how your updates to the queries in this project have affected the relationships between the tables. You should be able to see that there is no longer a relationship between the **Customers** table and the **Purchases** table. This is due to the fact that you removed the **CustomerId** column from the **Purchases** table.



13. Use your mouse to move and resize the four tables in the data model to match the following screenshot.

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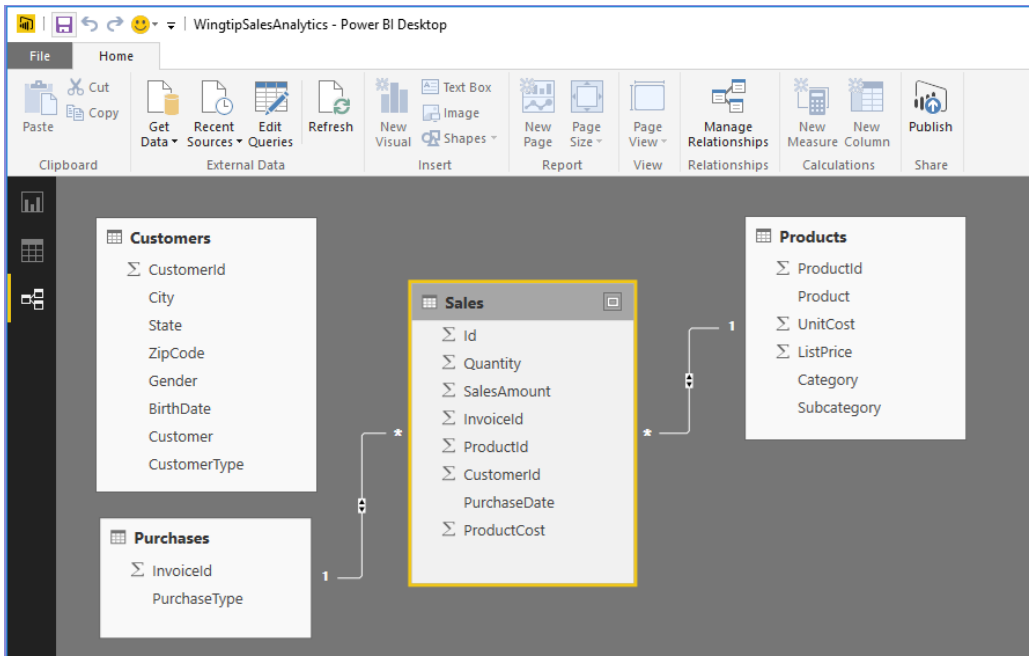
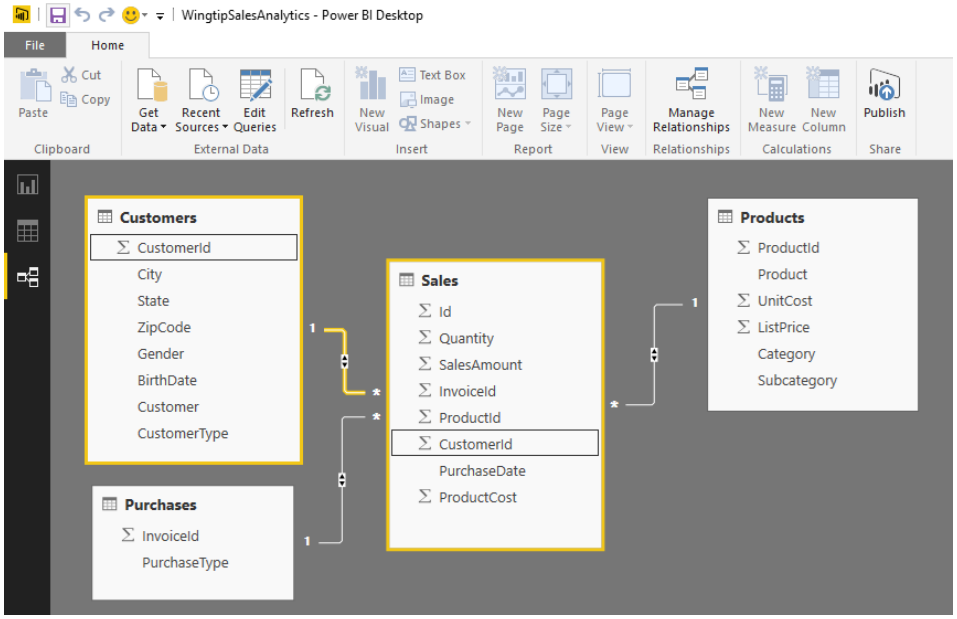


14. Create a new relationship between the **Sales** table and the **Customers** table by clicking on the **CustomerId** column in the **Sales** table and then dragging and dropping it on the **CustomerId** column of the **Customers** table. Once you have successfully completed this step, you should see a visual line between these two tables to indicate that the data model now contains the new relationship.



The tables in the data model have now been refactored into a "star schema" that is commonly used in data modeling for BI projects.

15. Save your work by clicking the Save button in the upper left corner of the Power BI Desktop window.

You are now done with your work modifying queries to transform data as it is being loaded into the data model of your project. Note that you will continue to work on the PBIX file with this project in the next lab and the ones that follow.

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Module 04: Using the Power Pivot Features of Power BI Desktop

Module Description

This module introduces students to the PowerPivot features and data modeling tools available when working with Power BI Desktop. Students will learn about the various ways that Power BI Desktop can be used to model data for richer analytics and reporting. The module discusses how to get up and running with the DAX programming language as well as how to extend tables in a dataset with Calculated Columns and Measures.

Module Agenda

- Data Modeling with PowerPivot and DAX
- Creating Calculated Columns
- Integrating Lookup Tables
- Creating Measures

Topics Covered

Building a Data Model with Power Pivot
Table Relationships
Relationship Properties
Converting Column Types
Formatting Columns
Working with DAX
Writing DAX Expressions
Calculated Columns vs Measures
Types of DAX Functions
When to Create Calculated Columns
Creating Calculated Columns
Calculated Column as a Column Label
Calculated Column for Customer Age Group
Calculated Column as a Row Label
Calculated Column used in a Slicer
Adding Lookup Tables to the Data Model
Importing the SalesRegions Table from Excel
Integrating the Lookup Table into the Data Model
The RELATED Function
Hiding the Lookup Table
Filtering on Sales Region
Benefits of Measures Over Columns
Creating Measures
Formatting Measures

Instructor Demos

- Creating Calculated Columns
- Creating Measures

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Building a Data Model with Power Pivot

- Steps to create a data model (aka BISM)
  - Create tables by importing data from external sources
  - Create relationships between tables
  - Modify columns (rename, set formatting, convert type)
  - Create calculated columns
  - Create measures
- Features not yet supported by Power BI Desktop
  - Creating dimensional hierarchies
  - Creating key performance indicators (KPIs)

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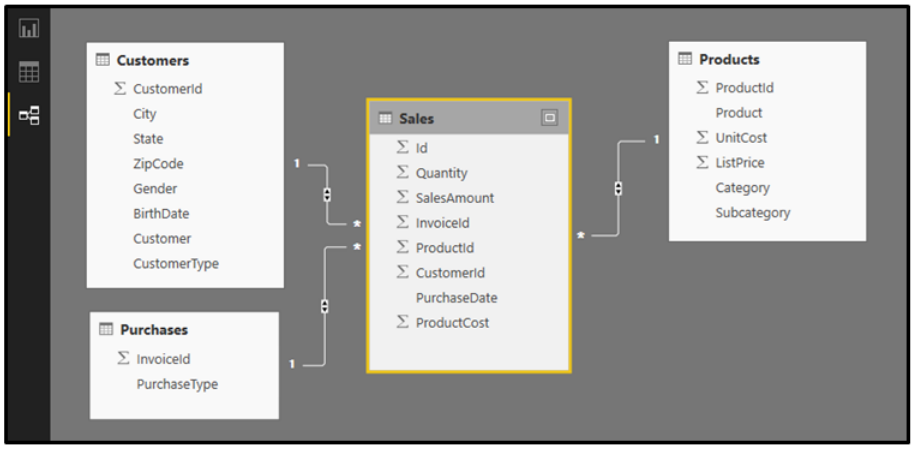
Table Relationships

- Tables in data model associated with relationships
  - Relationships based on single columns
  - Tabular model supports [1-to-1] and [1-to-many] relationships
  - Relationships based on single column in each table



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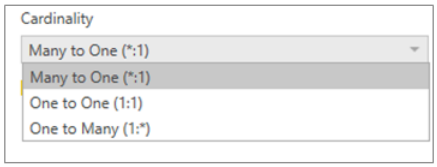
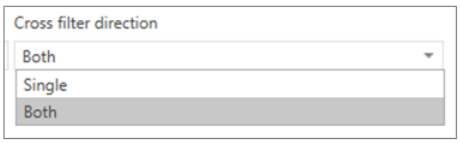
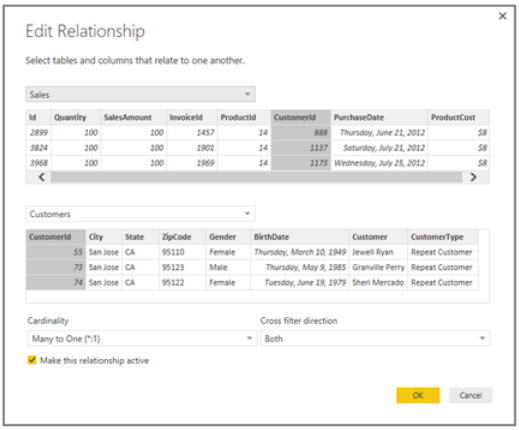
Relationship Properties

- Cardinality



- Cross filter direction





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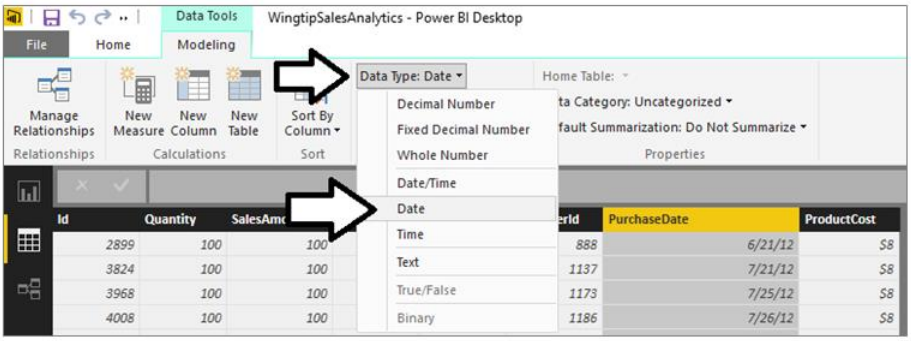
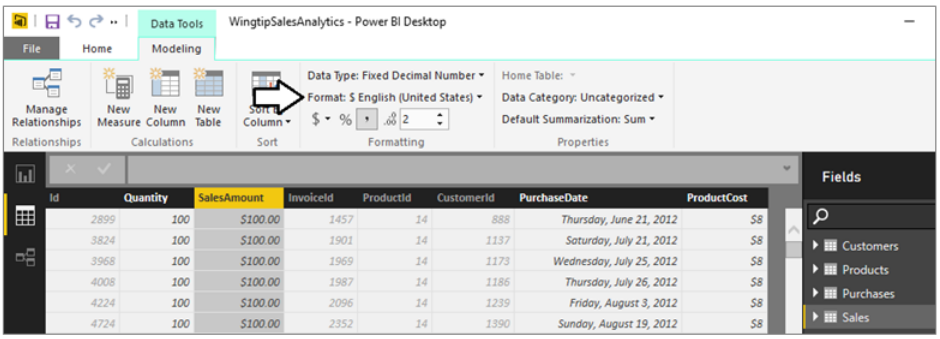
Converting Column Types

- Power Pivot allows you to convert columns
  - Alternative to converting column with Power Query



Formatting Columns

- Each column has its own formatting properties
  - Formatting propagated to reports and visuals
  - Makes it easier on data model consumers



Working with DAX

- DAX is the language used to create data model
  - DAX stands for "**D**ata **A**nalysis E**x**pression Language"
- DAX expressions are similar to Excel formulas
  - They always start with an equal sign (=)
  - DAX provides many built-in functions similar to Excel
- DAX Expressions are unlike Excel formulas…
  - DAX expressions cannot reference cells (e.g. A1 or C4)
  - Instead DAX expressions reference columns and tables

```
=SUM('Sales'[SalesAmount])
```

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Writing DAX Expressions

- Some DAX expressions are simple

```
Sales Revenue = Sum(Sales[SalesAmount])
```

- Some DAX expressions are far more complex

```
Sales Growth PM = IF(
  ( ISFILTERED(Calendar[Month]) && ISFILTERED(Calendar[Date]) = FALSE() ),
  DIVIDE(
    SUM(Sales[SalesAmount]) -
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    ),
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    )
  ),
  BLANK()
)
```

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Calculated Columns vs Measures

- Calculated Columns
  - Evaluated based on context of a single row
  - Evaluated when data is loaded into memory

```
Column1 = <DAX expression>
```

- Measures
  - Evaluated at query time based on current filter context
  - Commonly used for aggregations (e.g. SUM, AVG, etc.)
  - Used more frequently than calculated columns

```
Measure1 = <DAX expression>
```

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Types of DAX Functions

- Date and Time Functions
- Information Functions
- Logical Functions
- Mathematical and Trigonometric Functions
- Statistical Functions
- Filter Functions
- Text Functions
- Time Intelligence Functions

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When to Create Calculated Columns

- Measures often better choice than calculate columns
  - Don't create calculated column when you need a measure
  - Prefer to create calculated columns only in specific scenarios
- When should you create calculated columns?
  - To create headers for row labels or column labels
  - To place calculated results in a slicer for filtering
  - Define an expression strictly bound to current row
  - Categories text or numbers (e.g. customer age groups)

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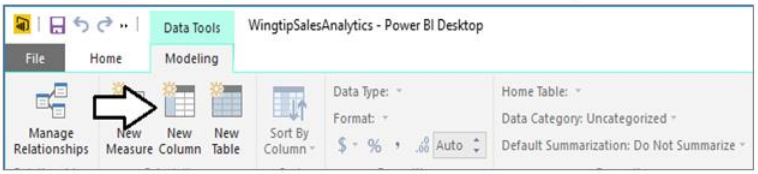
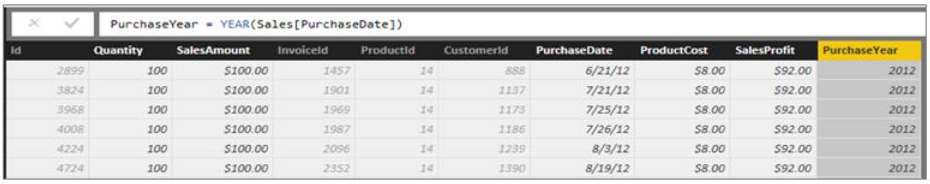
Creating Calculated Columns

- Edited in formula bar of Power Pivot data view
  - Start with name and then equals (=) sign
  - Enter a valid DAX expression
  - Clicking on column adds it into expression





Id	Quantity	SalesAmount	InvoiceId	ProductId	CustomerId	PurchaseDate	ProductCost	SalesProfit	PurchaseYear
2899	100	$100.00	1457	14	888	6/21/12	$8.00	$92.00	2012
3824	100	$100.00	1901	14	1137	7/21/12	$8.00	$92.00	2012
3968	100	$100.00	1969	14	1173	7/25/12	$8.00	$92.00	2012
4008	100	$100.00	1987	14	1186	7/26/12	$8.00	$92.00	2012
4224	100	$100.00	2096	14	1239	8/3/12	$8.00	$92.00	2012
4724	100	$100.00	2352	14	1390	8/19/12	$8.00	$92.00	2012

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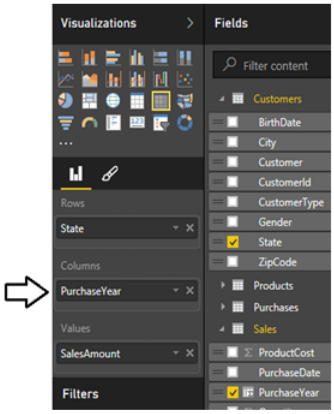
Calculated Column as a Column Label

- Calculate column can serve as...
  - Row labels
  - Column labels



State	2012	2013	2014	2015	Total
CA	$270,926.32	$550,160.02	$737,878.53	$770,402.11	$2,329,366.98
TX	$212,085.08	$490,643.98	$683,079.11	$919,030.36	$2,304,838.53
FL	$51,730.85	$300,866.87	$535,693.94	$891,344.92	$1,779,636.58
NC	$11,018.02	$164,804.24	$315,139.92	$448,638.72	$939,600.90
NY	$24,207.43	$165,046.23	$256,294.27	$430,971.24	$876,519.17
GA	$40,305.80	$152,807.51	$239,451.05	$417,037.28	$849,601.64

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Calculated Column for Customer Age Group

1. Calculate customer age from birthdate

```
Age = Floor( (TODAY()-Customers[BirthDate])/365, 1)
```

CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age
55	San Jose	CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66
73	San Jose	CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30
74	San Jose	CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36
78	San Jose	CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37
136	San Jose	CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70
150	San Jose	CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31

2. Calculate age groups using calculated column

```
Age Group =
  SWITCH( TRUE(),
    [Age] >= 65, "Ages 65 and over",
    [Age] >= 50, "Ages 50 TO 65",
    [Age] >= 40, "Ages 40 TO 49",
    [Age] >= 30, "Ages 30 TO 39",
    [Age] >= 18, "Ages 18 TO 23",
    [Age] < 18, "Ages under 18"
  )
```

CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group
55	San Jose	CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over
73	San Jose	CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39
74	San Jose	CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39
78	San Jose	CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39
136	San Jose	CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over
150	San Jose	CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39
178	San Jose	CA	95123	Male	9/7/89	Wayne Gordon	Repeat Customer	26	Ages 18 TO 23
183	San Jose	CA	95110	Female	5/26/85	Luella Vinson	Repeat Customer	30	Ages 30 TO 39
213	San Jose	CA	95123	Male	8/13/78	Rosario Knight	Repeat Customer	37	Ages 30 TO 39

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Calculated Column as a Row Label

- Age Group can now be used as row label

Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 18 TO 23	3278	478,405	$1,985,991.24
Total	**28471**	**4,032,502**	**$17,253,100.23**

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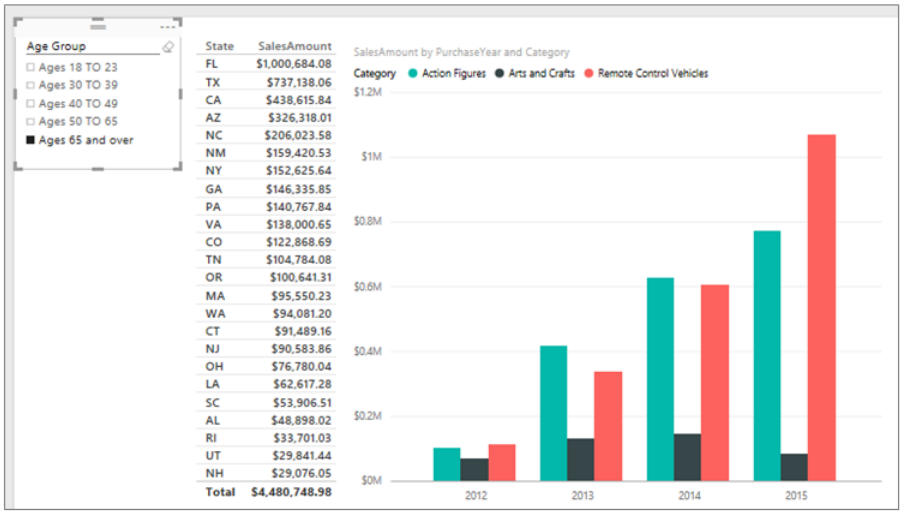
Calculated Column used in a Slicer

- Calculated column can populate slicer values



State	SalesAmount
FL	$1,000,684.08
TX	$737,138.06
CA	$438,615.84
AZ	$326,318.01
NC	$206,023.58
NM	$159,420.53
NY	$152,625.64
GA	$146,335.85
PA	$140,767.84
VA	$138,000.65
CO	$122,868.69
TN	$104,784.08
OR	$100,641.31
MA	$95,550.23
WA	$94,081.20
CT	$91,489.16
NJ	$90,583.86
OH	$76,780.04
LA	$62,617.28
SC	$53,906.51
AL	$48,898.02
RI	$33,701.03
UT	$29,841.44
NH	$29,076.05
Total	**$4,480,748.98**

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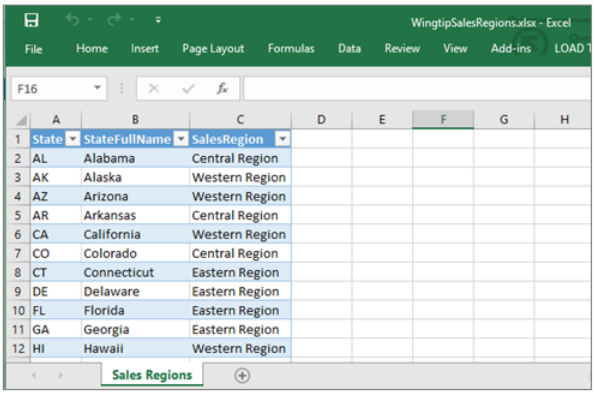
Adding Lookup Tables to the Data Model

- Data modeling might required adding lookup tables
  - Lookup tables inject extra related data into data model
- Example: Sales Regions table
  - Assign each state to specific sales region
  - Include full state name it required in reporting



State	StateFullName	SalesRegion
AL	Alabama	Central Region
AK	Alaska	Western Region
AZ	Arizona	Western Region
AR	Arkansas	Central Region
CA	California	Western Region
CO	Colorado	Central Region
CT	Connecticut	Eastern Region
DE	Delaware	Eastern Region
FL	Florida	Eastern Region
GA	Georgia	Eastern Region
HI	Hawaii	Western Region

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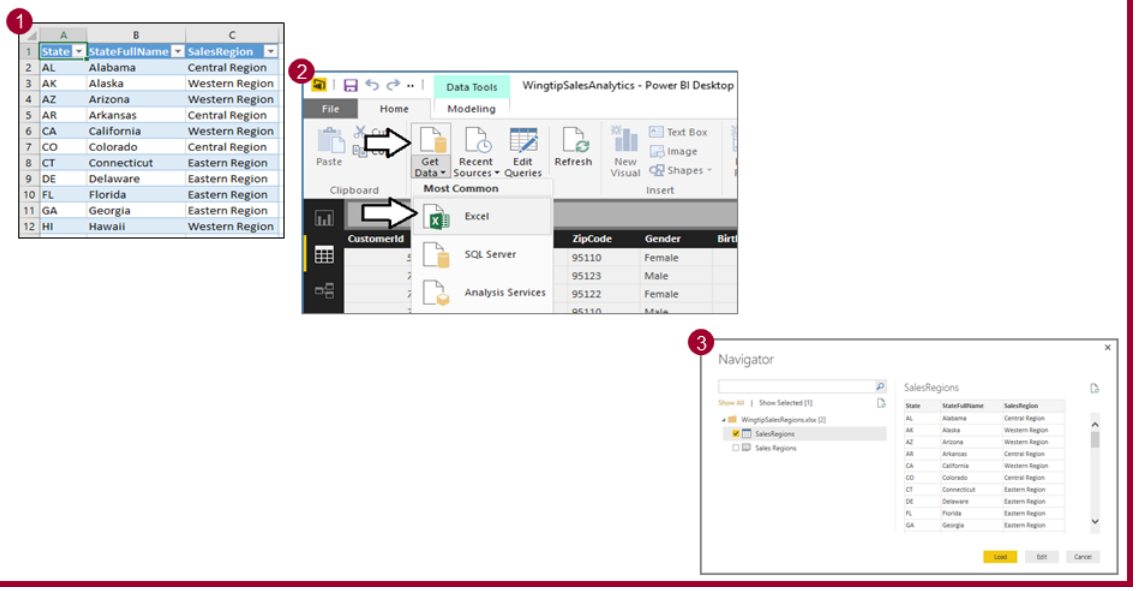
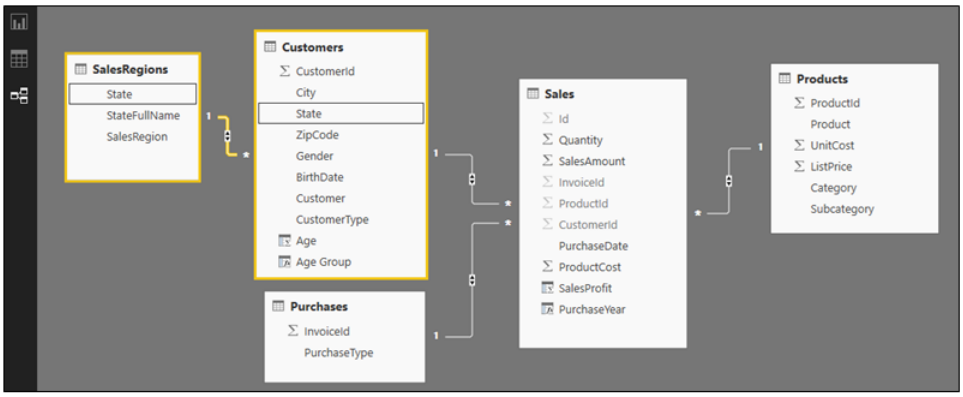
Importing the SalesRegions Table from Excel

- Import table from Excel using Power Query



Integrating the Lookup Table into the Data Model

- Lookup table must be integrated into data model
  - Accomplished by creating relationship to one or more tables



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The RELATED Function

- RELATED function performs cross-table lookup
  - Effectively replaces older VLOOKUP function
  - Used in many-side table to look up value from one-side
  - Used to pull data from lookup table into primary table

```
Sales Region = RELATED(SalesRegions[SalesRegion])
```

CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group	Sales Region
55	San Jose	CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over	Western Region
73	San Jose	CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39	Western Region
74	San Jose	CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39	Western Region
78	San Jose	CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39	Western Region
136	San Jose	CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over	Western Region
150	San Jose	CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39	Western Region

```
State Name = RELATED(SalesRegions[StateFullName])
```

State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group	Sales Region	State Name
CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over	Western Region	California
CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39	Western Region	California
CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39	Western Region	California
CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39	Western Region	California
CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over	Western Region	California
CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39	Western Region	California

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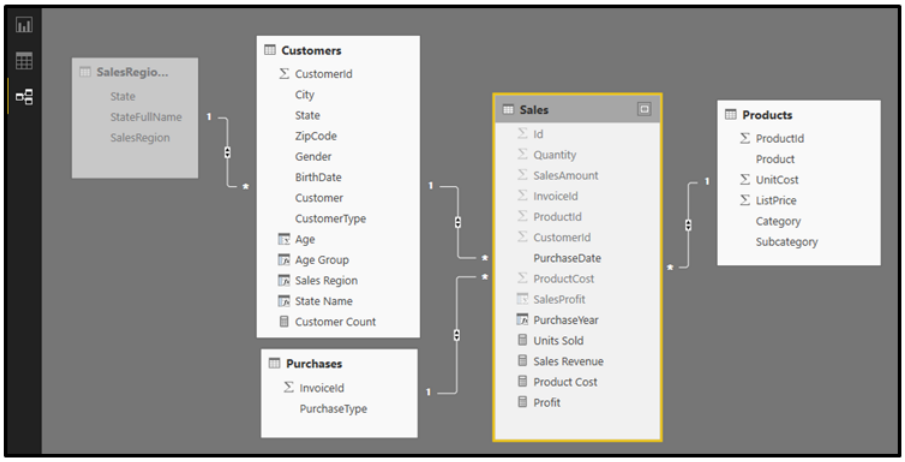
Hiding the Lookup Table

- Lookup table can often be hidden
  - simplifies reporting for data model consumers



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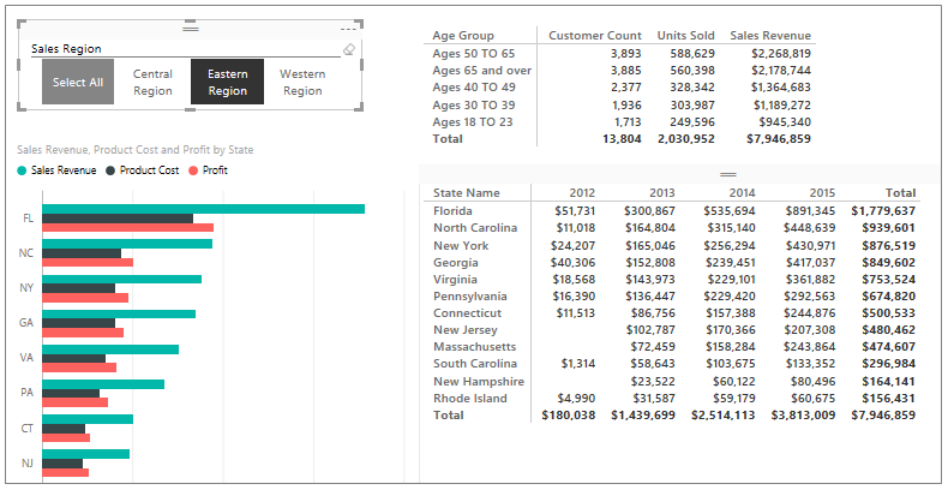
Filtering on Sales Region

- Calculated column used to calculate slicer values



Age Group	Customer Count	Units Sold	Sales Revenue
Ages 50 TO 65	3,893	588,629	$2,268,819
Ages 65 and over	3,885	560,398	$2,178,744
Ages 40 TO 49	2,377	328,342	$1,364,683
Ages 30 TO 39	1,936	303,987	$1,189,272
Ages 18 TO 23	1,713	249,596	$945,340
Total	**13,804**	**2,030,952**	**$7,946,859**

State Name	2012	2013	2014	2015	Total
Florida	$51,731	$300,867	$535,694	$891,345	$1,779,637
North Carolina	$11,018	$164,804	$315,140	$448,639	$939,601
New York	$24,207	$165,046	$256,294	$430,971	$876,519
Georgia	$40,306	$152,808	$239,451	$417,037	$849,602
Virginia	$18,568	$143,973	$229,101	$361,882	$753,524
Pennsylvania	$16,390	$136,447	$229,420	$292,563	$674,820
Connecticut	$11,513	$86,756	$157,388	$244,876	$500,533
New Jersey		$102,787	$170,366	$207,308	$480,462
Massachusetts		$72,459	$158,284	$243,864	$474,607
South Carolina	$1,314	$58,643	$103,675	$133,352	$296,984
New Hampshire		$23,522	$60,122	$80,496	$164,141
Rhode Island	$4,990	$31,587	$59,179	$60,675	$156,431
Total	**$180,038**	**$1,439,699**	**$2,514,113**	**$3,813,009**	**$7,946,859**

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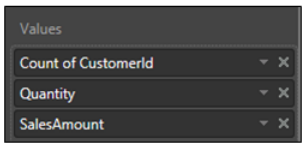
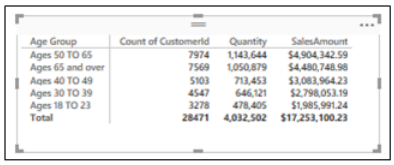
Benefits of Measures Over Columns

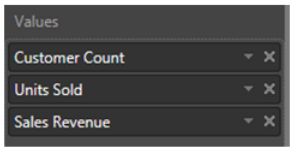
- Calculated columns can be aggregated in visual
  - However, aggregation details are stored in visual
  - Visual doesn't offer control over name and formatting

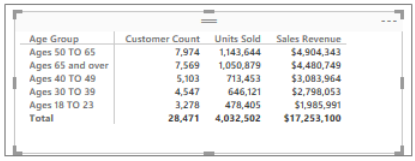




Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 18 TO 23	3278	478,405	$1,985,991.24
Total	28471	4,032,502	$17,253,100.23

- Measure defines name, aggregation and formatting
  - Work is done once and reused across many visuals
  - Makes data model more fool-proof for report designers





Age Group	Customer Count	Units Sold	Sales Revenue
Ages 50 TO 65	7,974	1,143,644	$4,904,343
Ages 65 and over	7,569	1,050,879	$4,480,749
Ages 40 TO 49	5,103	713,453	$3,083,964
Ages 30 TO 39	4,547	646,121	$2,798,053
Ages 18 TO 23	3,278	478,405	$1,985,991
Total	28,471	4,032,502	$17,253,100

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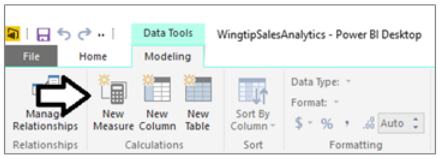
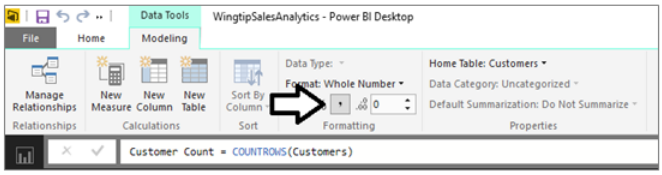
Creating Measures

- Measures have advantage over calculated columns
  - They are evaluated based on the current evaluation context
- Creating a measure with Power BI Desktop





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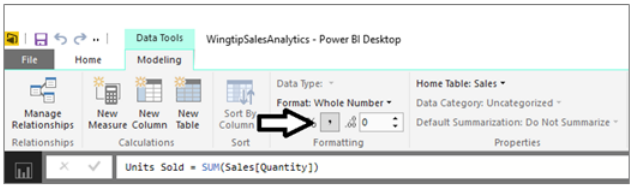
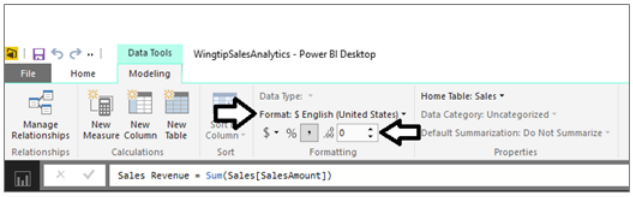
Formatting Measures

- Format as whole number



- Format as currency



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Module 04 Lab: Using the Power Pivot Features of Power BI Desktop

Lab Time: 40 minutes

Lab Folder: C:\Student\Modules\PowerPivot\Lab

Lab Overview: In this set of lab exercises, you will continue to work on the Power BI Desktop project you started in the previous lab. At this point, you have already imported Wingtip sales data from a SQL Azure database and transformed it using the Power Query features of Power BI Desktop to create a starting point for the data model associated with your project. In this lab you will begin to leverage the Power Pivot features of Power BI Desktop to enhance this data model by adding calculated columns and calculated fields. Along the way, you will add pages and visuals to a Power BI Desktop report so you can see the effects of your modeling efforts.

Important: This lab assumes you have completed the previous lab titled **Using the Power Query Features of Power BI Desktop** in which you created a Power BI Desktop project named **WingtipSalesAnalytics.pbix**. In the previous lab you should have imported data into the data model using data from the **WingtipSalesDB** database in SQL Azure and transformed the data into a schema that is better suited for data modeling and analysis. If you would like to begin work on this lab without first completing the previous lab, use the Windows Explorer to copy the lab solution file at **C:\Student\Modules\PowerQuery\LabSolution\WingtipSalesAnalytics.pbix** into the folder at **C:\Student\Projects**.

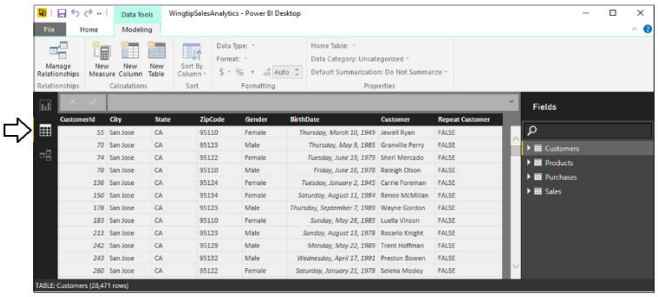
Exercise 1: Hiding and Formatting Columns in the Data Model

In this exercise you will start with the data model you created in the previous lab and begin by hiding and formatting table columns inside the data model. After that, you will create a simple report to see the effects of your formatting changes.

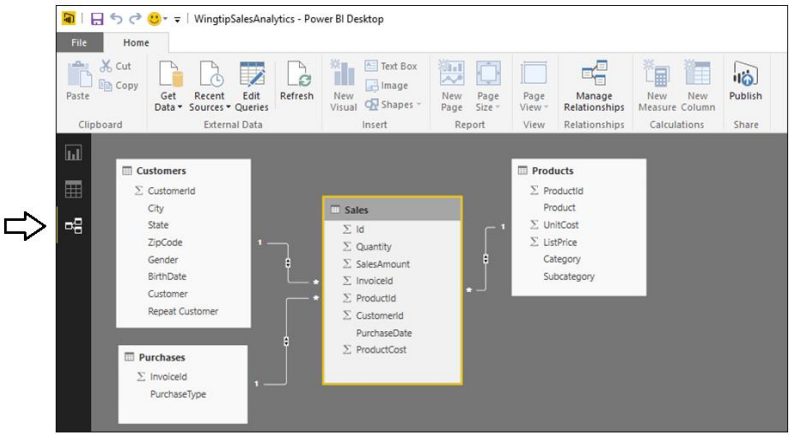
1. Launch Power BI Desktop to start a new project.
2. Open the Power BI Desktop project named **WingtipSalesAnalytics.pbix** from the previous lab located at the following path.

```
C:\Student\Projects\WingtipSalesAnalytics.pbix
```

3. When the project opens, click the table icon in the middle of the sidebar to enter data view mode.



4. Take a moment to review the data in each of the four tables in the data model by clicking on the tables inside the **Fields** list.
5. Click the bottom button in the sidebar to navigate to relationship view. You should see that the four tables are arraigned in a star schema where the **Sales** table has a relationship established with each of the three other tables in the data model



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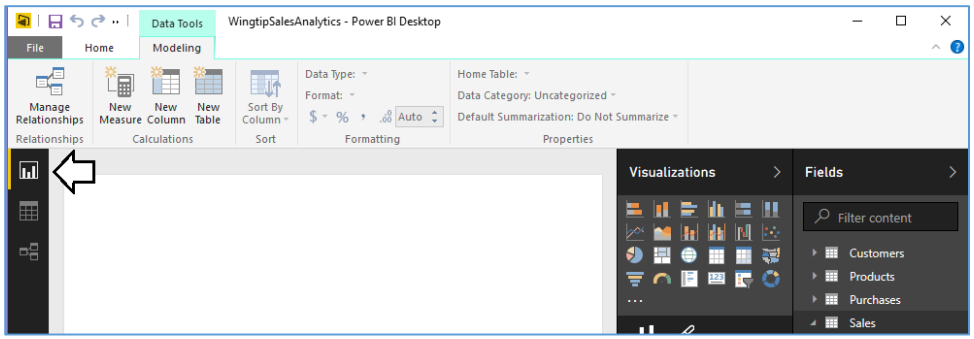
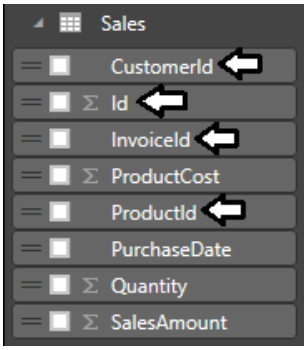
6. Now it's time to inspect the data model from a different perspective. More specifically, you will examine the data model from the perspective of a consumer who is designing reports and creating visuals using the Power BI Desktop report designer.
   a) Click the top button in the sidebar to navigate to report view.



   b) Inside the **Fields** list, use the mouse to expand the fields inside the **Sales** table. You can see that there are several fields in the Sales table that will never be used when designing reports such as the four identifier columns. The data model will be easier for consumers such as report designers to understand if you hide these types of fields which add unnecessary clutter.



7. Use relationship view to update the data model by hiding fields in the **Sales** table that are unnecessary to display in report view.
   a) Navigate to relationship view in the Power BI Desktop window.
   b) Using the mouse, right-click on the **Id** column in the **Sales** table and select the **Hide in Report View** command.
   c) Right-click on the **InvoiceId** column in the **Sales** table and select the **Hide in Report View** command.
   d) Right-click on the **CustomerId** column in the **Sales** table and select the **Hide in Report View** command.
   e) Right-click on the **ProductId** column in the **Sales** table and select the **Hide in Report View** command.
   f) Now, navigate back to report view and examine the set of fields displayed for the **Sales** table.

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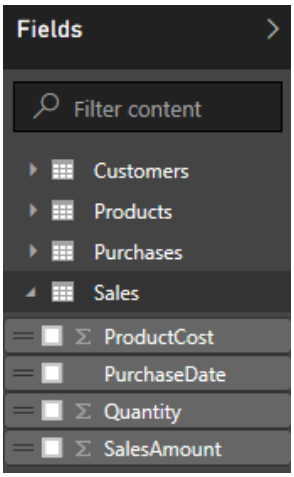
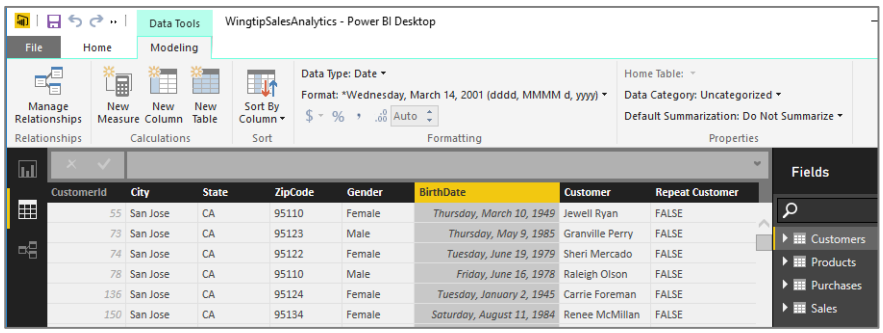
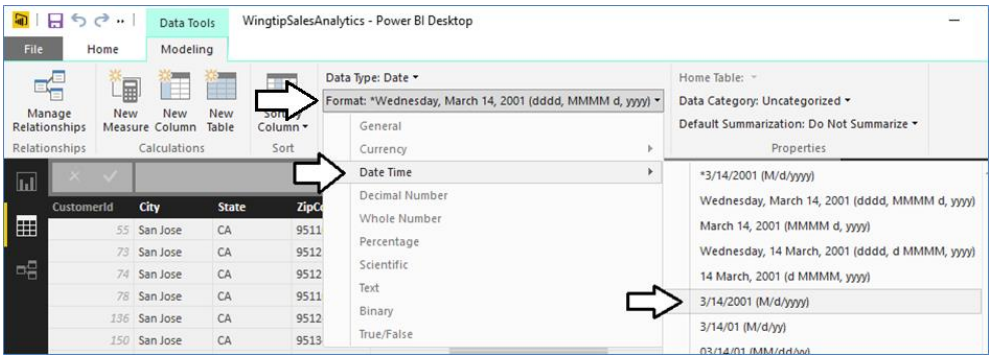


You should be able to see that hiding unnecessary columns from report view makes your data model easier to use. This is especially true in the scenario where you are creating a data model that other will be using to create reports and dashboards.

8. Modify the formatting of the **BirthDate** column in the **Customers** table.
   a) In the Power BI Desktop windows, navigate back to data view.
   b) In the **Fields** list on the right, select the **Customers** table to display its rows and columns.
   c) Select the **BirthDate** column by clicking on its column header.



   d) Modify the formatting of the **BirthDate** column by dropping down the **Format** button menu in the ribbon and selecting a format setting of **Date Time > 3/14/2001 (M/d/yyyy)**.



   e) The **BirthDate** column should now reflect the change in formatting.

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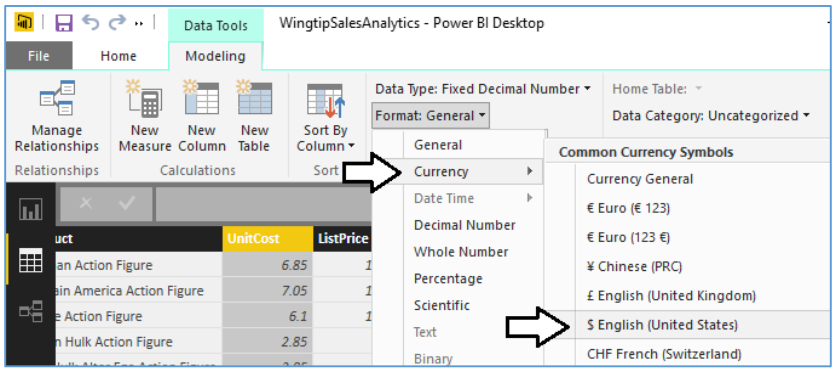
CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	Repeat Customer
55	San Jose	CA	95110	Female	3/10/1949	Jewell Ryan	FALSE
73	San Jose	CA	95123	Male	5/9/1985	Granville Perry	FALSE
74	San Jose	CA	95122	Female	6/19/1979	Sheri Mercado	FALSE
78	San Jose	CA	95110	Male	6/16/1978	Raleigh Olson	FALSE
136	San Jose	CA	95124	Female	1/2/1945	Carrie Foreman	FALSE

9. Modify the formatting of columns in the **Products** table.
   a) In the **Fields** list on the right, select the **Products** table to display its rows and columns.
   b) Select the **UnitCost** column by clicking on its column header.
   c) Use the **Format** menu button in the ribbon to update the format setting to **Currency > English (United States)**.



   d) Changing the format setting of the **ListPrice** column to **Currency > English (United States)** so it matches **UnitCost**.

ProductId	Product	UnitCost	ListPrice
1	Batman Action Figure	$6.85	$14.95
2	Captain America Action Figure	$7.05	$12.95
3	GI Joe Action Figure	$6.10	$14.95
4	Green Hulk Action Figure	$2.85	$9.95
5	Red Hulk Alter Ego Action Figure	$2.85	$9.95
6	Godzilla Action Figure	$14.25	$19.95

10. Modify the formatting of columns in the **Sales** table.
   a) In the **Fields** list on the right, select the **Sales** table to display its rows and columns.
   b) Select the **Quantity** column by clicking on its column header.
   c) Modify the **Quantity** column by clicking to select the comma button on the ribbon to add a comma separator.

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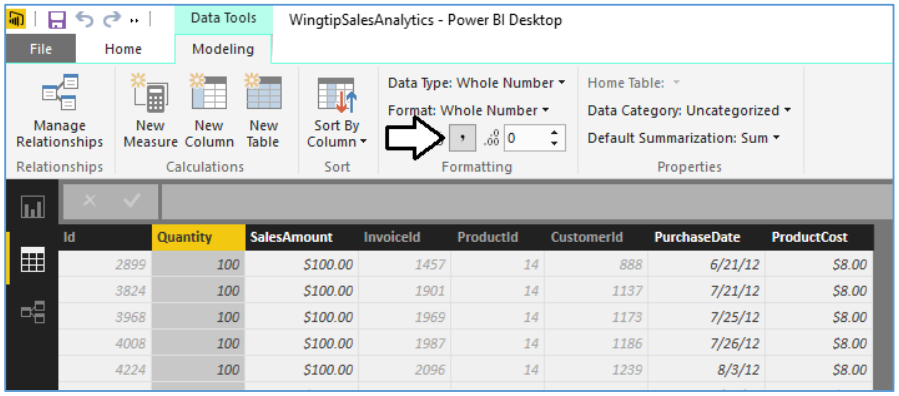
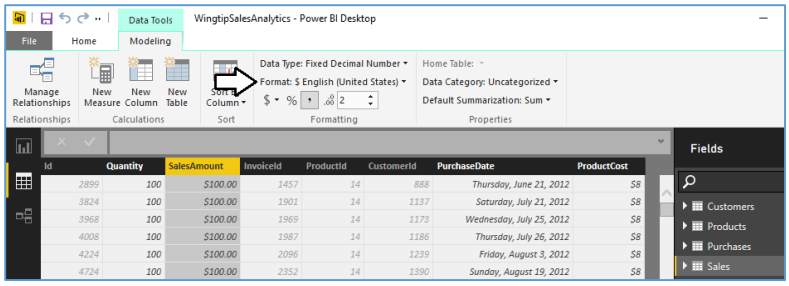


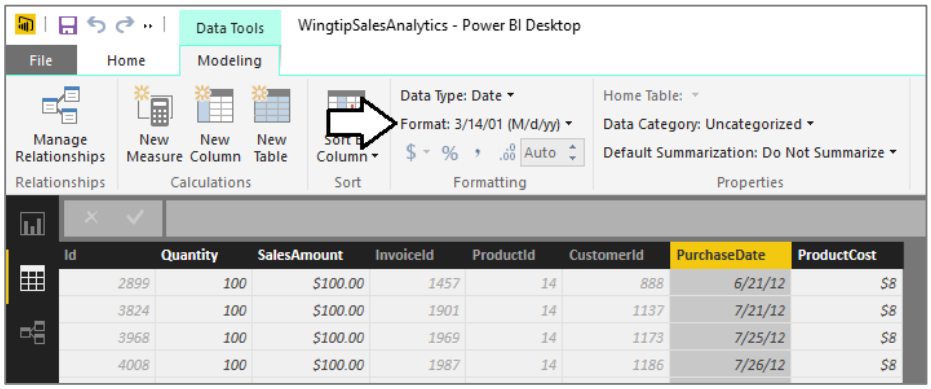
d) Select the **SalesAmount** column by clicking on its column header.

e) Modify the formatting of the **SalesAmount** column by dropping down the **Format** button menu in the ribbon and selecting a format setting of **Currency > English (United States)**.



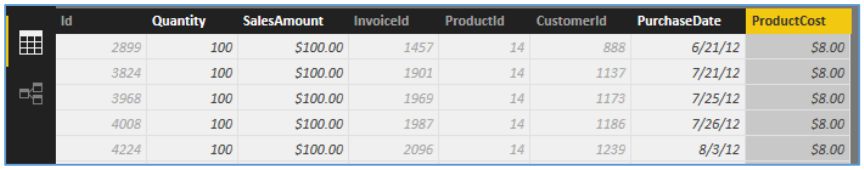
f) Select the **PurchaseDate** column by clicking on its column header.

g) Modify the formatting of the **PurchaseDate** column by dropping down the **Format** button menu in the ribbon and selecting a format setting of **Date Time > 3/14/2001 (M/d/yyyy)**.



h) Select the **ProductCost** column by clicking on its column header.

i) Modify the formatting of the **ProductCost** column by dropping down the **Format** button menu in the ribbon and selecting a format setting of **Currency > English (United States)**.



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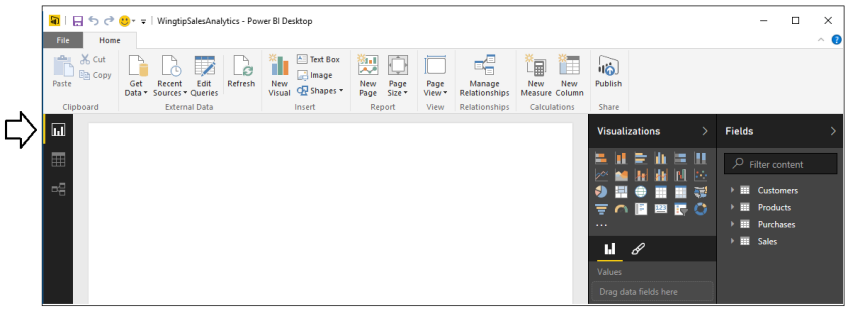
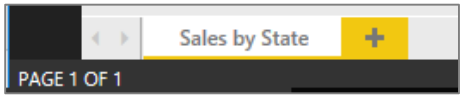
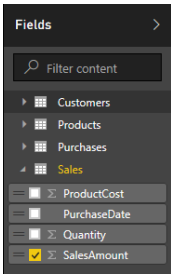
11. See the effect of your formatting by adding a visual to a report.
    a) Navigate to report view. There should be an empty report for the project with a single page named **Page 1**.



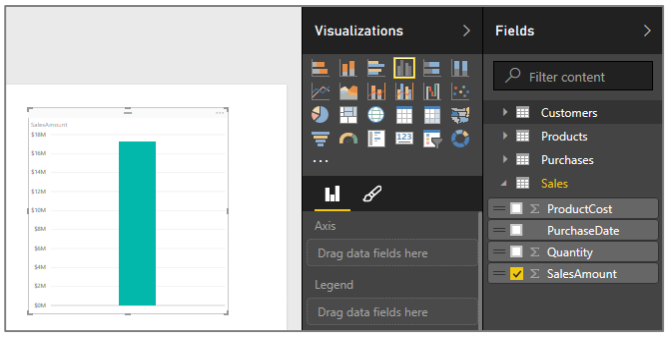
    b) Change the name of the page in the report from **Page 1** to **Sales by State**.



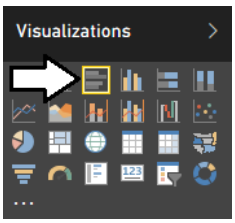
    c) Create a new visual in the report by selecting the checkbox for the **SalesAmount** column in the **Fields** list.



    d) When you select the **SalesAmount** column, Power BI Desktop will automatically add a new visual to the report based on the visualization type of **Clustered Column Chart**.



    e) Click the **Clustered Bar Chart** button in the **Visualizations** list to change the visualization type to a clustered bar chart.



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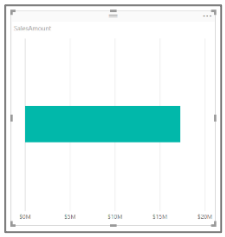
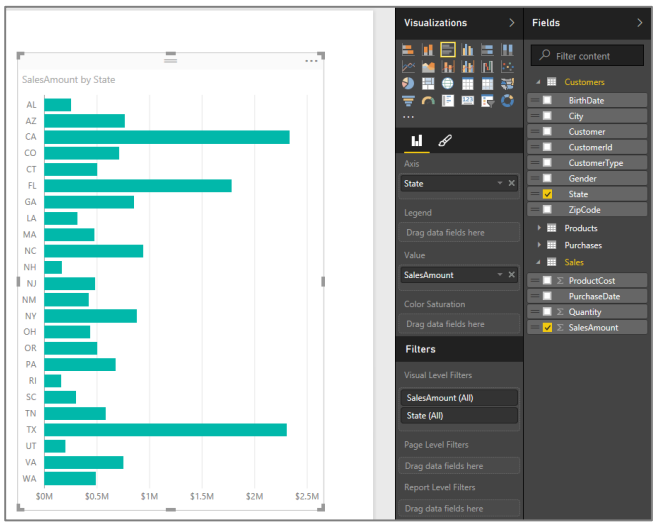
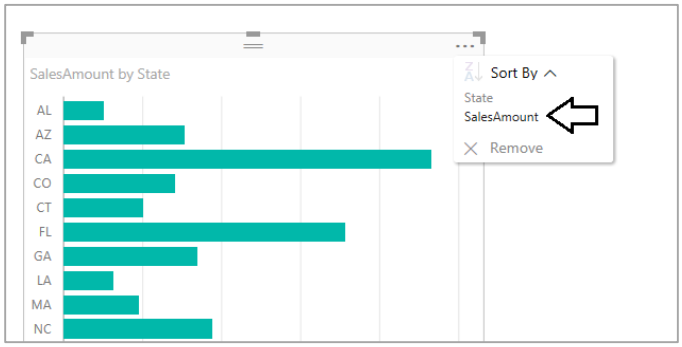
f) Since you haven't added any row labels yet, the clustered bar chart currently displays a single bar showing total sales.



g) Drag and drop the **States** field from the **Fields** list into the **Axis** well of the **Visualizations** pane.



h) Sort the data in the visualization by clicking the ellipse (**…**) button in the top right corner of the visual to invoke the fly-out menu. From the fly-out menu, select **Sort By ^** > **SalesAmount** to sort by the aggregated **SalesAmount** values in descending order.



i) The visual should now sort states with the greatest amounts of sales revenue to the top.

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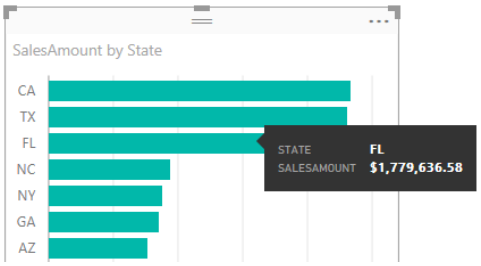
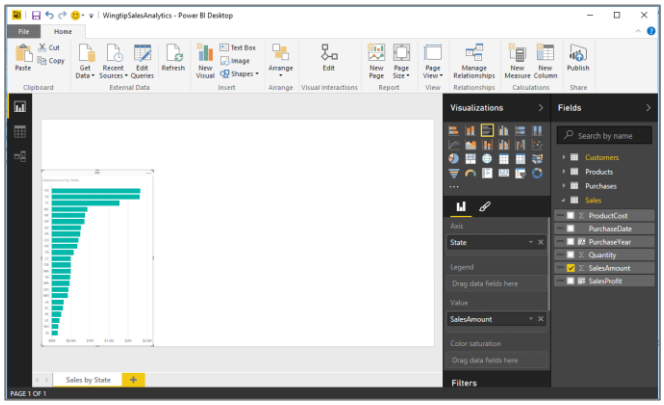


j) Use your mouse to reposition the visual to the bottom left corner of the page as shown in the following screenshot.

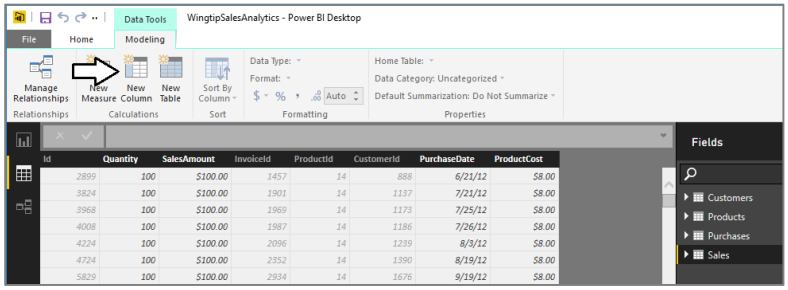


12. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 2: Extending the Data Model by Creating Calculated Columns

In this exercise you will create several calculated columns which will require you to write and test DAX expressions. After creating calculated columns, you will use them to enhance reports in the current project.

1. Add a calculated column to the **Sales** table named **SalesProfit** to determine profit by calculating the difference between **SalesAmount** and **ProductCost**.
   a) Navigate to data view.
   b) Select the **Sales** table in the **Fields** list.
   c) Create a new calculated column by clicking the **New Column** button in the ribbon.



   d) Enter to following DAX expression into the formula bar to create the calculated column named **SalesProfit**.

```
SalesProfit = Sales[SalesAmount]-Sales[ProductCost]
```

   e) Press the **ENTER** key to add the calculated column to the table. You should be able to see a **SalesProfit** value for each row in the **Sales** table.

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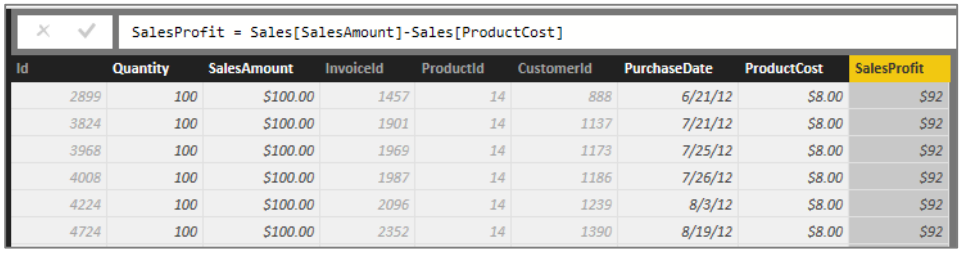
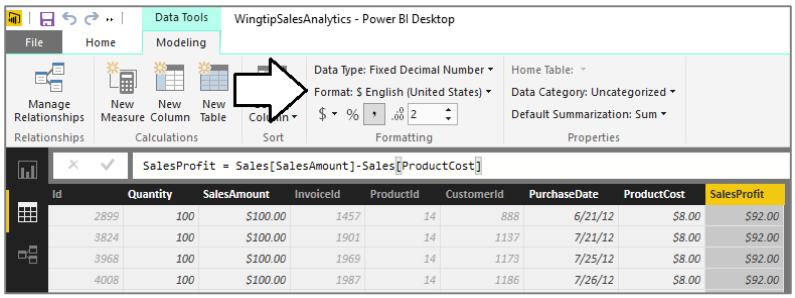
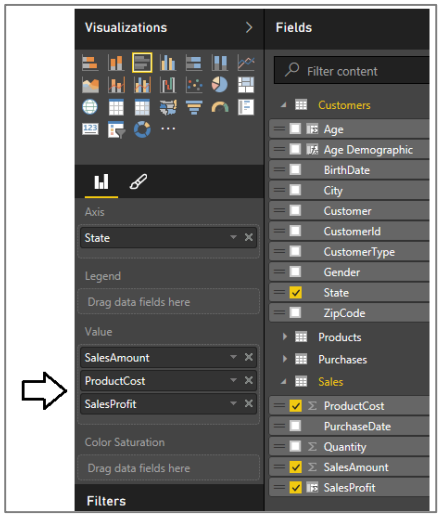


Id	Quantity	SalesAmount	InvoiceId	ProductId	CustomerId	PurchaseDate	ProductCost	SalesProfit
2899	100	$100.00	1457	14	888	6/21/12	$8.00	$92
3824	100	$100.00	1901	14	1137	7/21/12	$8.00	$92
3968	100	$100.00	1969	14	1173	7/25/12	$8.00	$92
4008	100	$100.00	1987	14	1186	7/26/12	$8.00	$92
4224	100	$100.00	2096	14	1239	8/3/12	$8.00	$92
4724	100	$100.00	2352	14	1390	8/19/12	$8.00	$92

f) Configure the column's formatting by using the **Format** menu on the ribbon to select **Currency > English (United States)**.



2. Update the clustered bar chart visual you created in the previous exercise.
   a) Navigate to report view.
   b) Select the visual you created in the previous exercise.
   c) Using your mouse, drag and drop the **ProductCost** column from the **Fields** list into the **Value** well in the **Visualizations** pane.
   d) Using your mouse, drag and drop the **SalesProfit** column from the **Fields** list into the **Value** well in the **Visualizations** pane.



   e) You should now see that the cluster bar chart is showing additional bars for product cost and profit.

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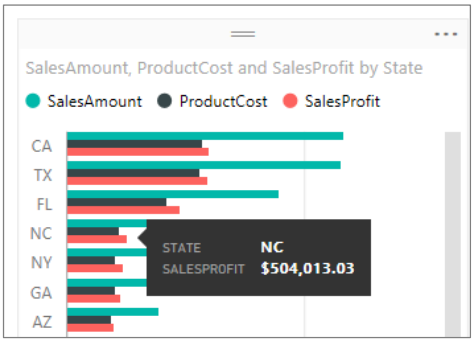
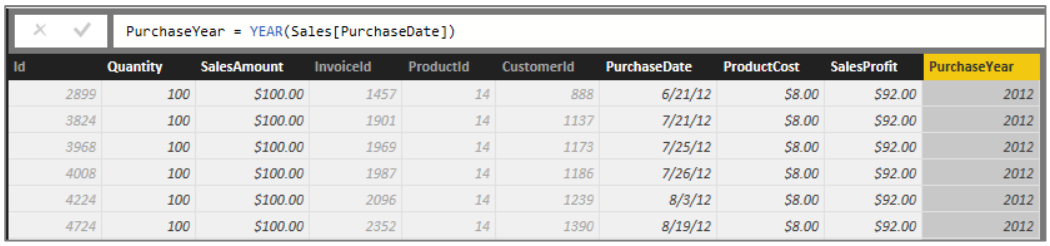


3. Add a calculated column to the **Sales** table named **PurchaseYear** to indicate the calendar year of each purchase.
   a) Navigate to data view.
   b) Select the **Sales** table in the **Fields** list.
   c) Create a new calculated column by clicking the **New Column** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the calculated column named **PurchaseYear**.

```
PurchaseYear = YEAR(Sales[PurchaseDate])
```

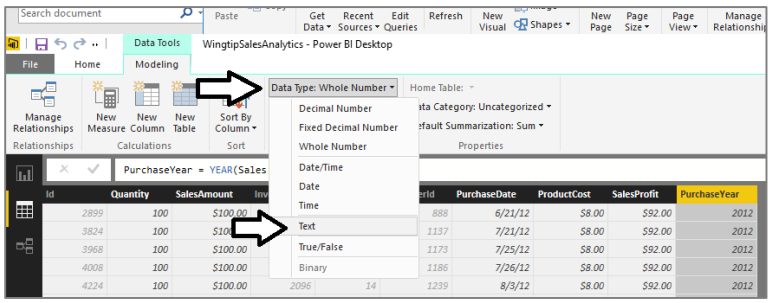
   e) Press the **ENTER** key to add the calculated column to the table. You should be able to see a calendar year value (e.g. 2012) for each row in the **Sales** table



PurchaseYear = YEAR(Sales[PurchaseDate])

Id	Quantity	SalesAmount	InvoiceId	ProductId	CustomerId	PurchaseDate	ProductCost	SalesProfit	PurchaseYear
2899	100	$100.00	1457	14	888	6/21/12	$8.00	$92.00	2012
3824	100	$100.00	1901	14	1137	7/21/12	$8.00	$92.00	2012
3968	100	$100.00	1969	14	1173	7/25/12	$8.00	$92.00	2012
4008	100	$100.00	1987	14	1186	7/26/12	$8.00	$92.00	2012
4224	100	$100.00	2096	14	1239	8/3/12	$8.00	$92.00	2012
4724	100	$100.00	2352	14	1390	8/19/12	$8.00	$92.00	2012

   f) Once the **PurchaseYear** column has been created, use the **Data Type** dropdown menu on the ribbon to change the column type from **Whole Number** to **Text**.



You might be wondering why it is important to modify the data type of the **PurchaseYear** column to be a **Text** column. If you leave the **Data Type** setting at its default value, the column type is set to the type **Whole Number**. This can cause confusion because in certain scenarios Power BI Desktop will assume that the **PurchaseYear** column values are numeric values that can be aggregated using operations such as SUM or AVERAGE. Configuring the **PurchaseYear** column with the **Text** data type is a technique that prevents Power BI Desktop from incorrectly assuming that it can aggregate its values.

4. Use the new calculated column named **PurchaseYear** in a report
   a) Navigate to report view.
   b) Make sure that no visuals are selected on the page so that you can create a new visual.
   c) Select the checkbox for the **SalesAmount** column in the **Fields** list to create a new visual.

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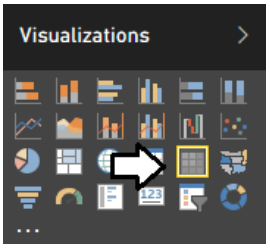
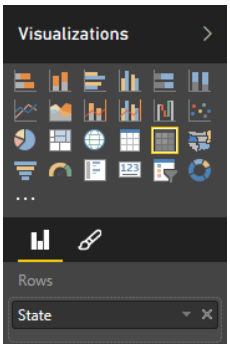
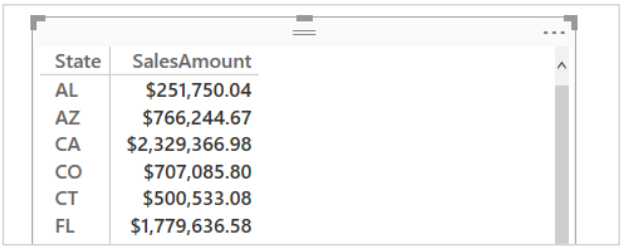
d) Click the **Matrix** button in the **Visualizations** list to change the visualization type to a matrix.



e) Add a second field to the visual by dragging the **State** column from the **Customers** table in the **Fields** list into the **Rows** well to displays a separate row for each state.

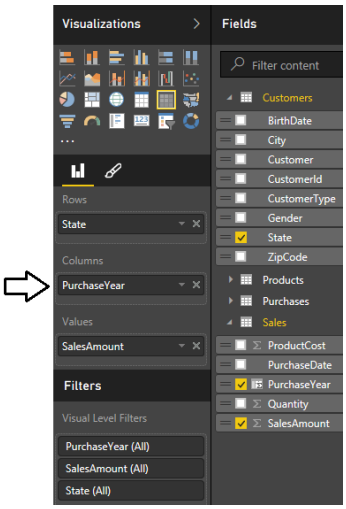


f) Now the matrix should display a row for each state that shows the aggregated sum of the **SalesAmount** column.



State	SalesAmount
AL	$251,750.04
AZ	$766,244.67
CA	$2,329,366.98
CO	$707,085.80
CT	$500,533.08
FL	$1,779,636.58

g) Extend the matrix visual to pivot on the **PurchaseYear** column. Accomplish this by using the mouse to drag the **PurchaseYear** column from the **Fields** list and drop it into the **Columns** well in the **Visualization** pane



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h) The visual should now display a column for each year from 2012 through 2015. Resize the width of the visual so you can see all the columns.

State	2012	2013	2014	2015	Total
AL	$8,537.95	$41,688.00	$77,091.38	$124,432.71	**$251,750.04**
AZ	$83,217.79	$176,586.42	$224,727.85	$281,712.61	**$766,244.67**
CA	$270,926.32	$550,160.02	$737,878.53	$770,402.11	**$2,329,366.98**
CO	$64,683.47	$154,678.89	$215,370.45	$272,352.99	**$707,085.80**
CT	$11,512.65	$86,755.99	$157,387.97	$244,876.47	**$500,533.08**
FL	$51,730.85	$300,866.87	$535,693.94	$891,344.92	**$1,779,636.58**
GA	$40,305.80	$152,807.51	$239,451.05	$417,037.28	**$849,601.64**
LA	$4,467.73	$54,639.88	$105,052.72	$150,823.54	**$314,983.87**
MA		$72,459.05	$158,283.62	$243,864.24	**$474,606.91**
NC	$11,018.02	$164,804.24	$315,139.92	$448,638.72	**$939,600.90**
NH		$23,522.41	$60,121.72	$80,496.42	**$164,140.55**
NJ		$102,786.77	$170,366.35	$207,308.44	**$480,461.56**
NM	$52,066.79	$99,342.05	$131,171.78	$139,195.07	**$421,775.69**
NY	$24,207.43	$165,046.23	$256,294.27	$430,971.24	**$876,519.17**
OH	$2,491.32	$99,245.08	$148,166.21	$186,107.10	**$436,009.71**
OR	$76,153.05	$108,898.70	$142,070.40	$172,165.22	**$499,287.37**
PA	$16,389.99	$136,447.11	$229,419.50	$292,563.22	**$674,819.82**
RI	$4,990.25	$31,586.78	$59,179.35	$60,674.54	**$156,430.92**
SC	$1,314.35	$58,643.31	$103,674.55	$133,352.10	**$296,984.31**
TN	$27,443.02	$135,755.12	$205,616.58	$215,253.52	**$584,068.24**
TX	$212,085.08	$490,643.98	$683,079.11	$919,030.36	**$2,304,838.53**
UT	$20,101.20	$36,832.07	$59,272.82	$83,136.96	**$199,343.05**
VA	$18,568.32	$143,972.83	$229,100.97	$361,881.60	**$753,523.72**
WA	$74,614.94	$101,064.69	$131,768.38	$184,039.11	**$491,487.12**
To...	**$1,076,82...**	**$3,489,23...**	**$5,375,37...**	**$7,311,66...**	**$17,253,100...**

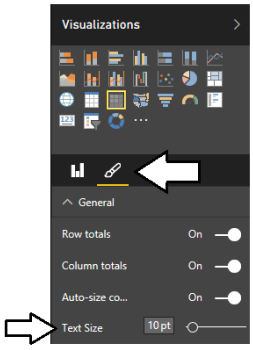
i) Now it's time to apply sorting on the matrix visual. Accomplish this by clicking on the **Total** column heading in the top right corner of the visual.

2014	2	Total
$77,091.38	$124,432.71	**251,750.04**
$224,727.85	$281,712.61	**$766,244.67**
$737,878.53	$770,402.11	**$2,329,366.98**
$215,370.45	$272,352.99	**$707,085.80**
$157,387.97	$244,876.47	**$500,533.08**

j) The rows in the visual should now be sorted so that the states with the greatest amount of sales revenue are on top.

State	2012	2013	2014	2015	Total
CA	$270,926.32	$550,160.02	$737,878.53	$770,402.11	**$2,329,366.98**
TX	$212,085.08	$490,643.98	$683,079.11	$919,030.36	**$2,304,838.53**
FL	$51,730.85	$300,866.87	$535,693.94	$891,344.92	**$1,779,636.58**
NC	$11,018.02	$164,804.24	$315,139.92	$448,638.72	**$939,600.90**
NY	$24,207.43	$165,046.23	$256,294.27	$430,971.24	**$876,519.17**
GA	$40,305.80	$152,807.51	$239,451.05	$417,037.28	**$849,601.64**

k) Increase the font size of the matrix visual. Accomplishing this by first clicking the Edit Pen button in the **Visualization** pane to view the appearance properties of the visual and then by modifying the **Text Size** property to a value of **10pt**.



l) Using the mouse, rearrange the two visuals on that page to match the following screenshot.

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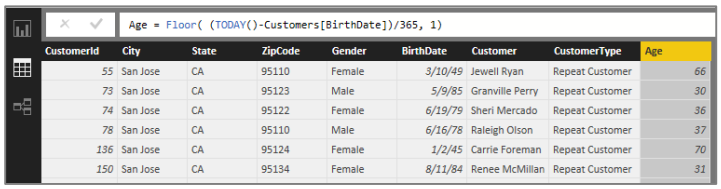
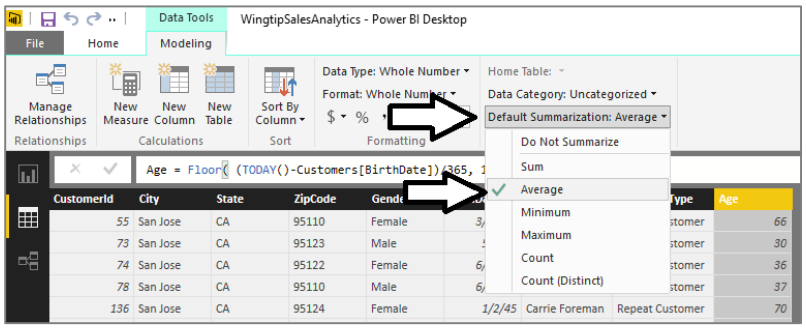
5. Add a calculated column to the **Customers** table named **Age** to indicate the age of the customer.
   a) Navigate to data view.
   b) Select the **Customers** table in the **Fields** list.
   c) Create a new calculated column by clicking the **New Column** button in the ribbon.
   d) Enter the following DAX expression into the formula bar to create the calculated column named **Age**.

```
Age = Floor( (TODAY()-Customers[BirthDate])/365, 1)
```

   e) Press the **ENTER** key to add the calculated column. You should be able to see a whole number for the age of each customer.



   f) Use the **Default Summarization** dropdown menu in the ribbon to change the default summarization setting for **Age** column from **Sum** to **Average**.



6. Add a calculated column to the **Customers** table named **Age Group** to break customers up into age-based sets.
   a) Create a new calculated column in the **Sales** table by clicking the **New Column** button in the ribbon.
   b) Enter to following DAX expression into the formula bar to create the calculated column named **Age Group**.

```
Age Group =
  SWITCH( TRUE(),
    [Age] >= 65, "Ages 65 and over",
    [Age] >= 50, "Ages 50 TO 65",
    [Age] >= 40, "Ages 40 TO 49",
    [Age] >= 30, "Ages 30 TO 39",
    [Age] >= 18, "Ages 18 TO 23",
    [Age] < 18, "Ages under 18"
)
```

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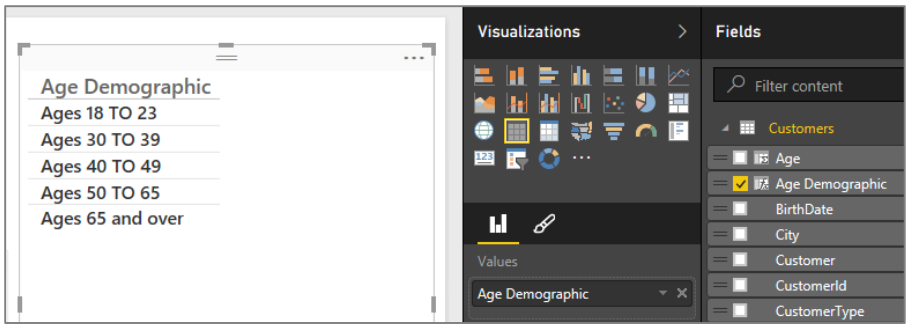
c) After creating the calculated column, you should be able to verify that the **Age Group** column calculates a value for each customer row which places that customer in a bucket for a particular age group.

```
Age Group =
  SWITCH( TRUE(),
    [Age] >= 65, "Ages 65 and over",
    [Age] >= 50, "Ages 50 TO 65",
    [Age] >= 40, "Ages 40 TO 49",
    [Age] >= 30, "Ages 30 TO 39",
    [Age] >= 18, "Ages 18 TO 23",
    [Age] < 18, "Ages under 18"
  )
```

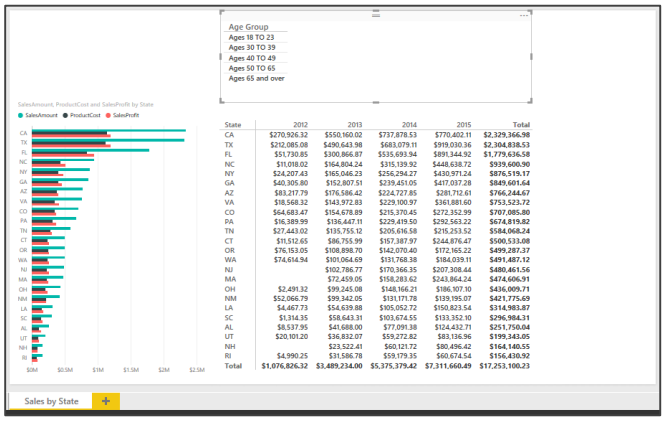
CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group
55	San Jose	CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over
73	San Jose	CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39
74	San Jose	CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39
78	San Jose	CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39
136	San Jose	CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over
150	San Jose	CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39
178	San Jose	CA	95123	Male	9/7/89	Wayne Gordon	Repeat Customer	26	Ages 18 TO 23
183	San Jose	CA	95110	Female	5/26/85	Luella Vinson	Repeat Customer	30	Ages 30 TO 39
213	San Jose	CA	95123	Male	8/13/78	Rosario Knight	Repeat Customer	37	Ages 30 TO 39

7. Use the **Age Group** calculated column as a row label in a matrix visual.
   a) Navigate to report view.
   b) Make sure that no visuals as selected on the page.
   c) Create a new visual in the report by selecting the checkbox for the **Age Group** column in the **Fields** list.

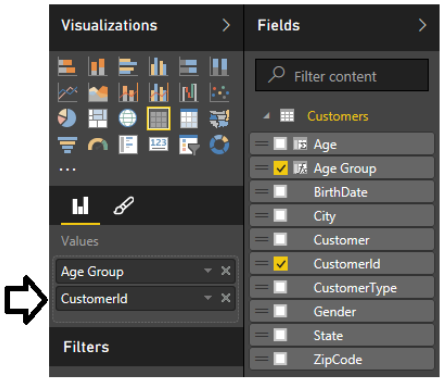


Note that this visual does not display a row for the age demographic value of **Age under 18** even thought you added that value to the DAX formula. The reason for this is that the Wingtip Sales database you are working with does not contain any customers under 18 years of age so the age demographic value of **Age under 18** is automatically filtered out of the visual.

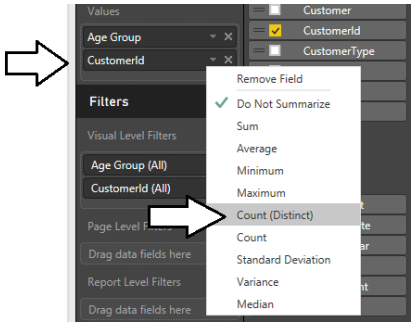
   d) Change the visualization type of the new visual by clicking the **Matrix** button in the **Visualizations** list.
   e) Use the mouse to resize and reposition the visual so it appears on top of the matrix you created earlier.



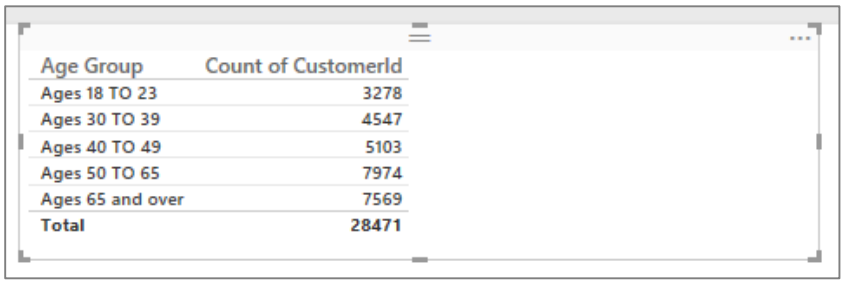
f) Now it's time to modify the matrix visual by adding a new column to show the count of customers in each age group. Accomplish this by dragging the **CustomerId** column from the **Customers** table in the **Fields** list and dropping it into the **Values** well in the **Visualizations** pane. When you drop the **CustomerId** column into the **Values** well, make sure to drop it so it appears underneath the **Age Group** column.



g) Click on the dropdown menu of the **CustomerId** field inside the **Values** well so you can see and change the aggregation that will be performed. Select the aggregation type that is **Count (Distinct)**.



h) Now you should see one row per age group which includes a total count of customers.



Age Group	Count of CustomerId
Ages 18 TO 23	3278
Ages 30 TO 39	4547
Ages 40 TO 49	5103
Ages 50 TO 65	7974
Ages 65 and over	7569
Total	**28471**

i) Drag the **Quantity** column from the **Sales** table and drop it into the **Values** well in the **Visualizations** pane.

j) Drag the **SalesAmount** column from the **Sales** table and drop it into the **Values** well in the **Visualizations** pane.

k) Configure the summarization type for the **Quantity** field and the **SalesAmount** field to perform a **Sum**.

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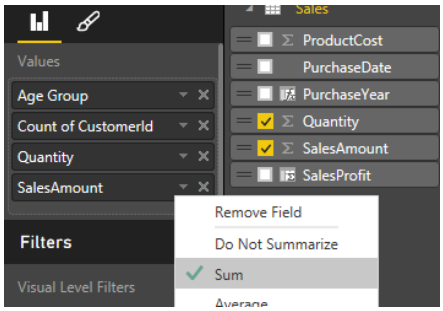

l) The visual should now display a new **Quantity** column displaying the total number of units sold as well as a **SalesAmount** column displaying total sales revenue.

Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 18 TO 23	3278	478,405	$1,985,991.24
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Total	**28471**	**4,032,502**	**$17,253,100.23**

m) Click on the column header for **SalesAmount** to sort the rows so that age groups with the greatest sales revenue to the top.

Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 18 TO 23	3278	478,405	$1,985,991.24
Total	**28471**	**4,032,502**	**$17,253,100.23**

At this point, you might be bothered by the fact that some of the column header names in this visual are not a pretty as they could be. For example, it would be less confusing to business users if the column displaying a count of customers had a column heading of **Customer Count** instead of **Count of CustomerId**. You will address this issue later in the lab exercise where you begin to extend the data model by creating measures.

8. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 3: Extending the Data Model with a Lookup Table

In this exercise, you will extend the data model by adding a new lookup table named **SalesRegions** which assigns a geographic sales region to each state. The work to accomplish this will involve importing data from an Excel workbook to create the **SalesRegions** table and also creating a relationship between the **SalesRegions** table and the **Customers** table. You will also create calculated columns in the **Customers** table to pull in related data from the **SalesRegions** table.

1. Locate the Excel workbook file which contains the **SalesRegions** table.
   a) Using Windows Explorer, open the folder at **c:\Student\Data** and locate the Excel workbook file named **SalesRegions.xlsx**.
   b) Double-click on named **SalesRegions.xlsx**. to open it inside Microsoft Excel 2016.
   c) Once the workbook file opens in Excel, take a moment to examine what's inside. You should be able to verify that there is a **SalesRegions** table which contains a row for each of the 50 states along with the state full name and an assigned sales region. As you can see from the following screenshot, the 50 states have been divided into three sales regions which are **Western Region**, **Central Region** and **Eastern Region**.

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	A	B	C
1	State	StateFullName	SalesRegion
2	AL	Alabama	Central Region
3	AK	Alaska	Western Region
4	AZ	Arizona	Western Region
5	AR	Arkansas	Central Region
6	CA	California	Western Region
7	CO	Colorado	Central Region
8	CT	Connecticut	Eastern Region
9	DE	Delaware	Eastern Region
10	FL	Florida	Eastern Region
11	GA	Georgia	Eastern Region
12	HI	Hawaii	Western Region

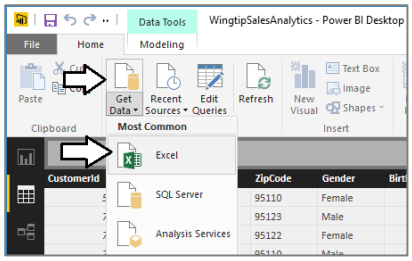
d) Close Microsoft Excel and make sure you do not save any chnages to **SalesRegions.xlsx**.

2. Import the **SalesRegions** table into the data model of the current project.

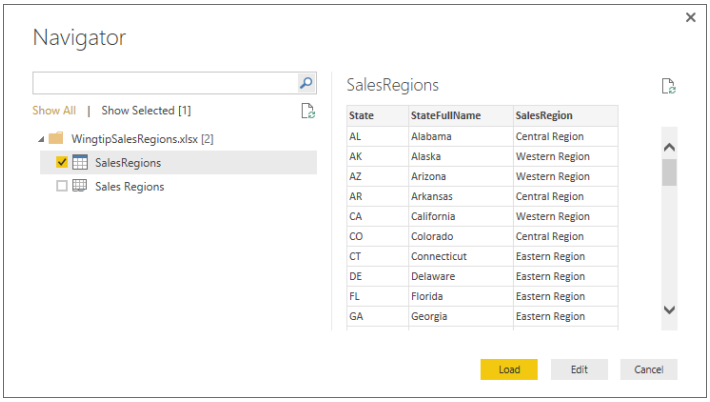
a) Navigate back to Power BI Desktop.

b) Click on the **Home** tab on the ribbon.

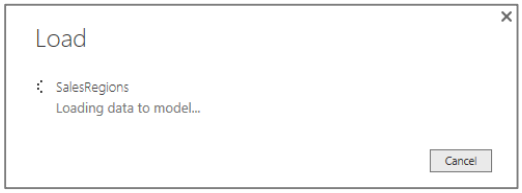
c) Drop down the **Get Data** menu in the ribbon and select the **Excel** command to display the **Navigator** dialog.



d) In the **Navigator** dialog, click the checkbox to select the **SalesRegion** table. Make sure to select the top checkbox for the **SalesRegion** table and not the bottom checkbox for the **Sales Region** worksheet. Once you have selected the **SalesRegion** table, you should be able to see a sample of its rows in the **Navigator** dialog as shown in the following screenshot.



e) Click the **Load** button to load the data and to create the **SalesRegions** table. Power BI Desktop will display the **Load** dialog until the import process completed.



f) Once the import process completes, you should be able to see **SalesRegions** table in data view.

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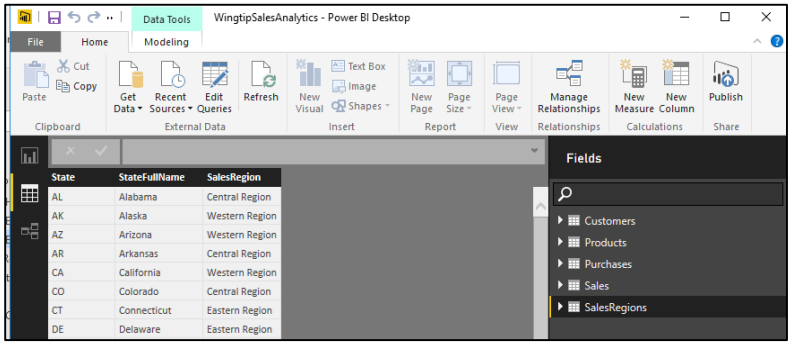
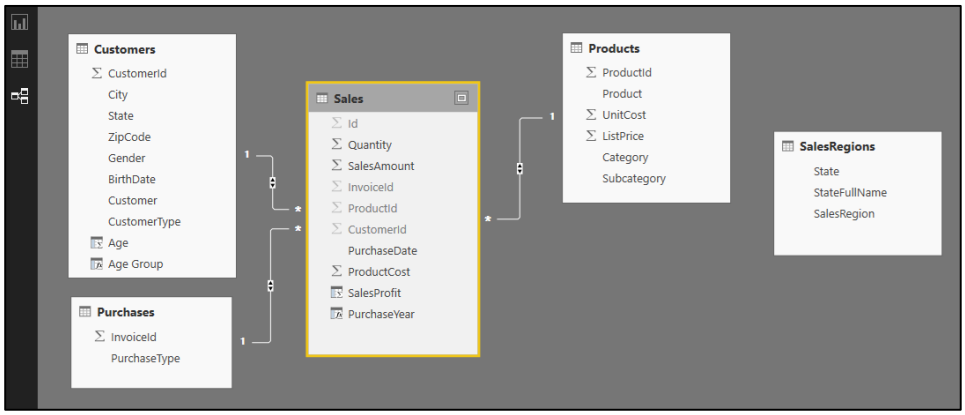
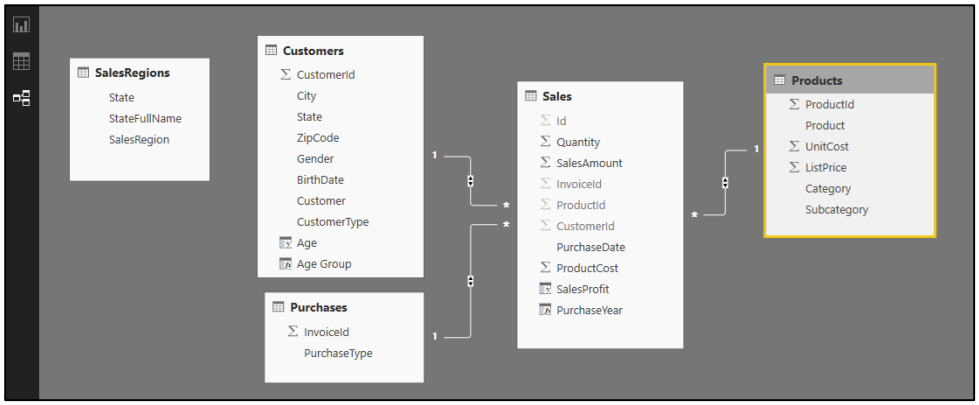


3. Define a relationship between the **Customers** table and the **SalesRegions** table.
   a) Navigate to relationship view.
   b) You should be able to see **SalesRegions** table. However, this table has been created without any relationships.



   c) Using your mouse, reorganize the layout of tables to match the following screenshot.



   d) Using your mouse, drag-and-drop the **State** column from the **Customers** table on top of the **State** column of the **SalesRegions** table to create a relationship between the two.

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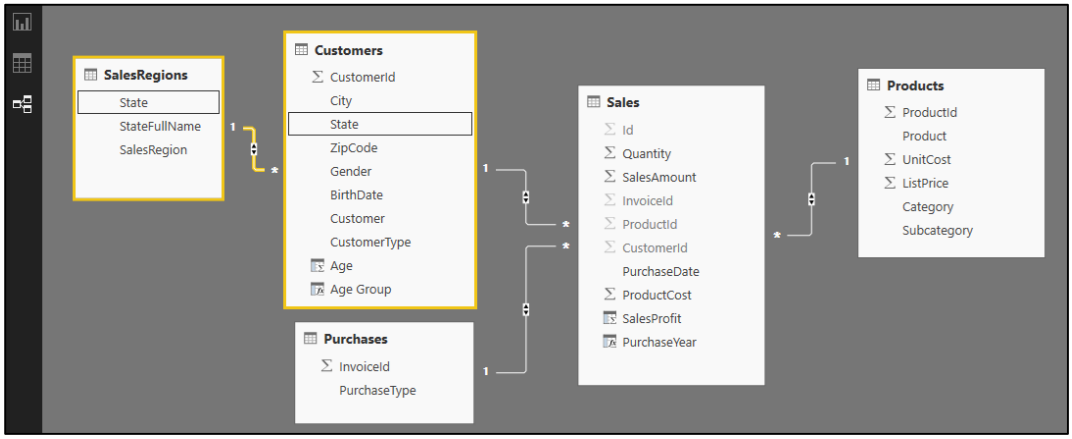
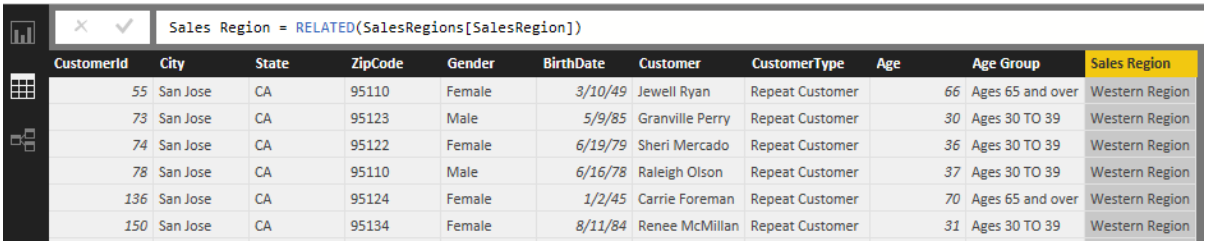


Now that you have created a relationship between the **SalesRegions** table and the **Customers** table, you can begin to use the **RELATED** function provided by DAX. More specifically, you can use the **RELATED** function to create calculated columns in the **Customers** table that are written to pull in data from the **SalesRegions** table.

4. Add a calculated column to the **Customers** table named **Sales Region** to display the sales region for each state.
   a) Navigate to data view.
   b) Select the **Customers** table in the **Fields** list.
   c) Create a new calculated column by clicking the **New Column** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the calculated column named **Sales Region**.

```
Sales Region = RELATED(SalesRegions[SalesRegion])
```

   e) Press the **ENTER** key to add the calculated column to the table. You should be able to see a value in the **Sales Region** column for each row in the **Customers** table.



```
Sales Region = RELATED(SalesRegions[SalesRegion])
```

CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group	Sales Region
55	San Jose	CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over	Western Region
73	San Jose	CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39	Western Region
74	San Jose	CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39	Western Region
78	San Jose	CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39	Western Region
136	San Jose	CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over	Western Region
150	San Jose	CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39	Western Region

5. Add a calculated column to the **Customers** table named **State Name** to display the full state name.
   a) Create a new calculated column in the **Customers** table by clicking the **New Column** button in the ribbon.
   b) Enter to following DAX expression into the formula bar to create the calculated column named **State Name**.

```
State Name = RELATED(SalesRegions[StateFullName])
```

   c) Press the **ENTER** key to add the calculated column to the table. You should be able to see a value in the **Sales Region** column for each row in the **Customers** table.

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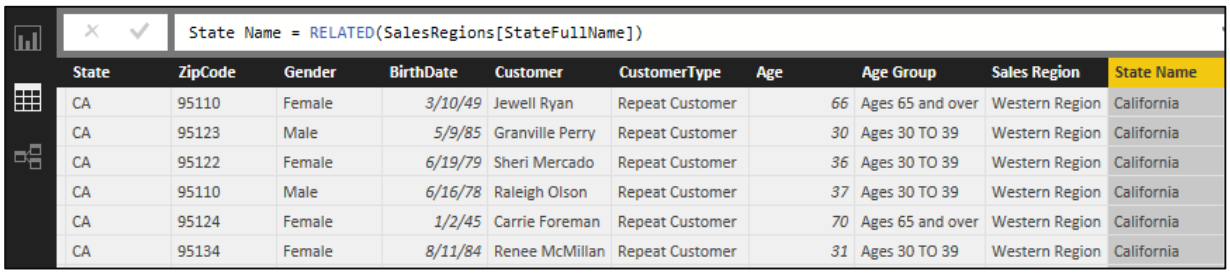
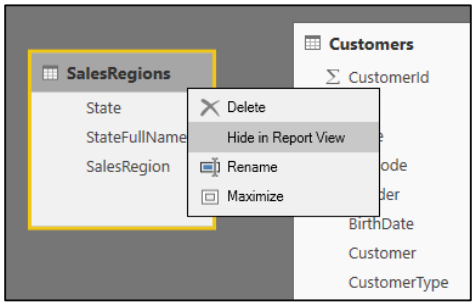


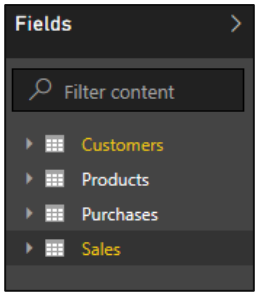
State	ZipCode	Gender	BirthDate	Customer	CustomerType	Age	Age Group	Sales Region	State Name
CA	95110	Female	3/10/49	Jewell Ryan	Repeat Customer	66	Ages 65 and over	Western Region	California
CA	95123	Male	5/9/85	Granville Perry	Repeat Customer	30	Ages 30 TO 39	Western Region	California
CA	95122	Female	6/19/79	Sheri Mercado	Repeat Customer	36	Ages 30 TO 39	Western Region	California
CA	95110	Male	6/16/78	Raleigh Olson	Repeat Customer	37	Ages 30 TO 39	Western Region	California
CA	95124	Female	1/2/45	Carrie Foreman	Repeat Customer	70	Ages 65 and over	Western Region	California
CA	95134	Female	8/11/84	Renee McMillan	Repeat Customer	31	Ages 30 TO 39	Western Region	California

Now that you have pulled all the important data from the **SalesRegions** table into the **Customers** table, there is no need to display the **SalesRegions** table in report view. In the next step, you will hide the **SaleRegions** table to simplify view of the data model that is shown in report view.

6. Hide the **SalesRegions** table from report view.
   a) Navigate to relationship view.
   b) Right-click on the the **SalesRegions** table



   c) Navigate to report view and verify that the **SalesRegions** table is not displayed as one of the tables in the **Fields** list.



7. Update the matrix with row labels based on the **State** column to use the **State Name** column instead.
   a) Navigate back to report view.
   b) Select the matrix visual with the row labels based on the **State** column.
   c) Remove the **State** field from the **Rows** well in the **Visualization** pane and replace it with the **State Name** column. The visual should now show the full state name instead of the two-character state abbreviation.

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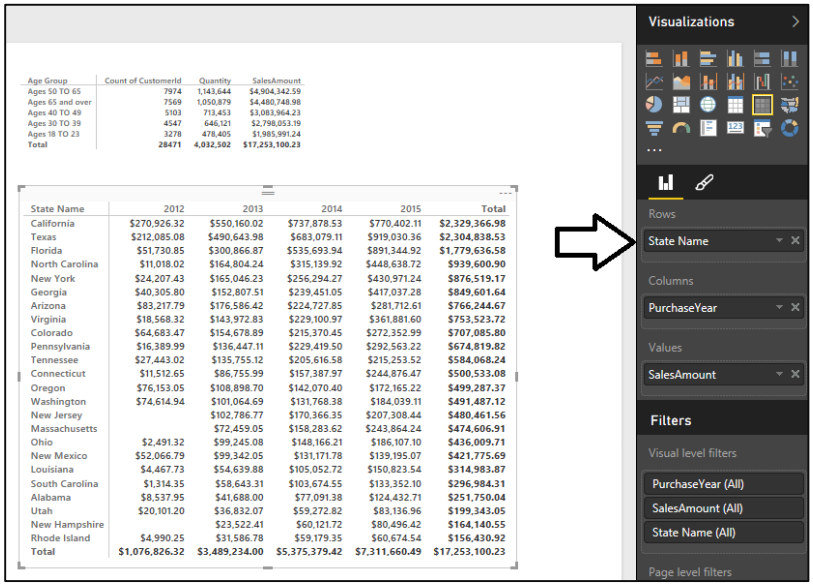
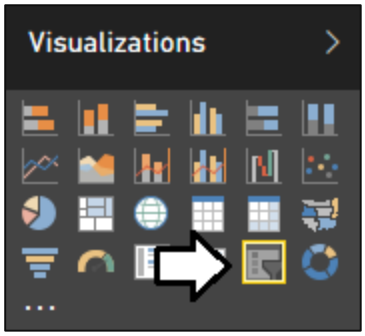
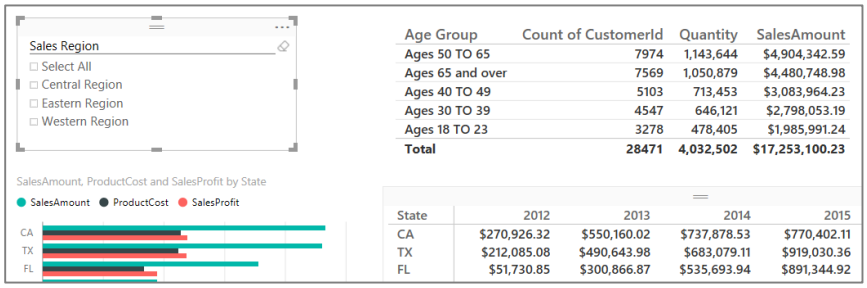


8. Add a slicer visual to the report to filter all displayed results by sales region.
   a) Navigate to report view if you are not already there.
   b) Make sure that no visuals are selected on the page so that you can create a new visual.
   c) Select the checkbox for the **Sales Region** column in the **Fields** list to create a new visual.
   d) Click the **Slicer** button in the **Visualizations** list to change the visual type to a slicer.



   e) Using the mouse, reposition the slicer visual so it appears in the upper, left-hand corner of the page as shown in the following screenshot.



Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 18 TO 23	3278	478,405	$1,985,991.24
Total	**28471**	**4,032,502**	**$17,253,100.23**

State	2012	2013	2014	2015
CA	$270,926.32	$550,160.02	$737,878.53	$770,402.11
TX	$212,085.08	$490,643.98	$683,079.11	$919,030.36
FL	$51,730.85	$300,866.87	$535,693.94	$891,344.92

   f) Change the alignment of the slicer visual from vertical to horizontal. Accomplishing this by first clicking the Edit Pen button in the **Visualization** pane to view the appearance properties of the visual and then by modifying the **Orientation** property to a value of **Horizontal**. Also enable the **Select All** property by setting its value to **On**.

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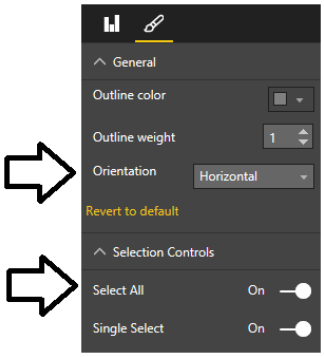
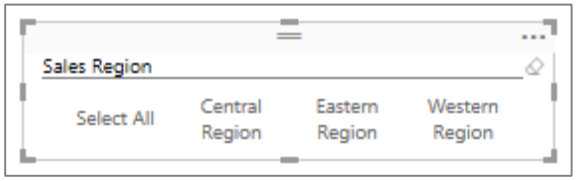


g) The slicer visual should now appear with a horizontal layout with an additional **Select All** node.



h) Click on the different nodes of the slicer visual to see its filtering effect. If you click on the **Eastern Region** node, all the other visuals apply a filter to only shows states assigned to the Eastern sales region.

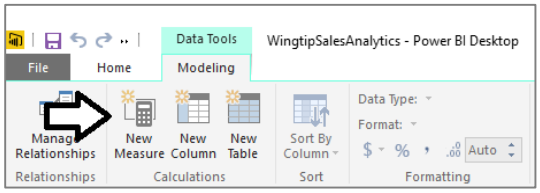
State Name	2012	2013	2014	2015	Total
Florida	$51,730.85	$300,866.87	$535,693.94	$891,344.92	$1,779,636.58
North Carolina	$11,018.02	$164,804.24	$315,139.92	$448,638.72	$939,600.90
New York	$24,207.43	$165,046.23	$256,294.27	$430,971.24	$876,519.17
Georgia	$40,305.80	$152,807.51	$239,451.05	$417,037.28	$849,601.64
Virginia	$18,568.32	$143,972.83	$229,100.97	$361,881.60	$753,523.72
Pennsylvania	$16,389.99	$136,447.11	$229,419.50	$292,563.22	$674,819.82
Connecticut	$11,512.65	$86,755.99	$157,387.97	$244,876.47	$500,533.08
New Jersey		$102,786.77	$170,366.35	$207,308.44	$480,461.56
Massachusetts		$72,459.05	$158,283.62	$243,864.24	$474,606.91
South Carolina	$1,314.35	$58,643.31	$103,674.55	$133,352.10	$296,984.31
New Hampshire		$23,522.41	$60,121.72	$80,496.42	$164,140.55
Rhode Island	$4,990.25	$31,586.78	$59,179.35	$60,674.54	$156,430.92
Total	$180,037.66	$1,439,699.10	$2,514,113.21	$3,813,009.19	$7,946,859.16

9. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 4: Extending the Data Model by Creating Measures

In this exercise you will create four measures named **Units Sold, Sales Revenue, Product Cost** and **Profit** that will perform sum aggregations on the **Sales** table. You will also create a measure named **Customer Count** that performs a distinct count aggregation on the **Customers** table. As you will see, creating measures to use in your report visuals will give you much greater control over the column names, formatting and aggregations that are displayed in your reports.

1. Create a measure named **Units Sold** to perform a sum aggregation on the **Quantity** column of the **Sales** table.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.

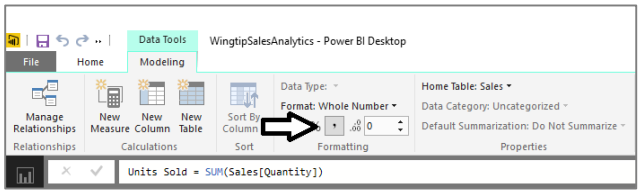


d) Enter to following DAX expression into the formula bar to create the calculated column named **Units Sold**.

```
Units Sold = SUM(Sales[Quantity])
```

e) Press the **ENTER** key to add the calculated column to data model.

f) Modify the formatting by clicking and selecting the Comma button on the ribbon to add a comma separator.



2. Create a measure named **Sales Revenue** to perform a sum aggregation on the **SalesAmount** column of the **Sales** table.

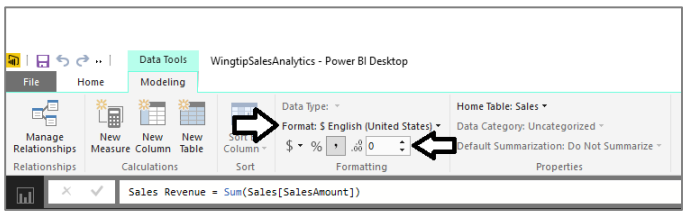
a) Create a new measure by clicking the **New Measure** button in the ribbon.

b) Enter to following DAX expression into the formula bar to create the calculated column named **Sales Revenue**.

```
Sales Revenue = Sum(Sales[SalesAmount])
```

c) Press the **ENTER** key to add the calculated column to data model.

d) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.



3. Create a measure named **Product Cost** to perform a sum aggregation on the **ProductCost** column of the **Sales** table.

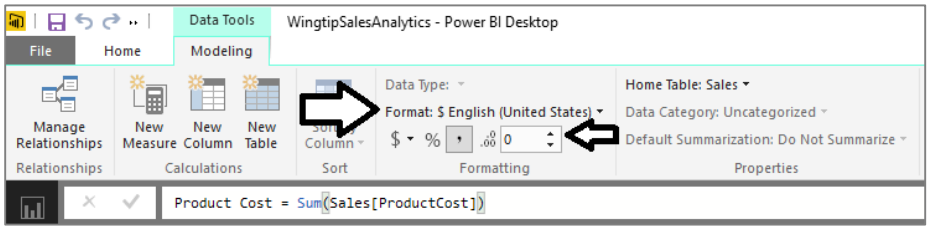
a) Create a new measure by clicking the **New Measure** button in the ribbon.

b) Enter to following DAX expression into the formula bar to create the calculated column named **Product Cost**.

```
Product Cost = Sum(Sales[ProductCost])
```

c) Press the **ENTER** key to add the calculated column to data model.

d) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.



4. Create a measure named **Profit** to perform a sum aggregation on the **SalesProfit** column of the **Sales** table.

a) Create a new measure by clicking the **New Measure** button in the ribbon.

b) Enter to following DAX expression into the formula bar to create the calculated column named **Profit**.

```
Profit = SUM(Sales[SalesProfit])
```

c) Press the **ENTER** key to add the calculated column to data model.

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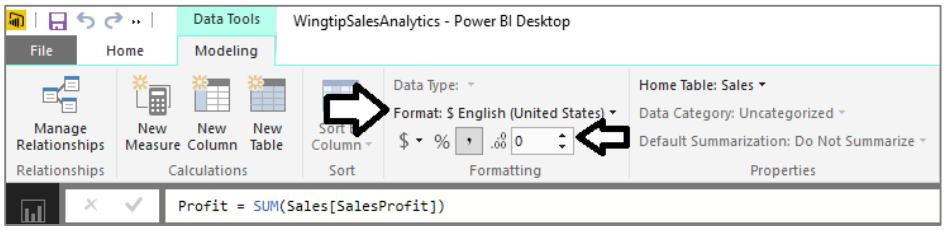
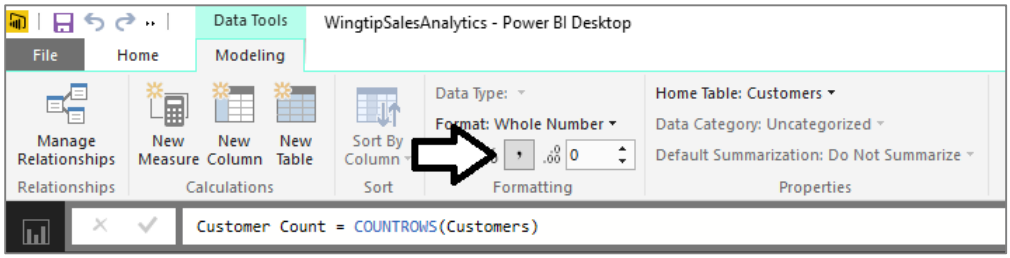
d) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.



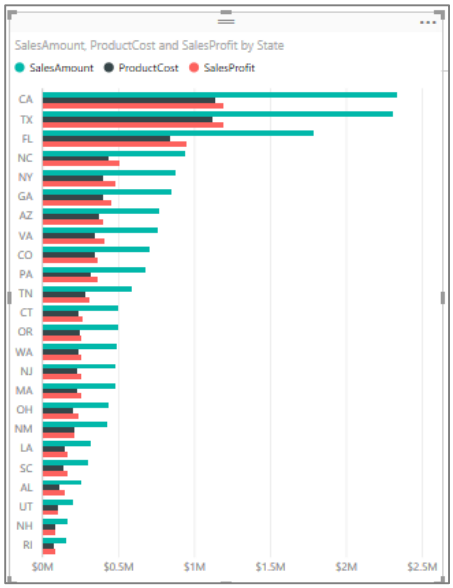
5. Create a measure named **Customer Count** to perform an aggregation to count the number of rows **in** the **Customers** table.
   a) Create a new measure by clicking the **New Measure** button in the ribbon.
   b) Enter to following DAX expression into the formula bar to create the calculated column named **Units Sold**.

```
Customer Count = COUNTROWS(Customers)
```

   c) Press the **ENTER** key to add the calculated column to data model.
   d) Modify the formatting by clicking and selecting the Comma button on the ribbon to add a comma separator.



6. Update the visuals in the report to use the new measures you have just created.
   a) Navigate to report view.
   b) Select the clustered bar chart visual.



   c) Examine the properties of this visual in the **Visualizations** pane. The **Value** well should currently contain the three fields named **SalesAmount**, **ProductCost** and **SalesProfit**.

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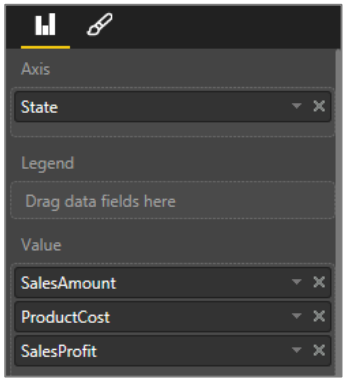
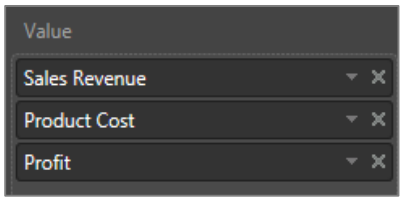
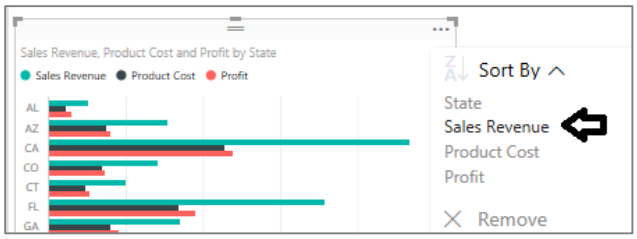


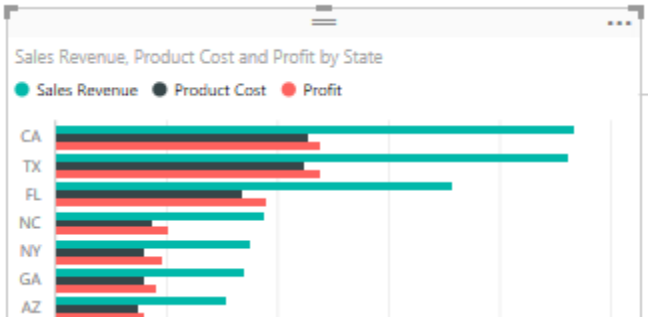
d) Remove those three fields from the **Value** well and replace them with the new measures named **Sales Revenue**, **Product Cost** and **Profit**.



e) You will notice that the sort order of this visual is now based on the **State** field because you removed the **SalesAmount** field that was being used for sorting. Resort the rows in the visual using **Sales Revenue**.



f) Now this visual looks more polished because it is using measures instead of aggregated columns to produce its values.



g) Select the matrix visual which displays sales revenue by state and year.

h) In the **Visualizations** pane, remove the **SalesAmount** column from the **Values** well and replace it with **Sales Revenue** measure.

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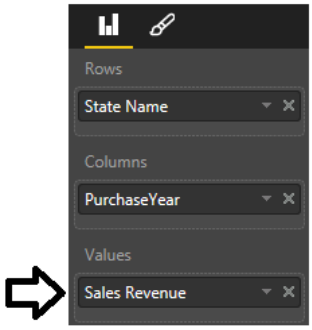


i) The matrix visual should display its numbers in currency with no decimal places.

j) Click the **Total** column header to sort the state rows by total sales revenue.

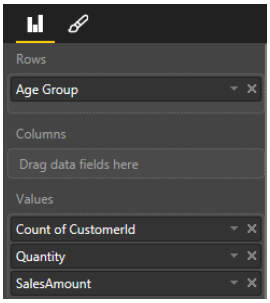
State Name	2012	2013	2014	2015	Total
California	$270,926	$550,160	$737,879	$770,402	$2,329,367
Texas	$212,085	$490,644	$683,079	$919,030	$2,304,839
Florida	$51,731	$300,867	$535,694	$891,345	$1,779,637
North Carolina	$11,018	$164,804	$315,140	$448,639	$939,601
New York	$24,207	$165,046	$256,294	$430,971	$876,519
Georgia	$40,306	$152,808	$239,451	$417,037	$849,602
Arizona	$83,218	$176,586	$224,728	$281,713	$766,245
Virginia	$18,568	$143,973	$229,101	$361,882	$753,524

k) Select the matrix visual which displays a row for each age group.

l) Notice how some of the columns contain text (e.g. **Count of CustomerId**) that is not very user-friendly.

Age Group	Count of CustomerId	Quantity	SalesAmount
Ages 50 TO 65	7974	1,143,644	$4,904,342.59
Ages 65 and over	7569	1,050,879	$4,480,748.98
Ages 40 TO 49	5103	713,453	$3,083,964.23
Ages 30 TO 39	4547	646,121	$2,798,053.19
Ages 18 TO 23	3278	478,405	$1,985,991.24
Total	**28471**	**4,032,502**	**$17,253,100.23**

m) Examine the properties of this visual in the **Visualizations** pane. The **Value** well should currently contain the three fields named **Count of CustomerId**, **Quantity** and **SalesAmount**.



n) Remove those three fields from the **Value** well and replace them with the new measures named **Customer Count**, **Units Sold** and **Sales Revenue**.

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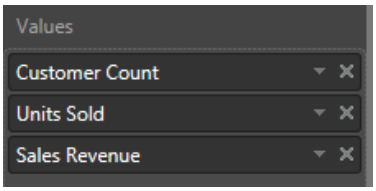
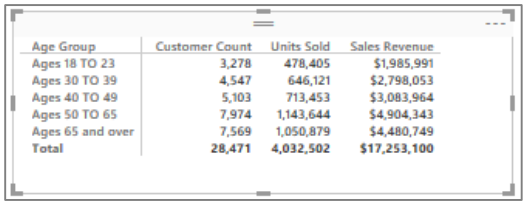
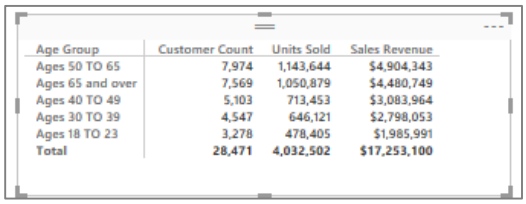


o) The columns of the matrix visual are now more user-friendly and the formatting of values looks better as well.



Age Group	Customer Count	Units Sold	Sales Revenue
Ages 18 TO 23	3,278	478,405	$1,985,991
Ages 30 TO 39	4,547	646,121	$2,798,053
Ages 40 TO 49	5,103	713,453	$3,083,964
Ages 50 TO 65	7,974	1,143,644	$4,904,343
Ages 65 and over	7,569	1,050,879	$4,480,749
Total	**28,471**	**4,032,502**	**$17,253,100**

p) Click on the **Sales Revenue** column header to sort the age groups by sales revenue.



Age Group	Customer Count	Units Sold	Sales Revenue
Ages 50 TO 65	7,974	1,143,644	$4,904,343
Ages 65 and over	7,569	1,050,879	$4,480,749
Ages 40 TO 49	5,103	713,453	$3,083,964
Ages 30 TO 39	4,547	646,121	$2,798,053
Ages 18 TO 23	3,278	478,405	$1,985,991
Total	**28,471**	**4,032,502**	**$17,253,100**

7. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

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Module 05: Extending Datasets to Support Time Intelligence

Module Description

This module will begin by introducing concepts and terms used when modeling a dataset using time dimensions. Students will learn why and how to create a specialized date tables to track time dimensions as well as how to design a time-dimensional hierarchy which allows users to drill down into more specific regions of time while analyzing data. The second half of the module focuses on the support in the DAX language for creating calculated columns and measures within a dataset which provide rich analytic capabilities to calculate year-to-date totals and rolling averages and to provide drill down capabilities to the level of month, week or day.

Module Agenda

- Understanding Evaluation Contexts
- Creating a Time Dimension Table
- Understanding DAX Time Intelligence Support
- Working with DAX Time Intelligence Functions

Topics Covered

Evaluation Contexts
Understanding Filter Context
Understanding Row Context
Understanding Iterators Like SUMX
DAX Functions With Tables Parameter
DAX Functions that Return a Table
Using the CALCULATE Function
Creating Calendar Table as Calculated Table
Adding Columns to Calendar Table
Configuring Sort Columns
Columns for Month in Year and Day in week
Integrating Calendar Table into Data Model
Creating Visuals with a Calendar Table
Hierarchical Row Labels in a Matrix
Functions That Return a Single Date
To Date Functions
Function That Return a Table of Dates
Balance Functions
Calculated Fields for QTD and YTD Sales
Using the CALCULATE Function
Matrix Visual with To-Date Running Totals
Sales Growth PM Measure - First Attempt
Using the ISFILTERED Function
Simulating KPIs with Power BI Desktop

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Evaluation Contexts

- DAX expressions evaluated using two context
  - Filter context
  - Row context
- Row Context
  - The set of active rows in a calculation
- Filter Context
  - The current row in a table iteration

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Understanding Filter Context

- Visuals apply various filters in evaluation contexts

Month in Year	2012	2013	2014	2015	Total
January	$6,306	$164,334	$385,275	$512,822	$1,068,737
February	$48,815	$126,501	$358,244	$597,684	$1,131,244
March	$53,958	$243,676	$381,309	$532,123	$1,211,067
April	$52,601	$300,872	$381,157	$602,751	$1,337,381
May	$61,756	$334,948	$438,261	$647,276	$1,482,241
June	$76,756	$321,715	$378,749	$608,448	$1,385,668
July	$104,408	$287,800	$359,744	$620,316	$1,372,268
August	$111,167	$298,483	$457,312	$678,499	$1,545,461
September	$110,716	$376,207	$505,332	$613,974	$1,606,229
October	$145,999	$362,943	$602,448	$620,735	$1,732,125
November	$156,751	$340,228	$545,572	$590,220	$1,632,770
December	$147,593	$331,526	$581,977	$686,814	$1,747,910
Total	$1,076,826	$3,489,234	$5,375,379	$7,311,660	$17,253,100

Filters on this evaluation

[Year] = 2015

[Month in Year] = "October"

- Filter context also affected by slicers and other filters

Sales Region
- Select All
- Central Region
- Eastern Region
- Western Region

Customer Type
- One-time customer
- Repeat Customer

Month in Year	2012	2013	2014	2015	Total
January	$425	$50,169	$61,295	$76,614	$188,503
February	$13,891	$40,133	$63,670	$101,542	$219,236
March	$19,121	$58,411	$73,839	$84,180	$235,551
April	$19,128	$53,711	$67,919	$91,762	$232,520
May	$22,939	$64,259	$78,668	$109,689	$275,555
June	$29,082	$50,564	$73,504	$88,047	$241,197
July	$34,809	$62,971	$69,053	$80,749	$247,582
August	$36,096	$61,217	$76,009	$94,719	$268,041
September	$39,415	$68,653	$82,697	$94,805	$285,570
October	$51,994	$69,122	$99,344	$84,177	$304,637
November	$47,020	$52,548	$85,924	$74,611	$260,102
December	$50,580	$66,260	$102,088	$94,877	$313,804
Total	$364,500	$698,018	$934,009	$1,075,771	$3,072,298

Filters on this evaluation

[Year] = 2015

[Month in Year] = "October"

[Sales Region] = "Western Region"

[Customer Type] = "Repeat Customer"

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Understanding Row Context

- There are 2 cases that create active row context
  - Evaluation of a calculated column

```
=(TODAY()-[BirthDate])/365
```

```
=LEFT([ProductCategory], Find(" >", [ProductCategory]))
```

  - Evaluation of a DAX function that iterates over a table

```
=SUMX(RELATEDTABLE(Sales), Sales[SalesAmount])
```

```
=SUMX(Sales,
      Sales[Quantity] * RELATED(Products[UnitCost]))
```

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Understanding Iterators Like SUMX

- Standard aggregation functions (e.g. SUM) have no row context
  - You can sum an individual column but you cannot sum an expressions

```
Gross Margin = SUM( Sales[SalesAmount]-Sales[ProductCost] )
```

The SUM function only accepts a column reference as an argument.

- Iterator functions (e.g. SUMX) iterate through rows in a target table
  - First argument accepts an expressions evaluates to a table of rows
  - Second argument accepts expression that evaluated for each row in table

```
Gross Margin = SUMX(Sales, Sales[SalesAmount]-Sales[ProductCost] )
```

- Iterator functions can also be used in calculated columns

```
Product Sales Revenue = SUMX(RELATEDTABLE(Sales), Sales[SalesAmount])
```

ProductId	Product	UnitCost	ListPrice	Category	Subcategory	Product Sales Revenue
1	Batman Action Figure	$6.85	$14.95	Action Figures	Tough Guys	$130,767.65
2	Captain America Action Figure	$7.05	$12.95	Action Figures	Tough Guys	$499,714.6
3	GI Joe Action Figure	$6.10	$14.95	Action Figures	Tough Guys	$168,905.1
4	Green Hulk Action Figure	$2.85	$9.95	Action Figures	Tough Guys	$82,764.1
5	Red Hulk Alter Ego Action Figure	$2.85	$9.95	Action Figures	Tough Guys	$13,691.2

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DAX Functions With Tables Parameter

- The following DAX functions create row context
  - AVERAGEX
  - COUNTAX
  - COUNTX
  - MAXX
  - MINX
  - SUMX

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DAX Functions that Return a Table

- ALL
- ALLEXCEPT
- CALCULATETABLE
- DISTINCT
- FILTER
- RELATEDTABLE
- VALUES

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Using the CALCULATE Function

- CALCULATE provides greatest amount of control
  - You'll see more about Calculate later in this module

```
Sales Revenue RT =
CALCULATE(
    SUM(Sales[SalesAmount]),
    FILTER(
        ALL('Calendar'),
        'Calendar'[Date] <= MAX('Calendar'[Date])
    )
)
```

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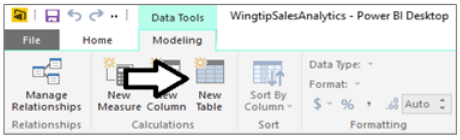
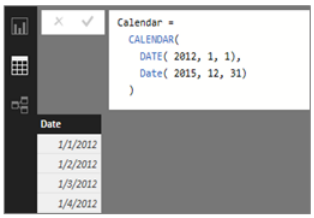
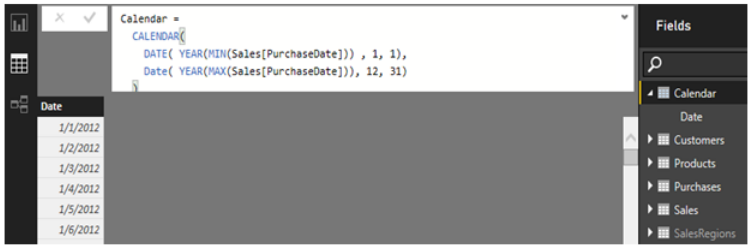
Creating Calendar Table as Calculated Table

- Use **New Table** command in ribbon



- Create calculate table using CALENDAR function in DAX





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Adding Columns to Calendar Table

- Year

```
Year = YEAR('Calendar'[Date])
```

Date	Year
1/1/2012	2012
1/2/2012	2012
1/3/2012	2012

- Quarter

```
Quarter = YEAR('Calendar'[Date]) &
          "-Q" &
          QUOTIENT( (MONTH('Calendar'[Date])-1), 3) + 1
```

Date	Year	Quarter
3/28/2012	2012	2012-Q1
3/29/2012	2012	2012-Q1
3/30/2012	2012	2012-Q1
3/31/2012	2012	2012-Q1
4/1/2012	2012	2012-Q2
4/2/2012	2012	2012-Q2

- Month

```
Month = FORMAT('Calendar'[Date], "MMM yyyy")
```

Date	Year	Quarter	Month
1/1/2012	2012	2012-Q1	Jan 2012
1/2/2012	2012	2012-Q1	Jan 2012
1/3/2012	2012	2012-Q1	Jan 2012

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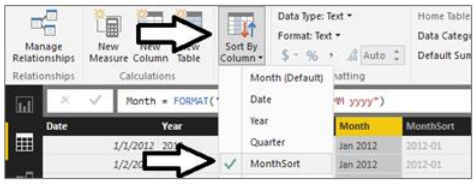
Configuring Sort Columns

- Some columns do not sort in desired fashion by default
  - For example, April will sort before January, February and March
  - Column must be configured with sort column for desired sorting

```
MonthSort = FORMAT('Calendar'[Date], "yyyy-MM")
```

Date	Year	Quarter	Month	MonthSort
1/1/2012	2012	2012-Q1	Jan 2012	2012-01
1/2/2012	2012	2012-Q1	Jan 2012	2012-01
1/3/2012	2012	2012-Q1	Jan 2012	2012-01



Columns for Month in Year and Day in week

```
Month in Year = FORMAT('Calendar'[Date], "MMMM")
```

Date	Year	Quarter	Month	MonthSort	Month in Year
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January

```
MonthInYearSort = MONTH('Calendar'[Date])
```

Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1

```
Day of Week = FORMAT('Calendar'[Date], "dddd")
```

Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort	Day of Week
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Sunday
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Monday
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Tuesday
1/4/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Wednesday
1/5/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Thursday
1/6/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Friday
1/7/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Saturday

```
DayOfWeekSort = WEEKDAY('Calendar'[Date], 2)
```

Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort	Day of Week	DayOfWeekSort
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Sunday	7
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Monday	1
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Tuesday	2
1/4/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Wednesday	3
1/5/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Thursday	4
1/6/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Friday	5
1/7/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Saturday	6

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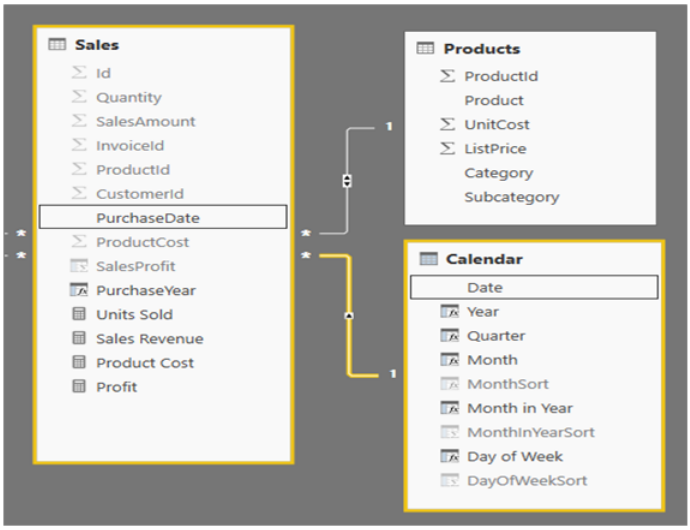
Integrating Calendar Table into Data Model

- Calendar table needs relationship to one or more tables



Creating Visuals with a Calendar Table

- **Year** for row labels and **Month in Year** as column labels

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2012	$6,306	$48,815	$53,958	$52,601	$61,756	$76,756	$104,408	$111,167	$110,716	$145,999	$156,751	$147,593	**$1,076,826**
2013	$164,334	$126,501	$243,676	$300,872	$334,948	$321,715	$287,800	$298,483	$376,207	$362,943	$340,228	$331,526	**$3,489,234**
2014	$385,275	$358,244	$381,309	$381,157	$438,261	$378,749	$359,744	$457,312	$505,332	$602,448	$545,572	$581,977	**$5,375,379**
2015	$512,822	$597,684	$532,123	$602,751	$647,276	$608,448	$620,316	$678,499	$613,974	$620,735	$590,220	$686,814	**$7,311,660**
Total	**$1,068,737**	**$1,131,244**	**$1,211,067**	**$1,337,381**	**$1,482,241**	**$1,385,668**	**$1,372,268**	**$1,545,461**	**$1,606,229**	**$1,732,125**	**$1,632,770**	**$1,747,910**	**$17,253,100**

- **Month in Year** for row labels and **Year** as column labels

Month in Year	2012	2013	2014	2015	Total
January	$6,306	$164,334	$385,275	$512,822	**$1,068,737**
February	$48,815	$126,501	$358,244	$597,684	**$1,131,244**
March	$53,958	$243,676	$381,309	$532,123	**$1,211,067**
April	$52,601	$300,872	$381,157	$602,751	**$1,337,381**
May	$61,756	$334,948	$438,261	$647,276	**$1,482,241**
June	$76,756	$321,715	$378,749	$608,448	**$1,385,668**
July	$104,408	$287,800	$359,744	$620,316	**$1,372,268**
August	$111,167	$298,483	$457,312	$678,499	**$1,545,461**
September	$110,716	$376,207	$505,332	$613,974	**$1,606,229**
October	$145,999	$362,943	$602,448	$620,735	**$1,732,125**
November	$156,751	$340,228	$545,572	$590,220	**$1,632,770**
December	$147,593	$331,526	$581,977	$686,814	**$1,747,910**
Total	**$1,076,826**	**$3,489,234**	**$5,375,379**	**$7,311,660**	**$17,253,100**

- **Month in Year** for row labels and **Year** as column labels

Day of Week	2012	2013	2014	2015	Total
Monday	$163,919	$486,428	$802,943	$1,090,519	**$2,543,808**
Tuesday	$154,244	$462,695	$772,438	$1,163,588	**$2,552,965**
Wednesday	$162,811	$425,869	$752,274	$1,029,697	**$2,370,651**
Thursday	$169,687	$513,948	$837,905	$1,066,526	**$2,588,067**
Friday	$146,575	$582,823	$736,297	$1,059,080	**$2,524,774**
Saturday	$162,219	$546,922	$694,322	$909,334	**$2,312,797**
Sunday	$117,372	$470,550	$779,200	$992,915	**$2,360,038**
Total	**$1,076,826**	**$3,489,234**	**$5,375,379**	**$7,311,660**	**$17,253,100**

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Hierarchical Row Labels in a Matrix

- Dimensional hierarchy can be represented with matrix
  - No support as of November 2016 to collapse and expand children

Year	Quarter	Units Sold	Sales Revenue	Product Cost	Profit
2012	2012-Q1	5,915	$109,079	$57,796	$51,283
	2012-Q2	9,998	$191,113	$105,009	$86,105
	2012-Q3	21,968	$326,291	$176,341	$149,950
	2012-Q4	28,559	$450,343	$244,690	$205,653
	Total	**66,440**	**$1,076,826**	**$583,836**	**$492,991**
2013	2013-Q1	67,144	$534,511	$274,583	$259,928
	2013-Q2	313,031	$957,536	$401,557	$555,979
	2013-Q3	276,121	$962,490	$420,217	$542,273
	2013-Q4	296,759	$1,034,697	$451,751	$582,946
	Total	**953,055**	**$3,489,234**	**$1,548,108**	**$1,941,126**
2014	2014-Q1	328,265	$1,124,829	$490,507	$634,322
	2014-Q2	327,970	$1,198,166	$529,601	$668,565
	2014-Q3	352,844	$1,322,388	$596,885	$725,503
	2014-Q4	400,171	$1,729,996	$843,429	$886,567
	Total	**1,409,250**	**$5,375,379**	**$2,460,422**	**$2,914,957**
2015	2015-Q1	380,321	$1,642,629	$803,675	$838,954
	2015-Q2	423,115	$1,858,474	$912,540	$945,934
	2015-Q3	420,095	$1,912,789	$946,017	$966,772
	2015-Q4	380,226	$1,897,768	$958,635	$939,133
	Total	**1,603,757**	**$7,311,660**	**$3,620,868**	**$3,690,793**
Total		**4,032,502**	**$17,253,100**	**$8,213,233**	**$9,039,867**

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Functions That Return a Single Date

- FIRSTDATE / LASTDATE
- FIRSTNONBLANK / LASTNONBLANK
- STARTOFMONTH / ENDOFMONTH
- STARTOFQUARTER / ENDOFQUARTER
- STARTOFYEAR / ENDOFYEAR

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To Date Functions

- Convenience To Date functions
  - TOTALMTD
  - TOTALQTD
  - TOTALYTD
- Convenience To Date functions really do this
  - CALCULATE (Expression, DATESMTD(Date) [, SetFilter])
  - TOTALMTD (Expression, Date [, SetFilter])

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Function That Return a Table of Dates

- PREVIOUSDAY / NEXTDAY
- PREVIOUSMONTH / NEXTMONTH
- PREVIOUSQUARTER / NEXTQUARTER
- PREVIOUSYEAR / NEXTYEAR
- DATESMTD / DATESQTD / DATESYTD
- SAMEPERIODLASTYEAR
- DATEADD
- DATESBETWEEN
- DATESINPERIOD
- PARALLELPERIOD

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Balance Functions

- DAX Functions return value at specific point in time
  - OPENINGBALANCEMONTH
  - OPENINGBALANCEQUARTER
  - OPENINGBALANCEYEAR
  - CLOSINGBALANCEMONTH
  - CLOSINGBALANCEQUARTER
  - CLOSINGBALANCEYEAR

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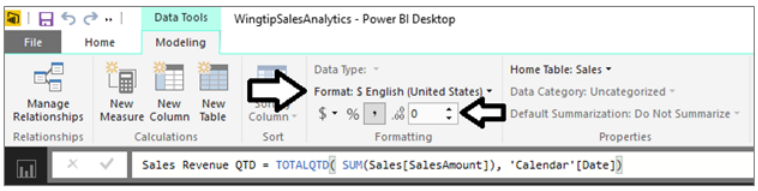
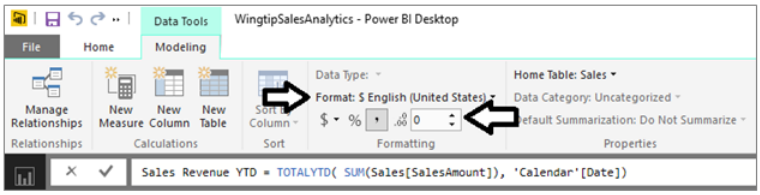
Calculated Fields for QTD and YTD Sales

- TOTALQTD function calculates quarter-to-date totals



- TOTALYTD function calculates year-to-date totals



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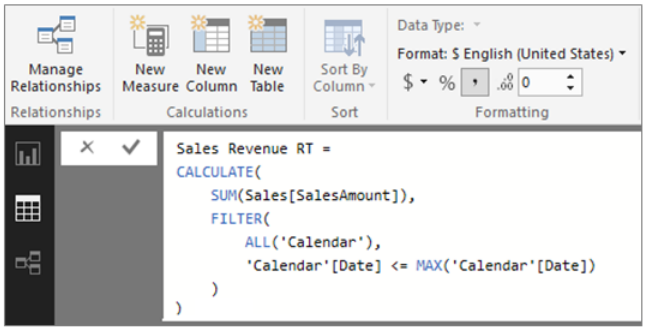
Using the CALCULATE Function

- Calculate a running total of sales revenue across years



Matrix Visual with To-Date Running Totals

- Running totals calculated using DAX

Year	Quarter	Month	Sales Revenue	Sales Revenue QTD	Sales Revenue YTD	Sales Revenue RT
2012	2012-Q1	Jan 2012	$6,306	$6,306	$6,306	$6,306
		Feb 2012	$48,815	$55,121	$55,121	$55,121
		Mar 2012	$53,958	$109,079	$109,079	$109,079
	2012-Q2	Apr 2012	$52,601	$52,601	$161,680	$161,680
		May 2012	$61,756	$114,357	$223,436	$223,436
		Jun 2012	$76,756	$191,113	$300,192	$300,192
	2012-Q3	Jul 2012	$104,408	$104,408	$404,600	$404,600
		Aug 2012	$111,167	$215,575	$515,767	$515,767
		Sep 2012	$110,716	$326,291	$626,483	$626,483
	2012-Q4	Oct 2012	$145,999	$145,999	$772,483	$772,483
		Nov 2012	$156,751	$302,750	$929,234	$929,234
		Dec 2012	$147,593	$450,343	$1,076,826	$1,076,826
2013	2013-Q1	Jan 2013	$164,334	$164,334	$164,334	$1,241,161
		Feb 2013	$126,501	$290,835	$290,835	$1,367,661

- Question: when did company reach $1,000,000 in sales

Nov 2012	$156,751	$302,750	$929,234	$929,234
Dec 2012	$147,593	$450,343	$1,076,826	$1,076,826
Jan 2013	$164,334	$164,334	$164,334	$1,241,161
Feb 2013	$126,501	$290,835	$290,835	$1,367,661

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Sales Growth PM Measure - First Attempt

- Create a measure named Sales Growth PM

```
Sales Growth PM =
DIVIDE(
  SUM(Sales[SalesAmount]) -
  CALCULATE(
    SUM(Sales[SalesAmount]),
    PREVIOUSMONTH(Calendar[Date])
  ),
  CALCULATE(
    SUM(Sales[SalesAmount]),
    PREVIOUSMONTH(Calendar[Date])
  )
)
```

- Use measure in matrix evaluating month and quarter
  - Measure returns correct value for Month
  - Measure returns incorrect and erroneous value for Quarter

Year	Quarter	Month	Sales Revenue	Sales Growth PM
2015	2015-Q1	Jan 2015	$512,822	-11.88 %
		Feb 2015	$597,684	16.55 %
		Mar 2015	$532,123	-10.97 %
		Total	**$1,642,629**	**182.25 %**
	2015-Q2	Apr 2015	$602,751	13.27 %
		May 2015	$647,276	7.39 %
		Jun 2015	$608,448	-6.00 %
		Total	**$1,858,474**	**249.26 %**
	2015-Q3	Jul 2015	$620,316	1.95 %
		Aug 2015	$678,499	9.38 %

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Using the ISFILTERED Function

- ISFILTERED function used to determine when perform evaluation

```
Sales Growth PM = IF(
  ( ISFILTERED(Calendar[Month]) && ISFILTERED(Calendar[Date]) = FALSE() ),
  DIVIDE(
    SUM(Sales[SalesAmount]) -
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    ),
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    )
  ),
  BLANK()
)
```

- Expression returns Blank when evaluation context isn't appropriate

Year	Quarter	Month	Sales Revenue	Sales Growth PM
2015	2015-Q1	Jan 2015	$512,822	-11.88 %
		Feb 2015	$597,684	16.55 %
		Mar 2015	$532,123	-10.97 %
		Total	**$1,642,629**	
	2015-Q2	Apr 2015	$602,751	13.27 %
		May 2015	$647,276	7.39 %
		Jun 2015	$608,448	-6.00 %
		Total	**$1,858,474**	
	2015-Q3	Jul 2015	$620,316	1.95 %
		Aug 2015	$678,499	9.38 %

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Simulating KPIs with Power BI Desktop

- KPIs are not yet support
  - But you can create something similar using measures

```
Sales Growth PM Eval =
IF( ISNUMBER([Sales Growth PM]),
    SWITCH(TRUE(),
      ([Sales Growth PM] >= 0.2), "EXCELLENT",
      ([Sales Growth PM] >= 0.1), "GOOD",
      ([Sales Growth PM] >= 0), "OK",
      ([Sales Growth PM] <  0), "BAD"
  ))
```

```
Sales Growth PQ Eval =
IF( ISNUMBER([Sales Growth PQ]),
    SWITCH(TRUE(),
      ([Sales Growth PQ] >= 0.2), "EXCELLECT",
      ([Sales Growth PQ] >= 0.1), "GOOD",
      ([Sales Growth PQ] >= 0), "OK",
      ([Sales Growth PQ] <  0), "BAD"
  )
)
```

Year	Quarter	Month	Sales Revenue	Sales Growth PM	Sales Growth PM Eval	Sales Growth PQ	Sales Growth PQ Eval
2014	2014-Q1	Jan 2014	$385,275	16.21 %	GOOD		
		Feb 2014	$358,244	-7.02 %	BAD		
		Mar 2014	$381,309	6.44 %	OK		
		Total	**$1,124,829**			**8.71 %**	**OK**
	2014-Q2	Apr 2014	$381,157	-0.04 %	BAD		
		May 2014	$438,261	14.98 %	GOOD		
		Jun 2014	$378,749	-13.58 %	AWFUL		
		Total	**$1,198,166**			**6.52 %**	**OK**
	2014-Q3	Jul 2014	$359,744	-5.02 %	BAD		
		Aug 2014	$457,312	27.12 %	EXCELLENT		
		Sep 2014	$505,332	10.50 %	GOOD		
		Total	**$1,322,388**			**10.37 %**	**GOOD**
	2014-Q4	Oct 2014	$602,448	19.22 %	GOOD		
		Nov 2014	$545,572	-9.44 %	BAD		
		Dec 2014	$581,977	6.67 %	OK		
		Total	**$1,729,996**			**30.82 %**	**EXCELLENT**

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Module 05 Lab: Extending a Data Model with Time Intelligence

Lab Time: 60 minutes

Lab Folder: C:\Student\Modules\TimeIntelligence\Lab

Lab Overview: In this lab, you will continue to work on the Power BI Desktop project you have been working with over the last two previous labs. At this point, you have already spent time designing the data model for Wingtip sales data that has been imported from a SQL Azure database. In this lab you will continue to extend the data model by adding a time dimension table named **Calendar** and by configuring this table so it can be used for time-based financial analysis. This will allow you to create measures using the DAX time intelligence functions.

Important: This lab assumes you have completed the previous lab titled **Using the Power Pivot Features of Power BI Desktop** in which you created a Power BI Desktop project named **WingtipSalesAnalytics.pbix**. If you would like to begin work on this lab without completing the earlier lab, copy the lab solution file at **C:\Student\Modules\PowerPivot\LabSolution\WingtipSalesAnalytics.pbix** into the folder at **C:\Student\Projects** using the Windows Explorer.

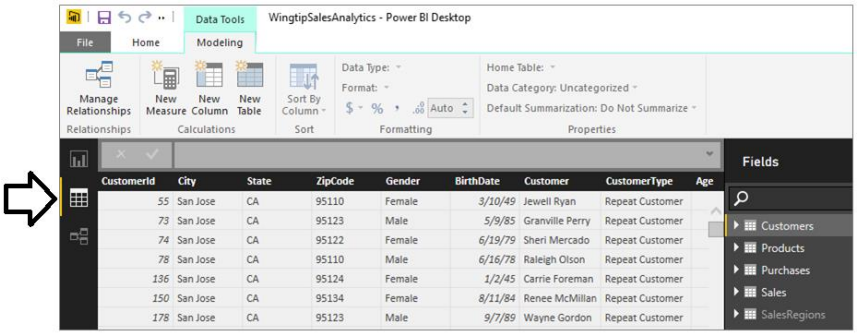
Exercise 1: Adding a Calendar Dimension Table

In this exercise you will create a calculated table named **Calendar** which will play the role of a time dimension table in the data model. The motivation for adding a time dimension table to your data model is that it will allow you to take advantage of the time intelligence support that is built into Power Pivot and DAX.

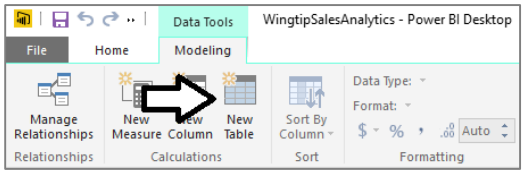
1. Launch Power BI Desktop to start a new project.
2. Open the Power BI Desktop project named **WingtipSalesAnalytics.pbix** from the previous lab located at the following path.

```
C:\Student\Projects\WingtipSalesAnalytics.pbix
```

3. When the project opens, click the table icon in the middle of the sidebar to enter data view mode.



4. Create a new calculated table named **Calendar**.
   a) Click the **New Table** button in the ribbon.



   b) Type the following DAX formula into the formula bar and press the **Enter** key to create the **Calendar** table.

```
Calendar =
  CALENDAR(
    DATE( 2012, 1, 1),
    Date( 2015, 12, 31)
  )
```

   c) You should be able to verify that the **Calendar** table has been created with a single column named **Date**. You should also be and to verify that there is one row in the **Calendar** table for each day in the calendar years of 2012, 2013, 2014 and 2015.

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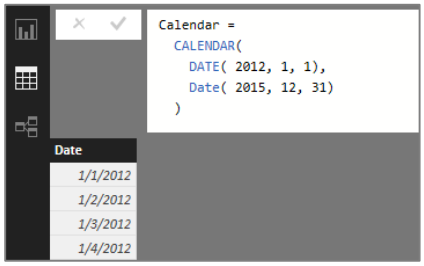


d) Modify the DAX expression for this calculated table so you do not have to hardcode literal values for the starting year or the ending year. First, replace the literal value for the starting year 2012 with the following DAX expression.

```
YEAR( MIN(Sales[PurchaseDate]) )
```

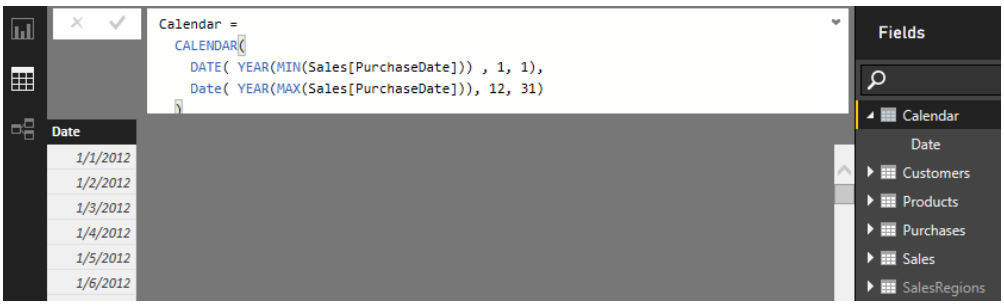
e) Next, replace the literal value for the ending year 2015 with the following DAX expressions.

```
YEAR( MAX(Sales[PurchaseDate]) )
```

f) At this point, your DAX expression to create the **Calendar** table should now match the following code listing.

```
Calendar =
  CALENDAR(
    DATE( YEAR( MIN(Sales[PurchaseDate]) ), 1, 1),
    Date( YEAR( MAX(Sales[PurchaseDate]) ), 12, 31)
  )
```

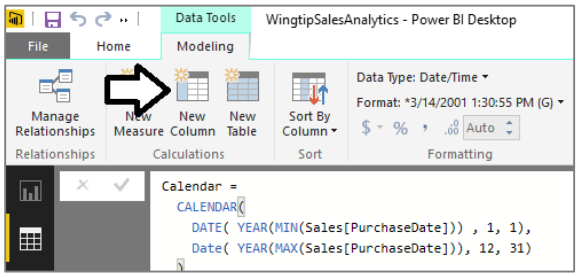
g) The **Calendar** table should continue to look as it did before starting at **1/1/20012** and running to **12/31/2015**.



The modification to the DAX expression to calculate the start date and end date dynamically provides flexibility. The new expression will now automatically add new rows for complete years if the **Sales** table is ever updated with purchases that occurred either before the start of 2012 or after the end of 2015.

5. Add a new column to the **Calendar** table named **Year** which display the financial year.

a) Create a new calculated column by clicking the **New Column** button in the ribbon.



b) Type in the following DAX expression and press the Enter key.

```
Year = YEAR('Calendar'[Date])
```

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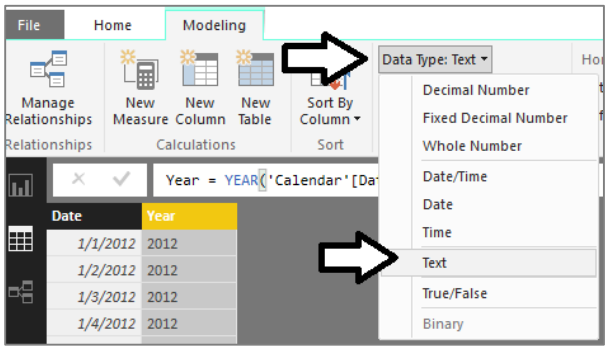
c) You should see that the **Calendar** table now contains a **Year** column displaying the year.

d) Configure the **Data Type** of the **Year** column to be **Text**.



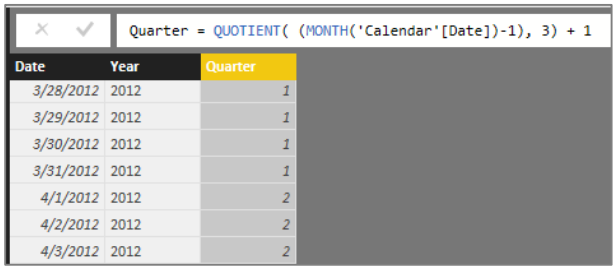
6. Add a new column to the **Calendar** table named **Quarter** which display the financial year and quarter.

a) Create a new calculated column by clicking the **New Column** button in the ribbon.

b) Type in the following DAX expression and press the Enter key.

```
Quarter = QUOTIENT( (MONTH('Calendar'[Date])-1), 3) + 1
```

c) The **Quarter** column now returns an integer value between 1 and 4 depending on what quarter the **Date** column value lies in.



d) Modify the DAX expression for the **Quarter** column to include the year and a bit more text formatting by typing in the following DAX expression and pressing the **Enter** key.

```
Quarter = YEAR('Calendar'[Date]) &
          "-Q" &
          QUOTIENT( (MONTH('Calendar'[Date])-1), 3) + 1
```

e) Now the **Quarter** column should return a value for each financial quarter in the format of **2012-Q1**.

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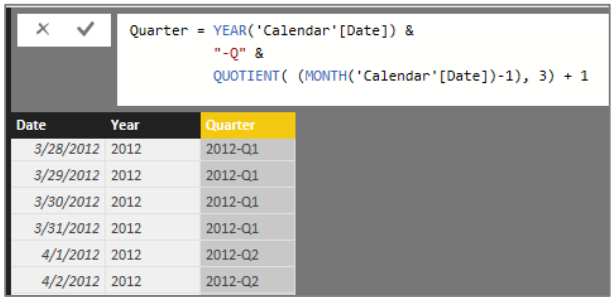
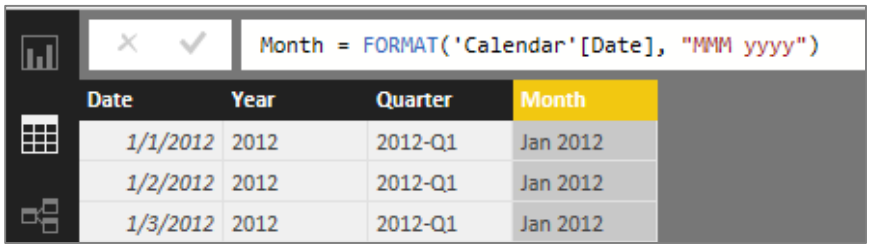


7. Add a new column to the **Calendar** table named **Month** which display the financial year and month.
   a) Create a new calculated column by clicking the **New Column** button in the ribbon.
   b) Type in the following DAX expression and press the Enter key.

```
Month = FORMAT('Calendar'[Date], "MMM yyyy")
```

   c) The column should now display

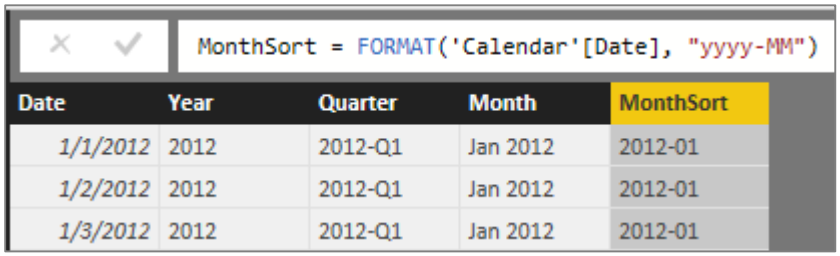


The **Month** column is a good example of a column whose value will not automatically be sorted in the chronological sort order. The default sort order of a text column like **Month** is to sort month names alphabetically so that April will sort before February, and February will sort before January. Therefore, you will now create an addition column named **MonthSort** whose sole purpose will be to provide assistance to the **Month** column to sort its values chronologically.

8. Add a new sort column to the **Calendar** table named **MonthSort** to control the sort order of the **Month** column.
   a) Create a new calculated column by clicking the **New Column** button in the ribbon.
   b) Type in the following DAX expression and press the Enter key.

```
MonthSort = FORMAT('Calendar'[Date], "yyyy-MM")
```

   c) You should be able to see that the **MonthSort** column produces a text value for each date in the format of **2012-01**. The key aspect of this format is that **MonthSort** values are sorted chronologically when they are sorted alphabetically.



   d) Configure the **Month** column to use the **MonthSort** column as its sort column. Accomplish this by clicking the column header of the **Month** column to select it and then by dropping down the **Sort By Column** menu button in the ribbon and selecting the **MonthSort** column.

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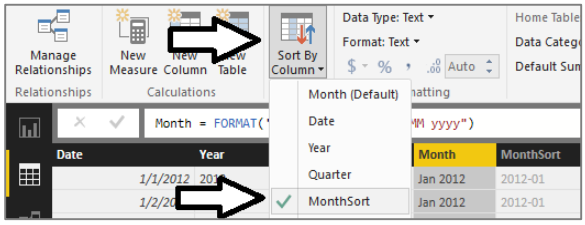
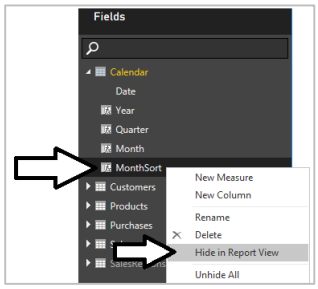


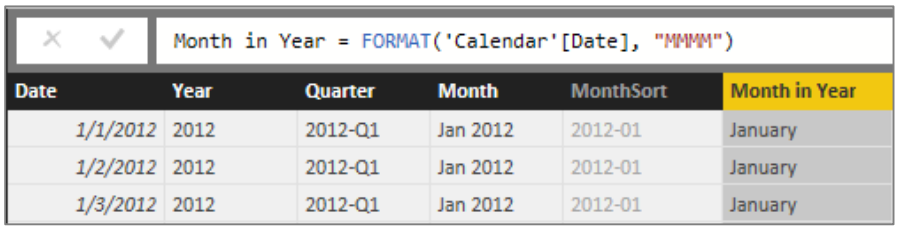
e) Hide the **MonthSort** column by right-clicking it on the **Fields** list and selecting the **Hide in Report View** menu command.



9. Add a new column to the **Calendar** table named **Month in Year** to display the financial month without the year.
   a) Create a new calculated column by clicking the **New Column** button in the ribbon.
   b) Type in the following DAX expression and press the Enter key.

```
Month in Year = FORMAT('Calendar'[Date], "MMMM")
```

   c) The **Month in Year** column should now display the month name for each date.



```
Month in Year = FORMAT('Calendar'[Date], "MMMM")
```

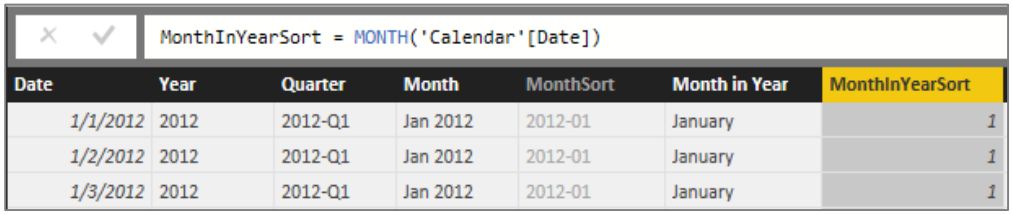
Date	Year	Quarter	Month	MonthSort	Month in Year
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January

Just like the **Month** column, the **Month in Year** column will need the assistance of a sort column.

10. Add a new sort column to the **Calendar** table named **MonthInYearSort** to control the sort order of the **Month in Year** column.
   a) Create a new calculated column by clicking the **New Column** button in the ribbon.
   b) Type in the following DAX expression and press the Enter key.

```
MonthInYearSort = MONTH('Calendar'[Date])
```

   c) As you can see, the **MonthInYearSort** column displays an integer value between 1 and 12 to indicate the month.



```
MonthInYearSort = MONTH('Calendar'[Date])
```

Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1

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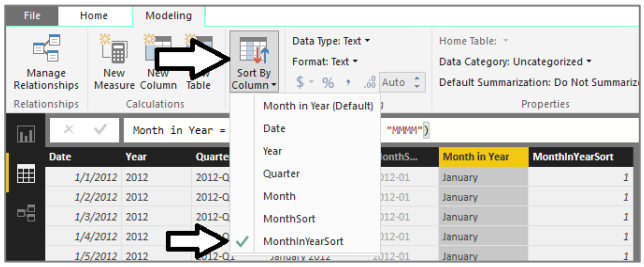
d) Configure the **Month in Year** column to use the **MonthInYearSort** column as its sort column. Accomplish this by clicking the column header of the **Month in Year** column to select it and then by dropping down the **Sort By Column** menu button in the ribbon and selecting the **MonthInYearSort** column.



e) Hide the **MonthInYearSort** column by right-clicking it in the **Fields** list and selecting the **Hide in Report View** command.

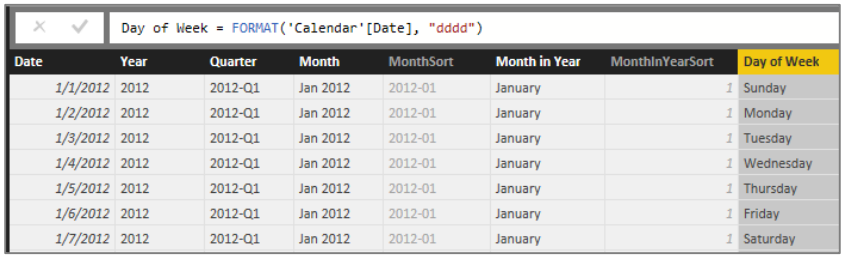
11. Add a new column to the **Calendar** table named **Day of Week** which display the day of the week.

a) Create a new calculated column by clicking the **New Column** button in the ribbon.

b) Type in the following DAX expression and press the Enter key.

```
Day of Week = FORMAT('Calendar'[Date], "dddd")
```

c) The **Day of Week** column should now display the name of the day (e.g. Monday) for each date.



Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort	Day of Week
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Sunday
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Monday
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Tuesday
1/4/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Wednesday
1/5/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Thursday
1/6/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Friday
1/7/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Saturday

12. Add a new sort column to the **Calendar** table named **DayOfWeekSort** to control the sort order of the **Day of Week** column.

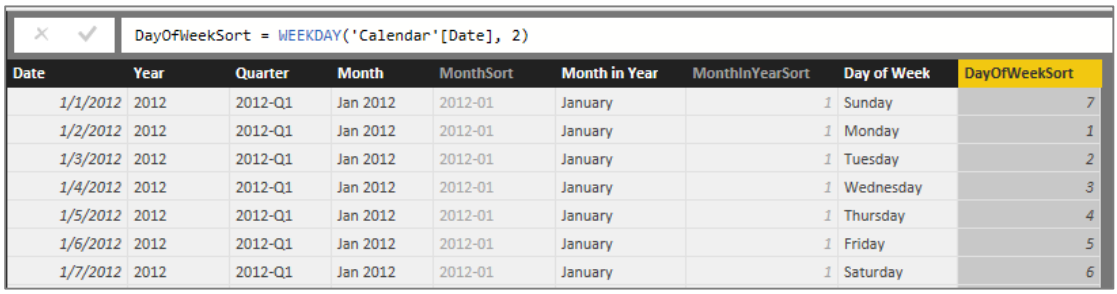
a) Create a new calculated column by clicking the **New Column** button in the ribbon.

b) Type in the following DAX expression and press the Enter key.

```
DayOfWeekSort = WEEKDAY('Calendar'[Date], 2)
```

The second argument passes to **WEEKDAY** function determines the starting day for the week. If you pass a value of 1, the starting day for the week will be Sunday. In this case you have passed a value of 2 which will make Monday the first day of the week.

c) Now the **DayOfWeekSort** column should return an integer value for each date indicating the day of the week. As you can see, each date that is a Monday has a value of 1.



Date	Year	Quarter	Month	MonthSort	Month in Year	MonthInYearSort	Day of Week	DayOfWeekSort
1/1/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Sunday	7
1/2/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Monday	1
1/3/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Tuesday	2
1/4/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Wednesday	3
1/5/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Thursday	4
1/6/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Friday	5
1/7/2012	2012	2012-Q1	Jan 2012	2012-01	January	1	Saturday	6

d) Configure the **Day of Week** column to use the **DayInWeekSort** column as its sort column. Accomplish this by clicking the column header of the **Day of Week** column to select it and then by dropping down the **Sort By Column** menu button in the ribbon and selecting the **DayInWeekSort** column.

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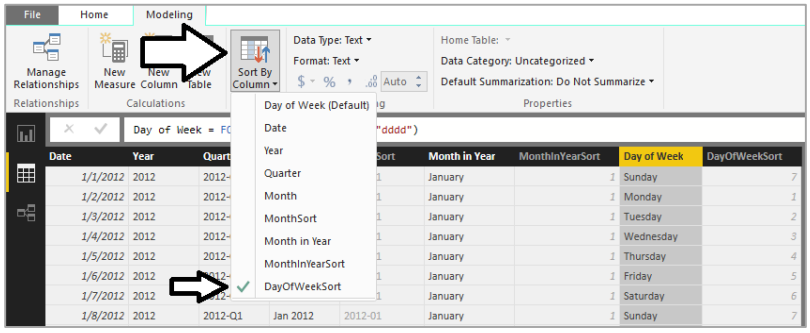


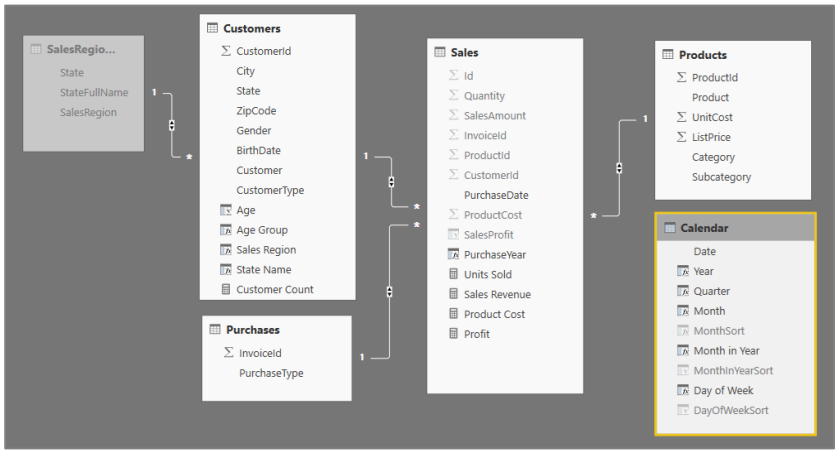
e) Hide the **DayInWeekSort** column by right-clicking it in the **Fields** list and selecting the **Hide in Report View** command.

At this point, you have created the **Calendar** table and added all the columns that it requires. The next step to integrate the **Calendar** table into the data model will be to create a relationship between the **Calendar** table and the **Sales** table.

13. Create a relationship between the **Calendar** table and the **Sales** table.

a) Navigate to relationship view. You should be able to see that the **Calendar** table is present. You should also be able to verify that the **Calendar** table does not have any existing relationships.

b) Using the mouse, rearrange the tables in relationship view to match the following screenshot where the **Calendar** table is positioned directly below the **Products** table and to the immediate right of the **Sales** table.



c) Create a new relationship by performing a drag and drop operation with the mouse to drag the **PurchaseDate** column from the **Sales** table and dropping it on the **Date** column of the **Calendar** table.

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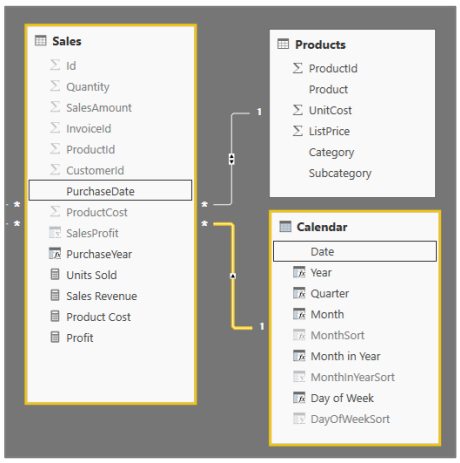


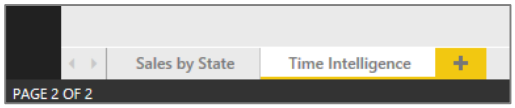
You have now completed the work of adding the **Calendar** table to the data model.

14. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

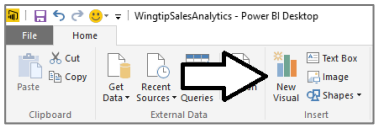
Exercise 2: Creating Visuals using the Calendar Table

In this exercise, you will leverage the **Calendar** table that you created in the previous exercise by creating a few new visuals to display sales revenue totals aggregated over various time intervals.

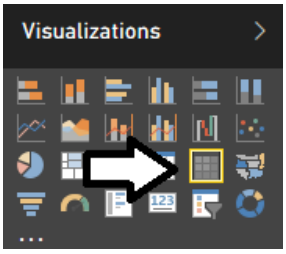
1. Create a new page in the project's report.
   a) Navigate to report view.
   b) Add a new page by clicking the (**+**) button to the right of the current page title.
   c) Once the new page has been created, modify its title to **Time Intelligence**.



   d) Now that you have created a new page, you can now add a few new visuals.
2. Create a new matrix visual to show sales revenue for specific time periods.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.



   b) Change the visual to a matrix by clicking the **Matrix** button in the **Visualizations** list.



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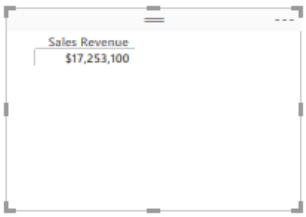
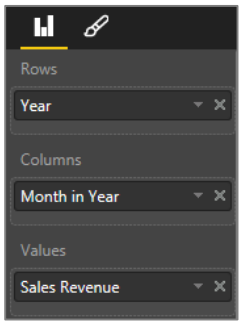
c) Select the checkbox next to the **Sales Revenue** measure in the **Fields** list. When you select the **Sales Revenue** measure, the report designer will add it to the **Values** well and the visual will show a single value for total sales revenue across the entire **Sales** table.



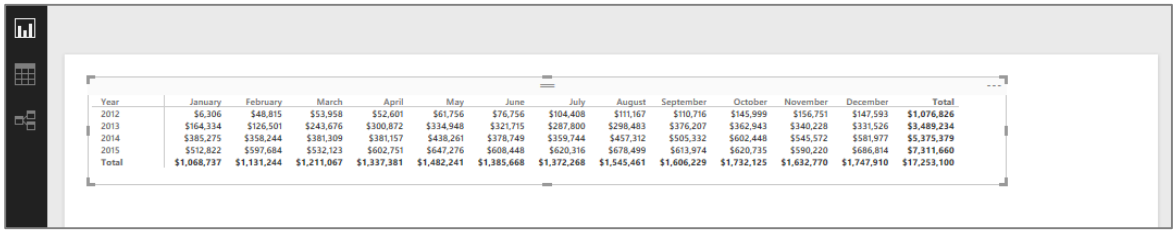
d) Now it's time to extend the matrix by adding row labels and column labels. First, drag and drop the **Year** column from the **Calendar** table in the **Fields** list into the **Rows** well in the **Visualizations** pane.

e) Now drag and drop the **Month in Year** column from the **Calendar** table in the **Fields** list into the **Rows** well in the **Visualizations** pane.



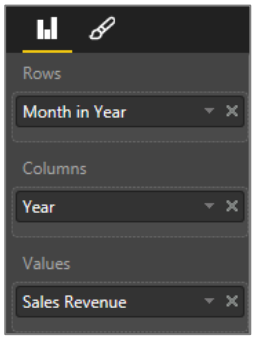
f) The matrix now has a column for each month and a row for each year.

g) Use your mouse to resize the matrix visual so you can see all the columns.



Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2012	$6,306	$48,815	$53,958	$52,601	$61,756	$76,756	$104,408	$111,167	$110,716	$145,999	$156,751	$147,593	$1,076,826
2013	$164,334	$126,501	$243,676	$300,872	$334,948	$321,715	$287,800	$298,483	$376,207	$362,943	$340,228	$331,526	$3,489,234
2014	$385,275	$358,244	$381,309	$381,157	$438,261	$378,749	$359,744	$457,312	$505,332	$602,448	$545,572	$581,977	$5,375,379
2015	$512,822	$597,684	$532,123	$602,751	$647,276	$608,448	$620,316	$678,499	$613,974	$620,735	$590,220	$686,814	$7,311,660
Total	$1,068,737	$1,131,244	$1,211,067	$1,337,381	$1,482,241	$1,385,668	$1,372,268	$1,545,461	$1,606,229	$1,732,125	$1,632,770	$1,747,910	$17,253,100

h) Now experiment by pivoting the matrix visual to display the exact same data using a different layout. Accomplish this by moving the **Month in Year** field into the **Rows** well and then moving the **Year** field into the **Columns** well. In effect, the **Month in Year** field and the **Year** field have just switched places.



i) The matrix should now display a row for each month and a column for each year.

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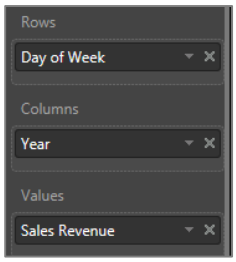
Month in Year	2012	2013	2014	2015	Total
January	$6,306	$164,334	$385,275	$512,822	$1,068,737
February	$48,815	$126,501	$358,244	$597,684	$1,131,244
March	$53,958	$243,676	$381,309	$532,123	$1,211,067
April	$52,601	$300,872	$381,157	$602,751	$1,337,381
May	$61,756	$334,948	$438,261	$647,276	$1,482,241
June	$76,756	$321,715	$378,749	$608,448	$1,385,668
July	$104,408	$287,800	$359,744	$620,316	$1,372,268
August	$111,167	$298,483	$457,312	$678,499	$1,545,461
September	$110,716	$376,207	$505,332	$613,974	$1,606,229
October	$145,999	$362,943	$602,448	$620,735	$1,732,125
November	$156,751	$340,228	$545,572	$590,220	$1,632,770
December	$147,593	$331,526	$581,977	$686,814	$1,747,910
Total	$1,076,826	$3,489,234	$5,375,379	$7,311,660	$17,253,100

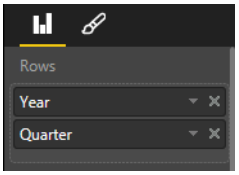
3. Create a new matrix visual to show sales revenue for specific time periods.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Make sure this new visual is positioned directly below the first visual that you created.
   c) Change the visual to a matrix by clicking the Matrix button in the **Visualizations** list.
   d) Drag and drop the **Day of Week** column from the **Calendar** table in the **Fields** list into the **Rows** well.
   e) Drag and drop the **Year** column from the **Calendar** table into the **Columns** well.
   f) Drag and drop the **Sales Revenue** measure from the **Calendar** table in the **Fields** list into the **Values** well.



   g) The matrix should now display a row for each day of the week and a column for each year.

Day of Week	2012	2013	2014	2015	Total
Monday	$163,919	$486,428	$802,943	$1,090,519	$2,543,808
Tuesday	$154,244	$462,695	$772,438	$1,163,588	$2,552,965
Wednesday	$162,811	$425,869	$752,274	$1,029,697	$2,370,651
Thursday	$169,687	$513,948	$837,905	$1,066,526	$2,588,067
Friday	$146,575	$582,823	$736,297	$1,059,080	$2,524,774
Saturday	$162,219	$546,922	$694,322	$909,334	$2,312,797
Sunday	$117,372	$470,550	$779,200	$992,915	$2,360,038
Total	$1,076,826	$3,489,234	$5,375,379	$7,311,660	$17,253,100

4. Add a third matrix visual to analyze sales data calculated at both the yearly level and the quarterly level.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a matrix by clicking the Matrix button in the Visualizations list.
   c) Drag and drop the **Year** column from the **Calendar** table into the **Rows** well.
   d) Drag and drop the **Quarter** column from the **Calendar** table into the **Rows** well.



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e) At this point, the visual has row labels for the **Year** column and the **Quarter** column.

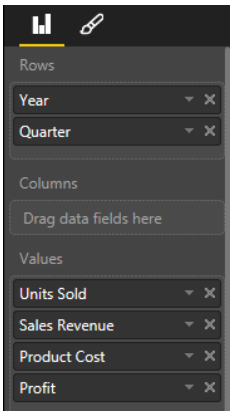
Year	Quarter
2012	2012-Q1
	2012-Q2
	2012-Q3
	2012-Q4
2013	2013-Q1
	2013-Q2
	2013-Q3
	2013-Q4
2014	2014-Q1
	2014-Q2
	2014-Q3
	2014-Q4
2015	2015-Q1
	2015-Q2
	2015-Q3
	2015-Q4

f) Drag and drop the **Units Sold** measure from the **Sales** table into the **Values** well.

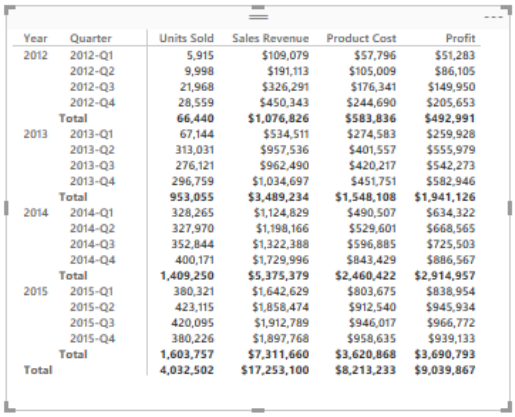
g) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Values** well.

h) Drag and drop the **Product Cost** measure from the **Sales** table into the **Values** well.

i) Drag and drop the **Profit** measure from the **Sales** table into the **Values** well.



j) The matrix should now display values for each measure calculated at the quarterly level as well as at the yearly level.



Year	Quarter	Units Sold	Sales Revenue	Product Cost	Profit
2012	2012-Q1	5,915	$109,079	$57,796	$51,283
	2012-Q2	9,998	$191,113	$105,009	$86,105
	2012-Q3	21,968	$326,291	$176,341	$149,950
	2012-Q4	28,559	$450,343	$244,690	$205,653
	Total	**66,440**	**$1,076,826**	**$583,836**	**$492,991**
2013	2013-Q1	67,144	$534,511	$274,583	$259,928
	2013-Q2	313,031	$957,536	$401,557	$555,979
	2013-Q3	276,121	$962,490	$420,217	$542,273
	2013-Q4	296,759	$1,034,697	$451,751	$582,946
	Total	**953,055**	**$3,489,234**	**$1,548,108**	**$1,941,126**
2014	2014-Q1	328,265	$1,124,829	$490,507	$634,322
	2014-Q2	327,970	$1,198,166	$529,601	$668,565
	2014-Q3	352,844	$1,322,388	$596,885	$725,503
	2014-Q4	400,171	$1,729,996	$843,429	$886,567
	Total	**1,409,250**	**$5,375,379**	**$2,460,422**	**$2,914,957**
2015	2015-Q1	380,321	$1,642,629	$803,675	$838,954
	2015-Q2	423,115	$1,858,474	$912,540	$945,934
	2015-Q3	420,095	$1,912,789	$946,017	$966,772
	2015-Q4	380,226	$1,897,768	$958,635	$939,133
	Total	**1,603,757**	**$7,311,660**	**$3,620,868**	**$3,690,793**
Total		**4,032,502**	**$17,253,100**	**$8,213,233**	**$9,039,867**

5. Using your mouse, arrange the new matrix visual on the right side of the page at the top to match the following screenshot.

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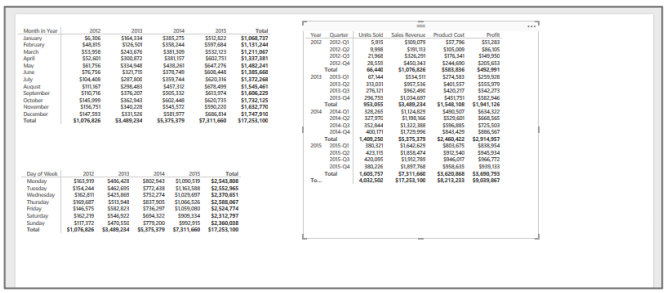
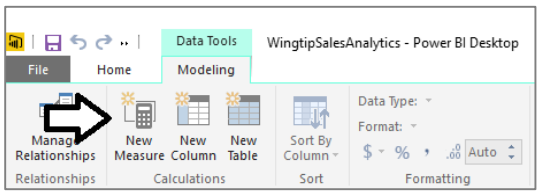


6. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

Exercise 3: Creating Measures using DAX Time Intelligence Functions

In this exercise, you will leverage various the Time Intelligence functions in DAX to analyze sales revenue using quarter to date (QTD) totals and year to date (YTD) totals. You will also use DAX to write an expression which calculate a running total of sales revenue through the entire 4 years of sales activity.

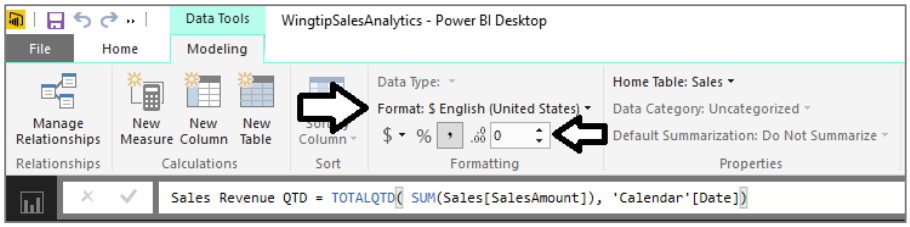
1. Create a measure named **Sales Revenue QTD** that calculates a quarter-to-date aggregate sum on the **SalesAmount** column of the **Sales** table.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.



   d) Enter to following DAX expression into the formula bar to create the new measure named **Sales Revenue QTD**.

```
Sales Revenue QTD = TOTALQTD( SUM(Sales[SalesAmount]), 'Calendar'[Date])
```

   e) Press the **ENTER** key to add the measure to data model.
   f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.



2. Create a measure named **Sales Revenue YTD** that calculates a year-to-date aggregate sum on the **SalesAmount** column of the **Sales** table.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the new measure named **Sales Revenue YTD**.

```
Sales Revenue QTD = TOTALYTD( SUM(Sales[SalesAmount]), 'Calendar'[Date])
```

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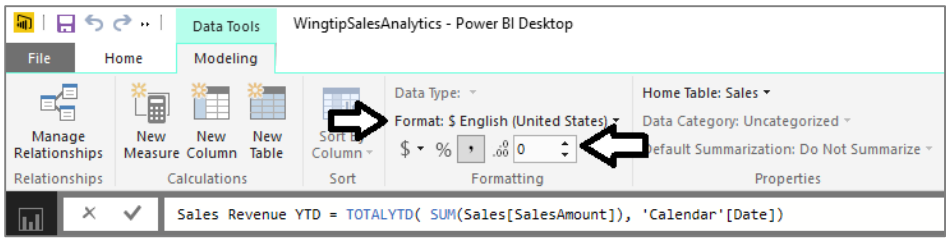
e) Press the **ENTER** key to add the measure to data model.

f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.



3. Create a measure named **Sales Revenue RT** that calculates a running total aggregate sum on the **SalesAmount** column of the **Sales** table.

a) Navigate to data view.

b) Select the **Sales** table from the **Fields** list.

c) Create a new measure by clicking the **New Measure** button in the ribbon.

d) Enter to following DAX expression into the formula bar to create the new measure named **Sales Revenue RT**.

```
Sales Revenue RT =
CALCULATE(
 SUM(Sales[SalesAmount]),
 FILTER(
    ALL('Calendar'),
    'Calendar'[Date] <= MAX('Calendar'[Date])
 )
)
```

e) Press the **ENTER** key to add the measure to data model.

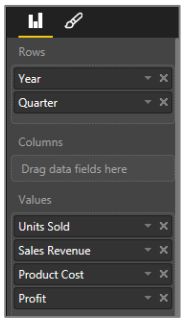
f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Currency > English (United States)**. Also use the spinner control below the format menu to set the number of decimal places shown to zero.

4. Use the three new measures in a matrix visual.

a) Navigate to report mode.

b) Select the matrix visual you created last that is currently positioned on the right-hand side of the page.

c) Examine the bottom of the **Visualizations** pane. Currently, the **Rows** well contains the **Year** column and the **Quarter** column. There are also four other measures in the **Values** well.



d) Remove all the measures from the **Values** well except for the **Sales Revenue** measure. At this point, your visual should match the one shown in the following screenshot where sales revenue totals as shown at the quarterly level and at the yearly level.

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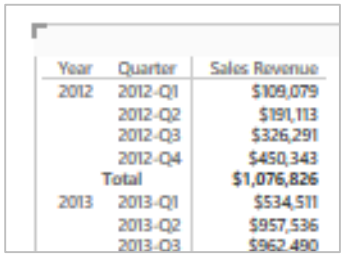
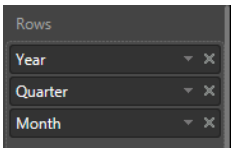
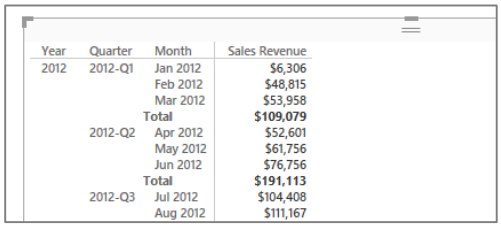


Year	Quarter	Sales Revenue
2012	2012-Q1	$109,079
	2012-Q2	$191,113
	2012-Q3	$326,291
	2012-Q4	$450,343
	Total	$1,076,826
2013	2013-Q1	$534,511
	2013-Q2	$957,536
	2013-Q3	$962,490

e) Drag and drop the **Month** column from the **Calendar** table into the **Rows** well below the two other columns.

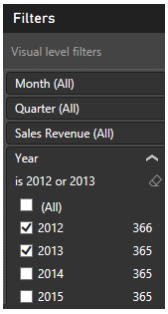


f) You should be able to see that now the visual now has a deeper level of granularity because it is show sales revenue broken out into a separate aggregate value for each month.

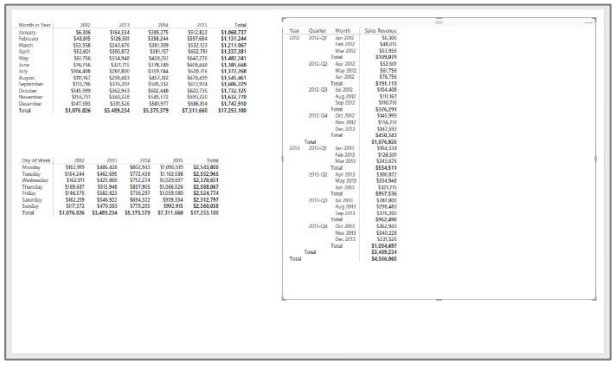


Year	Quarter	Month	Sales Revenue
2012	2012-Q1	Jan 2012	$6,306
		Feb 2012	$48,815
		Mar 2012	$53,958
		Total	$109,079
	2012-Q2	Apr 2012	$52,601
		May 2012	$61,756
		Jun 2012	$76,756
		Total	$191,113
	2012-Q3	Jul 2012	$104,408
		Aug 2012	$111,167

g) Set a filter on the matrix visual so that is only displays sales revenue for the calendar years of 2012 and 2013. Accomplish this by selecting the checkboxes for **2012** and **2013** in the **Year** filter located inside the **Filters** section in the **Visualizations** pane.



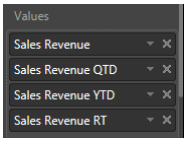
h) Resize the matrix visual to take up the entire right-hand side of the page.



i) Drag and drop the **Sales Revenue QTD** measure from the **Sales** table into the **Values** well.

j) Drag and drop the **Sales Revenue YTD** measure from the **Sales** table into the **Values** well.

k) Drag and drop the **Sales Revenue RT** measure from the **Sales** table into the **Values** well.



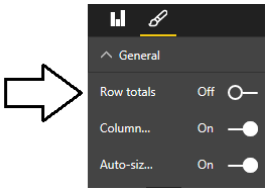
l) The matrix visual should now display three new columns for the three measure you added to the **Values** well.

Year	Quarter	Month	Sales Revenue	Sales Revenue QTD	Sales Revenue YTD	Sales Revenue RT
2012	2012-Q1	Jan 2012	$6,306	$6,306	$6,306	$6,306
		Feb 2012	$48,815	$55,121	$55,121	$55,121
		Mar 2012	$53,958	$109,079	$109,079	$109,079
		Total	**$109,079**	**$109,079**	**$109,079**	**$109,079**
	2012-Q2	Apr 2012	$52,601	$52,601	$161,680	$161,680
		May 2012	$61,756	$114,357	$223,436	$223,436
		Jun 2012	$76,756	$191,113	$300,192	$300,192
		Total	**$191,113**	**$191,113**	**$300,192**	**$300,192**
	2012-Q3	Jul 2012	$104,408	$104,408	$404,600	$404,600
		Aug 2012	$111,167	$215,575	$515,767	$515,767

m) Currently the matrix is showing a **Total** row with a quarterly rollup. You should observe that the **Total** row can be confusing with measures like these because the it displays the exact same aggregate value as the row above it.

Year	Quarter	Month	Sales Revenue	Sales Revenue QTD	Sales Revenue YTD	Sales Revenue RT
2012	2012-Q1	Jan 2012	$6,306	$6,306	$6,306	$6,306
		Feb 2012	$48,815	$55,121	$55,121	$55,121
		Mar 2012	$53,958	$109,079	$109,079	$109,079
		Total	**$109,079**	**$109,079**	**$109,079**	**$109,079**
	2012-Q2	Apr 2012	$52,601	$52,601	$161,680	$161,680
		May 2012	$61,756	$114,357	$223,436	$223,436

n) Look inside the **General** section for the visual in the **Visualizations** pane and set modify the **Row totals** property to **Off**.



o) The matrix visual is now better suited to display the three new measures you created in this exercise.

Year	Quarter	Month	Sales Revenue	Sales Revenue QTD	Sales Revenue YTD	Sales Revenue RT
2012	2012-Q1	Jan 2012	$6,306	$6,306	$6,306	$6,306
		Feb 2012	$48,815	$55,121	$55,121	$55,121
		Mar 2012	$53,958	$109,079	$109,079	$109,079
	2012-Q2	Apr 2012	$52,601	$52,601	$161,680	$161,680
		May 2012	$61,756	$114,357	$223,436	$223,436
		Jun 2012	$76,756	$191,113	$300,192	$300,192
	2012-Q3	Jul 2012	$104,408	$104,408	$404,600	$404,600
		Aug 2012	$111,167	$215,575	$515,767	$515,767
		Sep 2012	$110,716	$326,291	$626,483	$626,483
	2012-Q4	Oct 2012	$145,999	$145,999	$772,483	$772,483
		Nov 2012	$156,751	$302,750	$929,234	$929,234
		Dec 2012	$147,593	$450,343	$1,076,826	$1,076,826
2013	2013-Q1	Jan 2013	$164,334	$164,334	$164,334	$1,241,161
		Feb 2013	$126,501	$290,835	$290,835	$1,367,661

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p) Now imagine your boss asks you to determine in what month the company reached 1 million dollars in total sales revenue. By looking at down the list of values for the **Sales Revenue RT** measure, you can see that the company finally hit $1,000,000 in sales revenue in December of 2012.

Nov 2012	$156,751	$302,750	$929,234	$929,234
Dec 2012	$147,593	$450,343	$1,076,826	$1,076,826
Jan 2013	$164,334	$164,334	$164,334	$1,241,161
Feb 2013	$126,501	$290,835	$290,835	$1,367,661

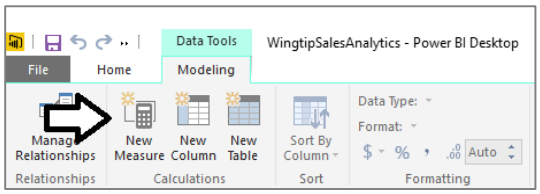
5. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

You have now learned how to use Time Intelligence functions in DAX together with a calendar table. Now you will move on to the final exercise where you will create additional measures to monitor sales growth.

Exercise 4: Creating Measures to Monitor Growth in Sales Revenue

In this exercise you will create new measures to calculate the growth of sales revenue on a quarter-by-quarter basis as well as on a month-by-month basis. After that you will create additional measures that will act as KPIs to monitor the health of sales growth and provide visual indications as to how each month has done when compared to the previous month.

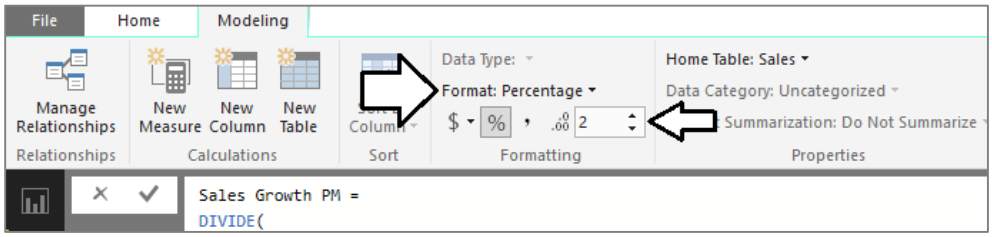
1. Create a measure named **Sales Growth PM** that calculates the percentage increase between sales revenue for the current month and sales revenue for the previous month.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.



   d) Enter to following DAX expression into the formula bar to create the measure named **Sales Growth PM**.

```
Sales Growth PM =
DIVIDE(
  SUM(Sales[SalesAmount]) -
  CALCULATE(
    SUM(Sales[SalesAmount]),
    PREVIOUSMONTH(Calendar[Date])
  ),
  CALCULATE(
    SUM(Sales[SalesAmount]),
    PREVIOUSMONTH(Calendar[Date])
  )
)
```

   e) Press the **ENTER** key to add the calculated column to data model.
   f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Percentage**. Also use the spinner control below the format menu to set the number of decimal places shown to **2**.



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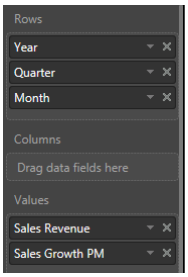
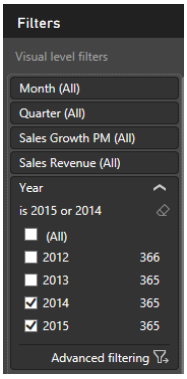
2. Create a new page in the project's report.
   a) Navigate to report view.
   b) Add a new page by clicking the (**+**) button to the right of the current page title.
   c) Once the new page has been created, modify its title to **Sales Revenue Growth**.

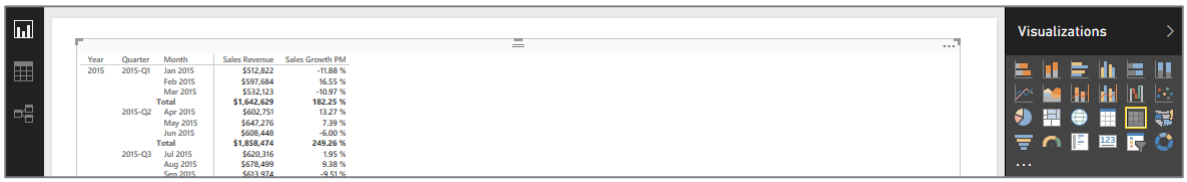
3. Create a new matrix visual to show month-to-month sales revenue growth in 2014 and 2015.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a matrix by clicking the Matrix button in the **Visualizations** list.
   c) Drag and drop the **Year** column from the **Calendar** table into the **Rows** well.
   d) Drag and drop the **Quarter** column from the **Calendar** table into the **Rows** well.
   e) Drag and drop the **Month** column from the **Calendar** table into the **Rows** well.
   f) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Value** well.
   g) Drag and drop the **Sales Revenue PM** measure from the **Sales** table into the **Value** well.
   h) The **Rows** well and the **Values** well for the matrix visual should match the following screenshot.



   i) Move down in the **Visualizations** page to the **Filters** section. Drop down the filter menu for **Year** and select the years of 2014 and 2015.



   j) Use your mouse the resize the matrix visual so you can see all the rows and columns. Give the matrix visual a width that is almost the same size of the page so you can add additional columns over the next few steps without having to resize the visual again.



k) Inspect the values produced by the **Sales Growth PM** measure. You can see that a value has been calculated for each month. You should also notice that the matrix currently displays values for the **Sales Growth PM** measure in the **Total** row. The values in the **Total** row are calculated at the quarterly level and not at the month level.

Year	Quarter	Month	Sales Revenue	Sales Growth PM
2015	2015-Q1	Jan 2015	$512,822	-11.88 %
		Feb 2015	$597,684	16.55 %
		Mar 2015	$532,123	-10.97 %
		Total	**$1,642,629**	**182.25 %**
	2015-Q2	Apr 2015	$602,751	13.27 %
		May 2015	$647,276	7.39 %
		Jun 2015	$608,448	-6.00 %
		Total	**$1,858,474**	**249.26 %**
	2015-Q3	Jul 2015	$620,316	1.95 %
		Aug 2015	$678,499	9.38 %

The **Sales Growth PM** measure was written to perform calculations on a month-to-month basis. However, there is currently a problem whenever this measure is evaluated in the context based on a larger time interval such as a quarter or a year. More specifically, the **Sales Growth PM** measure is currently producing a large and erroneous value when it is evaluated in the context of a quarter. Now that you have seen the problem, it's time to modify the DAX expression for the **Sales Growth PM** measure to return a blank value whenever the measure is evaluated in a context where the time interval is at a granularity other than at the month level.

4. Modify the DAX expression for the **Sales Revenue PM** measure.

a) Navigate to data view.

b) Select the **Sales Revenue PM** measure of the **Sales** table from the **Fields** list. When you select the **Sales Revenue PM** measure in the **Fields** list, you should then be able to see and modify its DAX expression in the formula bar.

c) Before you can modify the DAX expression for the **Sales Revenue PM** measure, you must be able to use the ISFILTERED function provided by DAX. You can write the following DAX expression to determine whether the current evaluation context is filtering at the month level.

```
ISFILTERED(Calendar[Month])
```

d) You can also write the following DAX expression to make sure that the current evaluation context is not filtering at a more granular level such as at the **Date** level.

```
ISFILTERED(Calendar[Date]) = FALSE()
```

e) You will need to ensure that both these expressions are true before the **Sales Revenue PM** measure evaluates to a value other than a blank value. You can write the following DAX expression using the DAX **&&** operator to return true when both inner conditions are true

```
( ISFILTERED(Calendar[Month]) && ISFILTERED(Calendar[Date]) = FALSE() )
```

f) Update the DAX expression for the **Sales Revenue PM** measure to match the following code listing.

```
Sales Growth PM =
IF(
  ( ISFILTERED(Calendar[Month]) && ISFILTERED(Calendar[Date]) = FALSE() ),
  DIVIDE(
    SUM(Sales[SalesAmount]) -
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    ),
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSMONTH(Calendar[Date])
    )
  ),
  BLANK()
)
```

g) Navigate back to report view and inspect the effects of your changes to the visual on the **Sales Revenue Growth** page.

h) You should see that the **Sales Growth PM** measure is now returning blank values in the **Total** row for the quarterly evaluation.

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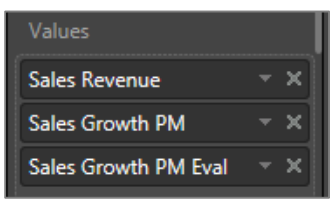
Year	Quarter	Month	Sales Revenue	Sales Growth PM
2015	2015-Q1	Jan 2015	$512,822	-11.88 %
		Feb 2015	$597,684	16.55 %
		Mar 2015	$532,123	-10.97 %
		Total	**$1,642,629**	
	2015-Q2	Apr 2015	$602,751	13.27 %
		May 2015	$647,276	7.39 %
		Jun 2015	$608,448	-6.00 %
		Total	**$1,858,474**	
	2015-Q3	Jul 2015	$620,316	1.95 %
		Aug 2015	$678,499	9.38 %

It is widely-accepted among BI experts and BI novices alike that a blank value is always better than large, erroneous value.

5. Create a measure named **Sales Growth PM Eval** that inspects the value of the **Sales Growth PM** measure and evaluates to a short string value to indicate the health of the sales growth value.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the measure named **Sales Growth PM Eval**.

```
Sales Growth PM Eval =
IF(
  ISNUMBER([Sales Growth PM]),
  SWITCH(TRUE(),
    ([Sales Growth PM] >= 0.2), "EXCELLENT",
    ([Sales Growth PM] >= 0.1), "GOOD",
    ([Sales Growth PM] >= 0), "OK",
    ([Sales Growth PM] >= -0.1), "BAD",
    ([Sales Growth PM] <  -0.1), "AWFUL"
  )
)
```

   e) Navigate to report view and select the matrix visual on the **Sales Revenue Growth** page.
   f) Drag and drop the **Sales Growth PM Eval** measure from the **Sales** table into the **Values** well in the **Visualizations** pane.



   g) You should now see values for the **Sales Growth PM Eval** measure which indicate the health of sales revenue growth.

Year	Quarter	Month	Sales Revenue	Sales Growth PM	Sales Growth PM Eval
2014	2014-Q1	Jan 2014	$385,275	16.21 %	GOOD
		Feb 2014	$358,244	-7.02 %	BAD
		Mar 2014	$381,309	6.44 %	OK
		Total	**$1,124,829**		
	2014-Q2	Apr 2014	$381,157	-0.04 %	BAD
		May 2014	$438,261	14.98 %	GOOD
		Jun 2014	$378,749	-13.58 %	AWFUL
		Total	**$1,198,166**		
	2014-Q3	Jul 2014	$359,744	-5.02 %	BAD
		Aug 2014	$457,312	27.12 %	EXCELLENT
		Sep 2014	$505,332	10.50 %	GOOD

6. Create a measure named **Sales Growth PQ** that calculates the percentage increase between sales revenue for the current quarter and sales revenue for the previous quarter.
   a) Navigate to data view.
   b) Select the **Sales** table from the **Fields** list.

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c) Create a new measure by clicking the **New Measure** button in the ribbon.

d) Enter to following DAX expression into the formula bar to create the measure named **Sales Growth PQ**.

```
Sales Growth PQ =
IF(
  ( ISFILTERED('Calendar'[Quarter]) &&
    (ISFILTERED('Calendar'[Month]) = FALSE() && ISFILTERED(Calendar[Date]) = FALSE())
  ),
  DIVIDE(
    SUM(Sales[SalesAmount]) -
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSQUARTER(Calendar[Date])
    ),
    CALCULATE(
      SUM(Sales[SalesAmount]),
      PREVIOUSQUARTER(Calendar[Date])
    )
  ),
  BLANK()
)
```

e) Press the **ENTER** key to add the calculated column to data model.

f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Percentage**. Also use the spinner control below the format menu to set the number of decimal places shown to **2**.

7. Create a measure named **Sales Growth PQ Eval** that inspects the value of the **Sales Growth PQ** measure and evaluates to a short string value to indicate the health of the sales growth value.

a) Navigate to data view.

b) Select the **Sales** table from the **Fields** list.

c) Create a new measure by clicking the **New Measure** button in the ribbon.

d) Enter to following DAX expression into the formula bar to create the measure named **Sales Growth PQ Eval**.

```
Sales Growth PQ Eval =
IF(
  ISNUMBER([Sales Growth PQ]),
  SWITCH(TRUE(),
    ([Sales Growth PQ] >= 0.2), "EXCELLENT",
    ([Sales Growth PQ] >= 0.1), "GOOD",
    ([Sales Growth PQ] >= 0), "OK",
    ([Sales Growth PQ] >= -0.1), "BAD",
    ([Sales Growth PQ] <  -0.1), "AWFUL"
  )
)
```

8. Add the **Sales Growth PQ** measure and the **Sales Growth PQ Eval** measure to the matrix visual.

a) Navigate to report view and select the matrix visual on the **Sales Revenue Growth** page.

b) There should already be three fields in the **Values** well for this visual.

c) Drag and drop the **Sales Growth PQ** measure from the **Sales** table into the **Values** well in the **Visualizations** pane.

d) Drag and drop the **Sales Growth PQ Eval** measure from the **Sales** table into the **Values** well in the **Visualizations** pane.

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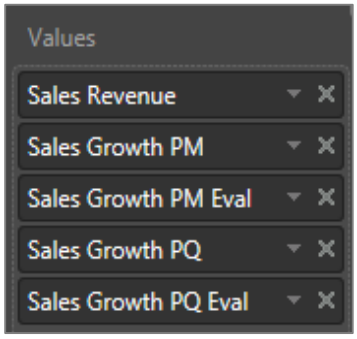

e) You should now see values for the **Sales Growth PQ** measure and the **Sales Growth PQ Eval** measure in the **Total** rows which are evaluated at the quarterly level.

Year	Quarter	Month	Sales Revenue	Sales Growth PM	Sales Growth PM Eval	Sales Growth PQ	Sales Growth PQ Eval
2014	2014-Q1	Jan 2014	$385,275	16.21 %	GOOD		
		Feb 2014	$358,244	-7.02 %	BAD		
		Mar 2014	$381,309	6.44 %	OK		
		Total	**$1,124,829**			**8.71 %**	**OK**
	2014-Q2	Apr 2014	$381,157	-0.04 %	BAD		
		May 2014	$438,261	14.98 %	GOOD		
		Jun 2014	$378,749	-13.58 %	AWFUL		
		Total	**$1,198,166**			**6.52 %**	**OK**
	2014-Q3	Jul 2014	$359,744	-5.02 %	BAD		
		Aug 2014	$457,312	27.12 %	EXCELLENT		
		Sep 2014	$505,332	10.50 %	GOOD		
		Total	**$1,322,388**			**10.37 %**	**GOOD**
	2014-Q4	Oct 2014	$602,448	19.22 %	GOOD		
		Nov 2014	$545,572	-9.44 %	BAD		
		Dec 2014	$581,977	6.67 %	OK		
		Total	**$1,729,996**			**30.82 %**	**EXCELLENT**

9. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

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Module 06: Designing Reports with Power BI Desktop

Module Description

This module begins by explaining the fundamental concepts and the relationship between reports, visualizations, dashboard and tiles. Students will learn how to design reports using Power BI Desktop and the standard set of Power BI visualizations as well as how to publish reports to the Power BI service. The module also discusses how to make reports more interactive using filters and slicers. Students will also learn how to create dashboards in Power BI which display summary information as well as how to use dashboard tiles to link a dashboard to reports and underlying datasets which allow users to drill down in greater levels of detail and granularity.

Module Agenda

- Understanding Visualization Types
- Working with Reports and Visuals
- Designing Interactive Reports
- Publishing Reports to the Power BI Service

Topics Covered

Built-in Visualization Types
Creating Reports
Creating Visuals
Modifying Visual Properties
Reusing Visuals
Calculating Percentage of Product sales
The Product Revenue Breakdown Report
Creating the Top 5 Products Report
Next Steps
There a Problem with Measure Filters
Fixing the Problem
Display Top 5 Products with Two Visuals
Creating the Top 10 Customers Report
The Finished Report
Publishing a Power BI Desktop Project

Examining What's Been Published
Examining Dataset Properties

Instructor Demos

- Creating Visuals with Power BI's Built-in Visualization Types

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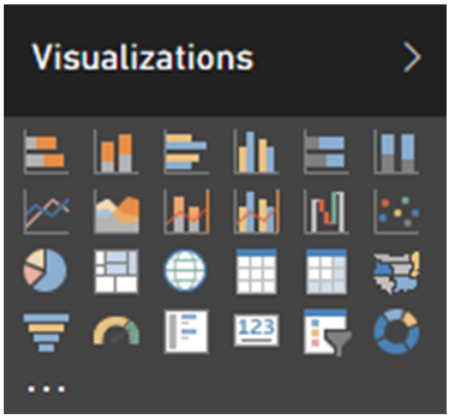
Built-in Visualization Types

- Table and Matrix visuals
- Slicers
- Single number card tiles
- Bar charts and Column charts
- Line charts and Pie charts
- Basic (Layered) Area chart
- Combo charts
- Tree Maps
- Waterfall charts
- Doughnut charts
- Funnel charts
- Gauge charts
- Maps (basic)
- Scatter and bubble charts



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Creating Reports

- Power BI Desktop project has one report
  - The report can contain many report pages
  - Report page contains visuals
- Reports can have filters
  - Visual-level filters
  - Page-level filters
  - Report-level filters

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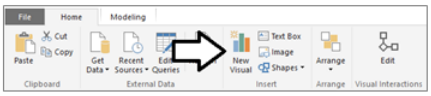
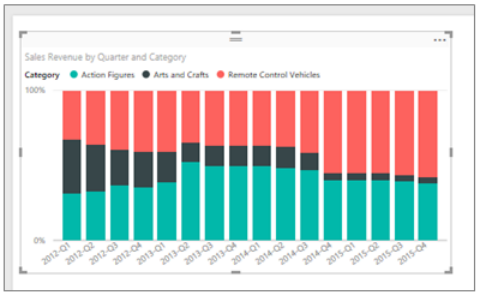
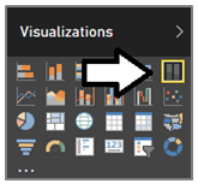
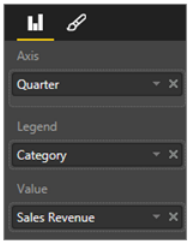
Creating Visuals

- Working with visuals
  - Add visual to a page
  - Change its visualization type
  - Add fields to visual wells









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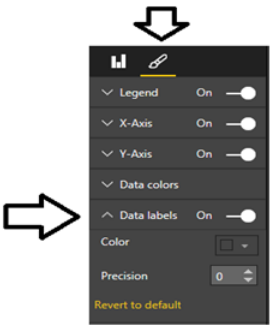
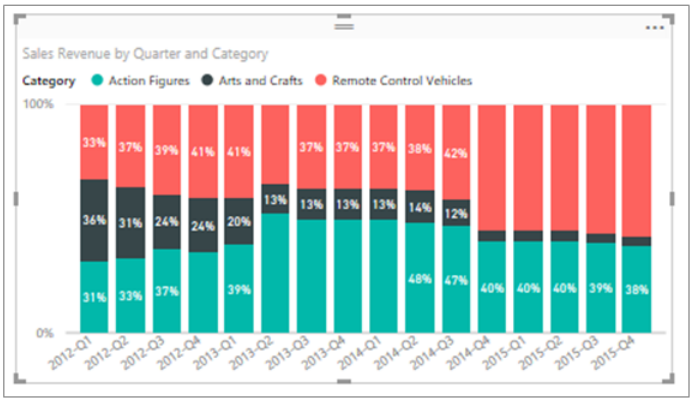
Modifying Visual Properties

- Each visual has editable properties
  - Data properties
  - Appearance properties





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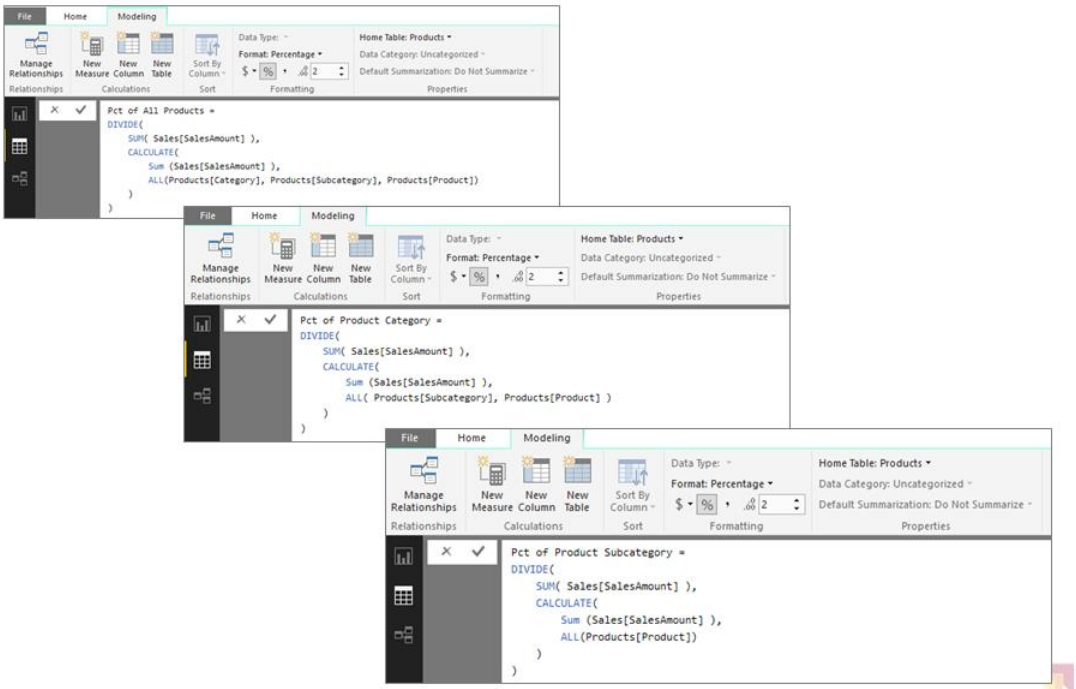
Reusing Visuals

- Visuals support copy-and-paste
  - Quick way to clone a visual for reuse

Calculating Percentage of Product sales



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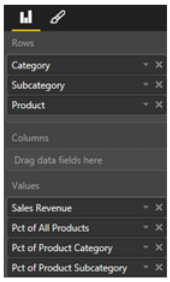
The Product Revenue Breakdown Report



Category	Subcategory	Product	Sales Revenue	Pct of All Products	Pct of Product Category	Pct of Product Subcategory
Action Figures	Cute and Huggable	Black Power Ranger Action Figure	$13,013	0.08 %	0.18 %	0.30 %
		Green Angry Bird Action Figure	$23,295	0.14 %	0.31 %	0.53 %
		Perry the Platypus Action Figure	$401,992	2.33 %	5.44 %	9.23 %
		Phineas and Ferb Action Figure Set	$292,706	1.70 %	3.96 %	6.72 %
		Red Angry Bird Action Figure	$61,654	0.36 %	0.83 %	1.42 %
		Twitter Follower Action Figure	$3,493,118	20.25 %	47.23 %	80.19 %
		Woody Action Figure	$70,287	0.41 %	0.95 %	1.61 %
		Total	**$4,356,065**	**25.25 %**	**58.90 %**	**100.00 %**
	Tough Guys	Batman Action Figure	$130,768	0.76 %	1.77 %	4.30 %
		Captain America Action Figure	$499,715	2.90 %	6.76 %	16.44 %
		GI Joe Action Figure	$168,905	0.98 %	2.28 %	5.56 %
		Godzilla Action Figure	$1,744,707	10.11 %	23.59 %	57.40 %
		Green Hulk Action Figure	$82,764	0.48 %	1.12 %	2.72 %
		Red Hulk Alter Ego Action Figure	$13,691	0.08 %	0.19 %	0.45 %
		Spiderman Action Figure	$398,834	2.31 %	5.39 %	13.12 %
		Total	**$3,039,384**	**17.62 %**	**41.10 %**	**100.00 %**
	Total		**$7,395,449**	**42.86 %**	**100.00 %**	**100.00 %**

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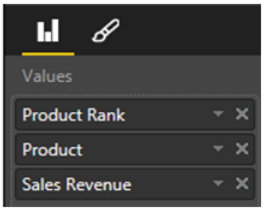
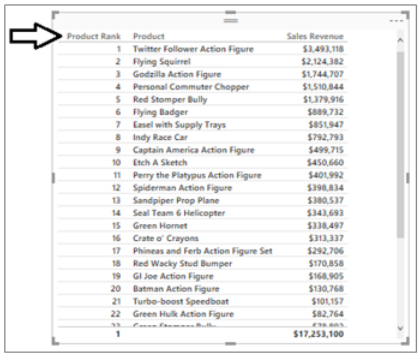
Creating the Top 5 Products Report

- It starts with creating measure to rank products

```
Product Rank =
RANKX(
    ALL(Products),
    CALCULATE( SUM(Sales[SalesAmount]) )
)
```

- Next, add **Product Rank** measure to table visual





Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	$3,493,118
2	Flying Squirrel	$2,124,382
3	Godzilla Action Figure	$1,744,707
4	Personal Commuter Chopper	$1,510,844
5	Red Stomper Bully	$1,379,916
6	Flying Badger	$889,732
7	Easel with Supply Trays	$851,947
8	Indy Race Car	$792,793
9	Captain America Action Figure	$499,715
10	Etch A Sketch	$450,660
11	Perry the Platypus Action Figure	$401,992
12	Spiderman Action Figure	$398,834
13	Sandpiper Prop Plane	$380,537
14	Seal Team 6 Helicopter	$343,693
15	Green Hornet	$338,497
16	Crate o' Crayons	$313,337
17	Phineas and Ferb Action Figure Set	$292,706
18	Red Wacky Stud Bumper	$170,858
19	GI Joe Action Figure	$168,905
20	Batman Action Figure	$130,768
21	Turbo-boost Speedboat	$101,157
22	Green Hulk Action Figure	$82,764
1		$17,253,100

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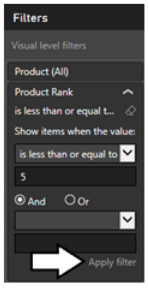
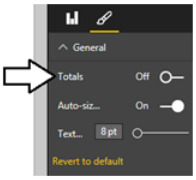
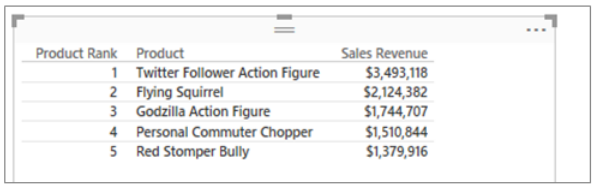
Next Steps

- Apply filter and remove Totals row







Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	$3,493,118
2	Flying Squirrel	$2,124,382
3	Godzilla Action Figure	$1,744,707
4	Personal Commuter Chopper	$1,510,844
5	Red Stomper Bully	$1,379,916

- Add slicer to make report interactive

Product Rank	Product	Sales Revenue
1	Easel with Supply Trays	$198,851
2	Godzilla Action Figure	$156,268
3	Red Stomper Bully	$125,251
4	Flying Badger	$69,931
5	Flying Squirrel	$64,564

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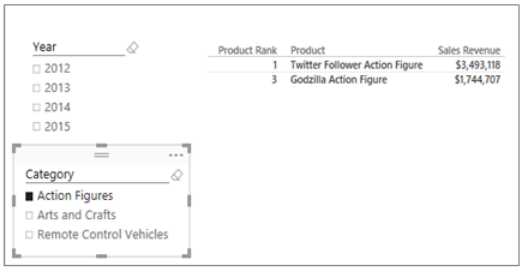
There a Problem with Measure Filters

- Add a Slicer to filter on product category

- Top 5 products ranking measure is now broken



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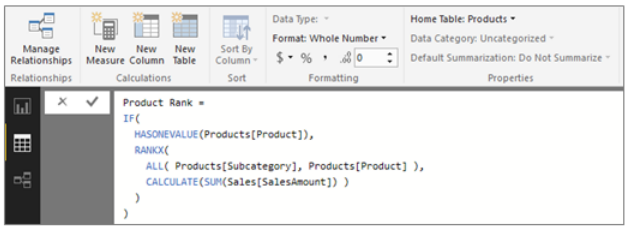
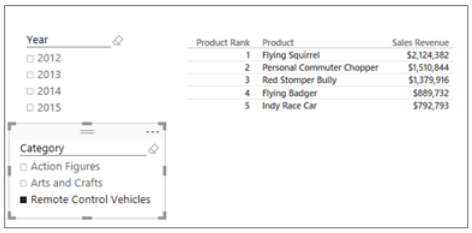
Fixing the Problem

- Rewrite DAX using ALL function
  - Include columns which should not be filtered



- Top 5 products ranking now works as expected



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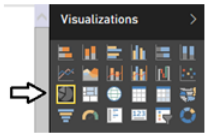
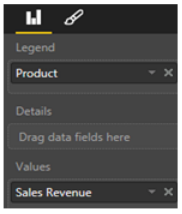
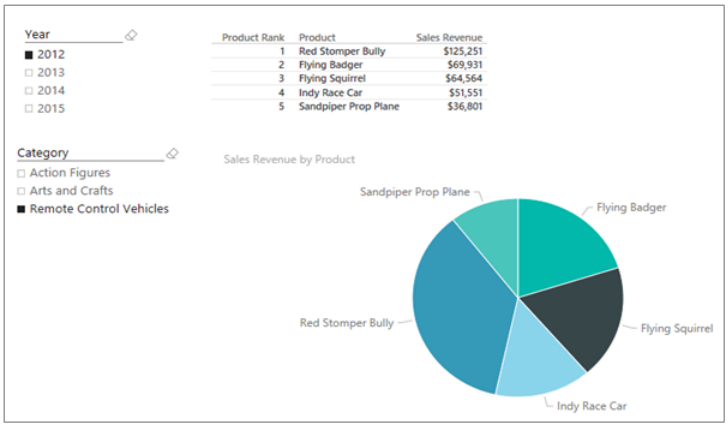
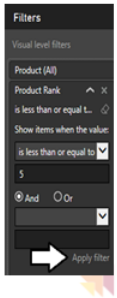
Display Top 5 Products with Two Visuals

- Add pie chart
  - Filter by product rank









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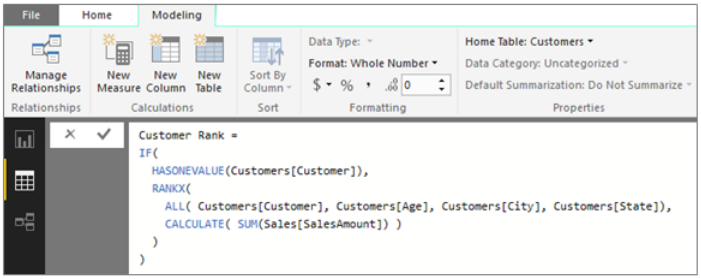
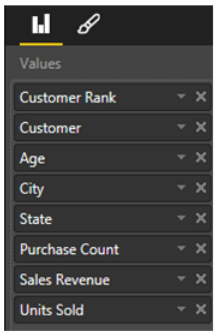
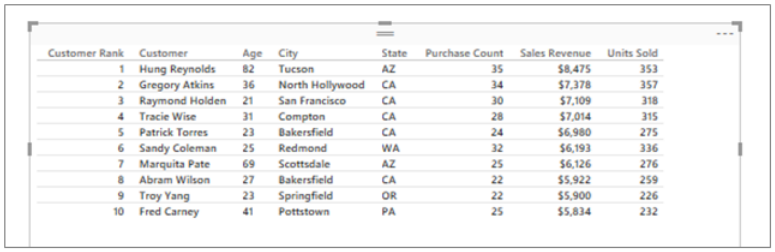
Creating the Top 10 Customers Report







Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Holden	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232

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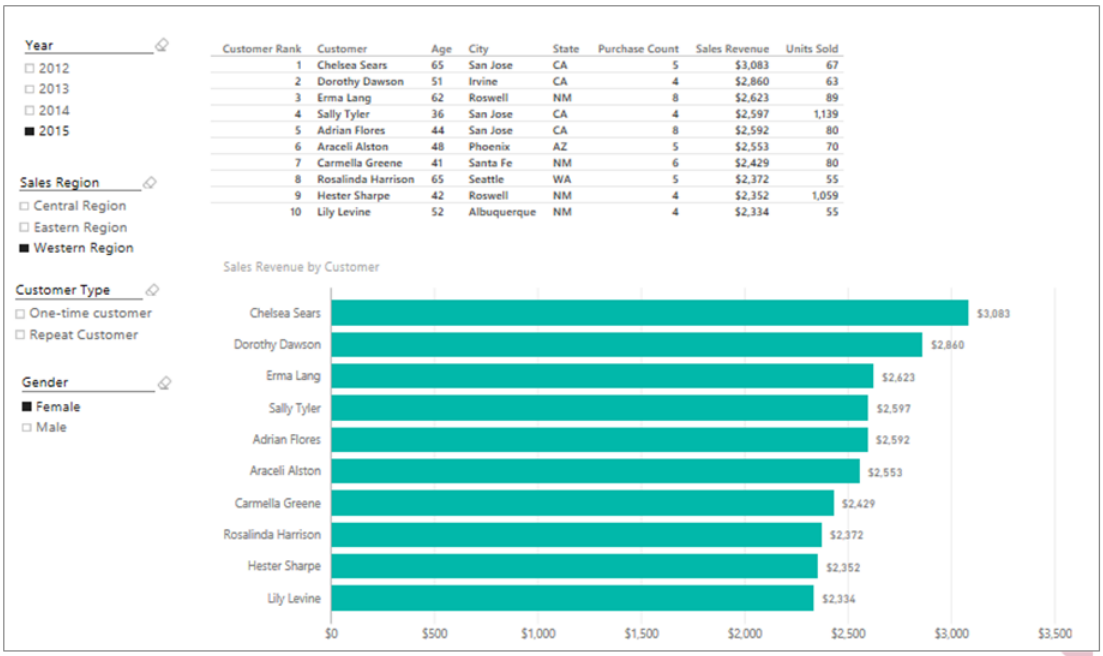
The Finished Report



Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Chelsea Sears	65	San Jose	CA	5	$3,083	67
2	Dorothy Dawson	51	Irvine	CA	4	$2,860	63
3	Erma Lang	62	Roswell	NM	8	$2,623	89
4	Sally Tyler	36	San Jose	CA	4	$2,597	1,139
5	Adrian Flores	44	San Jose	CA	8	$2,592	80
6	Araceli Alston	48	Phoenix	AZ	5	$2,553	70
7	Carmella Greene	41	Santa Fe	NM	6	$2,429	80
8	Rosalinda Harrison	65	Seattle	WA	5	$2,372	55
9	Hester Sharpe	42	Roswell	NM	4	$2,352	1,059
10	Lily Levine	52	Albuquerque	NM	4	$2,334	55

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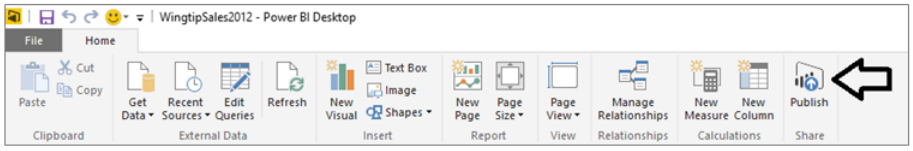
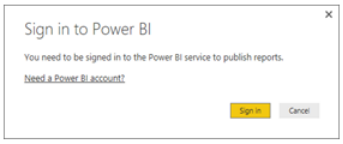
Publishing a Power BI Desktop Project

- Power BI Desktop provides **Publish** command
  - Used to publish project to Power BI service



  - Requires logging into your Office 365 account



  - Published articles added to your personal workspace

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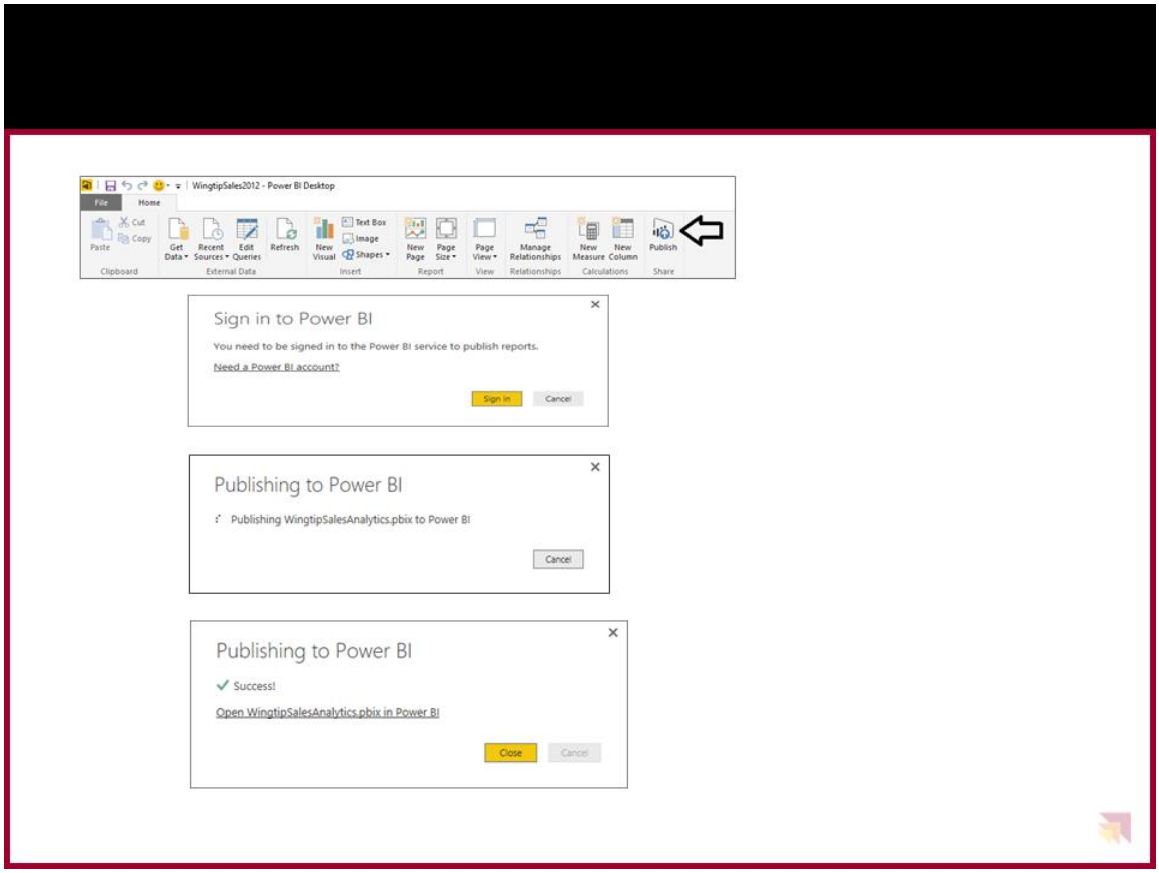

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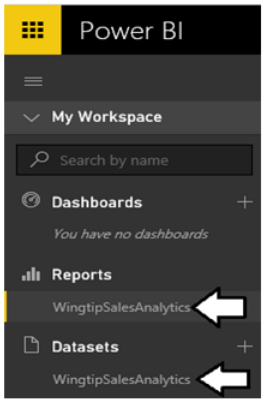
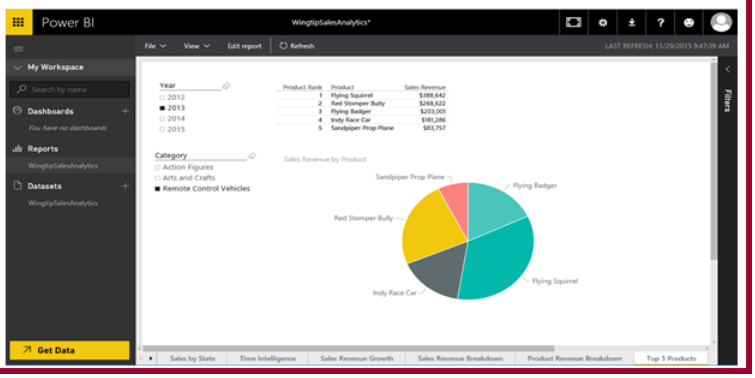
Examining What's Been Published

- Each project published
  - One main dataset
  - One main report





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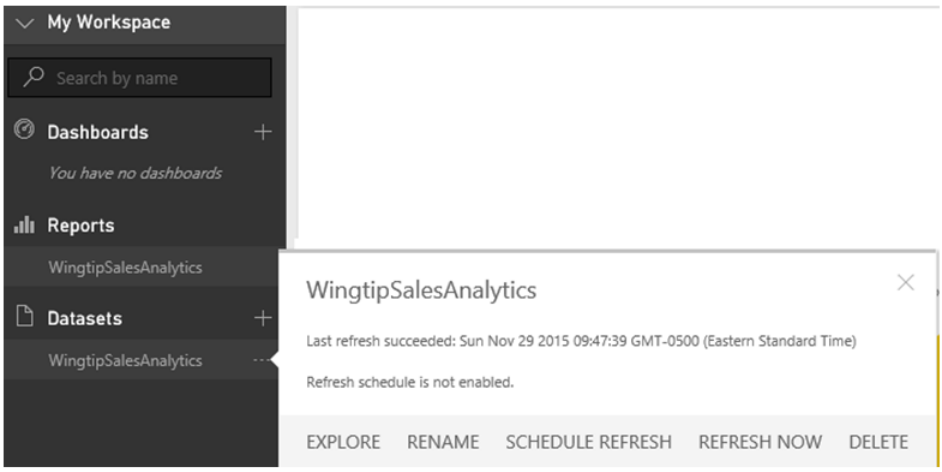
Examining Dataset Properties

- Datasets support renaming and refreshing



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Module 06 Lab: Designing Reports with Power BI Desktop

Lab Time: 60 minutes

Lab Folder: C:\Student\Modules\DesigningReports\Lab

Lab Overview: In this module you will continue to extend the Power BI Desktop project named **WingtipSalesAnalytics.pbix** that you have been with working with over the last few labs. In this lab you will focus on designing addition report pages. After creating and designing the several new report pages in the project, you will publish your reports and the underlying dataset to the Power BI service.

Important: This lab assumes you have completed the previous lab titled **Extending a Data Model with Time Intelligence** in which you extended the PBIX project with a calendar table and additional measures. If you would like to start this lab without completing the previous lab, copy the lab solution at **C:\Student\Modules\TimeIntelligence\LabSolution\WingtipSalesAnalytics.pbix** into the folder at **C:\Student\Projects** using the Windows Explorer.

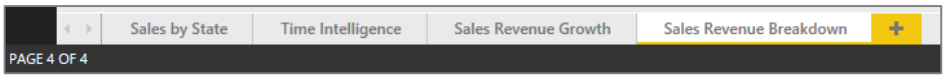
Exercise 1: Create the Sales Revenue Breakdown Report

In this exercise you will create the **Sales Revenue Breakdown** report to design a new report page that shows how sales revenue breaks down over the last 4 years in areas such as product category, customer type, sales region and purchase type.

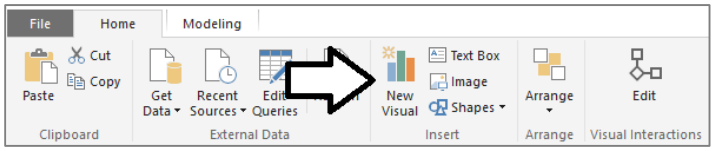
1. Launch Power BI Desktop.
2. Open the Power BI Desktop project named **WingtipSalesAnalytics.pbix** from the previous lab located at the following path.

```
C:\Student\Projects\WingtipSalesAnalytics.pbix
```

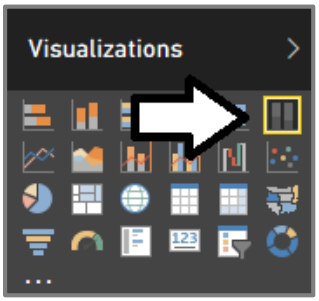
3. When the project opens, click the report icon on the top of the sidebar to enter report view mode.
   a) The project should already contain report pages named **Sales by State**, **Time Intelligence** and **Sales Revenue Growth**.
4. Create a new report page to the project and rename it to **Sales Revenue Breakdown**.



5. Add a new visual to the report to show sales revenue broken down by product category.
   a) Make sure the **Home** tab is active on the ribbon.
   b) Click on the **New Visual** button to add a new visual to the page.



   c) Click the **100% Stacked column chart** button in the **Visualizations** list to change the visualization type.



   d) Drag the **Quarter** column from the **Calendar** table in the **Fields** list and drop it into the **Axis** well in the **Visualizations** pane.
   e) Drag the **Category** column from the **Products** table and drop it into the **Legend** well in the **Visualizations** pane.
   f) Drag the **Sales Revenue** measure from the **Sales** table and drop it into the **Value** well in the **Visualizations** pane.

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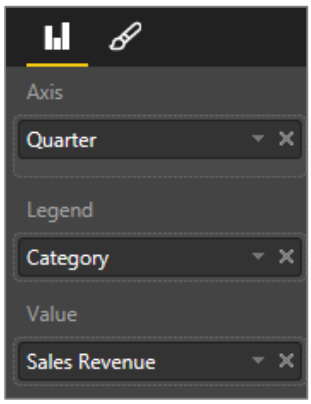
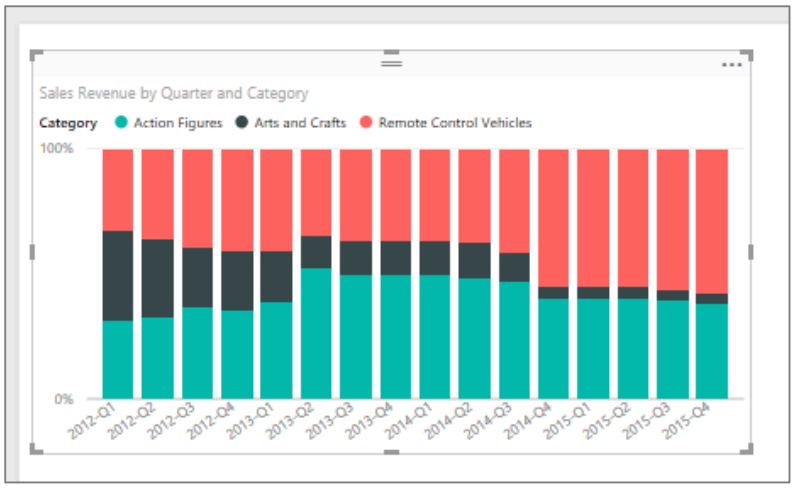
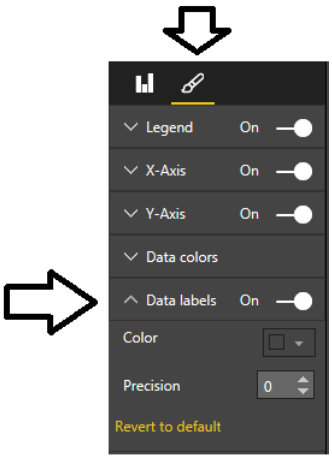


g) At this point, your visual should match the following screenshot.



h) Click on the **Edit Brush** icon in the **Visualizations** pane to view the appearance properties for the visual. Locate the **Data labels** property and change its value to **On** as shown in the following screenshot.



i) Now the visual should display percentage values showing revenue breakdown across categories for each quarter.

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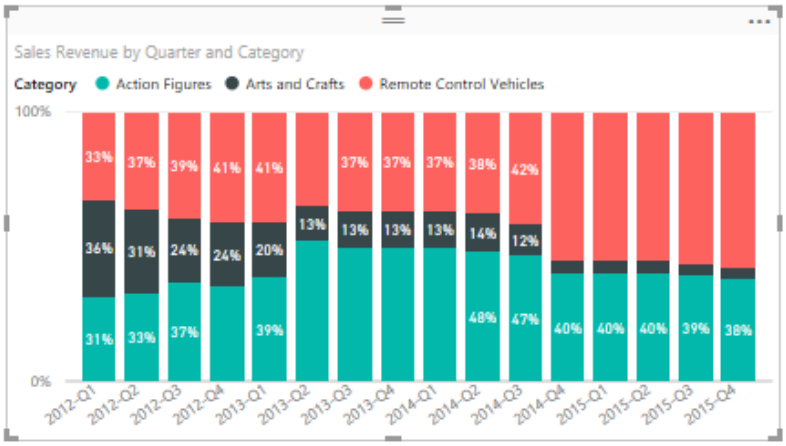
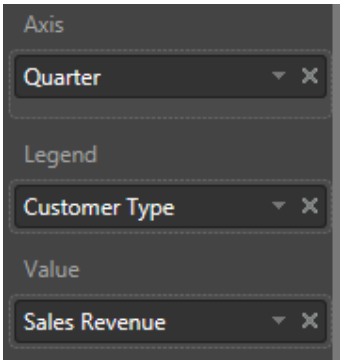
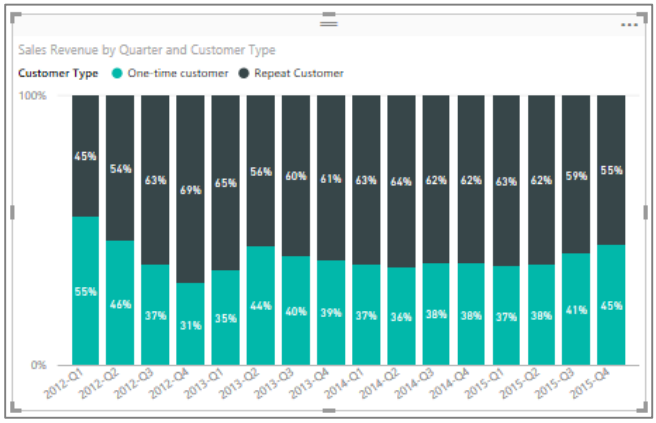


j) Reposition the visual so it takes up the entire upper, left-hand corner of the page.

6. Create a second visual to display a breakdown of sales revenue by customer type.
   a) Select the existing visual and copy it to the Windows clipboard.
   b) Perform a paste operation to add a second copy of the visual to the report page.
   c) Reposition the visual so it takes up the entire lower, left-hand corner of the page.
   d) Make sure the second visual is selected and examine its properties in the **Visualizations** pane.
   e) Remove the **Categories** column from the **Legend** well.
   f) Drag the **Customer Type** column from the **Customers** table and drop it into the **Legend** well in the **Visualizations** pane.



g) The new visual should now match the that is visual shown in the following screenshot.



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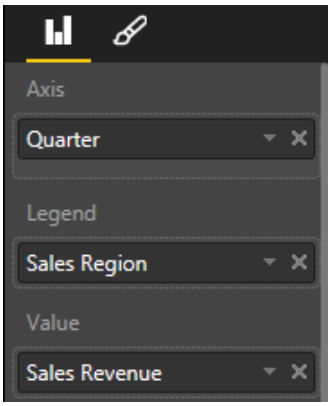
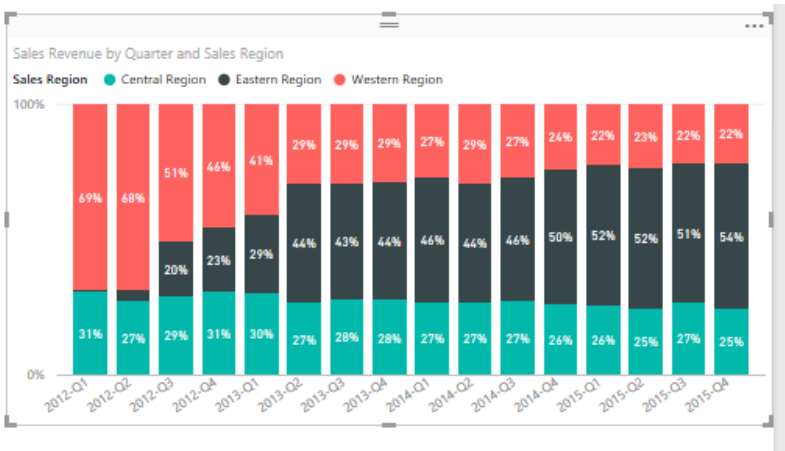
7. Create a third visual to display a breakdown of sales revenue by sales region.
   a) Select the first visual on the top, left of the page and copy it to the Windows clipboard.
   b) Perform a paste operation to add a new copy of the visual to the report page.
   c) Reposition the visual so it takes up the entire upper, right-hand corner of the page.
   d) Make sure the third visual is selected and examine its properties in the **Visualizations** pane.
   e) Remove the **Categories** column from the **Legend** well.
   f) Drag the **Sales Region** column from the **Customers** table and drop it into the **Legend** well in the **Visualizations** pane.



   g) The new visual should now match the visual shown in the following screenshot.



Over the next few steps you will use the **PurchaseType** column of the **Purchases** table to create a new visual. However, this column currently has a name that isn't as user-friendly as it could be. In the next step you will change the column name from **PurchaseType** to **Purchase Type** so the column name displays on report pages in a more user-friendly manner.

8. Change the name of the **PurchaseType** column to **Purchase Type**.
   a) Click the table icon in the middle of the sidebar to enter data view mode.
   b) Look at the **Fields** list and expand the columns inside the **Purchase** table.
   c) Locate the **PurchaseType** column.
   d) Right-click on the **PurchaseType** column in the Fields list and click the **Rename** command.
   e) Rename the column by adding a space so that the new column name is **Purchase Type**.

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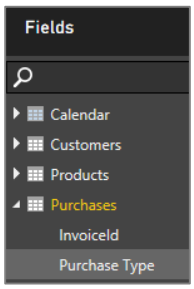
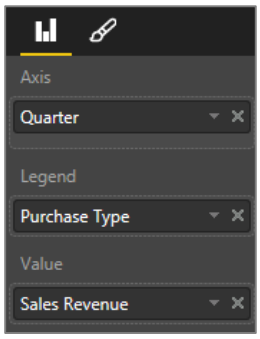
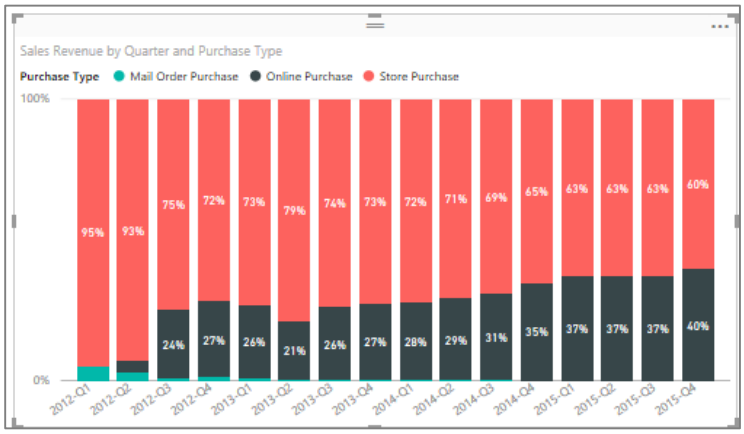


9. Create a fourth visual to display a breakdown of sales revenue by purchase type.
   a) Click the report icon on the top of the sidebar to navigate back to report view mode.
   b) Select the first visual on the top, left of the page and copy it to the Windows clipboard.
   c) Perform a paste operation to add a new copy of the visual to the report page.
   d) Reposition the visual so it takes up the entire lower, right-hand corner of the page.
   e) Make sure the new visual is selected and examine its properties in the **Visualizations** pane.
   f) Remove the **Categories** column from the **Legend** well.
   g) Drag the **Purchase Type** column from the **Purchases** table and drop it into the **Legend** well in the **Visualizations** pane.



   h) The new visual should now match the visual shown in the following screenshot.



10. Make sure that the four visuals are laid out on the page as shown in the following screenshot.

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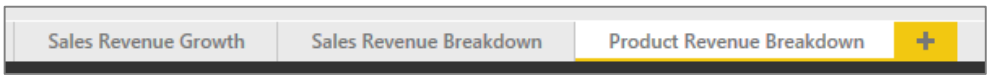
11. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

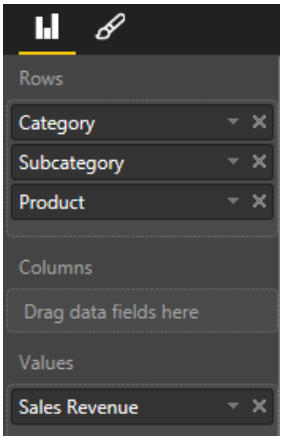
Exercise 2: Create the Product Revenue Breakdown Report

In this exercise you will create a new report page named **Product Revenue Breakdown**. Creating this report will involve creating new measures to calculate percentages that each product category, subcategory and product contribute to overall sales revenue.

1. Create a new report page and rename it to **Sales Revenue Breakdown**.



2. Create a new matrix visual to display sales revenue broken out by product category, subcategory and product.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a matrix by clicking the Matrix button in the **Visualizations** list.
   c) Drag and drop the **Category** column from the **Products** table into the **Rows** well.
   d) Drag and drop the **Subcategory** column from the **Products** table into the **Rows** well.
   e) Drag and drop the **Product** column from the **Products** table into the **Rows** well.
   f) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Value** well.



   g) The new visual should now match the visual shown in the following screenshot.

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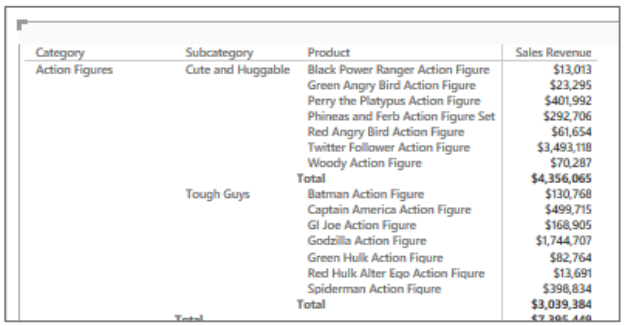
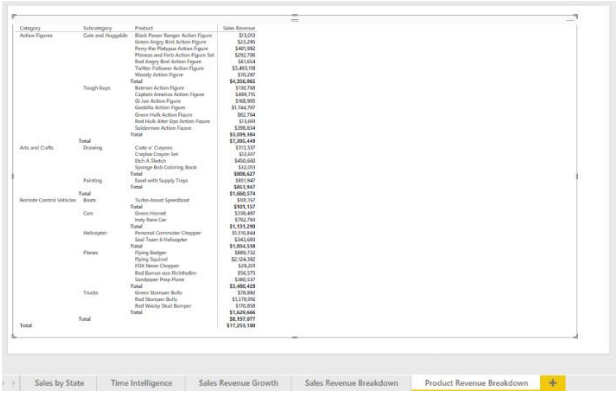


Category	Subcategory	Product	Sales Revenue
Action Figures	Cute and Huggable	Black Power Ranger Action Figure	$13,013
		Green Angry Bird Action Figure	$23,295
		Perry the Platypus Action Figure	$401,992
		Phineas and Ferb Action Figure Set	$292,706
		Red Angry Bird Action Figure	$61,654
		Twitter Follower Action Figure	$3,493,118
		Woody Action Figure	$70,287
		Total	$4,356,065
	Tough Guys	Batman Action Figure	$130,768
		Captain America Action Figure	$499,715
		GI Joe Action Figure	$168,905
		Godzilla Action Figure	$1,744,707
		Green Hulk Action Figure	$82,764
		Red Hulk Alter Ego Action Figure	$13,691
		Spiderman Action Figure	$398,834
		Total	$3,039,384

h) Reposition the visual so it takes up the height and the width of the entire report page. You need extra width for this visual because you will be adding more columns to it later in this exercise.

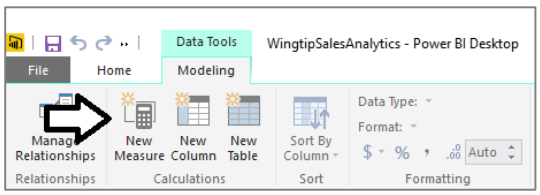


3. Create the **Pct of All Products** measure that calculates the percentage of sales revenue compared to that of all sales revenue.

a) Navigate to data view.

b) Select the **Products** table from the **Fields** list.

c) Create a new measure by clicking the **New Measure** button in the ribbon.



d) Enter to following DAX expression into the formula bar to create the measure named **Pct of All Products**.

```
Pct of All Products =
DIVIDE(
 SUM( Sales[SalesAmount] ),
 CALCULATE(
    Sum ( Sales[SalesAmount] ),
    ALL( Products[Category], Products[Subcategory], Products[Product] )
 )
)
```

e) Press the **ENTER** key to add the measure to the data model.

f) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Percentage**. Also use the spinner control below the format menu to set the number of decimal places shown to **2**.

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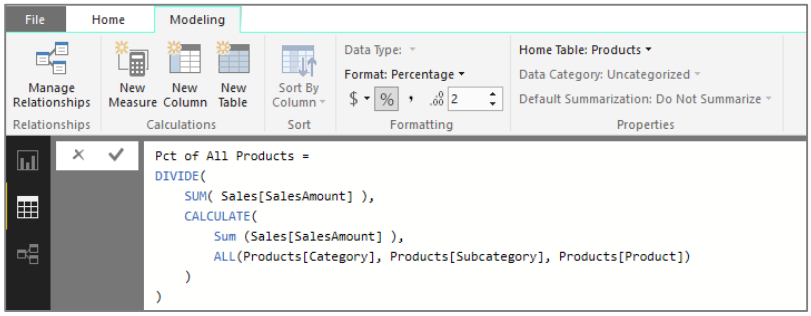
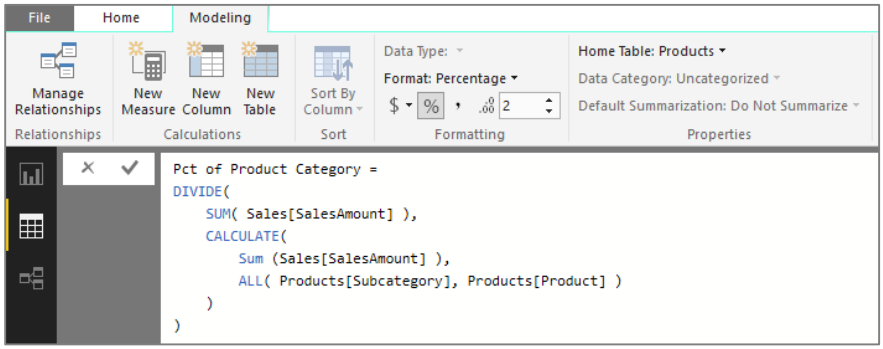


4. Create the **Pct of Product Category** measure that calculates the percentage of sales revenue within the current product category.
   a) Select the **Products** table from the **Fields** list.
   b) Create a new measure by clicking the **New Measure** button in the ribbon.
   c) Enter to following DAX expression into the formula bar to create the measure named **Pct of Product Category**.

```
Pct of Product Category =
DIVIDE(
 SUM( Sales[SalesAmount] ),
 CALCULATE(
    Sum ( Sales[SalesAmount] ),
    ALL( Products[Subcategory], Products[Product] )
 )
)
```

   d) Press the **ENTER** key to add the measure to the data model.
   e) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Percentage**. Also use the spinner control below the format menu to set the number of decimal places shown to **2**.



5. Create the **Pct of Product Subcategory** measure that calculates the percentage of sales revenue within the current subcategory.
   a) Select the **Products** table from the **Fields** list.
   b) Create a new measure by clicking the **New Measure** button in the ribbon.
   c) Enter to following DAX expression into the formula bar to create the measure named **Pct of Product Subcategory**.

```
Pct of Product Subcategory =
DIVIDE(
 SUM( Sales[SalesAmount] ),
 CALCULATE(
    Sum ( Sales[SalesAmount] ),
    ALL( Products[Product] )
 )
)
```

   d) Press the **ENTER** key to add the measure to the data model.
   e) Modify the formatting by dropping down the **Format** menu on the ribbon and selecting **Percentage**. Also use the spinner control below the format menu to set the number of decimal places shown to **2**.

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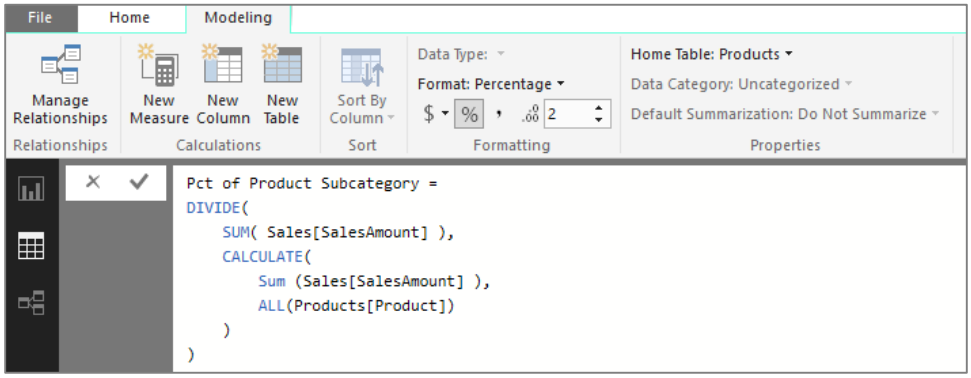
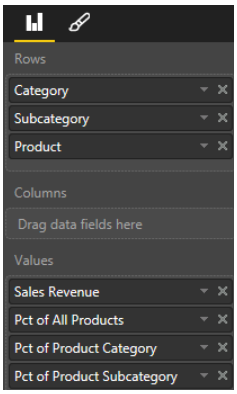


6. Modify the matrix visual on the **Sales Revenue Breakdown** report page to include the three new measures.
   a) Click the report icon on the top of the sidebar to enter report view mode.
   b) Make sure that the active report page is the **Sales Revenue Breakdown** report page.
   c) Select the matrix visual that you created earlier in this exercise.
   d) Drag and drop the **Pct of All Products** measure from the **Products** table into the **Values** well.
   e) Drag and drop the **Pct of Product Category** measure from the **Products** table into the **Values** well.
   f) Drag and drop the **Pct of Product Subcategory** measure from the **Products** table into the **Values** well.



   g) Your visual should now match the one shown in the following screenshot. If you examine the values of the **Pct of Product Subcategory** measure, you should see that the products in a subcategory have percentages that sum to 100% for that subcategory. If you examine the values of the **Pct of Product Category** measure, you should see that the products in a category have percentages that sum to 100% for that category.

Category	Subcategory	Product	Sales Revenue	Pct of All Products	Pct of Product Category	Pct of Product Subcategory
Action Figures	Cute and Huggable	Black Power Ranger Action Figure	$13,013	0.08 %	0.18 %	0.30 %
		Green Angry Bird Action Figure	$23,295	0.14 %	0.31 %	0.53 %
		Perry the Platypus Action Figure	$401,992	2.33 %	5.44 %	9.23 %
		Phineas and Ferb Action Figure Set	$292,706	1.70 %	3.96 %	6.72 %
		Red Angry Bird Action Figure	$61,654	0.36 %	0.83 %	1.42 %
		Twitter Follower Action Figure	$3,493,118	20.25 %	47.23 %	80.19 %
		Woody Action Figure	$70,287	0.41 %	0.95 %	1.61 %
		Total	**$4,356,065**	**25.25 %**	**58.90 %**	**100.00 %**
	Tough Guys	Batman Action Figure	$130,768	0.76 %	1.77 %	4.30 %
		Captain America Action Figure	$499,715	2.90 %	6.76 %	16.44 %
		GI Joe Action Figure	$168,905	0.98 %	2.28 %	5.56 %
		Godzilla Action Figure	$1,744,707	10.11 %	23.59 %	57.40 %
		Green Hulk Action Figure	$82,764	0.48 %	1.12 %	2.72 %
		Red Hulk Alter Ego Action Figure	$13,691	0.08 %	0.19 %	0.45 %
		Spiderman Action Figure	$398,834	2.31 %	5.39 %	13.12 %
		Total	**$3,039,384**	**17.62 %**	**41.10 %**	**100.00 %**
	Total		**$7,395,449**	**42.86 %**	**100.00 %**	**100.00 %**

7. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

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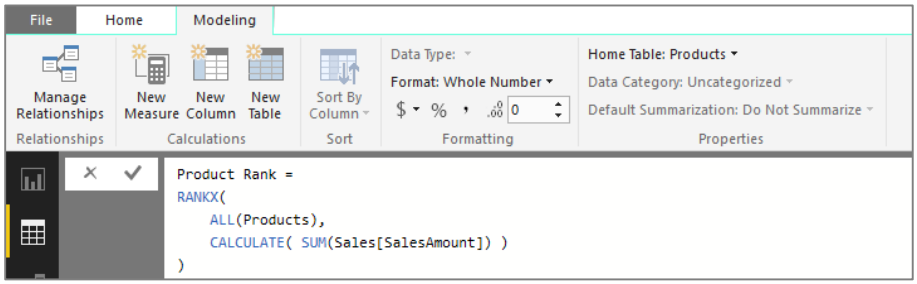
Exercise 3: Create the Top 5 Products Report

In this exercise you will create a measure named **Product Rank** that ranks products according to their sales revenue. You will then work to create a report that displays the top 5 selling products. You will design this report to be interactive allowing the user to filter on a specific year or a specific product category to see what products are the best sellers.

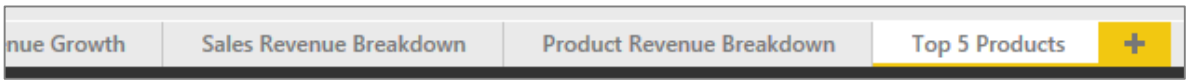
1. Create a new measure named **Product Rank** to determine the top selling products.
   a) Navigate to data view.
   b) Select the **Products** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the measure named **Product Rank**.

```
Product Rank =
RANKX(
 ALL(Products),
 CALCULATE( SUM(Sales[SalesAmount]) )
)
```

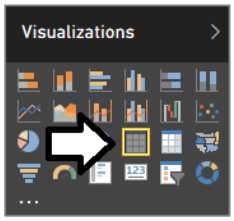
   e) Press the **ENTER** key to add the measure to the data model.
   f) Ensure the formatting for this measure is set to **Whole Number** as shown in the following screenshot.



2. Create a new report page named **Top 5 Products**
   a) Navigate to report view.
   b) Create a new report page and rename it to **Top 5 Products**.



3. Add a new table visual to display the top 5 products.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a matrix by clicking the **Table** button in the **Visualizations** list.



   c) Drag and drop the **Product Rank** measure from the **Products** table into the **Values** well.
   d) Drag and drop the **Product** column from the **Products** table into the **Rows** well.
   e) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Rows** well.

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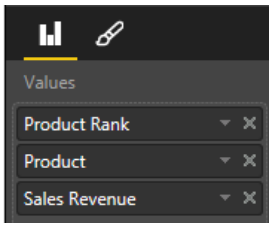
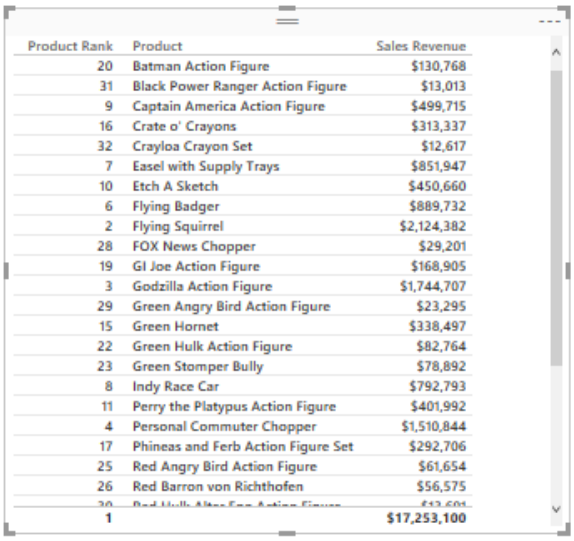
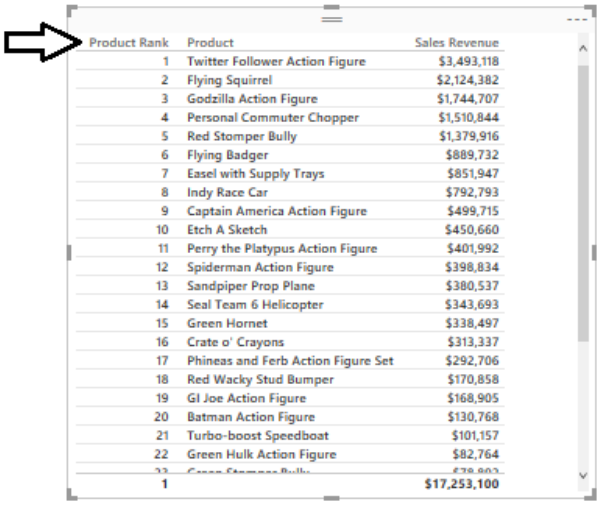


f) The new visual should now match the visual shown in the following screenshot.



Product Rank	Product	Sales Revenue
20	Batman Action Figure	$130,768
31	Black Power Ranger Action Figure	$13,013
9	Captain America Action Figure	$499,715
16	Crate o' Crayons	$313,337
32	Crayloa Crayon Set	$12,617
7	Easel with Supply Trays	$851,947
10	Etch A Sketch	$450,660
6	Flying Badger	$889,732
2	Flying Squirrel	$2,124,382
28	FOX News Chopper	$29,201
19	GI Joe Action Figure	$168,905
3	Godzilla Action Figure	$1,744,707
29	Green Angry Bird Action Figure	$23,295
15	Green Hornet	$338,497
22	Green Hulk Action Figure	$82,764
23	Green Stomper Bully	$78,892
8	Indy Race Car	$792,793
11	Perry the Platypus Action Figure	$401,992
4	Personal Commuter Chopper	$1,510,844
17	Phineas and Ferb Action Figure Set	$292,706
25	Red Angry Bird Action Figure	$61,654
26	Red Barron von Richthofen	$56,575
1		$17,253,100

g) Click on the **Product Rank** column header twice to sort the visual so the products with the lowest ranks are sorted to the top.



Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	$3,493,118
2	Flying Squirrel	$2,124,382
3	Godzilla Action Figure	$1,744,707
4	Personal Commuter Chopper	$1,510,844
5	Red Stomper Bully	$1,379,916
6	Flying Badger	$889,732
7	Easel with Supply Trays	$851,947
8	Indy Race Car	$792,793
9	Captain America Action Figure	$499,715
10	Etch A Sketch	$450,660
11	Perry the Platypus Action Figure	$401,992
12	Spiderman Action Figure	$398,834
13	Sandpiper Prop Plane	$380,537
14	Seal Team 6 Helicopter	$343,693
15	Green Hornet	$338,497
16	Crate o' Crayons	$313,337
17	Phineas and Ferb Action Figure Set	$292,706
18	Red Wacky Stud Bumper	$170,858
19	GI Joe Action Figure	$168,905
20	Batman Action Figure	$130,768
21	Turbo-boost Speedboat	$101,157
22	Green Hulk Action Figure	$82,764
1		$17,253,100

h) Drag and drop the **Product Rank** measure from the **Products** table into **Visual level filters** well of the **Filters** section.

i) Configure the **Product Rank** filter to only display products with a rank of 5 or lower as shown in the following screenshot and then click the **Apply Filter** link to apply the filter to the visual.

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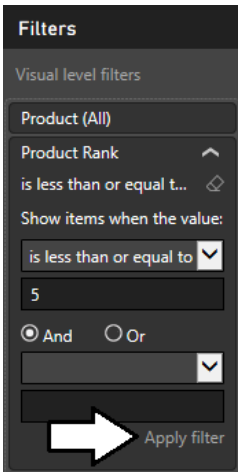
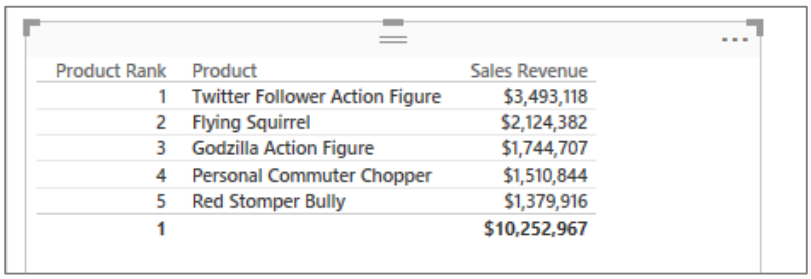
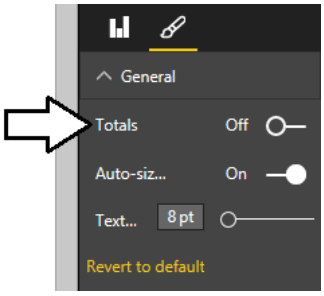


j) Your visual should now display the top 5 selling products as shown in the following screenshot. You should be able to observe that the visual is displaying the **Totals** row at the bottom which needs to be removed.

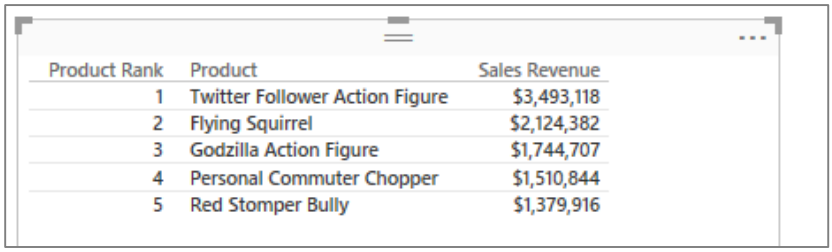


Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	$3,493,118
2	Flying Squirrel	$2,124,382
3	Godzilla Action Figure	$1,744,707
4	Personal Commuter Chopper	$1,510,844
5	Red Stomper Bully	$1,379,916
1		**$10,252,967**

k) Locate the **Totals** property for the table visual in the **General** section of the property sheet and set its value to **Off**.



l) Your top 5 products visual should now look better when it is displayed without the **Totals** row.



Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	$3,493,118
2	Flying Squirrel	$2,124,382
3	Godzilla Action Figure	$1,744,707
4	Personal Commuter Chopper	$1,510,844
5	Red Stomper Bully	$1,379,916

4. Add a new slicer visual to the page to filter the top 5 products visual by **Year**.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.

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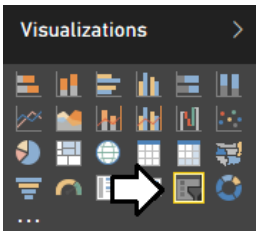
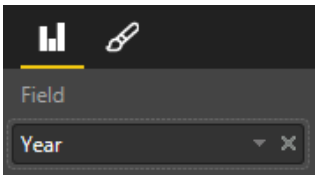
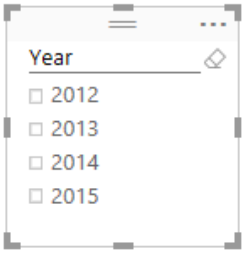


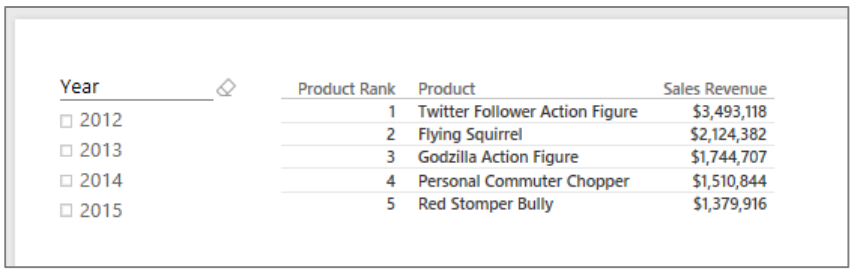
c) Drag and drop the **Year** column from the **Sales** table into the **Values** well.



d) You should now have a slicer visual that matches the following screenshot.



e) Reposition the two visuals on the page to match the following screenshot.



f) Try using the **Year** slicer by selecting individual years. You should see that the visual with the top 5 products changes whenever you select a different year.

5. Add a second slicer visual to the top five products visual by **Product Category**.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.

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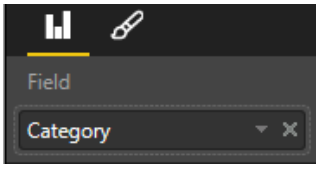
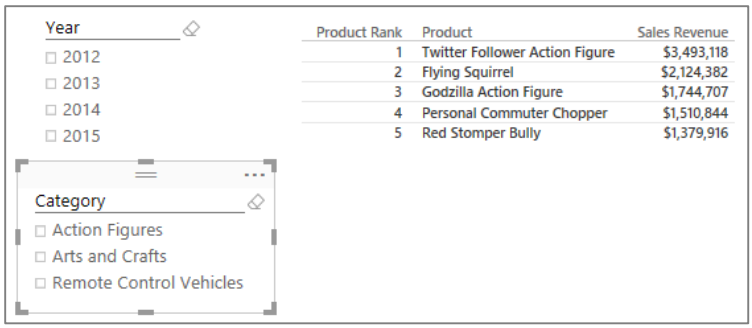
b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.

c) Drag and drop the **Category** column from the **Products** table into the **Values** well.



d) Reposition the new visual to match the page layout shown in the following screenshot.



e) Try using the **Category** slicer by selecting individual product categories. You should see that there is now a problem with the report because the visual with the top 5 products doesn't show 5 products.

The problem you are facing here has to do with the manner in which the **Product Rank** measure is filtering during its evaluation. The problem is that the measure does not correctly filter by the product category column when determining the top 5 products. Therefore, you must modify the DAX expression for the **Product Rank** measure in order to calculate the top 5 selling products within a specific category when that category is selected in the slicer.

6. Modify the DAX expressions for the **Product Rank** measure to correct the filter problem with product category.

a) Navigate to data view.

b) Expand the **Products** table from the **Fields** list.

c) Select the **Product Rank** measure in the **Products** table so you can view and modify its DAX expression in the formula bar.

d) Modify the DAX expression for the **Product Rank** measure to match the following code listing.

```
Product Rank =
IF(
  HASONEVALUE(Products[Product]),
  RANKX(
    ALL( Products[Subcategory], Products[Product] ),
    CALCULATE( SUM(Sales[SalesAmount]) )
  )
)
```

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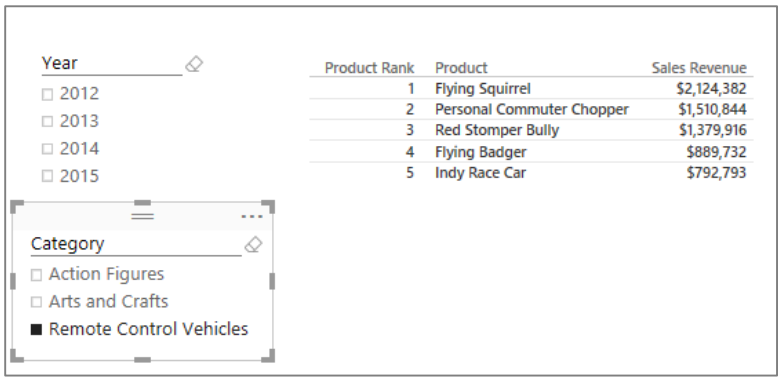
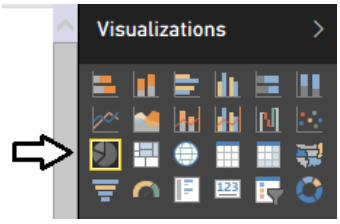
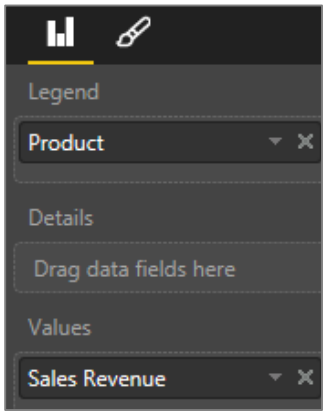
7. Test the changes you made to the **Product Rank** measure.
   a) Navigate to report view.
   b) Test the measure by selecting different categories using the **Category** slicer. At this point, the page filtering should be working correctly as you should see 5 top products when selecting a product category.



8. Add a new Pie chart visual to display the top 5 products.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a pie chart by clicking the Pie Chart button in the **Visualizations** list.



   c) Drag and drop the **Product** column from the **Products** table into the **Legend** well.
   d) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Values** well.



   e) Drag and drop the **Product Rank** measure from the **Products** table into **Visual level filters** well of the **Filters** section.
   f) Configure the **Product Rank** filter to only display products with a rank of 5 or lower as shown in the following screenshot and then click the **Apply Filter** link to apply the filter to the visual.

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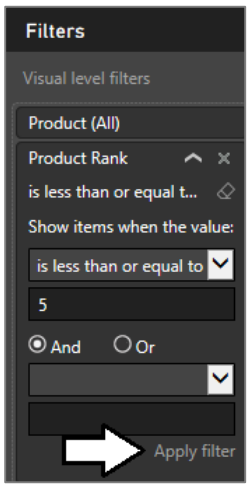
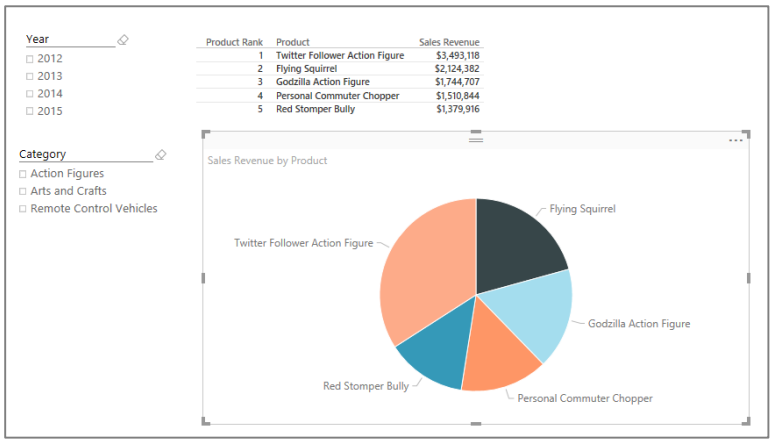
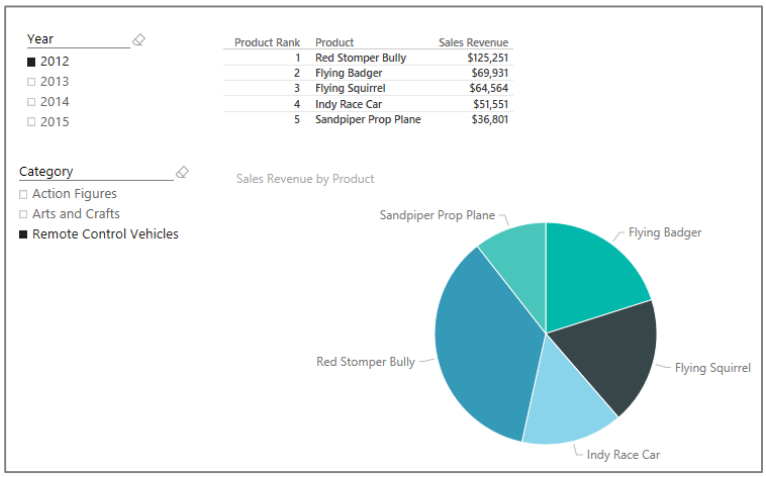


g) Reposition the new visual to match the page layout shown in the following screenshot.



h) Test your work by using the two slicer visuals on the page to select different combinations of years and product category. Both the table and the pie chart with the top 5 products should update together and stay in sync as you change the filter selection.



9. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

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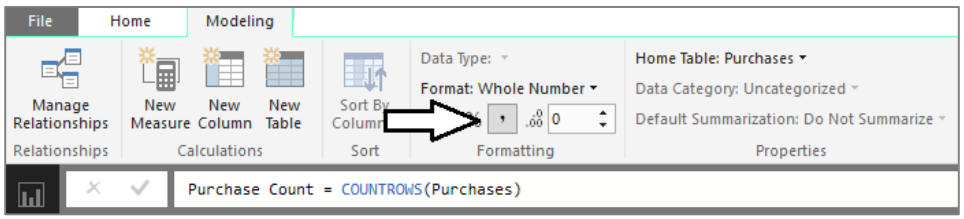
Exercise 4: Create the Top 10 Customers Report

In this exercise you will create a measure named **Customer Rank** that ranks customers according to their sales revenue. You will then work to create a report that displays the top 10 customers. You will also design this report to be interactive allowing the user to filter on a specific year or a specific product category to see what products are the best sellers.

1. Create a new measure named **Purchase Count** to determine the number of purchases.
   a) Navigate to data view.
   b) Select the **Purchases** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the measure named **Purchase Count**.

```
Purchase Count = COUNTROWS(Purchases)
```

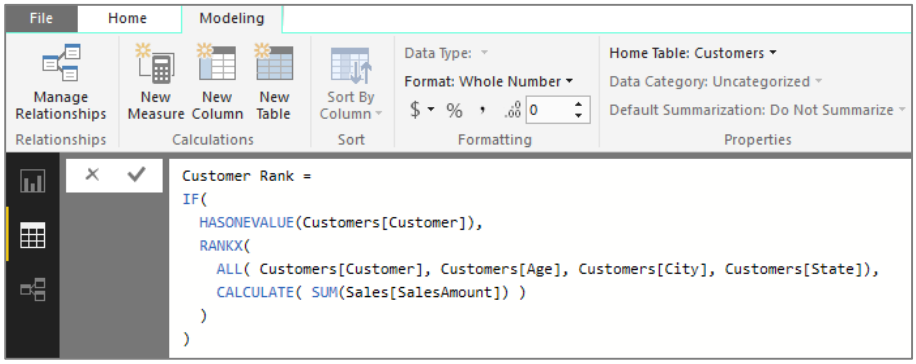
   e) Press the **ENTER** key to add the measure to the data model.
   f) Ensure the formatting for this measure is set to **Whole Number** as shown in the following screenshot. Also check the comma button to format values over 1000 with a comma separator.



2. Create a new measure named **Customer Rank** to determine the top ranked customers with respect to sales revenue.
   a) Navigate to data view if you are not already there.
   b) Select the **Customers** table from the **Fields** list.
   c) Create a new measure by clicking the **New Measure** button in the ribbon.
   d) Enter to following DAX expression into the formula bar to create the measure named **Customer Rank**.

```
Customer Rank =
IF(
  HASONEVALUE(Customers[Customer]),
  RANKX(
    ALL( Customers[Customer], Customers[Age], Customers[City], Customers[State]),
    CALCULATE( SUM(Sales[SalesAmount]) )
  )
)
```

   e) Press the **ENTER** key to add the measure to the data model.
   f) Ensure the formatting for this measure is set to **Whole Number** as shown in the following screenshot.



3. Create a new report page named **Top 10 Customers**.

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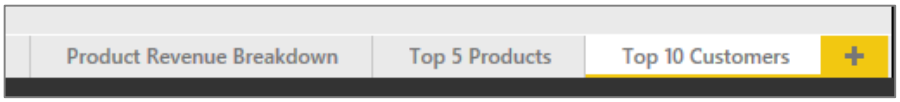
a) Navigate to report view.

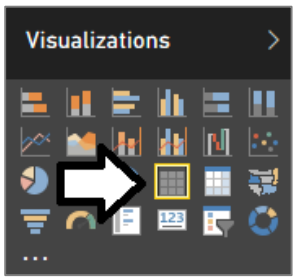
b) Create a new report page and rename it to **Top 10 Customers**.



4. Add a new table visual to display the top 10 customers.

a) Click the **New Visual** button on the ribbon to add a new visual to the page.

b) Change the visual to a table by clicking the **Table** button in the **Visualizations** list.



c) Drag and drop the **Customer Rank** measure from the **Customers** table into the **Values** well.

d) Drag and drop the **Customer** column from the **Customers** table into the **Values** well.

e) Drag and drop the **Age** column from the **Customers** table into the **Values** well.

f) Drag and drop the **City** column from the **Customers** table into the **Values** well.

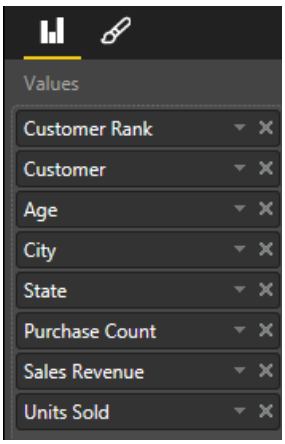
g) Drag and drop the **State** column from the **Customers** table into the **Values** well.

h) Drag and drop the **Purchase Count** measure from the **Products** table into the **Values** well.

i) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Values** well.

j) Drag and drop the **Units Sold** measure from the **Sales** table into the **Values** well.

k) The **Values** well for your visual should match the following screenshot.



l) The new visual should now display as the visual shown in the following screenshot.

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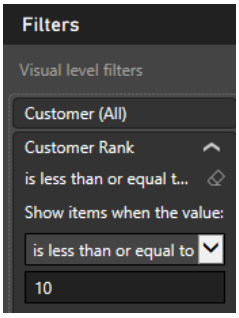
Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
11131	Aaron Cardenas	58	Dorchester	MA	1	$439	22
12383	Aaron Combs	21	Burbank	CA	2	$375	61
6276	Aaron Gonzalez	51	Greenville	NC	2	$988	41
26722	Aaron Moore	71	Houston	TX	1	$42	3
2977	Aaron Mullins	44	Napa	CA	3	$1,477	1,015
4526	Aaron Nelson	41	North Haven	CT	1	$1,172	1,011
16048	Abby Benton	59	Tucson	AZ	1	$257	107
24778	Abby Buckley	75	Glen Mills	PA	1	$85	28
25857	Abby Burt	23	Colorado Springs	CO	1	$61	7
15884	Abby Cook	35	Waterbury	CT	1	$260	108
6896	Abby Doyle	34	Spokane	WA	2	$872	28
19636	Abby Jarvis	66	Cincinnati	OH	1	$179	11
10260	Abby Lindsey	67	Dallas	TX	1	$500	10
6899	Abby Mooney	35	Braintree	MA	1	$871	13
16751	Abby Olson	71	Tallahassee	FL	1	$242	114
24700	Abdul Cote	47	Amarillo	TX	1	$88	4
21478	Abdul Dillard	25	Bakersfield	CA	1	$140	7
23569	Abdul Dudley	70	Raleigh	NC	1	$100	100
6969	Abdul Ellison	20	Knoxville	TN	7	$859	55
24055	Abdul Le	50	Allentown	PA	1	$100	5
Total					66,043	$17,253,100	4,032,502

m) Click on the **Customer Rank** column header twice to sort the visual so the customers with the greatest amount of sales revenue are sorted to the top.

Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Hol...	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232
11	Luisa Strickland	38	Bend	OR	25	$5,802	247
12	Victor Puckett	52	Eureka	CA	21	$5,748	229
13	Marco Bradsh...	72	Dallas	TX	25	$5,721	312
14	Ernesto Bernard	29	Vancouver	WA	28	$5,703	320
14	Max Simpson	63	Rochester	NY	11	$5,703	1,127
16	Sandy Vincent	35	San Jose	CA	25	$5,571	281
17	Neva Stephen...	35	Bellevue	WA	25	$5,564	288
18	Chadwick Joh...	33	San Francisco	CA	22	$5,561	219
19	Helga Simmons	45	Scottsdale	AZ	19	$5,445	233
20	Bobbie Steph...	56	Denver	CO	22	$5,410	1,216
Total					66,043	$17,253,100	4,032,502

n) Drag and drop the **Customer Rank** measure from the **Customers** table into **Visual level filters** well of the **Filters** section.

o) Configure the **Customer Rank** filter to only display customers with a rank of 10 or lower as shown in the following screenshot and then click the **Apply Filter** link to apply the filter to the visual.



p) Your visual should now display the top 10 customers as shown in the following screenshot. Note that the visual is still showing the **Totals** row at the bottom which needs to be removed.

Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Holden	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232
Total					277	$66,930	2,947

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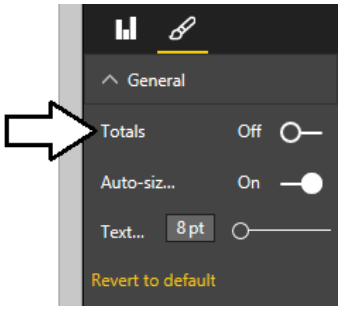
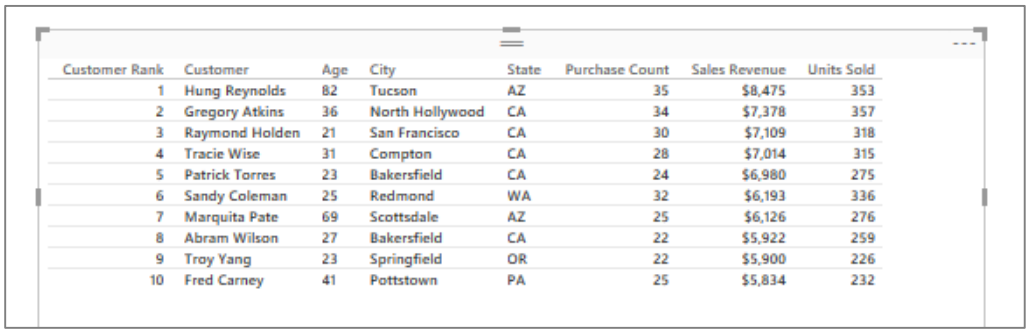
q) Locate the **Totals** property in the **General** section of the property sheet for the table visual and set it to a value of **Off**.



r) You visual should now look better when it is displayed without the **Totals** row.

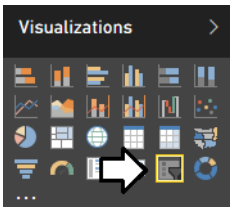


Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Holden	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232

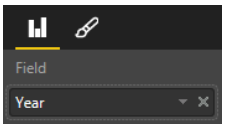
5. Add a new slicer visual to the page to filter the top 10 customers visual by **Year**.

a) Click the **New Visual** button on the ribbon to add a new visual to the page.

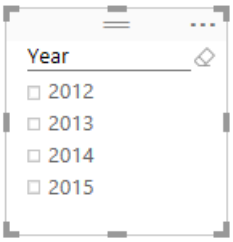
b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.



c) Drag and drop the **Year** column from the **Sales** table into the **Values** well.



d) You should now have a slicer visual that matches the following screenshot.



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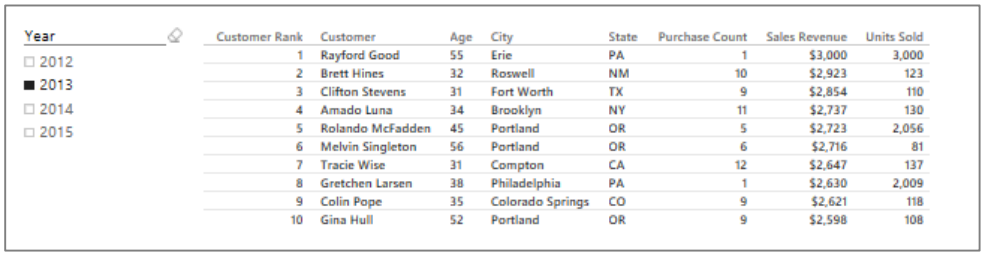
e) Reposition the two visuals on the page to match the following screenshot.

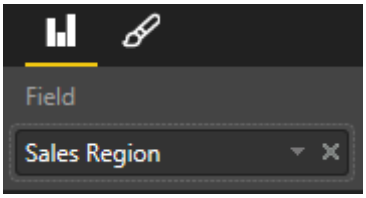
Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Holden	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232

f) Try using the slicer by selecting individual years. You should see that the visual with the top 10 customers list changes when you select a different year.

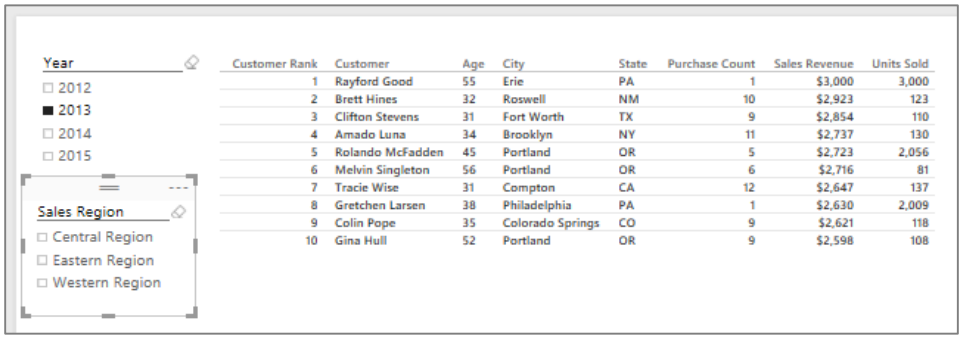


Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Rayford Good	55	Erie	PA	1	$3,000	3,000
2	Brett Hines	32	Roswell	NM	10	$2,923	123
3	Clifton Stevens	31	Fort Worth	TX	9	$2,854	110
4	Amado Luna	34	Brooklyn	NY	11	$2,737	130
5	Rolando McFadden	45	Portland	OR	5	$2,723	2,056
6	Melvin Singleton	56	Portland	OR	6	$2,716	81
7	Tracie Wise	31	Compton	CA	12	$2,647	137
8	Gretchen Larsen	38	Philadelphia	PA	1	$2,630	2,009
9	Colin Pope	35	Colorado Springs	CO	9	$2,621	118
10	Gina Hull	52	Portland	OR	9	$2,598	108

6. Add a second slicer visual to filter the top 10 customers visual by **Sales Region**.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.
   c) Drag and drop the **Category** column from the **Products** table into the **Values** well.



   d) Reposition the new visual to match the page layout shown in the following screenshot.



Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Rayford Good	55	Erie	PA	1	$3,000	3,000
2	Brett Hines	32	Roswell	NM	10	$2,923	123
3	Clifton Stevens	31	Fort Worth	TX	9	$2,854	110
4	Amado Luna	34	Brooklyn	NY	11	$2,737	130
5	Rolando McFadden	45	Portland	OR	5	$2,723	2,056
6	Melvin Singleton	56	Portland	OR	6	$2,716	81
7	Tracie Wise	31	Compton	CA	12	$2,647	137
8	Gretchen Larsen	38	Philadelphia	PA	1	$2,630	2,009
9	Colin Pope	35	Colorado Springs	CO	9	$2,621	118
10	Gina Hull	52	Portland	OR	9	$2,598	108

7. Add a third slicer visual to filter the top 10 customers visual by **Customer Type**.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.
   c) Drag and drop the **Customer Type** column from the **Customers** table into the **Values** well.

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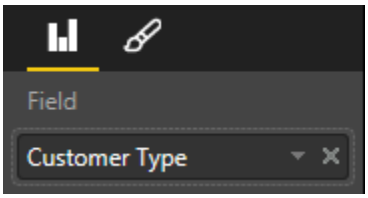
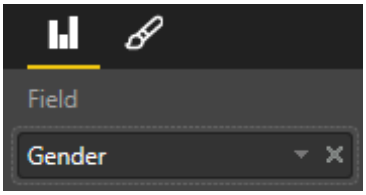
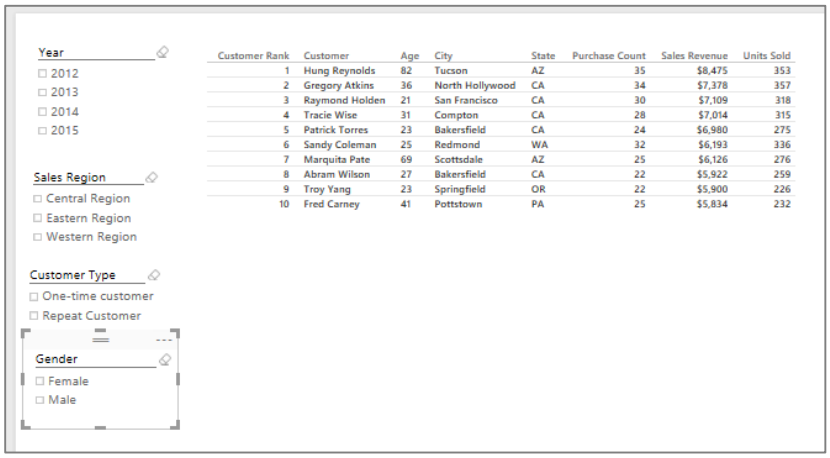


d) Reposition the new visual to match the page layout shown in the following screenshot.

8. Add a fourth slicer visual to filter the top 10 customers visual by **Gender**.
   a) Click the **New Visual** button on the ribbon to add a new visual to the page.
   b) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.
   c) Drag and drop the **Gender** column from the **Customers** table into the **Values** well.



d) Reposition the new visual to match the page layout shown in the following screenshot.



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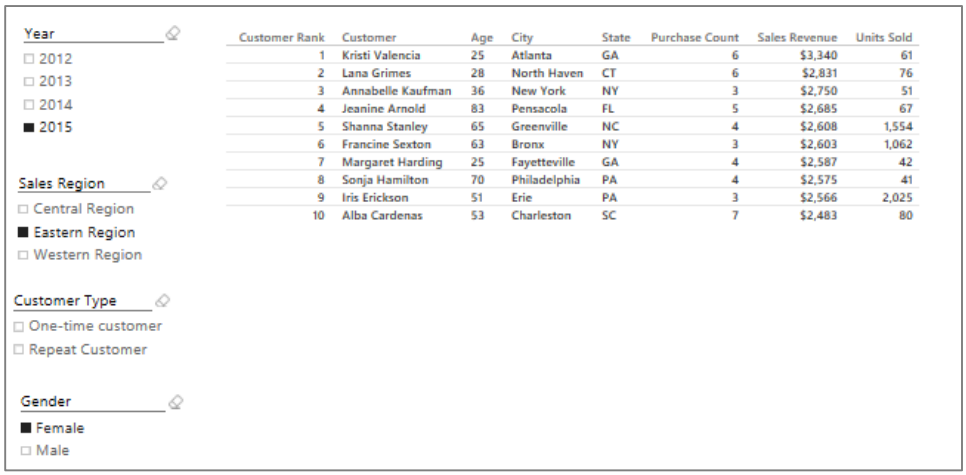
9. Now interact with the slicers on the page to answer the following questions.
   a) Who were the top 10 customers in 2014 who were one-time customers?

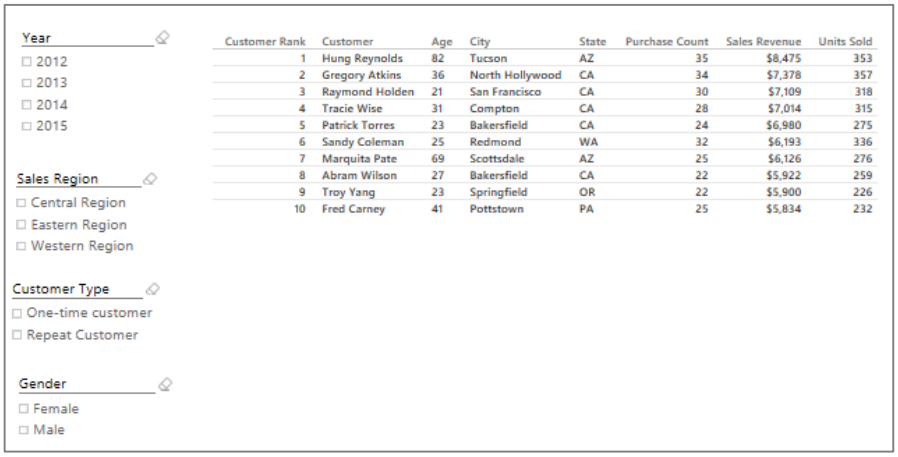
Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Mitzi Franco	71	Tucson	AZ	1	$2,540	2,009
2	Earl Merrill	63	Grand Junction	CO	1	$2,400	2,004
3	Tamra White	32	Riverdale	NJ	1	$2,270	2,009
4	Nelson Bowers	62	Seattle	WA	1	$2,200	2,008
5	Vonda Marks	35	Charlotte	NC	1	$2,140	2,002
6	Bradley Burns	47	Tuscaloosa	AL	1	$2,117	2,009
7	Juliet Bass	62	Clark	NJ	1	$2,104	2,008
8	Quinn Wooten	44	Pittsburgh	PA	1	$2,100	2,100
9	Vickie Wong	48	Birmingham	AL	1	$2,065	2,005
10	Hassan Slater	54	Miami	FL	1	$2,040	2,002
10	Liliana Prince	43	Scottsdale	AZ	1	$2,040	2,002

   b) Who were the top 10 female customers from the Eastern sales region in 2015?



Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Kristi Valencia	25	Atlanta	GA	6	$3,340	61
2	Lana Grimes	28	North Haven	CT	6	$2,831	76
3	Annabelle Kaufman	36	New York	NY	3	$2,750	51
4	Jeanine Arnold	83	Pensacola	FL	5	$2,685	67
5	Shanna Stanley	65	Greenville	NC	4	$2,608	1,554
6	Francine Sexton	63	Bronx	NY	3	$2,603	1,062
7	Margaret Harding	25	Fayetteville	GA	4	$2,587	42
8	Sonja Hamilton	70	Philadelphia	PA	4	$2,575	41
9	Iris Erickson	51	Erie	PA	3	$2,566	2,025
10	Alba Cardenas	53	Charleston	SC	7	$2,483	80

10. Clear the filter on all the slicers on the page so the table shows results for all sales.



Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Hung Reynolds	82	Tucson	AZ	35	$8,475	353
2	Gregory Atkins	36	North Hollywood	CA	34	$7,378	357
3	Raymond Holden	21	San Francisco	CA	30	$7,109	318
4	Tracie Wise	31	Compton	CA	28	$7,014	315
5	Patrick Torres	23	Bakersfield	CA	24	$6,980	275
6	Sandy Coleman	25	Redmond	WA	32	$6,193	336
7	Marquita Pate	69	Scottsdale	AZ	25	$6,126	276
8	Abram Wilson	27	Bakersfield	CA	22	$5,922	259
9	Troy Yang	23	Springfield	OR	22	$5,900	226
10	Fred Carney	41	Pottstown	PA	25	$5,834	232

11. Add a new bar chart to show the sales revenue breakdown for the top 10 customers.
   a) Change the visual to a slicer by clicking the Slicer button in the **Visualizations** list.

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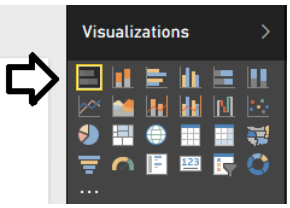
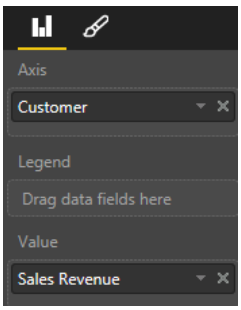
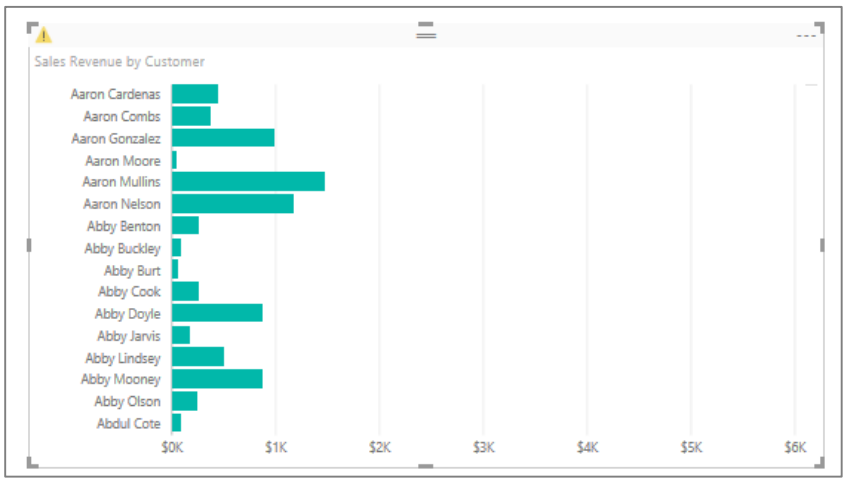


b) Drag and drop the **Customer** column from the **Customers** table into the **Axis** well.

c) Drag and drop the **Sales Revenue** measure from the **Sales** table into the **Values** well.

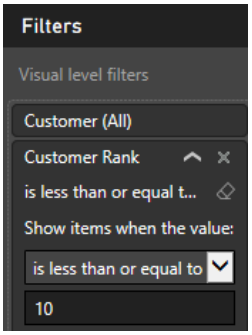


d) At this point, your visual should match the one shown in the following screenshot. Note that the visual currently shows an error because there are too many customers to show them all at once.



e) Drag and drop the **Customer Rank** measure from the **Customers** table into **Visual level filters** well of the **Filters** section.

f) Configure the **Customer Rank** filter to only display customers with a rank of 10 or lower as shown in the following screenshot and then click the **Apply Filter** link to apply the filter to the visual.



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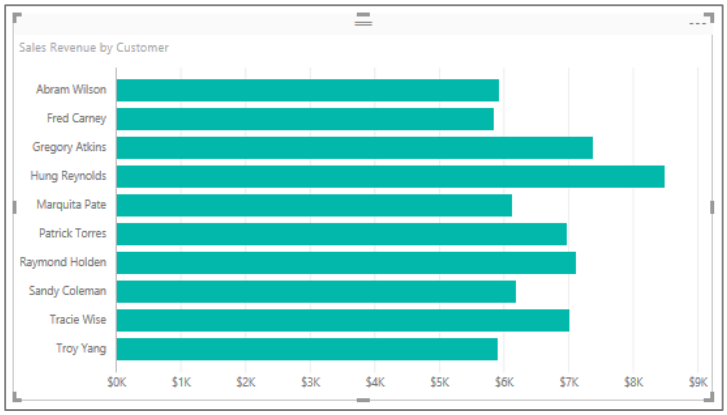
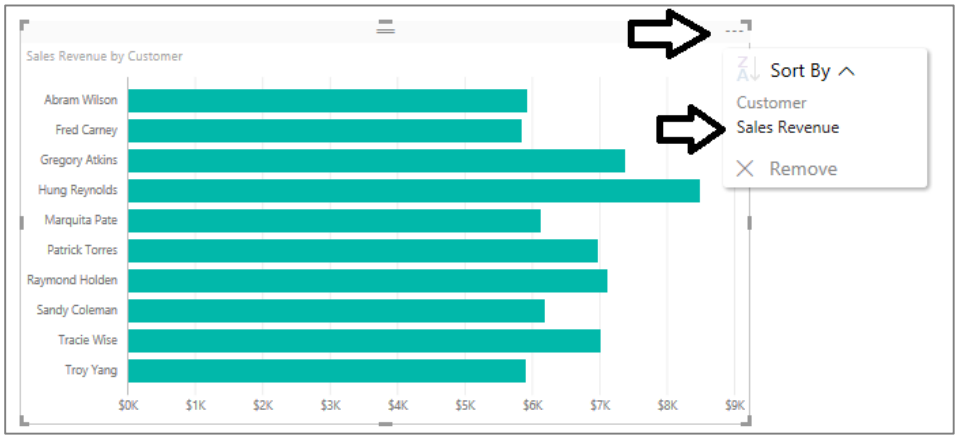
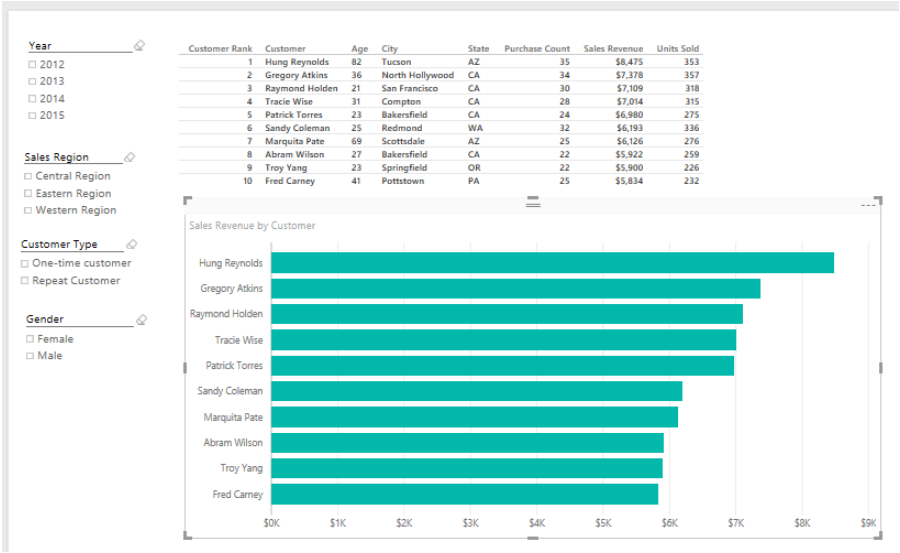
g) The visual should now match the following screenshot.



h) Click the ellipse (**...**) menu at the top, right corner of the visual and select Sort By ^ > Sales Revenue to sort the bars in the bar chart so that customers with the greatest revenue are at the top.



i) The customers in the visual should now be sorted with the greatest amounts of sales revenue at the top. Reposition the new visual to match the page layout shown in the following screenshot.



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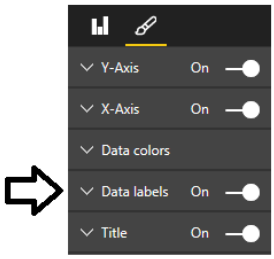
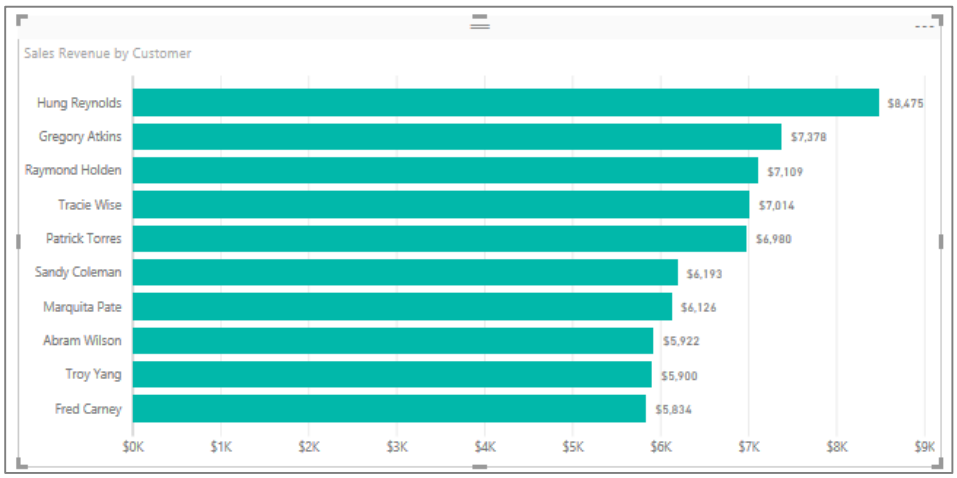
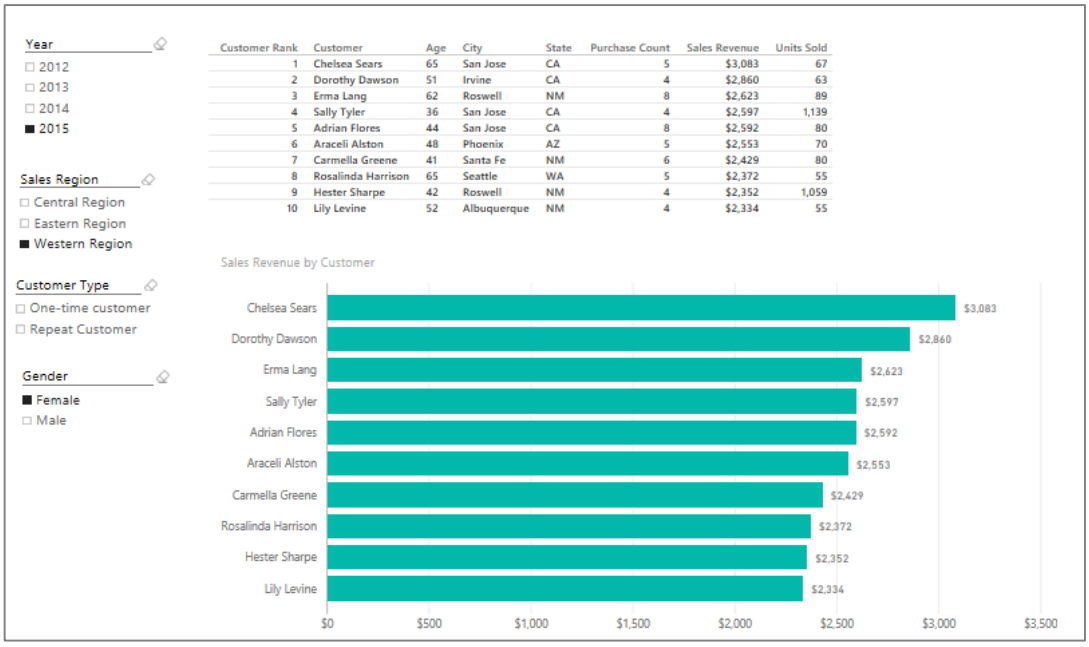
j) Add a small bit of formatting by selecting the bar chart and then changing the **Data labels** property setting from **Off** to **On**.



k) Now the visual should display an individual sales revenue total for each of the top 10 customers.



12. Test you work by using the slicer to select different combinations of years, sales region, customer type and gender. Both the table and the bar chart with the top 10 customers should update together and stay in sync as you change the filter selection.



Customer Rank	Customer	Age	City	State	Purchase Count	Sales Revenue	Units Sold
1	Chelsea Sears	65	San Jose	CA	5	$3,083	67
2	Dorothy Dawson	51	Irvine	CA	4	$2,860	63
3	Erma Lang	62	Roswell	NM	8	$2,623	89
4	Sally Tyler	36	San Jose	CA	4	$2,597	1,139
5	Adrian Flores	44	San Jose	CA	8	$2,592	80
6	Araceli Alston	48	Phoenix	AZ	5	$2,553	70
7	Carmella Greene	41	Santa Fe	NM	6	$2,429	80
8	Rosalinda Harrison	65	Seattle	WA	5	$2,372	55
9	Hester Sharpe	42	Roswell	NM	4	$2,352	1,059
10	Lily Levine	52	Albuquerque	NM	4	$2,334	55

13. Save the work you have done by clicking the Save button in the upper left corner of the Power BI Desktop window.

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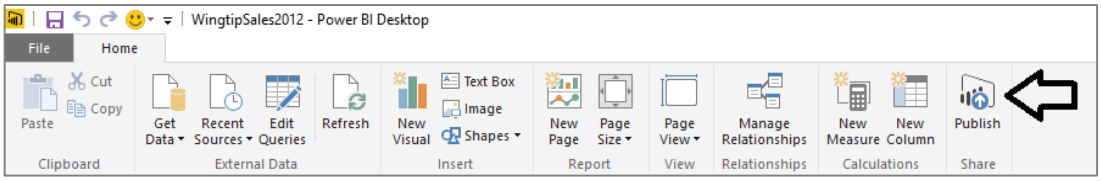
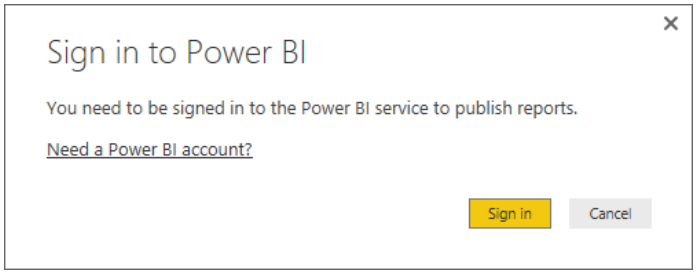
Exercise 5: Publish Your Project and Its Reports to the Power BI Service

In this exercise you will complete your work by publishing the PBIX file to your personal workspace in the Power BI service.

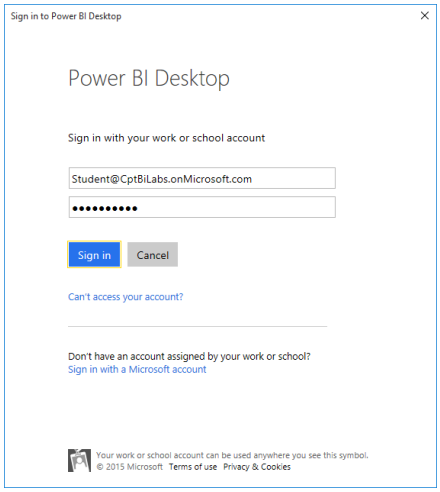
1. Make sure you still have the **WingtipSalesAnalytics.pbix** file open that you created in the previous exercise.
2. Click the **Publish** button on the far right-hand side of the ribbon..



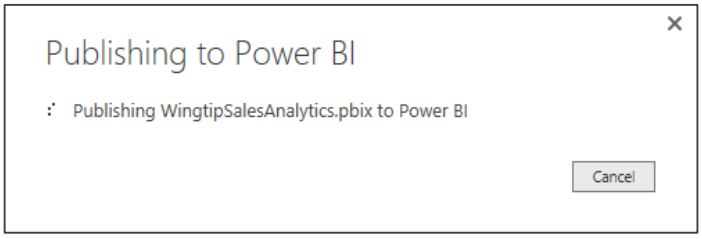
3. When promoted with the **Sign in to Power BI** dialog, click the **Sign In** button



4. Sign into the Power BI service using your primary Office 365 account to give Power BI Desktop the access to publish the PBIX file.



5. After you have signed in, Power BI Desktop will display the **Publishing to Power BI** dialog showing you that the publishing process is underway.



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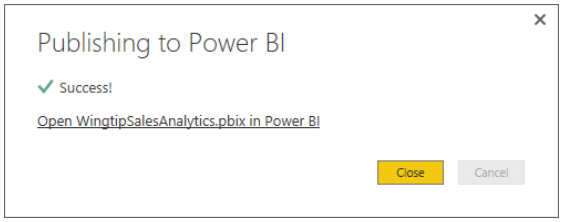
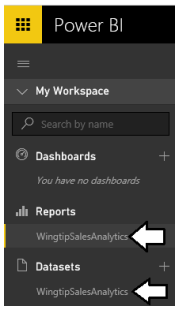
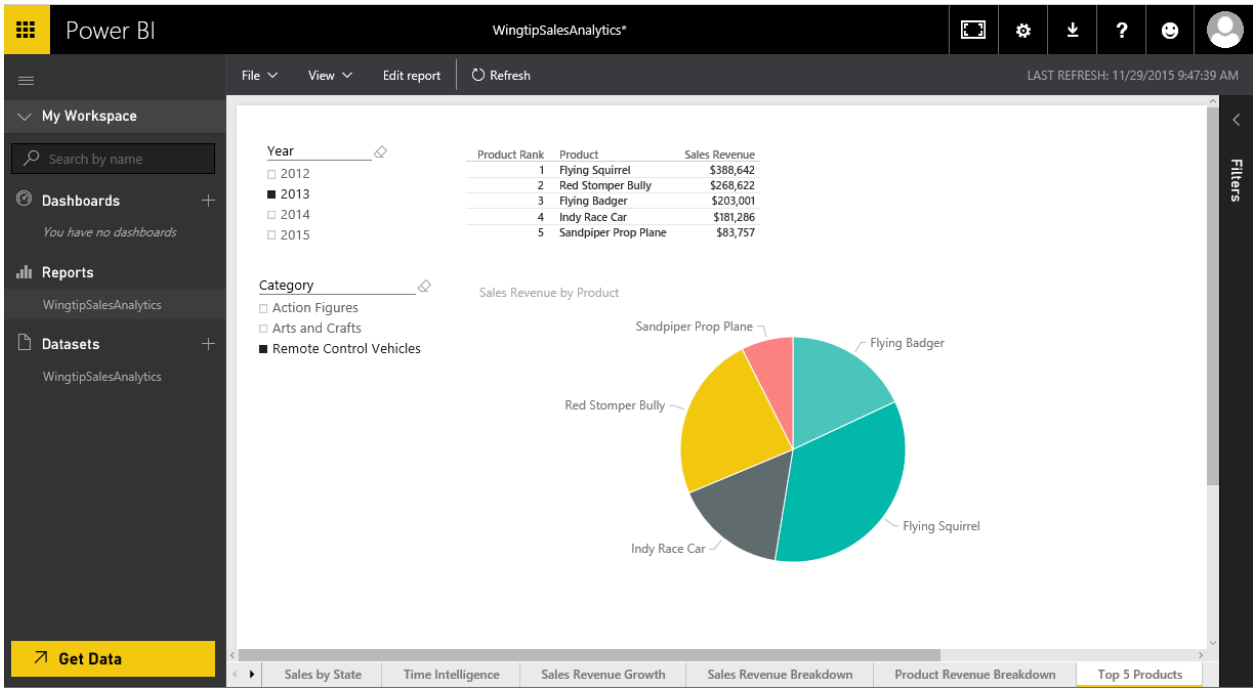
6. Once the publishing process has completed, the **Publishing to Power BI** dialog will display a success message and provide you with a link to **Open WingtipSalesAnalytics.pbix in Power BI**. Click on that link to navigate to the Power BI service using the browser.



7. Once you navigate to the Power BI service in the browser, you should be able to see that the publishing process added a dataset and a report named **WingtipSalesAnalysis** that appear in the left navigation along with any other datasets and reports that were already part of your personal workspace.



8. Inspect the various report pages that you created over the last few labs.



You have now successfully created and published your **WingtipsalesAnalysis.pbix** project using Power BI Desktop. In the next lab you will begin to consolidate the visuals you have created in these report pages into dashboards and you will also learn the various techniques you can use to deploy dashboards and share them with various groups of Office 365 users.

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