



# K2's Advanced Topics In Power BI



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# Learning Objectives



Upon completing this session, you should be able to:

- List the steps necessary to create formulas using Data Analysis Expressions (DAX)
- Identify the importance of Key Performance Indicators (KPIs)
- Apply appropriate security techniques to your Power BI reports and dashboards
- Identify the purpose of Apps in the context of Power BI



***BUT FIRST, IT'S ALWAYS ABOUT THE DATASET!***



## “Fact” Tables And “Dim” Tables

- Generally, **“fact” tables contain the numerical data we wish to summarize**, such as sales transactions, hours recorded, and disbursements for expenses
- On the other hand, **“dim” tables contain the categories by which we want to summarize the data in the fact tables**
  - Examples, include dates, product lines, accounts, vendors, customers, etc.
- Consider the example of data that you might query into Power BI from an accounting application...

# “Fact” Tables And “Dim” Tables



- You should seek to construct your dim tables so that they contain as few columns as necessary to accomplish you mission
- If you mix dissimilar information in the same dim table, it will become increasingly difficult to manage your data models
- Let’s see the example on the following slide...

# “Fact” Tables And “Dim” Tables



Account Number	Account Name	Department ID	Department Name
6010	Advertising Expense	10	Retail
6010	Advertising Expense	20	Wholesale
6010	Advertising Expense	30	OEM
6010	Advertising Expense	40	Corporate
6020	Amortization Expense	10	Retail
6020	Amortization Expense	20	Wholesale
6020	Amortization Expense	30	OEM
6020	Amortization Expense	40	Corporate
6030	Bad Debt Expense	10	Retail
6030	Bad Debt Expense	20	Wholesale
6030	Bad Debt Expense	30	OEM
6030	Bad Debt Expense	40	Corporate

Account Number	Account Name
6010	Advertising Expense
6020	Amortization Expense
6030	Bad Debt Expense

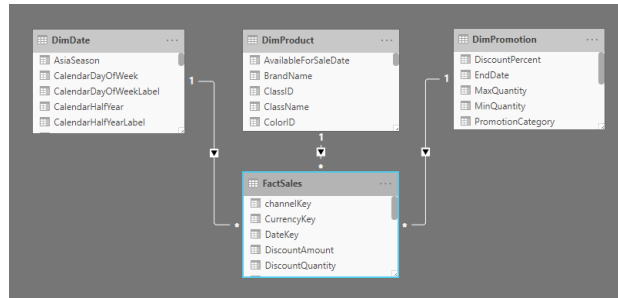
  

Department ID	Department Name
10	Retail
20	Wholesale
30	OEM
40	Corporate

# “Star” Vs “Snowflake” Schema



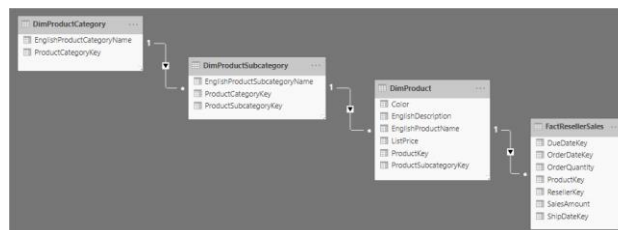
- “Star” schemas position the fact table at the core of the dataset, with individual dim tables linking directly to the fact table



# “Star” Versus “Snowflake” Schema



- “Snowflake” schemas position often “daisy-chain” several dim tables together before linking to the fact table



## “Star” Versus “Snowflake” Schema



- As a rule, a star schema is strongly preferred because it provides better performance
- This comes as a result of having fewer joins between the various tables in the dataset
- As a result, **queries and calculations typically run faster in the star environment** than in the snowflake environment
- Further, **star schemas are typically easier to modify**, such as when you need to add another table to the dataset

## Import Vs. Direct Query Mode

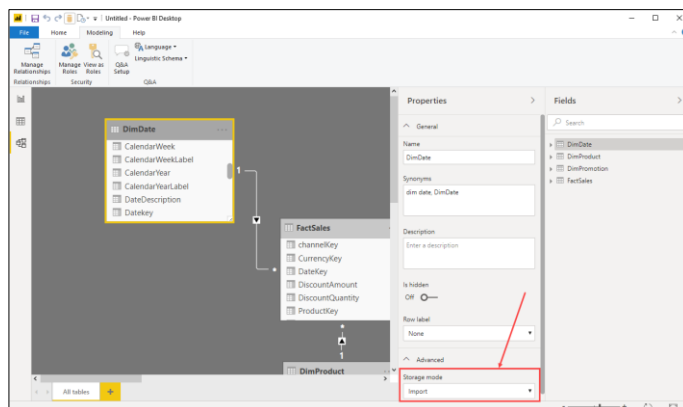


- When linking data into a Power BI dataset, you have two options for accessing the data – **Import** and **Direct Query**
- **Import loads the data to the dataset** in Power BI
  - Once imported, **you can refresh the data on demand; you can also set scheduled refreshes** in Power BI Service
  - Import is limited to 1 GB file size
- **Direct Query does not load any data into the dataset; instead in queries data in real-time** from the data source
  - **Direct Query is typically used when accessing data from large databases**

# Import Vs. Direct Query Mode



- **Import is the default setting**, but you can change that if necessary
- Go to **Storage Mode** to make the change
- Also note the **“Dual” option available in Storage Mode**



# Power BI And Gateways

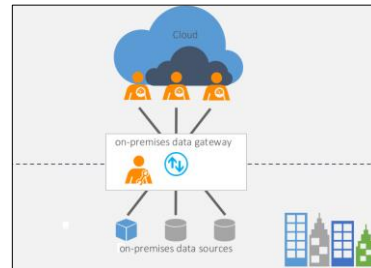


- Gateways are one of the most misunderstood features of Power BI
- **A gateway facilitates connections between local data sources and Power BI Service**
  - A gateway ***is necessary*** when maintaining the link between a local data source and Power BI service
  - A gateway ***is not necessary*** to maintain a link between a local data source and Power BI Desktop
  - A gateway ***is not necessary*** to maintain a link between a cloud-based service and Power BI.com

# Power BI And Gateways



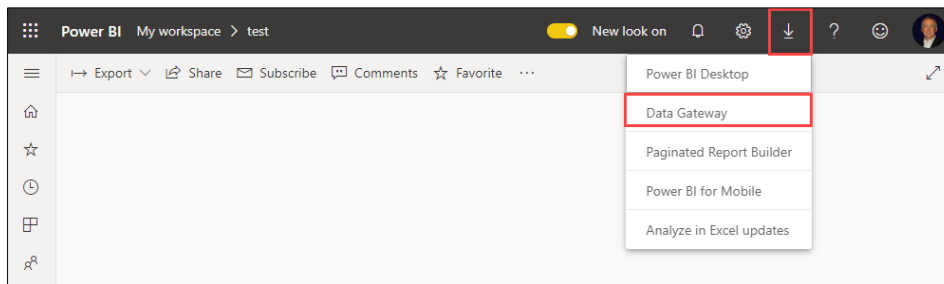
- Microsoft offers two options for gateways
  1. **Personal Gateway** – used if you are working independently and other users will not need access to the data; this version does not support Direct Query
  2. **Enterprise (a/k/a Standard) Gateway** – used if multiple users will need access to the data; this version supports both Import and Direct Query
- You can download your gateway at <https://powerbi.microsoft.com/en-us/gateway/>



# Managing Your Gateways



- You can manage your gateways from within Power BI Service
- To do so, **click the arrow near the top, right corner of the Power BI window**

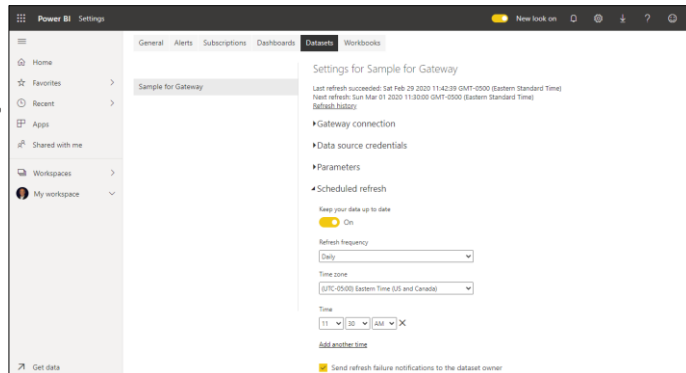




# Managing Your Gateways



- You can also **schedule refreshes using your Gateway**
- Up to **eight refreshes per day** can be scheduled using the gateway



# Adding Your Own Data To Power BI



- On occasion you may need to **add your own data to a dataset** in Power BI
- If that need arises, you can create a user-defined table in Power BI
- To do so, **from the Home tab click Enter Data** to initiate the process of adding a user-defined table in Power BI
- Once you add the table and populate it with data, it will be treated like any other table in Power BI and you can relate it to other tables
- Be aware however, **data in the table cannot be edited**, although you can **use the Replace Values feature of Power Query to modify it**



## ***CREATING FORMULAS IN POWER BI WITH DATA ANALYSIS EXPRESSIONS***

## Data Analysis Expressions



- **Data Analysis Expressions (DAX) is a library of approximately 300 functions that you can use to create user-defined calculations** in your Power BI datasets
  - You can also use DAX in Excel data models, Azure Analysis Services, and SQL Server Analysis Services
- DAX formulas in some ways resemble Excel formulas, but in many ways the functions used are different
- Visit <https://k2e.fyi/daxfunctions> for a complete listing of all options

# Data Analysis Expressions



- Functions that are the same in DAX as in Excel include:
  - **AVERAGE, AVERAGEA, COUNT, COUNTA, MAX, MIN, PRODUCT, and SUM**
- **Functions that are similar in DAX to Excel counterparts include:**
  - **TEXT** in Excel is **FORMAT** in DAX
  - **SUMIFS** in Excel is **CALCULATE** in DAX
  - **CHOOSE** in Excel is **SWITCH** in DAX
  - **VLOOKUP** in Excel is **RELATED** in DAX

# DAX & Calculated Columns



- Let's use DAX to add a new **calculated column** to a dataset using the **ROUND** function
- Once we add this column, we can use the data as if it were "native" to the underlying dataset
- Let's begin by right-clicking in the fields pane, followed by choosing **New Column**
- Then we will enter the following formula  
**AverageRev = Round(Data1[Net Revenue]/Data1[Hours] ,2)**

# DAX & Calculated Measures



- **A measure is a single calculation, like an Excel formula stored in a cell** in a traditional workbook
- For example, **you could create a measure to summarize total sales, payroll, etc.**
- To create a measure, right-click on a table in the Field pane and choose **New measure**
- The enter a formula such as  
**AverageRev = SUM(Data1[Net Revenue])/SUM(Data1[Hours])**



## ***KEY PERFORMANCE INDICATORS***

# Key Performance Indicators



- Microsoft defines **Key Performance Indicators (KPIs)** as **“a visual cue that communicates the amount of progress made toward a measurable goal”**
- Examples of KPIs could include
  - Progress of sales team members toward quotas
  - Measuring a company’s financial performance against expectations, including budget vs. actual comparisons, comparisons to competitors, comparisons to industry, etc.
  - Relating customer/client measurements such as Net Promoter Scores and customer surveys to established objectives

# KPIs In Power BI



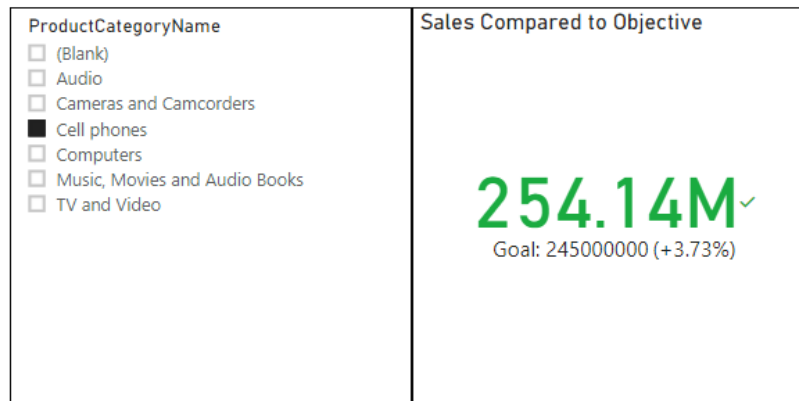
- You can **add KPIs to Power BI reports and dashboards rather easily** and **if you know how to do this in Excel, then you are well on your way to success with KPIs in Power BI**
- KPIs have three components
  1. A **base value** that represents the “actual” data
  2. A **target value** that represents the objective
  3. The **KPI visualization** that shows the comparison
- Let’s create a KPI that shows progress toward meeting sales objectives, by product category...

## Our Steps To Add A KPI...



1. To the dataset, **add a table that includes the target values for each Product Category**
2. For the ProductCategoryName field, **add a Slicer**
3. Drag the **SalesAmount** field to the canvas
4. Change the visualization to a **KPI** and customize the visualization by **adding the FiscalYearLabel** field from the **DimDate** table to the **Trend** axis and the **2020 SalesTarget** field from the **2020SalesTargets** table to the **Target** goals field

## The Finished KPI



# An Alternative Presentation...



Audio Sales Compared to Objective <b>52.85M!</b> Goal: 55000000 (-3.91%)	Cameras and Camcorder Sales Compared to Objective <b>868.52M!</b> Goal: 955000000 (-9.06%)	Cell Phone Sales Compared to Objective <b>254.14M✓</b> Goal: 245000000 (+3.73%)
Computer Sales Compared to Objective <b>987.72M!</b> Goal: 1200000000 (-17.69%)	Music, Movies, and Audio Books Sales Compared to Objective <b>53.18M✓</b> Goal: 45000000 (+18.18%)	TV and Video Sales Compared to Objective <b>472.16M!</b> Goal: 527500000 (-10.49%)



## ***ADDING ADDITIONAL VISUALIZATION OPTIONS***

# What If You Want More Choices



- Power BI offers **approximately 25 visualization choices natively**
- However, if you have a need for a visualization that in the as-delivered environment, you can go to Microsoft's AppSource and download custom visualizations
- Some of these are free, some are "freemium," and some are for purchase

## Examples In AppSource

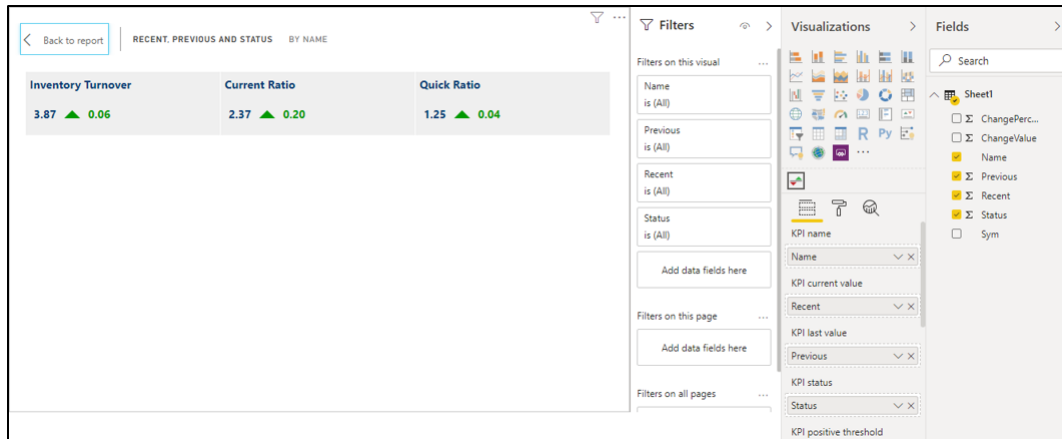
The screenshot displays the Microsoft AppSource interface for Power BI custom visualizations. At the top, there are filters for 'Trials', 'Pricing Model', and 'Ratings', all set to 'All'. Below the filters, there are tabs for 'Power BI visuals' and 'Add-Ins'. The main content area shows 'App results (254)' with a grid of visualization cards. Each card includes a thumbnail, title, author, description, rating, and a 'Get it now' button. The visible cards are:

- Individuals and Moving Range Control Chart by PQ Systems**: An SPC chart for analysis of process stability and variability where the sample size is one. Rating: 5 stars (1). Free.
- Growth Rate Combo Chart by Djeeni**: Line and column chart displaying the percentage differences between the selected column. Rating: 5 stars (1). Free.
- Individuals Control Chart by PQ Systems**: An SPC chart for analysis of process stability where the sample size is one. Rating: 5 stars (3). Additional purchase may be required.
- Ultimate Stacked**: The Ultimate Stacked Chart can show bars, columns, lines and small multiples. Rating: 5 stars (3). Additional purchase may be required.
- Candlestick by OKViz**: This visual is designed to present stock data, using a specialized chart made of several candles. Rating: 5 stars (5). Free.
- Zebra BI Charts**: One visual, many charts. Waterfall, variance, column, area, line, dot, combo... in small. Rating: 5 stars (25). Additional purchase may be required.
- KPI Ticker by MAQ Software**: Display multiple key performance indicators (KPIs) in an automatically rotating visual. Rating: 5 stars (17). Free.
- Dynamic Tooltip by MAQ Software**: Enhance readability of reporting charts by providing additional data points as tooltips. Rating: 5 stars (23). Free.





# Example Created With KPITicker



## *THE ROLE OF APPS IN POWER BI*

## What Is A Power BI App?



- ***An app is a Power BI content type that **combines related dashboards and reports, all in one place. An app can have one or more dashboards and one or more reports, all bundled together...*****
- ***Apps are an easy way to share different types of content at one time. App designers create the dashboards and reports and bundle them together into an app...***
- ***With apps, whenever the app author releases updates, you automatically see the changes. The author also controls how often the data is scheduled to refresh, so you don't need to worry about keeping it up to date.***

## If You Are The Designer...

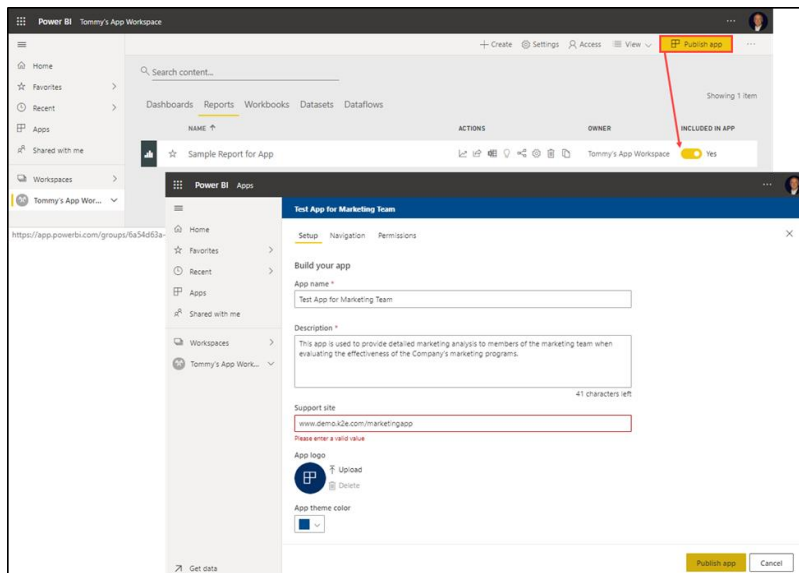
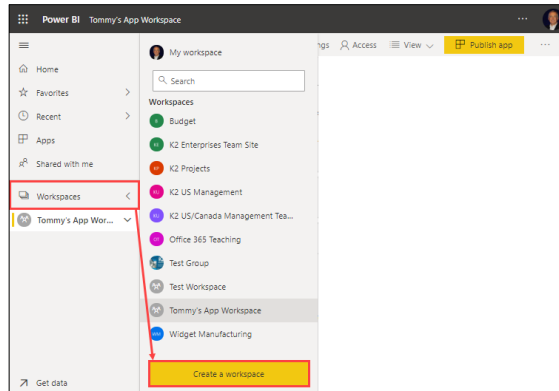


- **You can distribute Power BI reports and dashboards through apps**
- **You can also use apps to control which team members have access...this, of course, helps you to stay in control of disseminating critical – and potentially sensitive – data throughout your organization**
- **You must have a Power BI Pro license to create an app**
- **Also, your users must have Power BI Pro licenses to access and utilize the apps you distribute**
  - **However, these licenses are not required of end users if the content is in a Power BI Premium account**



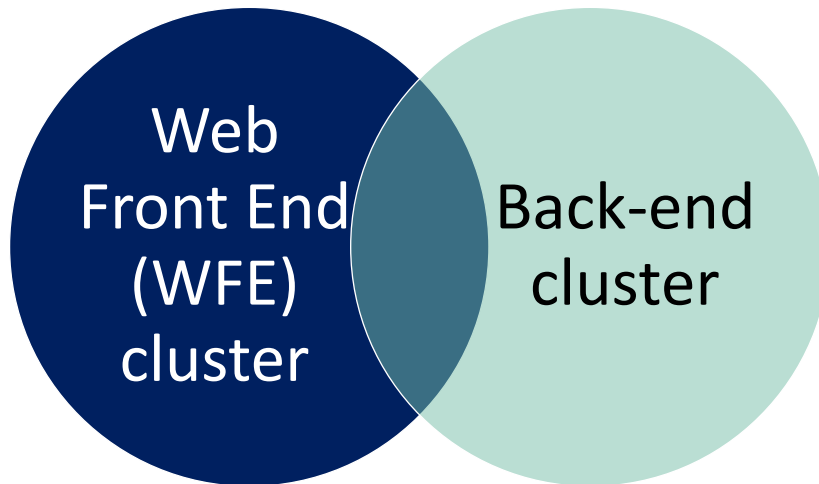
## If You Are The Designer...

- To create an app, you must first create an app workspace
- You can add other users to your app workspace
- You can also address security issues in the app workspace



## Publishing An App

## Two Security Methods In Power BI



## Web Front End Cluster



The WFE manages the initial connection and log-in to Power BI

From an end-user standpoint, there is very little to do here, other than log-in to your Power BI account

# Back-End Cluster Security Tools



- In the Back-End Cluster, **you can enable Row-Level Security (RLS) in Power BI to control what data each user can see**
- **Notably, RLS works only in Power BI Service**
  - However, you set up RLS partially in Power BI Desktop

# Five Steps To Setting Up RLS In Power BI



Set up Roles in Power BI for each of your user groups

Add a DAX expression to filter the data for each Role that you establish

Validate each Role in Power BI Desktop to ensure it is working as intended

Add members to each Role, as appropriate

Test and validate each role in Power BI Service



## ***IMPROVING PERFORMANCE IN POWER BI REPORTS AND DASHBOARDS***



### **If You Import Your Data...**

Keep the size of the dataset as small as possible using one or more of the following techniques

- **Remove unnecessary rows and columns** as part of the query function
- **Consider summarizing data prior to importing it...**do you need every sales transaction, or would a daily summary suffice?
- **If possible, load numeric info instead of text** because Power BI stores that information more efficiently
- **Consider using the Dual or Mixed mode** instead of Import or Direct Query

## If You Use Direct Query...



- **Ensure the integrity of the relationships in the source data...**if you have unrelated records between a fact and dim table, performance can be affected
- **Add indexes on tables** to optimize load speeds
- **Consider adding transformations** to the data to reduce the number of DAX functions
- **Minimize relative data filtering**, such as “last year” ...using absolute date filters such as “09/01/2020” is more efficient

## If You Use Direct Query...



- **Always use the simplest measure** possible to avoid unnecessary calculation times
- **Hide the one-side column of a one-to-many relationship to reduce the number of tables** from which values are used in a visualization
- **Apply filters before you create visualizations** of large datasets
- Also, for large datasets, **consider disabling cross-filtering and recognize that filters based on measures, TopN filters, and multi-select Slicer filters can adversely affect performance**

# Summary



- Creating simple reports and dashboards in Power BI is easy!
- However, **adding layers of sophistication and security to reports and dashboards is where many users stumble**
- That need not be the case!
- As you've seen in this session, **you can easily address many of the advanced issues surrounding Power BI** and get past some of the stumbling blocks of the past
- **This is where you'll begin to realize the largest ROI on your Power BI investment and efforts!**



***THANK YOU!***