Data Exploration with Power BI

Slides cedidos pela Microsoft Portugal para uso nas aulas do ISEG

Ana Claro (anaclaro@microsoft.com)

Microsoft Power BI

Slides cedidos pela Microsoft Portugal para uso nas aulas do ISEG

Jan Tielens

Tech. Evangelist at Microsoft Belux

Presentation outline

01: Microsoft Power BI overview

02: Working with the Power BI service

03: Connecting to Power BI data sources

04: Creating Power BI Desktop solutions

06: Summary

A new generation of BI

Today, BI extends to everyone

3rd wave
End user BI

2nd wave
Self-service BI

1st wave
Technical BI

Everyone

Analyst to end user

IT to end user

A new generation of BI

Turning data into business insights is challenging

Common BI challenges include…

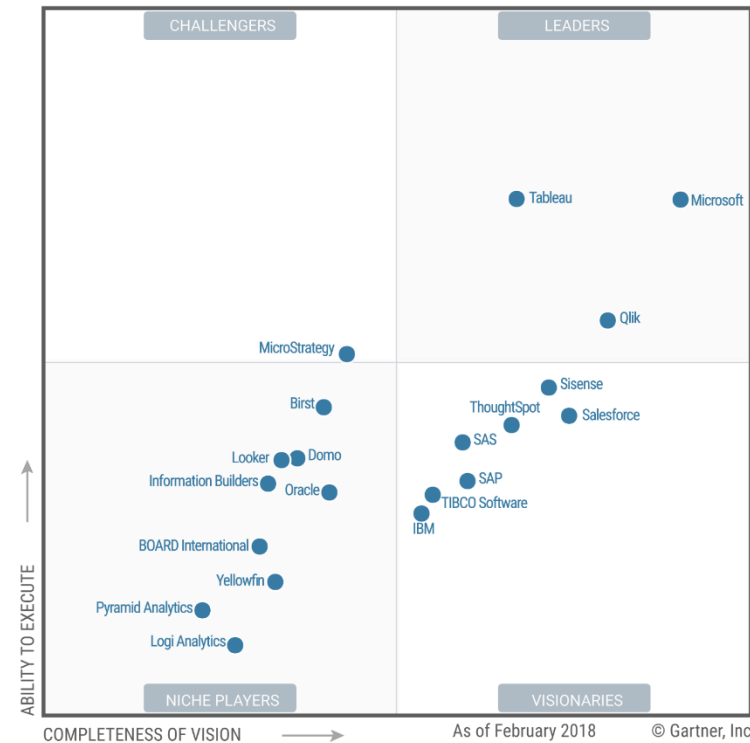|	
👁 **End-to-end view**	Data often resides in disparate locations, making it difficult to see a complete picture of your business
🏢 **Multiple data sources**	Data residing in SaaS solutions, and other external locations, is difficult to access and refresh securely
➡ **Right data for the right users at the right time**	Different roles have different needs, and business users need the latest operational data

Gartner®

A Leader in the Magic Quadrant for BI & Analytics*

CHALLENGERS | LEADERS

- Tableau
- Microsoft
- Qlik
- MicroStrategy
- Sisense
- Birst
- ThoughtSpot
- Salesforce
- Looker
- Domo
- SAS
- Information Builders
- Oracle
- SAP
- TIBCO Software
- IBM
- BOARD International
- Yellowfin
- Pyramid Analytics
- Logi Analytics

ABILITY TO EXECUTE

COMPLETENESS OF VISION   As of February 2018   © Gartner, Inc

NICHE PLAYERS | VISIONARIES

Introducing Microsoft Power BI

Experience your data. Any data, any way, anywhere.

Power BI is a cloud-based business analytics service that enables:

- Fast and easy access to data
- A live 360º view of the business
- Data discovery and exploration
- Insights from any device
- Collaboration across the organization
- Anyone to visualize and analyze data
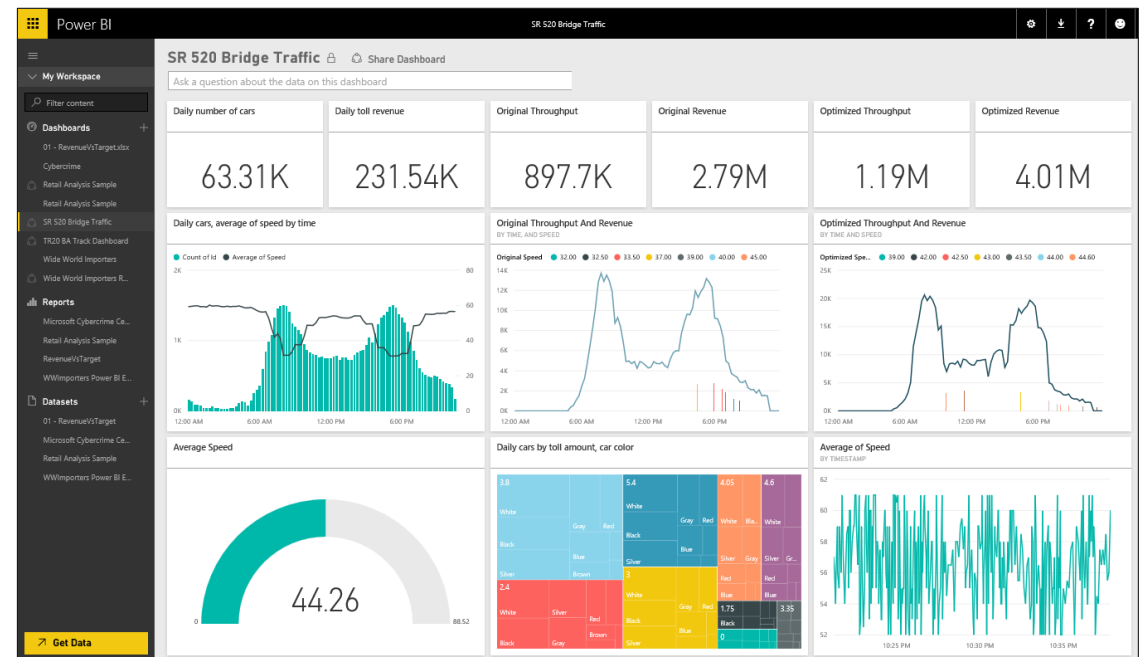
Power BI

Introducing Microsoft Power BI

Key benefits and differentiators

Pre-built content packs, consisting of dashboards and reports, for popular SaaS solutions

Real-time dashboard updates

Secure, live connection to your data sources, on-premises and in the cloud

Intuitive data exploration by using natural language query

Integration with familiar Microsoft products, and commitment for scale and availability in Azure

Fast deployment, hybrid configuration, secure, and integrated with existing IT systems

Power BI overview

Data sources

SaaS solutions
E.g. Marketo, Salesforce, GitHub, Google analytics

On-premises data
E.g. Analysis Services

Organizational content packs
Corporate data sources, or external data services

Azure services
E.g. Azure SQL, Stream Analytics

Excel files
Workbook data or data models

Power BI Desktop files
Related data from files, databases, Azure, and other sources

Power BI service

Content packs

Live dashboards

Visualizations

Reports

01001
10101 Datasets

Data refresh

Natural language query

Sharing & collaboration
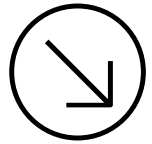
Key takeaways

- Power BI is a cloud-based business analytics service, delivering end user BI
- Power BI delivers numerous benefits and differentiators
  - Pre-built content packs
  - Real-time dashboard updates
  - Live connections to on-premises and cloud data sources
  - Intuitive data exploration by using natural language query
  - Integration with familiar Microsoft products and services
  - Fast deployment, hybrid configuration, secure, and integrated with existing IT systems
- Microsoft is placed furthest in vision within the **BI and Analytics Platform** Leaders quadrant

Power BI benefits by role

Whatever the role, Power BI brings all data together

Business user
- Import data from SaaS sources, and work with dashboards and reports

Business analyst
- Import, reshape and model data
- Create compelling reports and visualizations
- Create content packs to share insights

BI professional
- Connect to live Azure data services
- Connect to on-premises Analysis Services databases
- Empower colleagues to create their own reports

Developer
- Integrate applications with Power BI
- Create real-time dashboards
- Develop custom visuals

Experience your data in new ways

"Hey Cortana, show me my sales opportunity"
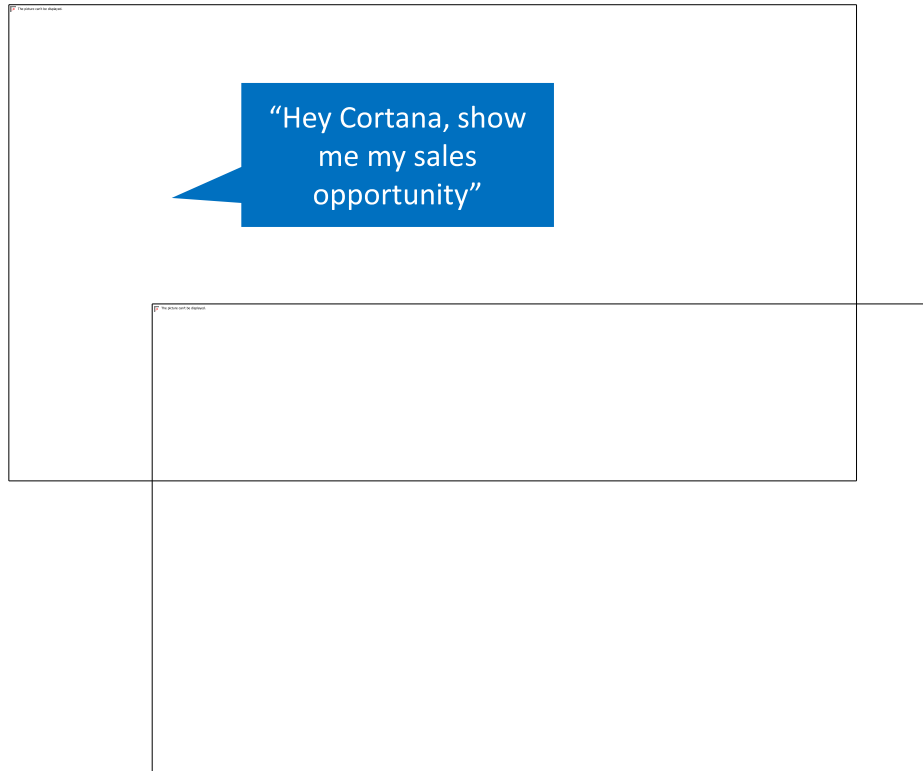
→ Natural language query—ask questions of your data more naturally

- Type questions in plain language – Power BI Q&A will provide the answers

- Q&A will provide suggested questions, terms and visuals for your dataset

- Q&A intelligently filters, sorts, aggregates, groups, and displays data based on the question

- Pin the answers to your dashboard

- Add your own suggested questions to dataset, e.g. frequently asked questions

→ Cortana integration—allows you to access your data from Windows 10

→ Quick insights—auto discover patterns and insights in your data

Seamless integration with Office 365
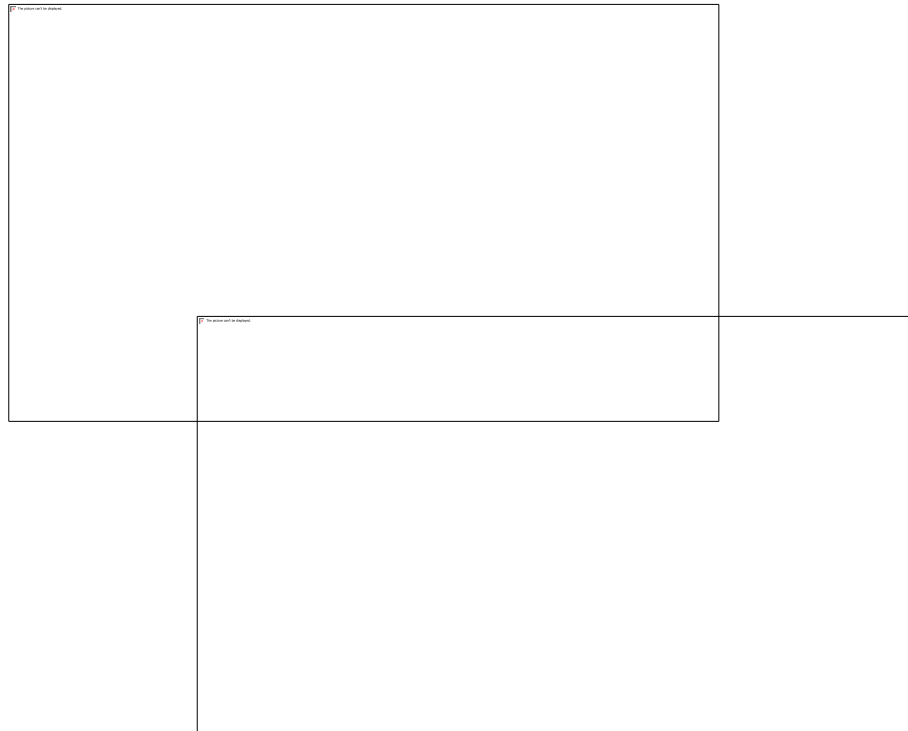
→ Team collaboration through support for Office 365 Groups

→ Seamless navigation to other workloads in Office 365

→ Use Excel data and pin live charts to your Power BI dashboards

→ View Excel spreadsheets through support for Excel Online

See your data the way you want it
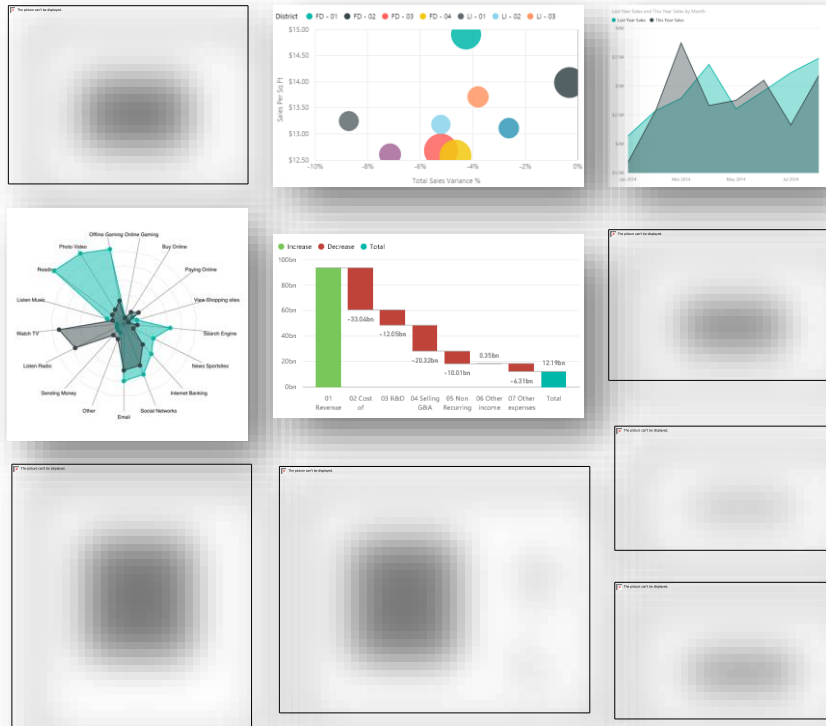
→ Visualize data in a variety of ways

→ Growing number of visualization types

Donuts, basic area, waterfall, filled maps, tree maps, funnel, gauges combo charts and more

Custom visuals available from Power BI Visuals Gallery (visuals.powerbi.com)
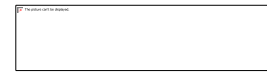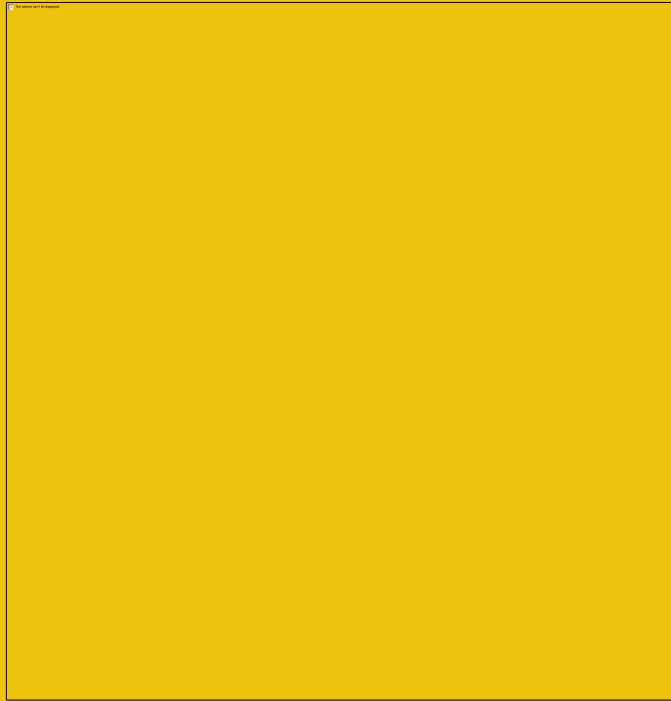
Tools to develop, test, package new custom visuals

→ Visualizations on report page are connected – select value in one visualization to change other visualizations

→ Full screen pop out mode for report visuals to show additional details

Get started quickly

Pre-built solutions include dashboards, reports, and data models available out-of-the-box for SaaS services or built by your organization

Marketo

intuit QuickBooks

SendGrid

GitHub

Microsoft Dynamics CRM

zendesk

Visual Studio Online

twilio

MailChimp

Dynamics Marketing

appfigures

Google Analytics

SQL SENTRY

Adobe Analytics

Sweet IQ

Azure Audit Logs

salesforce

Microsoft Dynamics NAV

Azure Mobile Engagement

Application Insights

SQL Database Auditing

Power BI Components
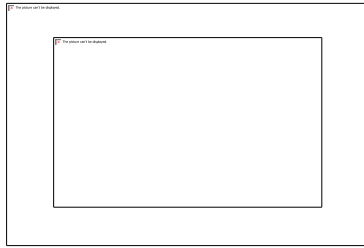
Power BI Desktop is a free companion authoring and ad-hoc data exploration tool for data analysts and developers
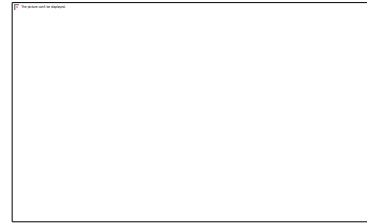
Power BI Service to share and collaborate through the organization
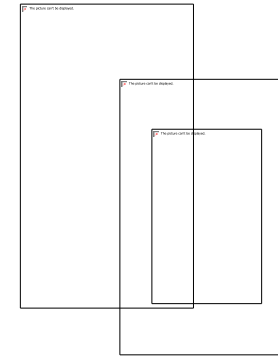
Power BI Native apps for iPad, iPhone, Android and Windows devices

Seamless integration across the Microsoft Data Platform provides quicker and more cost effective deployment for any data project

Data Warehouse

Internet of Things

Big Data

Advanced Analytics

Resources

Power BI site

- http://powerbi.microsoft.com

Power BI documentation

- http://support.powerbi.com/

Power BI community

- http://community.powerbi.com/

Power BI blog

- http://blogs.msdn.com/b/powerbi/

Tip: Power BI is evolving at a rapid rate.
One of the best ways to keep pace with updates is
to subscribe to the Power BI blog.

Introducing the Power BI online service

The Power BI online service offers a simple, intuitive experience for interacting with data

The service and features have been designed to:

- Simplify engaging with data from heterogeneous sources
- Fuel faster, more insightful business decisions
- Deliver a rich, consolidated view of key information, no matter where the underlying data is stored
- Share data insights

Introducing the Power BI online service

Continued

Users engage with the service by using a supported web browser, or mobile application

- Microsoft Edge
- Internet Explorer, 10 or 11
- Chrome desktop, latest version
- Safari Mac, latest version
- Firefox desktop, latest version

Note: Mobile applications will be covered later in this module
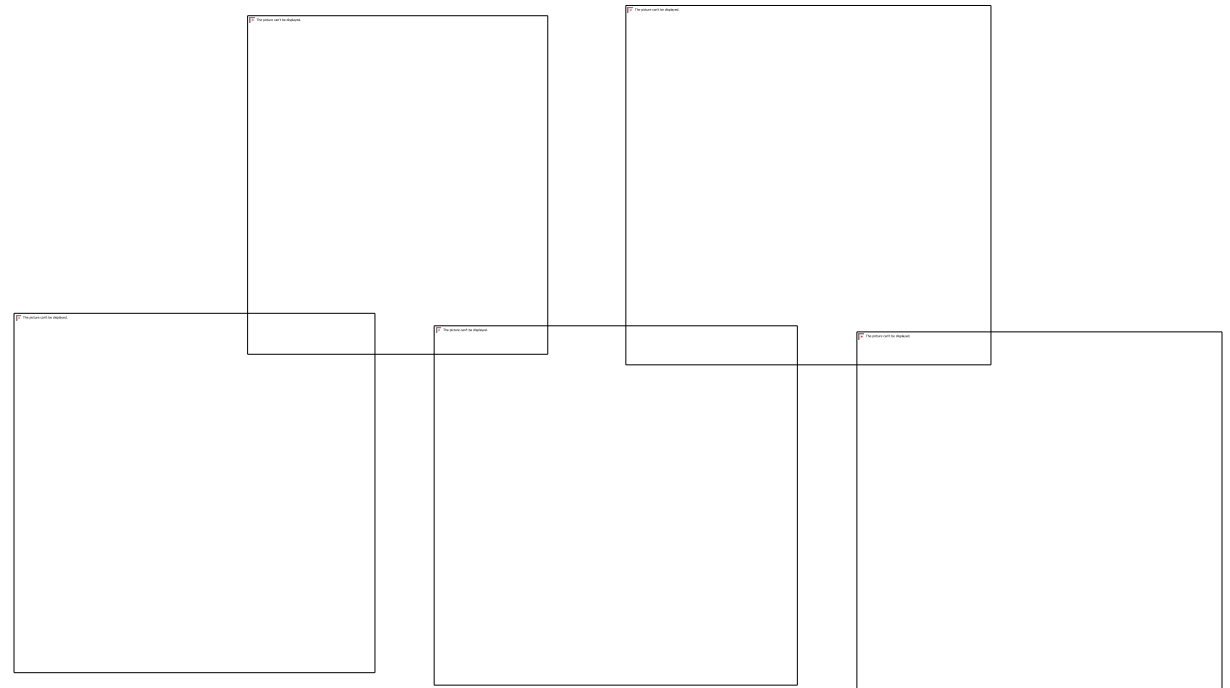
Introducing the Power BI online service

Continued

Users typically work with Power BI "building blocks":

- Datasets
- Reports
- Dashboards

Use the **Navigation Pane** to create, or select items of interest

Note: Creating and managing datasets will be covered in the next module
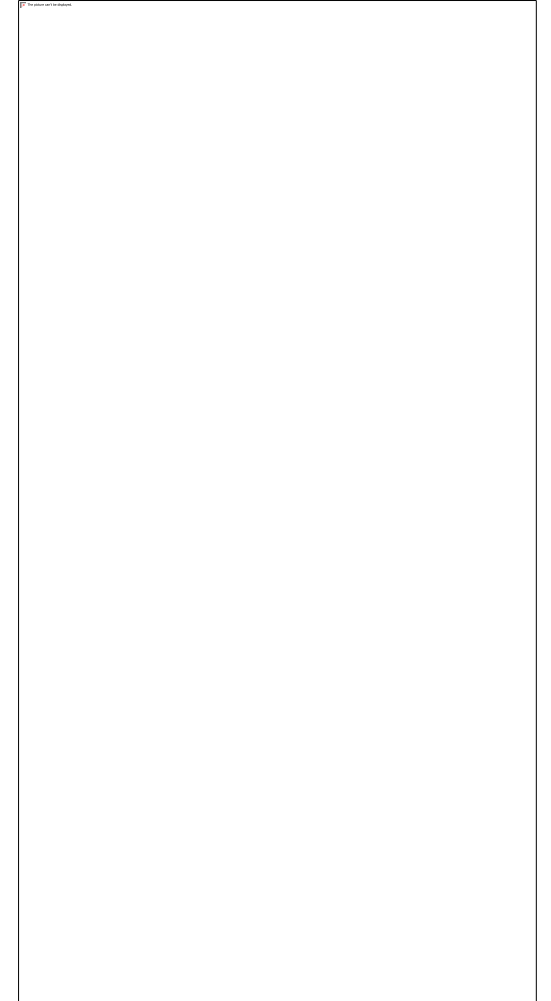
Creating and exploring reports

Creating reports

Use reports to layout visualizations across one or more pages

Rich, interactive reports can be created, updated and explored in the web browser experience

- A report is based on a single dataset
- Reports consist of one or more pages
- Each page can be named, and consists of visualizations and shapes
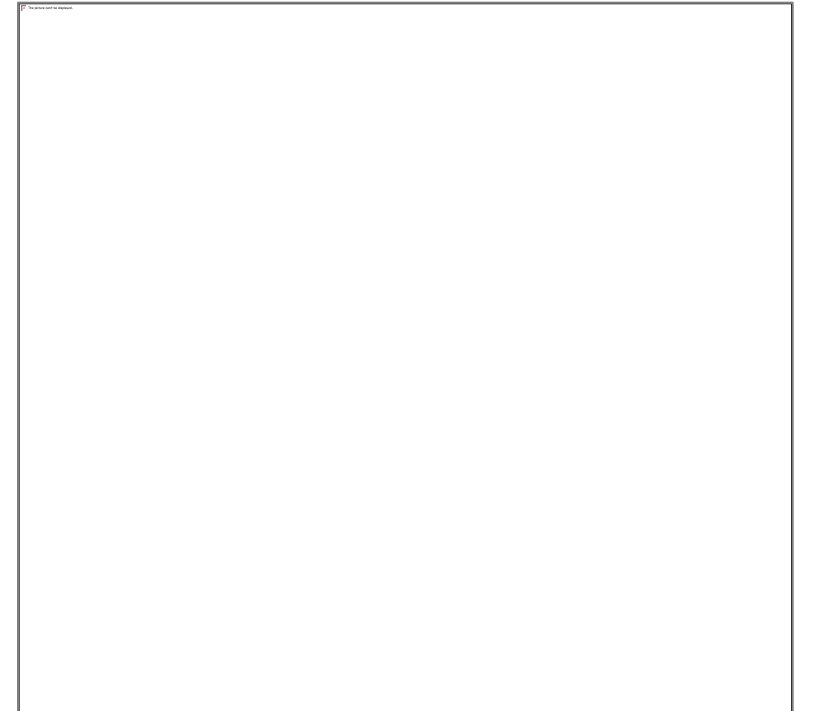
Creating and exploring reports

Creating reports

Dataset fields are used to layout a visualization

- Visualization type and format can be adjusted to suit

Filtering can be applied at report, page or visualization level

Sorting can be set at visualization level
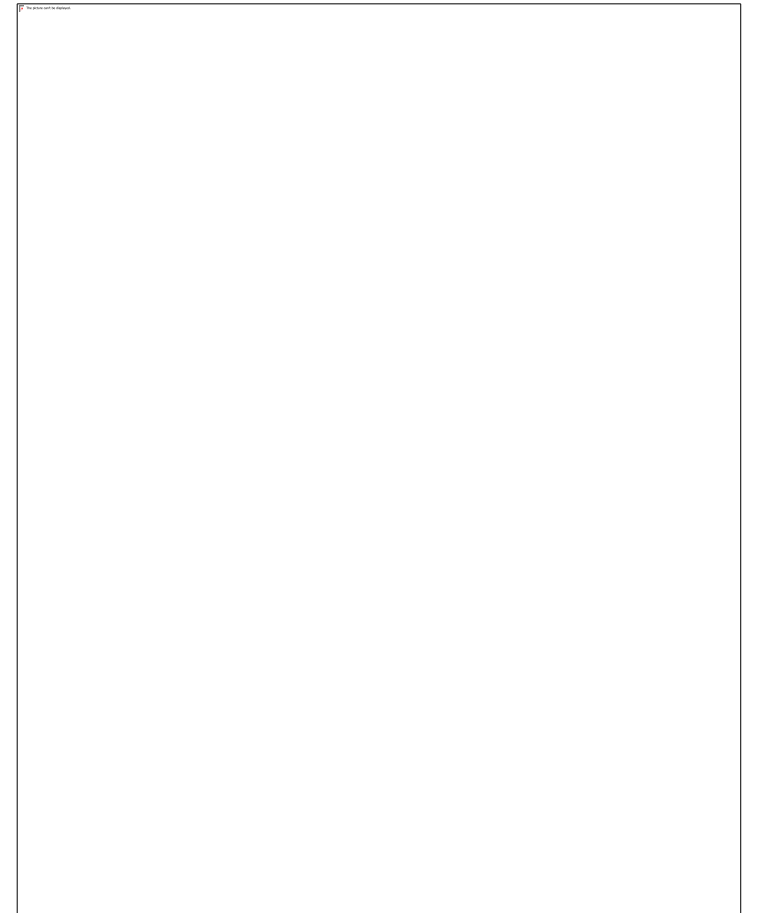
Creating and exploring reports

Creating reports: Visualization types

Choose from numerous modern visualization types:

- Filter data:
  - Slicer
- Display numeric values:
  - Card, Multi Row Card, Table, Matrix, KPI
- Graphically visualize data:
  - Bar, Column, Line, Combo, Scatter, Waterfall, Pie, Donut, Funnel, Treemap, Gauge, R Script
- Spatially visualize data:
  - Map, Filled map, Shape map (preview)

Import custom visuals

Custom visuals are covered later in this training course

Tip: Hover the cursor of each icon to reveal a tooltip description of the visualization type

Creating and exploring reports

Exploring reports

Reports are either in **Reading View** or **Editing View**

- In both views, report pages can be opened in **Full Screen Mode**, or individual visualizations can be popped out/in to see them zoomed in/out

In Reading View:

- Users cannot change the report definition
- Users can interact by changing filters or sorting
- Users can highlight values in one visualization to filter other page visualizations
- Shared reports can only be opened in Reading View

In Editing View:

- Users can interact, as in Reading View
- Users can also update the report (add/remove/reorder pages or visualizations)

Assembling dashboards

Dashboards display tiles in a single canvas

- A tile is sourced by "pinning" either a report, report visualization, or a Q&A response
- A dashboard can be based on one or more datasets
- Tiles can be resized and repositioned, and their titles/subtitles can be updated
  - Tiles can be sized to 1-5 units wide/high

Assembling dashboards

Continued

Dashboards enable interactivity

- By default, clicking on a tile will drill through to its source
- However, a custom link (URL) can be set to override this default behavior

Dashboard tiles can reflect live, real-time data

- For non real-time datasets, tile thumbnails are automatically cached every 15 minutes

Dashboards can be displayed in **Full Screen Mode**

- Additionally, all tiles can be
  displayed by using Fit to Screen

Note: Live dashboards can be achieved with Azure Stream Analytics integration or the Power BI REST API. Both topics are covered later in this course.

Connecting to Power BI data sources

The picture can't be displayed.

Connecting to data through Power BI is easy, and can be achieved with a variety of data source formats:

- Content packs:
  - My Organization
  - Services
- Files, including:
  - Power BI Desktop files
  - Excel workbooks
- Databases and data services—cloud and on-premises

Note: Organizational content packs were introduced in the previous module
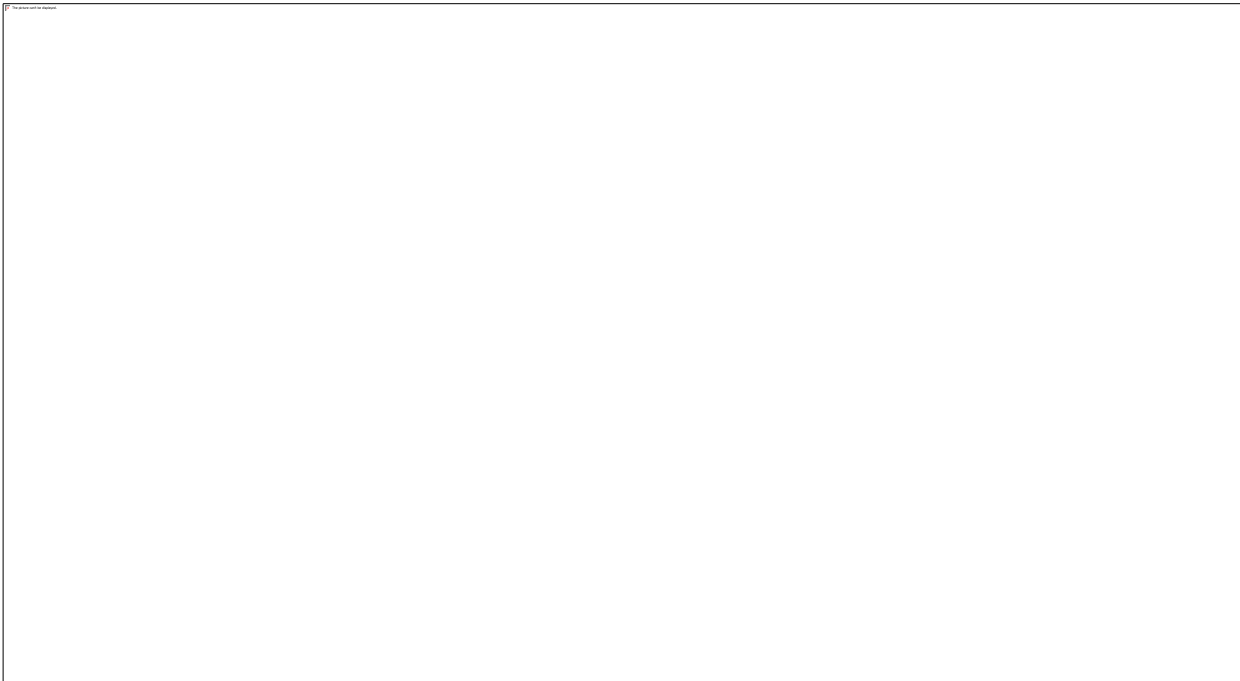
Connecting to Power BI data sources

Formats: Content packs: SaaS applications
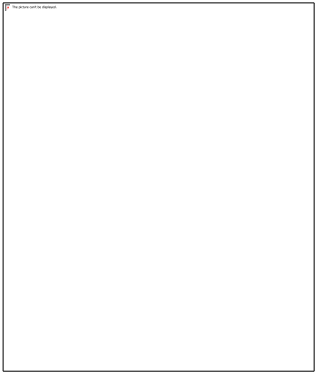
Power BI enables connections to SaaS applications

- Connections require an existing subscription
- Each content pack provides pre-built dashboards and reports

Connecting to Power BI data sources

Formats: Files

Files can be uploaded, or connected to on OneDrive for Business, OneDrive Personal or SharePoint Online

- Updates to OneDrive files will appear automatically in dashboards and reports

Supported file types:

- Power BI Desktop files

- Excel workbooks

- CSV files

Maximum size for uploaded files: 250MB

Note: Power BI Desktop files will be covered in the next module

Connecting to Power BI data sources

Formats: Files: Excel 2016

Excel 2016 supports direct publication to the Power BI service

- Publication must be made to OneDrive for Business
- Updates made from Excel 2016 will be reflected automatically in Power BI datasets

Connecting to Power BI data sources

Formats: Files: Transposition to Power BI

Power BI Desktop files:

- File ► Power BI dataset
- Report ► Power BI report
- An empty dashboard is automatically created, with a token tile to connect to the dataset (drills through to the report)

Excel workbooks:

- Data model content takes precedence over worksheet content
- Workbook data model ► Power BI dataset
- Power View sheets ► Pages of a Power BI report
- PivotTables, PivotCharts and custom fields are not recognized

Keeping data current in Power BI

Power BI enables online and on-premises data refresh for datasets uploaded from:

- Power BI Desktop files
- Excel workbooks, where Power Query or Power Pivot is used to query data

Data refresh can be on-demand, or scheduled

- Minimum schedule frequency is hourly

Achieved via a gateway

- Personal
- On-Premises Data Gateway

Note: Gateway access requires the **Power BI Pro** license

Keeping data current in Power BI

Authentication

In order for Power BI to refresh a dataset, credentials must be provided for the data sources included in the dataset

Credentials are securely stored so Power BI can connect to the data source on behalf of the user

- Once specified, the credentials are retained, and may be updated

Introducing Power BI Desktop

Power BI Desktop is a visual data exploration and reporting tool

- A freely downloadable 32- or 64-bit desktop application optimized for use with the Power BI service

- Integrates proven Microsoft technologies
  - Excel add-ins: Power Query, Power Pivot and Power View

- Enables multiple ways to transform schema and data

- Updated (at least) on a monthly basis
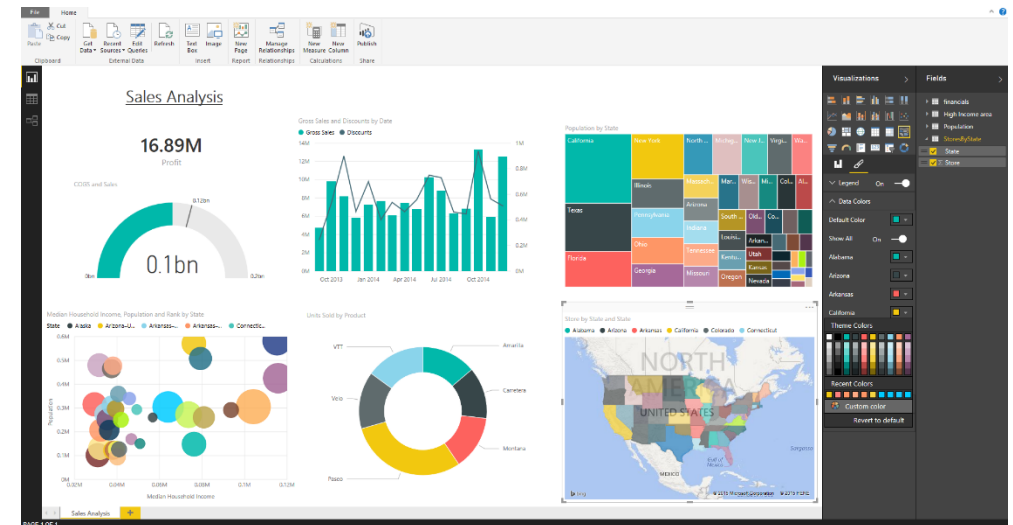
Introducing Power BI Desktop

User experience: Getting data
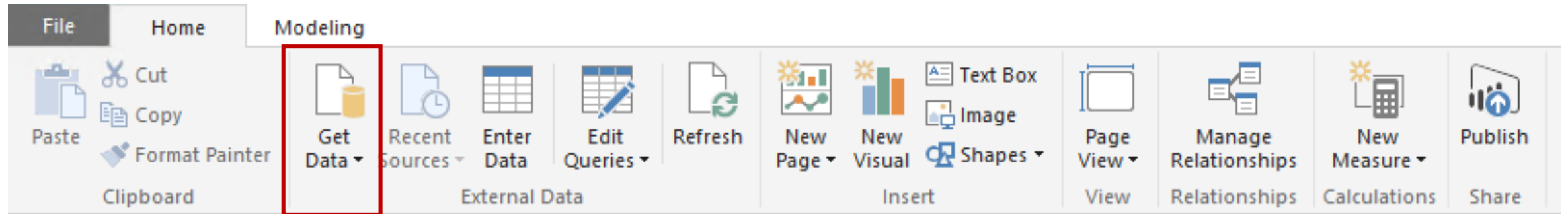
A query is defined by "getting data"
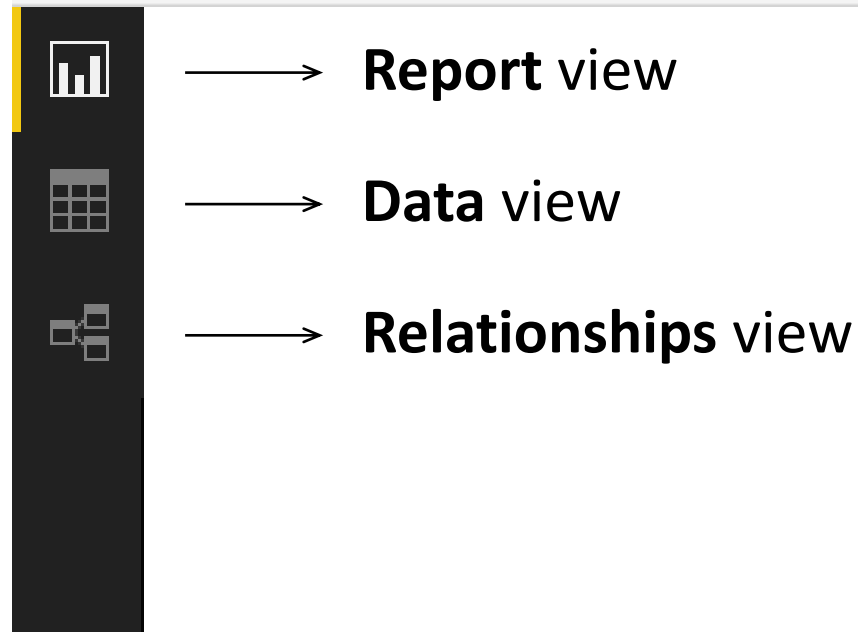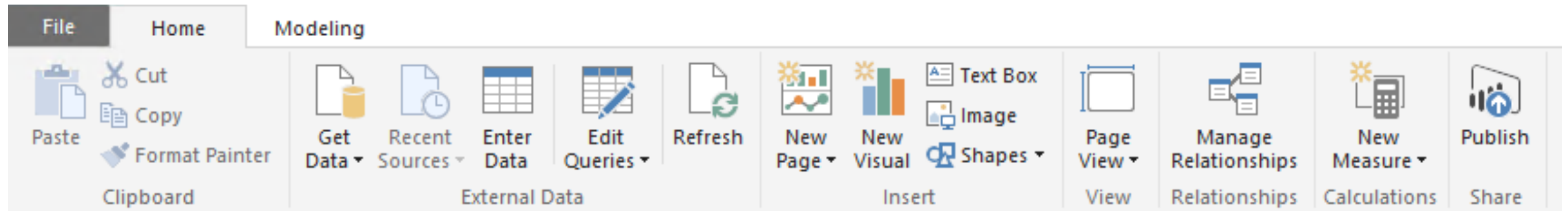
- Source types include File, Database, Azure, Online Services and Other

Data can be simply and quickly loaded "as is"

- Typically: Select type ▶ Define connection ▶ Authenticate ▶ Load
- Optionally, the **Query Editor** can be used to transform queries

Introducing Power BI Desktop

User experience: Three views

→ **Report** view

→ **Data** view

→ **Relationships** view
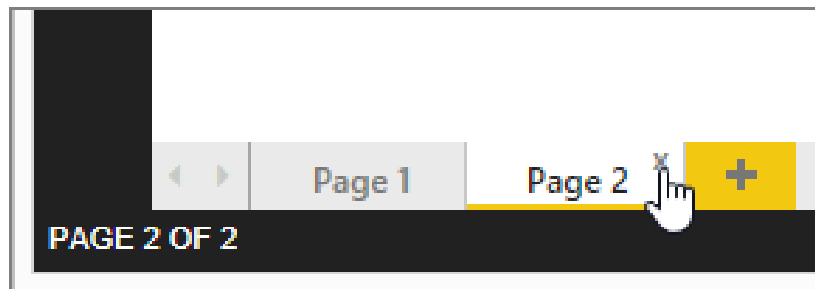
Introducing Power BI Desktop

User experience: Report view

Work in **Report View** to create any number of report pages with visualizations

- It provides almost the same design experience as the report Editing View in the Power BI service
- A report will have at least one blank page to start, and any number of pages can be added
- Pages appear, and can be managed, in the navigator pane

Introducing Power BI Desktop

The intent of the application is to land the user on the report canvas as quickly as possible

- Built-in intelligence will often infer relationships, and detect data types and categories
- Evidence suggests that most schemas are relatively simple, and so the optimized path is: Load data ► Visualize

Many model transformations can be applied while working in Report View

- Change data types, formats, calculation formulas
- Rename fields
- Sort columns
- Manage relationships

Note: The versatility of Report View, and the immediate visualization of model transformations, is a strong competitive advantage over many other data analysis and reporting products
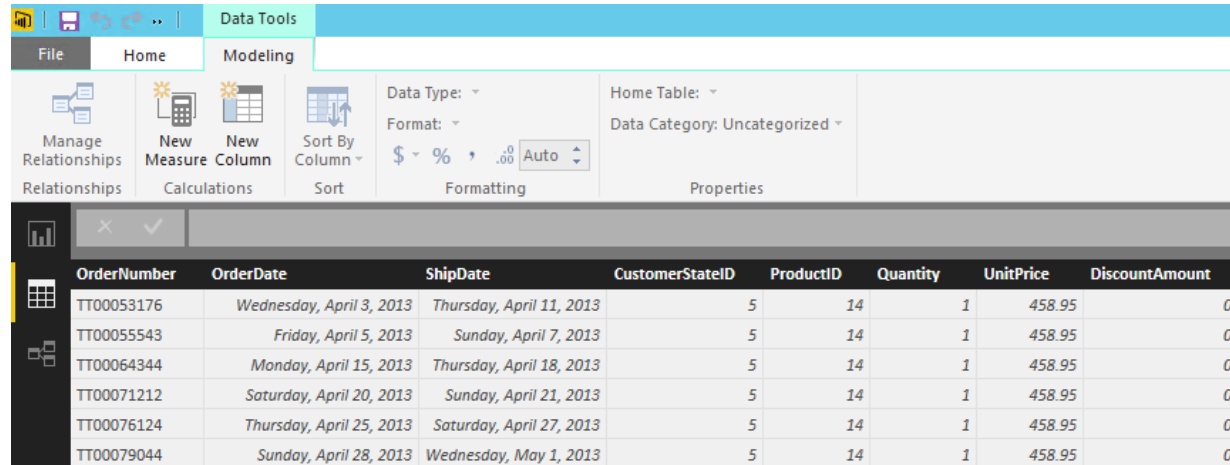
Introducing Power BI Desktop

User experience: Data view

Work in **Data View** to inspect, explore, and understand data in the model

- It is a different experience from how you can view tables, columns, and data in **Query Editor**
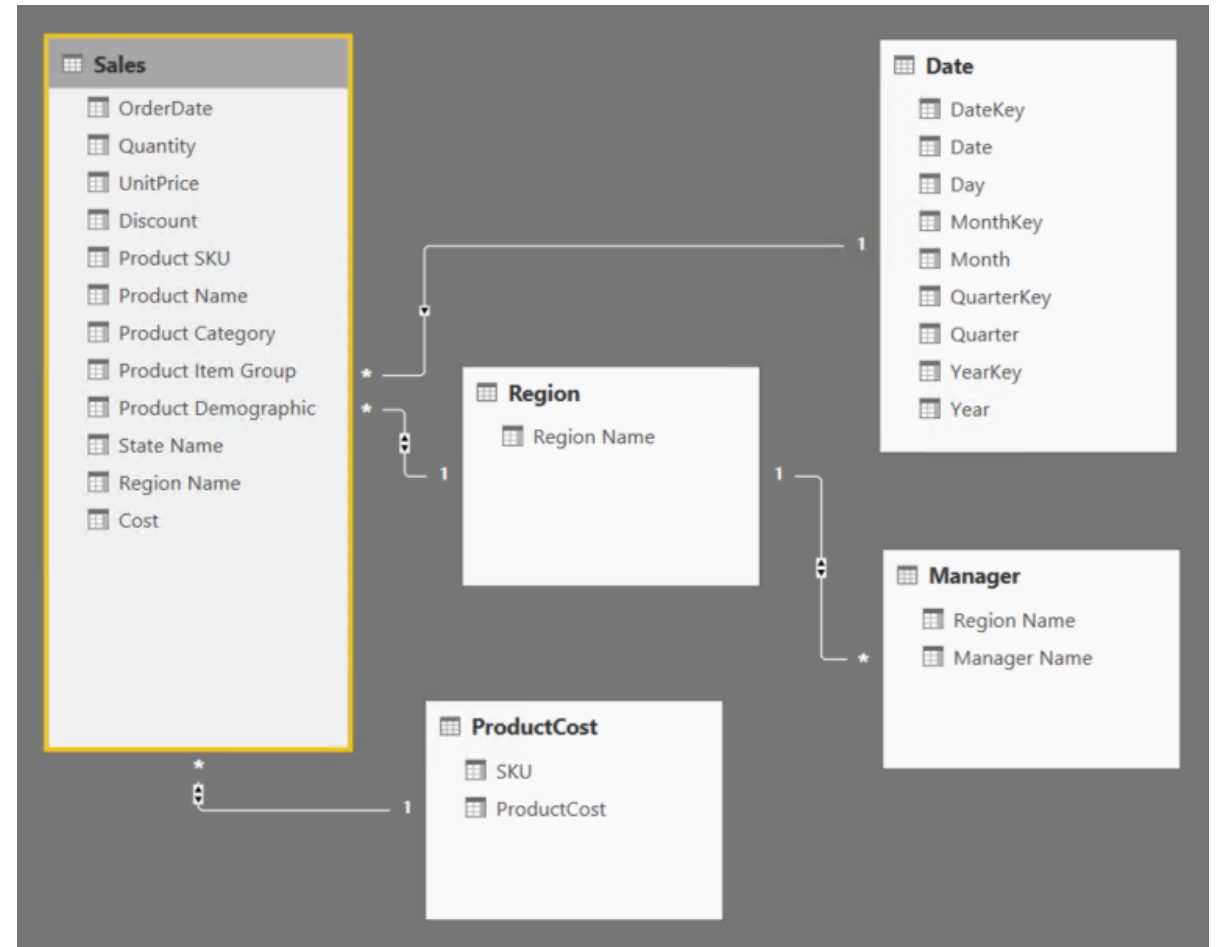- This is a view of the data <u>after it has been loaded</u> into the model

Introducing Power BI Desktop

User experience: Relationships view

Work in **Relationships View** to view all tables, columns, measures and relationships in the model

Introducing Power BI Desktop

Complex schemas: Development methodology

In contrast to the simple and quick "get then visualize" approach, more complex schemas may follow this methodology:

1. Create queries and use the **Query Editor** to filter, cleanse and reshape data
2. Configure/refine relationships to establish the foundations of a model
3. Enrich the model with calculation logic and formatting
4. Design interactive reports with a broad range of modern data visualizations
5. Publish solutions directly to the Power BI service

Create queries ▶ Configure relationships ▶ Enhance the model ▶ Design reports ▶ Publish to Power BI

Creating queries

Create queries	Configure relationships	Enhance the model	Design reports	Publish to Power BI
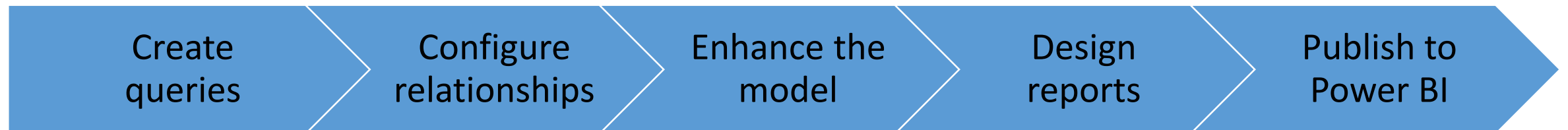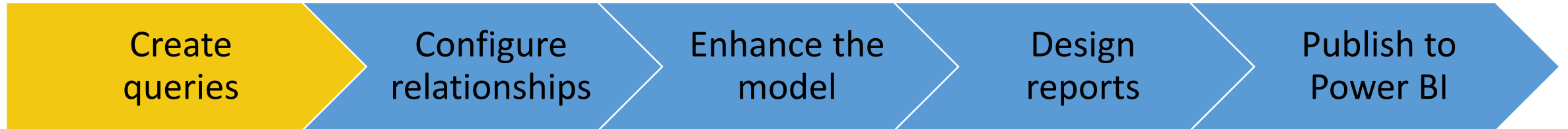
Queries can be edited before loading into the model

Once created, each query:

- Is referenced by a unique name
- Defines query steps by using the language "M"
  - Most query step logic does not require writing formulas
  - Advanced logic can be written, and even exposed as functions
- Is used to load data into a model table

Creating queries

Defining query steps

The **Query Editor** can be used to filter, cleanse and reshape data into the desired result

- Steps can easily be produced by applying column filters, and by using the commands available from the ribbon, or the query and column context menus
- It is possible to select a step and preview the data at that step
- Steps can be removed – but take care not to remove a step that downstream steps depend on
- Step formulas can be viewed or edited in the formula bar

Creating queries

Numerous commands are available on the **Query Editor** ribbons and context menus to:

- Manage columns
- Reduce rows, including removing errors
- Transform
- Split
- Add columns, by using formulas

As the editor experience is WYSIWYG, users can easily experiment and rollback changes

Configuring relationships

| Create queries | Configure relationships | Enhance the model | Design reports | Publish to Power BI |
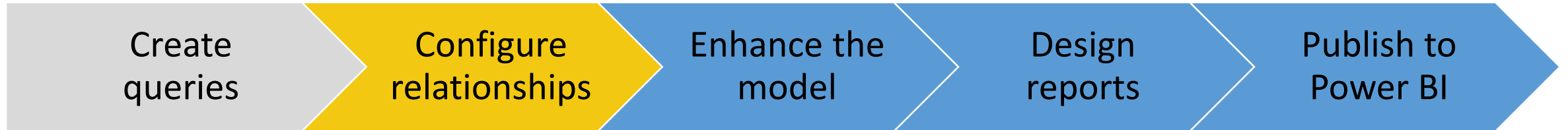
Relationships enable filters on one table to appropriately propagate filter to other tables

- Note: Relationships are not foreign key (integrity) constraints

They can be defined between any two tables, regardless of their data connection or source type

- However, they must be based on single columns with matching data types
- There is no support for self-referencing relationships

Enhancing the model

Hierarchies

Hierarchies can be added to a table, enabling navigation between columns (in the one-to-many direction)
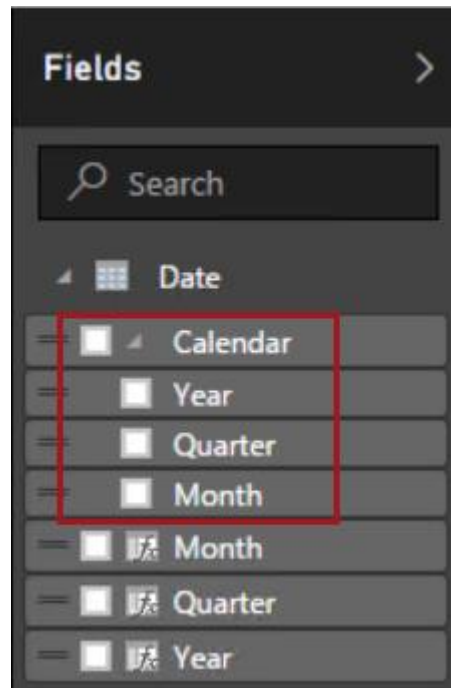
Enhancing the model

Calculations

There are three different types of calculations, and each are defined by using DAX:

- Calculated columns
- Calculated tables
- Measures

DAX = Data Analysis EXpressions (DAX), consisting of:

- Excel functions (~80 functions)
- Table functions
- Aggregate functions
- Relationship navigation functions
- Context modification functions
- Time Intelligence functions

Note: DAX theory is not covered in this training course

Enhancing the model

Define **Calculated Columns** to add new columns to tables

Column values for each row are materialized and stored in the model

- If possible, to reduce the model size, avoid creating them

Column values are recalculated when:

- The table is refreshed
- Formula dependencies are refreshed

Enhancing the model

Define **Measures** to add aggregation logic to the model

Values are not materialized in the model

- Formulas are evaluated at query time

Common aggregate functions:

- SUM
- COUNT, DISTINCTCOUNT
- AVERAGE
- MIN, MAX

Note: Summarizable columns are aggregated by reports—so defining measures is not necessary for simple aggregation requirements

Designing reports

| Create queries | Configure relationships | Enhance the model | Design reports | Publish to Power BI |
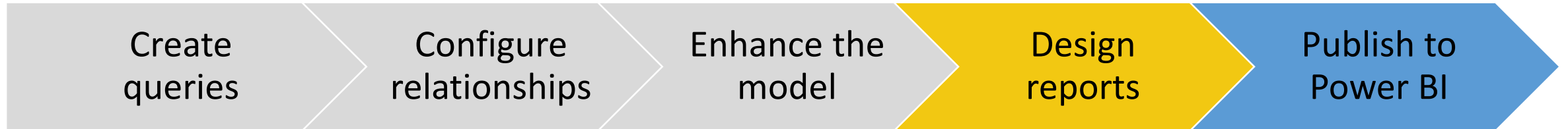
Reports can be designed based on the visible model interface

The design experience is almost the same as is available in the Power BI online service

- Text boxes, images and shapes can be added
- Text boxes can contain hyperlinks
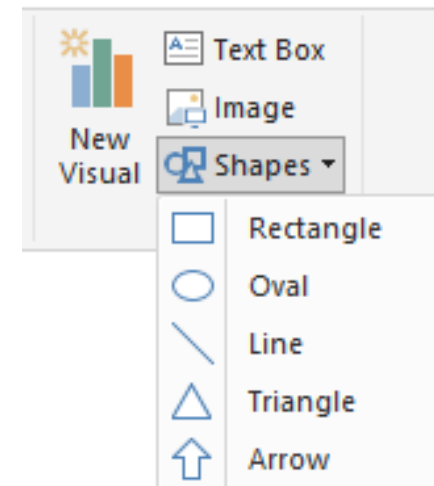
Designing reports

Custom visuals

Custom visuals can be imported to extend beyond the out-of-the-box visualizations

- A gallery of visuals created by the Power BI community is available at https://app.powerbi.com/visuals
- Browse through the visuals or submit one of your own for others to use
- The list of available visuals is growing each month
- Custom visuals will render in the Power BI service

Note: The topic of custom visual development is covered later in this training course
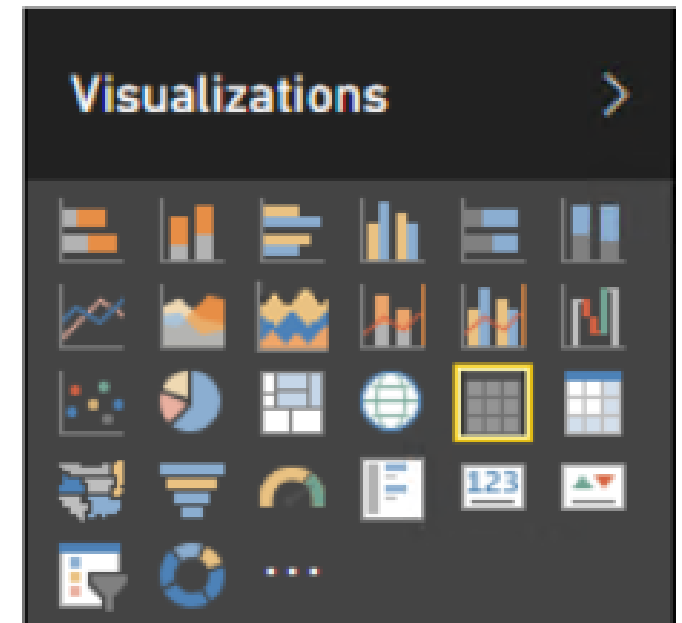
Designing reports

Custom visuals: Gallery (subset)

* And the list
is growing!

Publishing to Power BI

Create queries → Configure relationships → Enhance the model → Design reports → Publish to Power BI
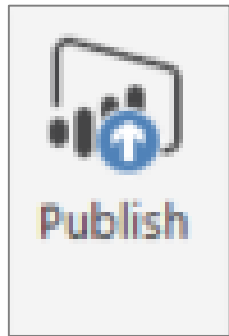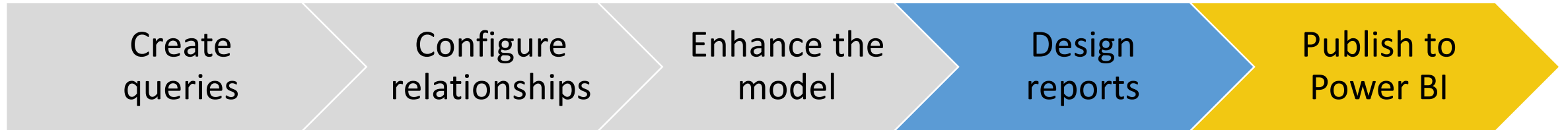
The Power BI Desktop file can be uploaded to the Power BI service, or published directly

- Publish directly to your workspace or a group

Note, if overwriting an existing dataset:

- If there are two or more datasets with the same name, remove one, or rename the Power BI Desktop file
- Renaming columns or measures can break existing reports or dashboard tiles

Lab

Lab - Questions

Management questions to be answered with a dashboard

- How are the sales at my company by months in addition to years?
- How is my company compared to other manufactures?
- How is the sales of units by various states along with the sales by years/ months?
- In which years the sales were higher (analyze the revenue by year and % of revenue for each year)?
- Compare the revenue by competitors over time

DAX

DAX (**Data Analysis Expressions**) is a collection of functions, operators, and constants that can be used in a formula, or expression, to calculate and return one or more values. Stated more simply, DAX helps you create new information from data already in your model.

DAX stands for **Data Analysis Expressions**, and it is the formula language used throughout:
- Power BI
- Excel
- SQL SSAS Tabular Model

DAX

DAX Components

This formula includes the following syntax elements:
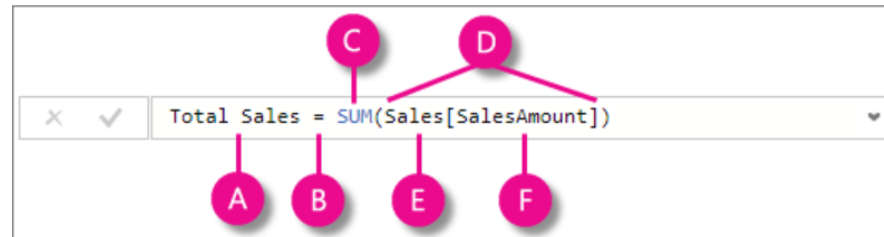
A. The measure name **Total Sales**.

B. The equals sign operator (**=**) indicates the beginning of the formula. When calculated, it will return a result.

C. The DAX function **SUM** adds up all of the numbers in the **Sales[SalesAmount]** column.

D. Parenthesis **()** surround an expression containing one or more arguments. All functions require at least one argument. An argument passes a value to a function.

E. The referenced table **Sales**.

F. The referenced column **[SalesAmount]** in the Sales table. With this argument, the SUM function knows on which column to aggregate a SUM.

DAX

Functions

DAX is a functional language.
Functions are predefined formulas that perform calculations by using specific values, called arguments, in a particular order or structure. Arguments can be other functions, another formula, expression, column references, numbers, text, logical values such as TRUE or FALSE, or constants.

DAX includes the following categories of functions:
- Date and Time,
- Time Intelligence,
- Information,
- Logical,
- Mathematical,
- Statistical,
- Text,
- Parent/Child
- and Other functions.

https://msdn.microsoft.com/en-us/library/ee634396.aspx

DAX

Calculated Columns
- Can be used to add columns to tables
- Can be used to calculated other columns or for visualizations
- It affects all the rows
- Have a single formula for each column
- Operate row by row
- Only refresh on data load
- More column = more space

Measures
- Only used on value sections
- Always filtered and evaluated on the visual is rendered
- Calculated "on the fly"
- Used in simple or complexed formulas

DAX

DEMO

Calculated Column

SalesAmount = Sales[Quantity] * Sales[Unit Price]

GrossMargin = Sales[Net Price] - Sales[Unit Cost]

GrossMarginPct = Sales[GrossMargin] / Sales[SalesAmount]

Measures

GrossMarginPct = sum(Sales[GrossMargin]) / sum(Sales[SalesAmount])

DAX

Aggregation

Aggregations are a way of collapsing, summarizing, or grouping data. When you start with raw data from tables or other data sources, the data is often flat, meaning there is lots of detail but it has not been organized or grouped in any way. This lack of summaries or structure might make it difficult to discover patterns in the data. Therefore, an important part of the analyst's job is to define aggregations that simplify, abstract, or summarize patterns in answer to a specific business question.

Works only in numeric columns

Agregate only one column

Total Sales = SUM (Sales[SalesAmount])

SUM (Sales[Net Price] * Sales[Quantity])

Function	Use
AVERAGE	Returns the average (arithmetic mean) of all the numbers in a column.
AVERAGEA	Returns the average (arithmetic mean) of all the values in a column. Handles text and non-numeric values.
COUNT	Counts the number of numeric values in a column.
COUNTA	Counts the number of values in a column that are not empty.
MAX	Returns the largest numeric value in a column.
MAXX	Returns the largest value from a set of expressions evaluated over a table.
MIN	Returns the smallest numeric value in a column.
MINX	Returns the smallest value from a set of expressions evaluated over a table.
SUM	Adds all the numbers in a column.

DAX

The X Aggregators

SUMX
AVERAGEX
MINX
MAXX

Iterate over the table and evaluate the expression for each row – row by row

Alway receive two parameter (table and expression)

Total Sales = SUM (Sales[SalesAmount])

Total Sales = SUMX (Sales; Sales[Net Price] * Sales[Quantity])

DAX

Counting Values

COUNT – only for numeric columns
COUNTA – count anything but not blanks

COUNTBLANK – count blanks
COUNTROWS – rows in a table

DISTINCTCOUNT – count distinct values

DAX

Exercise - Counting Functions

1. Calculate the number of Sales Rows

Exercise - Counting Functions

1. Calculate the number of Sales Rows

Sales Rows = COUNTROWS (Sales)

DAX

DATE Functions

DATE(<year>, <month>, <day>)	Returns the specified date in datetime format.
DATEVALUE(date_text)	Converts a date in the form of text to a date in datetime format.
DAY(<date>)	Returns the day of the month, a number from 1 to 31.
MONTH(<datetime>)	Returns the month as a number from 1 (January) to 12 (December).
NOW()	
	Returns the current date and time in datetime format.
TIME(hour, minute, second)	Converts hours, minutes, and seconds given as numbers to a time in datetime format.
TIMEVALUE(time_text)	Converts a time in text format to a time in datetime format.
WEEKDAY(<date>, <return_type>)	Returns a number from 1 to 7 identifying the day of the week of a date. By default the day ranges from 1 (Sunday) to 7 (Saturday).
DATEDIFF(<start_date>, <end_date>, <interval>) Returns the count of interval boundaries crossed between two date	
...	

Time intelligence use a diferente approach, with a data table

DAX

Exercise - DATE Functions

1. Calculate the number of days between Order Date and Delivery Date

DAX

Exercise - DATE Functions - SOLUTION

1. Calculate the number of days between Order Date and Delivery Date

   = DATEDIFF(DATEVALUE(Sales[Order Date]);DATEVALUE(Sales[Delivery Date]);DAY)

DAX

EXERCISE

Calculate the % of sales / total sales

DAX

EXERCISE

Calculate the % of sales / total sales

                                              = DIVIDE (

                                                    SUMX (Sales, Sales [Quantity] * Sales [Unit Price]),

                                                    SUMX (ALL(Sales), Sales [Quantity] * Sales [Unit Price]),

)

DAX

Solves the most common business challenges

There are five distinct groups of Quick measure calculation types, each with a collection of calculations. Those groups and calculations are the following:

Aggregate within a category
- Average within category
- Variance within category
- Max within category
- Min within category
- Weighted average per category

Filters and baselines
- Filtered measure
- Difference from baseline
- Percentage difference from baseline
- Totals from new categories

Text
- Star rating
- Concatenated list of values

Time intelligence
- Year-to-date total
- Quarter-to-date total
- Month-to-date total
- Year over year change
- Quarter over quarter change
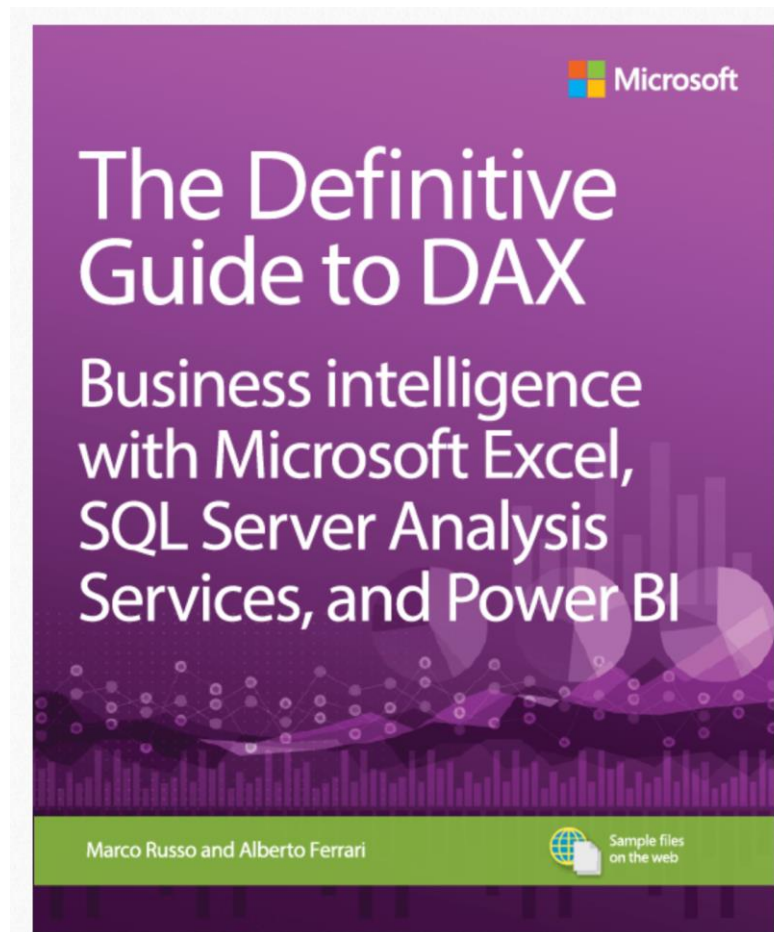- Month-over-month change
- Rolling average

Totals
- Running total
- Total for category (filters applied)
- Total for category (filters not applied)

Mathematical operations
- Addition
- Subtraction
- Multiplication
- Division
- Percentage difference

https://docs.microsoft.com/en-us/power-bi/desktop-quick-measures

Microsoft

The Definitive Guide to DAX

Business intelligence with Microsoft Excel, SQL Server Analysis Services, and Power BI

Marco Russo and Alberto Ferrari

Sample files on the web

DAX

DAX 101

https://youtu.be/klQAZLr5vxA

Advanced DAX

https://youtu.be/6ncHnWMEdic

Resources

Continued

Explore Virtual Labs!

Immerse yourself in a virtual hands-on lab and experience the product first hand,
or try our guided experiences, and click through a tour of the various product features.

View system requirements for virtual labs

- https://technet.microsoft.com/en-us/virtuallabs
- Search the growing library of Power BI technical labs

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