



Business Analytics with Power BI

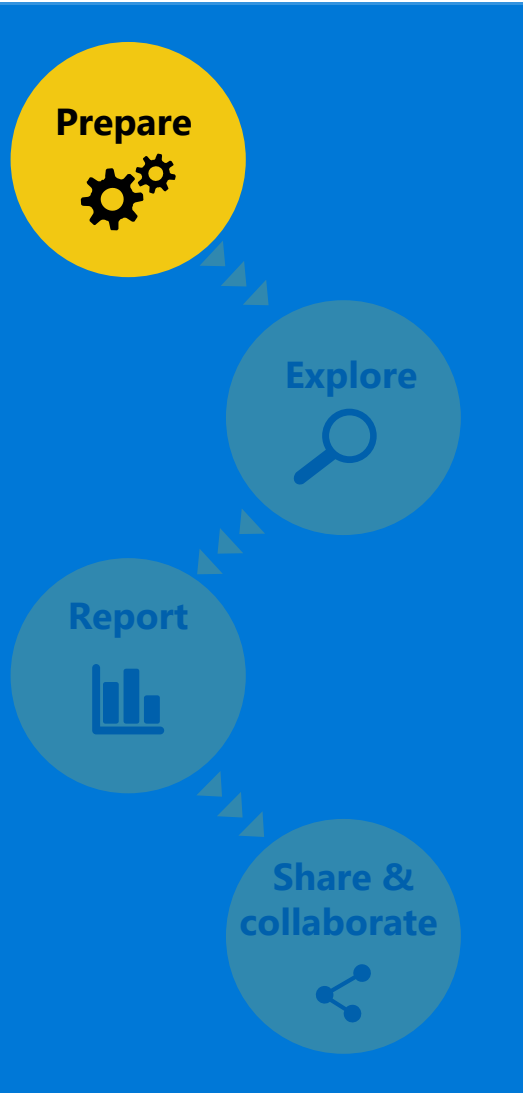
Microsoft Services



Module 1: Power BI Desktop

Lesson 4: Creating a Data Model

Creating a Data Model



- After data connections are created and the data is shaped according to the business requirements, we start **modeling** it
- Relationships between the extracted tables can be established to allow filtering
- Calculations can be created for **additional context** or for implementing business metrics or even **key performance indicators**
- Data can be **categorized, typed, and formatted**
- Custom sorting can be implemented for the attributes

Creating a Data Model

Data View

The screenshot shows the Power BI Desktop interface in Data View. The title bar reads 'Contoso Sales Sample for Power BI Desktop - Power BI Desktop'. The ribbon has tabs for 'File', 'Home', and 'Modeling'. The 'Modeling' ribbon is active, showing options like 'Manage Relationships', 'New Measure', 'New Column', 'Sort By Column', 'Sort', 'Data Type', 'Format', 'Data Category', and 'Properties'. The main area displays a data grid for the 'Stores' table. To the right is the 'Fields' pane. Callouts A-F point to specific UI elements: A (Data View icon), B (Data Grid), C (Modeling Ribbon), D (Formula bar), E (Search), and F (Fields List).

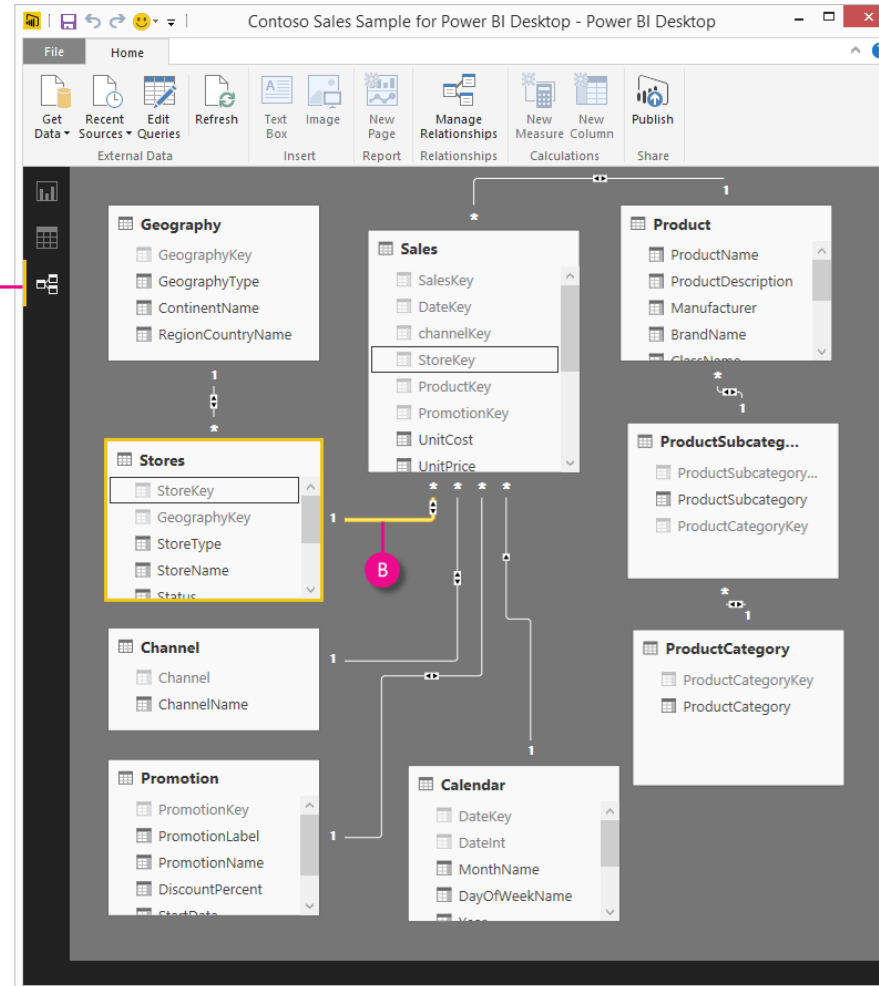
StoreKey	GeographyKey	StoreType	StoreName	Status	CloseReason	EmployeeCount
1	693	Store	Contoso Seattle No.1 Store	On		17
2	693	Store	Contoso Seattle No.2 Store	On		25
3	856	Store	Contoso Kennewick Store	On		26
4	424	Store	Contoso Bellevue Store	On		19
5	677	Store	Contoso Redmond Store	On		33
6	575	Store	Contoso Yakima Store	On		47
7	838	Store	Contoso Granger Store	On		22
8	935	Store	Contoso Sunnyside Store	On		17
9	941	Store	Contoso Toppenish Store	On		25
10	947	Store	Contoso Wapato Store	On		25
11	813	Store	Contoso Cle Elum Store	On		26
13	930	Store	Contoso Snoqualmie Store	On		33
14	825	Store	Contoso Fall City Store	On		47
15	678	Store	Contoso Renton Store	On		22
16	627	Store	Contoso Everett Store	On		17
17	551	Store	Contoso Spokane Store	On		25
18	944	Store	Contoso Veradale Store	On		26
20	824	Store	Contoso Englewood Store	On		33
21	950	Store	Contoso Wheat Ridge Store	On		47
22	571	Store	Contoso Westminster Store	On		22
23	836	Store	Contoso Grand Junction Store	On		17
24	887	Store	Contoso New Castle Store	On		25

TABLE: Stores (306 rows)

- A Data View icon
- B Data Grid – Shows the data for a selected table
- C Modeling Ribbon – Manage relationships, calculations, data types, formats, and categorization
- D Formula bar – DAX formulas for calculations
- E Search – Search for tables or column names
- F Fields List – Select a table or column to view in the Data Grid

Creating a Data Model

Relationship View



A Relationship View icon – Shows the relationships in the model. Here you can create relationships or view them.

B Relationship – You can **hover** your cursor over a **relationship** to show the columns used.

Double-click on a relationship to open it in the **Edit Relationship** dialog box

In the example, Sales and Stores have a relationship via StoreKey

Creating a Data Model

Relationships

- They **connect two tables** allowing filtering and calculations using columns from both. **No need to flatten!**
- They are based on a **single column** from **each table**. One table acts as a lookup table and the other as a referencing table
- The **datatypes** for the columns **do not have to be the same**
- Relationships can be **created manually** or **automatically inferred** by the tool
- **More than one relationship** can exist between two tables

Creating a Data Model

Prepare



Explore



Report



Share & collaborate



Relationships - Cardinality

- Many to One (*:1) or One to Many (1:*)

Edit Relationship

Select tables and columns that relate to one another.

FactInternetSales

ProductKey	OrderDateKey	DueDateKey	ShipDateKey	CustomerKey	PromotionKey	CurrencyKey	S
528	20130128	20130209	20130204	14870	1	100	
528	20130129	20130210	20130205	15319	1	100	
528	20130131	20130212	20130207	16384	1	100	

DimCurrency

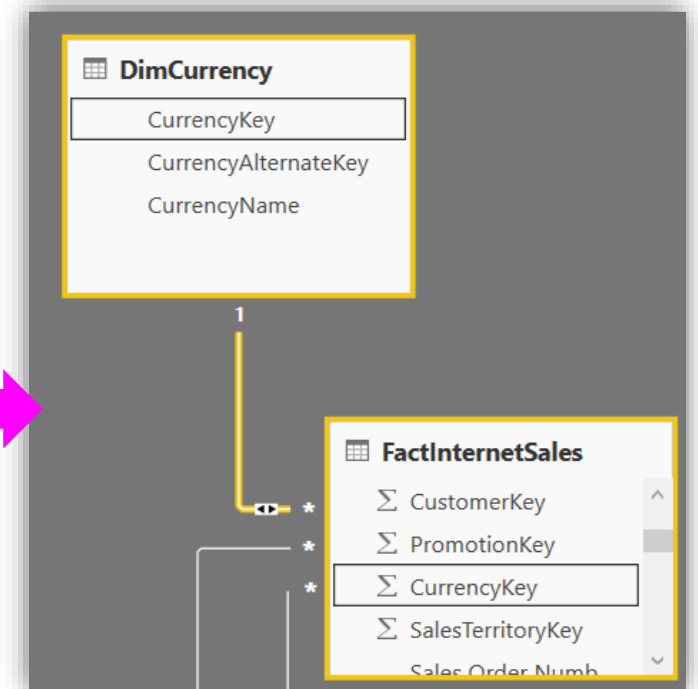
CurrencyKey	CurrencyAlternateKey	CurrencyName
1	AFA	Afghani
2	DZD	Algerian Dinar
3	ARS	Argentine Peso

Cardinality: Many to One (*:1)

Cross filter direction: Both

☒ Make this relationship active

OK Cancel



Creating a Data Model

Relationships - Cardinality

- One to One (1:1)

Create Relationship

Select tables and columns that relate to one another.

ProjectBudget

Approved Projects	BudgetAllocation	AllocationDate
Blue	40000	Saturday, December 1, 2012
Red	100000	Saturday, December 1, 2012
Green	50000	Saturday, December 1, 2012

CompanyProjectPriority

Project	Priority
Blue	A
Red	B
Green	C
Yellow	C
Purple	B

Advanced options

Cardinality: One to One (1:1)

Cross filter direction: Both

☒ Make this relationship active

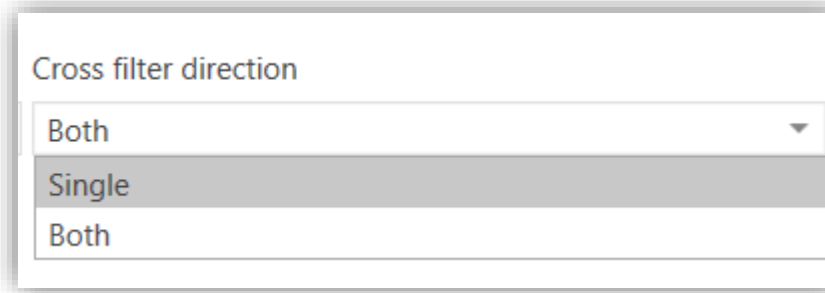
- In a One to One relationship **there are no repeating values** for the column in either table.
- Power BI Desktop will **automatically detect** this and set it automatically.
- Only set it if **always true**

Project	Priority	BudgetAllocation	AllocationDate
Blue	A	40,000	12/1/2012
Red	B	100,000	12/1/2012
Green	C	50,000	12/1/2012
Yellow	C		
Purple	B		
Orange	C		

Creating a Data Model

Relationships - Direction

- The direction of the relationship determines how data can be filtered.

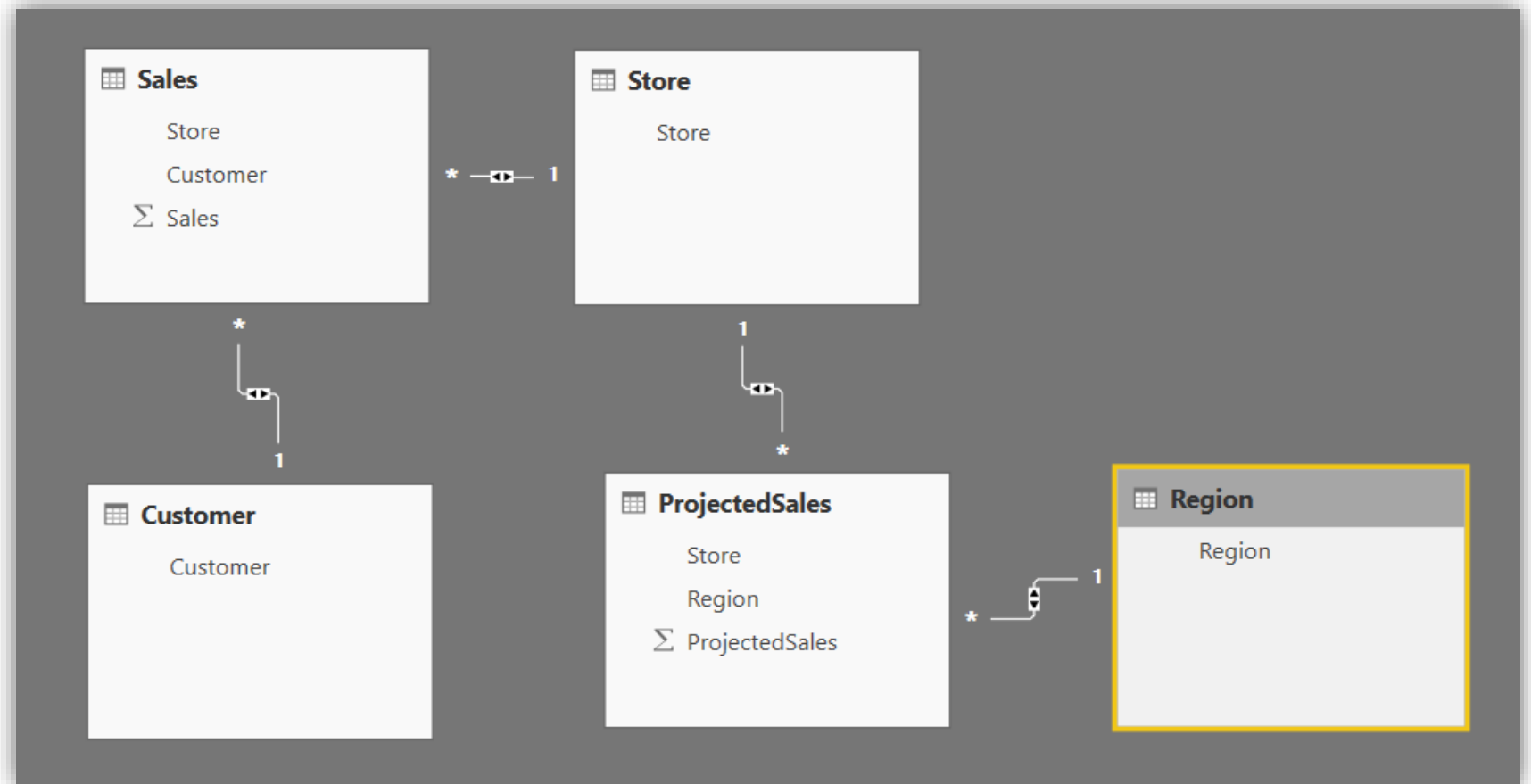


- Single** is the typical behavior in star-schemas where dimension tables (lookup) filter fact tables (transactional tables)
- Both** is the new default. The tables act as if together in a single table so filtering is possible on either side of the relationship.

Creating a Data Model

Relationships – Direction

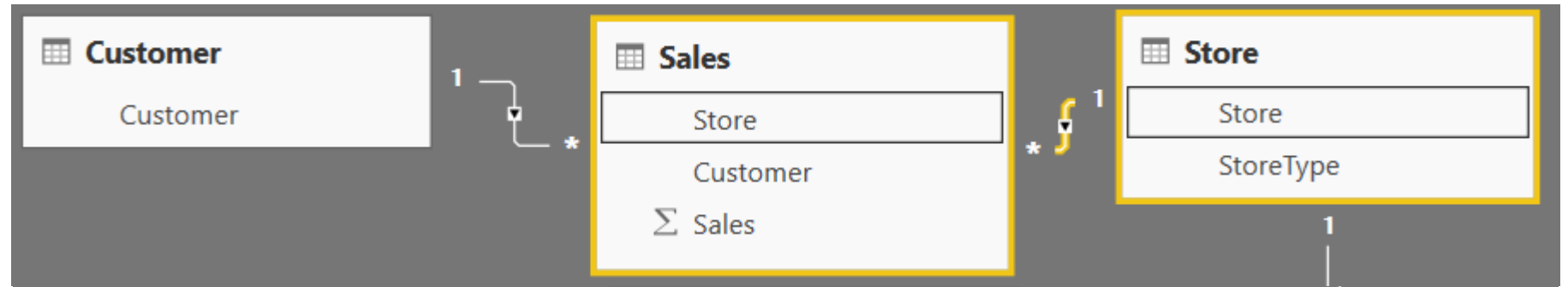
- As a single table, can you explain a little bit better?



Creating a Data Model

Relationships – Direction

- As a single table, can you explain a little bit better?

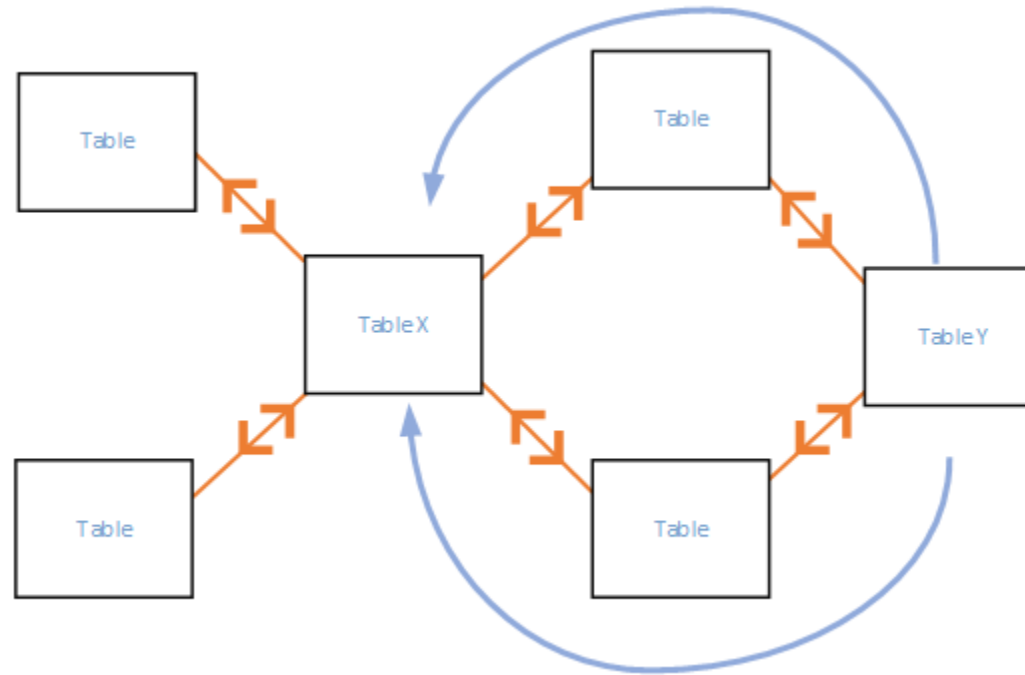


- This allows questions like “In how many store types did my customers purchased products?”
- With a single direction between Sales and Store, this wouldn’t be possible.

Creating a Data Model

Relationships – Direction

- So when should I change the default? If you have **loops** in your relationships and be aware of **multiple fact tables**.

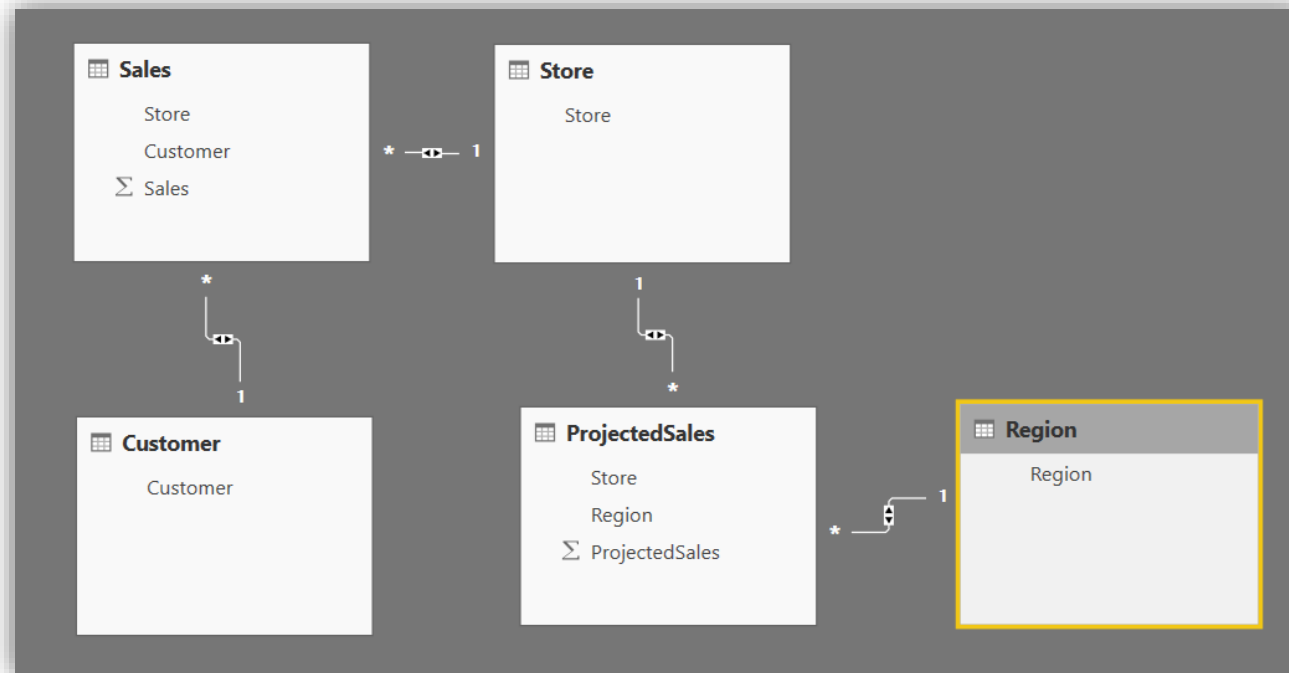


- Power BI Desktop will **automatically detect ambiguity** and **will not allow Both** direction type in this case.
- Deactivate one of the relationships or import the intermediate tables again.

Creating a Data Model

Relationships – Direction

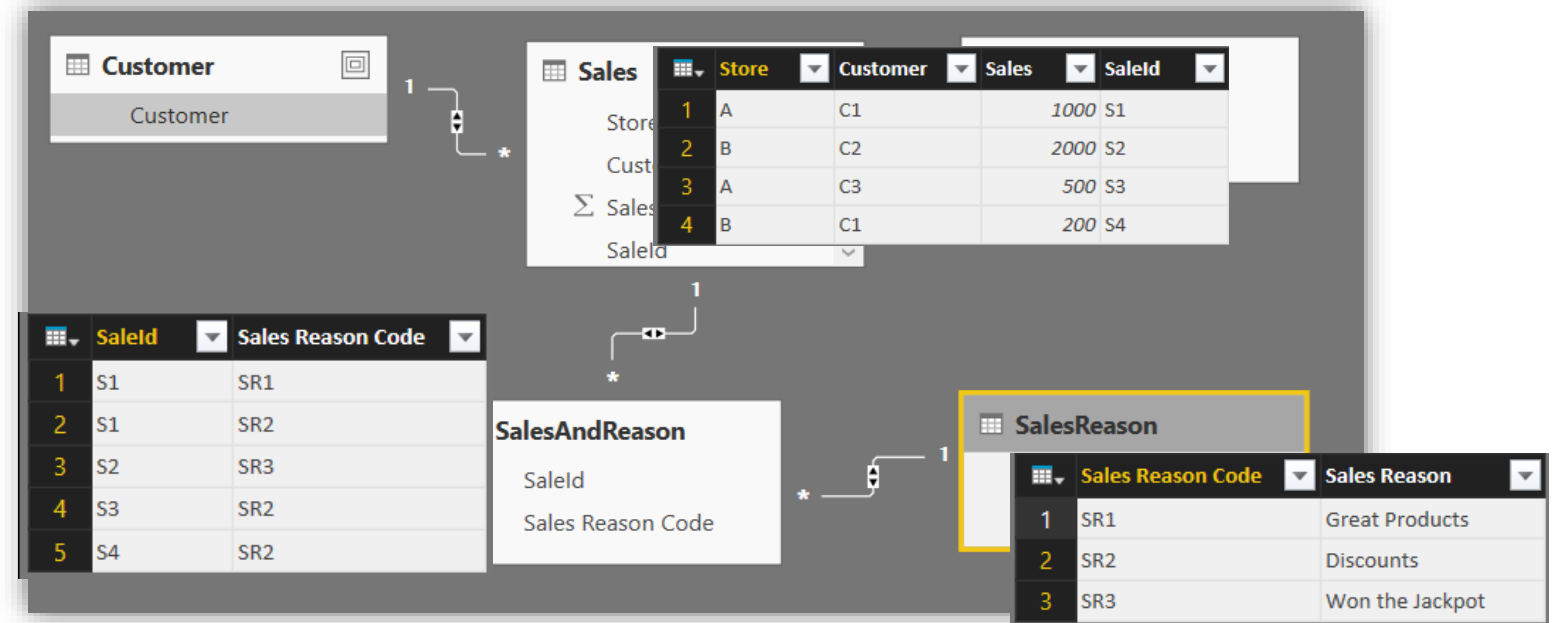
- *"With great power comes great responsibility"*
- Don't turn on "Both" direction for every relation. It is **slower** and might return **unexpected results**



Creating a Data Model

Relationships – How about Many to Many

- The Both direction type enables Many to Many relationships



Sales Reason	Sales
Won the Jackpot	2000
Discounts	1700
Great Products	1000
Total	3700

Σ 4700

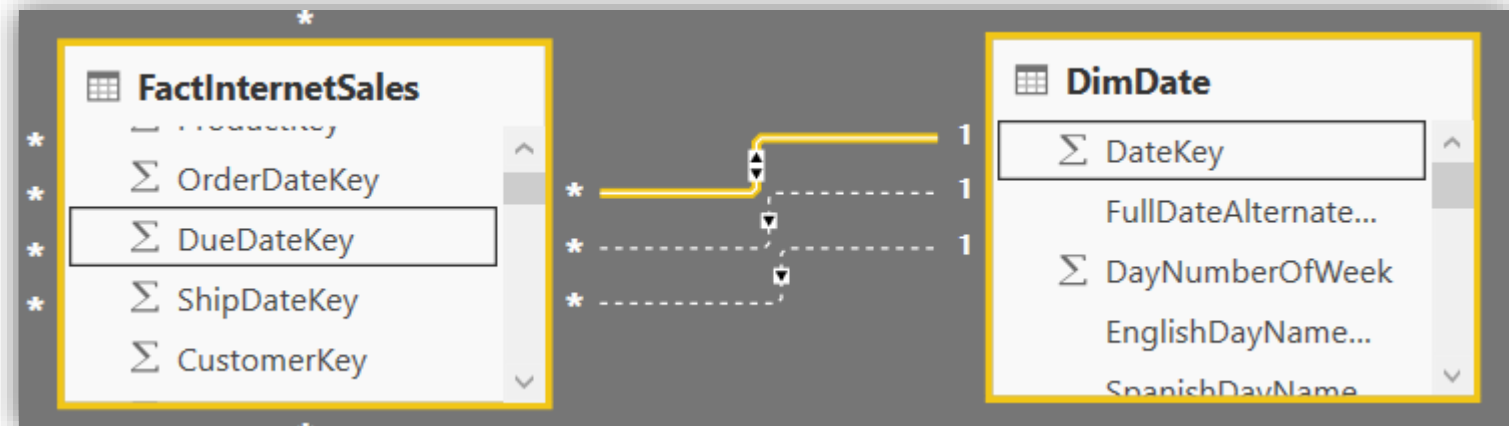
Total Sales

3700

Creating a Data Model

Relationships – Active and Inactive

- **More than one** relationship can exist between two tables, but **only one** can be **active** at a time
- The **columns** from the transactional table must be **different**

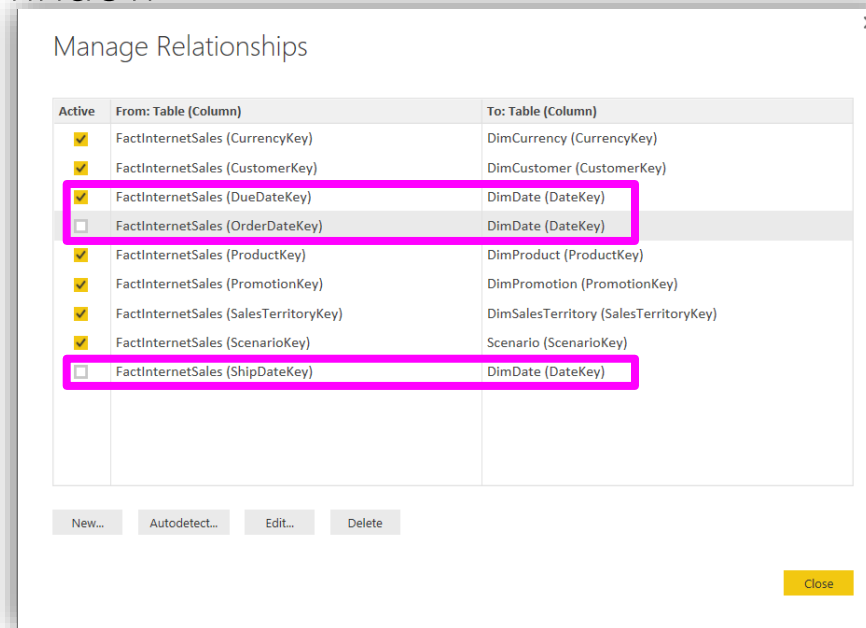


- In the above example, three relationships exist. The **full line** represents the **active** (in this case, we aggregate on Due Date)

Creating a Data Model

Relationships – Active and Inactive

- It is possible to control which relationship is active by using the Manage Relationships window



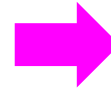
- It is also possible to use DAX to activate a relationship in a calculation or import the lookup table more than once

Creating a Data Model

Relationships – Parent-Child

- Not supported natively. As a workaround, **denormalize** the table.

Parent-Child	
Key	Parent
Sintra	Lisbon
Lisbon	Portugal
Portugal	Europe

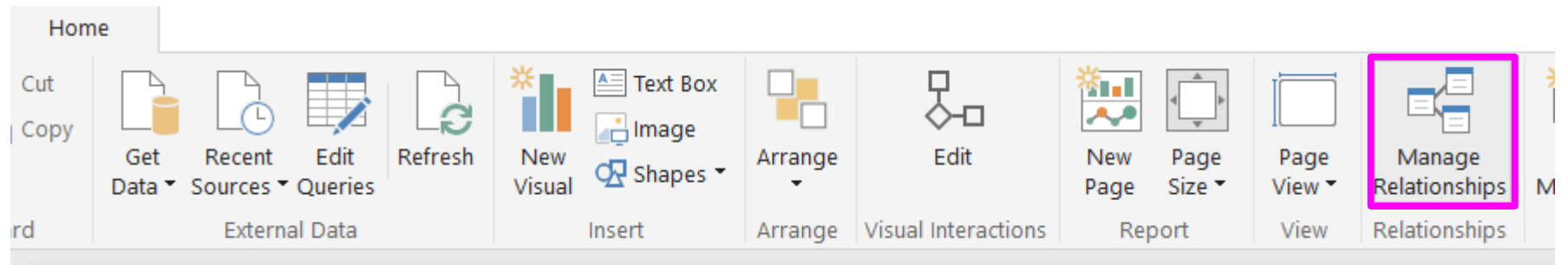


Denormalized			
Key	District	Country	Region
Sintra	Lisbon	Portugal	Europe

Creating a Data Model

Relationships – Creation

- Relationships can be created manually by using the **Manage Relationships** tab.

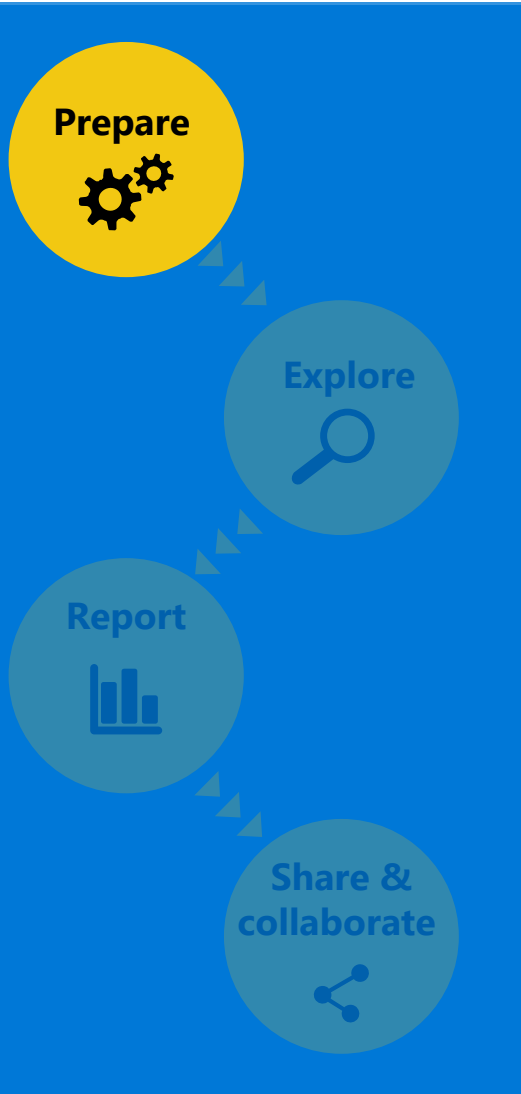


- Or by dragging-and-dropping columns in the Relationship Viewer
- There is also an **auto-detect** feature where Power BI desktop will rely on **column names and data types** (or constraints defined in the data source) to detect relationships

Creating a Data Model

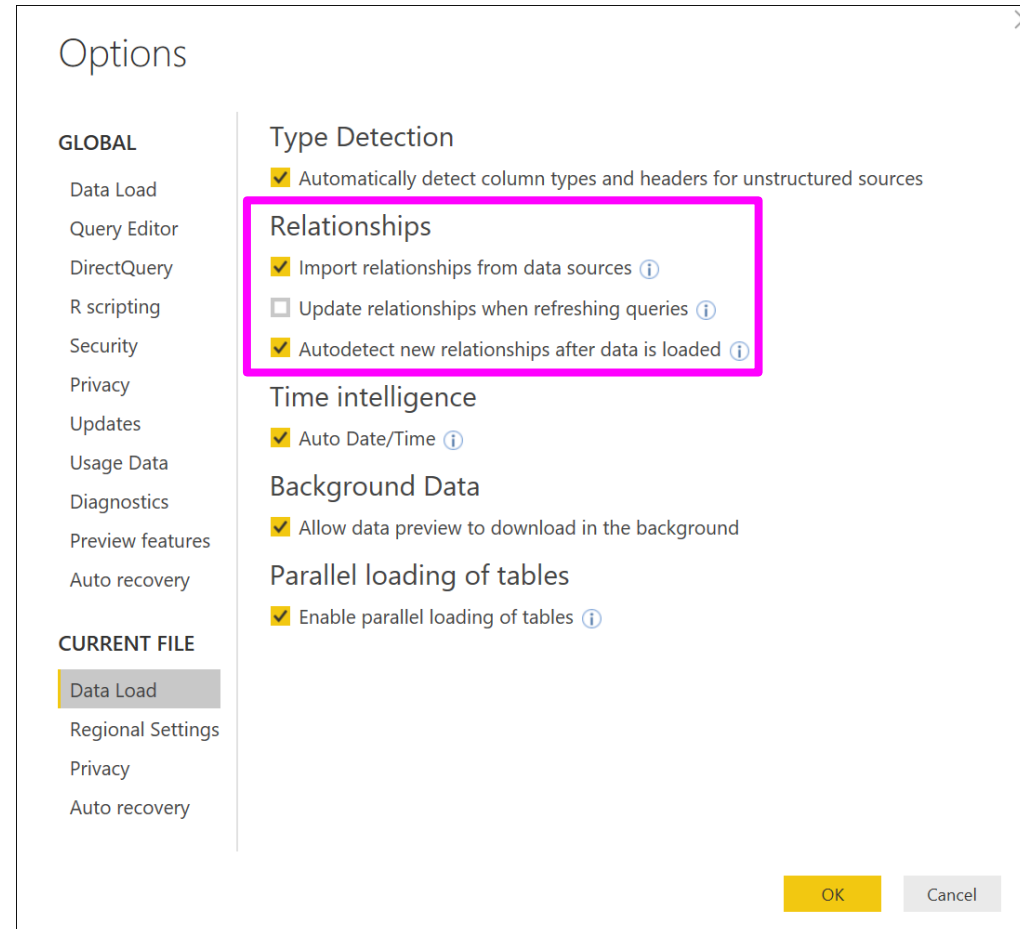
Relationships – Data Quality Issues

- If data has **null** or **blank values** for the columns that support relationships either:
 - Remove those rows (which might affect statistics and summarizations)
 - Define a default value that replaces those values so that a match is made
- If **duplicate values** exist in a lookup table, a relationship **cannot be created**
- **Remove the duplicates** so that the lookup table contains none. You can use the data shaping features of Power BI Desktop to do it.



Creating a Data Model

Relationships – Options



- Import relationships from data sources (like foreign keys in relational databases)
- Update relationships when refreshing queries – might remove manual relationships
- Autodetect after data is loaded – useful when adding more tables to the model

Creating a Data Model

Relationships – DirectQuery

Create Relationship

Select tables and columns that relate to one another.

FactFinance

FinanceKey	DateKey	OrganizationKey	DepartmentGroupKey	ScenarioKey	AccountKey	Amount	D
1	20101229	3	1	1	60	22080	25
2	20101229	3	1	2	60	20200	25
3	20101229	3	1	2	61	2000	25

DimAccount

AccountKey	ParentAccountKey	AccountCodeAlternateKey	ParentAccountCodeAlternateKey	AccountDescription
1	null	1	null	Balance Sheet
2	1	10	1	Assets
3	2	110	10	Current Assets

Cardinality: Many to One (*:1)

Cross filter direction: Single

☒ Make this relationship active

☒ Assume Referential Integrity. [Learn More](#)

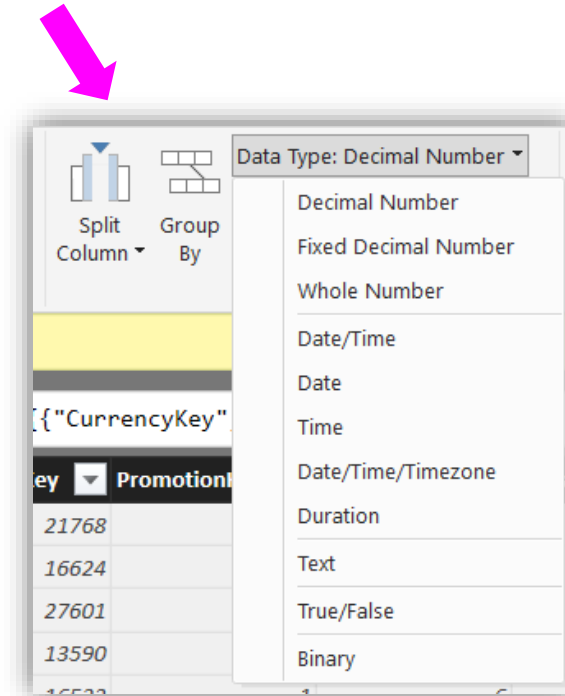
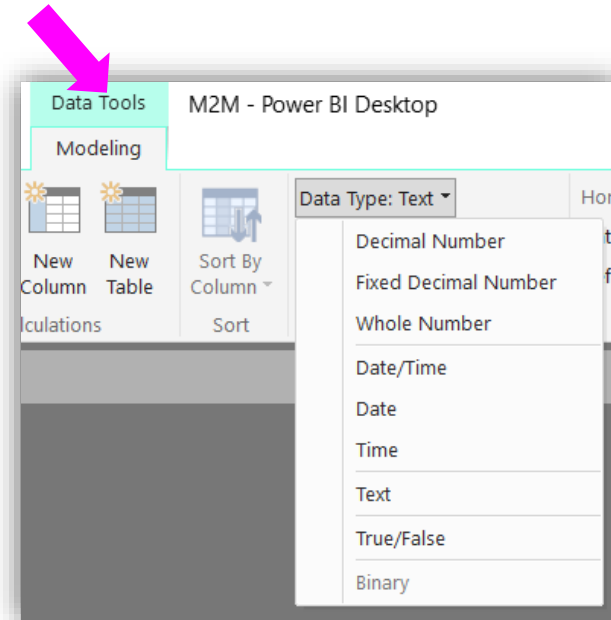
OK Cancel

- Assume Referential Integrity is an optimization to tell the engine that there are **no “lookup failures”** between the two tables – typical in data warehousing scenarios between facts and dimensions
- Bidirectional cross filtering should be set when Referential Integrity is also set.

Creating a Data Model

Data Types

- Power BI Desktop **optimizes data types automatically** when loading the data for more efficient storage, calculations, and data visualization
- Data types **can be set** both at the **Query Editor** and in the **Modeling** tab



Creating a Data Model

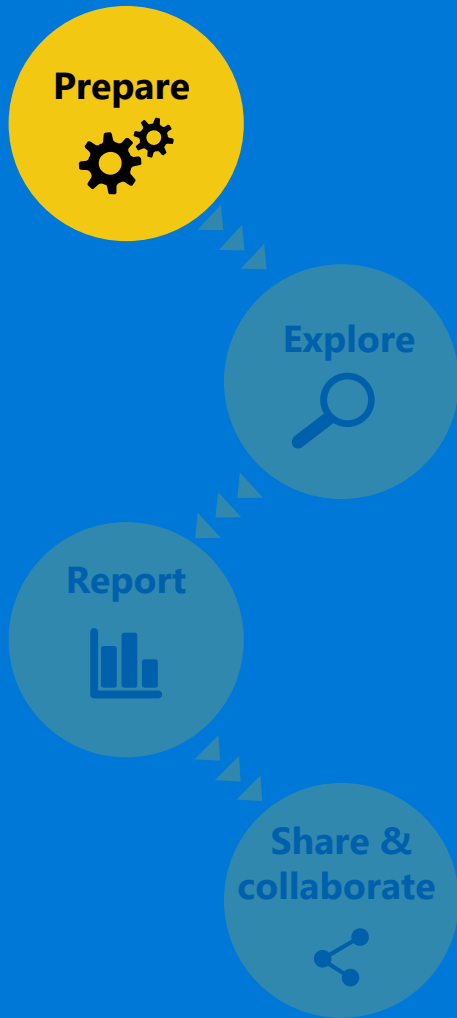
Data Types

- **Numeric Types**

- **Decimal Number** – eight byte floating point number. The largest value is 15 digits long and decimal separator can occur anywhere.
- **Fixed Decimal Number** – It allows 19 digits with 4 digits of precision. The largest value is 922,337,203,685,477.5807 . Digits to the right of the 4 digits of precision are truncated. Good to avoid rounding errors.
- **Whole Number** – eight byte integer value. It has no decimal places. It allows 19 digits from -2^{63} to $2^{63}-1$ and allows the largest value of the numeric types.
- **Percentage** – An input value such as “5%” will be automatically recognized as a Percentage value and converted to a 2-digit precision decimal number (i.e. 0.05).

- **Text type**

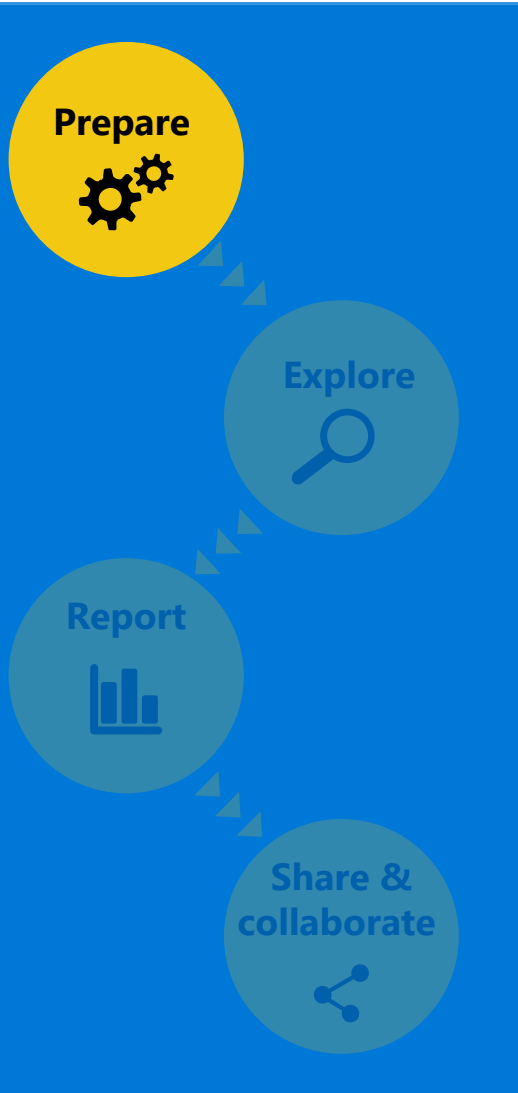
- **True/False type**



Creating a Data Model

Data Types

- Date/Time Types
 - Date/Time – Dates with time from year 1900 to 9999
 - Date – A date without a time portion
 - Time – Only the time portion
 - Date/Time/Timezone – Represents a UTC Date/Time
 - Duration – The difference between two Date/Time or Time fields.
- Blank/Nulls type – represents and replaces SQL nulls.



Creating a Data Model

Data Categorization

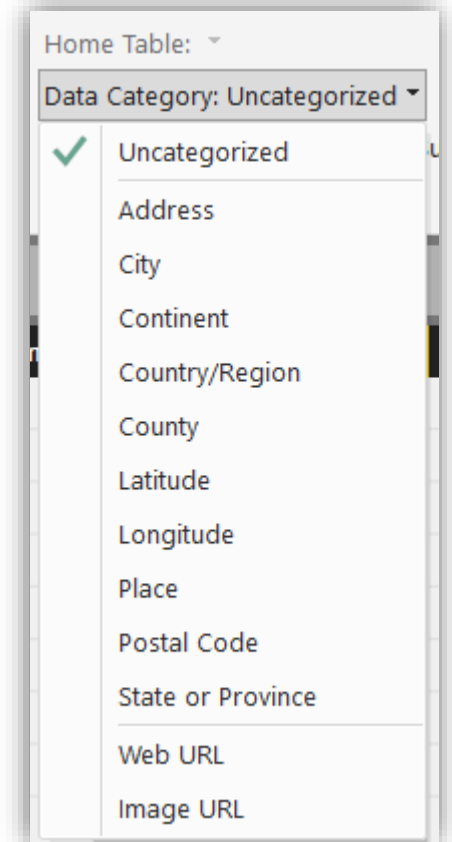
- Categorizing the fields is **relevant** for **geographical** fields or for **image** or **URL** fields

GeoCode	Sales Amount
AL	\$ 10,175,870.00
AR	\$ 4,351,530.00
AZ	\$ 6,114,241.00
CA	\$ 6,688,589.00
KY	\$ 53,832,611.00

Am I seeing country sales or US states' sales?

Is AL, Albania or Alabama? Or, is AR, Argentina or Arkansas?

- In the modeling tab a field can be classified at a certain **geographical** granularity or as an **image** that comes from an **URL** or a text field which is actually an **URL**.
- Power BI desktop will **render data based on this categorization**



Creating a Data Model

Prepare



Explore



Report

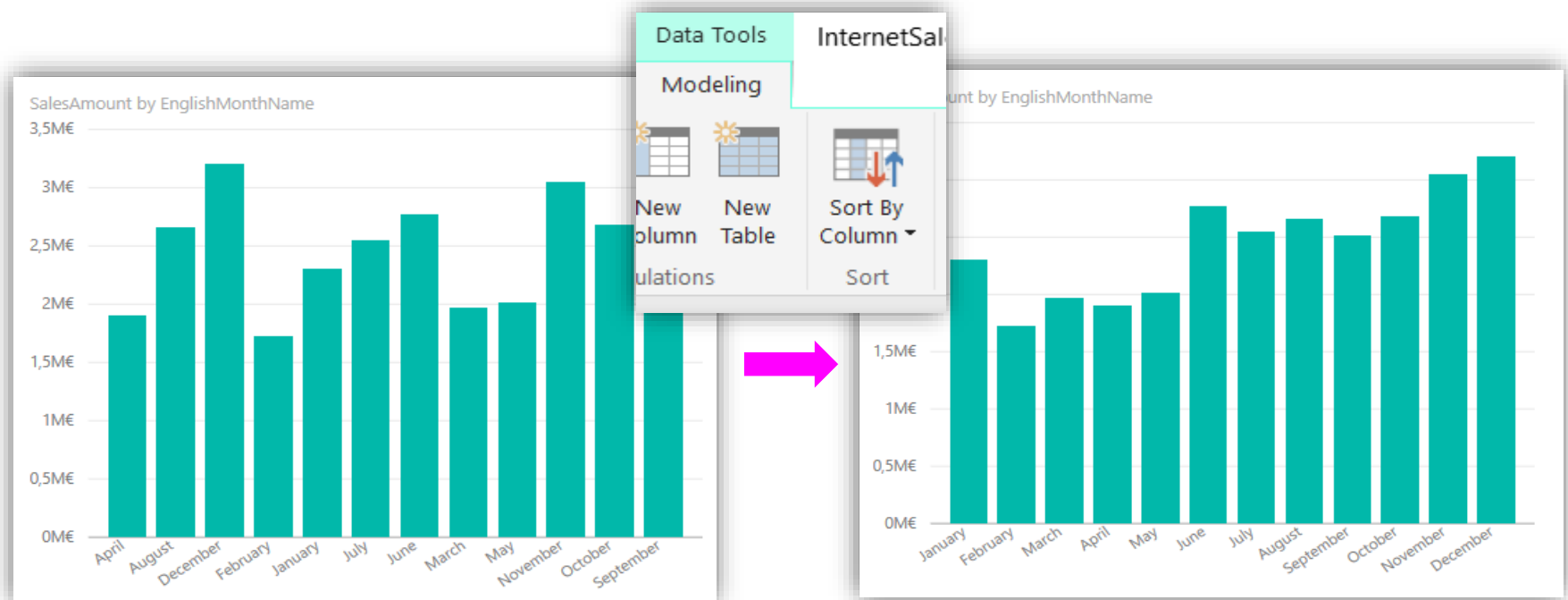


Share & collaborate



Sorting by Column

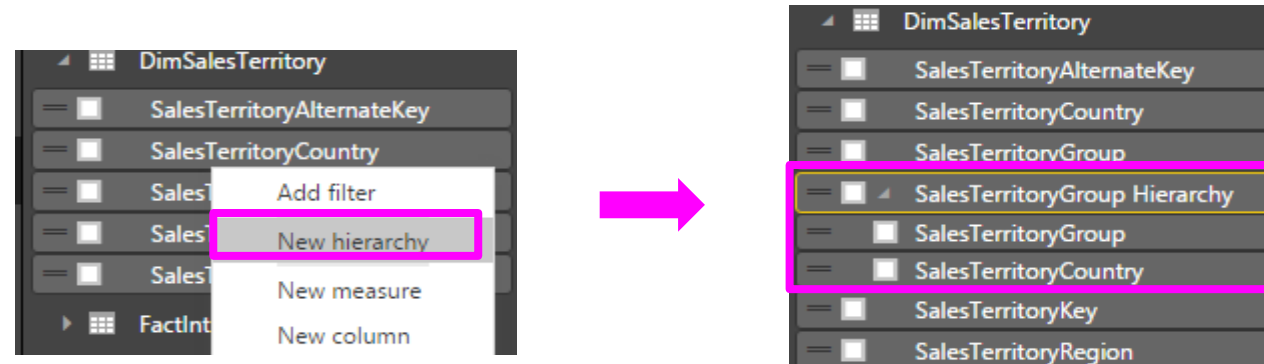
- By **default**, Power BI desktop will **sort** data in a column based on the **alphabet**
- It is possible to **use a separate column to determine sorting**



Creating a Data Model

Hierarchies

- Can be created in the Data View

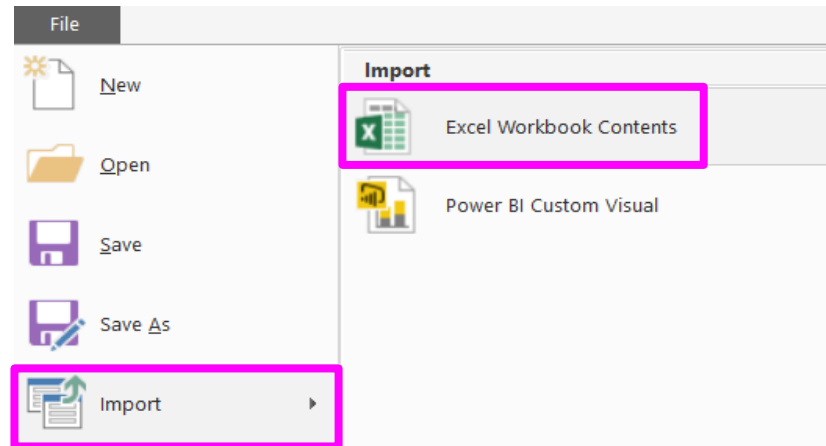


- They must use attributes from a single entity
- Can be used in the different visualizations, allowing drilling
- Imported Power Pivot models or connected to SSAS models with hierarchies are also usable

Creating a Data Model

Import From Microsoft Excel

- If you already have **data models created in Excel**, you can import them into Power BI Desktop (opposite, not possible)



- Power Query, Power Pivot and Power View content will be “migrated”
- When finished, there is no longer a dependency on the Excel file

Demonstration

Data model quick tour

Lab 1 Exercise 2: Creating the Data Model