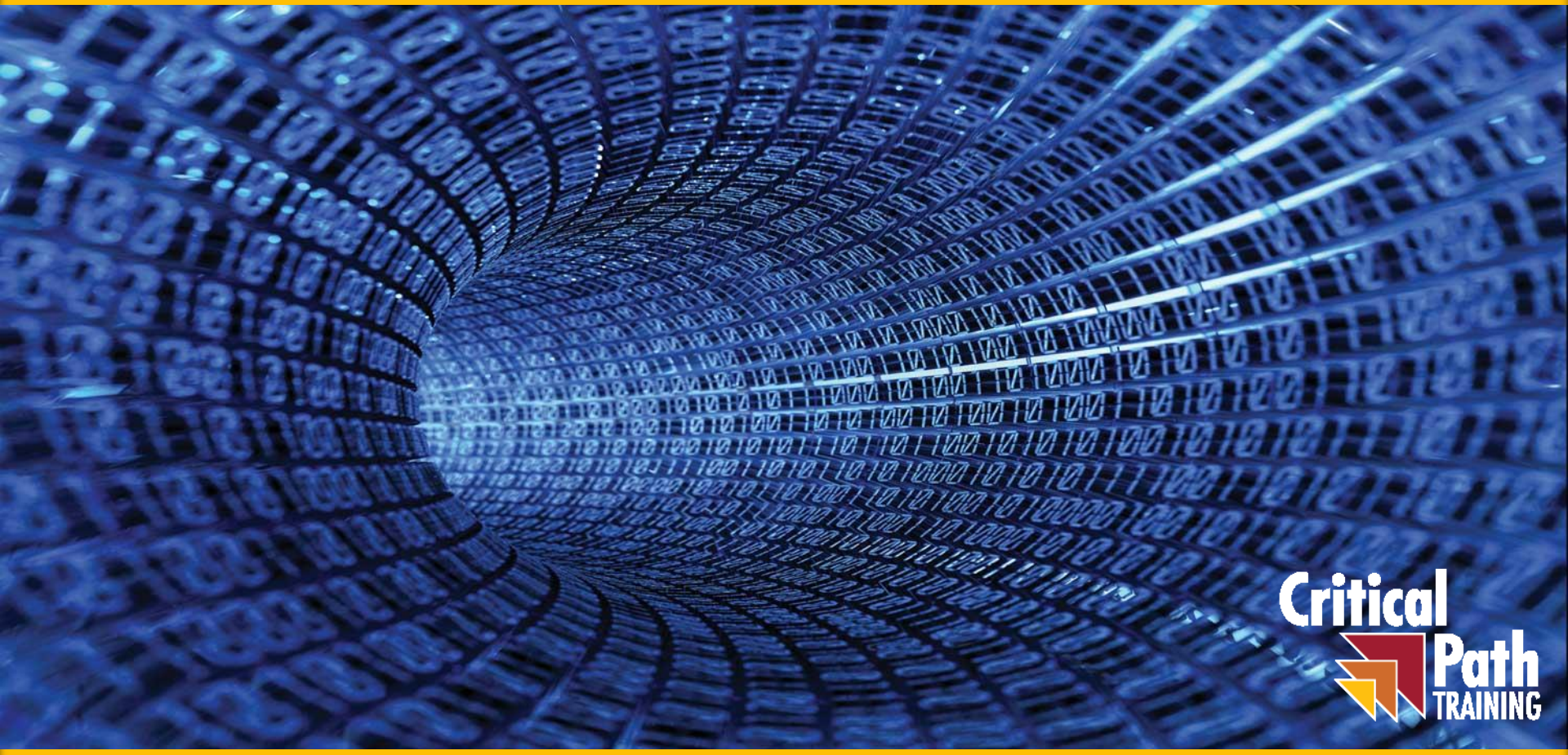
Designing a Data Model with Power BI Desktop



Agenda

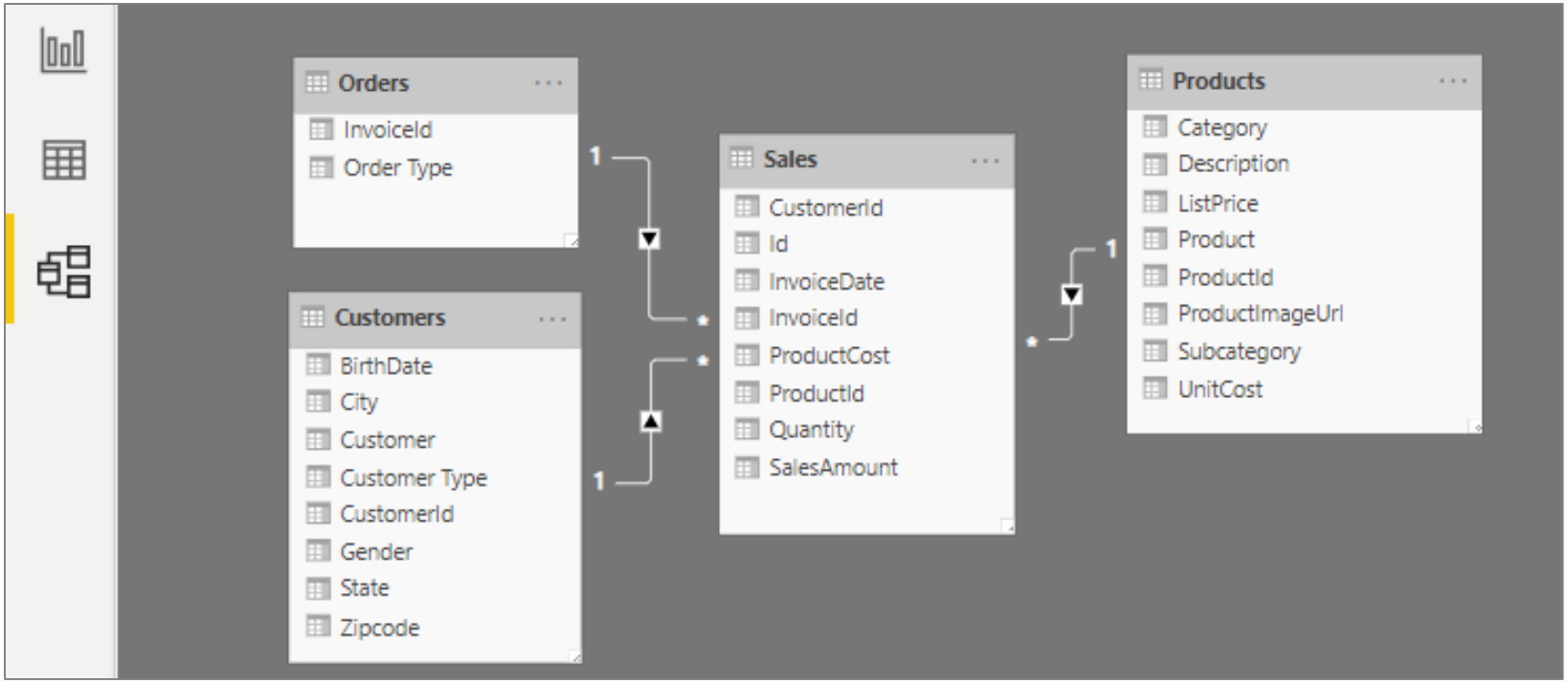
- Creating Table Relationships
- Creating Calculated Columns and Measure
- Creating Tables using DAX Expressions
- Configuring Fields for Geographic Mapping

Data Modeling with Power BI Desktop

- Steps to create a data model with Power Pivot
  - Create relationships between tables
  - Modify native columns (e.g. set formatting and data category)
  - Create calculated columns
  - Create measures
  - Create dimensional hierarchies
  - Add Calendar table(s)

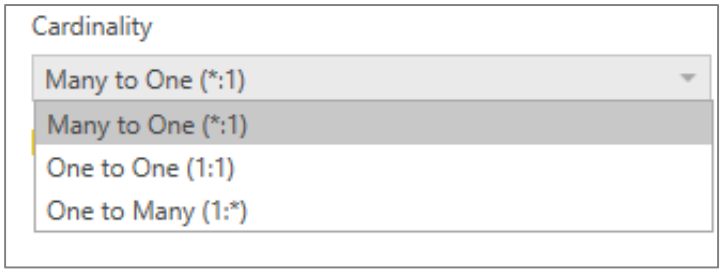
Table Relationships

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

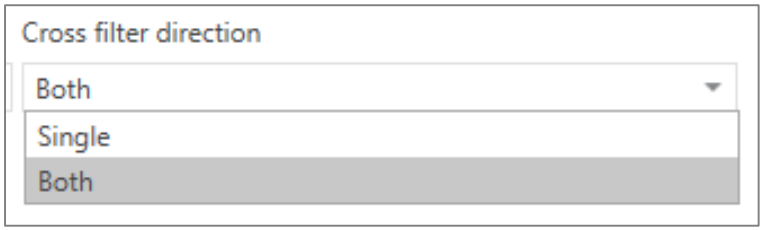


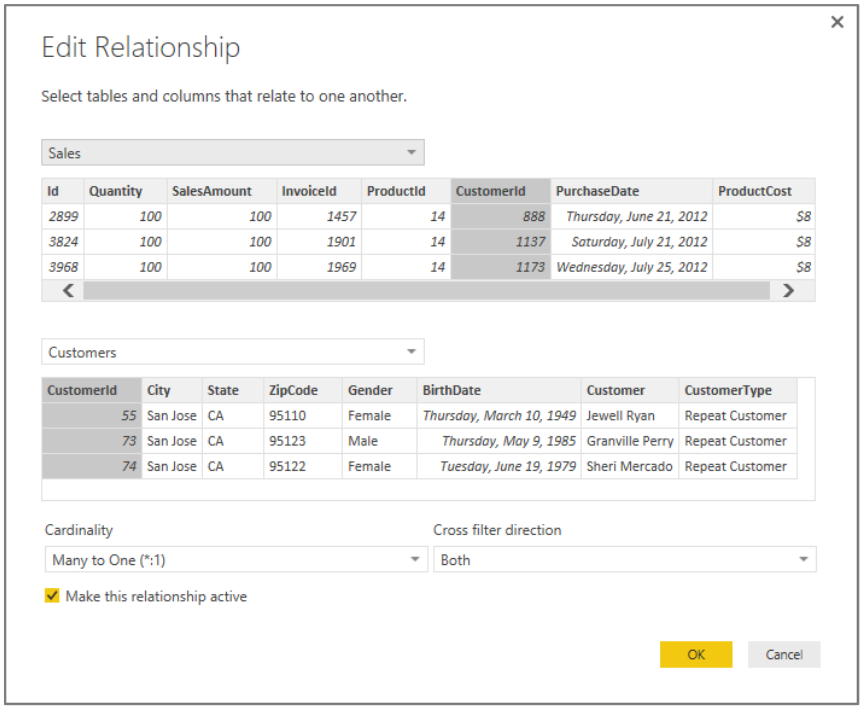
Relationship Properties

- Cardinality



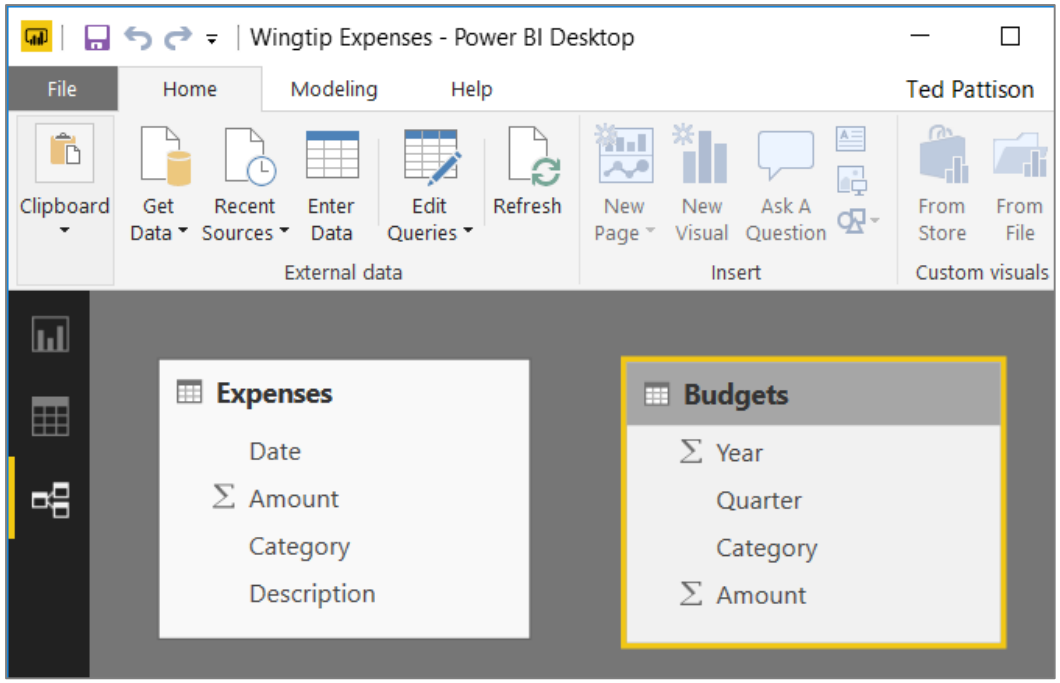
- Cross filter direction





How Do You Create a Relationship Here?

- Two tables don't have fields to create relationship
  - The solution is to create two new calculated columns

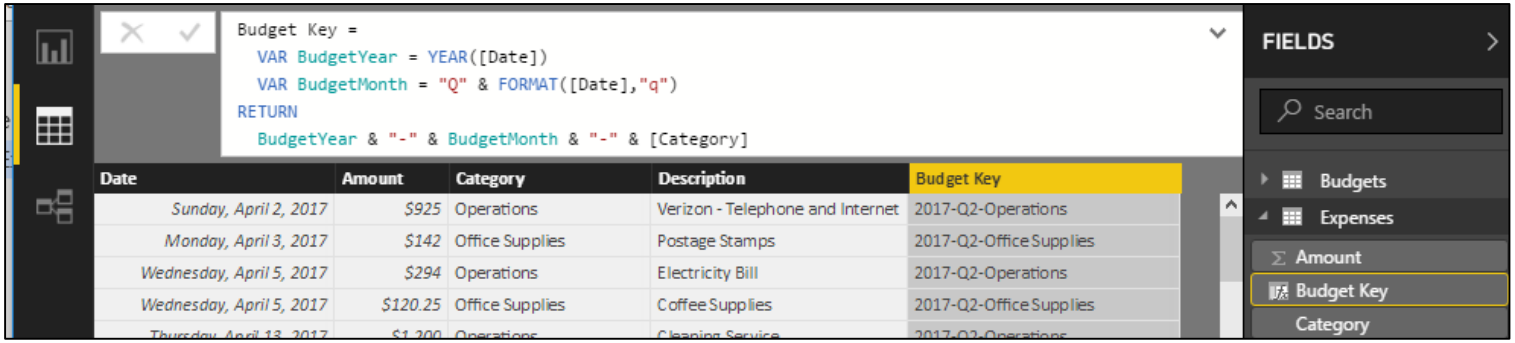


Creating Composite Key Fields

- Create composite key column in Budgets

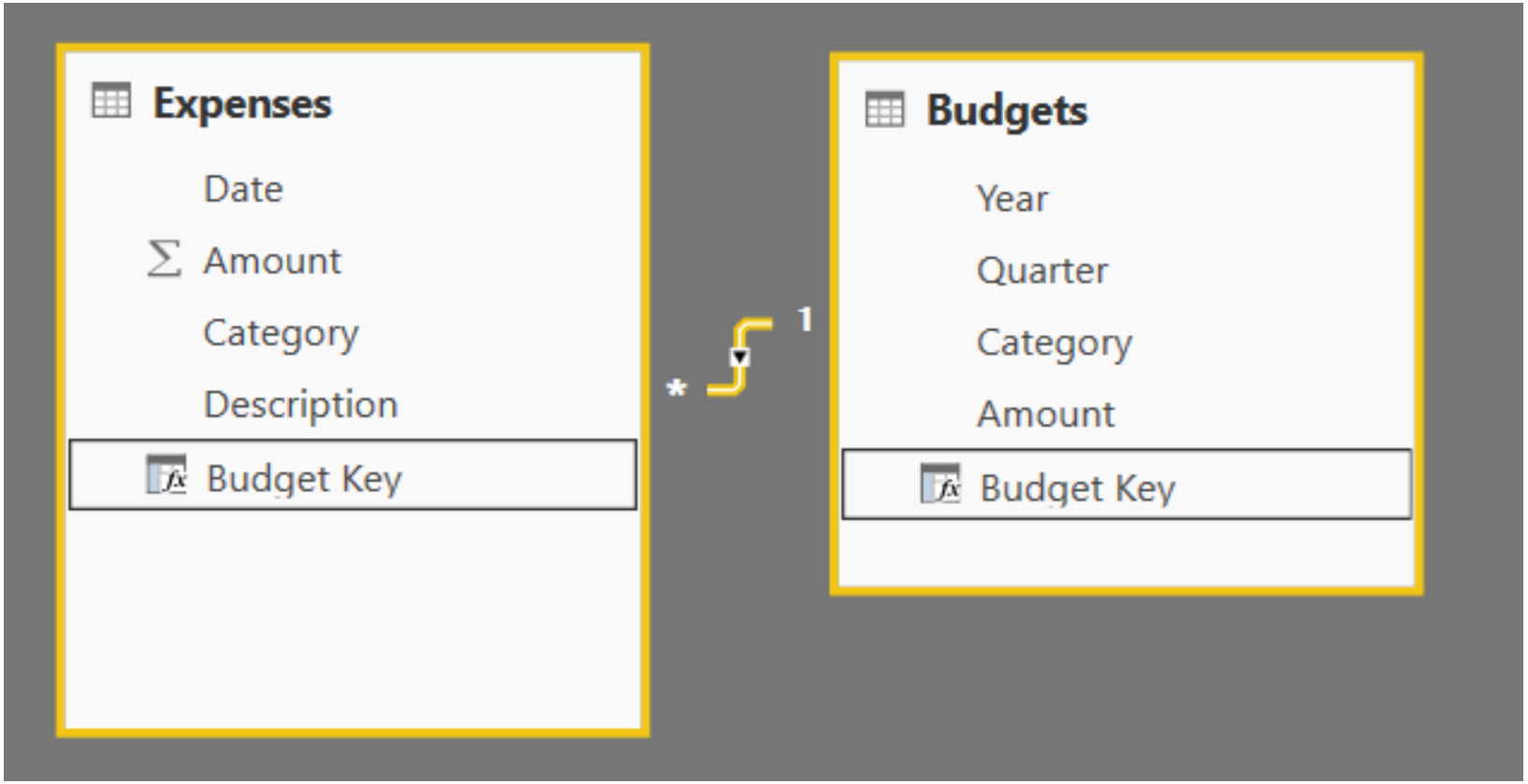
Year	Quarter	Category	Amount	Budget Key
2017	Q1	Marketing	$5,000	2017-Q1-Marketing
2017	Q1	Office Supplies	$8,000	2017-Q1-Office Supplies
2017	Q1	Operations	$8,000	2017-Q1-Operations
2017	Q1	Research & Development	$5,000	2017-Q1-Research & Development
2017	Q2	Marketing	$6,000	2017-Q2-Marketing
2017	Q2	Office Supplies	$4,000	2017-Q2-Office Supplies
2017	Q2	Operations	$7,000	2017-Q2-Operations

- Create composite key column in Expenses



Date	Amount	Category	Description	Budget Key
Sunday, April 2, 2017	$925	Operations	Verizon - Telephone and Internet	2017-Q2-Operations
Monday, April 3, 2017	$142	Office Supplies	Postage Stamps	2017-Q2-Office Supplies
Wednesday, April 5, 2017	$294	Operations	Electricity Bill	2017-Q2-Operations
Wednesday, April 5, 2017	$120.25	Office Supplies	Coffee Supplies	2017-Q2-Office Supplies
Thursday, April 13, 2017	$1,200	Operations	Cleaning Service	2017-Q2-Operations

Create Relationship Using Composite Keys



Agenda

- ✓ Creating Table Relationships
- ➢ Creating Calculated Columns and Measure
- Creating Tables using DAX Expressions
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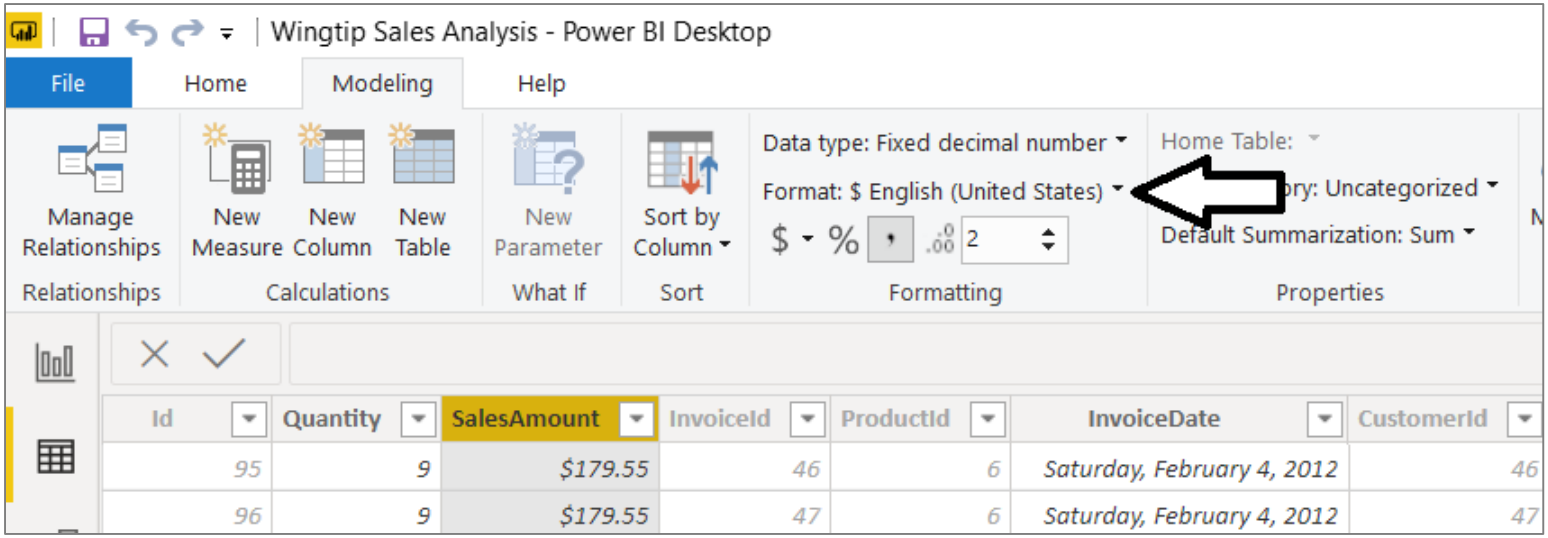
Formatting Columns

- Each column has its own formatting properties
  - Formatting propagates to reports and visuals
  - Visuals automatically display values using format properties



Working with DAX

- DAX is the language used to create data models
  - 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])
```

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()
)
```

Creating Variables in DAX Expressions

- Variables can be added at start of expression
  - Use **VAR** keyword once for each variable
  - Use **RETURN** keyword to return expression value

```
Budget Key =
  VAR BudgetYear = YEAR([Date])
  VAR BudgetMonth = "Q" & FORMAT([Date],"q")
RETURN
  BudgetYear & "-" & BudgetMonth & "-" & [Category]
```

Calculated Columns vs Measures

- Calculated Columns (aka 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>
```

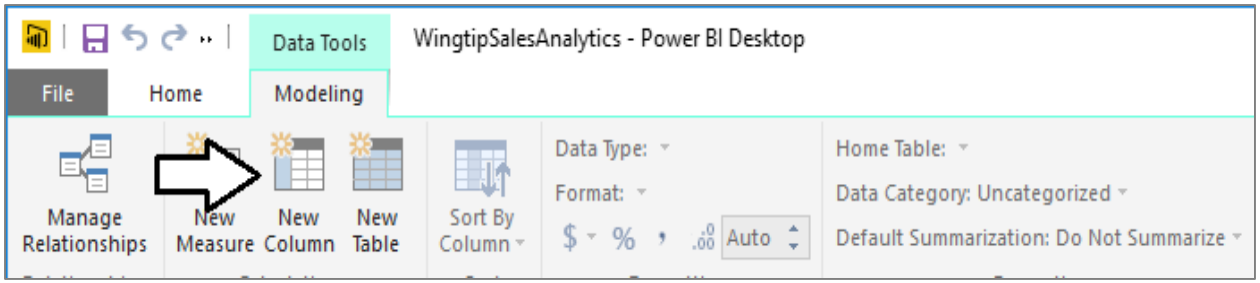
When to Create Calculated Columns

- 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)

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




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

CustomerId	City	State	Zipcode	Gender	BirthDate	Customer	Customer Type	Age
760	San Jose	CA	95133	Female	3/16/1968	Lucile Blake	One-time Customer	51
881	San Jose	CA	95133	Female	7/19/1942	Rochelle Owen	One-time Customer	77
940	San Jose	CA	95133	Female	3/7/1943	Corinne Finch	One-time Customer	76
1119	San Jose	CA	95133	Female	9/3/1990	Twila Massey	One-time Customer	29

Calculated Column for Customer Age Group

1. Calculate customer age from birthdate

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

CustomerId	City	State	Zipcode	Gender	BirthDate	Customer	Customer Type	Age
760	San Jose	CA	95133	Female	3/16/1968	Lucile Blake	One-time Customer	51
881	San Jose	CA	95133	Female	7/19/1942	Rochelle Owen	One-time Customer	77
940	San Jose	CA	95133	Female	3/7/1943	Corinne Finch	One-time Customer	76
1119	San Jose	CA	95133	Female	9/3/1990	Twila Massey	One-time Customer	29

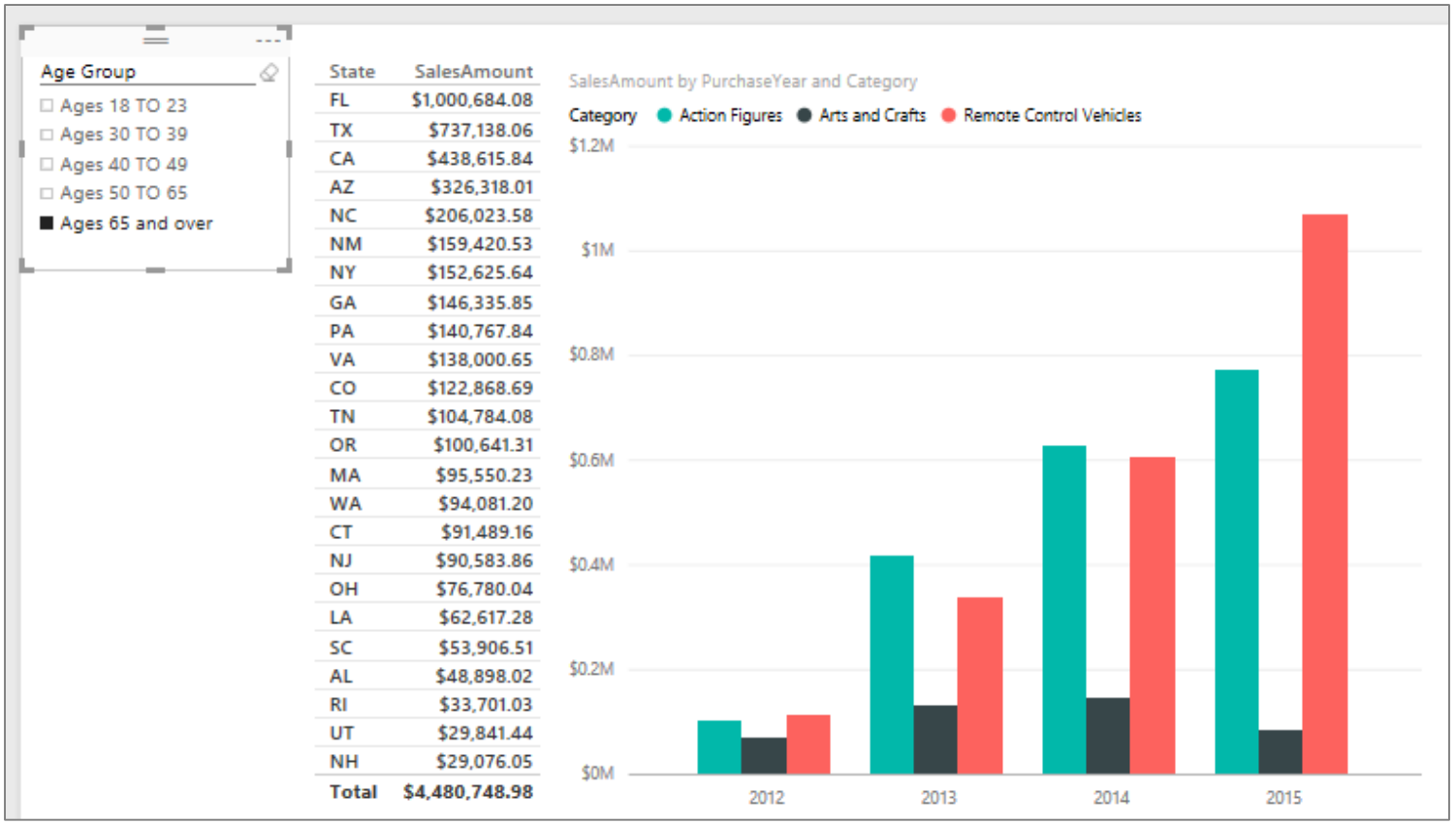
2. Calculate age groups using calculated column

```
1  Age Group =
2  SWITCH (
3      TRUE(),
4      [Age] >= 65, "65 and over",
5      [Age] >= 50, "50 to 64",
6      [Age] >= 40, "40 to 49",
7      [Age] >= 30, "30 to 39",
8      [Age] >= 18, "18 to 29",
9      [Age] < 18, "Under 18"
10 )
```

CustomerId	City	State	Zipcode	Gender	BirthDate	Customer	Customer Type	Age	Age Group
760	San Jose	CA	95133	Female	3/16/1968	Lucile Blake	One-time Customer	51	50 to 64
881	San Jose	CA	95133	Female	7/19/1942	Rochelle Owen	One-time Customer	77	65 and over
940	San Jose	CA	95133	Female	3/7/1943	Corinne Finch	One-time Customer	76	65 and over
1119	San Jose	CA	95133	Female	9/3/1990	Twila Massey	One-time Customer	29	18 to 29

Calculated Column used in a Slicer

- Calculated column can populate slicer values

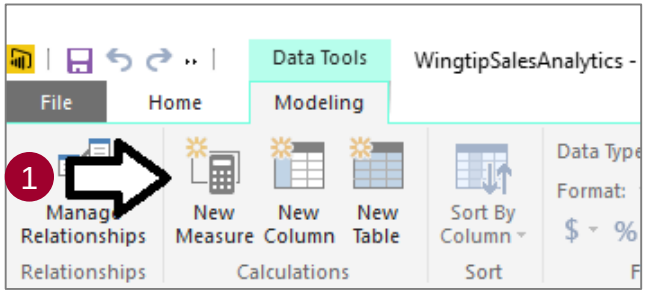


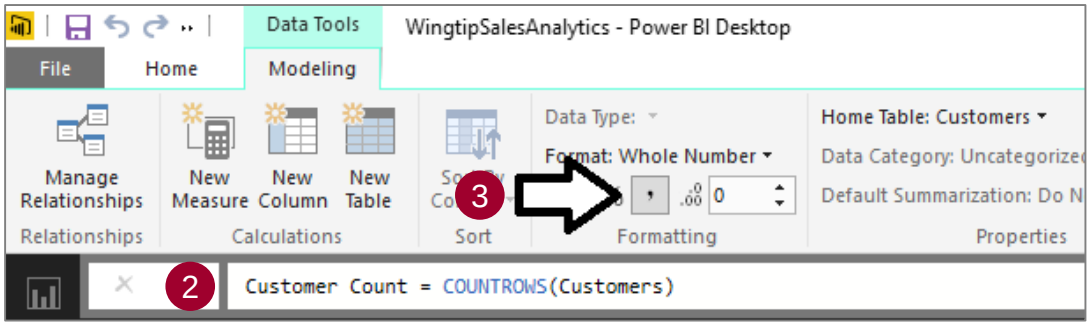
State	SalesAmount
FL	$1,000,684.08
TX	$737,138.06
CA	$438,615.84
AZ	$326,318.01
NC	$206,023.58
NM	$159,420.53
NY	$152,625.64
GA	$146,335.85
PA	$140,767.84
VA	$138,000.65
CO	$122,868.69
TN	$104,784.08
OR	$100,641.31
MA	$95,550.23
WA	$94,081.20
CT	$91,489.16
NJ	$90,583.86
OH	$76,780.04
LA	$62,617.28
SC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

Creating Measures

- Measures have advantage over calculated columns
  - They are evaluated based on the current evaluation context

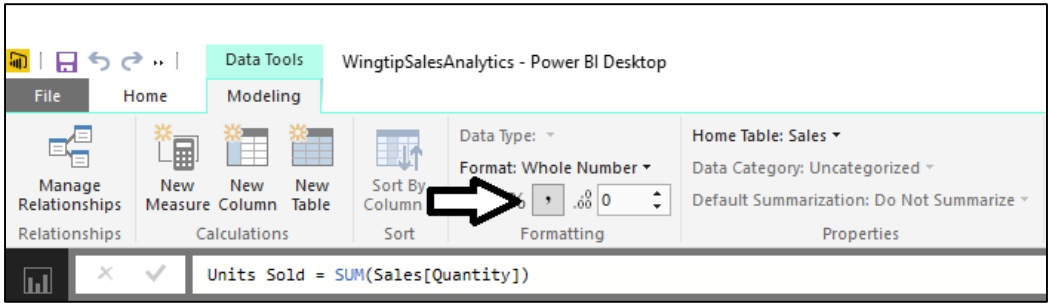
- Creating a measure with Power BI Desktop
  1. Click New Measure button
  2. Give measure a name and write DAX expressions
  3. Configure formatting



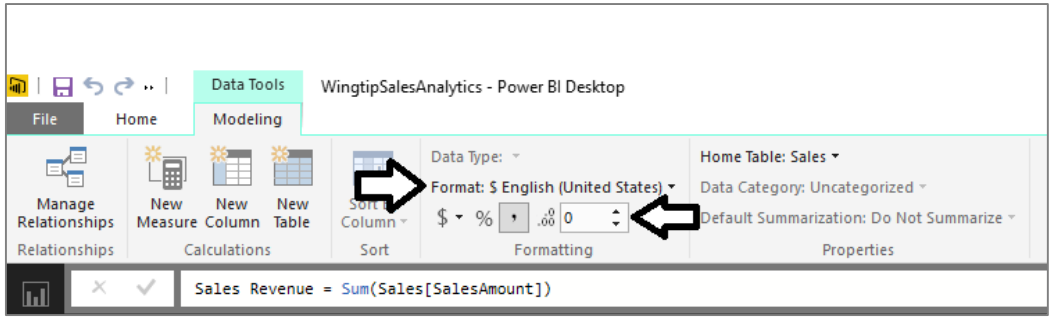


Formatting Measures

- Format as whole number



- Format as currency



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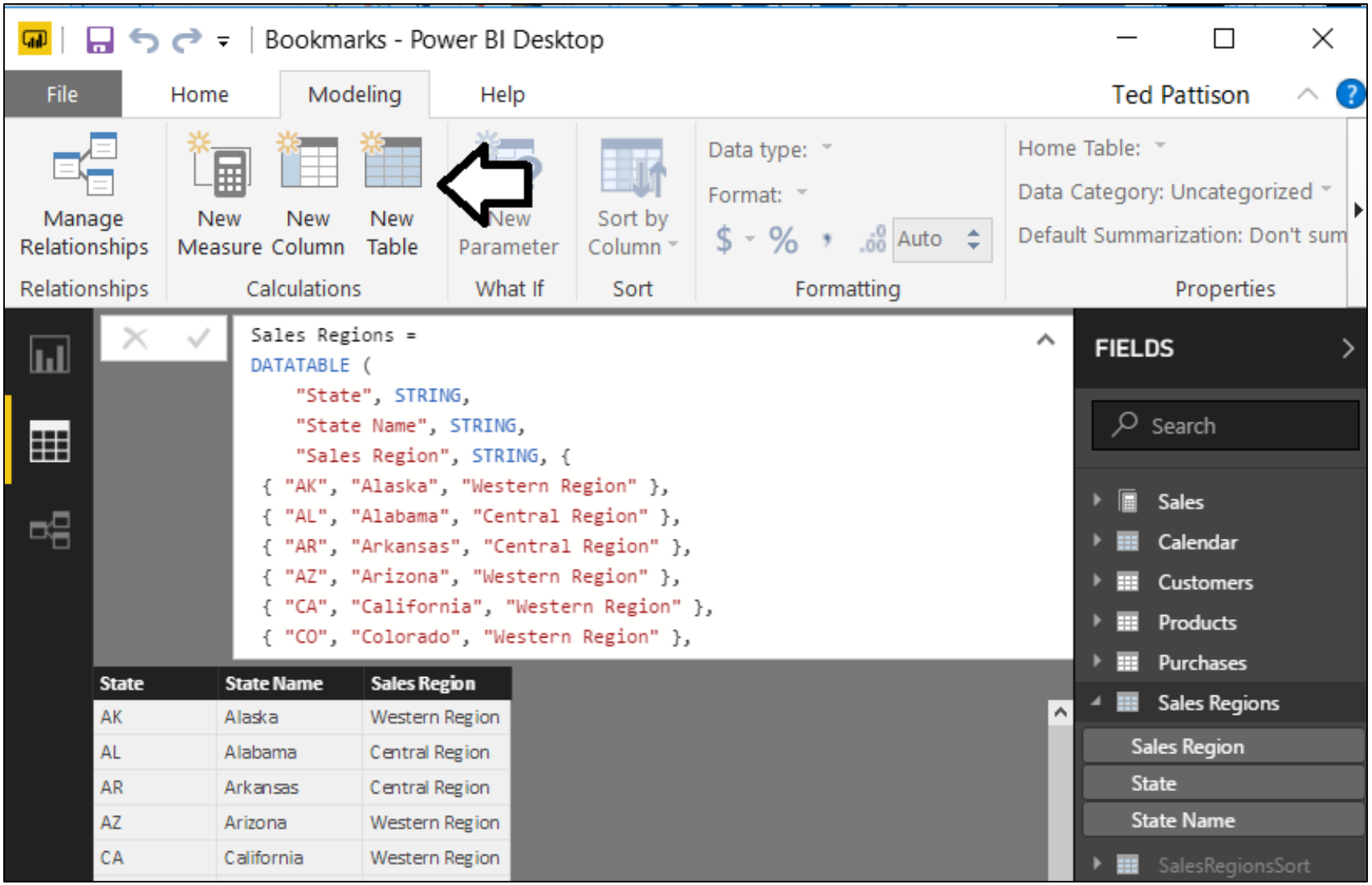
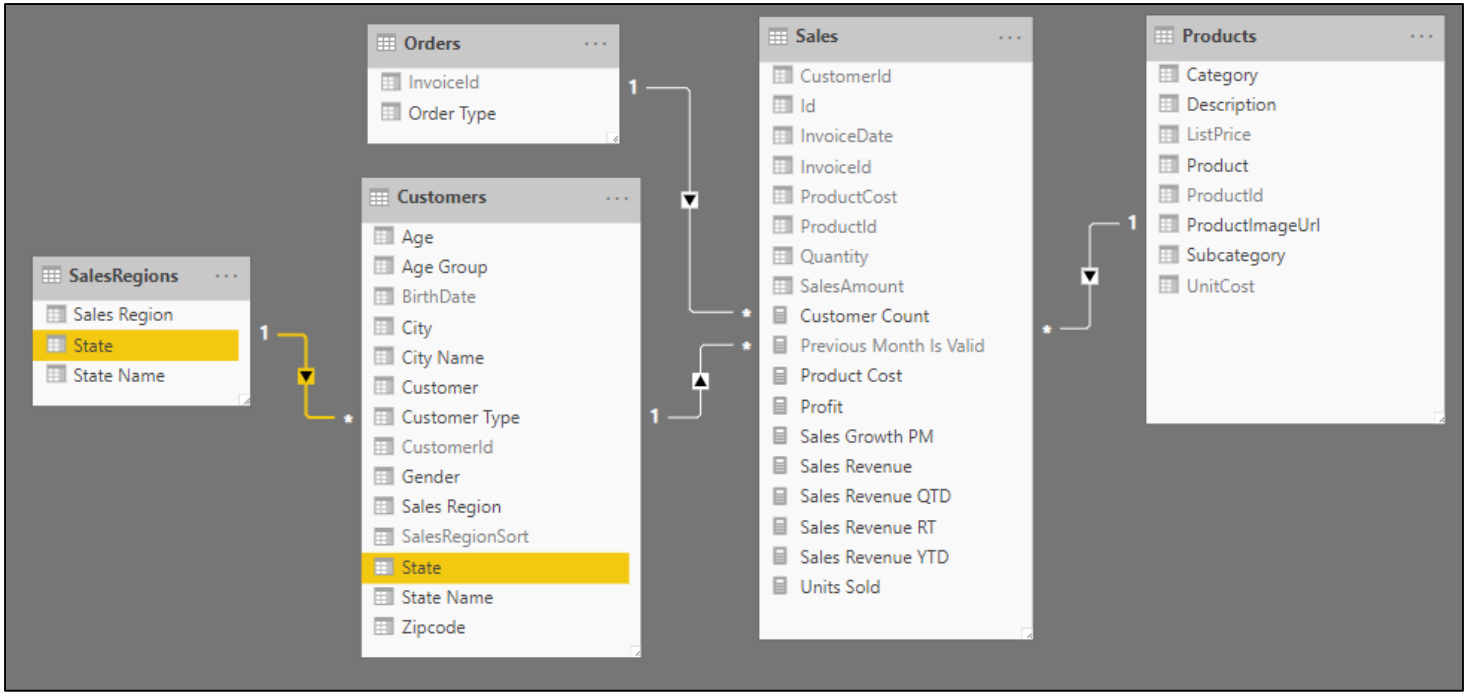
Creating Tables Dynamically using DAX



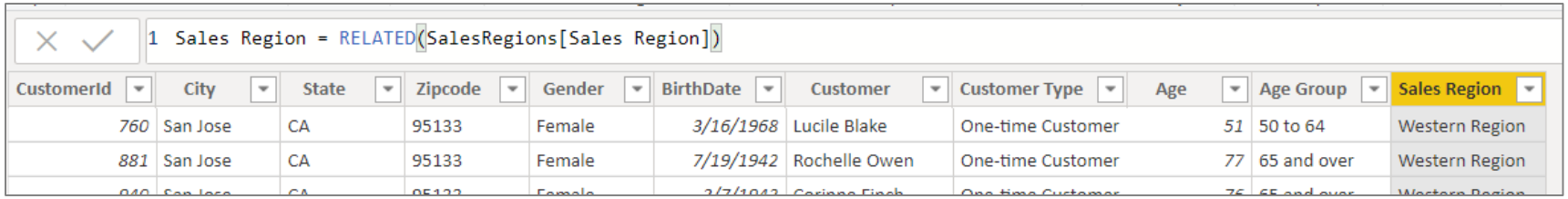
Integrating the Lookup Table into the Data Model

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



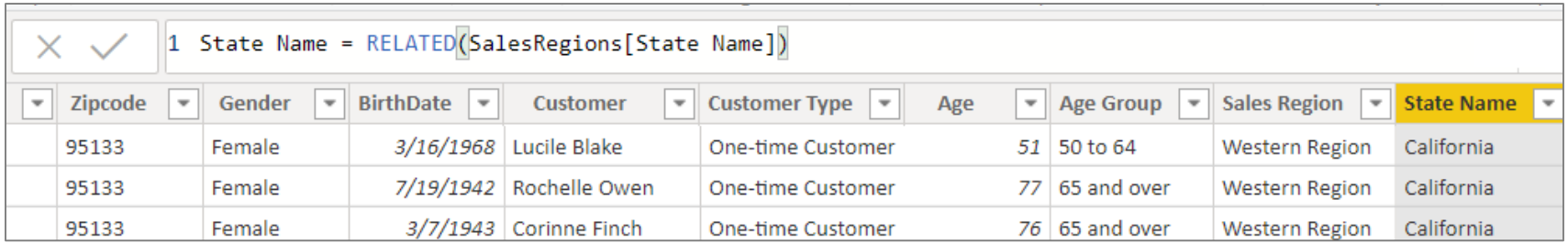
The RELATED Function

- 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



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

CustomerId	City	State	Zipcode	Gender	BirthDate	Customer	Customer Type	Age	Age Group	Sales Region
760	San Jose	CA	95133	Female	3/16/1968	Lucile Blake	One-time Customer	51	50 to 64	Western Region
881	San Jose	CA	95133	Female	7/19/1942	Rochelle Owen	One-time Customer	77	65 and over	Western Region



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

Zipcode	Gender	BirthDate	Customer	Customer Type	Age	Age Group	Sales Region	State Name
95133	Female	3/16/1968	Lucile Blake	One-time Customer	51	50 to 64	Western Region	California
95133	Female	7/19/1942	Rochelle Owen	One-time Customer	77	65 and over	Western Region	California
95133	Female	3/7/1943	Corinne Finch	One-time Customer	76	65 and over	Western Region	California

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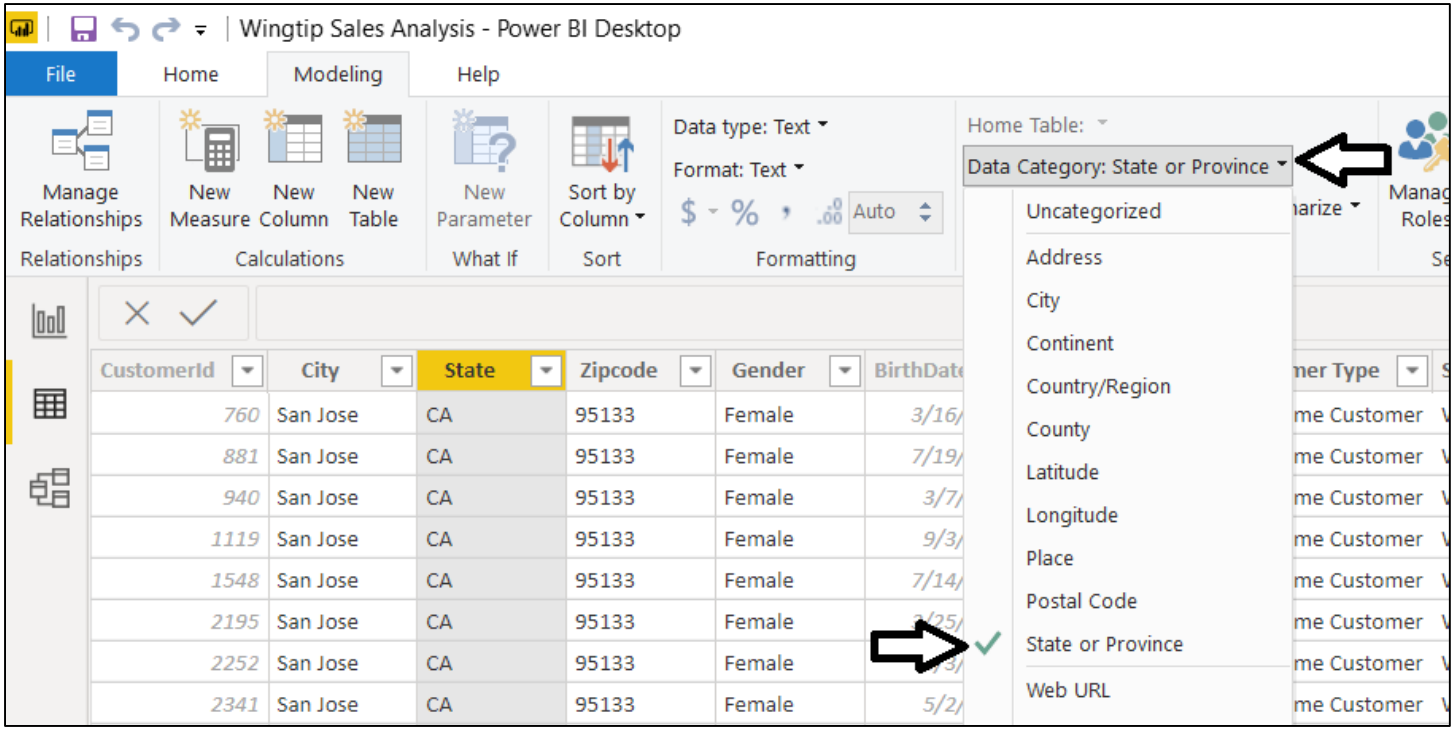
Geographic Field Metadata

- Fields in data model have metadata properties
  - Metadata used by visuals and reporting tools
  - Used as hints to Bing Mapping service



Eliminate Geographic Ambiguity

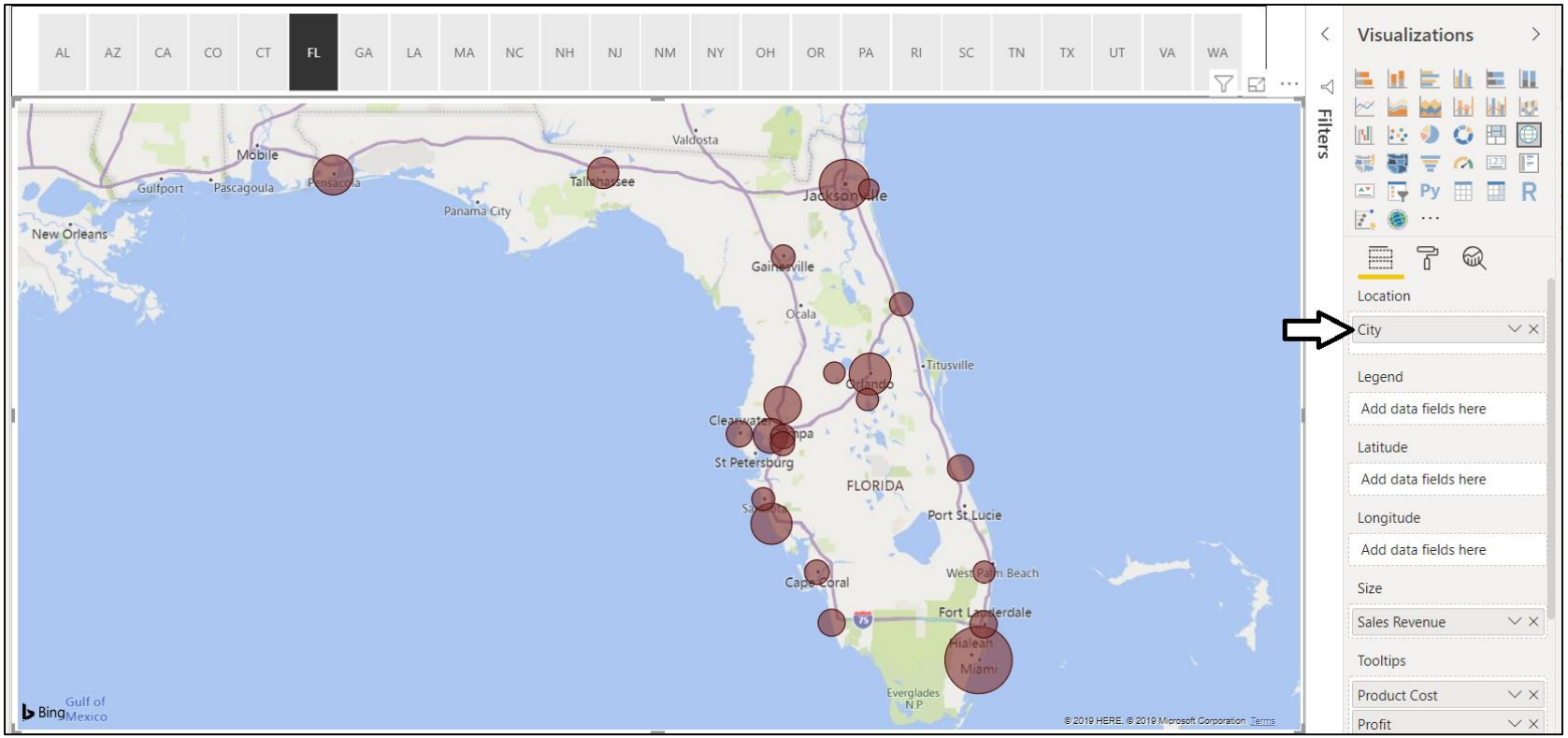
- City name alone is ambiguous
  - "Athens" defaults to Greece not Georgia
  - Concatenate city name with state to disambiguate

```
1  City = [City Name] & ", " & [State]
```

BirthDate	Customer	Customer Type	Age	Age Group	Sales Region	State Name	SalesRegionSort	City
3/16/1968	Lucile Blake	One-time Customer	51	50 to 64	Western Region	California	1	San Jose, CA
7/19/1942	Rochelle Owen	One-time Customer	77	65 and over	Western Region	California	1	San Jose, CA
3/7/1943	Corinne Finch	One-time Customer	76	65 and over	Western Region	California	1	San Jose, CA
9/3/1990	Twila Massey	One-time Customer	29	18 to 29	Western Region	California	1	San Jose, CA
7/14/1955	Kellie Yang	One-time Customer	64	50 to 64	Western Region	California	1	San Jose, CA
3/25/1951	Megan Martin	One-time Customer	68	65 and over	Western Region	California	1	San Jose, CA

Using Map Visual with a Geographic Field

- Map Visual shows distribution over geographic area
  - Visual automatically updates when filtered



Summary

- ✓ Creating Table Relationships
- ✓ Creating Calculated Columns and Measure
- ✓ Creating Tables using DAX Expressions
- ✓ Configuring Fields for Geographic Mapping