

# 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
  - Creating Dimensional Hierarchies
  - Using the DAX Calculate Function
  - Calendar Tables and Time Intelligence



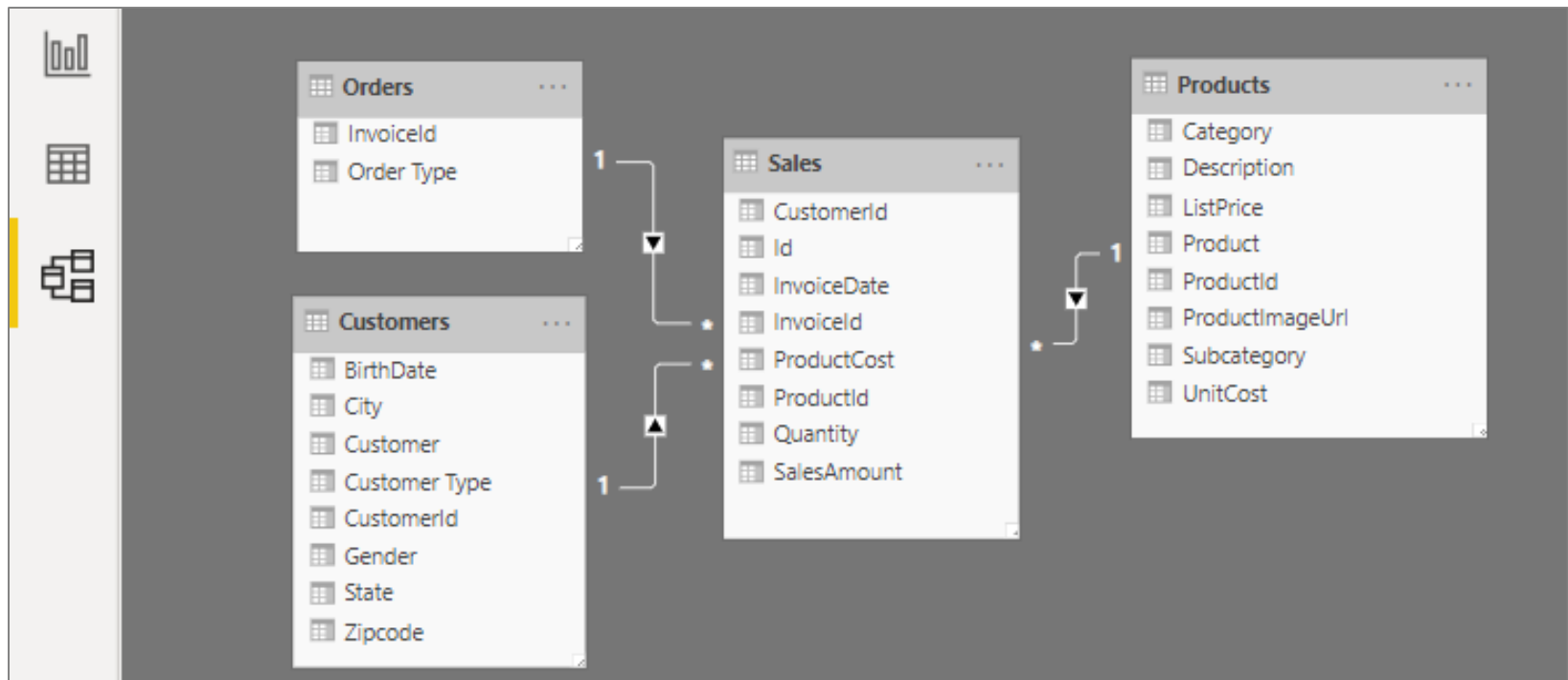
# Data Modeling with Power BI Desktop

- 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

Cardinality

Many to One (\*:1)

Many to One (\*:1)

One to One (1:1)

One to Many (1:\*)

- Cross filter direction

Cross filter direction

Both

Single

Both

Edit Relationship

Select tables and columns that relate to one another.

Sales

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

Customers

CustomerId	City	State	ZipCode	Gender	BirthDate	Customer	CustomerType
55	San Jose	CA	95110	Female	Thursday, March 10, 1949	Jewell Ryan	Repeat Customer
73	San Jose	CA	95123	Male	Thursday, May 9, 1985	Granville Perry	Repeat Customer
74	San Jose	CA	95122	Female	Tuesday, June 19, 1979	Sheri Mercado	Repeat Customer

Cardinality

Many to One (\*:1)

Cross filter direction

Both

☒ Make this relationship active

OK Cancel



# 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

The screenshot shows the Power BI interface with a table named 'Budgets'. The formula bar at the top displays the formula: `Budget Key = [Year] & "-" & [Quarter] & "-" & [Category]`. The table has five columns: Year, Quarter, Category, Amount, and Budget Key. The 'Budget Key' column contains values like '2017-Q1-Marketing'. On the right, the 'FIELDS' pane shows the 'Budgets' table selected, with 'Amount', 'Budget Key', and 'Category' listed. 'Budget Key' is highlighted with a yellow box.

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

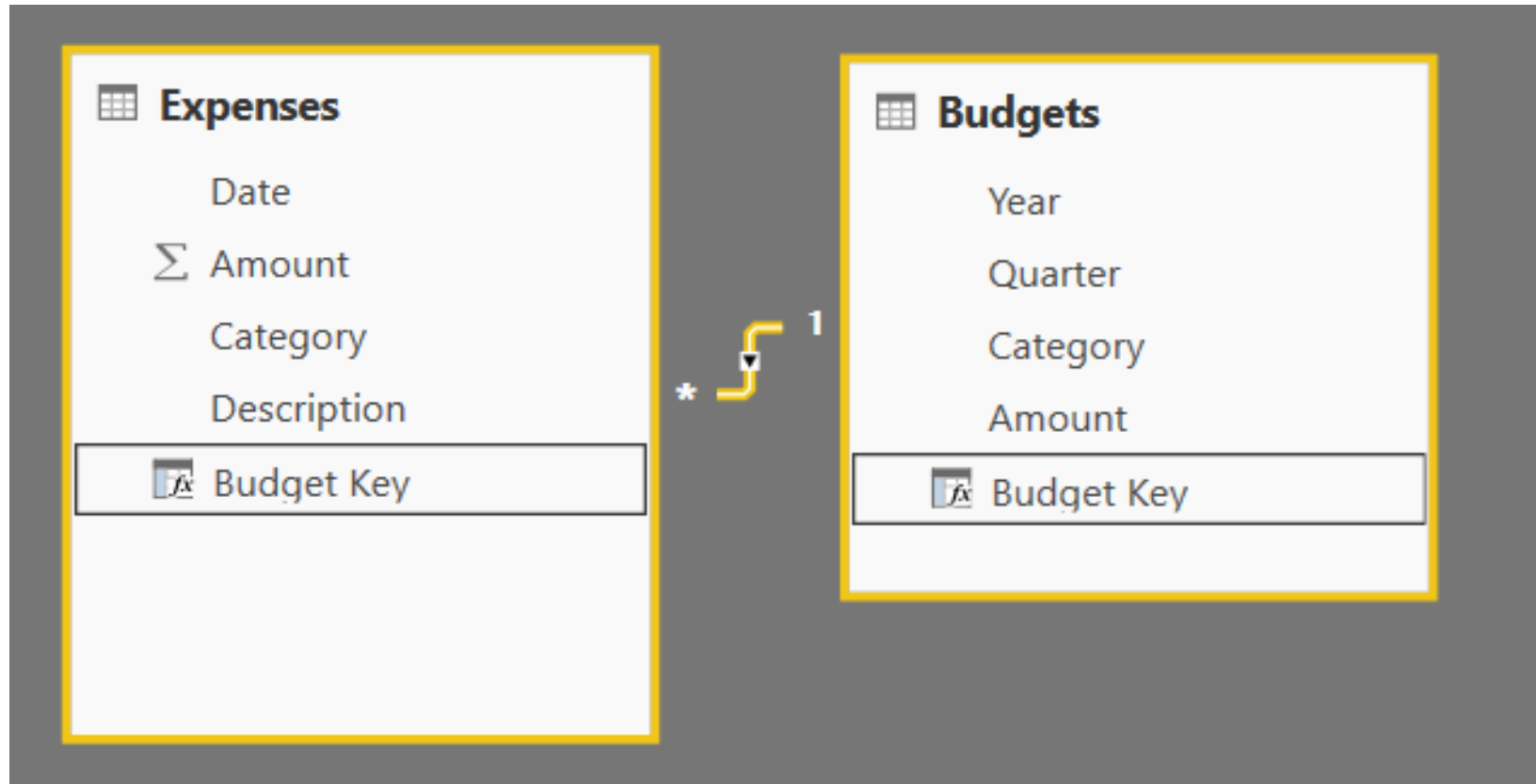
- Create composite key column in Expenses

The screenshot shows the Power BI interface with a table named 'Expenses'. The formula bar at the top displays the formula: `Budget Key = VAR BudgetYear = YEAR([Date]) VAR BudgetMonth = "Q" & FORMAT([Date], "q") RETURN BudgetYear & "-" & BudgetMonth & "-" & [Category]`. The table has five columns: Date, Amount, Category, Description, and Budget Key. The 'Budget Key' column contains values like '2017-Q2-Operations'. On the right, the 'FIELDS' pane shows the 'Expenses' table selected, with 'Amount', 'Budget Key', and 'Category' listed. 'Budget Key' is highlighted with a yellow box.

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





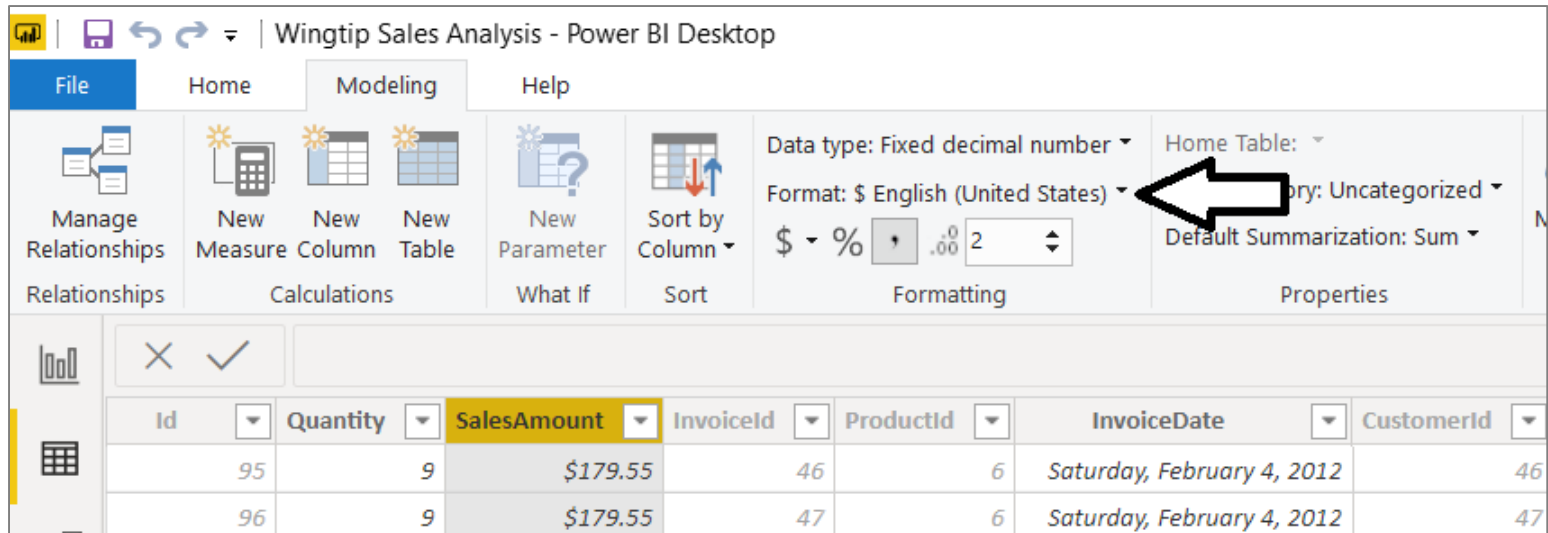
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# Formatting Columns

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



Wingtip Sales Analysis - Power BI Desktop

File Home Modeling Help

Manage Relationships Relationships

New Measure Calculations

New Column

New Table

New Parameter What If

Sort by Column Sort

Data type: Fixed decimal number

Format: \$ English (United States)

\$ % , .00 2

Formatting

Home Table: Sales

Property: Uncategorized

Default Summarization: Sum

Properties

Id	Quantity	SalesAmount	InvoiceId	ProductId	InvoiceDate	CustomerId
95	9	\$179.55	46	6	Saturday, February 4, 2012	46
96	9	\$179.55	47	6	Saturday, February 4, 2012	47



# Working with DAX

- DAX is the language used to create data models
  - DAX stands for "Data Analysis Expression 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

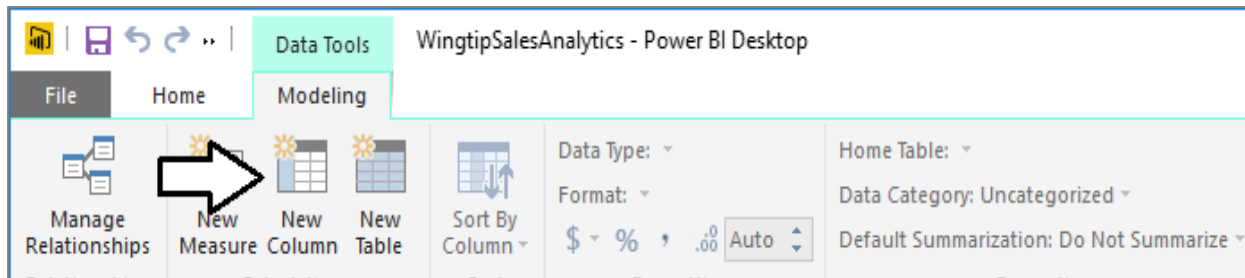
- Measures often better choice than calculate columns
  - Don't create calculated column when you need a measure
  - Prefer to create calculated columns only in specific scenarios
- When should you create calculated columns?
  - To create headers for row labels or column labels
  - To place calculated 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



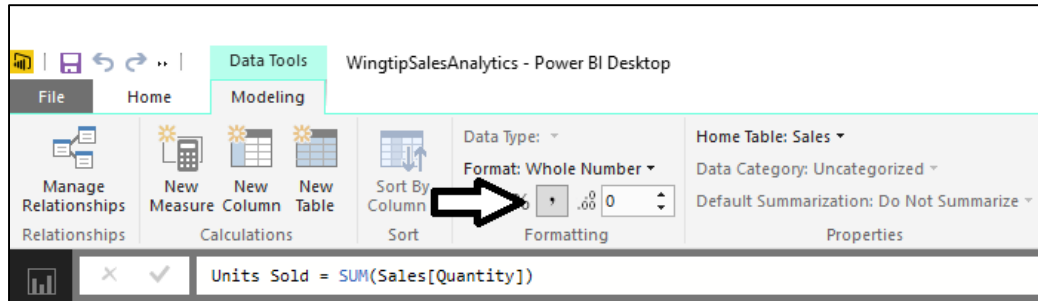
# Creating Measures

- 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

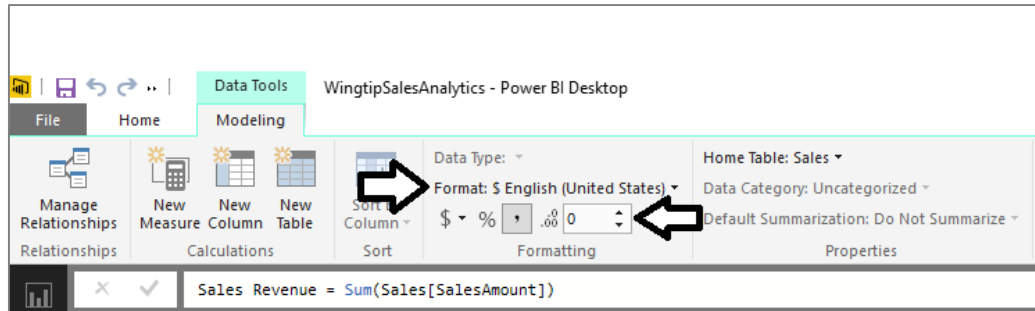


# Formatting Measures

- Format as whole number



- Format as currency

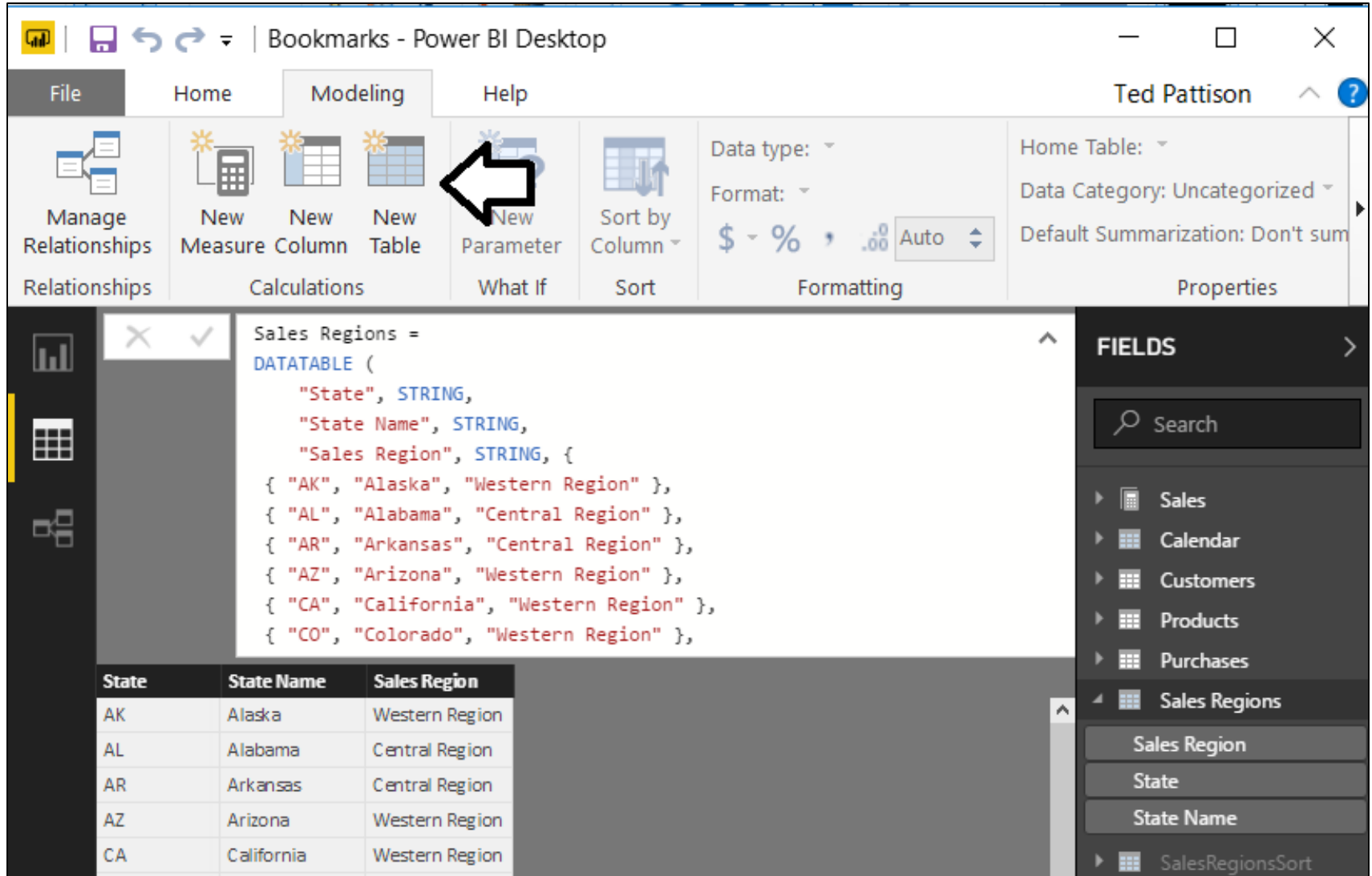


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# Creating Tables Dynamically using DAX



The screenshot shows the Power BI Desktop interface with the 'Modeling' ribbon selected. A large black arrow points to the 'New Table' button. The 'Sales Regions' table is being created using the following DAX formula:

```
Sales Regions =  
DATATABLE (  
    "State", STRING,  
    "State Name", STRING,  
    "Sales Region", STRING, {  
        { "AK", "Alaska", "Western Region" },  
        { "AL", "Alabama", "Central Region" },  
        { "AR", "Arkansas", "Central Region" },  
        { "AZ", "Arizona", "Western Region" },  
        { "CA", "California", "Western Region" },  
        { "CO", "Colorado", "Western Region" },  
    }  
)
```

The resulting table is displayed below the formula:

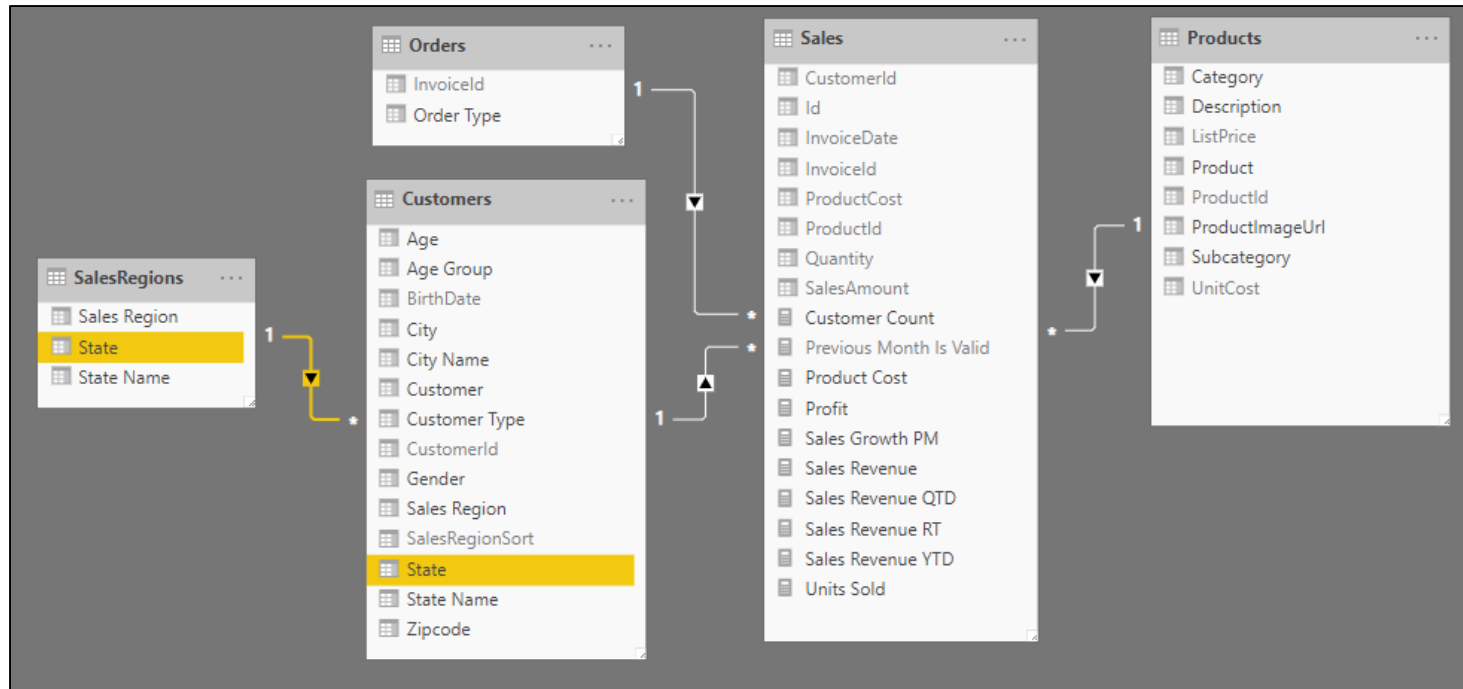
State	State Name	Sales Region
AK	Alaska	Western Region
AL	Alabama	Central Region
AR	Arkansas	Central Region
AZ	Arizona	Western Region
CA	California	Western Region

The 'FIELDS' pane on the right shows the 'Sales Regions' table selected, with its columns 'Sales Region', 'State', and 'State Name' listed.



# 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
949	San Jose	CA	95133	Female	3/7/1943	Corinne Finch	One-time Customer	76	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

Wingtip Sales Analysis - Power BI Desktop

File Home Modeling Help

Manage Relationships Relationships

New Measure Calculations

New Column

New Table

New Parameter What If

Sort by Column Sort

Data type: Text

Format: Text

\$ - % , .00 Auto

Formatting

Home Table: Data Category: State or Province

Uncategorized

Address

City

Continent

Country/Region

County

Latitude

Longitude

Place

Postal Code

State or Province

Web URL

CustomerId	City	State	Zipcode	Gender	BirthDate
760	San Jose	CA	95133	Female	3/16/
881	San Jose	CA	95133	Female	7/19/
940	San Jose	CA	95133	Female	3/7/
1119	San Jose	CA	95133	Female	9/3/
1548	San Jose	CA	95133	Female	7/14/
2195	San Jose	CA	95133	Female	3/25/
2252	San Jose	CA	95133	Female	3/3/
2341	San Jose	CA	95133	Female	5/2/



# Eliminate Geographic Ambiguity

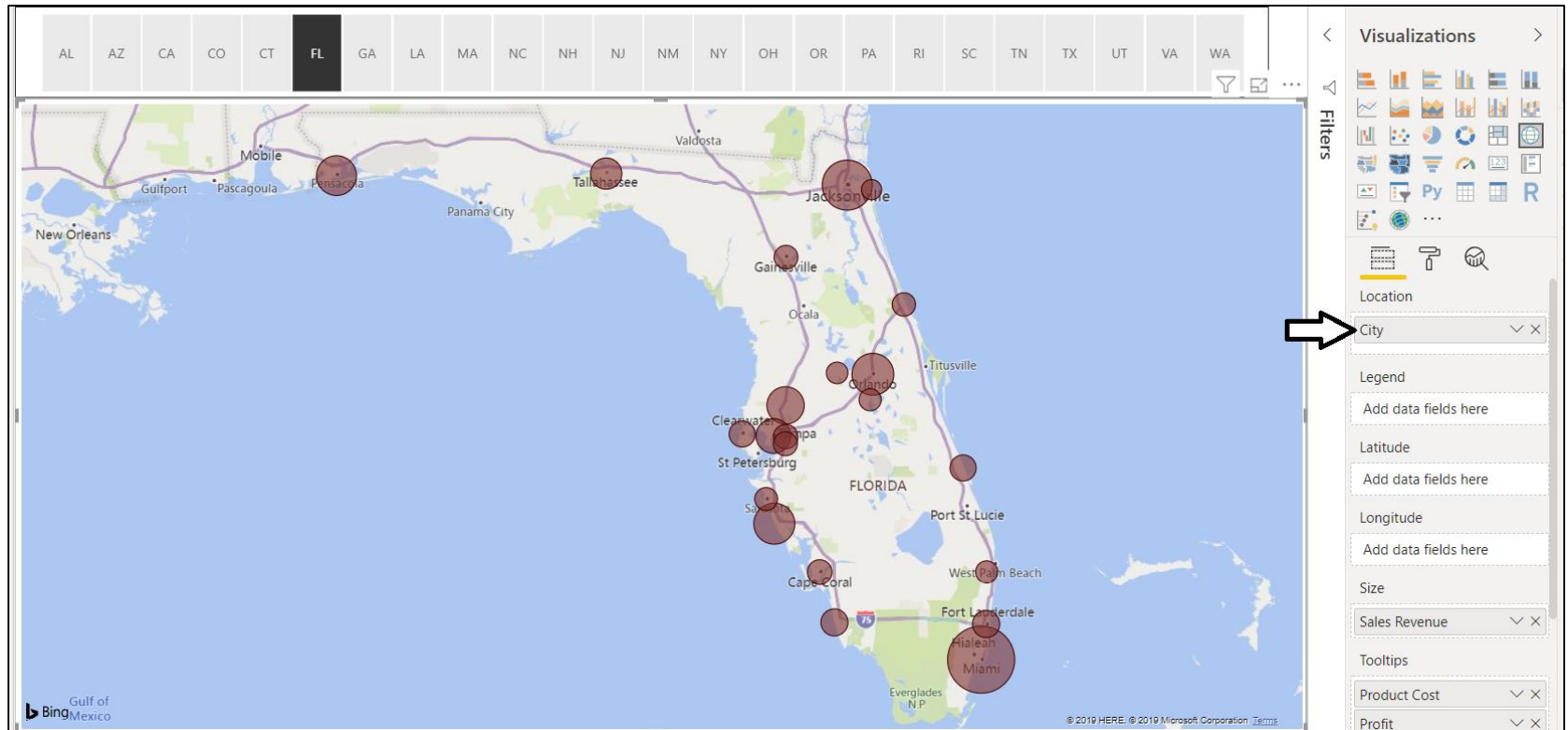
- City name alone is ambiguous
  - "Athens" defaults to Greece not Georgia
  - Concatenate city name with state to disambiguate

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



# Agenda

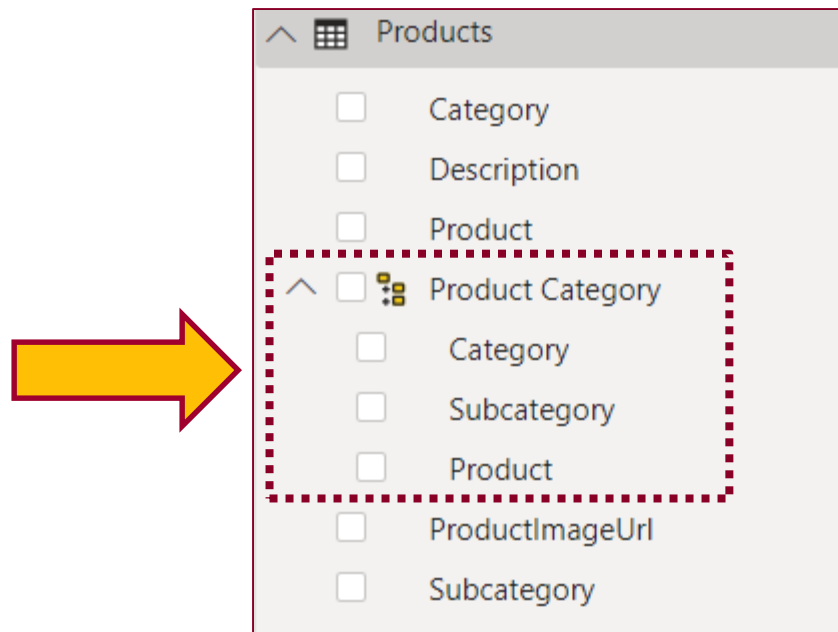
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# Dimensional Hierarchies

- Hierarchy created from two or more columns
  - All columns in hierarchy must be from the same table
  - Defines parent-child relationship between columns
  - Provides path to navigate through data
  - Provides path to drill down into greater level of detail



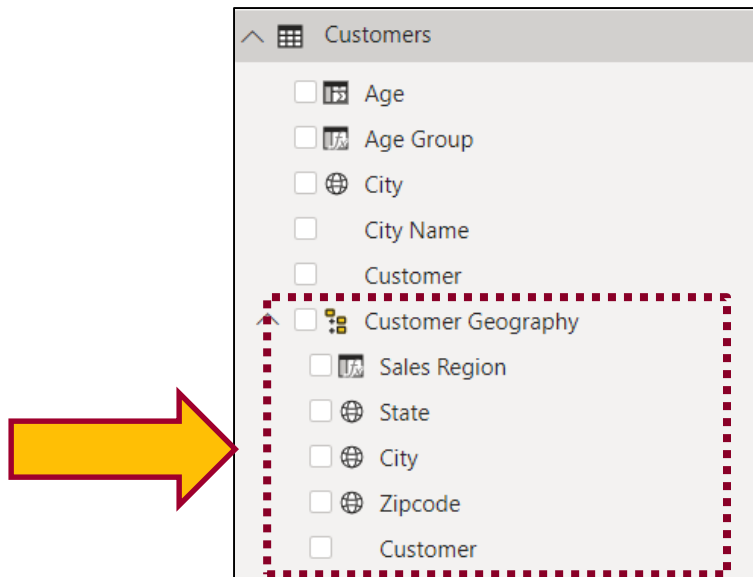
# Pulling Columns for Hierarchy into Single Table

- Sometimes hierarchy columns are spread across tables
  - Use RELATED function from DAX to pull columns into single 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
940	San Jose	CA	95133	Female	3/7/1942	Carlene Finch	One-time Customer	75	65 and over	Western Region

- Then create hierarchy in the table with all the columns



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# A Tale of Two Evaluation Contexts

- Row Context
  - Context includes all columns in iteration of current row
  - Used to evaluate DAX expression in calculated column
  - Only available in measures with iterator function (e.g. SUMX)
- Filter Context
  - Context includes filter(s) defining current set of rows
  - Used by default to evaluate DAX expressions in measures
  - Can be fully ignored or partially ignored using DAX code
  - Not used to evaluate DAX in calculated columns



# Understanding Row Context

- Row context used to evaluate calculated columns

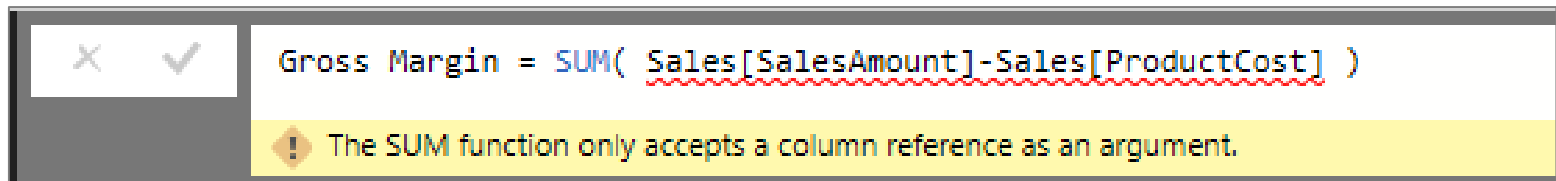
✕	✓	City = [City Name] & ", " & [State]			
	Age Group	Sales Region	State Name	SalesRegionSort	City
48	Ages 40 TO 49	Western Region	California	1	San Jose, CA
74	Ages 65 and over	Western Region	California	1	San Jose, CA
73	Ages 65 and over	Western Region	California	1	San Jose, CA
25	Ages 18 TO 23	Western Region	California	1	San Jose, CA
61	Ages 50 TO 65	Western Region	California	1	San Jose, CA
65	Ages 65 and over	Western Region	California	1	San Jose, CA

✕	✓	Age = Floor( (TODAY()-Customers[BirthDate])/365, 1)			
Customer	Customer Type	Age	Age Group	Sales Region	State Name
Lucile Blake	One-time Customer	48	Ages 40 TO 49	Western Region	California
Rochelle Owen	One-time Customer	74	Ages 65 and over	Western Region	California
Corinne Finch	One-time Customer	73	Ages 65 and over	Western Region	California

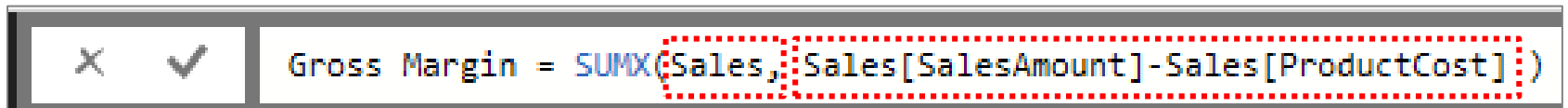


# Understanding Iterators Like SUMX

- Standard aggregation functions (e.g. SUM) have no row context
  - You can use SUM to sum values of a single column
  - You cannot use SUM to sum results of an expressions



- Iterator functions (e.g. SUMX) iterate through rows in target table



- First argument accepts expressions that evaluates to table of rows
- Second argument accepts expression that is evaluated for each row



# Understanding Filter Context

- Visuals apply various filters in different evaluation contexts

Month in Year	2012	2013	2014	2015	Total
Jan	\$3,063	\$307,182	\$629,969	\$959,863	\$1,900,077
Feb	\$33,218	\$291,942	\$609,637	\$969,330	\$1,904,126
Mar	\$49,213	\$346,186	\$628,618	\$675,533	\$1,699,551
Apr	\$40,434	\$380,869	\$661,588	\$722,456	\$1,805,347
May	\$83,840	\$377,376	\$748,193	\$698,311	\$1,907,720
Jun	\$136,670	\$353,586	\$814,333	\$785,793	\$2,090,382
Jul	\$144,244	\$391,202	\$788,469	\$921,994	\$2,245,908
Aug	\$197,952	\$476,884	\$869,143	\$1,084,189	\$2,628,168
Sep	\$215,097	\$504,532	\$890,958	\$1,088,863	\$2,699,449
Oct	\$239,513	\$577,439	\$988,789	\$1,211,810	\$3,017,551
Nov	\$376,503	\$579,507	\$999,574	\$1,305,029	\$3,260,613
Dec	\$424,240	\$769,473	\$1,644,980	\$1,732,932	\$4,571,625
Total	\$1,943,986	\$5,356,177	\$10,274,251	\$12,156,103	\$29,730,517

## Filters on this evaluation

[Year] = 2015

[Month in Year] = "October"

- Filter context also affected by slicers and other filters

### Sales Region

- ☒ Western Region
- ☐ Central Region
- ☐ Eastern Region

### Customer Type

- ☐ One-time Customer
- ☒ Repeat Customer

Month in Year	2012	2013	2014	2015	Total
Jan		\$117,712	\$202,751	\$182,616	\$503,079
Feb	\$8,264	\$126,522	\$181,564	\$184,674	\$501,024
Mar	\$22,434	\$148,668	\$160,857	\$169,933	\$501,892
Apr	\$22,235	\$178,506	\$183,987	\$194,197	\$578,925
May	\$36,719	\$169,582	\$210,150	\$173,661	\$590,112
Jun	\$55,119	\$158,668	\$217,947	\$196,431	\$628,166
Jul	\$72,823	\$187,093	\$233,333	\$193,830	\$687,079
Aug	\$90,917	\$169,789	\$233,101	\$209,895	\$703,703
Sep	\$77,898	\$155,469	\$225,287	\$213,017	\$671,672
Oct	\$84,735	\$208,700	\$197,377	\$207,227	\$698,039
Nov	\$130,678	\$168,821	\$227,856	\$190,144	\$717,498
Dec	\$147,043	\$203,781	\$234,393	\$195,796	\$781,013
Total	\$748,866	\$1,993,312	\$2,508,601	\$2,311,421	\$7,562,200

## Filters on this evaluation

[Year] = 2015

[Month in Year] = "October"

[Sales Region] = "Western Region"

[Customer Type] = "Repeat Customer"





# Using the CALCULATE Function

- CALCULATE function provides greatest amount of control
  - First argument defines expression to evaluate
  - Second argument defines table on which to evaluate expression
  - You can evaluate expressions with or without current filter context

```
Pct of All Products =  
DIVIDE(  
    SUM( Sales[SalesAmount] ),  
    CALCULATE(  
        Sum (Sales[SalesAmount] ),  
        ALL(Products[Category], Products[Subcategory], Products[Product])  
    )  
)
```

```
Pct of Product Category =  
DIVIDE(  
    SUM( Sales[SalesAmount] ),  
    CALCULATE(  
        Sum (Sales[SalesAmount] ),  
        ALL( Products[Subcategory], Products[Product] )  
    )  
)
```



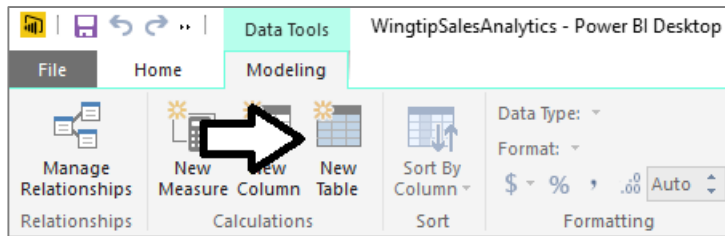
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- ✓ Using the DAX Calculate Function
- Calendar Tables and Time Intelligence

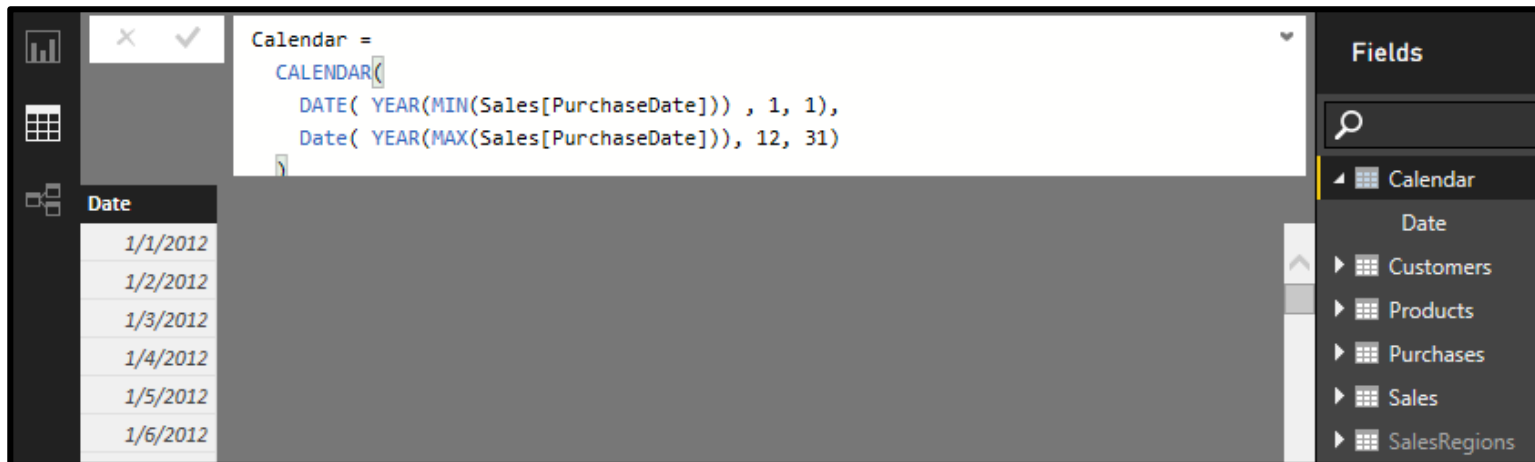


# Creating Calendar Table as Calculated Table

- Use **New Table** command in ribbon



- Create calendar table using DAX **CALENDAR** function



# Adding Columns to Calendar Table

- Creating the **Year** column

X ✓ Year = YEAR('Calendar'[Date])	
Date	Year
1/1/2012	2012
1/2/2012	2012
1/3/2012	2012

- Creating the **Quarter** column

X ✓ Quarter = YEAR('Calendar'[Date]) & "-Q" & FORMAT('Calendar'[Date], "q")			
Date	Year	Quarter	
01/01/2012	2012	2012-Q1	
01/02/2012	2012	2012-Q1	
01/03/2012	2012	2012-Q1	
01/04/2012	2012	2012-Q1	
01/05/2012	2012	2012-Q1	

- Creating the **Month** column

X ✓ 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	



# Configuring Sort Columns

- Month column will not sort in desired fashion by default
  - For example, April will sort before January, February and March
- Creating a sort column for the **Month** column
  - MonthSort** sorts alphabetically & chronologically at same time

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

- Configure **Month** column with **MonthSort** as sort column

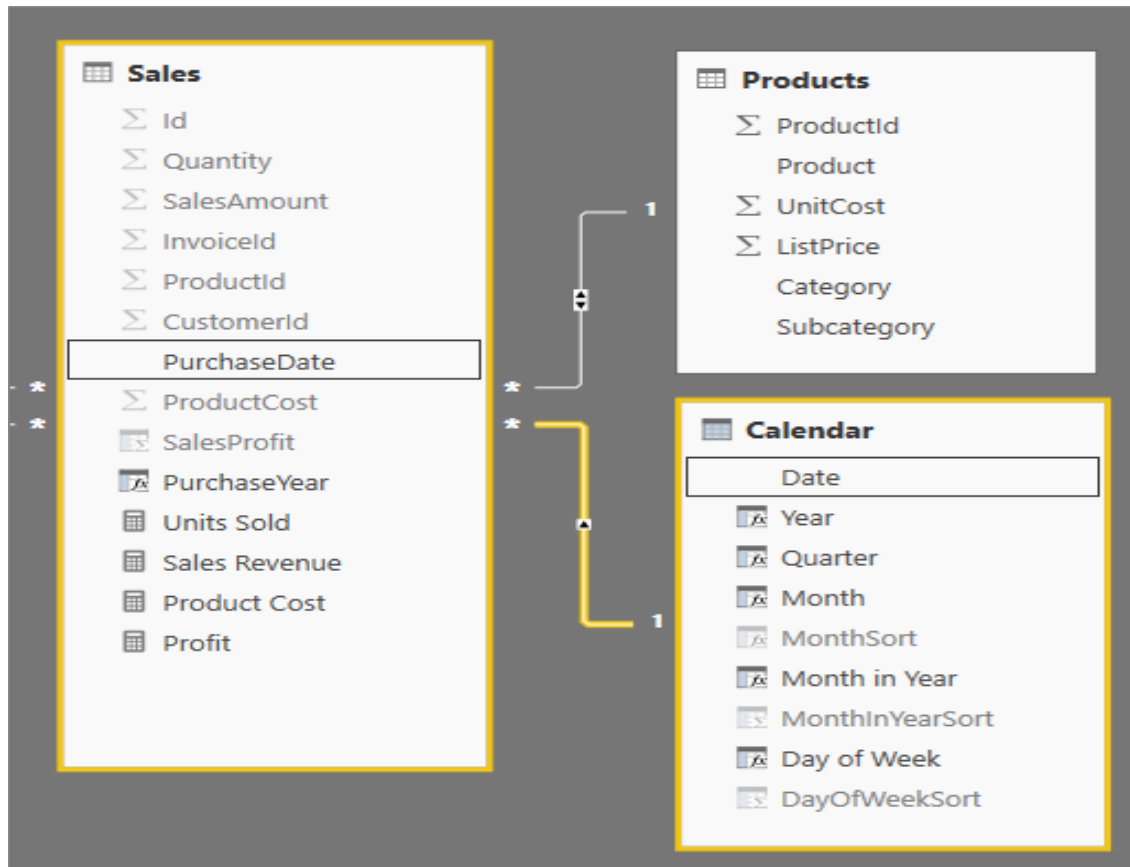
The screenshot shows the Power BI Desktop interface. In the 'Table' view, the 'Month' column is highlighted in yellow. A right-click context menu is open over the 'Month' column, and the 'Sort By Column' option is selected. The 'Sort By Column' dropdown menu is open, showing a list of columns: 'Month (Default)', 'Date', 'Year', 'Quarter', and 'MonthSort'. The 'MonthSort' option is checked with a green checkmark. In the background, the 'MonthSort' DAX formula is visible: `MonthSort = FORMAT('Calendar'[Date], "yyyy-MM")`. The table data shows two rows for January 2012, both with the same 'MonthSort' value of '2012-01'.





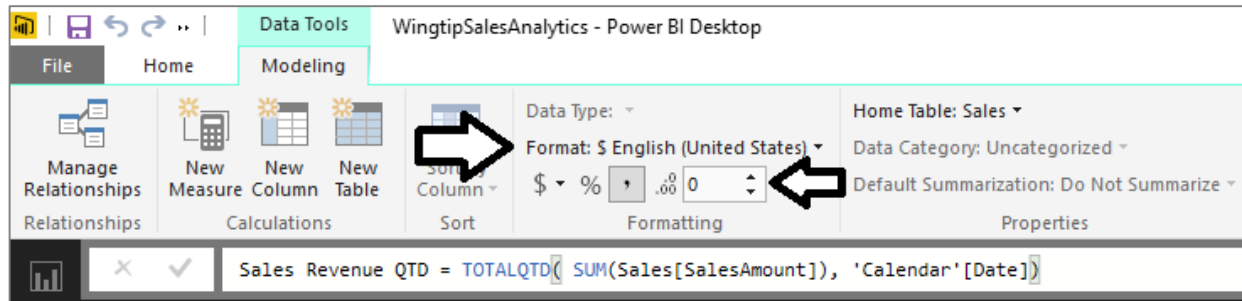
# Integrating Calendar Table into Data Model

- Calendar table needs relationship to one or more tables

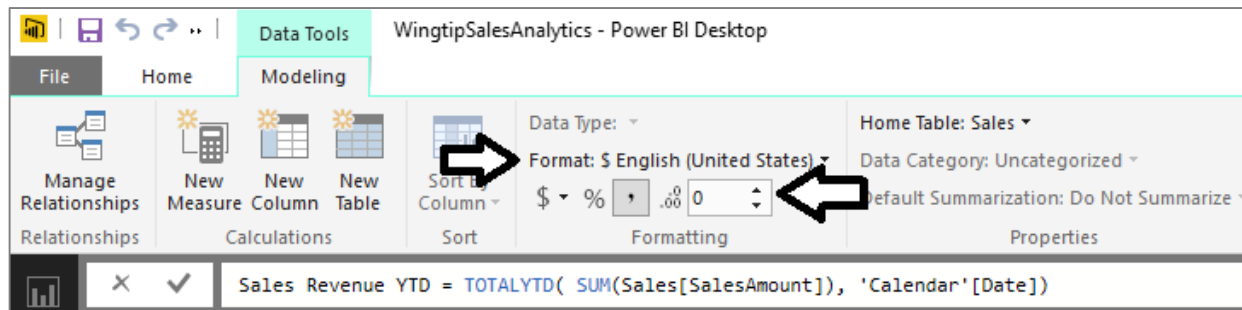


# Calculated Fields for QTD and YTD Sales

- TOTALQTD function calculates quarter-to-date totals



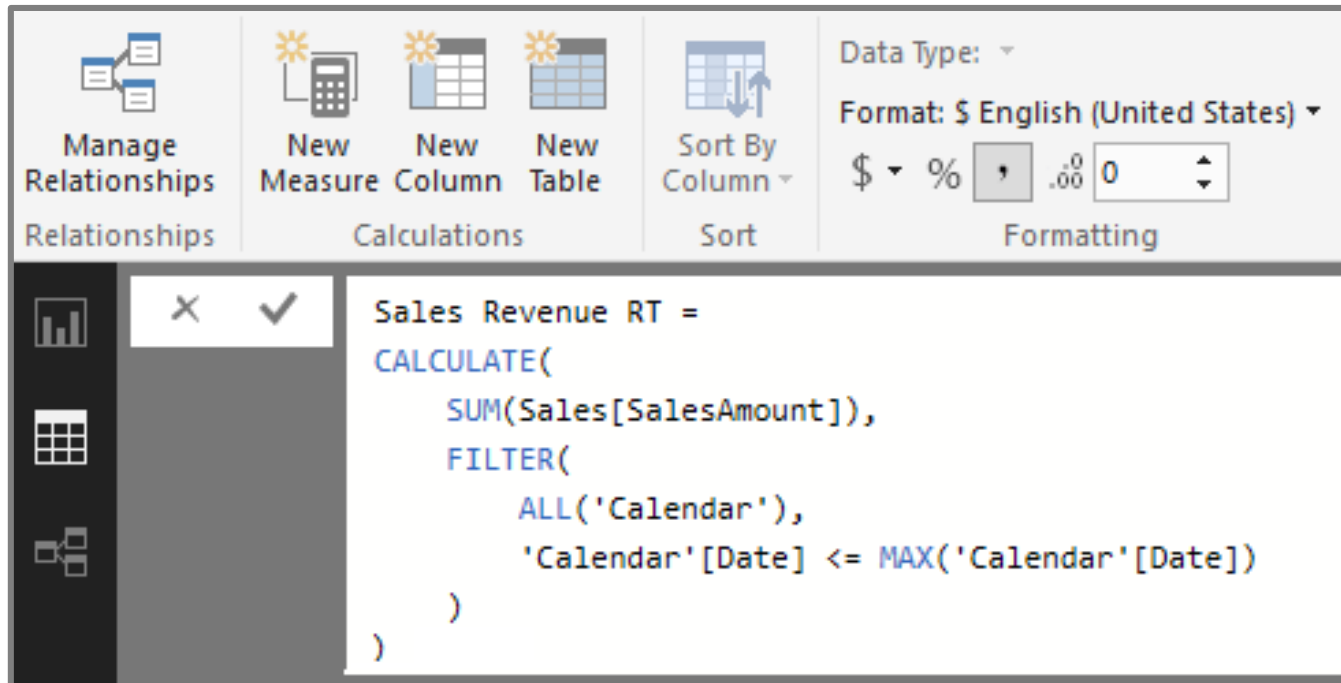
- TOTALYTD function calculates year-to-date totals





# Creating Running Total using CALCULATE

- Calculate a running total of sales revenue across years
  - This must be done using **CALCULATE** function



# 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 when filtered by Month
  - Measure returns large, erroneous value when filtered by Quarter

Year	Quarter	Month	Sales Revenue	Sales Growth PM
2014	2014-Q1	Jan 2014	\$629,969	-18.13 %
		Feb 2014	\$609,637	-3.23 %
		Mar 2014	\$628,618	3.11 %
		Total	\$1,868,225	142.79 %
	2014-Q2	Apr 2014	\$661,588	5.24 %
		May 2014	\$748,193	13.09 %
		Jun 2014	\$814,333	8.84 %
2014	2014-Q3	Total	\$2,224,114	253.81 %
		Jul 2014	\$788,469	-3.18 %



# Using the ISFILTERED Function

- ISFILTERED function used to determine when perform evaluation

```
Sales Growth PM =  
IF(  
  ( ISFILTERED(Calendar[Month]) && NOT(ISFILTERED(Calendar[Date])) ),  
  DIVIDE(  
    SUM(Sales[SalesAmount]) -  
    CALCULATE(  
      SUM(Sales[SalesAmount]),  
      PREVIOUSMONTH(Calendar[Date])  
    ),  
    CALCULATE(  
      SUM(Sales[SalesAmount]),  
      PREVIOUSMONTH(Calendar[Date])  
    )  
  ),  
  BLANK()  
)
```

- Expression returns Blank value when evaluation context is invalid

Year	Quarter	Month	Sales Revenue	Sales Growth PM
2014	2014-Q1	Jan 2014	\$629,969	-18.13 %
		Feb 2014	\$609,637	-3.23 %
		Mar 2014	\$628,618	3.11 %
		<b>Total</b>	<b>\$1,868,225</b>	
	2014-Q2	Apr 2014	\$661,588	5.24 %
		May 2014	\$748,193	13.09 %
		Jun 2014	\$814,333	8.84 %
		<b>Total</b>	<b>\$2,224,114</b>	
	2014-Q3	Jul 2014	\$788,469	-3.18 %
		Aug 2014	\$869,143	10.23 %



# Summary

- ✓ Creating Table Relationships
- ✓ Creating Calculated Columns and Measure
- ✓ Creating Tables using DAX Expressions
- ✓ Configuring Fields for Geographic Mapping
- ✓ Creating Dimensional Hierarchies
- ✓ Using the DAX Calculate Function
- ✓ Calendar Tables and Time Intelligence

