

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



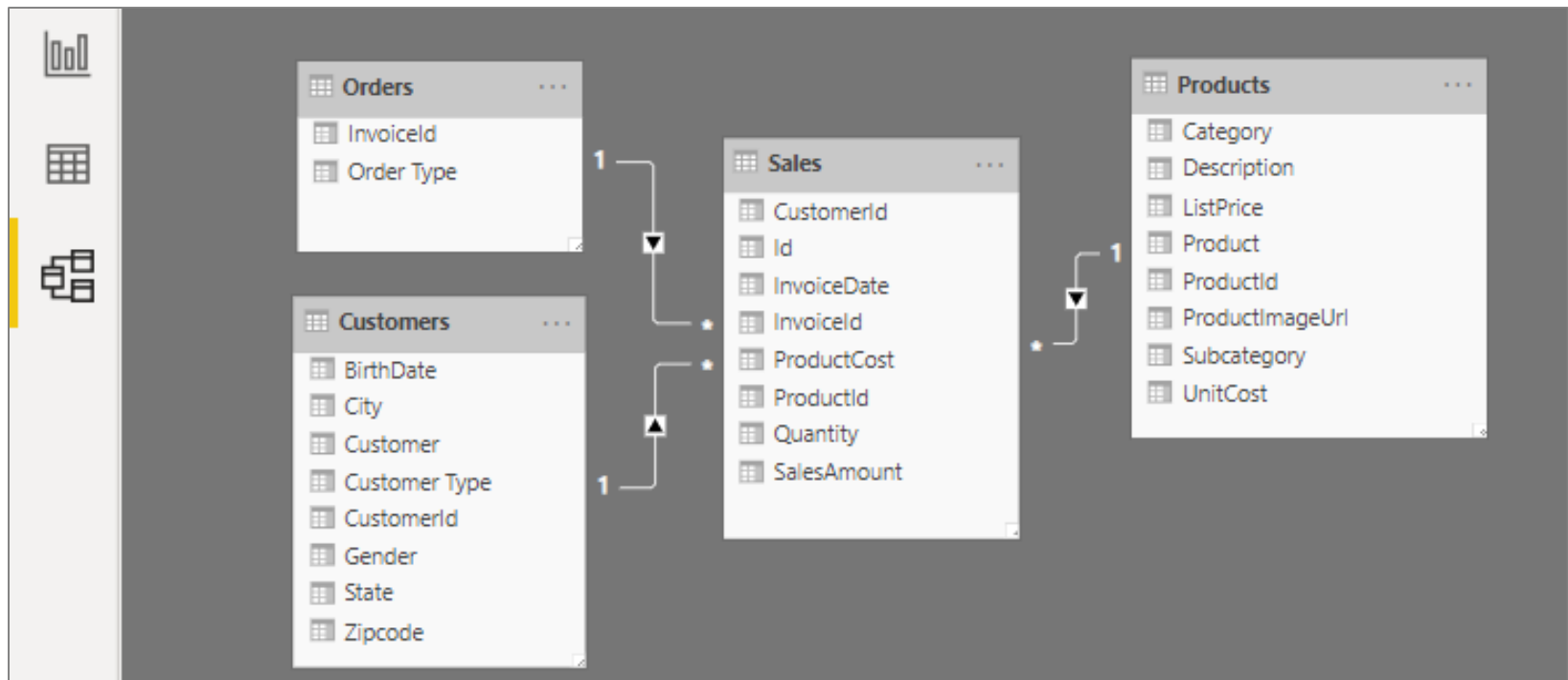
Data Modeling with Power BI Desktop

- 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 with 'Amount', 'Budget Key', and 'Category' fields 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 |

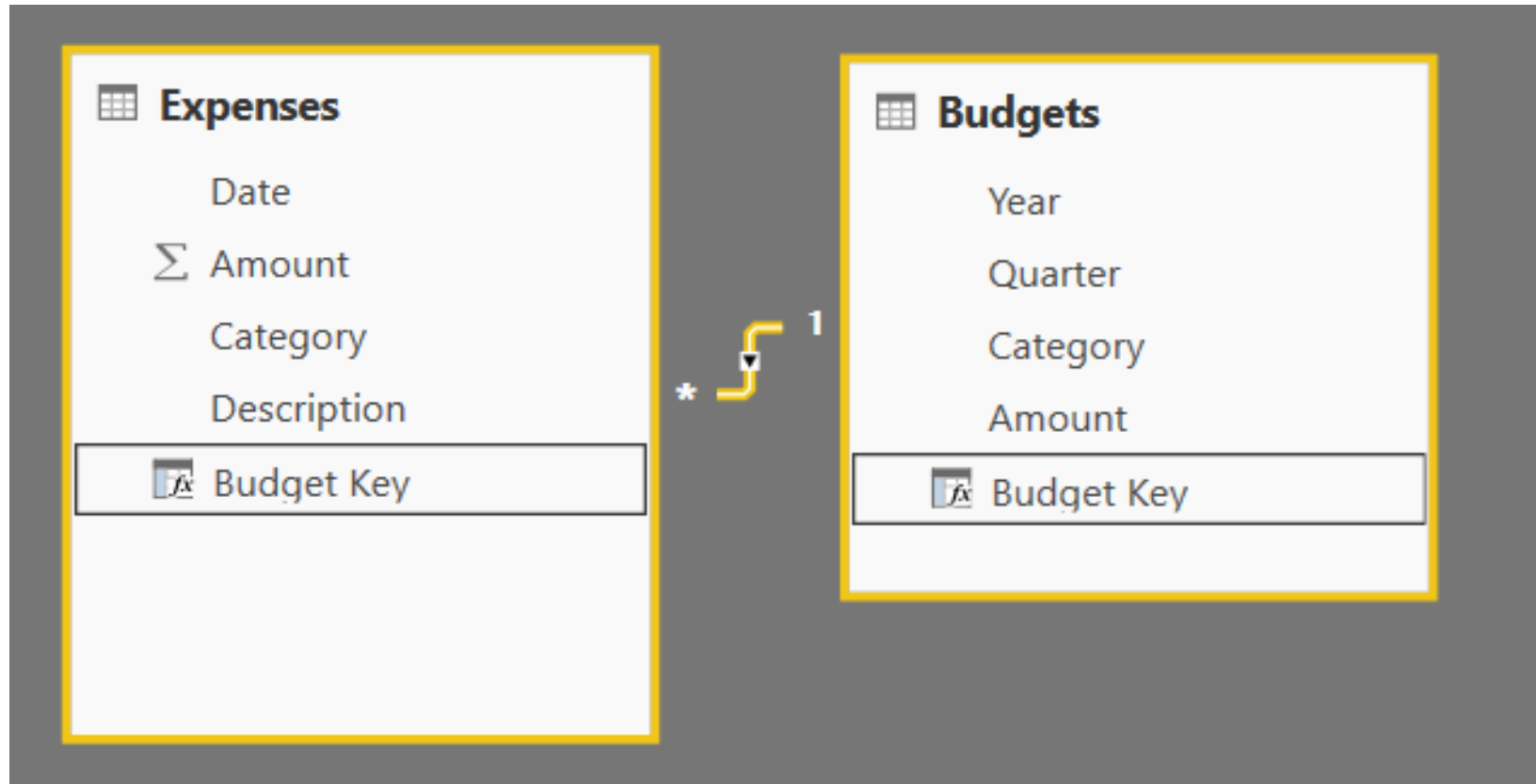
- Create composite key column in Expenses

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 with 'Amount', 'Budget Key', and 'Category' fields 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



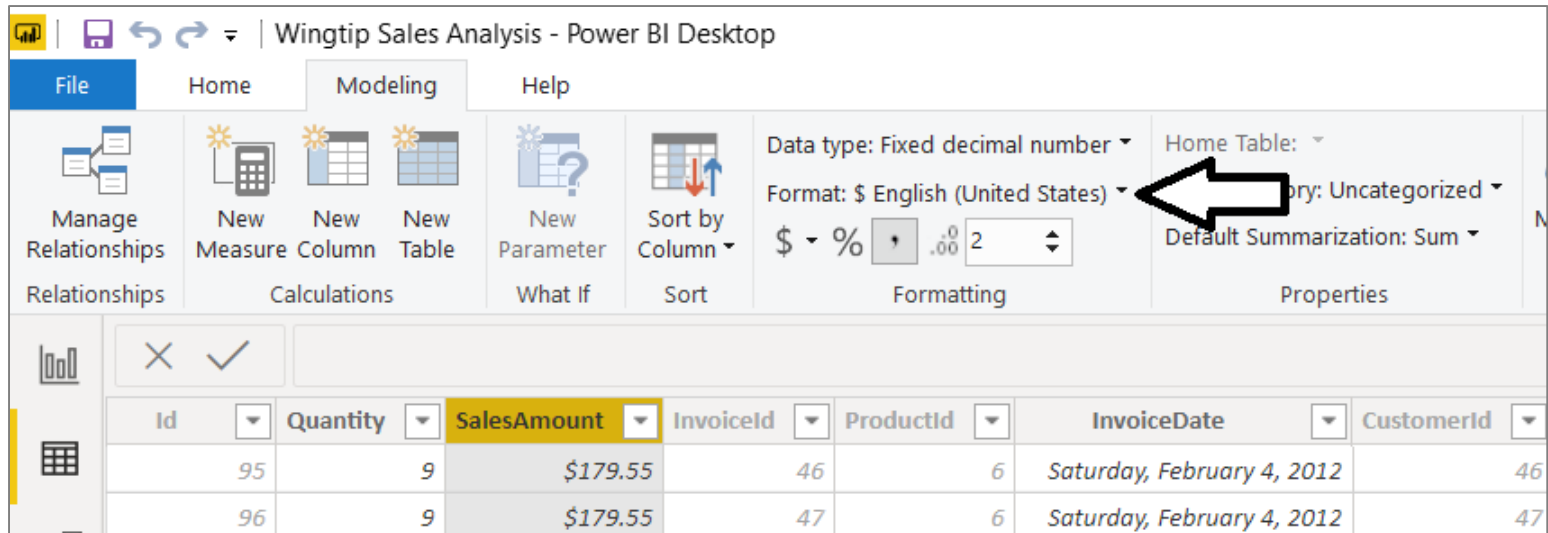
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Formatting Columns

- 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>`



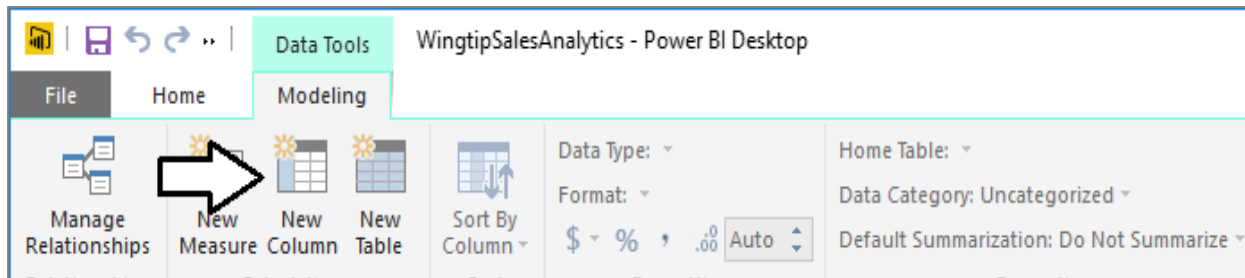
When to Create Calculated Columns

- 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



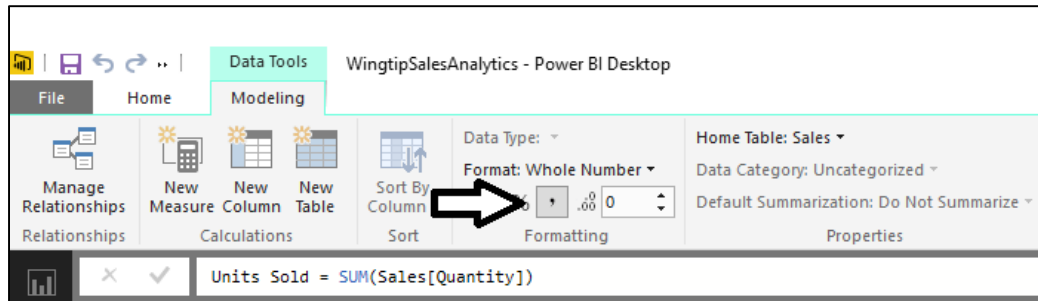
Creating Measures

- 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

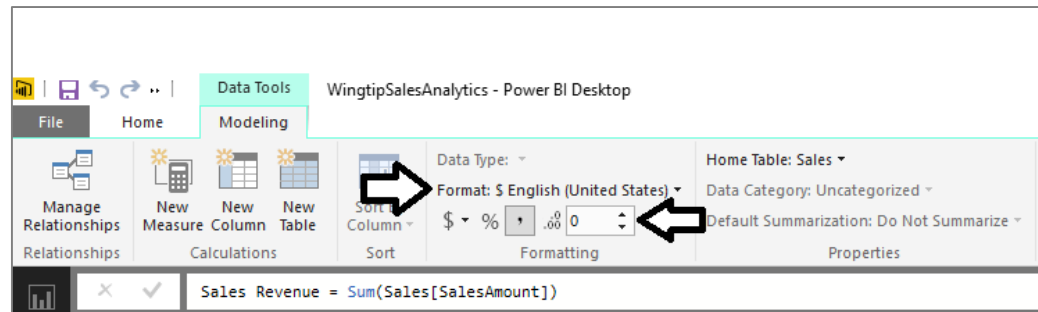


Formatting Measures

- Format as whole number



- Format as currency

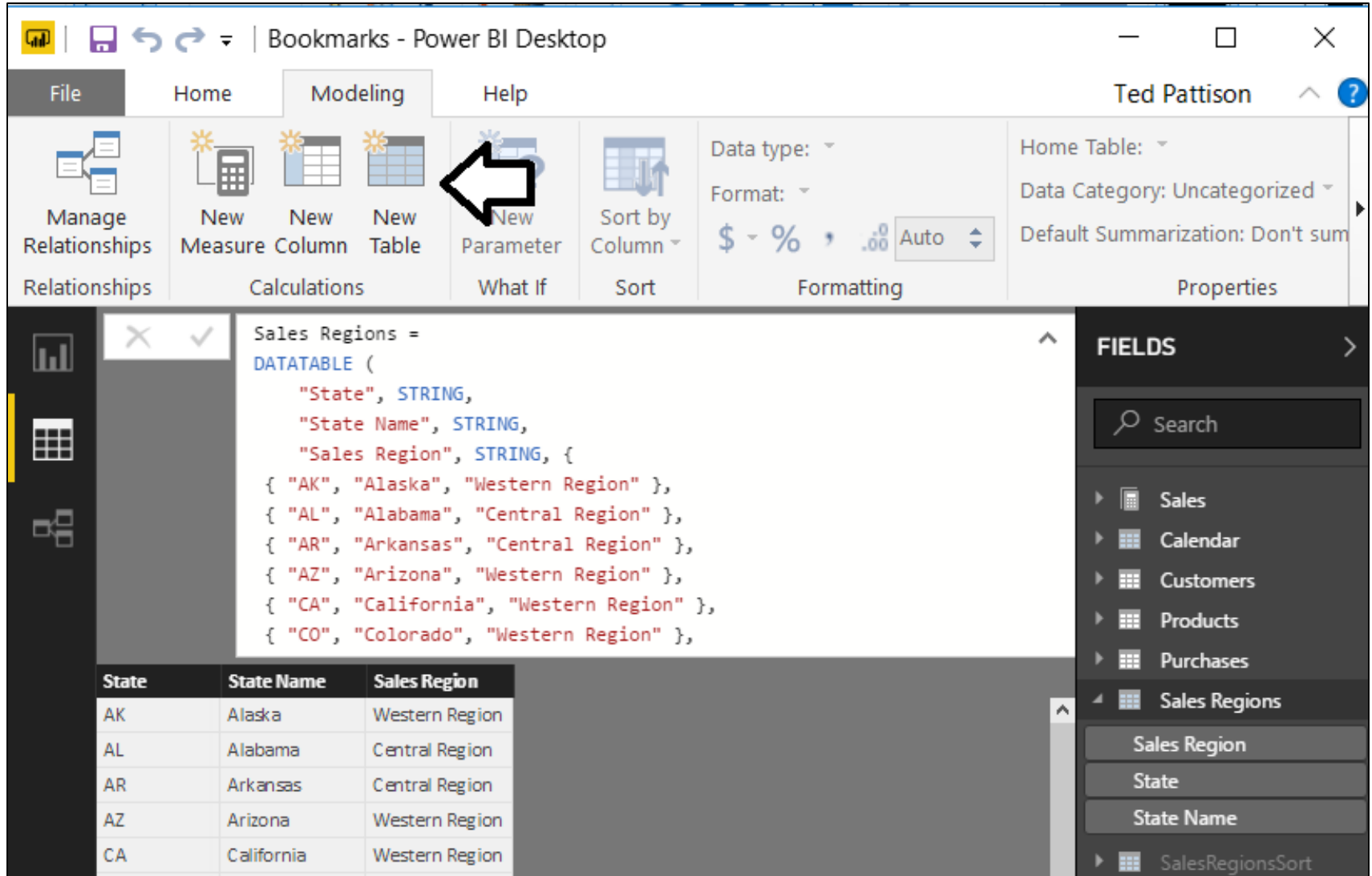


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Creating Tables Dynamically using DAX



Bookmarks - 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: Format: \$ % , .00 Auto

Home Table: Data Category: Uncategorized Default Summarization: Don't sum

Ted Pattison

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" },
    }
```

| 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 |

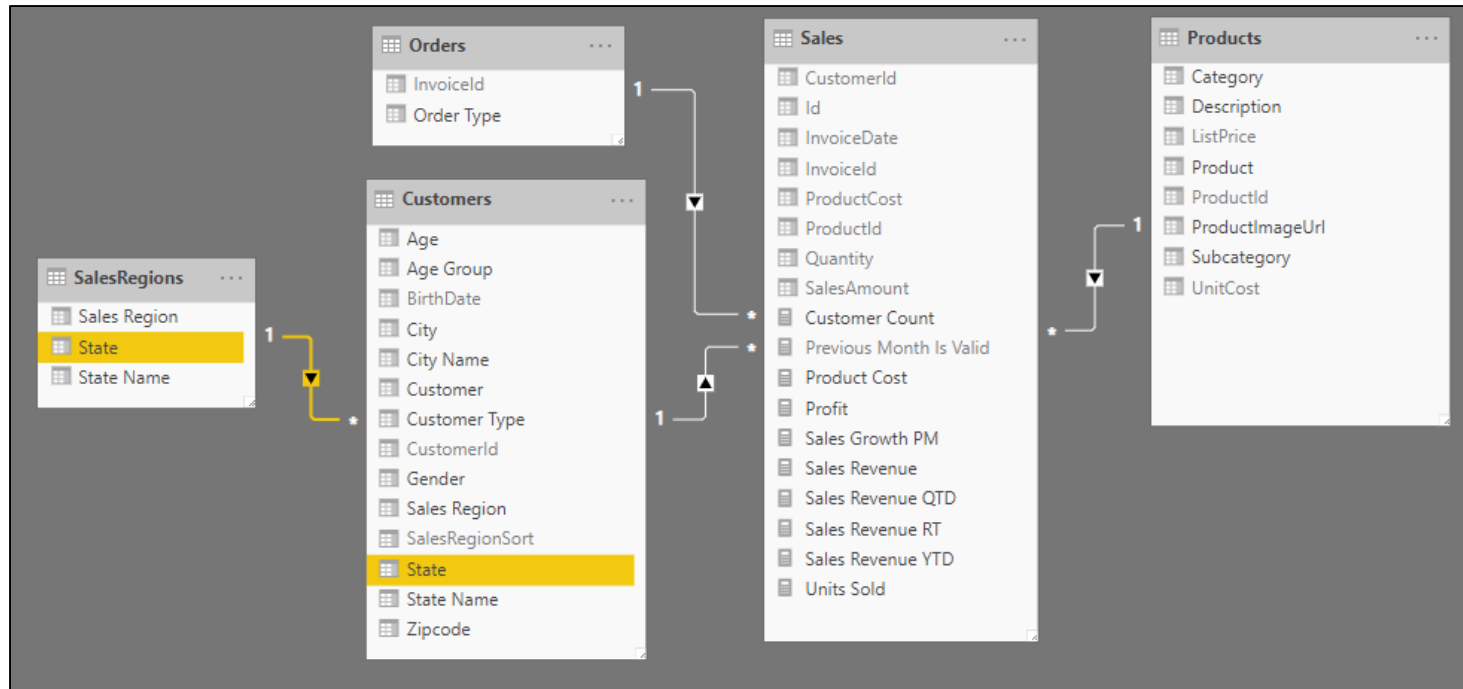
FIELDS

Search

- Sales
- Calendar
- Customers
- Products
- Purchases
- Sales Regions**
 - Sales Region
 - State
 - State Name
- SalesRegionsSort

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

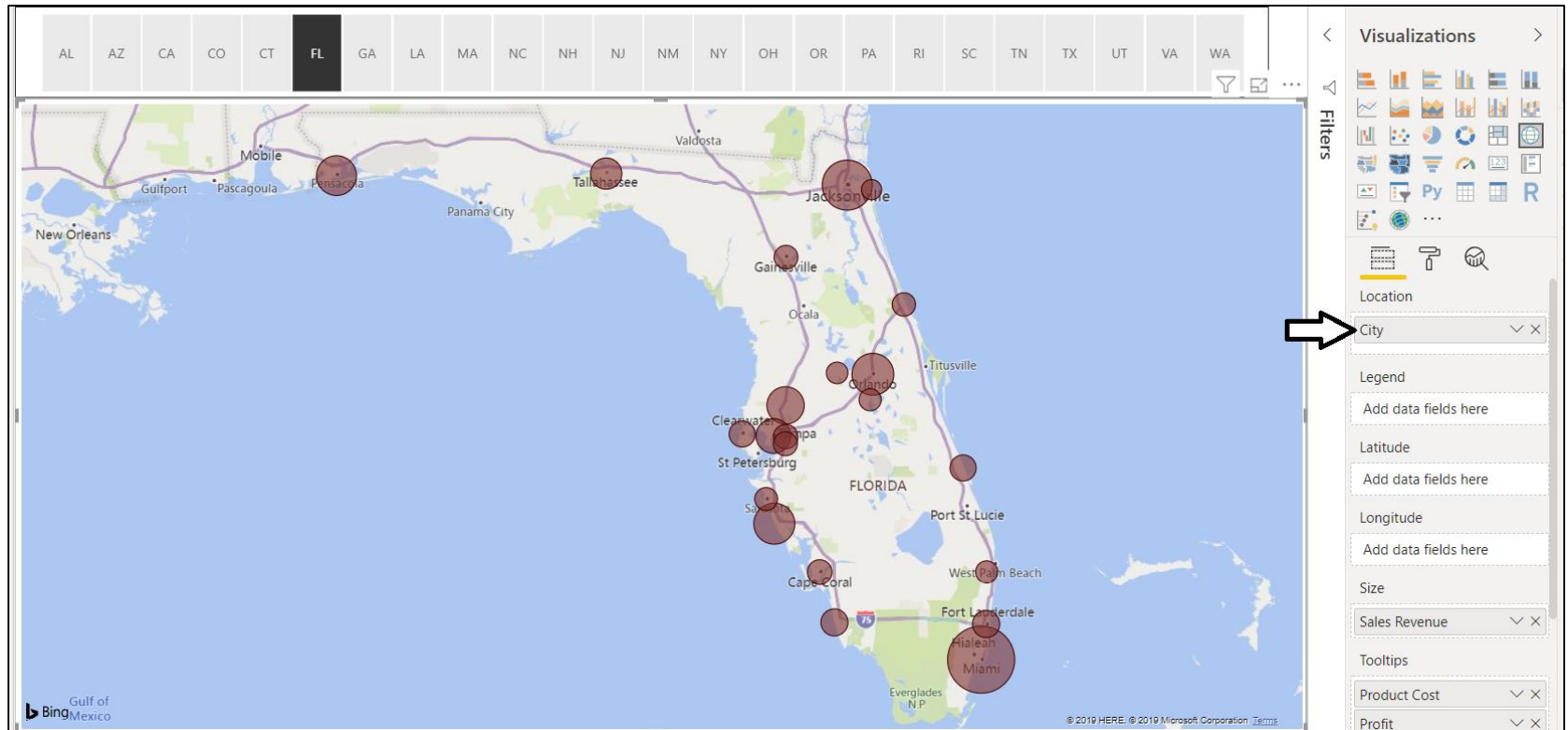
- City name alone is ambiguous
 - "Athens" defaults to Greece not Georgia
 - Concatenate city name with state to disambiguate

| 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



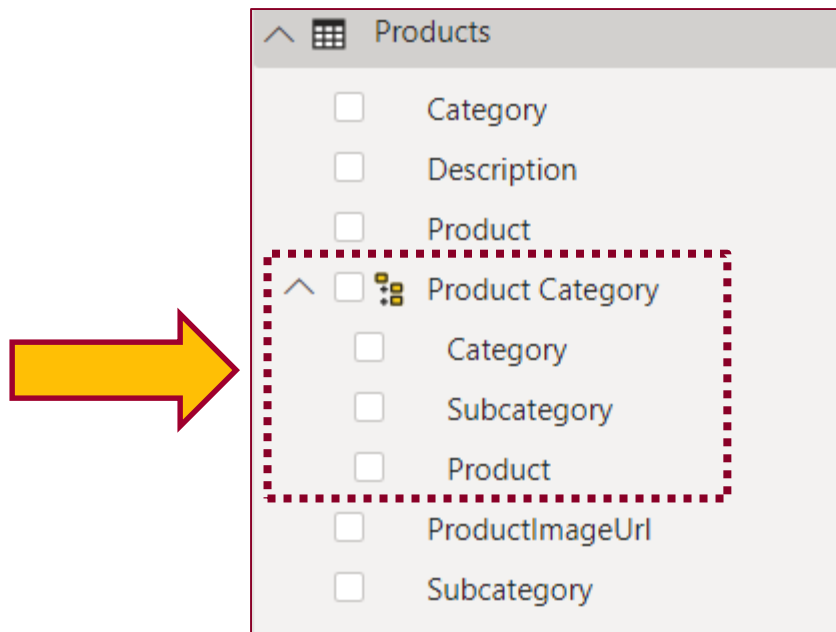
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Dimensional Hierarchies

- 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



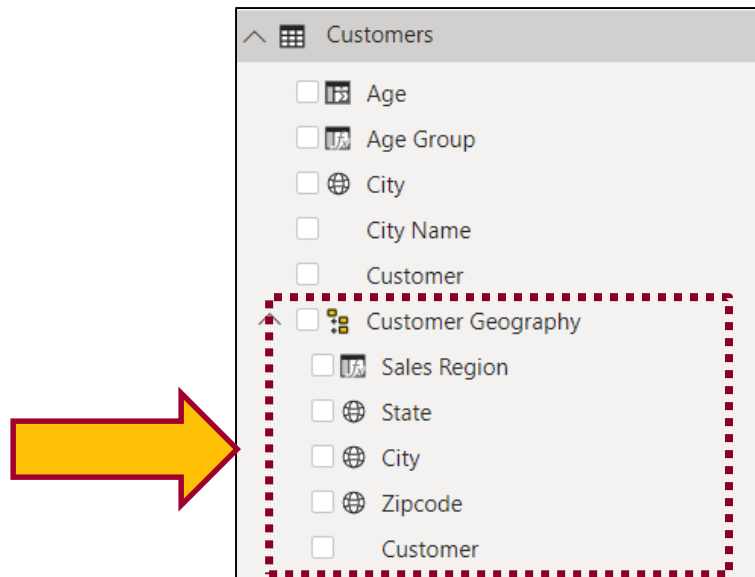
Pulling Columns for Hierarchy into Single Table

- 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

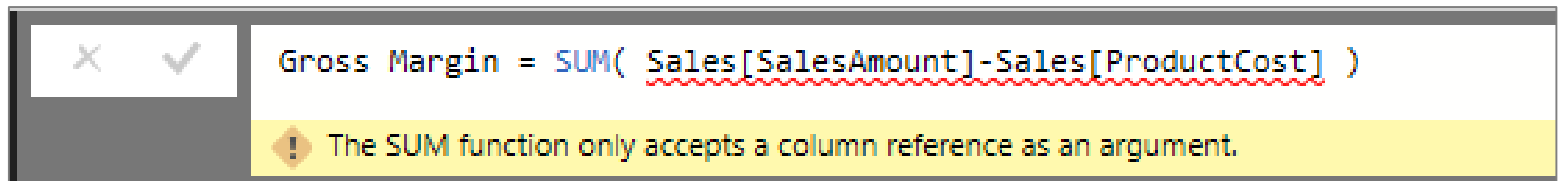
| ✕ | ✓ | City = [City Name] & ", " & [State] | | | |
|----|------------------|-------------------------------------|------------|-----------------|--------------|
| | Age Group | Sales Region | State Name | SalesRegionSort | City |
| 48 | Ages 40 TO 49 | Western Region | California | 1 | San Jose, CA |
| 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 |

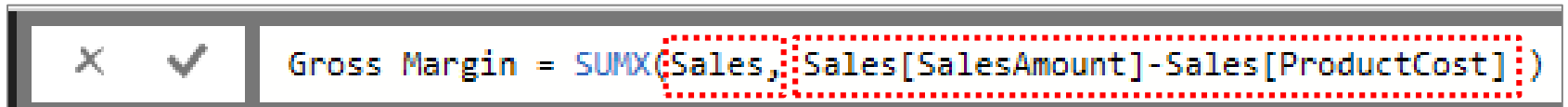


Understanding Iterators Like SUMX

- 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 | |
|-------------------------------------|----------------|
| <input checked="" type="checkbox"/> | Western Region |
| <input type="checkbox"/> | Central Region |
| <input type="checkbox"/> | Eastern Region |

| Customer Type | |
|-------------------------------------|-------------------|
| <input type="checkbox"/> | One-time Customer |
| <input checked="" type="checkbox"/> | 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] )  
    )  
)
```



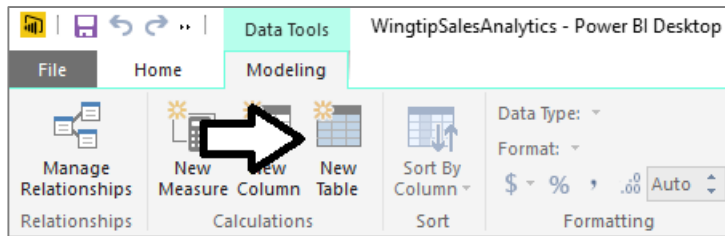
Agenda

- ✓ 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

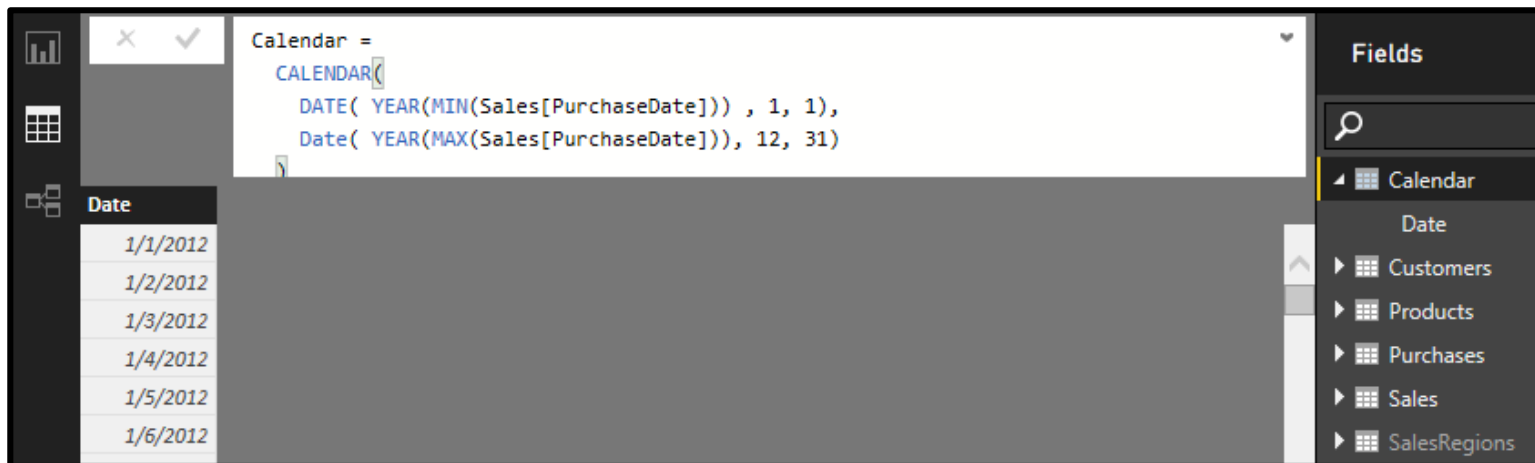


Creating Calendar Table as Calculated Table

- 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 selected. The 'Sort By Column' dropdown menu is open, showing 'MonthSort' as the selected option. The 'MonthSort' column is highlighted in yellow in the table view. The table view shows the following data:

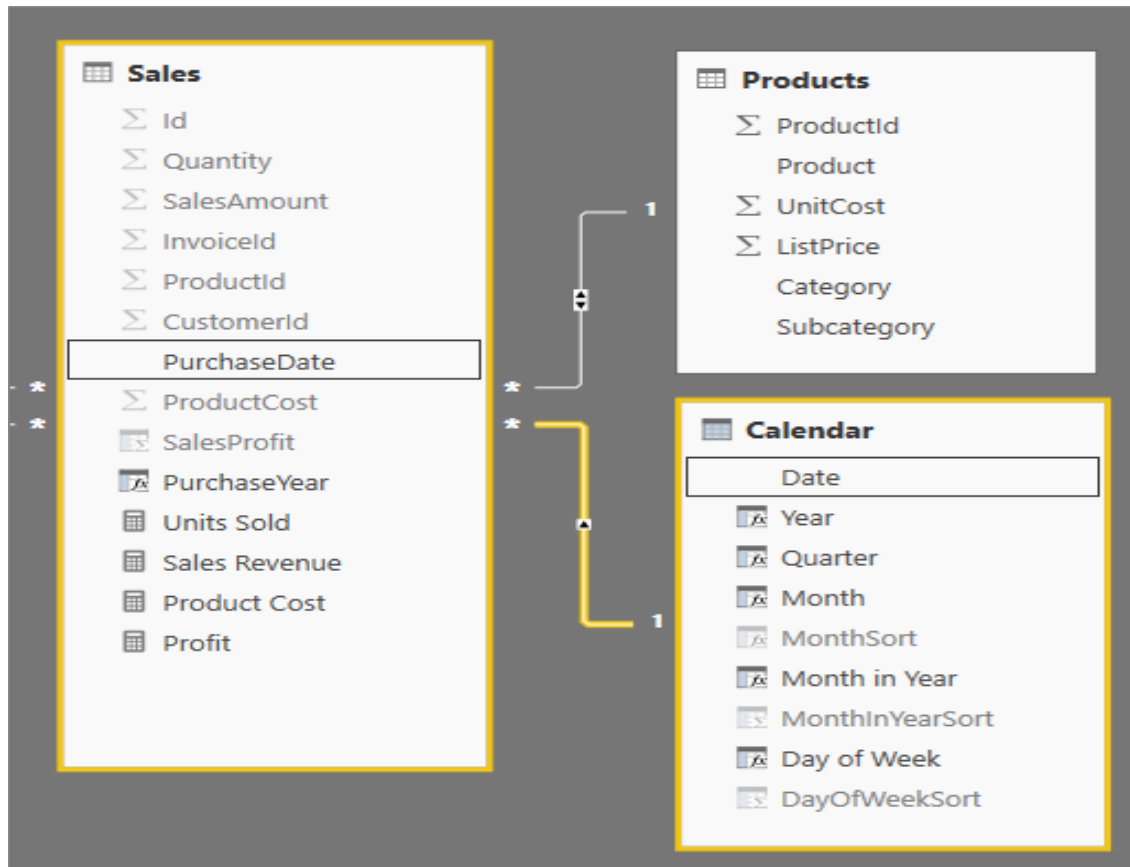
| Date | Year | Month | MonthSort |
|----------|------|----------|-----------|
| 1/1/2012 | 2012 | Jan 2012 | 2012-01 |
| 1/2/2012 | 2012 | Jan 2012 | 2012-01 |

Arrows indicate the flow from the 'Sort By Column' dropdown to the 'MonthSort' column in the table view.



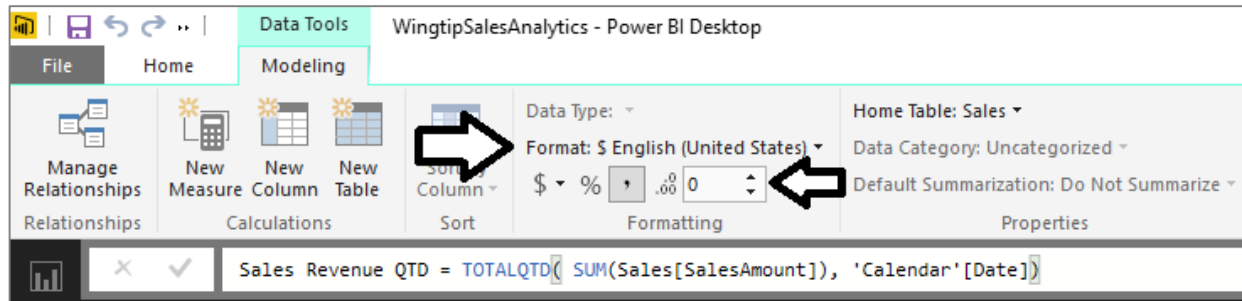
Integrating Calendar Table into Data Model

- Calendar table needs relationship to one or more tables

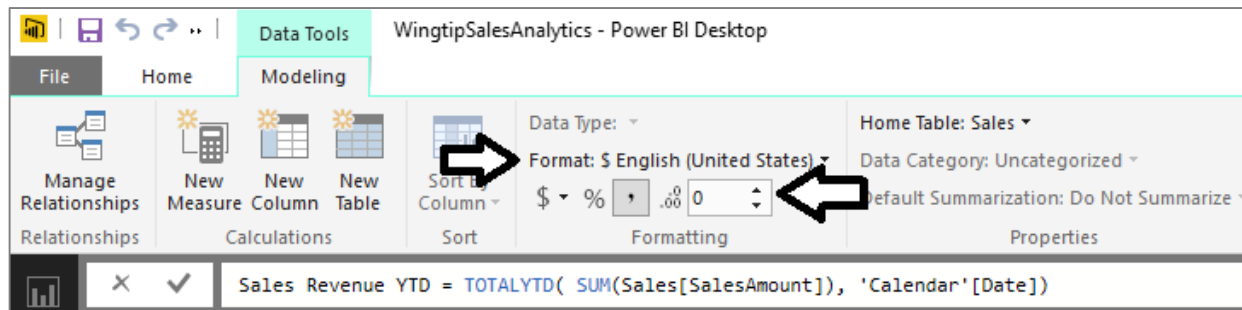


Calculated Fields for QTD and YTD Sales

- TOTALQTD function calculates quarter-to-date totals

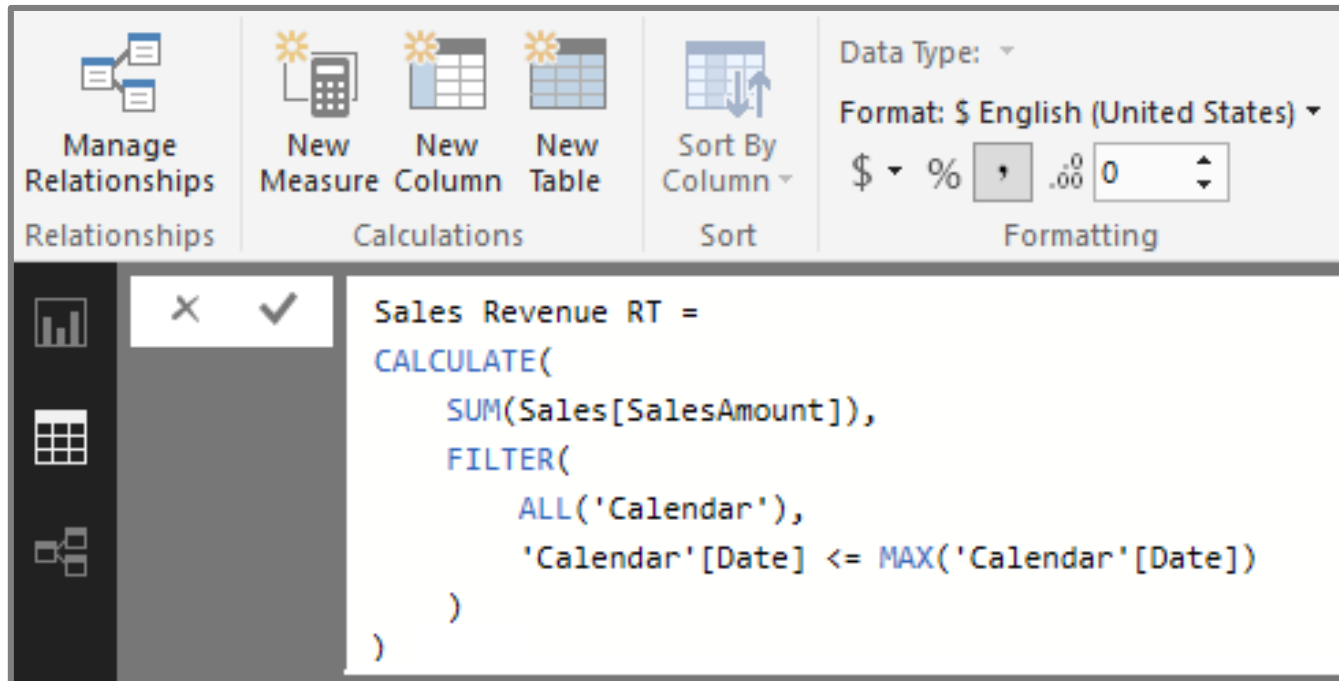


- TOTALYTD function calculates year-to-date totals



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 % |
| | | Total | \$1,868,225 | |
| | 2014-Q2 | Apr 2014 | \$661,588 | 5.24 % |
| | | May 2014 | \$748,193 | 13.09 % |
| | | Jun 2014 | \$814,333 | 8.84 % |
| | | Total | \$2,224,114 | |
| | 2014-Q3 | Jul 2014 | \$788,469 | -3.18 % |
| | | Aug 2014 | \$869,143 | 10.23 % |



Summary

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