

# Designing a Data Model with Power BI Desktop



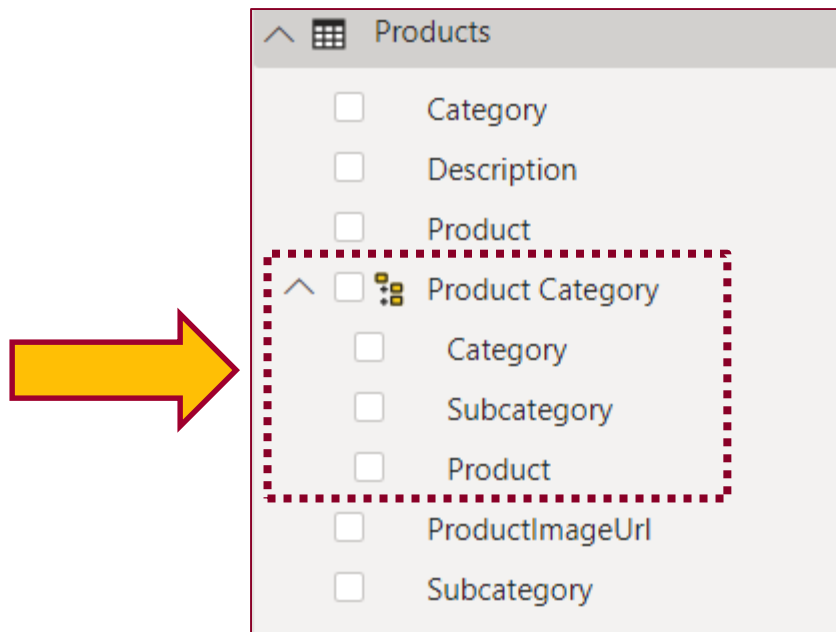
# Agenda

- Creating Dimensional Hierarchies
- Understanding Evaluation Context and Calculate
- Creating a Calendar Table
- Calling DAX Time Intelligence Functions
- Writing Contextually-aware DAX Expressions
- Calculating the Top 5 Products



# 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



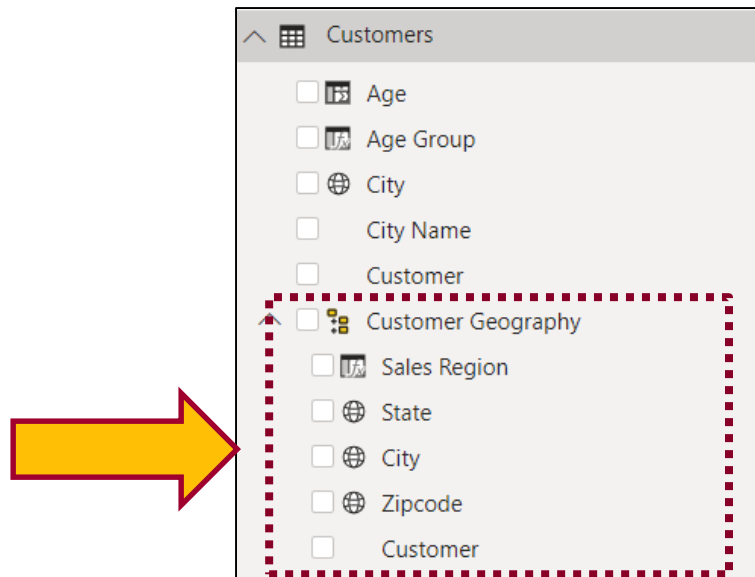
# Pulling Columns for Hierarchy into Single Table

- 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	76	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

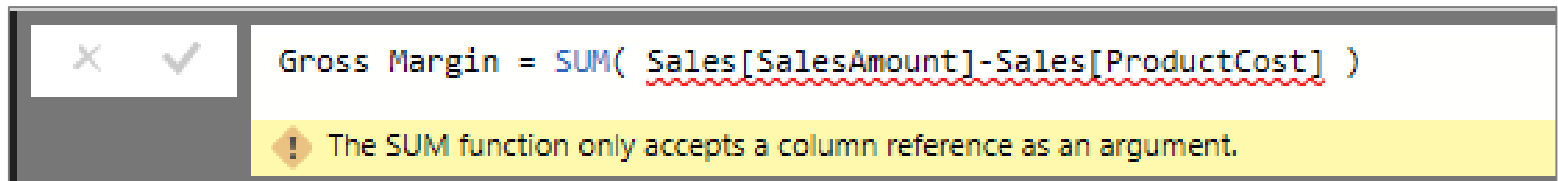
✕	✓	City = [City Name] & ", " & [State]			
	Age Group	Sales Region	State Name	SalesRegionSort	City
48	Ages 40 TO 49	Western Region	California	1	San Jose, CA
74	Ages 65 and over	Western Region	California	1	San Jose, CA
73	Ages 65 and over	Western Region	California	1	San Jose, CA
25	Ages 18 TO 23	Western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

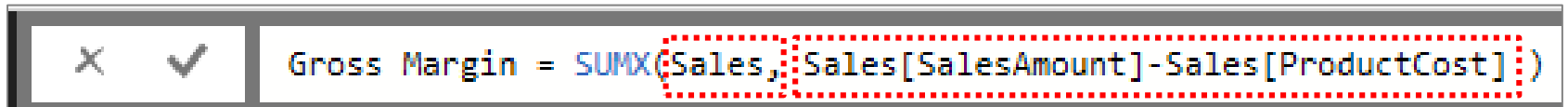


# Understanding Iterators Like SUMX

- 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] )  
    )  
)
```



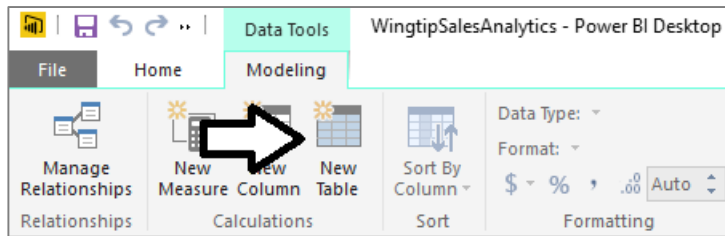
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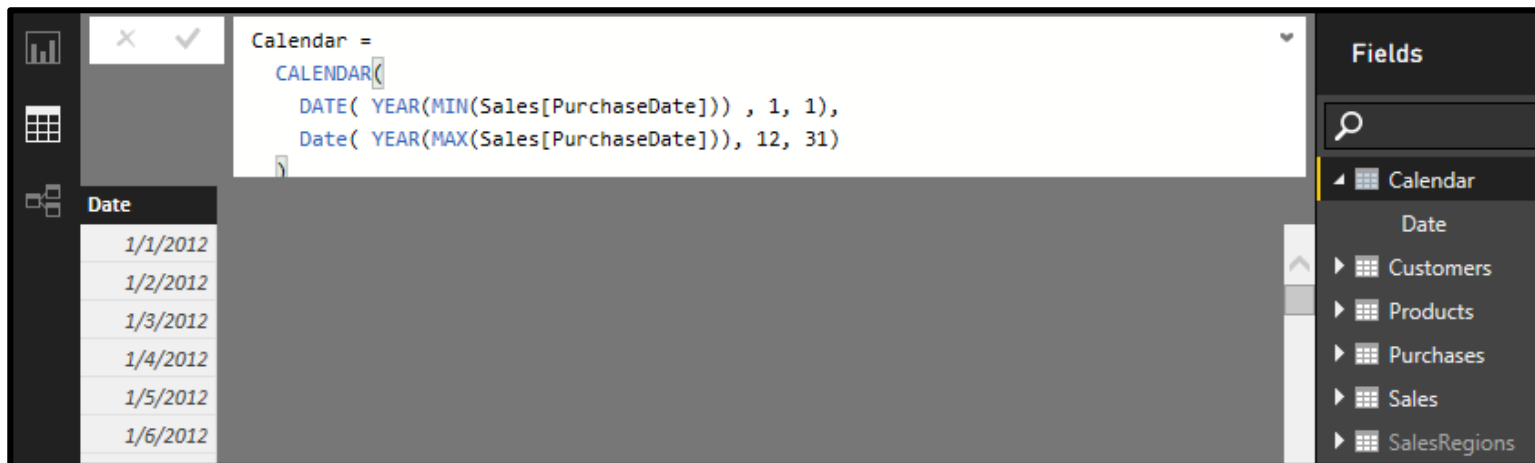


# Creating Calendar Table as Calculated Table

- Use **New Table** command in ribbon



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



# Adding Columns to Calendar Table

- Creating the **Year** column

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

- Creating the **Quarter** column

✕ ✓ 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

✕ ✓ 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 data is as follows:

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.







# Integrating Calendar Table into Data Model

- Calendar table needs relationship to one or more tables



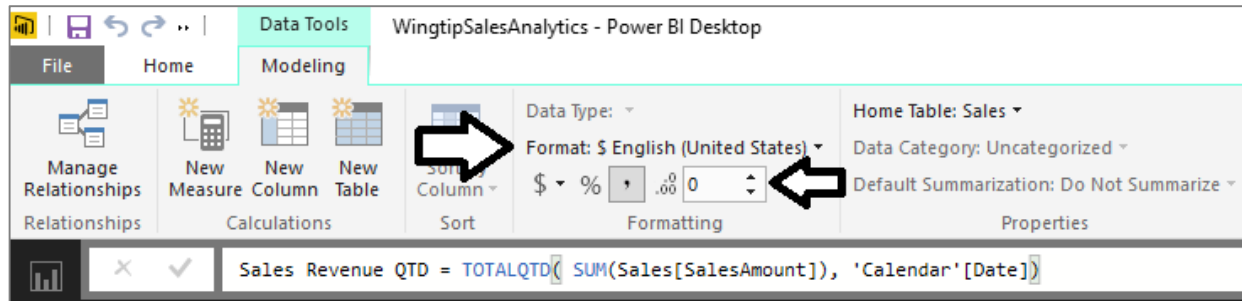
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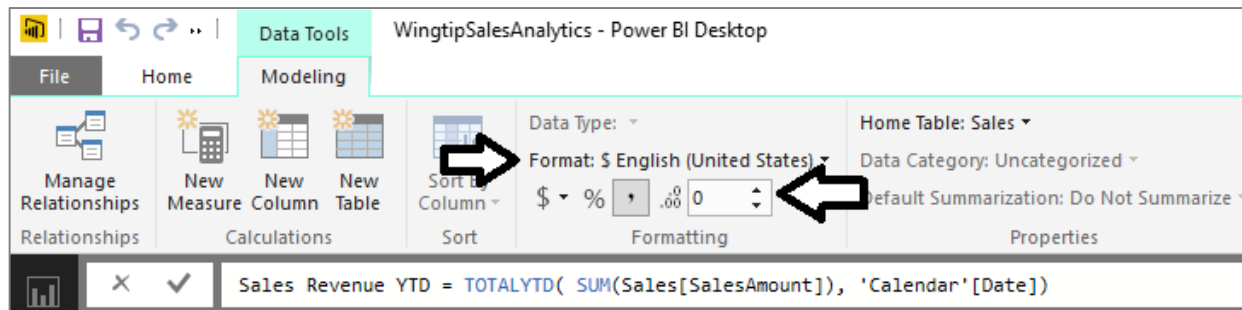


# Calculated Fields for QTD and YTD Sales

- TOTALQTD function calculates quarter-to-date totals

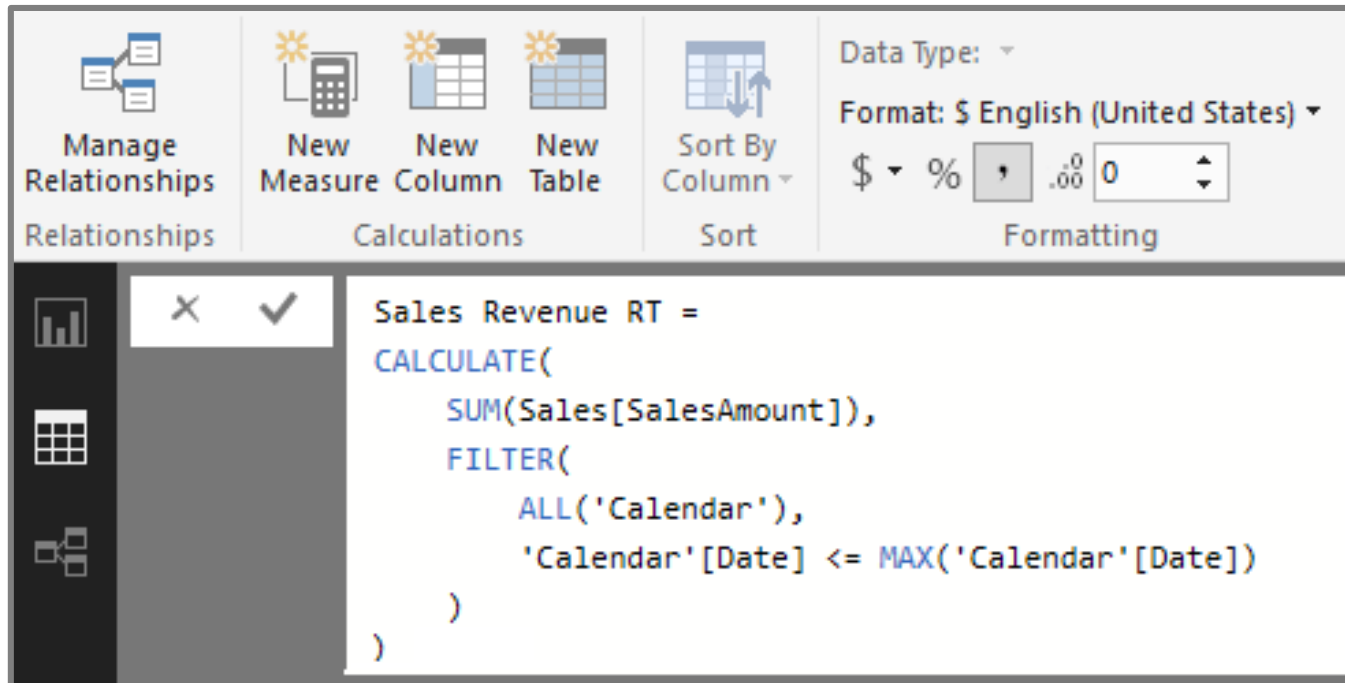


- TOTALYTD function calculates year-to-date totals



# Creating Running Total using CALCULATE

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



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# 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-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

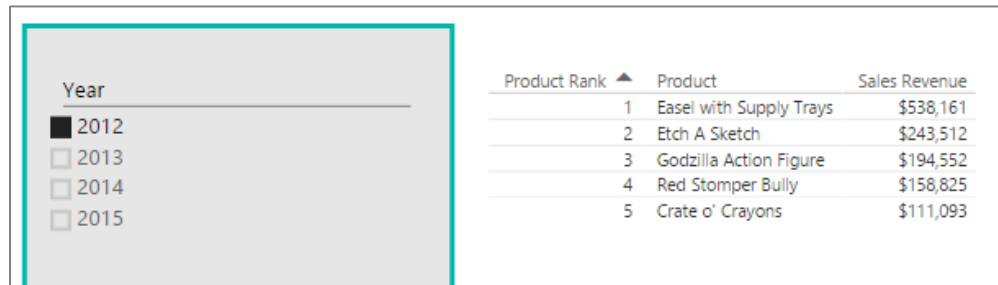
Year	Quarter	Month	Sales Revenue	Sales Growth PM
2014	2014-Q1	Jan 2014	\$629,969	-18.13 %
		Feb 2014	\$609,637	-3.23 %
		Mar 2014	\$628,618	3.11 %
		<b>Total</b>	<b>\$1,868,225</b>	
	2014-Q2	Apr 2014	\$661,588	5.24 %
		May 2014	\$748,193	13.09 %
		Jun 2014	\$814,333	8.84 %
		<b>Total</b>	<b>\$2,224,114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





# Problems with the Filter Context

- RANKX function is affected by filter context
  - Sometimes you get the results you are expecting



The screenshot shows a filter panel on the left with a 'Year' section containing checkboxes for 2012, 2013, 2014, and 2015. The 2012 checkbox is selected. To the right is a table with three columns: 'Product Rank' (with an upward arrow), 'Product', and 'Sales Revenue'.

Product Rank	Product	Sales Revenue
1	Easel with Supply Trays	\$538,161
2	Etch A Sketch	\$243,512
3	Godzilla Action Figure	\$194,552
4	Red Stomper Bully	\$158,825
5	Crate o' Crayons	\$111,093

- Sometimes you might get unexpected results



The screenshot shows a filter panel on the left with two sections: 'Year' with checkboxes for 2012, 2013, 2014, and 2015, and 'Category' with checkboxes for Action Figures, Arts and Crafts, and Remote Control Vehicles. The 'Action Figures' checkbox is selected. To the right is a table with three columns: 'Product Rank' (with an upward arrow), 'Product', and 'Sales Revenue'.

Product Rank	Product	Sales Revenue
2	Twitter Follower Action Figure	\$3,508,806
3	Godzilla Action Figure	\$2,970,735

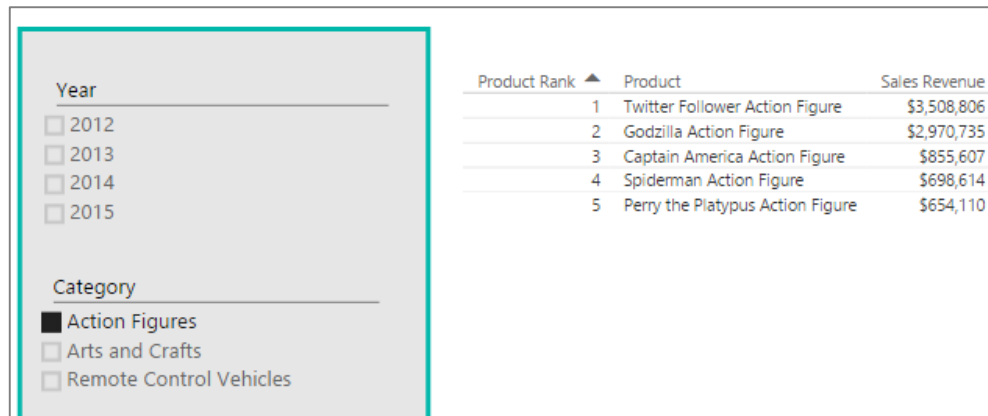


# Writing Context Aware DAX Code

- When using RANKX...
  - It's recommended to call **HASONEVALUE** function
  - When calling ALL function, pass one or more columns

```
Product Rank =  
IF(  
    HASONEVALUE(Products[Product]),  
    RANKX(  
        ALL( Products[Subcategory], Products[Product] ),  
        CALCULATE( SUM(Sales[SalesAmount]) )  
    )  
)
```

- Ranking function now evaluates product ranking for specific Category



Product Rank	Product	Sales Revenue
1	Twitter Follower Action Figure	\$3,508,806
2	Godzilla Action Figure	\$2,970,735
3	Captain America Action Figure	\$855,607
4	Spiderman Action Figure	\$698,614
5	Perry the Platypus Action Figure	\$654,110



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# Ranking Products By Sales using RANKX

- DAX provides RANKX function for ranking
  - Can be used to track top 5 products by sales revenue

```
Product Rank =  
RANKX(  
    ALL(Products),  
    CALCULATE( SUM(Sales[SalesAmount]) )  
)
```

- You can sort and filter on output of RANKX function

Product Rank ▲	Product	Sales Revenue
1	Flying Squirrel	\$3,828,783
2	Twitter Follower Action Figure	\$3,508,806
3	Godzilla Action Figure	\$2,970,735
4	Personal Commuter Chopper	\$2,613,193
5	Red Stomper Bully	\$2,538,233

Product Rank ▲

is less than or equal to...

Show items when the value:

is less than or equal to ▼

5

☒ And ☐ Or








▼

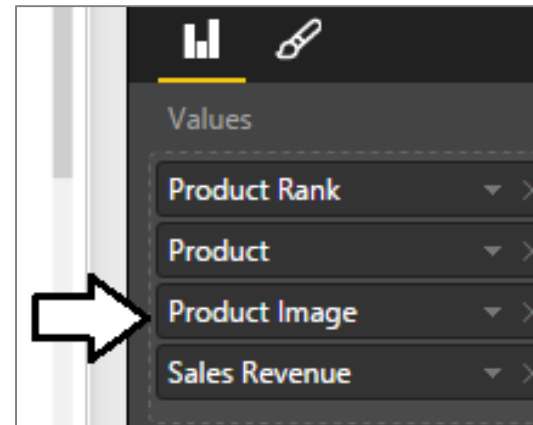
Apply filter



# More Ranking Evaluation Problems

- Adding new column to table creates new problem
  - Ranking run separately for each separate Product Image
  - Every product has unique Product Image and is given rank of 1

Product Rank	Product	Product Image	Sales Revenue
1	Batman Action Figure		\$40,395
1	Black Power Ranger Action Figure		\$4,223
1	Captain America Action Figure		\$125,110
1	Crate o' Crayons		\$322,711
1	Crayloa Crayon Set		\$12,868
1	Easel with Supply Trays		\$928,620
1	Etch A Sketch		\$293,175

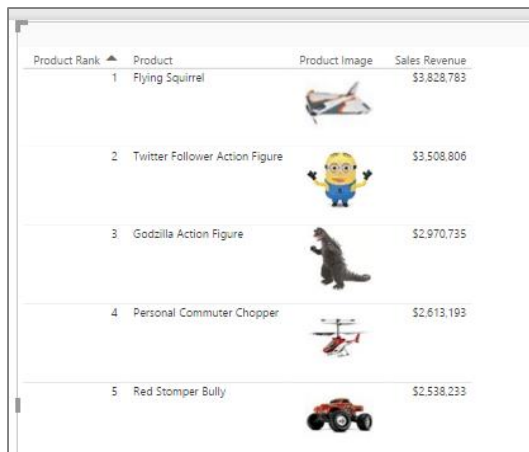


# Getting It Right






- Call to RANKX must be modified again
  - You must specify which columns to factor into ranking

```
Product Rank =  
IF(  
    HASONEVALUE(Products[Product]),  
    RANKX(  
        ALL( Products[Subcategory], Products[Product], Products[Product Image] ),  
        CALCULATE( SUM(Sales[SalesAmount]) )  
    )  
)
```

- Context-aware DAX code corrects problems with visual



A screenshot of a Power BI table visual displaying a ranked list of products. The table has four columns: 'Product Rank' (with a sort arrow), 'Product', 'Product Image', and 'Sales Revenue'. The data is sorted by rank, showing the top five products. Each row includes a small image of the product.

Product Rank	Product	Product Image	Sales Revenue
1	Flying Squirrel		\$3,828,783
2	Twitter Follower Action Figure		\$3,508,806
3	Godzilla Action Figure		\$2,970,735
4	Personal Commuter Chopper		\$2,613,193
5	Red Stomper Bully		\$2,538,233



# Summary

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