

Numeric Calculations with DAX

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DAX

Data Analysis Expressions (not Data Analytic Expressions)

Born with “PowerPivot for Excel”

Lives in Power BI and Analysis Services Tabular as well

Influenced by other languages

Excel (function based syntax, 100+ functions share same source code)

SQL (relational function, row context)

MDX (measures, implicit join, filter context)

Language for both, **measures** and **calculated columns**

And: calculated tables, row level security, queries

Easy syntax

Complex semantic

Model based

Allowing for powerful computations

Sample Calculations

Sales Amount

Margin

Margin in %



Calculated Columns

Convention: `'Table'[Column]`

Specify the table name

Calculation is done row-by-row

Every row has its own *row context*

And persisted in the model during model refresh

Data type is determined by formula

Can be changed by user

We will concentrate on **numeric** (calculated) columns

Excel can use calculated columns as filter only

You can put them on *Filters*, *Columns* & *Rows* of a pivot table

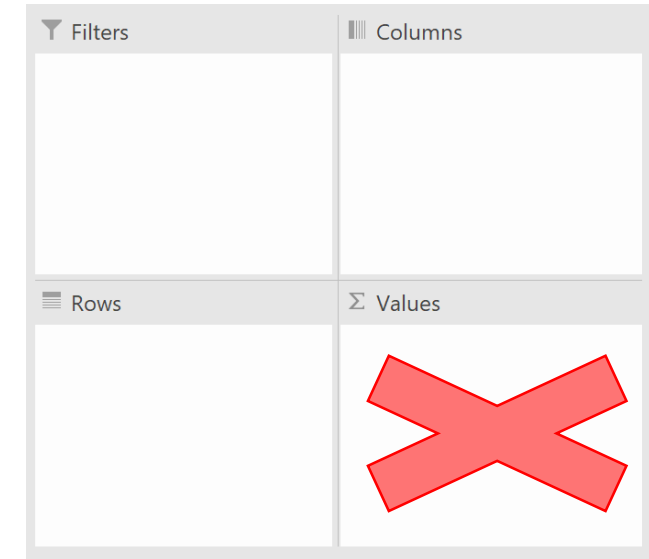
But you can't put them in the *Values* field

Power BI automatically creates an **implicit measure**

Simple aggregations which are driven by column property *Default Summarization*

Measure is invisible

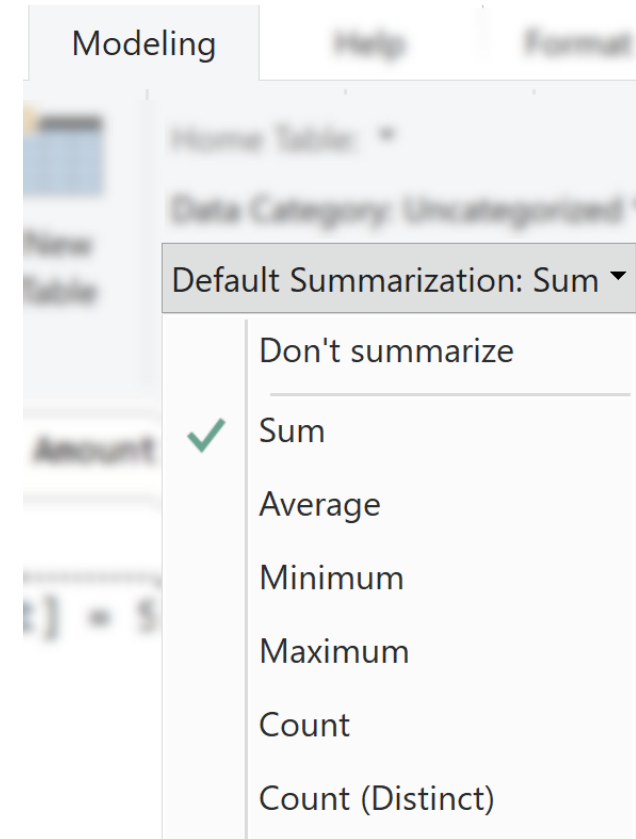
Well-intentioned ... can be the opposite of well done



Default Summarization

Modelling property of (calculated) column
Can be changed per visual

- Don't summarize
- ✓ Sum
- Average
- Minimum
- Maximum
- Count (Distinct)
- Count
- Standard deviation
- Variance
- Median





Calculated Columns in Power BI

$$\textit{Implicit Measure} = \sum (\textit{Calculated Column's expression})$$

- Don't summarize
- ✓ Sum
- Average
- Minimum
- Maximum
- Count (Distinct)
- Count
- Standard deviation
- Variance
- Median



'Sales' [Sales Amount]

= 'Sales' [Price] * 'Sales' [Quantity]

Sales			
Date	Price	Quantity	Sales Amount
2019-07-01	10	3	30
2019-07-01	20	1	20
2019-07-02	30	4	120
2019-07-03	100	5	500
Total			670

implicit measure

'Sales'[Margin]

= 'Sales'[Sales Amount] - 'Sales'[TotalCost]

Sales			
Date	Sales Amount	TotalCost	Margin
2019-07-01	50	40	10
2019-07-02	120	75	45
2019-07-03	500	350	150
Total	670	465	205

implicit measure

'Sales'[Margin %]

= 'Sales'[Margin] / 'Sales'[Sales Amount]

Sales			
Date	Margin	Sales Amount	Margin %
2019-07-01	5	20	25.00%
2019-07-01	5	30	16.67%
2019-07-02	45	120	37.50%
2019-07-03	150	500	30.00%
Total			109.17%

implicit measure



Measure

Convention: `[Measure]`

- Omit the table name

Lives detached from any table rows

- Calculation *context* is defined via filters, not via a single row

- Filters: slicer, cross filter, page filter, rows & columns of pivot table, ...

Calculation is NOT done row-by-row

- Unless we explicitly demand so

Calculation result is NOT saved in model

Behave the same in Excel & Power BI



[Margin %]

$$:= \text{SUM('Sales'[Margin])} / \text{SUM('Sales'[Sales Amount])}$$

Date	Margin	Sales Amount	Margin %
2019-07-01	10	50	20.00%
2019-07-02	45	120	37.50%
2019-07-03	150	500	30.00%
Total	205	670	30.60%



[Margin]

$:= \text{SUM}(\text{Sales}[\text{Sales Amount}]) - \text{SUM}(\text{Sales}[\text{TotalCost}])$

Date	Sales Amount	TotalCost	Margin
2019-07-01	50	40	10
2019-07-02	120	75	45
2019-07-03	500	350	150
Total	670	465	205



[Sales Amount]

~~$:= \text{SUM}(\text{'Sales' [Price]}) * \text{SUM}(\text{'Sales' [Quantity]})$~~

Date	Price	Quantity	Sales Amount
2019-07-01	30	4	120
2019-07-02	30	4	120
2019-07-03	100	5	500
Total	160	13	2080



[Sales Amount]

:=

```
SUMX (  
    'Sales',  
    'Sales'[Price] * 'Sales'[Quantity]  
)
```

Sales			
Date	Price	Quantity	Sales Amount
2019-07-01	10	3	30
2019-07-01	20	1	20
2019-07-02	30	4	120
2019-07-03	100	5	500
Total		13	670

Sales Amount

$$\text{Sales Amount} = \sum (\text{Price} * \text{Quantity})$$

~~$$\text{Sales Amount} = \sum \text{Price} * \sum \text{Quantity}$$~~



Margin

$$\textit{Margin} = \sum (\textit{Sales Amount} - \textit{Total Cost})$$



$$\textit{Margin} = \sum \textit{Sales Amount} - \sum \textit{Total Cost}$$



Margin in %

$$\text{Margin in \%} = \frac{\sum \text{Margin}}{\sum \text{Sales Amount}}$$



~~$$\text{Margin in \%} = \frac{\sum \text{Margin}}{\sum \text{Sales Amount}}$$~~



Take-aways

Take special care of all your numeric columns

Ordinary columns and calculated columns alike

Change *Default Summarization* to *Don't Summarize* for all numeric columns, where an aggregation does not make sense

e. g. Price, Calendar Year, Month Number, ...

Create a **measure** for all the others

With the correct aggregation

Hide the original column

Don't create (numeric) **calculated columns** at all

Use Power Query / M if necessary (eg. for certain visuals)

Next level

Using an iterator (eg. SUMX) in a **calculated column**

Using a **measure** inside a **calculated column**

'Sales'[Sales Amount SUMX]

The **calculated column's row context** is **not filtering** the 'Sales' table inside of SUMX.

=
SUMX (
 'Sales',
 'Sales'[Price] * 'Sales'[Quantity]
)

Sales				
Date	Price	Quantity	Sales Amount	SUMX
2019-07-01	10	3		670
2019-07-01	20	1		670
2019-07-02	30	4		670
2019-07-03	100	5		670

'Sales'[Sales Amount M]

Row context is (implicitly) transitioned into a *filter context* when a **measure** is referenced inside a *row context*.

Sales			
Date	Price	Quantity	Sales Amount M
2019-07-01	10	3	30
2019-07-01	20	1	20
2019-07-02	30	4	120
2019-07-03	100	5	500

= [Sales Amount]

```
[Sales Amount] :=  
SUMX (  
    'Sales',  
    'Sales'[Price] * 'Sales'[Quantity]  
)
```

'Sales'[Sales Amount CALCULATE]

CALCULATE() performs a transition of a *row context* into a *filter context*.

Sales			
Date	Price	Quantity	CALCULATE
2019-07-01	10	3	30
2019-07-01	20	1	20
2019-07-02	30	4	120
2019-07-03	100	5	500

```
=  
CALCULATE(  
    SUMX (  
        'Sales',  
        'Sales'[Price] * 'Sales'[Quantity]  
    )  
)
```

Take-aways

Calculated columns can reference other columns (row-by-row)

Row context does not filter a table

CALCULATE() explicitly *transitions* a *row context* into a *filter context*

Measures are implicitly wrapped in a CALCULATE()

Include table name when referencing columns
(*'Table'* [*Column*])

Omit table name when referencing measures ([*Measure*])

Makes it clear that *context transition* might happen

Makes it possible to move a *measure* to another table

Next level

Manipulate *filter context* with CALCULATE

Wrap-up

DAX has easy syntax, but complex semantic

Don't create (numeric) **calculated columns**

Use Power Query / M if necessary (eg. for certain visuals)

Create a **measure** for all calculations

With the correct aggregation

Hide the original column

Include table name when referencing columns

(**'Table'** [**Column**])

Omit table name when referencing measures (**[Measure]**)

Questions?

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