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DAX Functions – Basics

1. DAX FUNCTIONS – INTRODUCTION

DAX stands for **D**ata **A**nalysis E**x**pressions. DAX is a formula language and is a collection of functions, operators, and constants that can be used in a formula or expression to calculate and return one or more values. DAX is the formula language associated with the Data Model of Microsoft Excel Power Pivot and with Microsoft Power BI.

DAX is not a programming language, however it is a formula language that allows the users to define custom calculations in calculated columns and calculated fields (also known as measures). DAX helps you create new information from the existing data in your Data Model. DAX formulas enable you to perform data modeling, data analysis, and use the results for reporting and decision making.

For an in-depth understanding of DAX, refer to the tutorial – DAX in this tutorials library.

What is a DAX Function?

A DAX function is an inbuilt function provided in the DAX language to enable you to perform various actions on the data in the tables in your Data Model.

DAX functions enable you to perform commonly used data calculations on the Data Model. Some of the DAX functions have same names and functionality as that of Excel functions but have been modified to use DAX data types and to work with tables and columns, as highlighted in the next section. DAX has additional functions that are designed to work with relational data and perform dynamic aggregation.

DAX functions play an important role in the usage of DAX for data modeling and reporting.

Excel Functions vs. DAX Functions

There are certain similarities between the Excel functions and the DAX functions and there are certain differences too. Following are the similarities and differences between Excel functions and DAX functions:

Similarities Between Excel Functions and DAX Functions

- Certain DAX functions have the same name and the same general behavior as Excel functions.
-
- DAX has lookup functions that are similar to the array and vector lookup functions in Excel.

Differences Between Excel Functions and DAX Functions

- DAX functions have been modified to take different types of inputs and some of the DAX functions might return a different data type. Hence, you need to understand the usage of these functions separately though they have the same name.
-
- You cannot use DAX functions in an Excel formula or use Excel functions in DAX formula, without the required modifications.
-
- Excel functions take a cell reference or a range of cells as a reference. DAX functions never take a cell reference or a range of cells as a reference, but instead take a column or table as a reference.
-
- Excel date and time functions return an integer that represents a date as a serial number. DAX date and time functions return a datetime data type that is in DAX but not in Excel.
-
- Excel has no functions that return a table, but some functions can work with arrays. Many of the DAX functions can easily reference complete tables and columns to perform calculations and return a table or a column of values. This ability of DAX adds power to the Power Pivot, Power View and Power BI, where DAX is used.
-
- DAX lookup functions require that a relationship is established between the respective tables.

DAX Parameter Naming Conventions

DAX has standard parameter names to facilitate the usage and understanding of the DAX functions. Further, you can use certain prefixes to the parameter names. If the prefix is clear enough, you can use the prefix itself as the parameter name.

You need to understand DAX parameter naming conventions so as to understand the syntax of the DAX functions and use the values for the required parameters correctly.

Refer to the chapter - DAX Parameter Naming Conventions for details.

Types of DAX Functions

DAX supports the following types of functions.

- DAX Table-Valued Functions
    - DAX Filter Functions
    - DAX Aggregation Functions
    - DAX Time Intelligence Functions
- DAX Date and Time Functions
- DAX Information Functions

- DAX Logical Functions
- DAX Math and Trig Functions
- DAX Other Functions
- DAX Parent and Child Functions
- DAX Statistical Functions
- DAX Text Functions

DAX Table-Valued Functions

Many DAX functions take tables as input or output tables or do both. These DAX functions are called DAX table-valued functions. Because a table can have a single column, DAX table-valued functions also take single columns as inputs. You have the following types of DAX table-valued functions:

- DAX Aggregation functions
- DAX Filter functions
- DAX Time intelligence functions

DAX Aggregation Functions

DAX Aggregation functions aggregate any expression over the rows of a table and are useful in calculations.

Refer to the chapter - DAX Aggregation functions for details.

DAX Filter Functions

DAX Filter functions return a column or a table or values related to the current row. You can use DAX Filter functions to return specific data types, look up values in related tables and filter by related values. DAX Lookup functions work by using tables and relationships between them. DAX Filter functions enable you to manipulate the data context to create dynamic calculations.

Refer to the chapter - DAX Filter functions for details.

DAX Time Intelligence Functions

DAX Time Intelligence functions return a table of dates or the use a table of dates to calculate an aggregation. These DAX functions help you create calculations that support the needs of Business Intelligence analysis by enabling you to manipulate data using time periods, including days, months, quarters, and years.

Refer to the chapter - DAX Time Intelligence functions for details.

DAX Date and Time Functions

DAX Date and Time functions are similar to the Excel date and time functions. However, DAX Date and Time functions are based on the datetime data type of DAX.

Refer to the chapter - DAX Date and Time functions for details.

DAX Information Functions

DAX Information functions look at the cell or row that is provided as an argument and tell you whether the value matches the expected type.

Refer to the chapter - DAX Information functions for details.

DAX Logical Functions

DAX Logical Functions return information about values in an expression. For example, DAX TRUE function lets you know whether an expression that you are evaluating returns a TRUE value.

Refer to the chapter - DAX Logical functions for details.

DAX Math and Trig Functions

DAX Mathematical and Trigonometric functions are very similar to the Excel mathematical and trigonometric functions.

Refer to the chapter - DAX Math and Trig functions for details.

DAX Parent and Child Functions

DAX Parent and Child functions are useful in managing data that is presented as a parent/child hierarchy in the Data Model.

Refer to the chapter - DAX Parent and Child functions for details.

DAX Statistical Functions

DAX Statistical functions are very similar to the Excel Statistical functions.

Refer to the chapter - DAX Statistical functions for details.

DAX Text Functions

DAX Text functions work with tables and columns. With DAX Text functions, you can return part of a string, search for text within a string or concatenate string values. You can also control the formats for dates, times, and numbers.

Refer to the chapter - DAX Text functions for details.

DAX Other Functions

These DAX functions perform unique actions that cannot be defined by any of the categories most other functions belong to.

Refer to the chapter - DAX Other functions for details.

DAX Function Description Structure

If you have to use a DAX function in a DAX formula, you need to understand the function in detail. You should know the syntax of the function, the parameter types, what the function returns, etc.

In this tutorial, a common function description structure is used for all the DAX functions so that you can read and interpret the DAX functions effectively.

Refer to the chapter - DAX Function Description Structure for details.

2. DAX FUNCTIONS – DAX PARAMETER NAMING CONVENTIONS

DAX has standard parameter names to facilitate the usage and understanding of the DAX functions. Further, you can use certain prefixes to the parameter names. If the prefix is clear enough, you can use the prefix itself as the parameter name.

To understand the syntax of the DAX functions and to use data values appropriately for the relevant DAX function parameters, you need to understand DAX parameter naming conventions.

Parameter Names

Following are the DAX standard parameter names –

Parameter Name	Description
expression	Any DAX expression that returns a single scalar value, where the expression is to be evaluated multiple times (for each row/context).
value	Any DAX expression that returns a single scalar value where the expression is to be evaluated exactly once before all other operations.
table	Any DAX expression that returns a table of data.
tableName	The name of an existing table using standard DAX syntax. It cannot be an expression.
columnName	The name of an existing column using standard DAX syntax, usually fully qualified. It cannot be an expression.
name	A string constant that will be used to provide the name of a new object.
order	An enumeration used to determine the sort order.
ties	An enumeration used to determine the handling of tie values.

type	An enumeration used to determine the data type for PathItem and PathItemReverse.

Prefixing Parameter Names or Using the Prefix Only

You can qualify a parameter name with a prefix –

- The prefix should be descriptive of how the argument is used.
-
- The prefix should be in such a way that ambiguous reading of the parameter is avoided.

For example,

- **Result_ColumnName** - Refers to an existing column used to get the result values in the DAX LOOKUPVALUE () function.

- **Search_ColumnName** - Refers to an existing column used to search for a value in the DAX LOOKUPVALUE () function.

You can omit the parameter name and use only the prefix, if the prefix is clear enough to describe the parameter. Omitting the parameter name and using only prefix can sometimes help in avoiding the clutter during reading.

For example, Consider **DATE (Year_value, Month_value, Day_value)**. You can omit the parameter name – value, that is repeated thrice and write it as DATE (Year, Month, Day). As seen, by using only the prefixes, the function is more readable. However, sometimes the parameter name and the prefix have to be present for clarity.

For example, Consider **Year_columnName**. The parameter name is ColumnName and the prefix is Year. Both are required to make the user understand that the parameter requires a reference to an existing column of years.

3. DAX FUNCTIONS – DESCRIPTION STRUCTURE

If you have to use a DAX function in a DAX formula, you need to understand the function in detail. You should know the syntax of the function, the parameter types, what the function returns, etc.

To enable you to understand how to read and interpret the DAX functions, a uniform function description structure is used in this tutorial.

- The different types of DAX functions are grouped by the type name of the DAX functions as chapters.
-
- Each of these chapters provides a brief description of the utility of the respective type of DAX functions.
-
- The brief description will be followed by the list of DAX functions corresponding to that chapter (Type/Category of DAX functions).
-
- Each DAX function name is hyperlinked to DAX function details that have the following DAX function description structure:
-
    - Description
    - Syntax
    - Parameters
    - Return Value
    - Remarks
    - Example

The following sections explain each of these headings that appear in each DAX function explanation.

Description

In the Description section, you will learn what the DAX function is about and where it can be used.

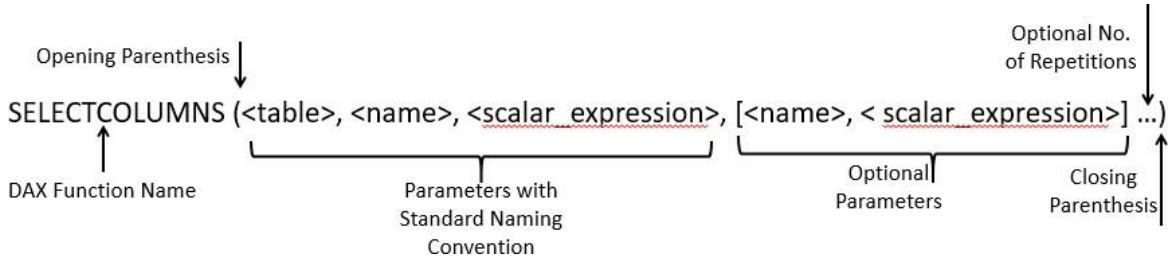
If the DAX function is introduced in Excel 2016, the same will be mentioned here. (Rest of the DAX functions exist in Excel 2013.)

Syntax

In the Syntax section, you will learn the exact function name and the respective parameters.

- DAX function name is given in UPPERCASE letters.
-
- DAX function name is followed by opening parenthesis.
- Each parameter follows standard DAX parameter naming convention and is enclosed in angle brackets.
-
- If a parameter is optional, it is further enclosed in square brackets.
-
- The parameters are separated by commas.
-
- Ellipses … are used to show an optional number of repetitions of parameters.
-
- The function syntax ends with closing parenthesis.

Example



Parameters

In the Parameters section, each of the parameters of the specific DAX function is listed in a table with its description. For example, the parameters of the above example DAX function SELECTCOLUMNS is listed in the following table.

Parameter	Description
Table	Table or a DAX expression that returns a table.
Name	The name given to the column, enclosed in double quotes.
scalar_expression	DAX expression that returns a scalar value like a column reference, integer, or string value.

Return Value

In the Return Value section, you will learn about what value the DAX function will return and its data type.

Remarks

In the Remarks section, you will learn about any extra information that you need to know about the usage of the DAX function. You will also understand the potential errors and the reasons.

Example

An example of the usage of the DAX function is given in this section.

Note: When you write DAX functions with the data values for the parameters, you will follow the naming conventions as given below:

- A Table name is specified as it appears in the Data Model. E.g. Sales.
- A Column name is specified as it appears in the Data Model with square brackets enclosing it.

  For example, [Sales Amount]

  - It is recommended to use fully qualified names for columns, i.e. a column name is prefixed with the table name that contains it.

    For example, Sales[Sales Amount].

  - If the table name contains spaces, it should be enclosed in single quotes.

    For example, 'East Sales'[Sales Amount]

- A DAX function can return a column or table of values, in which case, it needs to be used as a parameter of another DAX function that requires a column or table.

DAX Aggregation Functions

4. DAX AGGREGATE FUNCTIONS – OVERVIEW

DAX Aggregation functions aggregate any expression over the rows of a table and are useful in calculations.

Following are the DAX Aggregation functions:

- DAX ADDCOLUMNS function
- DAX AVERAGE function
- DAX AVERAGEA function
- DAX AVERAGEX function
- DAX COUNT function
- DAX COUNTA function
- DAX COUNTAX function
- DAX COUNTBLANK function
- DAX COUNTROWS function
- DAX COUNTX function
- DAX CROSSJOIN function
- DAX DISTINCTCOUNT function
- DAX GENERATE function
- DAX GENERATEALL function
- DAX MAX function
- DAX MAXA function
- DAX MAXX function
- DAX MIN function
- DAX MINA function
- DAX MINX function
- DAX PRODUCT function
- DAX PRODUCTX function
- DAX ROW function
- DAX SELECTCOLUMNS function
- DAX SUM function
- DAX SUMMARIZE function
- DAX SUMMARIZE function with Options

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- DAX SUMX function
- DAX TOPN function

5. DAX FUNCTIONS – ADDCOLUMNS

Description

Adds calculated columns to the given table or table expression.

Syntax

ADDCOLUMNS (<table>, <name>, <expression>, [<name>, <expression>] …)

Parameters

Parameter	Description
table	Table or a DAX expression that returns a table.
name	The name given to the column, enclosed in double quotes.
expression	DAX expression that returns a scalar expression, evaluated for each row of table.

Return Value

A table with all its original columns and the added ones.

Remarks

--

Example

```
=ADDCOLUMNS (
        Products,"East_Sales", SUMX (RELATEDTABLE(East_Sales),
                IF([Product]=East_Sales[Product],
                        East_Sales[Sales Amount],0)
                )
        )
```

6. DAX FUNCTIONS – AVERAGE

Description

Returns the average (arithmetic mean) of all the numbers in a column.

Syntax

AVERAGE (<column>)

Parameters

Parameter	Description
Column	The column that contains the numbers for which you want the average.

Return Value

Returns a decimal number that represents the arithmetic mean of the numbers in the column.

Remarks

- If the column contains logical values or empty cells, those values are ignored and the rows are not counted.
-
- Cells with the value zero are included and the rows are counted for the divisor.
-
- Whenever there are no rows to aggregate, the function returns a blank. However, if there are rows, but none of them meet the specified criteria, the function returns 0.

Example

=AVERAGE (Sales[Sales Amount])

7. DAX FUNCTIONS – AVERAGEA

Description

Returns the average (arithmetic mean) of the values in a column. Handles text and non-numeric values.

Syntax

AVERAGEA (<column>)

Parameters

Parameter	Description
column	The column that contains the values for which you want the average.

Return Value

Returns a decimal number.

Remarks

The AVERAGEA function takes a column and averages the numbers in it and handles non-numeric data types according to the following rules:

- Values that evaluate to TRUE count as 1.
- Values that evaluate to FALSE count as 0 (zero).
- Values that contain non-numeric text count as 0 (zero).
- Empty text ("") counts as 0 (zero).

Example

=AVERAGEA (East_Sales[Sales Amount])

8. DAX FUNCTIONS – AVERAGEX

Description

Calculates the average (arithmetic mean) of a set of expressions evaluated over a table.

Syntax

AVERAGEX (<table>, <expression>)

Parameters

Parameter	Description
table	Name of a table, or an expression that specifies the table over which the aggregation can be performed.
expression	An expression with a scalar result, which will be evaluated for each row of the table in the first argument.

Return Value

A decimal number.

Remarks

The AVERAGEX function enables you to evaluate expressions for each row of a table, and then take the resulting set of values and calculate its arithmetic mean. Therefore, the function takes a table as its first argument and an expression as the second argument.

In all other respects, AVERAGEX follows the same rules as AVERAGE. You cannot include non-numeric or null cells.

Example

=AVERAGEX (East_Sales,East_Sales[Unit Price]*East_Sales[No. of Units])

9. DAX FUNCTIONS – COUNT

Description

Counts the number of cells in a column that contain numbers.

Syntax

COUNT (<column>)

Parameters

Parameter	Description
column	The column that contains the numbers to be counted.

Return Value

Returns a whole number.

Remarks

You can use columns containing any type of data, but only numbers are counted. The COUNT function counts the rows that contain the following kinds of values:

- Numbers
- Dates

If the row contains text that cannot be translated into a number, the row is not counted. When the function finds no rows to count, it returns a blank. When there are rows, but none of them meet the specified criteria, then the function returns 0.

Example

=COUNT (ProductInventory[UnitsBalance])

10. DAX FUNCTIONS – COUNTA

Description

Counts the number of cells in a column that are not empty. It counts not just the rows that contain numeric values, but also the rows that contain nonblank values, including text, dates, and logical values.

Syntax

COUNTA (<column>)

Parameters

Parameter	Description
column	The column that contains the values to be counted.

Return Value

Returns a whole number.

Remarks

When the function does not find any rows to count, the function returns a blank. When there are rows, but none of them meet the specified criteria, then the function returns 0.

Example

```
=COUNTA (ProductInventory[UsageDate])
```

11. DAX FUNCTIONS – COUNTAX

Description

Counts nonblank results when evaluating the result of an expression over a table. That is, it works just like the COUNTA function, however it is used to iterate through the rows in a table and count rows where the specified expressions result in a nonblank result.

Syntax

COUNTAX (<table>, <expression>)

Parameters

Parameter	Description
table	The table containing the rows for which the expression will be evaluated.
expression	The expression to be evaluated for each row of the table.

Return Value

A whole number.

Remarks

The COUNTAX function counts the cells containing any type of information, including other expressions. For example, if the column contains an expression that evaluates to an empty string, the COUNTAX function treats that result as nonblank. Usually, the COUNTAX function does not count empty cells but in this case the cell contains a formula, so it is counted.

Whenever the function finds no rows to aggregate, the function returns a blank. However, if there are rows, but none of them meet the specified criteria, the function returns 0.

Example

```
Medal Count Summer Sports:=COUNTAX (
                    FILTER (Results, Results[Season]="Summer"),
                    Results[Medal])
```

12. DAX FUNCTIONS – COUNTBLANK

Description

Counts the number of blank cells in a column.

Syntax

COUNTBLANK (<column>)

Parameters

Parameter	Description
column	The column that contains the blank cells to be counted.

Return Value

A whole number. If there are no blank rows, blank is returned.

Example

=COUNTBLANK(Results[Medal])

13. DAX FUNCTIONS – COUNTROWS

Description

Counts the number of rows in the specified table, or in a table defined by an expression.

Syntax

COUNTROWS (<table>)

Parameters

Term	Definition
table	The name of the table that contains the rows to be counted, or an expression that returns a table.

Return Value

Returns a whole number.

Remarks

This function can be used to count the number of rows in a base table, but more often is used to count the number of rows that result from filtering a table, or applying a context to a table.

Example

=COUNTROWS (CALENDAR (DATE (2016,8,1), DATE (2016,10,31))) returns 92.

=COUNTROWS (Results) returns 34094.

=COUNTROWS (Events) returns 995.

Remarks

You can use columns containing any type of data, but only blank cells are counted. Cells that have the value zero (0) are not counted, as zero is considered a numeric value and not a blank.

Example

=COUNTBLANK (SalesTarget[SalesTarget])

14. DAX FUNCTIONS – COUNTX

Description

Counts the number of rows that contain a number or an expression that evaluates to a number, when evaluating an expression over a table.

Syntax

COUNTX (<table>, <expression>)

Parameters

Parameter	Description
table	The table containing the rows to be counted.
expression	An expression that returns the numbers you want to count.

Return Value

Returns a whole number.

Remarks

The COUNTX function counts only numeric values or dates. Parameters that are logical values or text that cannot be translated into numbers are not counted.

If the function finds no rows to count, it returns a blank. When there are rows, but none meets the specified criteria, then the function returns 0.

Example

```
=COUNTX (RELATEDTABLE (East_Sales), IF ([Product]=East_Sales[Product],1,0))
```

15. DAX FUNCTIONS – CROSSJOIN

Description

Returns a table that contains the Cartesian product of all rows from all tables in the parameters. The columns in the new table are all the columns in all the parameter tables.

Syntax

CROSSJOIN (<table1>, <table2>, [<table3>] …)

Parameters

Parameter	Description
table1	Table or a DAX expression that returns a table.
table2	Table or a DAX expression that returns a table.
table3	Optional. Table or a DAX expression that returns a table.

Return Value

Returns a table that contains the Cartesian product of all rows from all tables in the parameters. The columns in the new table are all the columns in all the parameter tables.

Remarks

- Column names from table parameters must all be different in all tables or an error is returned.
-
- The total number of rows in the result table is the product of the number of rows from all tables in the parameters.
-
- The total number of columns in the result table is the sum of the number of columns from all tables in the parameters.

For example, if table1 has r1 rows and c1 columns, table2 has r2 rows and c2 columns, and table3 has r3 rows and c3 columns, then the resulting table will have -

r1 × r2 × r3 rows and c1 + c2 + c3 columns

Example

=CROSSJOIN (Salesperson,Products)

16. DAX FUNCTIONS – DISTINCTCOUNT

Description

Counts the distinct values in a column.

Syntax

DISTINCTCOUNT (<column>)

Parameters

Parameter	Description
column	The column that contains the values to be counted.

Return Value

A whole number.

Remarks

You can use columns containing any type of data. When the function finds no rows to count, it returns a blank.

Example

```
=DISTINCTCOUNT (Sales[Account])
```

17. DAX FUNCTIONS – GENERATE

Description

Returns a table with the Cartesian product between each row in table1 and the table that results from evaluating table2 in the context of the current row from table1.

Syntax

GENERATE (<table1>, <table2>)

Parameters

Parameter	Description
table1	Table or a DAX expression that returns a table.
table2	Table or a DAX expression that returns a table.

Return Value

A table that can be passed as a parameter to a DAX function.

Remarks

- If the evaluation of table2 for the current row in table1 returns an empty table, then the result table will not contain the current row from table1. This is different than GENERATEALL () where the current row from table1 will be included in the results, and columns corresponding to table2 will have null values for that row.
-
- All column names from table1 and table2 must be different or an error is returned.

Example

```
=GENERATE (

    SUMMARIZE(Salesperson,Salesperson[Salesperson]),
    SUMMARIZE(SalesTarget,SalesTarget[SalesTarget],"MaxTarget",MAX(SalesTar
    get[SalesTarget])))
```

18. DAX FUNCTIONS – GENERATEALL

Description

Returns a table with the Cartesian product between each row in table1 and the table that results from evaluating table2 in the context of the current row from table1.

Syntax

GENERATEALL (<table1>, <table2>)

Parameters

Parameter	Description
table1	Table or a DAX expression that returns a table.
table2	Table or a DAX expression that returns a table.

Return Value

Returns a table with the Cartesian product between each row in table1 and the table that results from evaluating table2 in the context of the current row from table1.

Remarks

- If the evaluation of table2 for the current row in table1 returns an empty table, then the current row from table1 will be included in the results, and columns corresponding to table2 will have null values for that row. This is different than GENERATE () where the current row from table1 will not be included in the results in such a case.
-
- All column names from table1 and table2 must be different or an error is returned.

Example

```
=GENERATEALL (

    SUMMARIZE(Salesperson,Salesperson[Salesperson]),
    SUMMARIZE(SalesTarget,SalesTarget[SalesTarget],"MaxTarget",MAX(SalesTar
    get[SalesTarget])))
```

19. DAX FUNCTIONS – MAX

Description

Returns the largest numeric value in a column.

Syntax

MAX (<column>)

Parameters

Parameter	Description
column	The column in which you want to find the largest numeric value.

Return Value

A decimal number.

Remarks

The following types of values in the column are considered:

- Numbers
- Dates

Empty cells, logical values, and text are ignored.

Example

=MAX (Sales[Sales Amount])

20. DAX FUNCTIONS – MAXA

Description

Returns the largest value in a column.

Syntax

MAXA (<column>)

Parameters

Parameter	Description
column	The column in which you want to find the largest value.

Return Value

Returns a decimal number.

Remarks

The MAXA function takes as argument a column, and looks for the largest value among the following types of values:

- Numbers
-
- Dates
-
- Logical values, such as TRUE and FALSE. Rows that evaluate to TRUE count as 1 and rows that evaluate to FALSE count as 0 (zero).

Empty cells are ignored. If the column contains no values that can be used, MAXA returns 0 (zero).

Example

=MAXA (ProductInventory[UsageDate])

21. DAX FUNCTIONS – MAXX

Description

Evaluates an expression for each row of a table and returns the largest numeric value.

Syntax

MAXX (<table>, <expression>)

Parameters

Parameter	Description
table	The table containing the rows for which the expression will be evaluated.
expression	The expression to be evaluated for each row of the table that returns a numeric value.

Return Value

Returns a decimal number.

Remarks

Of the values to evaluate, only the following are counted:

- Numbers. If the expression does not evaluate to a number, MAXX returns 0 (zero).
- Dates.

Empty cells, logical values, and text values are ignored.

Example

=MAXX (East_Sales,East_Sales[No. of Units]*East_Sales[Unit Price])

22. DAX FUNCTIONS – MIN

Description

Returns the smallest numeric value in a column.

Syntax

MIN (<column>)

Parameters

Parameter	Description
column	The column in which you want to find the smallest numeric value.

Return Value

A decimal number.

Remarks

The following types of values in the column are considered:

- Numbers
- Dates

Empty cells, logical values and text are ignored.

Example

```
=MIN (Sales[Sales Amount])
```