

Introduction to Mathcad 15 – part 1

Writing text

In default settings Mathcad starts to write in mathematical mode. To begin text region in Mathcad document begin sentence with double quote symbol “ or press spacebar after the first written word.

To mix mathematical and text modes use the combination **Ctrl+Shift+A** to create math region inside the text region.

Variables & calculations

Open the *Calculator* toolbar and practice calculating simple numeral equations. Common shortcuts are listed in the table below.

Shortcut	Action	Shortcut	Action
[Lower index	Ctrl + 0	Greater or equal to
Shift+ 6	Upper index	Ctrl + 9	Lower or equal to
Ctrl + U	Units	Ctrl + =	Boolean equal to
Ctrl + F	Built-in functions	Ctrl + 3	Not equal to
Ctrl + M	Matrix	#	Product of n elements
Ctrl + Shift + A	Math region	Ctrl + 4	Sum of vector
/	Fraction	~	Global definition
\	Square root	:	Definition
?	Derivative	;	Range of variables
&	Integral	Ctrl + .	Symbolic arrow
Shift + 2	2D plot		
Ctrl + 2	3D plot		
Ctrl + 7	Polar plot		
Ctrl + L	Limit		

Example:

$$1/2+2/3+3/5 =$$

$$2 * 6^{\frac{1}{5}} + \frac{2^3}{1.5 * 5^3} =$$

To define variable write its name and colon. To define range of variables use semicolon between the first and last value in range.

A:5 (you will see A:=5) or **b:1;10** (you will see b:=1..10).

Another possibility is using indexed variables which can be used to present the change of parameters. First define index **i:1;10** and then variable **a_i:100+(i-1)*25**

Example:

Write ideal gas equation and calculate gas volume for a set of chosen parameters.

To define function simply place the name of variable in brackets and define the function:

F(x):x²+x (you will see F(x):= x²+x)

Calculate F(x) for a couple of values.

Example

Use ideal gas equation to write a function of volume versus temperature.

Using indexed variable for temperature present the change of volume with the change of temperature. Start the temperature from 273K and change it in 25K steps.

Print both – temperature and volume on the screen.

Matrix

Sometimes you might need to define some variables as matrixes. In that case use the matrix toolbar to create vector or matrix for your data. The entries in the matrix can be either numbers or functions.

Mathcad provides built-in functions to calculate matrix determinant, transposition and inversion. Other useful functions allow users to use one column of bigger matrix or link two or more matrixes into one. All this commands can be found on matrix toolbar except of linking.

To link matrixes by rows use the **augment(A,B)** command, and to link matrixes by columns use the **stack(A,B)** command. It's important, that the linked matrixes have same number of rows/columns.

Another useful commands are *rows* and *cols* which give the information about the number of rows/columns in matrix.

Example

Create 3 different matrixes – two with numbers and one with functions. Calculate their determinants and inversions.

Choose one column and one row (How to do this?) of your matrixes and print it.

Link two matrixes together and calculate their dimension.

The last thing about matrixes is sorting. Mathcad allows users to sort the elements in matrix in two ways. If one have just one column (vector) use command $sort(A)$ to sort increasingly or $reverse(sort(A))$ to sort decreasingly.

For bigger matrixes one can sort the elements by elements of specified column or row. It is done using commands $csort(A,n)$ or $rsort(A,n)$ where n is the number of column/row.

Try this commands on one of your previous matrixes.

Exchanging data with other software

Mathcad allows you to insert and edit objects from other applications into its workspace. This outside objects can be a Matlab file, en Excel file or SmartSketch object. During this course we will only use Excel external files. To insert such file use **Insert/Component menu**, which will start insert wizard. You can either create a new file to insert or use one that already exists. To exchange data between Excel and Mathcad you have to specify the input and output variables.

For Excel input variables you only need to specify the starting cell and the range of cells will be automatically adjusted to data from Mathcad.

For output variables you need to specify the first and the last cell which will be transferred to Mathcad. For example if you want to transfer a 10X10 matrix, starting at C2 to Mathcad you have to create an output variable C2:L11.

Exercise

Now use all new skills and prepare a procedure that will calculate solid fuel composition in different states. The input data are the ultimate and proximate analysis in analytical state. Start the document with the headline, containing your name, group, date and the title of the document. Use mixed regions to explain what the meaning of variables and equations used in the document. Present the result as a MSEXcel table **inside** the Mathcad file.

References:

1. Matchad user guide
2. R. Motyka, D.Rasała – MATHCAD – od obliczeń do programowania