

Mathcad Crash Course



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1. Alfasoft

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2. Editing

Math

Use the keyboard and shortcut keys as much as possible when working with Mathcad. By memorising the most often used shortcut keys you will save a lot of time and become much more efficient using Mathcad.

Mathcad Shortcut Keys

+ for addition

$$2 + 2 = 4$$

- for subtraction

$$4 - 2 = 2$$

***** for multiplication

$$4 \cdot 2 = 8$$

/ for division

$$\frac{2}{4} = 0.5$$

^ for power of

$$2^3 = 8$$

**** for square root

$$\sqrt{4} = 2$$

Every function can be written "as is" in Mathcad

Examples: $\sin(\pi)$, $\log(10)$, $\ln(4)$, etc.

Use the undo shortcut **Ctrl Z**
instead of the Delete or Backspace keys!

The 4 Equal Signs

In Mathcad it's important to know the difference between the four most used equal signs, and when to use the correct one. Each equal sign has its own meaning and use in Mathcad. For new users of Mathcad these equal signs causes confusion, and many users like to use the same (the numerical) equal sign for calculations where other equal signs needs to be used.

It's very important to be aware that Mathcad has two separate calculation engines. One for numerical calculations and one for symbolic calculations, which calculation engine to use depends solely upon which equal sign you choose to enter for your calculation.

The 4 Equal Signs in Mathcad

These are the four most used equal signs in Mathcad. Know the difference and when to use the correct one!

1. **=**

The standard equal sign for doing numerical calculations in Mathcad.

3. **→** **Ctrl .**

The arrow equal sign for doing symbolic calculations in Mathcad.

5. **⋮=** **⋮**

The colon-equal sign for defining variables, functions and just about anything in Mathcad.

7. **⚡=⚡** **Ctrl +**

The bold equal sign for use in equations.

3. Typical mistakes

Dont use predefines variables when solving equations!

If you define and use a variable in your document, and then later in the document try to solve an equation using the same variable, you will often times end up with no results. Since you have defined the variable earlier in your document, the equation will most often not give any meaning to Mathcad.

Example:

$$x := 1$$

$$x^2 + 2x - 4 = 0 \text{ solve, } x \rightarrow$$

Bad solve variable.

(You're in fact stating that $1+2-4 = 0$... No sense!)

To avoid this problem either use other variables, or since this is a symbolical calculation, you can reset the variable (symbolic engine only!) by defining $x::x$ above the equation to be solved.

$$x := 1$$

$$x::x$$

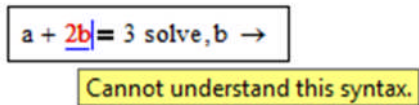
$$x^2 + 2x - 4 = 0 \text{ solve, } x \rightarrow \begin{pmatrix} \sqrt{5} - 1 \\ -\sqrt{5} - 1 \end{pmatrix}$$

The variables b, h and o are special!

The variables b, h and o are built in operators for converting numbers from binary, hexadecimal and octal bases to our decimal system. Especially the variable b is commonly used as a variable when solving equations (Example. $a + 2b = 2$). Since b is the built in binary operator in Mathcad, you must write the multiplication operator between the number in front of b and b. If you don't manually enter this multiplication operator between the number and b, Mathcad will think that what you want to convert the number in front of b, and you will most often get an error message.

Example:

Fail:



$a + 2b = 3 \text{ solve, } b \rightarrow$

Cannot understand this syntax.

Ok:

$$a + 2 \cdot b = 3 \text{ solve, } b \rightarrow \frac{3}{2} - \frac{a}{2}$$

In the first example I have written "a+2b [Ctrl +] 3", and in the last example I have written "a+2*b [Ctrl +] 3".

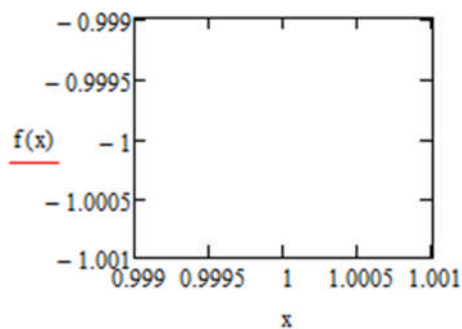
Don't use defined variables as ranges when graphing!

If you try to graph a function, and the independent variable you are using for the graph has been defined earlier in your document, Mathcad will plot only one point in you graph (almost invisible). Mathcad does only plot the point defined for the independent variable, and not the usual range.

Example:

$$x := 1$$

$$f(x) := x^2 + 2x - 4$$



If you look at the plot above, you will see that the x-range is very narrow around the point $x = 1$ (which of course is the same value as x is defined earlier in the document).

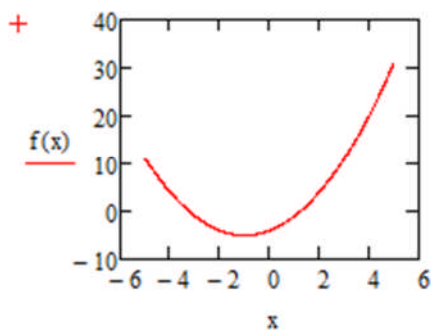
To avoid this problem use another variable name for the independent variable (in the graph window write z instead of x , and $f(z)$ instead of $f(x)$). Or you can redefine x as a range variable above the graph region.

Example:

$$x := 1$$

$$f(x) := x^2 + 2x - 4$$

$$x := -5, -4.99 \dots 5$$



Don't redefine Mathcads in-built units!

A typical mistake is to redefine a predefined unit variable in Mathcad. This is especially true for the meter and second unit variables (m and s).

Example:

$$\begin{array}{ll} \underline{m} := 10\text{kg} & a := 9.81 \frac{\text{m}}{\text{s}^2} \\ \\ \underline{F} := m \cdot a & \text{(Newtons Second Law of Motion)} \\ \\ F = 981 \frac{\text{kg}}{\text{s}^2} & \text{(Wrong units... Was expecting N)} \end{array}$$

In the example above I start with redefining (away) Mathcads predefined unit variable meter (m) to 10 kg, while I in the next definition of the variable "a" uses the same redefined "m" variable ("m" is not meter any more, but 10 kg!). That's why I don't get the force unit Newton for my result at the end of my calculations.

Example:

$$\begin{array}{ll} \text{mass} := 10\text{kg} & a := 9.81 \frac{\text{m}}{\text{s}^2} \\ \\ \underline{F} := \text{mass} \cdot a & \text{(Newtons Second Law of Motion)} \\ \\ F = 98.1\text{N} \end{array}$$

In my last example above I have avoided redefining the unit variable m by choosing another variable name for my calculations.

4. Settings

ORIGIN = 1

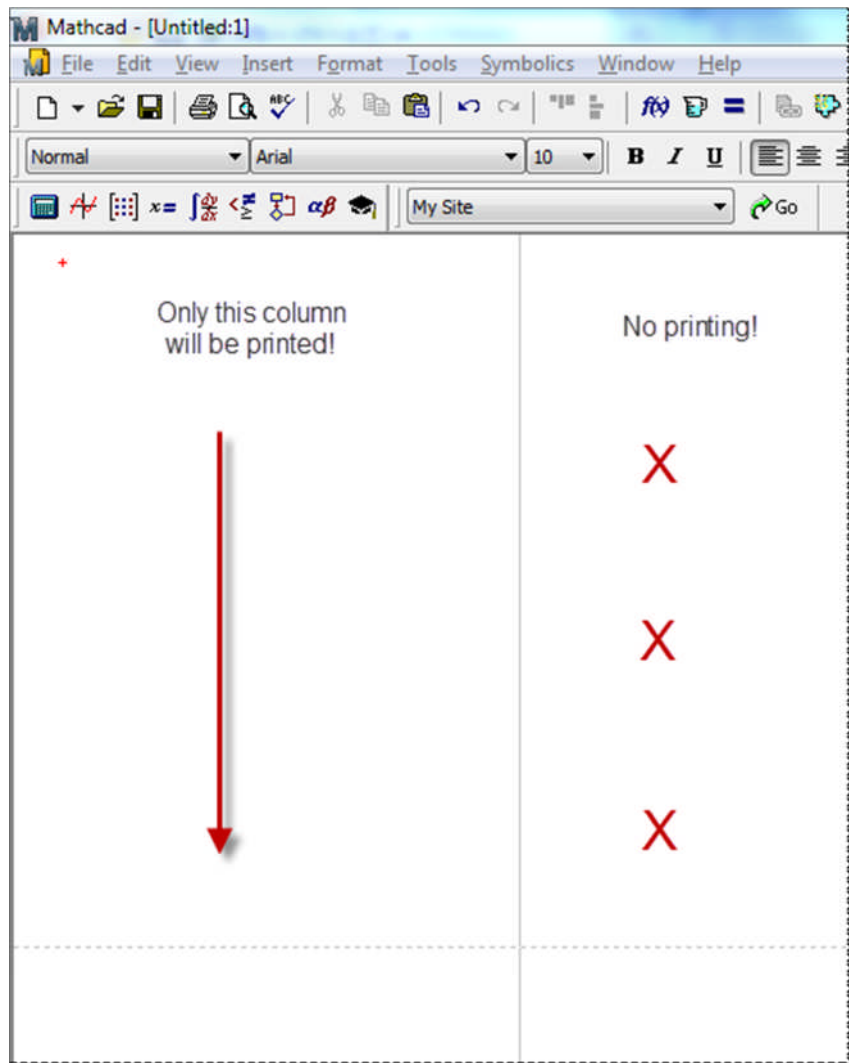
If you want to have the vector and matrix index start at 1 in Mathcad (and not the default 0), do one of the following:

- **Tools > Worksheet Options > Array Origin (ORIGIN) = 1**
- Define **ORIGIN:1** in the start of your document. Note that you have to write uppercase ORIGIN.

Print only left column

I often use the area to the right of my main document for my own comments and control/draft calculations. But I only want the main, left column to be printed when I want to publish my Mathcad document.

To make Mathcad only print the main, left column choose **File > Page Setup**, and check for **Print single page width**.

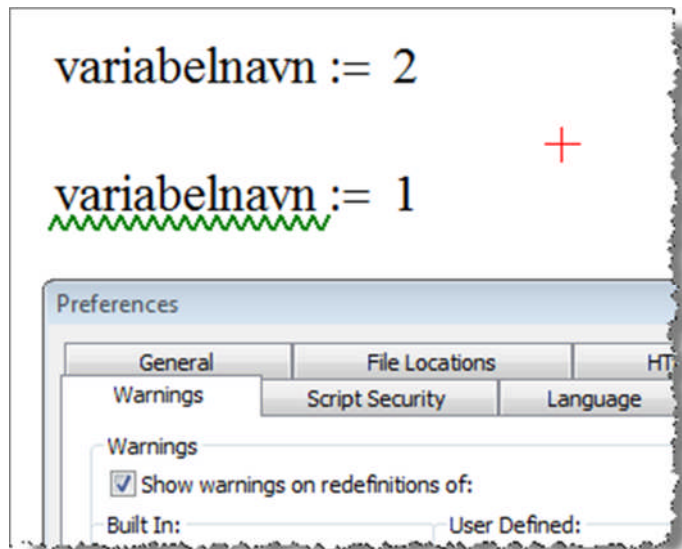


Warnings

By default Mathcad will add a green zig-zag underline if you redefine a previously defined variable or predefined unit or constant in your document. This is a nice warning, and keeps you alert about which variable names to use in your document.

But the green zig-zag underlines also get printed, which you would most often not want. To turn these warning on and off choose:

Tools > Preferences > Warnings, and check/uncheck **Show warnings on redefinitions of:**.



Autosave

Nothing is as frustrating as having a crash when editing a document in Mathcad, and losing all your work for the last hour.

That's why I am recommending turning on the auto-save feature in Mathcad. To do this choose **Tools > Preferences > Save**, check for **Autosave every...**, and enter your preferred time interval (I use 5 minutes).

5. Tips

Numerical results for symbolic calculations

Often times it can be useful to see the numerical result, in addition to the (exact and often complex) symbolic results in Mathcad. To do this click your symbolic result and then hit the "=" key to also get the numerical result.

Example:

$$x^2 + 2x - 4 = 0 \text{ solve, } x \rightarrow \begin{pmatrix} \sqrt{5} - 1 \\ -\sqrt{5} - 1 \end{pmatrix} = \begin{pmatrix} 1.236 \\ -3.236 \end{pmatrix}$$

Function/variable definition of symbolic calculations

This example shows how to use the symbolic results further in your calculations, and assigning them to a variable or function.

Example:

$$\text{ORIGIN} := 1$$

$$\text{svar} := x^2 + 2x - 4 = 0 \text{ solve, } x \rightarrow \begin{pmatrix} \sqrt{5} - 1 \\ -\sqrt{5} - 1 \end{pmatrix}$$

$$\text{svar} = \begin{pmatrix} 1.236 \\ -3.236 \end{pmatrix} \quad \text{svar}_1 = 1.236 \quad \text{svar}_2 = -3.236$$

$$f(a) := x^2 + a \cdot x - 4 \text{ solve, } x \rightarrow \begin{pmatrix} \frac{\sqrt{a^2 + 16}}{2} - \frac{a}{2} \\ -\frac{a}{2} - \frac{\sqrt{a^2 + 16}}{2} \end{pmatrix}$$

$$f(2) = \begin{pmatrix} 1.236 \\ -3.236 \end{pmatrix} \quad f(2)_1 = 1.236 \quad f(2)_2 = -3.236$$

Please note the use of vector indices in the example above, since the results are given as vectors with two elements.

6. Training

Alfasoft offers training and consultancy services for Mathcad, either in-house in your company or in our course labs in Lillestrøm, Norway and Gothenburg, Sweden. We also offer online training for Mathcad.

In-house training

Course labs in Lillestrøm and Gothenburg

Online