

# MAA121/MAG131: Differential Equations

## Computational Assignment 0: Beginning with MATHEMATICA

Submit by: Thursday 18 February 2010

This assignment will not be assessed but you need to submit it via Blackboard and your submission will be recorded. This is to make sure that you are familiar with Blackboard Assignment submission system. You will receive detailed instructions about Blackboard assignment submission via e-mail.

Switch on the computer and start Mathematica. It might be necessary first to install Mathematica on the PC, on campus this is done from *Novell-delivered Applications* center. See <http://www-maths.swan.ac.uk/staff/vm/ODE/Start/Start.html> for the detailed instructions on *How to install and start MATHEMATICA for the first time*.

Run *"First 5 Minutes with Mathematica"* tutorial which you will find on the *"Startup palette"* or under *Help* menu. Take your time, you do not need to finish it exactly in 5 minutes!

After you finished with the Tutorial, start working with your own Mathematica notebook, which is usually called Untitled-1.nb (but you could rename it at any time). Start typing the instructions from the next page of this handout, followed by the key combination *Shift + Enter* (for PCs, or *Enter* key on the numerical keypad for Macs). *Shift + Enter* will execute your instruction. Analyze the output and if you are having trouble, look into *Documentation Center* under the *Help* menu. You are not supposed to memorize all Mathematica instructions but you need to learn how to use *Help* efficiently. There is also extensive online documentation on <http://www.wolfram.com/services/> website.

*Note:* Most problems with Mathematica are caused by:

- 1) Missing SPACES, or spaces where there should not be spaces. For instance, `x y` and `xy` are different. The first will be interpreted as an instruction to multiply `x` by `y`, the second as the unique symbol `xy`!
- 2) Wrong CASES. For example, `Integrate` and `integrate` are different. All Mathematica commands begin with the capital letter!
- 2) Missing or the wrong sort of BRACKETS. Square brackets used for function arguments, like `Sin[x]` but *not* `Sin(x)`. Round brackets are used for grouping: `(2+3)*4` means add `2 + 3` first, then multiply by 4. Never `[2 + 3] * 4!`

Start typing, following each line by *Shift + Enter*:

2 + 2	this will wake the program up
3+1/2	
(3+1)/2	note the difference the brackets make
3/1+2	the value is stored exactly, not as a decimal approximation
3/(1+2)	this command displays 78 significant figures
3/117	no spaces between digits - one number
N[3/177 ,78]	a space means multiply
36	set the variable x to the value 3
3 6	what was x again?
x = 3	x squared
x	another power of x
x^2	
x^(-2)	
y = 2	a space means multiply
x y	no space means a new variable with name 'xy'
xy	set the value of t to be $y - z$ x (note z is not known yet)
t = y - z x	
z=2	
t	now z has a numerical value, so does t
z=1	this over-writes the previous value of z
t	so the value of t changes
Clear[z]	this instructs the computer to forget any value for z
t	so now z appears as an unknown quantity again
(* testing *)	things between the bracket stars are kept as comments in the program
f[z_] := 1 + 2 z + z^2	defines a function $f(z) = 1 + 2z + z^2$ . Remember the underline!
f[1]	evaluates the function on a known number. No underline anymore!
f[2/3]	
f[a]	evaluates the function on an unknown variable
Plot[f[z],{z, -4, 5}]	plots a graph of the function $f(z)$ in the domain $[-4, 5]$ .
N[Log[3] ,34]	displays $\log(3)$ to 34 significant figures (note this is the natural logarithm)
Sqrt[4] + Pi	Sqrt is the square root function, and Pi is $\pi$
Plot[x + 1/(1 - x), {x, -2, 3}]	look in the function browser to see other functions available
Expand[(x+5)(y-x)(3 x + 2)]	plots a graph without defining the function separately
	this plots a graph where x and y are functions of another variable t
	this command multiplies out brackets

Remember that you always could consult Mathematica *Documentation Centre* which you will find under the *Help* menu. You do not have to submit anything you have done so far, that was just to give you some initial feeling of what MATHEMATICA is about and how to operate it. It is a good idea at this stage to have a look at an online Mathematica screencast tutorial:

<http://www.wolfram.com/broadcast/screencasts/handsonstart/>

<http://www.wolfram.com/broadcast/screencasts/handsonstartpart2/>

<http://www.wolfram.com/broadcast/screencasts/mathematicabasics/>

There are many more useful screencasts at <http://www.wolfram.com/broadcast/#Tutorials>

**Now, as a first small assignment, open a new mathematica notebook and write instructions to draw the graph of  $g(x) = xe^{-x} + \sin(x)$  for  $x$  in the range  $[-3, 17]$ . <sup>1</sup> Save your completed Mathematica notebook as xxxxxx-ex0.nb file, where xxxxxx is your student number; and submit it via Blackboard assignment submission system. You will receive detailed instructions about Blackboard assignment submission via e-mail.**

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<sup>1</sup>Note that Mathematica uses a capital E for the exponential number e.