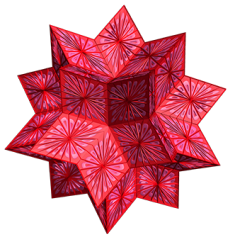
Mathematics Computer Laboratory - Math 1200 - Version 14

Lab 1 - Mathematica Basics Part I©



1. You may access the required software, called Mathematica, in the following three ways. 1. Get your own free copy by filling out the form at https://www.weber.edu/software/mathematica_request.html . 2. Any campus computer lab, including Tracy Hall Computer Lab, TY 126, and Elizabeth Hall Computer Lab, EH 213. 3. Virtual Lab: See http://www.weber.edu/virtuallab .

2. Here is how to get on Mathematica:

   Log in on a computer. Move the mouse pointer to the **Mathematica icon**, which looks like the above star like symbol, and rapidly **click twice** using the **left mouse button**. You may find the mathematica icon on the desktop, under the button Start - Programs - Wolfram or Mathematica, or by doing a search for Mathematica. Then click on NewDocument , or on New Notebook, if a notebook doesn't automatically open. If you need help, ask the lab aide.

3. Entering information is like using a word processor. You can also use the arrow and backspace keys for editing. Try typing some text and practice editing it. Mathematica displays all work in "cells". The brackets on the far right indicate the cell. You can create a new cell for your next input by clicking the mouse below the cell you have been working in. First a horizontal line will appear and then when you type a new cell will be created.

   Throughout this lab and future labs input the statements in `True Type` font exactly as is!

4. Mathematica will do arithmetic operations using the usual symbols $+$, $-$, $*$, $/$, $\hat{}$. A blank space between two terms also indicates multiplication but using $*$ might facilitate later editing. To see how it works, enter the following calculation followed by the appropriate **Evaluation** (Execution) key command; the **Enter** button on the number pad (not ⟵┘ on the main keyboard) should work on all computers.

   `4*8` **Enter** (in the number pad, not the Return key)

   (In place of the **Enter** key, you may also use Shift ⟵┘.) Now use Mathematica to evaluate the following. Remember to push the **Enter** key after each part. Check the answers using a calculator. If the output is the same as the input, you probably have made an error in typing.

   (a) `3+6*5` (Does Mathematica follow order of operation rules?)

   (b) `274/3` (Try this again with a decimal point after either number.)

   (c) `((3.24*6.791)-14.7)/(4.5+82/3)`
   Mathematica will not accept brackets or braces as computational grouping symbols. Try $[(3.24 * 6.791) - 14.7]/(4.5 + 82/3)$. Do you get the same answer?)

   (d) `2.6^2.99` (The symbol ^ is the power sign.)

   (e) `3 5` (Don't forget the space between 3 and 5.)

5. All built-in Mathematica commands or words begin with a capital letter and use "brackets" if a grouping symbol is appropriate. Type in and evaluate each of the following.

   (a) `Log[12.7]` (This is the natural logarithm $\ln 12.7$.)
   (b) `E^2.5` (This is $e^{2.5}$.)
   (c) `Log[E,12.7]` (This is the same as `Log[12.7]` or $\ln 12.7$.)
   (d) `Log[10,72.8]` (This is the common logarithm $\log 72.8$.) Notice that the first number always indicates the base.
   (e) `Sqrt[64.0]` (This is $\sqrt{64}$.)
   (f) `Abs[-2.5]` (This is $|-2.5|$.)
   (g) `I*I` I is $i = \sqrt{-1}$.

6. You can find a numerical approximation using the function `N` and `NumberForm`. Type in and evaluate each of the following.

   (a) `E` (This symbol stands for the exact value of e and will only be replaced with its numerical value if asked.)
   (b) `N[E]` (Approximate value of e.)
   (c) `Pi` (This symbol stands for the exact value of π and will only be replaced with its numerical value if asked.)
   (d) `N[Pi]` (Approximate value of π.)
   (e) `Pi//N` (This is another way of asking for the numerical value of the π.)

   The function `N` calculates the answer to 16 significant figures (not decimal places) but *Mathematica* only displays the default number of places. For viewing the answer to more than the default number of display places but **no more than 16** significant figures you must use the `NumberForm` command along with `N`. Try the following.

   (f) `NumberForm[N[E],10]`
   (g) `NumberForm[N[Pi], 16]`

   You can use the command `N` by itself for calculating and displaying the answer for **more than 17** significant figures. Try the following.

   (h) `N[Pi, 17]` (Did you get one more digit than the last part?)
   (i) `N[Sqrt[2], 50]` (This gives the value of the irrational number $\sqrt{2}$ to 50 places.)

7. You can also input mathematics in a more standard form using palettes. A basic palette is usually present on the top right hand side of the screen. (If it is not, you can get it by clicking consecutively on the buttons Palettes, and Basic Math Assistant.) You can get a form by clicking on it in the palette. You can fill a form by clicking on each location and typing. You can also **Tab** between different locations in a form. Use the palette to type in each of the following and then evaluate each one.

   (a) $3^{5.2}$
   (b) $\sqrt{37.4}$
   (c) $\sqrt{3.1^{2.7}}$
   (d) $\frac{125.3}{72}$
   (e) The numerical value of $\sqrt{\frac{5}{9}}$. See part 6.

8. The % key allows you to call back a previous output line. To call back the output from the previous line enter %, two lines up %%, 3 lines up %%%, etc. Evaluate the following.

   (a) `N[E^2]`

   (b) `Log[%]` This is the natural logarithm of the last output or $\ln(e^2)$ which, of course, is equal to 2.

   (c) `Log[%%]` This is the natural logarithm of the two outputs before, which is again $\ln(e^2) = 2$.

   (d) `Log[%]` What is this? Verify your answer!

9. Mathematica can work symbolically to perform algebraic operations. Try these.

   (a) `Expand[(a+1)^5]`

   (b) `Simplify[3x^2-x-9+x^2+7x+5]`

   (c) `Factor[x^4 - 1]`

   (d) `Together[2/(x-3)-1/(x+2)]`

   (e) `Apart[5/((x-3)(x+2))]`

   (f) `Cancel[(x^2-2x-3)/(x^2-9)]`

Now use Mathematica and what you have learned so far in the following exercises.

A. Find the numerical value of each of the following; be sure to type each one in the correct Mathematica syntax. Use a calculator to check your work.

   (i) $4 - 3[5 + 2(9 - 5)]$

   (ii) $\frac{5\cdot4-3\cdot6}{8\cdot2+4(-3)}$

   (iii) $7\{29 - 3[4(5^2 - 1) - 6]\} + 1$

B. Try each of the following; then find the syntax errors and correct them.

   (i) `expand[(2x+y)^3]`

   (ii) `Expand[[2x+y]^3]`

   (iii) `Factor(x^4-1)`

   (iv) `Cancel[5(x+2)/[(x-3)(x+2)]]`

C. Find the approximate value of each of the following; be careful to use correct Mathematica syntax.

   (i) $\ln 8.2$

   (ii) $\log(5^2 - 1)$

   (iii) $(4.1)^{2.3}$

   (iv) e^2 to 16 decimal places

   (v) $\pi^e(\pi + e)$ to 25 decimal places

D. Use Mathematica to do the following.

(i) Write $(x+2)^4$ in expanded form.

(ii) Write $x^3+9x^2+27x+27$ in factored form.

(iii) Simplify $(2x-3)(4x^2-9x-2)-3(x^3+2x^2-3x+5)$

(iv) Combine $\frac{x}{(x-3)(x-1)}+\frac{1}{(x+1)(x-1)}$ into a single fraction and simplify.

(v) Rewrite $\frac{x-1}{(2x-7)(x-3)}$ as sum or difference of two fractions with denominators $2x-7$ and $x-3$.

(vi) Rewrite $\frac{x^2-5x+6}{x^2-4}$ in lowest terms.

10. It is essential, both as a courtesy to future users, and to continued problem-free usage, to leave the computers as you find them. When you are done, close the software being used and/or log off properly.