

Lab 1**Tuesday August 27****Important reminders**

- To evaluate a command, you must hit shift + enter. You can do this from anywhere in the cell, not just the end of the cell.
- Case matters! `Sin[x]` is the function sin; `sin[x]` is creating a new variable.
- Built-in mathematica commands are capitalised, often in CamelCase. Examples include `PlotRange` (which is not `Plotrange` or `plotrange`).
- Types of parentheses matter! `()` is used for grouping. `[]` is used for function inputs. `{}` is used for lists.
- Pay attention to colors. Black means Mathematica knows what you're talking about. Blue means a so-far-undefined variable. Light green means a bound variable. Purple means parentheses you need to match. Red means something is wrong.
- The syntax for defining functions is very picky. Don't forget the underscore or colon.
- Watch your punctuation! The most common errors are minor punctuation and spelling errors.
- Mathematica tracks what you've told it, not what's currently on the screen. If you need it to forget one thing, use the `Clear[x]` command. If you need to start over, go to the menu and choose Evaluation → Quit Kernel → Local.

Mathematica Basics

1. Use Mathematica to do some basic arithmetic operations. Run the commands `3+4`, `3 - 5`, `7*12`, `6/3`, and `2^8`. Try a few more, of your own choice. What happens if you divide by zero?
2. Run the command `171/7`. Notice the answer isn't terribly helpful. Why do you think this is? Now run `N[171/7]`. What happens? (Hint: `N` stands for "Numeric").
3. Now try arithmetic with some variables. Enter the commands `x+3`, `3*y`, `x/y`, and `elephant - 7` (on separate lines).
4. Now set `y=x^2-1` and run each line of your previous code again. What changes?
5. Set `x = 3` and run each line of your code again. Then run `Clear[x]` and run your code again.
6. Run `seven = 8` and then run `seven + 3`. What happens? Now run `Clear[seven]` and never, ever do this again.
7. Run `x=0`. Now Run `x=x+1`. Run that line of code repeatedly until you reach ten.
8. Run `Sin[Pi]`. Note the capitalization! Try a couple other trig commands. What happens if you run `Sin[1]` ?
9. Run `Sqrt[5]` Is that helpful? Can you get a useful answer?
10. Define a function by entering `f[x_]:=x^2-1`. Calculate `f[3]` and `f[7]`.

Graphs and Functions

1. Plot a parabola by running the command `Plot[x^2, {x, -3, 3}]` Try changing the domain (given by `{x, -3, 3}`) and see what happens.
2. Now plot the function `f[x]` in the same way. (Stop and think: what does Mathematica think the function `f[x]` means, and why?) Pick a couple other functions and plot them; they can be as complicated as you like.
3. Now let's plot two functions on the same graph. Run the command `Plot[{f[x], x+1}, {x, -2, 2}]` (Note the `{}` here; they are important!) Again, play with the domain.
4. Try plotting three functions at once. Choose your own! Play with the domain again.
5. Now go to the Help menu, load the Wolfram Documentation, and search for "Plot." Go to "Examples" and under it "Options" and then "PlotStyle", and figure out how to choose three different colors for the three functions you have plotted.
6. Plot the function `x` on the domain `[-5, 5]`. Then on a separate graph plot `5x` on `[-5, 5]`. Notice that these graphs look nearly identical, despite representing different functions, which makes the functions hard to compare. Look up the `PlotRange` option and make a better pair of graphs with the same scale.
7. Plot the functions `x` and `x^10` on one graph, on the interval `[0, 10]`. What happens? Do you get two graphs? Do it again with domain `[0, 1]`.
8. Finally we'll learn about Tables. Enter `Y= Table[{x, f[x]}, {x, -2, 2, .5}]`. What do you get? What does the `.5` signify? Try using some other functions.
9. Enter the commands `TableForm[Y]` and `ListPlot[Y]`. What do they do?

Approximation

Try to approximate each of the following quantities in your head by finding some similar value you can compute easily. Use Mathematica to check your answers. When does this work well, and why?

Hint: use decimal points in your input, or the `N` function.

Hint: If your exact answer is close to a round number, see if you can figure out why.

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|-------------------|----------------|-----------------|
| 1. $\sqrt{10}$ | 7. 1.1^3 | 13. 2.01^5 |
| 2. $\sqrt{13}$ | 8. 1.01^3 | 14. 2.5^5 |
| 3. $\sqrt{101}$ | 9. 1.01^{30} | 15. $\sin(.05)$ |
| 4. $\sqrt{40800}$ | 10. 2.1^3 | 16. $\sin(.5)$ |
| 5. $\sqrt[3]{10}$ | 11. 2.01^3 | 17. $\cos(.05)$ |
| 6. $\sqrt[4]{10}$ | 12. 2.1^5 | 18. $\cos(1)$ |