

Getting Started with Mathematica

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1 Starting the Document

1. Open a new notebook.
2. In the Format drop down, under Style, select Title and type “Introduction to Mathematica”.
3. Push the down arrow to start a new cell.
4. In this cell, select Format → Style → Section
5. Enter the section title “Entering Calculations”.
6. Press the down arrow to create a new cell and select Format → Style → Subsection and then enter the section title “Free-Form Input”
7. Repeat the above step two more times to create subsections titled “Wolfram Language” and “Palettes”

2 Entering Calculations

Free-Form Input

1. Select the line between Free-Form Input and Wolfram Language.
2. Enter “= graph $7x + 2 = 0$ ”. Hit Shift+Enter to evaluate the expression. The program connects to the Wolfram servers to figure out what you want and then does it. A plot of the functions we entered should come up.
3. Underneath the text you originally entered, you’ll see a read-out of the Wolfram Language corresponding to your free-form input.
4. If one wasn’t already created for you, create a new cell by hitting the down arrow.
5. In the new cell, hit the “=” button and enter “Integral of $\cos(x^2)$ ” and hit Shift+Enter to evaluate.
6. Next to your input, you’ll see a plus-sign. Select this to see more information that that program pulled from the Wolfram servers, such as graphs and Step-by-Step solutions. To collapse this information, select the plus-sign again (which is now a minus-sign).

7. You can also ask for information from the Wolfram servers, such as the number of turkeys in Turkey, and do mathematical computations with that data, such as the GDP of Turkey divided by the number of turkeys in Turkey.

Wolfram Language

1. Move your cursor to the line below our subsection title “Wolfram Language”.
2. Change the format style to ItemNumbered.
3. There are four main things you need to know when programming with the Wolfram Language. Type each of the four things into your document with the item numbered.
 - (a) All built-in functions start with capital letters.
 - (b) All function arguments are enclosed with square brackets []].
 - (c) Lists, ranges, and domains are enclosed with curly braces .
 - (d) Shift+Enter to run a calculation.
4. Hit the down arrow to start a new cell.
5. Enter “Integrate” for the Integrate function. Click the double chevrons to bring up a list of input masks. We want the second one.
6. Integrate x^2 from -2 to 3 (remember to hit Shift+Enter to run the calculation). You should get $35/3$.

Palettes

1. Move your cursor below the “Palettes” subsection title.
2. In the Palettes drop-down, select Basic Math. This will bring up the basic math palette.
3. Under the 3D tab in Basic Commands, select Plot3D. This will enter the Plot3D function and input mask into our selected cell.
4. Plot the function $\sin(xy)$ where x and y both run from $-\pi$ to π . Note:
 - You may use either a space or a * to denote multiplication.
 - You can enter π either from the palette or by typing Pi.
 - Don’t forget to capitalize Sin and use square brackets.

3 Basic Calculations

1. Press the down arrow to start a new cell, and change the formatting style to Section. Enter the section name “Basic Calculations” and then press the down arrow.
2. Mathematica always gives us an exact answer, unless we tell it otherwise. Enter $16/728$ and hit Shift+Enter. Mathematica will reduce the fraction to its lowest form.
3. We can also define variables. For example, suppose we want to define the variable a to be 5. Enter “ $a = 5$ ” and hit Shift+Enter.

4. Once a variable has been defined, we can use it in calculations. For example, we can type “ $3a + 1$ ” and get the result of 16.
5. If we want to clear the variable, we just enter the function Clear with the variable we want to clear as the argument.
6. We can use Mathematica to solve equations. For example, we can solve $3 + 12y = 0$ for y by using the Solve command. Note that in this case, we use a double equal sign, since we are not defining a variable and that we need to tell the program that the variable we want to solve for is y . Syntax: `Solve[3 + 12y == 0, y]`.
7. We can also define functions. For example, suppose we want to define a function $f(x) = x^2$. Then, we type the following syntax:

```
f[x_] := x^2
```

8. Once we’ve defined a function, we can use it in computations. For example, we can calculate 3^2 or solve for $x^2 = 36$.

3.0.1 Basic Graphics

1. Start a new cell, if you aren’t already in one, and change the formatting style to Section. Enter the section title “Basic Graphics” and press the down arrow.
2. Use free-form to enter “graph of $\sin(x)$ ”. (Remember to type = first and then hit Shift+Enter).
3. You can use the suggestions bar to add labels and make other changes to the output.
4. We can also use Mathematica to draw 3D plots of functions, like we did before. In this case, we can drag the graphic to rotate it, hold Ctrl and drag to zoom in and out, and hold Shift and drag to pan the image.
5. We can also do a contour plot, and move the cursor over the contours to see the various values they represent.

3.0.2 Interactive Models

1. One of the most powerful aspects of Mathematica is in its interactive models.
2. Suppose we wanted to see the graph of $\sin(rx)$ as r varies in some range. We will start by plotting our usual sine function from 0 to 2π .
3. In the next cell, use the Manipulate function with the following syntax:

```
Manipulate[
Plot[Sin[frequency x], {x, 0, 2 Pi}], {frequency, 1,
5}]
```

4. We can manipulate any mathematical object. For example, suppose we want to be able to quickly switch between a few trig functions. We can use the following syntax:

```
Manipulate[
Plot[function[frequency x], {x, 0, 2 Pi}], {frequency, 1,
5}, {function, {Sin, Cos, Tan}}
```

5. Here's another example:

```
Manipulate[Expand[(y + z)^n], {n, 2, 100, 1}]
```