

# Introduction to *Mathematica*

The best way to learn about *Mathematica* is to play around with a variety of things the program can do. Below is a list of inputs. One at a time, type in each input and have *Mathematica* process the input by hitting SHIFT+RETURN or the ENTER key on the number pad. Look at the output and try to figure out how it relates to the input you entered. Experiment with changing parts of the input to get different outputs. Note that you can edit an input or copy it and paste it elsewhere.

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## Numbers and arithmetic

```
Pi
N[Pi]
N[Pi, 50]
2 Pi
2. Pi
2 + 3
2 * 3
2 / 3
2. / 3
```

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## Manipulating expressions

```
Factor[x^2 - 5 x + 6]
a = (x + 1)^2 + (3 x + 2)^3
Expand[a]
b = (3 x + 1)^2 / x + 2 / x^2
Together[b]
a * b
Simplify[a * b]
```

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## Solving equations

```
Solve[x^2 + 5 x + 6 == 0, x]
Solve[Sin[x] + Cos[x] == x, x]
FindRoot[Sin[x] + Cos[x] == x, {x, 1}]
```

Note: When using FindRoot, it's often best to have a graph at hand.

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## Functions

```
f[x] = x^3
f[x]
f[3]
Clear[f]
f[x_Real] = x^3
f[x]
f[3]
f[3.]
f[3 + I]
```

```
Clear[f]
f[x_] = x^3
f[x]
f[3]
f[3.]
f[3 + i]
Clear[f]
```

Note: It is good practice to clear any assignments you no longer need.

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## Graphics

```
Plot[Sin[x], {x, 0, 2 Pi}]
Plot[{Sin[x], Cos[x]}, {x, 0, 2 Pi}]
plot1 = Plot[Sin[x], {x, 0, 2 Pi}]
plot2 = Plot[Cos[x], {x, 0, 2 Pi}]
Show[plot1, plot2]
Graphics[{Blue, Line[{{0, 1}, {1, 1}}], Red, Circle[{0, 0}, 2]}]
Plot3D[Sin[x] Sin[y], {x, 0, 4 Pi}, {y, 0, 4 Pi}]
ContourPlot[Sin[x] Sin[y], {x, 0, 4 Pi}, {y, 0, 4 Pi}]
Manipulate[Plot[a Sin[x], {x, 0, 2 Pi}], {a, -1, 1}]
Manipulate[Plot[a Sin[x], {x, 0, 2 Pi}, PlotRange -> {-1, 1}], {a, -1, 1}]
Animate[Plot[a Sin[x], {x, 0, 2 Pi}, PlotRange -> {-1, 1}], {a, -1, 1}]
```

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## Calculus

```
D[x^3, x]
D[x^3, {x, 2}]
f[x_] = x^2
f'[x]
f''[x]
Integrate[x^2, x]
Integrate[x^2, {x, 1, 3}]
NIntegrate[x^2, {x, 1, 3}]
Integrate[x^2, {x, a, b}]
Integrate[Sin[n x], {x, 0, 2 Pi}]
Integrate[Sin[n x], {x, 0, 2 Pi}, Assumptions -> n ∈ Integers]
Integrate[Exp[-x^2], x]
Integrate[Exp[-x^3], x]
```