Hands-On Start to Mathematica

This is a basic start to Mathematica

Notebook: Basic Algebra

In[1]:=
```
2 + 2
```
Out[1]=
```
4
```

In[2]:=
```
1 + 2 + 3
```
Out[2]=
```
6
```

In[3]:=
```
% + 4
```
Out[3]=
```
10
```

After you perform a calculation, the Suggestions Bar will provide options for further computation:

Standard symbols work for mathematical operations:
(Use a space or * for multiplication, not the “x” character.)

In[4]:=
```
5 + 2 * 3 - 7.5
```
Out[4]=
```
3.5
```

In[5]:=
```
((5 - 3) ^ (1 + 2)) / 4
```
Out[5]=
```
2
```

There are many built-in function. For example, Greatest Common Divisor (GCD) can be calculated as:

In[6]:=
```
GCD[12, 15]
```
Out[6]=
```
3
```

Fractions and Decimals

In[7]:=
```
1 / 4 + 1 / 3
```
Out[7]=
$$\frac{7}{12}$$

(Use CTRL+ / to enter fractions.)

In[8]:=
$$\frac{1}{2} + \frac{1}{2}$$
Out[8]=
```
1
```

In[9]:=
```
Together[1 / a + 1 / b]
```

Out[9]=
$$\frac{a + b}{a\ b}$$

In[10]:=
```
.25 + 1 / 3
```

Out[10]=
```
0.583333
```

To get a numerical estimates of result:

In[11]:=
```
N[1 / 4 + 1 / 7]
```

Out[11]=
```
0.392857
```

To specify the accuracy to which your answer is displayed

In[12]:=
```
N[1 / 4 + 1 / 7, 10]
```

Out[12]=
```
0.3928571429
```

To express in scientific form:

In[13]:=
```
ScientificForm[0.00123]
```

Out[13]//ScientificForm=
$$1.23 \times 10^{-3}$$

ScientificForm is applied automatically when appropriate, for example:

In[14]:=
```
N[100!]
```

Out[14]=
$$9.33262 \times 10^{157}$$

Variables and functions: variables start with letters and can also contain numbers

In[15]:=
```
a1 / 2
```

Out[15]=
$$\frac{a1}{2}$$

A space between two variables or numbers indicates multiplication: for example a b means a*b

In[16]:=
```
a b + 5 x x
```

Out[16]=
$$a\ b + 5\ x^2$$

In[17]:=
```
ab + 5 xx
```

Out[17]=
$$ab + 5\ xx$$

Use /. and → to make substitutions in an expression, for example if you want to replace x by 2 in this example then:

In[18]:=
```
1 + 2 x /. x → 2
```

Out[18]=
```
5
```

You can assign a value using a symbol. For example:

In[19]:=
```
x = 2
```
Out[19]=
```
2
```

In[20]:=
```
1 + 2 x
```
Out[20]=
```
5
```

You can define a function yourself, for example:

In[21]:=
```
f[x_] = 1 + 3 x
```
Out[21]=
```
7
```

In[41]:=
```
x = 5
```
Out[41]=
```
5
```

In[44]:=
```
f[x_] = 1 + 3 x
```

In[47]:=
```
16
```

In[50]:=
```
Clear[x]
```

Use ctrl + 6 for the exponent.

Algebra and properties: we can factor or expand algebraic expressions:

In[46]:=
```
Factor[x^2 + 2 x + 1]
```
Out[46]=
```
36
```

In[51]:=
```
2 + 2 == 4
```
Out[51]=
```
True
```

In[52]:=
```
1 + z == 15
```
Out[52]=
```
1 + z == 15
```

Here, == is used to represent an equation:

To solve an inequality:

In[53]:=
```
Solve[x^2 + 5 x - 6 == 0, x]
```
Out[53]=
```
{{x → -6}, {x → 1}}
```

For approximate results, use NSolve

In[54]:=
```
NSolve[7 x^2 + 3 x - 5 == 0, x]
```
Out[54]=
```
{{x → -1.08618}, {x → 0.657611}}
```

You can solve the system of equations:

In[55]:=
```
Solve[{x^2 + 5 == y, 7 x - 5 == y}, {x, y}]
```
Out[55]=
```
{{x → 2, y → 9}, {x → 5, y → 30}}
```

To find the root of an equation: just use Roots function

In[56]:=
```
Roots[x^2 + 3 x - 4 == 0, x]
```

Out[56]=
$$x == -4 \,||\, x == 1$$

If a polynomial is not easily factorable, approximate results may be more useful

In[57]:=
```
NRoots[360 + 234 x - 1051 x^2 + 11 x^3 + 304 x^4 - 20 x^5 == 0, x]
```

Out[57]=
$$x == -1.79025 \,||\, x == -0.498678 \,||\, x == 0.797819 \,||\, x == 1.68398 \,||\, x == 15.0071$$

The Reduce command reduces a set of inequalities into a simple form: Type <= for less than and equal to

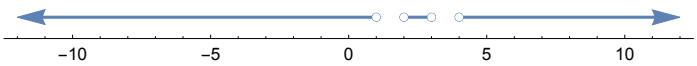
In[58]:=
```
Reduce[{0 < x < 2, 1 ≤ x ≤ 4}, x]
```

Out[58]=
$$1 \le x < 2$$

NumberLinePlot is a handy way to visualize these results

In[59]:=
```
NumberLinePlot[x < 1 || 2 < x < 3 || x > 4, {x, -10, 10}]
```

Out[59]=



In[63]:=
```
Solve[a x^2 + b x + c == 0, x]
```

Out[63]=
$$\left\{\left\{x \to \frac{-b-\sqrt{b^2-4\,a\,c}}{2\,a}\right\}, \left\{x \to \frac{-b+\sqrt{b^2-4\,a\,c}}{2\,a}\right\}\right\}$$

Solve simultaneous equations:

In[68]:=
```
Solve[{3 x + 2 y == 15, 3 x - 3 y == 12}] // N
```

Out[68]=
$$\{\{x \to 4.6, y \to 0.6\}\}$$

In[69]:=
```
Solve[{3 x + 2 y == 15, 3 x - 3 y == 12}, {x, y}] // N
```

Out[69]=
$$\{\{x \to 4.6, y \to 0.6\}\}$$

In[70]:=
```
Solve[{3 a x + 2 y == 15, 3 x - 3 b y == 12}, {x, y}] // N
```

Out[70]=
$$\left\{\left\{x \to -\frac{1.\,(-8.-15.\,b)}{2.+3.\,a\,b}, y \to -\frac{3.\,(-5.+4.\,a)}{2.+3.\,a\,b}\right\}\right\}$$

In[71]:=
```
Solve[{3 a x + 2 y == 15, 3 x - 3 b y == 12}, {x, y}]
```

Out[71]=
$$\left\{\left\{x \to -\frac{-8-15\,b}{2+3\,a\,b}, y \to -\frac{3\,(-5+4\,a)}{2+3\,a\,b}\right\}\right\}$$