Welcome to Maple, eh! The very first thing we want to do before we start working is to type:

```
restart
```

This clears the memory buffer of any existing variable or function definitions.

**Functions:**
To define a function \( f(x) = \sin(x) \), say, type

\[
f := x \rightarrow \sin(x)
\]

\[
(1)
\]

You can then call this function using a variable as input,

\[
f(x)
\]

\[
\sin(x)
\]

\[
(2)
\]

or you can evaluate it as an actual number as input:

\[
f\left(\frac{\pi}{4}\right)
\]

\[
\frac{1}{2} \sqrt{2}
\]

\[
(3)
\]

Maple likes to give us results symbolically, not numerically, so in order to see what that number is, type

```
evalf(\%)
```

\[
0.7071067810
\]

(4)

Here, `evalf()` means "evaluate function", and the \( \% \) means "last line calculated". We can alternatively combine the two steps:

```
evalf\left(f\left(\frac{\pi}{4}\right)\right)
```

\[
0.7071067810
\]

(5)

Note that we can choose (almost) any name we want for our functions, as long as they don't conflict with pre-defined variable or function names. So, instead of the lame \( f(x) \), we could instead have called it `myfirstfunction`:

```
myfirstfunction := x \rightarrow \sin(x)
```

\[
(6)
\]

which we can invoke accordingly:

```
myfirstfunction(x)
```

\[
\sin(x)
\]

(7)

Functions can be multivariate, and we'll frequently need to define these. For example,

\[
f^2 := (x, a) \rightarrow a \cdot \sin(x)
\]
\( (x, a) \rightarrow a \sin(x) \) \hspace{1cm} (8)

is now a sine function whose amplitude we can vary as input:

\[
\begin{align*}
&f_2(x, a) \\
&f_2\left(\frac{\pi}{4}, 1\right) \\
&f_2\left(\frac{\pi}{4}, 2\right)
\end{align*}
\]  
\[
\begin{align*}
&= a \sin(x) \\
&= \frac{1}{2} \sqrt{2} \\
&= \sqrt{2}
\end{align*}
\hspace{1cm} (9) (10) (11)

and so on. There's no limit to how many input variables you want to define.

**Plotting**

After we define our functions, we will also want to plot them. Plotting is a fairly simple procedure, but you have to watch your syntax.

Suppose we want to plot \( f(x) \) as defined above. The only variable is \( x \); so we would type

\[ plot(f(x), x=0..2 \cdot \text{Pi}) \]
That is, of course, what we expect to see! We can vary the range to whatever we want.

To plot our second function of two variables, let's type:

```plaintext
plot(f2(x, a), x=0..2*Pi)
```
Uh oh! Why didn't it show anything? Duh! We forgot to set a value for $a$. Let's try again:

```latex
plot(f2(x, 1), x=0..2 Pi)
```
plot(f2(x, 2), x=0..2*Pi)
Integrating and Differentiating

The other important thing we'll need to do is calculus. To differentiate a function, type

\[
\text{diff}(f(x), x) = \cos(x)
\]

To perform an indefinite integrate, type

\[
\text{int}(f(x), x) = -\cos(x)
\]

and for a definite integral, we need to specify bounds (but they need not be numerical):

\[
\text{int}(f(x), x = 0 .. \text{Pi}) = 2
\]

\[
\text{int}(f(x), x = 0 .. \frac{b}{2})
\]
\[ 1 - \cos\left( \frac{1}{2} b \right) \]  

This works with multivariate functions as well, and this time you don't need to define the value of any other variable (but you can if you want):

\[ \text{diff}(f^2(x, a), x) \quad a \cos(x) \]  

\[ \text{diff}(f^2(x, 2), x) \quad 2 \cos(x) \]  

\[ \text{int}(f^2(x, a), x) \quad -a \cos(x) \]  

and so on.

We can perform higher-order derivatives. Here's the second derivative:

\[ \text{diff}(f(x), x^2) \quad -\sin(x) \]  

\[ \text{diff}(f^2(x, a), x^2) \quad -a \sin(x) \]  

and we can also perform multidimensional integration:

\[ \text{int}(\text{int}(f^2(x, a), x=0..b), a=-1..c) \quad \frac{1}{2} (1 - \cos(b)) \left( c^2 - 1 \right) \]  

The possibilities are endless, but that's enough to start you out on the road.