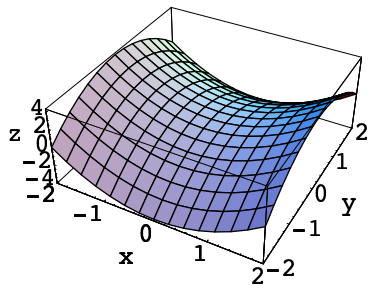# ■ More on Plotting with Mathematica

Many commands in *Mathematica* come with options. They are of the form: Option -> {Chosen value for the option}. In classes I was looking for an option to label axes. It is of the form
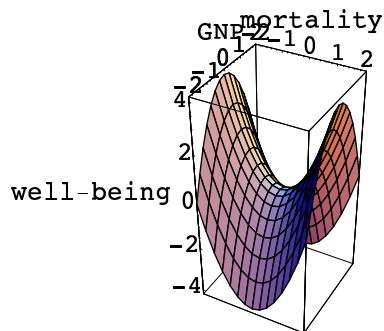AxesLabel -> {"lable1", "label2", "label3"}. Here is an example:

`In[2]:= Plot3D[x^2-y^2, {x, -2, 2}, {y, -2, 2}, AxesLabel → {"x", "y", "z"}]`

`Out[2]= ▬ SurfaceGraphics ▬`

Of course, I could have chosen any lables instead of x, y, z. Here is an option which will change the proportions of the box in which the graph is viewed:

`In[4]:= Plot3D[x^2-y^2, {x, -2, 2}, {y, -2, 2},
        AxesLabel → {"mortality", "GNP", "well-being"}, BoxRatios -> {2, 2, 4}]`

`Out[4]= ▬ SurfaceGraphics ▬`

Instead of having to re write a function, you cna define it once and for all. Make sure to not forget to put the underscore after the variables INSIDE the function. You only do that ONCE, when you define the function. It tells *Mathematica* that these letters are to be treated as variables:

```
In[5]:=  f[x_, y_] = 2 x^2 + y^2
```

Out[5]= $2 x^2 + y^2$

You can then perform on f any operation you'd do by hand:

```
In[6]:=  f[2, Pi]
```

Out[6]= $8 + \pi^2$
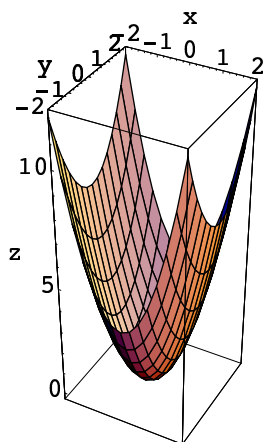
If you want a numerical value, use the N commmand:

```
In[7]:=  N[f[2, Pi]]
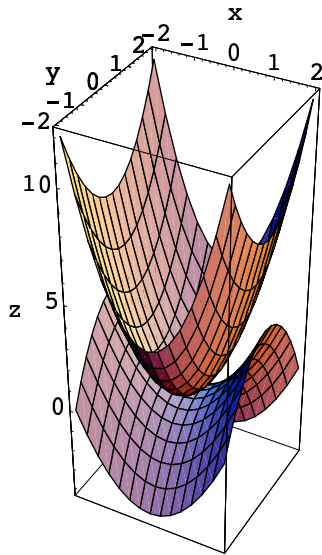```

Out[7]=  17.8696

You can graph f as before:

```
In[10]:=  Plot3D[f[x, y], {x, -2, 2}, {y, -2, 2},
            AxesLabel → {"x", "y", "z"}, BoxRatios -> {2, 2, 5}]
```


Out[10]= - SurfaceGraphics -

Finally, you can show several graphs together:

In[11]:= **Show[%10, %2]**

Out[11]= ▪ Graphics3D ▪

Note the very important trick here: I have used two previous outputs (2 and 10) by using the % sign. You can always do that in many situations with mathematica. For instance, If I want to square f(2, π), I can refer to Output 6, where I computed f(2, π):

In[13]:= **a = %6**

Out[13]= $8 + \pi^2$

In[14]:= **a^2**

Out[14]= $(8 + \pi^2)^2$

In[15]:= **Expand[a^2]**

Out[15]= $64 + 16 \pi^2 + \pi^4$

In[16]:= **N[a^2]**

Out[16]= 319.323

A last point about graphics: you ccan change the point from which the graph is seen with the ViewPoint option. The best way to do that is to go to the "Input" menu and select 3D Viewpoint selector. You can then orient the little box, and click paste when you like its orientation. That will paste something like ViewPoint -> {2.3, 3.45, -2.221} wherever your cursor is on the notebook.

In[17]:= **Show[%11, ViewPoint** -> **{0.297, 1.207, -0.170}]**
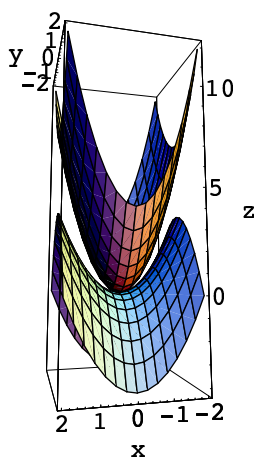
Out[17]= ■ Graphics3D ■

Don't forget the comma before ViewPoint!