MT 2800 Names: _____
Lab 1

Instructions: Complete the 6 activities in this handout. Submit a copy of your *Mathematica* notebook with this sheet. You may work alone or with a partner.

Mathematica can plot functions of 2 variables and their contour plots.

Defining functions follows the same syntax as it does with one variable. For example, to define $f(x, y) = x^2 + y^2$, type

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

Plotting functions and their contour plots follows pretty much the same syntax as well. Recall, to graph a 1-varible function f(x) from x=-5 to x=5, type

```
Plot[f[x],{x,-5,5}]
```

To plot a function of 2 variables, type

```
Plot3D[f[x,y],{x,-5,5},{y,-5,5}]
```

Note that you have to specify the range of values for both x and y. You can rotate the graph simply by clicking on it and dragging the mouse. Try it!

For contour plots use this command:

```
ContourPlot[f[x,y],{x,-5,5},{y,-5,5}]
```

Activities:

1. Use Mathematica to graph $f(x, y) = x^2 - y^2$ and its contour plot.

   Does the graph agree with the contour plot? In the contour plot, the shading goes from light to dark. Which is higher—light or dark?

2. By hand, try to sketch $f(x, y) = xy$. Can you guess what kind of shape the graph has (be honest). Okay, now graph the function and its contour plot using Mathematica and see what you get. Now that you see the graph, what sort of shape is it? CAUTION: You will need to type x*y, since it's x times y. If you type xy, Mathematica will think that's a different variable (variables can have more than one letter to them).

3. Use Mathematica to graph $f(x, y) = x^2 + y^2$ (say x and y from -2 to 2). Externally name your plot "surface." Then use Mathematica to graph $g(x, y) = 2x + 2y - 2$ on the same range of x and y. Externally name this plot "plane." Now use the Show command to combine these two graphs. What do you see? If necessary, rotate until you see exactly what's going on. Describe what you see below.

4. In #3 above, you saw the Calc III analog of an important Calc I concept. Here is another. Use Mathematica to graph $f(x,y) = x^3 - 3x + y^3 - 3y$ and its contour plot. Use x and y between -2 and 2. Do you see any local maximums or local minimums? Review question: How did we find local max's and min's in Calc I?

5. Use Mathematica to graph $f(x,y) = 4 - x - 2y$. Use x and y between 0 and 1. Initially, do not rotate this graph. Based on what you first see, decide which axis is Which. By hand, label the axes x, y, and z on your Mathematica printout.

6. Use Mathematica to graph the following functions. Adjust the range of x and y to get a nice graph that shows the important features.

   a. $f(x,y) = x^2 - y$.

   b. $g(x,y) = \dfrac{1}{1 + x^2 + y^2}$.

   c. $h(x,y) = x \sin y$.