MT 135-56/8 **Multivariable Functions with *Derive*™ *6*,** **Fall, 2004**

The purpose of these exercises is to explore functions of two variables in Derive.

3-D Graphs in Derive:
It is often helpful to see the graph of a function of two variables. Start by choosing "New 3D-plot Window" from the Window menu at the top of the screen in Derive. Go back to the Window menu and select "Tile Vertically," so that you can see the graph and the algebra window simultaneously. Author a function of two variables in the algebra window, or highlight an existing function, and then move to the plot window. (Click on the title bar of a window to move to that window.) Click the "plot" button on the toolbar:

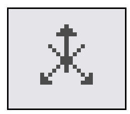

Figure 1: 3D Plot Button

You can rotate the plot in discrete steps by using the left/right/up/down arrow keys on the keyboard, or by clicking on the "rotate" buttons on the toolbar. You can also initiate a continuous horizontal rotation of the plot by clicking the appropriate button on the toolbar.

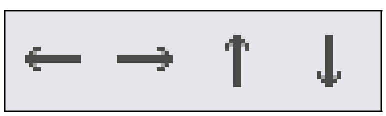

Figure 2:
Discrete Rotation Buttons

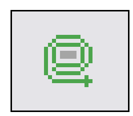

Figure 3:
Continuous Rotation Button

In addition to zooming in or out by using the "zoom" buttons, you can also shrink or magnify the graph, without changing the visible portion of the graph.

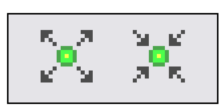

Figure 4: Magnify and Shrink Plot Buttons

Finally, you can change the visible portion of the graph manually by using the Set menu and choosing "Plot Range ... Minimum/Maximum."

Try This:
In the algebra window, author the expression $z = x^2 - y^2$. You should see the plot shown in Figure 5 below. Rotate the plot in several directions in order to get a better feeling for its shape.

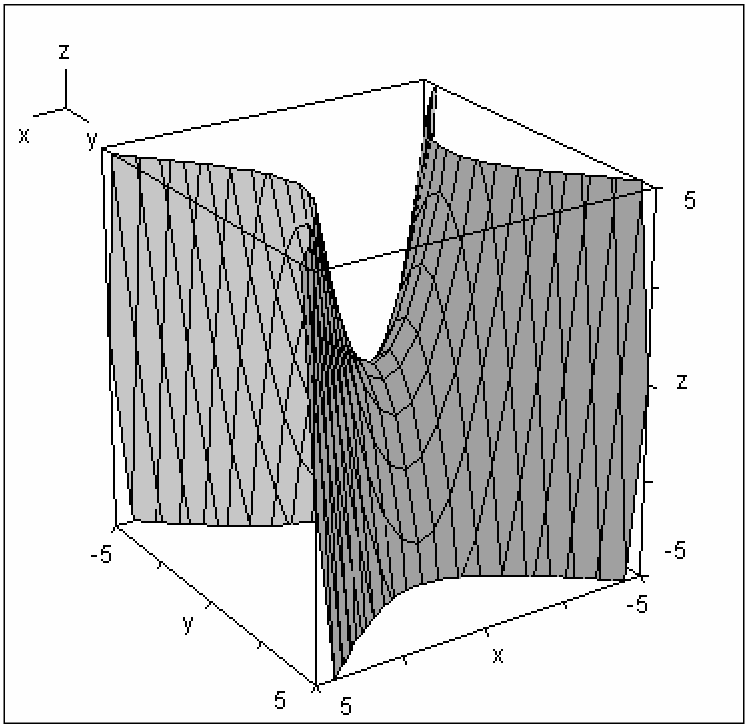

Figure 5: A 3D Plot

Tracing 3D Graphs:
The curves you see drawn on the surface of the graph are *traces* – each represents a specific value of either *x* or *y*. By clicking the "trace" button (see Figure 6), you can isolate one trace in each direction (*x* and *y*).

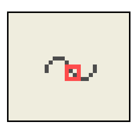

Figure 6: Trace Button

Move to different traces by clicking the "plot tracing buttons" that appear in the plot window. The coordinates of the point where the two traces meet are given in the plot status bar below the plot window. Clicking the trace button a second time will turn off the tracing feature.

You can increase or decrease the frequency of the trace curves (and thereby increasing or decreasing the "smoothness" of the graph) by changing the plot parameters. While in the plot window, access the Edit menu and select "Plot." Increasing the number of panels will create more trace curves and make the resulting graph appear smoother. You can click the "Plot Color" tab to change the colors of your plot if you like. Replotting a graph will also change its color.

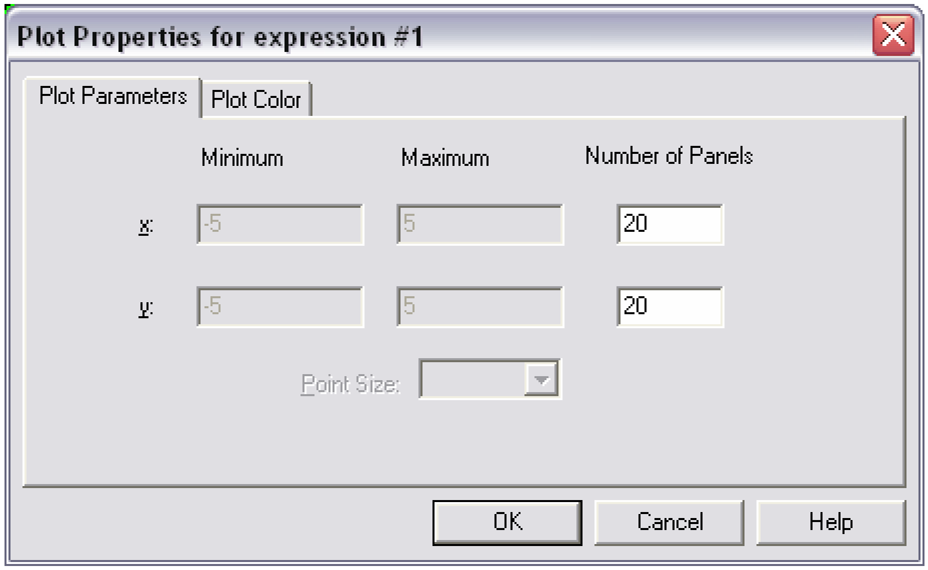

Figure 7: "Plot Properties" Dialog Box

Try This:
Trace the graph of $z = x^2 - y^2$ until you see the traces that are highlighted in white in Figure 8. Check the plot status bar to see that the x-coordinate is -0.5 and the y-coordinate is 1.5.

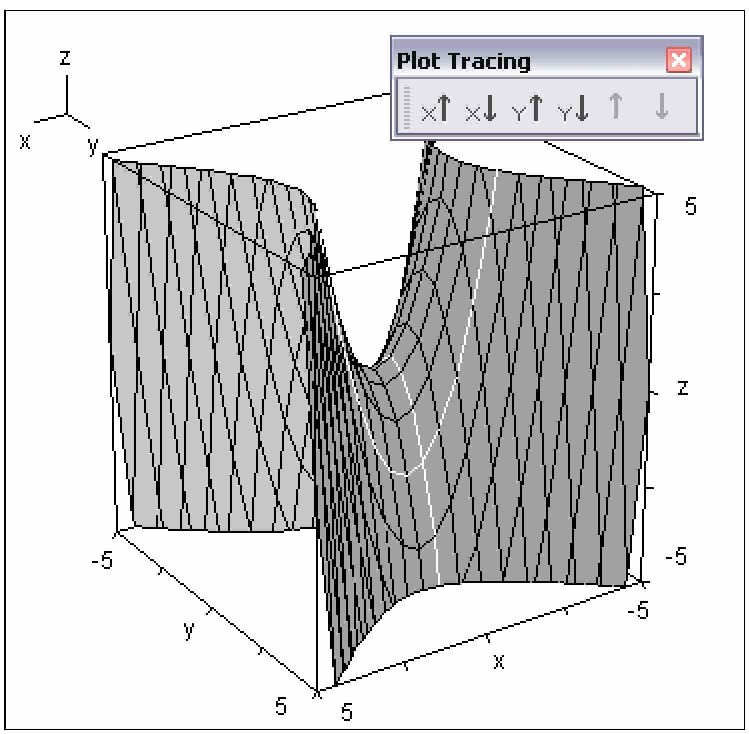

Figure 8: Tracing a 3D Plot

Exercises:
Use *Derive*™ *6* for the following exercises. For this assignment, you will print your results from Derive.

For each function given below, do the following:

a) Plot each function. Then change the number of panels to 30 in the x- and y-directions and set the given maximum and minimum values of x, y, and z. You have to plot the function before changing these settings.
b) Trace the graph to approximate the coordinates (x, y, z) of each relative extremum and saddle point. Record your results.
c) While in the plot window, choose "Embed" from the File menu. This will put a copy of the graph into the algebra window.
d) Print the algebra window, showing both the function and its graph. On that paper, write a SENTENCE for each relative extremum or saddle point. (Your sentence should say something like, "The function appears to have a relative minimum at $(2,3,-4)$.")

1. $z = \dfrac{x+y}{x^2+y^2+2y+2}$; $-5 \le x \le 5$, $-5 \le y \le 5$, $-2 \le z \le 1$

2. $z = (x-y-2)^3 - 6xy + 12y$; $-1 \le x \le 4$, $-3 \le y \le 2$, $-2 \le z \le 2$