LIVEMATH JumpStart — Lesson 3 : Functions

Mulitivariable Functions : Part Two - Graphing

How about graphing functions of more than one variable? Of course!

It takes two dimensions to graph a function of one variable. The horizontal axis represents input into the function and the vertical axis represents the output. The points on the graph indicate which output resulted from which inputs.

When graphing a function of two variables we will need two axes for the inputs and then a third axis representing the output from the function for a total of three dimensions.

Graphing functions of more than two varables is not very easy since we live in a three dimensional world (not to mention that your computer screen is still ony two dimensional). So, let's stick with functions of two variables and make some graphs.

When graphing a function of one variable people usually call the horizontal axis the x-axis and the vertical axis the y-axis. That is they call the input (the function's argument or variable) into the function x and they call the output from the function y. Hence you usually see things like

$y = f(x)$

$y = 3x - 2.$

Similarly with function's of two variables people have chosen the "usual" names. The inputs are called x and y. All of the inputs form the xy-plane. The output is traditionally called z. Of course you can change all of these, but we'll start with them here.

To graph a function or expression of two variables assign the name z to the expression.

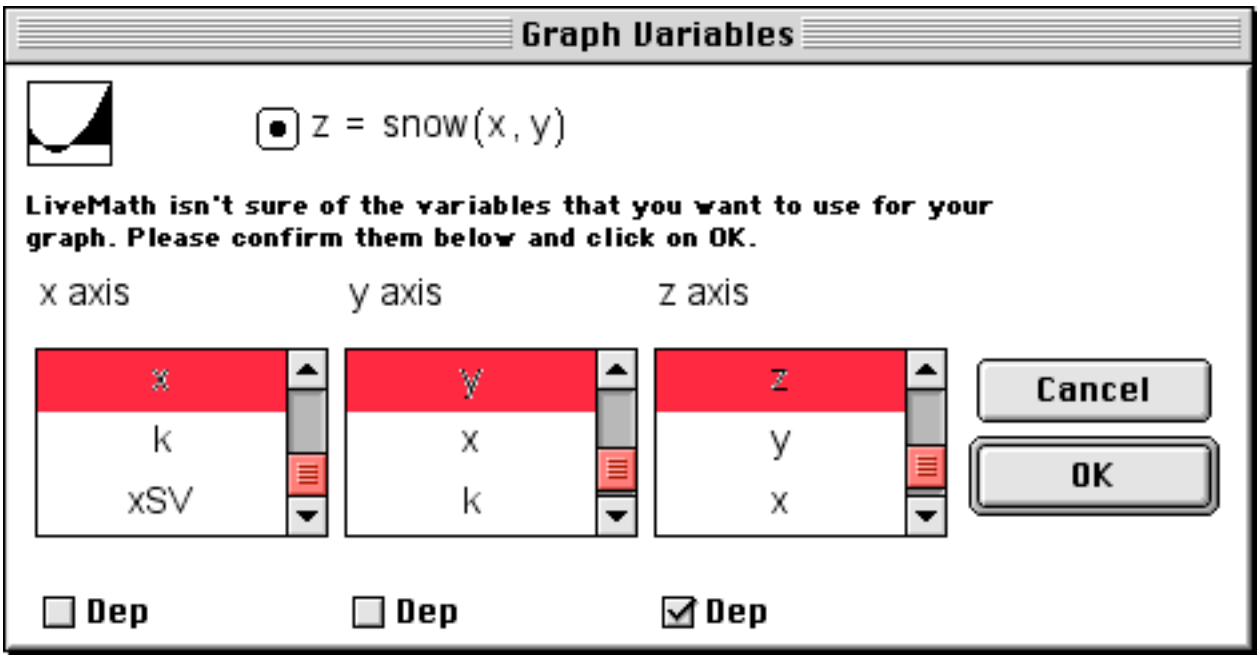
$\text{snow}(x, y) = x^2 + y^2$

$z = \text{snow}(x, y)$

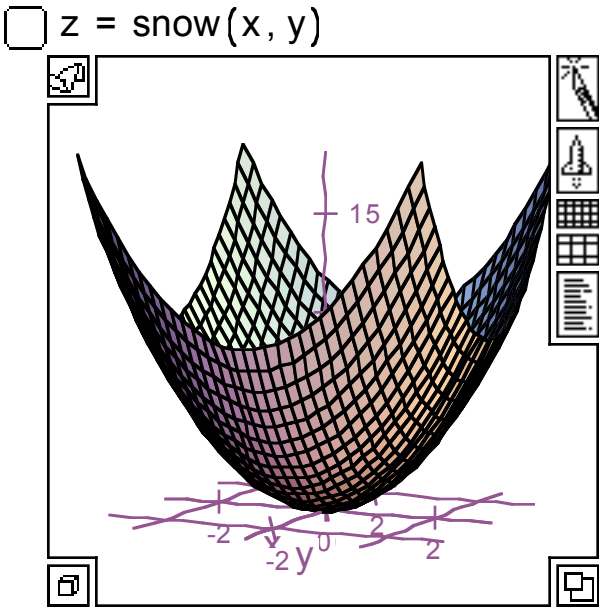
Click on the equal sign in the equation to highlight the equation.

Click on the 3D-Graph button  in the palette.

LiveMath will probably ask you about which variable is the dependent variable via a dialog box.



Once you click OK LiveMath will graph the function.



Just like the whole x-axis could possibly be put into a function of one variable, the whole xy-plane could possibly be put into a function of two variables. LiveMath can draw neither because they are infinite in length and width.

Just is in the single variable case, here you must pick dimensions for the viewing window.

It is easier to visualize how the window cuts off the rest of the graph in the single variable case than it is here with two variables. Here the dimensions are restricting how much of the xy-plane will be shown and the xy-plane is drawn on an angle in the viewing window.

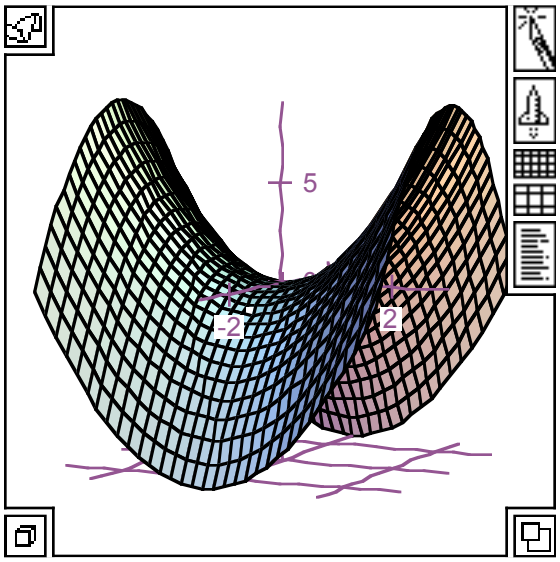
To visualize the restriction here, imagine a rectangular box growing vertically from the xy-plane and cutting off the graph. It takes some practice.

This is a three dimensional representation of a function of two variables. Well, the three dimensional representation is being drawn on a two dimensional screen.

It is 3-dimensional!

LiveMath is aware that your graph has three dimensions and it will allow you to investigate these dimensions graphically in real time.

$w = x^2 \square y^2$



w is used here becuase there is already a z defined in this notebook.
Instead of w we could have used z and given the z's subscripts to distinguish them.

Move your cursor onto of the graph above. The cursor will turn into a hand. "Grab" the graph by clicking the (left) mouse button and holding it down. Move the cursor. The graph will move.

If you move the cursor and then lift the mouse button before actually stopping the mouse, you will "throw" the graph. This will cause the graph to spin on its own. You can stop it by clicking on the viewing window.

Now It's Your Turn... Follow the directions below to get hands on experience.

1.

Graph $z = 3 x^2 + y^2 + 2$

2.

Define the function

$coffee(x, y) = 3 x - 4 y$

Graph it. What shape is the graph?

3.

Graph $z = x^2$ in three dimesions.

In other words, $z = x^2 + 0 y$.

To accomplish this you will probably need to manually assign the axis in the dialog box that will come up.