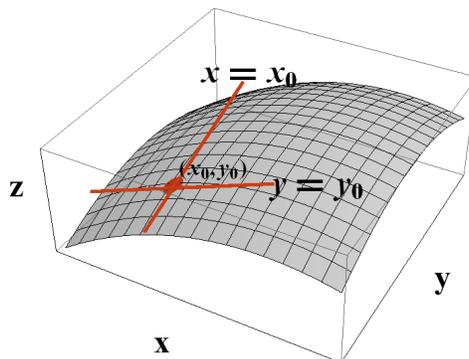# Discovery Exercise for Tangent Plane Approximations

The drawing shows a function $z = f(x, y)$. Our goal is to find a plane that will approximate this function near the point (x_0, y_0, z_0): a tangent plane to the surface. The drawing does not show the tangent plane, but it does show two tangent lines at that point, one with a constant x and one with a constant y.

1. For a given function $f(x, y)$, how would we find the slope of the line labeled $y = y_0$? (Remember that this is the slope of the function in the x-direction, holding y constant.)

2. How would we find the slope of the line labeled $x = x_0$?

3. Recall that we are looking for a plane that we can use to approximate f. The equation for a plane can be written in the form $z = a(x - x_0) + b(y - y_0) + c$. Use this equation to answer the following questions:

   (a) At the point (x_0, y_0), what is the value of z?

   (b) What is the slope of z at that point as you move in the x direction?

   (c) What is the slope of z at that point in the y direction?

4. Find the values of a, b, and c for which the plane $z(x, y)$ has the same value, slope in the x direction, and slope in the y direction as $f(x, y)$ at the point (x_0, y_0).

   See Check Yourself #24 at felderbooks.com/checkyourself

5. Once we have made the proper choice, will our plane also match the slopes of the original function in all *other* directions at that point? How do you know?