

## 5. Tangent Planes

I develop the equation of a tangent plane early in order to help students understand the geometric meaning of the total differential. In my opinion, it is not very satisfying to determine the tangent plane to a surface at a given point if you cannot visually verify the answer.

When I assign these exercises, I usually require students to submit a print-out from the applet showing their tangent plane, the surface and the point of tangency.

**Exercise:** Determine the tangent plane of the following surface at the point  $(1, 0.5)$  in its domain. Use CalcPlot3D to print the graph of this surface (with  $-2$  to  $2$  on  $x$ - and  $y$ -axes) along with this tangent plane. Show the point of tangency.

$$z = f(x, y) = x^2 + xy + y^2$$

To create this plot, first enter the function in Function 1. Then enter the tangent plane function (solved for  $z$ ) in Function 2. Graph these surfaces together. Then choose **Add a Point** from the Graph menu. Enter the coordinates of the point on the surface, and keep the default values for the other choices. To make it easier to see both surfaces, make them semi-transparent using either Ctrl-T or the **Make Surfaces Transparent** option on the **View Settings** menu.

Answer: Tangent plane equation:  $z = 1.75 + 2.5(x - 1) + 2(y - 0.5)$

