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4. Level curves

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The graph of a function $f(x,y)$ is a surface in space whose height is described by

$$z = f(x,y)\,. \tag{2.3}$$

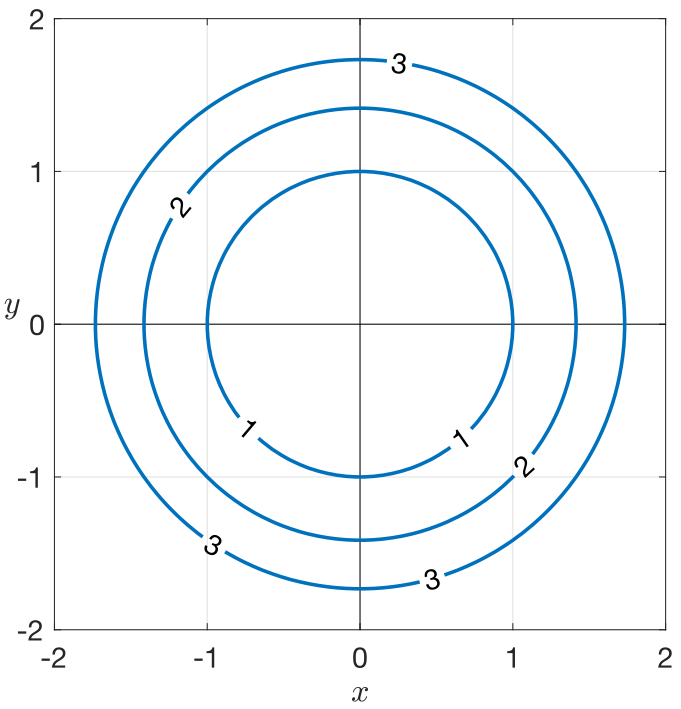
It can be difficult to visualize functions in three dimensions. Sometimes it is easier to think about what the function looks like in the xy-plane at fixed heights z. To do this, we draw what are called level curves.

> **Definition 4.1** The **level curves** of a function $f(x,y)$ are given by $f(x,y) = k$ where k is a constant.

The level curves of $f(x,y) = x^2 + y^2$ for k have the form

$$x^2 + y^2 = k \tag{2.4}$$

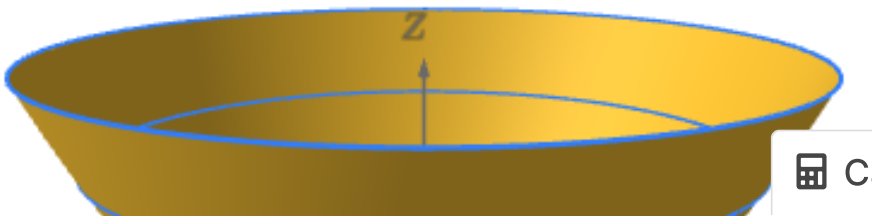
which represents a circle of radius $\sqrt{k}$ centered at the origin. The level curves for $k = 1$, 2, and 3 are shown in the figure below. These correspond to circles of radius 1, $\sqrt{2}$, and $\sqrt{3}$, respectively.



The level curves are related to the 3-dimensional graph as shown. Notice that the circles of radius $\sqrt{k}$ correspond to circles of height $z = k$ in three dimensions.

▼ **Paraboloid with level curves**

Interactive 3D Image Below: Click and drag to rotate the image. Right clicking changes the focus of the rotation.



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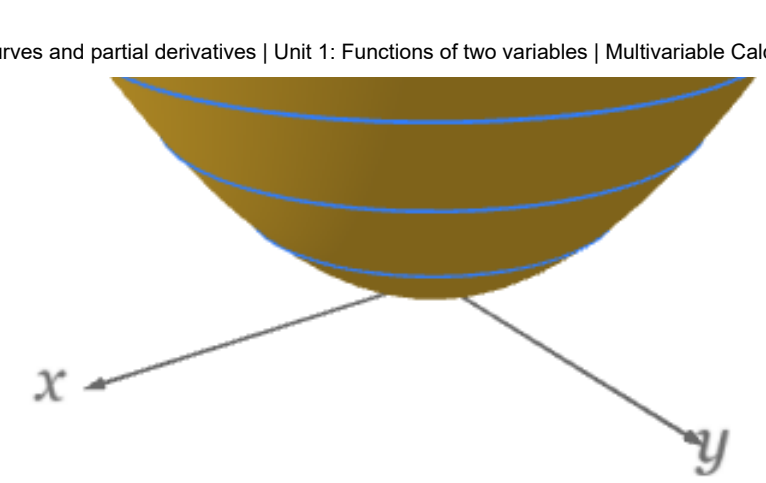

4. Level curves

Topic: Unit 1: Functions of two variables / 4. Level curves

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- Where does sqrt(k) comes from ? 6
  Could someone please show me the algebra for the radius of the circle x^2 + y^2 = k ?
- Is it safe to think that level curves are analogous to contour lines on a map? 3

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