## Gradient vector fields

1. Consider the function $z=f(x, y)=x y$. Below is a plot showing level sets for $z$ from -15 to 15 in steps of 1 in the window $-4 \leq x \leq 4,-4 \leq y \leq 4$.
(a) On the level curve plot, draw estimates of gradient vectors at a variety of points throughout the window.
(b) Compute the gradient $\vec{\nabla} f(x, y)$.
(c) For each of the points at which you estimated a gradient vector in (a), evaluate the gradient vector from (b). Compare your estimate with the exact value.

2. Consider the function $z=f(x, y)=x^{2}+y^{2}$. Below is a plot showing level sets for $z$ from 0 to 17 in steps of 1 in the window $-3 \leq x \leq 3,-3 \leq y \leq 3$. (Note that the level set for $z=0$ is the point at the origin.)
(a) On the level curve plot, draw estimates of gradient vectors at a variety of points throughout the window.
(b) Compute the gradient $\vec{\nabla} f(x, y)$.
(c) For each of the points at which you estimated a gradient vector in (a), evaluate the gradient vector from (b). Compare your estimate with the exact value.

