Here is the graph of $f(x, y) = \frac{1}{xy}$ with $|x| \leq 1$ and $|y| \leq 1$. The $z$-axis is compressed to give a better view. The domain of $f$ is the whole $xy$-plane except without either the $x$-axis or the $y$-axis. Do you see why? What is the range of $f$?