6.2.1 Interactive: Bivariate Normal

Bivariate Normal - Directions for Use

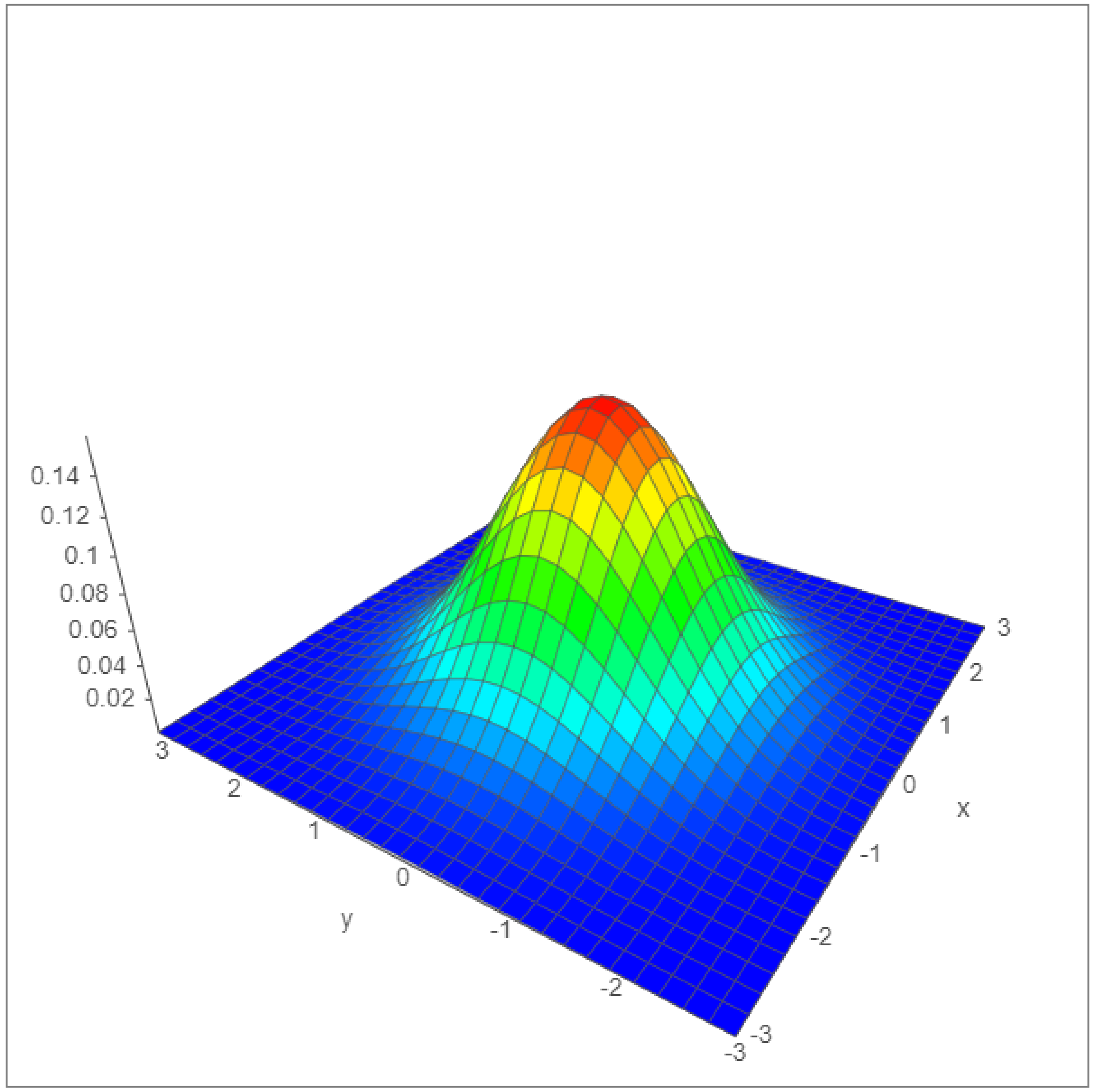
A graph of the Bivariate Normal joint PDF, where the components are marginally standard Normal and have correlation parameter ρ, is below. You can use the slider to change the correlation ρ in this graph. You can also drag the graph to rotate it and get a view from different angles.

> YOU SHOULD TRY:
>
> Set the correlation at a few key values: 0, close to -1, and close to 1. What does the graph look like for values of ρ close to zero? What about when ρ is close to -1, and when it is close to 1?

Controls

ρ: 0

Reset



Bivariate Normal - Detailed Description

The Bivariate Normal is a 3-dimensional graph of the joint PDF of a Bivariate Normal random vector (X,Y), where X and Y have correlation ρ and are marginally Normal with mean 0 and variance 1.

In our graph, the x-axis goes from -3 to 3, as does the y-axis. The graph looks like a mountain, with exactly one peak, which is when x = 0 and y = 0.

Slicing the graph by intersecting it with a plane perpendicular to the x-axis or perpendicular to the y-axis yields a Univariate Normal curve. The contours of the graph, i.e., sets of (x,y) points where the density is a constant, are ellipses.

For $\rho = 0$, X and Y are independent; for ρ not equal to 0, X and Y are correlated. For $\rho = 0$, the graph is rotationally symmetric, i.e., the contours are circles and the density at (x,y) depends only on how far (x,y) is from (0,0), not on the angle that (x,y) is at. As ρ increases, the graph becomes more and more squashed and elongated, until when ρ is very close to 1, the graph is almost 2-dimensional, indicating an almost perfect linear relationship between X and Y, with this line having positive slope. The same is true as ρ decreases towards -1, except now the slope is negative.