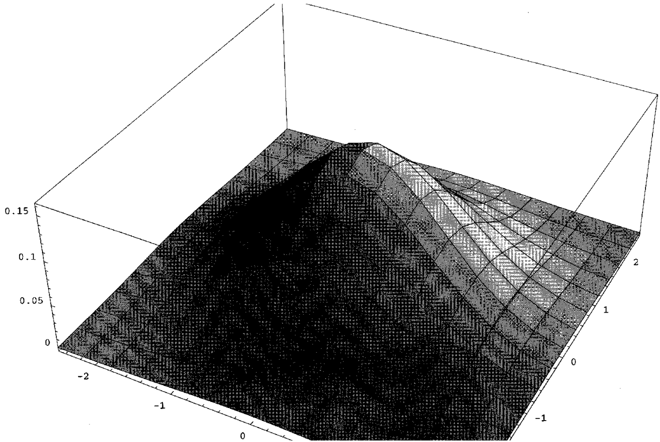
2D NORMAL DISTRIBUTION

RV (X, Y); given: E{X} $= \hat{x}$, E{Y} $= \hat{y}$, σ_X, σ_Y,
$COV(X, Y) = \rho \cdot \sigma_X \sigma_Y$
The RV (X, Y) has the 2-D normal distribution — the joint distribution function $f(x, y) =$

$$\frac{1}{2\pi\sigma_X\sigma_Y\sqrt{1-\rho^2}} \cdot \exp\left\{-\frac{1}{1-\rho^2}\left[\frac{(x-\hat{x})^2}{2\sigma_X^2} - \frac{(x-\hat{x})(y-\hat{y})}{\sigma_X\sigma_Y}\rho + \frac{(y-\hat{y})^2}{2\sigma_Y^2}\right]\right\}$$

ISOLINES ...

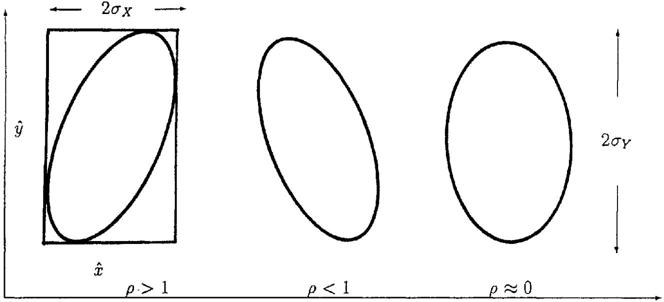


the iso-lines — $f(x,y) = const$

$$\left[\frac{(x-\hat{x})^2}{2\sigma_X^2} - \frac{(x-\hat{x})(y-\hat{y})}{\sigma_X\sigma_Y}\rho + \frac{(y-\hat{y})^2}{2\sigma_Y^2}\right] = (1-\rho^2) * const$$

ISOLINES ...

putting $const = 1$ the above equation describes an ellipse whose central point is $(\hat{x}, \hat{y})$, inserted into a rectangle whose sides are $2\sigma_X$ i $2\sigma_Y$:



SUCH ELLIPSES ARE CALLED COVARIANCE ELLIPSES

play: Joint Density of Bivariate Gaussian Random Variables.cfg