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Bivariate normal distribution, alternative expression

created by **Thijs van den Berg**

$$
\begin{aligned}
p(x,y) &= p(x)p(y|x) \\
p(x) &= \frac{1}{\sigma_x\sqrt{2\pi}}\exp\left(-\frac{\nu_x}{2}\right) \\
p(y|x) &= \frac{1}{\sigma_y\sqrt{2\pi}\sqrt{1-\rho}}\exp\left(-\frac{(\nu_y-\rho\nu_x)^2}{2(1-\rho^2)}\right) \\
\nu_x &= \frac{x-\mu_x}{\sigma_x}, \nu_y = \frac{y-\mu_y}{\sigma_y}
\end{aligned}
$$

The bivariate normal density function can be expressed as the product of a normal distributed variable with a conditional probability distribution function.

Symbol list:

$p(x,y)$	Bivariate normal probability distribution function
$p(x)$	Univariate normal probability distribution function
$p(y\|x)$	The conditional probability of y given x
μ_x	Mean of x
σ_x	Standard deviation of x
μ_y	Mean of y
σ_y	Standard deviation of y
ρ	Correlation between x and y