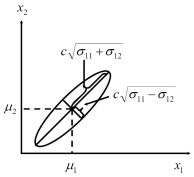
Multivariate Normal Distribution

$$N_p(\boldsymbol{\mu}, \boldsymbol{\Sigma}) = \frac{1}{(2\pi)^{p/2}|\boldsymbol{\Sigma}|^{1/2}} e^{\frac{-(\mathbf{X}-\boldsymbol{\mu})^T\boldsymbol{\Sigma}^{-1}(\mathbf{X}-\boldsymbol{\mu})}{2}}$$

Contour of Distance



$$c^2 = (\mathbf{X}-\boldsymbol{\mu})^T_{1\times p}\boldsymbol{\Sigma}^{-1}(\mathbf{X}-\boldsymbol{\mu})_{p\times 1}$$
$$= \frac{1}{\lambda_1}y_1^2 + \frac{1}{\lambda_2}y_2^2 + \cdots + \frac{1}{\lambda_p}y_p^2$$
, where $\lambda_1 = \sigma_{11} + \sigma_{12},\ \lambda_2 = \sigma_{11} - \sigma_{12}$

Linear Combinations of Variables

$$\mathbf{Z} = \mathbf{C}\mathbf{X}\ \boldsymbol{\mu}$$