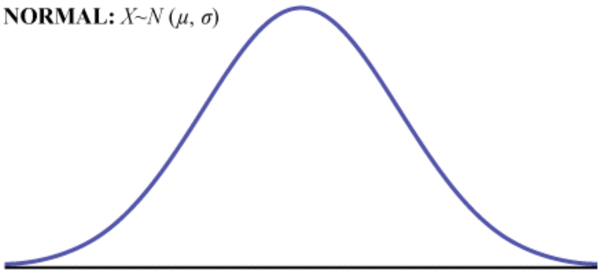
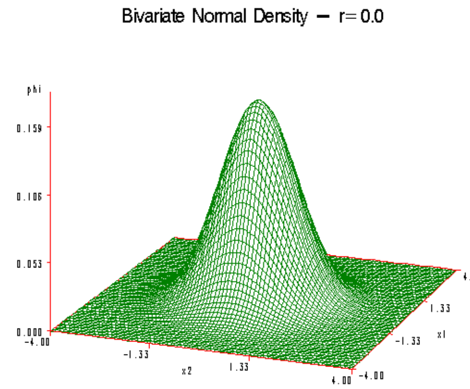
Discriminant Analysis

Tuesday, July 11, 2023 1:07 PM





Bivariate Normal

$$\begin{bmatrix} X_1 \\ X_2 \end{bmatrix} \sim \text{Normal}\left(\bar{\mu} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix}, \Sigma = \begin{bmatrix} Var(X_1) & Cov(X_1, X_2) \\ Cov(X_2 X_1) & Var(X_2) \end{bmatrix}\right)$$

Multivariate Normal

$$\begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_k \end{bmatrix} \sim \text{Multi-variate Normal}\left(\bar{\mu} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_k \end{bmatrix}, \Sigma = \underset{k \times k}{\begin{bmatrix} \sigma_1^2 & Cov(X_1, X_2) & \cdots & Cov(X_1, X_k) \\ \vdots & \sigma_2^2 & & \vdots \\ \vdots & & \ddots & \vdots \\ Cov(X_k, X_1) & \cdots & \cdots & \sigma_k^2 \end{bmatrix}}\right)$$

$$\boxed{\delta_i(\bar{x}) = \underbrace{\underset{1\times k}{x^T} \underset{k\times k}{\Sigma_{\square}^{-1}} \underset{k\times 1}{\mu_i}}_{1\times 1} - \underbrace{\frac{1}{2}\underset{1\times k}{\mu_i^T} \underset{k\times k}{\Sigma_{\square}^{-1}} \underset{k\times 1}{\mu_i}}_{1\times 1} + \underbrace{\log(P(C_i))}_{1\times 1}}$$

Training

X_1 X_2 .... X_k	y
	A
	A

A, B, ...

Testing

X_1 X_2 ... X_k	δ_A	δ_B	δ_C	Prediction
	18.	19.	22.	C

A
A
B
B
C
C

A, B, C

18.	19.	22.	C

Gaussian NB : Consider / Assume all the features to be independent

Discriminant :- Not necessarily all features independent