QDA (Quadratic Discriminant Analysis)

The mean and covariance are different for each class. Therefore, we requires to calculate it separately.

the covariance of each class Y

$$\Sigma_y = \frac{1}{N_y - 1} \sum_{y_i = y} (x_i - \mu_y)(x_i - \mu_y)^T$$

taking the log on both side, we get

$$\delta_k(x) = \log \pi_k \ - \frac{1}{2} \mu_k^T \mathbf{\Sigma}_k^{-1} \mu_k + x^T \mathbf{\Sigma}_k^{-1} \mu_k - \frac{1}{2} x^T \Sigma_k^{-1} x - \frac{1}{2} \log |\Sigma_k|$$