Algorithms & DATA - COMS20017

Tutorial #2 Questions

(Q1) For the data displayed in the following table,

x	y
-2.4	0
-1.2	0
-0.2	0
0.9	1
2.1	1

fit a Gaussian distribution to each class, and compute the posterior probability that $x = 1.3$ is in class 1, given a prior of $P(y = 1) = 0.4$.

(Q2) Consider a two (equiprobable) class, one-dimensional problem with samples distributed according to the Laplace pdf in each class, that is,

$$p(x|\omega_i) = \frac{1}{2\sigma_i} \exp -\frac{|x - \mu_i|}{\sigma_i}$$

compute the threshold value, x_0, for minimum error probability classification.

(Q3) In a three-class, two-dimensional problem, the feature vectors in each class are normally distributed with covariance matrix:

$$\Sigma = \begin{pmatrix} 1.2 & 0.4 \\ 0.4 & 1.8 \end{pmatrix}$$

The mean vectors for each class are $\mu_1 = [0.1, 0.1]^T$, $\mu_2 = [2.1, 1.9]^T$, and $\mu_3 = [-1.5, 2.0]^T$. Assuming that the three classes are equiprobable, i.e. $P(\omega_1) = P(\omega_2) = P(\omega_3)$, classify the feature vector $\mathbf{x} = [1.6, 1.5]^T$ according to the Bayes minimum error probability classifier.

(Q4) For the data displayed in the following table,

x	y
-2.1	-4.2
-0.9	-2.3
0.2	-0.1
1.2	2.1
2.4	3.9

compute the least-squares parameter fit for a model of the form $\hat{y} = w_1 + w_2 x$.

(Q5) For the data displayed in the following table,

x	y
-2.1	-4.2
-0.9	-2.3
0.2	-0.1
1.2	2.1
2.4	3.9

compute the least-squares parameter fit for a model of the form $\hat{y} = w_1 x + w_2 x^2$.