

Name:

NetID:

ECE398BD - Quiz 3-1

March 5, 2015

Time: 20 minutes

Problem 1 *Binary Hypothesis Testing* [10 points]

Consider the following Binary Hypothesis Test:

$$H_{-1} : X \sim p(x|-1)$$

$$H_1 : X \sim p(x|1)$$

$$\text{where } p(x|-1) = \begin{cases} 0.1 & x=0 \\ 0.2 & x=1 \\ 0.1 & x=2 \\ 0.6 & x=3 \\ 0 & \text{otherwise} \end{cases} \quad \text{and } p(x|1) = \begin{cases} 0.3 & x=0 \\ 0.2 & x=1 \\ 0.2 & x=2 \\ 0.3 & x=3 \\ 0 & \text{otherwise} \end{cases}.$$

Using the prior $\pi_{-1} = 0.6, \pi_1 = 0.4$, describe the Bayes classifier (MAP decision rule) [5 points] and calculate the corresponding probability of error [5 points]. You may use a joint probability matrix or the likelihood ratio test for each $x = 0, 1, 2, 3$ to describe the Bayes classifier.

Problem 2 *Errors* [10 points]

Describe the difference between training error and prediction (generalization) error.

Problem 3 *Linear Classifiers* [10 points]

1. Draw a picture of the support of two distributions (on \mathbb{R}^2) for which a linear classifier would work well. [5 points]
2. Draw a picture of the support of two distributions (on \mathbb{R}^2) for which a linear classifier would not work well. [5 points]

Remember that the support of a distribution is where it is non-zero.