

**BIOMETRICS**  
Fall 2013

Assignment 2

Due on October 8, 2013 at 5pm in the TA room mailbox

Justify your answers.

**Problem 1:**

Consider a two-category classification problem where

- $\Omega = \{\omega_1, \omega_2\}$
- $P(x | \omega_1) = N(2, 1)$  (Normal distribution with  $\mu = 2, \sigma^2 = 1$ )
- $P(x | \omega_2) = N(3, 0.5)$
- $\omega_1$  and  $\omega_2$  are equally probable
- $\lambda_{11} = 0, \lambda_{12} = 2, \lambda_{21} = 1, \lambda_{22} = 0$

Find the optimal decision regions given the following loss functions:

- a)  $\lambda_{11} = 0, \lambda_{12} = 2, \lambda_{21} = 1, \lambda_{22} = 0$
- b)  $\lambda_{11} = 1, \lambda_{12} = 2, \lambda_{21} = 3, \lambda_{22} = 4$

where  $\lambda_{ij}$  is the loss incurred by classifying a sample that belongs to class  $\omega_j$  as class  $\omega_i$ .  
What are the optimal decision regions?

Please give exact solutions, as well as numeric approximations if appropriate.

**Problem 2:**

Pattern Classification text, chapter 2, problem 12.

**Problem 3:**

Pattern Classification text, chapter 2, problem 13.

**Problem 4 (required only for 6000 level):**

Pattern Classification text, chapter 2, problem 14, parts a, b, and c.

**Problem 5 (required only for 6000 level):**

Pattern Classification text, chapter 2, problem 23, parts a, b, c, and d. For (c), please write an expression for  $\mathbf{x}_w$  in terms of  $\mathbf{x}_0$ ; for (d), use the value of  $\mathbf{x}_0$  given in (a).

**Problem 6:**

Pattern Classification text, chapter 2, problem 27.