Indian Institute of Science

E9-252: Mathematical Methods and Techniques in Signal Processing

Instructor: Shayan G. Srinivasa

Home Work #2, Fall 2013

Late submission policy: Points scored = Correct points scored $\times e^{-d}$, d = # days late

Assigned date: Sep 7^{th} 2013 **Due date:** Sep 17^{th} 2013 in class

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PROBLEM 1: Let $X = \cos(\theta)$ and $Y = \sin(\theta)$ denote two random variables, where, $\theta \sim U[0, 2\pi]$. Examine if X and Y are (a) independent (b) correlated. (5 pts.)

PROBLEM 2: Consider a communication channel that uses ternary signaling with equal symbol probabilities at the source. Let t denote the transmitted signal and r denote the received signal. The following information is known about the channel from measurements.

TABLE 1. Channel information

$P(r = s_j \mid t = s_i)$	$t = s_1$	$t = s_2$	$t = s_3$
$r = s_1$	0.3	0.4	0.3
$r = s_2$	0.2	0.5	0.3
$r = s_3$	0.5	0.1	0.4

(1) Compute the a-posteriori probabilities $P(t = s_i | r = s_j)$ for every pair i and j.

(2) How would you choose your decision rule to minimize the probability of error ?

(10 pts.)

PROBLEM 3: Let $X(t) = A\cos(\omega t)$ be a random process taking equally likely possible ternary values of ω from the set $\Omega = \{0, \frac{\pi}{2}, \pi\}$.

(1) Plot the sample functions.

(2) Obtain the probability distribution and probability mass function of the random variables $X(1)$ and $X(2)$.

(3) Obtain the conditional probability mass function of $X(1)$ given $X(2) = A$. Plot the probability distribution function.

(15 pts.)

PROBLEM 4: Problem 1.4.7 from the text Moon and Stirling. (5 pts.)

PROBLEM 5: Problem 1.4.10 from the text Moon and Stirling. (15 pts.)