Department of Electrical Engg. IIT Delhi

EEE768, Detec. & Est Theory, Major Exam, m.m. 40, Dur. 1hr.

. MAKE ASSUMPTIONS, IF REQUIRED

Prob. 1 : Let $\underline{r} = H\underline{a} + \underline{n}$, be the received vector. Here $\underline{a}$ is $K \times 1$ parameter vector which is $N(\underline{\mu}_a, V_a)$ distributed & $\underline{n}$ is $L \times 1$ noise $N(0, V_n)$ distributed. Find minimum variance estimator for $\underline{a}$. (7)

Prob. 2 (a) Making & stating clearly, the assumptions required derive the KLT when $\underline{X}$ is $L \times 1$ finite dimensional. (7)

(b) Show that $\sum_{i=1}^{N} x_i \phi_i(t)$, where $x_i = \int_0^T X(t) \phi_i(t) dt$ converges to X_t for every t. Here $\phi_i(t)$ is KLT basis.

Prob 3 : Suppose a binary source generates a sequence of 1's and 0's. After K observations, we wish to estimate θ = Prob { source output = 1 }. Find ML estimate of θ and compute its variance. Is it unbiased? Is it efficient. (6)

Prob. 4 : Let $A = \begin{bmatrix} 3 & 0 & 1 \\ 2 & 1 & 1 \\ 1 & -1 & 0 \end{bmatrix}$ & $v_1 = (1\ 2\ 0)$ & $v_2 = (2\ 1\ 3)$. Find the projections of v_1 & v_2 onto (i) row span of A; (ii) column span of A. (7)

Prob. 5 For Wilcoxon test with number of observations equal to 6 (six) and $P_F \leq 2^{-4}$, determine the threshold. Also give the P_F actually obtained. (7)

Prob. 6 For binary erasure decision problem, starting from first principles, i-e. defining the problem & assumptions, plot the decision regions, for different possibilities,