

ELL 705 : Stochastic Filtering and Identification

Minor Exam

14-02-2022

Time : 90 mins

Read the following instructions carefully

- Honor code must be strictly followed in letter and spirit. No discussion is allowed. There is a **ZERO TOLERANCE POLICY** toward plagiarism of any sort.
- Electronic delivery of a **single pdf** on Moodle.

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1. The following temperature measurements are taken from 10 different temperature sensors with known variances. Assuming white sensor noise, fuse the information from different sensors and estimate the temperature. Under what additional assumptions, is the estimator MVUE? (5)

Sensor	1	2	3	4	5	6	7	8	9	10
Meas. (°C)	61.2	64.3	59.1	64.1	63.8	62.9	58.2	60.7	61.5	63.7
Variance	0.36	2.25	1.69	0.25	0.49	2.89	3.2	1.4	1.2	2.7

2. Consider i.i.d. measurements X_1, X_2, \dots, X_N with the following distribution

$$f_{X_i}(x; \theta) = \frac{3\theta^3}{(x + \theta)^4}, \quad x > 0, \theta > 0, \quad i = 1, 2, \dots, N$$

Determine the CRLB for an unbiased estimator of θ . Does an efficient estimator of θ exist? (5)

3. Consider i.i.d. measurements X_1, X_2, \dots, X_N where each X_i has a Poisson distribution with a mean θ . Determine the MLE of $\phi = \sqrt{\theta}$. What is the asymptotic distribution of the obtained estimator? (5)
4. Suppose N samples are independently drawn from a Normal distribution with a known variance of σ_x^2 and unknown mean μ_x . Find the MAP estimator of the mean μ_x . Assume that the prior distribution for the mean is $N(0, \sigma_\mu^2)$ (5)

Maximum Marks : 20