

ELEG 5633: Detection and Estimation

Homework 12

1. The data $x[n] = Ar^n + w[n]$ for $n = 0, 1, \dots, N - 1$ are observed, where A is an unknown parameter, r is a known constant, and $w[n]$ is WGN with known variance σ^2 . Find the BLUE of A and the minimum variance. Does the variance approach zero as $N \rightarrow \infty$?
2. The observed samples $x[n]$ for $n = 0, 1, \dots, N - 1$ are i.i.d according to the following PDFs

(a) Laplacian

$$p(x[n]|\mu) = \frac{1}{2} \exp\{|x[n] - \mu|\}$$

(b) Gaussian $x[n] \sim \mathcal{N}(\mu, 1)$

Find the BLUE of the mean μ in both cases. (Hint: for the Laplacian case, assume $x[n] = \mu + w[n]$, then find the variance of $x - \mu$)

3. (Curve fitting). The file HW12_data.mat contains two vectors, $\mathbf{x} = [x(t_1), \dots, x(t_N)]^T$ and $\mathbf{v} = [t_1, \dots, t_N]$. Download the file, and you can load the data in Matlab by using the command:

load HW12_data.mat

We would like to find the polynomial fitting of the data

$$x(t_n) = \theta_0 + \theta_1 t_1 + \dots + \theta_{p-1} t_n^{p-1} + w(t_n)$$

- (a) Using BLUE, solve the coefficients $\boldsymbol{\theta}$ with Matlab by setting $p = 5$.
- (b) Plot the raw data (as ‘*’) and the fitted curve in the same figure.