

Random signal analysis I (ECE673)
Assignment 5

The due date for this assignment is Wednesday Oct. 11

Please provide detailed answers.

1. Calculate the PDF of $Y = \exp(X)$ where $X \sim \mathcal{U}(0, 1)$. Moreover, evaluate the average and variance of Y .
2. Following the previous problem, estimate (i) the PDF of Y (i.e., evaluate the histogram); (ii) the average $E[Y]$; (iii) the variance $\text{var}(Y)$, using MATLAB and compare your result with your answers at the previous point. Please include your MATLAB code and the obtained plot and outcomes.
3. The signal-to-noise ratio (SNR) of a given measurement defines its accuracy. If X is a random variable modelling the measurement, the SNR is defined as $E[X]^2/\text{var}(X)$ and is seen to increase as the mean (which represents the true value to be measured) increases and/or the variance (which represents the power of the measurement error $X - E[X]$) decreases. (i) Determine the SNR if the measurement is $X = A + U$ where A is the true value to be measured (a constant) and U models the measurement error with $U \sim \mathcal{U}(-1/2, 1/2)$. (ii) In order to have a SNR of 1000 what should A be? (iii) Say now that the measurement X is modelled by an exponential random variable (the true value to be measured is the mean $1/\lambda$). Explain why the SNR does not increase as the mean increases.