Random signal analysis I (ECE673) Assignment 4

The due date for this assignment is Wednesday Oct. 4th

Please provide detailed answers.

- 1. If Y = 2X + 1, where X is a Poisson random variable with $\lambda = 5$, find the set of possible values for $Y(S_Y)$ and the expression of the probability mass function of $Y(p_Y[y_i])$. Moreover, evaluate the variance of Y.
- 2. (i) Evaluate the probability mass function (PMF) $p_Y[k]$ of $Y = X^2$ where X is a binomial random variable bin(2, 0.3).

(*ii*) Write a MATLAB code that allows you to compare your result at point (*i*) with the estimate of $\hat{p}_{Y}[k]$ obtained through Monte Carlo iterations. Increasing the number of realizations (Monte Carlo simulations) improves the estimate?

(*iii*) Evaluate (through analysis) the averages E[X] and E[Y] and the variances var(X) and var(Y).

(*iv*) Modify your MATLAB code at point (*ii*) in order to obtain the estimates E[X], $\widehat{E[Y]}$, $\widehat{var(X)}$ and $\widehat{var(Y)}$ through Monte Carlo simulations. Compare with your analysis at point (*iii*).

3. A DC current source X is connected to a resistor of resistance of 1 Ohm. Due to measurement errors and sources of uncertainty such as the temperature, the current X is better modelled as a random variable distributed according to $X \sim \mathcal{N}(0, 1)$ (the average is the nominal value, the variance measures the squared measurement error). What is the probability that the voltage across the resistor is between -1 and 1 Volts? To answer this question, use MATLAB in order to evaluate the CDF of a standard Gaussian variable $\mathcal{N}(0, 1)$ ($\Phi(x) = 1 - Q(x) = 1 - 1/2 \operatorname{erf} c(x/\sqrt{2})$).