

ECE537 Random Processes

Programming Assignment 1

Please submit your report to the TA before the tutorial session.

Question 1 - Let Z be a random variable with the following CDF.

$$P(Z \leq z) = \begin{cases} 0 & z < 0 \\ 0.5z & 0 \leq z < 1 \\ 0.25 + 0.25z & 1 \leq z < 3 \\ 1 & 3 \leq z \end{cases}$$

- (a) Generate $N = 100$ independent samples of Z and plot the histogram.
- (b) Find the average of the samples and compare it to the expected value.
- (c) Find the empirical variance and compare it to the true variance.
- (d) For $N = 100, 200, 300, 400, 500, 1000, 2000, 5000$ samples of Z find the average and variance and plot them as a function of N . Do they converge as N increases?

Question 2 - Consider two biased dice each with the following PMF:

$$P(X = 1) = P(X = 2) = 0.25$$

and

$$P(X = 3) = P(X = 4) = P(X = 5) = P(X = 6) = 0.125$$

- (a) Generate $N = 100$ independent samples of the two dice tosses denoted by (X, Y) , and show the joint empirical PMF in a table.
- (b) Using the simulated data, study whether the two random variables X and Y are independent.
- (c) Define

$$\begin{aligned} Z_1 &= X + Y \\ Z_2 &= X - Y \end{aligned}$$

Using the simulated data, study whether Z_1 and Z_2 are independent?