

ECE537 Random Processes

Programming Assignment 2

Question 1 - Let $X = (X_1, X_2)$ consist of two Gaussian distributed random variables X_1 and X_2 .

- (a) Assume $E(X_1) = E(X_2) = 0$ and $\sigma^2(X_1) = \sigma^2(X_2) = 1$. Let $\rho = 0$. Take $N = 100$ samples from the distribution of X and plot the scattergram (samples shown in the X_1 - X_2 plane). Explain your observation.
- (b) Let $E(X_1) = 1$ and $E(X_2) = 2$ and $\sigma^2(X_1) = 2$ and $\sigma^2(X_2) = 1$. For $\rho = -1, -0.5, 0, 0.5, 1$ take $N = 100$ samples from the distribution of X and plot the scattergram (five different plots). Explain your observation.
- (c) Use the samples of X in part (b) with $\rho = 0.5$ to find the marginal PDF of X_1 and plot as a histogram. Estimate the expected value and the variance of the marginal PDF. Explain your observation.

Question 2 - Let X_i be a uniform random variable distributed in the interval $[0, 1]$. Define

$$S_n = \sum_{i=1}^n X_i,$$

where X_i 's are independent.

- (a) For $n = 1, \dots, 1000$, plot $\frac{1}{n}S_n$ as a function of n . Does $\frac{1}{n}S_n$ converge? What is the limit?
- (b) Let $n = 100$. Define

$$Z_{100} = \frac{S_{100} - 50}{\sqrt{100/12}}$$

Note that Z_{100} is a random variable. Generate 1000 samples of Z_{100} and plot the histogram of Z_n .

- (c) Overlap a Gaussian pdf with the histogram in part (b). Explain your observation.
- (d) Use your simulated data to estimate the expected value and the variance of Z_n and compare with the theoretical values.