

Exercises

Week 2

Programming Exercises:

Problem O2.1:

- a) Generate 100 samples of a discrete random variable with the following probability mass function (PMF)
 $p_k = 0.2, 0.6, 0.2$ for $k = 1, 2, 3$
- b) Estimate the PMF and cumulative distribution function (CDF) of the RV using those 100 samples and compare the resulting plots with the given theoretical PMF and CDF. Note whether the estimated and theoretical functions match.
(Hint: Use relative frequency approach to estimate probabilities from finite samples of RV)

Problem O2.2:

- a) Plot the Binomial PMFs for $n = 48$ and $p = 0.1, 0.3, 0.5, 0.75$
- b) Plot the $P[X \leq x]$ and $P[X > x]$
- c) Show that the sum of the PMF of the random variable = 1
- d) Plot histograms of the 1000 realizations of the above RVs and show that they approximate to the theoretical PMFs
- e) Find the mean and variance of the RV and compare with the theoretical values

Problem O2.3:

- a) Plot the PMFs and CDFs of geometric RVs for $p = 0.1, 0.5, 0.9$
- b) Plot the $P[X \leq x]$ and $P[X > x]$
- c) Show that the sum of the PMF of the random variable = 1
- d) Plot histograms of the 1000 realizations of the above RVs and show that they approximate to the theoretical PMFs
- e) Find the mean and variance of the RV and compare with the theoretical values

Problem O2.4:

- a) Problem 3.86 from textbook

Problem O2.5:

- a) Plot the probability density function (PDF) and CDF of Gaussian RVs with the following parameters:
mean=0, variance=1
mean=0, variance=3

mean=4, variance=0.1

- b) For each of the above cases, generate $N = 50, 100, 1000, 10000$ realizations of RVs and plot their histogram.
- c) Also, compare the histogram with the respective PDFs. What difference do you see as the value of N is increased.
- d) Estimate the means and the variances of the generated RVs and compare with theoretical values. Do they match?

Problem O2.6:

- a) Plot the probability density function (PDF) and CDF of Uniform RVs with the following parameters:
 $b = 1, a = -1$
 $b = 5, a = 10$
 $b = -20, a = 20$
- b) For each of those cases, generate $N = 50, 100, 1000, 10000$ realizations of RVs and plot their histogram.
- c) Also, compare the histogram with the respective PDFs. What difference do you see as the value of N is increased.
- d) Estimate the means and the variances of the generated RVs and compare with theoretical values. Do they match?

Problem Set from Textbook¹:

Problems 3.2 (a,b,c), 3.9, 3.17, 3.20, 4.11, 4.12, 4.18, 4.22, 4.40, 4.44, 4.59, 4.63, 4.80, 4.90

¹ Textbook: A. Leon-Garcia, *Probability, Statistics and Random Processes for Electrical Engineering*, 2008, 3rd Ed. Prentice Hall