ECE 302: Probabilistic Methods for Electrical and Computer Engineering
Summer: 2018
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PURDUE UNIVERSITY

Computer Assignment 1

Summer 2018
(Due: June 29, 2018)

Computer assignment 1 is due on June 29, 2018 (Friday) at 3pm. Please put your assignment with your MATLAB code in the dropbox located at MSEE 330. No late computer problem will be accepted.

Exercise 1.
Write a MATLAB program to simulate the following experiments.

(a) Draw a dice 100 times. That is, generate a sequence of 100 random numbers from the set $\{1, \ldots, 6\}$. Call this sequence $X_1, \ldots, X_{100}$. Plot the histogram of $X_1, \ldots, X_{100}$, with bin centers $\{1, \ldots, 6\}$. Do not use a for-loop in your code. Submit your program and plot.

(b) Repeat (a) by drawing the dice 10000 times.

(c) Draw another dice 100 times. Call this sequence $Y_1, \ldots, Y_{100}$. Let $Z_i = X_i + Y_i$ for $i = 1, \ldots, 100$. Plot the histogram of $Z_1, \ldots, Z_{100}$. Submit your plot.

(d) Repeat (d) by drawing the dices 10000 times.

(e) Using the histogram found in (d), find the probability that $4 < Z_i \leq 7$.

(f) In (c)-(d), Z_i is a sum of two random variables X_i and Y_i. What if we sum more random variables? That is, $Z_i = X_i^{(1)} + X_i^{(2)} + \ldots + X_i^{(K)}$. Let $K = 10$. Plot the histogram of $\{Z_1, \ldots, Z_{10000}\}$. Submit your histogram. Pay attention to the bin centers.

(g) Repeat (f) by setting $K = 100$. Plot the histogram of $\{Z_1, \ldots, Z_{10000}\}$. Submit your histogram. Pay attention to the bin centers.

Exercise 2.
A collection of letters, a-z, is mixed in a jar. Two letters are drawn at random, one after the other. What is the probability of drawing a vowel (a,e,i,o,u) and a consonant in either order? Write a MATLAB program to verify your answer. That is, randomly draw two letters without replacement and check whether one is a vowel and the other is a consonant. Compute the probability by repeating the experiment for `N` times, where `N` is an integer selected from the set `Nset = round(logspace(2,5,100))`. Overlay and plot the following results in one single figure:

1. The true probability you find in Exercise 2. Call this `prob_true`.
2. The estimated probability at each `N`. Call this `prob_est`.
3. `prob_true + prob_std./sqrt(Nset)` and `prob_true - prob_std./sqrt(Nset)`, where `prob_std` is the standard deviation of the estimated probability.

What is the minimum `N` (a rough estimate) that can ensure your estimated probability is within 5% of the true probability?

Submit your code, your plot, and the minimum N. You may use for-loop in this exercise.