

Probability and Statistics Spring 2023

HW5 Matlab assignment

1. Comparison of Binomial distributions and Poisson distributions

1.(a) Write a Matlab function to generate a Binomial distribution (with parameters input by the user) without using Matlab's built-in Binomial distribution function. You are required to code from scratch using the mathematical formula of a Binomial distribution. Yes, you may use permutation and combination functions implemented by Matlab.

1.(b) Write a Matlab function to generate a Poisson distribution with any parameter given by the user. You are required to code from scratch as in 1.(a).

1.(c) Use the functions written in 1.(a) to generate a probability table as in textbook p.746. Your results should be very close to the textbook table. (Hint: You may want to look at the table function in Matlab.)

1.(d) Use the function written in 1.(b) to generate a probability table as in textbook p.753.

1.(e) Use Matlab built-in functions for Binomial and Poisson distributions to compare plots of probability distributions under the following four conditions of Binomial distributions: $(n, p) = (10^4, 0.01), (10^4, 0.1), (10^4, 0.2), (10^4, 0.5)$. Calculate parameters of Poisson distributions by using approximation from Binomial distributions. Generate a figure for each (n, p) condition. In each figure, overlay the corresponding Binomial distribution and the Poisson distribution with different colors. Comment on the accuracy of approximation under each (n, p) condition and explain why your observations make sense. You are encouraged to quantify errors from approximating Binomial distributions with Poisson distributions under these conditions.

2. Generating random samples of a probability distribution

2.(a) X is a discrete random variable and its probability distribution $f(x)$ is listed as the table below. The probability distribution $f(x)$ is zero when X equals to values not listed in the table. Please plot the probability distribution $f(x)$ versus X according to the table below.

| | | | | | | | | | | | | | | |
|------------------------------|---|---|---|---|---|----|---|---|---|----|----|----|----|----|
| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| $f(x)*100$ | 4 | 6 | 7 | 8 | 8 | 11 | 7 | 6 | 5 | 3 | 6 | 12 | 10 | 7 |

2.(b) Please write a Matlab function to generate random samples of X with number of samples input by users. Then, use your function to generate 10^4 samples of X and make a relative frequency plot of the samples. Compare the relative frequency plot to the plot in 2.(a). Do they look alike? Why (or why not)?