Probability and Statistics Spring 2023
HW2 Matlab assignment

1. Numerical simulation of Baye's rule

1.(a) In Example 2.41 (textbook p. 94), three machines B1, B2, and B3 have 2%, 3%, and 2% of defective rates, respectively. Please write a Matlab function to simulate the random process of defect occurrences with a specified defective rate and a number of products to be manufactured. The input parameters for this function are defective rate and total number of products to be produced. The output should be a row vector with length of total number of products with 0s representing non-defective and 1s to be defective.

For example, if we would like to produce 10,000 products using B1 with a defective rate of 2%, then the function should output 10,000 numbers with roughly 200 of them to be 1 (representing 'defective') with the rest to be 0 (representing 'non defective'). Note that to simulate real world scenarios, however, these 1s should be randomly distributed among 10,000 output numbers and the total number of 1s should slightly vary from time to time (e.g., the total number of 1s can be 198, 199, 200, 201, 202… etc). In other words, although the nominal defective rate for a machine is 2%, it is okay NOT to get EXACTLY 200 defectives among 10,000 products in a sample.

1.(b) Use the function in 1.(a) to simulate machine B1 by producing 10,000 products. Please repeat the process for 1,000 times and save each output data. For 1,000 repetitions, you only need to save 1,000 numbers each representing total number of defectives for each experiment. The 1,000 numbers should look like [199, 201, 202, 205, 195...]. You don't need to save 1,000 vectors with each containing 10,000 elements. Please plot relative frequency histogram of total number of 1s in 1,000 repetitions with 10~30 bars (should be sufficient to demonstrate the results). Please turn in your 1,000 numbers with a .mat file.

1.(c) Now, please simulate the situation in Example 2.41 where B1, B2 and B3 make 30%, 45% and 25% of products. Assuming that there are a total of 100,000 products to be made, perform an experiment similar to that in 1.(b) to find out actual P(B3|A) in data. Repeat the experiment for 10 times and compare P(B3|A) to its theoretical value shown in Example 2.42 (textbook p.95). Similar to 1.(b), please save 10 numbers with each representing P(B3|A) you estimate from each production simulation. Please turn in these 10 numbers with a .mat file. You don't need to turn in 10 vectors each containing 100,000 elements.