

# CENG 222

## Statistical Methods for Computer Engineering

Spring 2021-2022

### Homework 4

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Due date: 03/07/2022, Sunday, 23:55

In a small village, several vehicles use a bridge to cross over a river. Everyday several automobiles and trucks use this bridge.

The number of automobiles that pass over the bridge on a day is a Poisson random variable with  $\lambda = 50$  and the number of trucks that pass over the bridge on a day is a Poisson random variable with  $\lambda = 10$ .

The weight of each automobile is a Gamma distributed random variable in kilograms with  $\alpha = 190$  and  $\lambda = 0.15$ .

The weight of each truck is a Gamma distributed random variable in kilograms with  $\alpha = 110$  and  $\lambda = 0.01$ .

The bridge is not safe if the total weight of all the vehicles that pass over the bridge on a day is more than 200 tons. You are asked to estimate the probability of this by conducting a Monte Carlo simulation study.

**Q1. (15 pts.)**

(a) Use Normal approximation to determine the size of your Monte Carlo simulation so that with probability 0.99, your answer should differ from the true value by no more than 0.02. (5pts)

(b) Answer the following questions; (2.5pts each)

- What is the expected value for the weight of an automobile?
- What is the expected value for the weight of a truck?
- What is the expected value for the total weights of all automobiles that pass over the bridge on a day?
- What is the expected value for the total weights of all trucks that pass over the bridge on a day?

## Q2. (85 pts.)

Implement a Matlab/Octave code that does this simulation. As the size of the simulation use your answer in part **a** of Q1. In your report provide the following;

- Estimate the probability that the total weight of all the vehicles that pass over the bridge on a day is more than 200 tons.
- Estimate the total weight,  $X$ , of all the vehicles that pass over the bridge on a day.
- Estimate  $Std(X)$  and comment on the accuracy of your estimator of  $X$ .

For this question, you can use the example solution "hw4.m" that is available on ODTUClass as the baseline. Note that, this file is the solution of a previous year's homework and you need to make necessary changes. Please use **fprintf** lines similar to that in the example solution (three lines at the bottom) and provide a screenshot of the output of these lines in your report.

You can use Example 5.9 from the book to sample from the Poisson distribution and Example 5.11 to sample from the Gamma distribution.

## Submission

Submit your Matlab source code and a short report that describes the Monte Carlo study and answers Q1 via ODTUClass before the deadline. Your report should be a Word/Latex pdf document. Late submission is allowed with 20 points per day late submission penalty. For your questions, you can send an email to "mduymus@ceng.metu.edu.tr".