CS5233 Assignment 1 (24/25 Semester 2)

Assignment Deadline: noon, 17th February 2025 (Monday).

Do both A and B:

(A) Simulation and Analysis of a Customer Service Centre

Background and Problem

A newly established parcel delivery company plans to open its first customer service centre in Singapore to handle inquiries, complaints, and support requests from customers. Before finalizing decisions on the number of service counters, staff, and overall layout, the company seeks to simulate the centre's operations. Delivering prompt and cost-effective service is critical to ensuring customer satisfaction in the competitive delivery industry.

Your assignment

Create a model of the office and simulate its operation. Some questions of interest are:

- What is the average waiting time for customers if there is only one service counter?
- What percentage of customers will wait longer than 6 minutes if there is only one counter?
- How many counters are required to ensure that at least 90% of customers wait less than 6 minutes for service?

You may assume customer inter-arrival times and service times follow exponential distributions with rate parameters λ_1 and λ_2 respectively. Initially, you may assume that there are 10 customer arrivals per hour on average and each customer needs 8 minutes service on average. You should run other experiments with various values of λ_1 and λ_2 and summarize your findings in a table.

(B) Simulation and Analysis of a Telephony System

Background and Problem

In telephony systems different models are used to evaluate the quality of service (QoS). Consider a model consisting of two nodes connected to each other by a number of communication channels. Typically, a node represents a city and channels are the available telephone lines. A telephone call may originate in any of the two nodes at any time. If there is a free channel available, the originating call is established and one of the free channels is allocated to the call. The channel allocation lasts throughout the whole telephone conversation and no other call may use that channel until the conversation is terminated. If all channels are occupied the originating call is blocked. The caller must hang up and try again later. In some older models the channels can operate in one direction only. In such systems, a predefined number of channels are used in one direction and the rest of the channels are used for calls in the other direction. In newer systems, all channels are bi-directional and can operate in both directions.

Your assignment

A system like the one described above is used by two cities, A and B. The system is about to be upgraded from an older type where the channels are uni-directional to a newer type where the channels are bi-directional. The system designers engage you to create simulation models of both systems to predict their performance. The following data has been collected from the current system:

- Times between attempted calls from A to B are exponentially distributed with a mean of 12 seconds
- Times between attempted calls from B to A are exponentially distributed with a mean of 15 seconds
- Conversation times are exponentially distributed with a mean of 5 minutes

The designers wish to address the following questions:

- How many channels would be needed in the old system to achieve a QoS guarantee of maximum 5% blocked calls, if there were equal number of channels in each direction?
- How could the old system be re-configured to reduce the number of blocked calls further if it is allowed to assign different number of channels to each direction?
- For the new system, how many channels are needed to provide the same QoS guarantee of maximum 5% blocked calls? How are the channels utilized in this case?

Approach

You are recommended to use the Arena simulation package. A guided tour of Arena can be found in the book “Simulation with Arena”, by Kelton, Sadowski and Sturrock, McGrawHill. This as well as other documents can be found in the Arena folder in Canvas.
Note: you may also use a high-level programming language to implement your simulator. If you intend to do so, please email me with cc to TA to inform us your group number and what progamming language you will be using.

Deliverables

You are expected to submit a report (a maximum of 10 pages is allowed for your report) for both assignments describing your experiments, results obtained, and your conclusions. Additional pages will incur penalty.

Please submit your report (in a zipped file containing the report and code) on canvas. Please name your file "cs5233assign1_group??"). Remember to include your group number and details in your report. Omission of required information will also incur penalty.