CS5233 - Simulation and Modeling Techniques
Assignment #1 - Group 8

Aristotelis Mitsiou - e0732850@u.nus.edu
Sun Guangda - e0546086@u.nus.edu
Mark Myers II - mbmyersii@u.nus.edu
Monica Jethra - mjethra@nus.edu.sg

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Part A - Harbour Simulation

Details

- Ships arrive at a harbour with inter-arrival times that are IID exponential random variables with a mean of 1.25 days.
- The harbour has a dock with two berths, each equipped with a crane for unloading the ships.
- Ships arriving when both berths are occupied join a FIFO queue.
- The time for one crane to unload a ship is distributed uniformly between 0.5 and 1.5 days.
- Assume that no ships are in the harbour at start time (time 0).
- Run the simulation for 100 days.

Analysis

The simulation models the behavior of a harbour over the course of 100 days. We then performed 1000 replications of the simulation to obtain more information on the simulation's behavior.

- **What is the Minimum, Maximum, and Average time that a ship spends in the harbour; from its arrival until it has been completely unloaded?**

Minimum in 1000 reps	Maximum in 1000 reps	Average of 1000 reps
0.5000	5.4894	1.1070

Table 1: Time in Harbour (Days)

- **What is the expected utilization of each crane?**

Crane A	50.55%
Crane B	30.40%

Table 2: Crane Utilization

- **What is the percentage of ships that stay in the harbour for more than 2 days?**

Ships w/ Wait-Time > 2 Days	3.216%

Table 3: Excessive Wait-Time

Part B - Travel Agency Simulation

Details

- Create a model of the office and simulate its operation.
- Make the inter-arrival time, and service time, exponentially distributed with mean ℓ_1 and ℓ_2 respectively.
- Initially, tune your simulation such that inter-arrival time yields 10 customer per hour on average ($\ell_1 = 6$min), and each customer takes 8 minutes to serve on average ($\ell_2 = 8$min).
- Run several experiments with various values for ℓ_1 and ℓ_2.
- If the terminal(s) are servicing other customers, than newly arriving customers will be added to a FIFO queue.

Analysis

The simulation models the behavior of a travel agency office over the course of a single 12hr working day. We then repeat the simulation with different values for the average customer arrival time, and the average customer processing time. This allows us to observe the behavior of the office under a myriad of conditions.

- **What is the average waiting time of the customers if there is a single customer service desk (or terminal)?**

ℓ_1	ℓ_2	Avg. Wait-Time
6	8	106.83
6	16	195.48
12	8	23.32
6	4	9.22
12	4	1.24

Table 4: Average Wait-Time with Single Terminal (min)

- **What percentage of customers will wait longer than 5 minutes if there is a single terminal?**

ℓ_1(min)	ℓ_2(min)	Wait-Time > 5min
6	8	92.77%
6	16	97.73%
12	8	64.29%
6	4	52.14%
12	4	10.20%

Table 5: Excessive Wait-Time (>5min), with Single Terminal

- **How many terminals would be needed to guarantee that 90% or more of the customers will wait less than 4 minutes for service?**

ℓ_1(min)	ℓ_2(min)	Num. Terminals
6	8	3
6	16	5
12	8	2
6	4	2
12	4	2

Table 6: Terminals Needed to Guarantee 90% Wait < 4min