MN50753 Heuristics and Simulation

Individual Coursework

Due date: 9th May 2024 14:00

You are going to simulate a small-scale call centre. There are two classes of customers calling: Premium and Standard. 6 premium and 8 standard customer calls arrive to the system in an hour based on historical data. There are two types of servers answering the calls: experienced and rookie servers. 40% of the premium customers are directed to experienced servers upon arrival and rest to the rookie servers. All of the standard customers are directed to rookie servers. However, premium customers have priority over standard customers, i.e. the rookie servers first answer the calls of premium customers and then standard ones. Premium customers calls take Triangular(5,7,10) amount of time in minutes while standard calls take expo(3) minutes.

Premium customers have a waiting tolerance that is normal distributed with mean 5 minutes and standard deviation 1 minute. Standard customers have a waiting tolerance that is normal distributed with mean 8 minutes and standard deviation 2 minutes. Please note that customer tolerance cannot be negative.

There is an operating policy of the call centre; the problems that cannot be solved in 10 minutes by a rookie server are considered as calls that need further assistance and directed to experienced servers (the calls that take more than 10 minutes with a rookie server is cut and sent to experienced servers). These calls with experienced servers take an additional time (additional to 10 minutes with the rookie server) which is uniform between (3,5) minutes. Moreover, these additional calls have priority over the premium calls in the experienced server queue.

There are 2 experienced and 3 rookie servers working in the centre. One of the experienced servers takes a lunch break between 12.00-13.00 while the other takes a break between 13.00 and 14.00. Rookie servers go to lunch break one by one in the following times: 12.30-13.30, 13.30-14.30, 14.30-15.30.

At the end of the call, customers are asked if they want to answer a brief feedback questionnaire. There are 2 people, Alan and Mary, devoted to analysing these feedback and report back to management about results. They wait until 15 feedback are piled to analyse them.

You can assume that all customers fill the feedback questionnaire. You can use the data provided in Table 1 to estimate the time it takes to analyse 15 feedback surveys.

The call centre operates between 9.00 and 17.00 in a workday. Simulate the system until 500 customers are served and make 40 replications.

a. Find the following statistics:

       Average waiting time in the rookie server queue

Average waiting time in the experienced server queue
Average utilization of the rookie servers
Average utilization of the experienced servers
Average waiting time of a premium customer
Average waiting time of standard customer
Average time spent in the system by a customer (independent of the type)
Number of calls directed to experienced servers from rookie servers
Number of premium/standard customers that balk
Average utilization of Alan and Mary

b. What can you say about the performance of the system? Can you suggest any changes/improvements to the system? Please state at least 3 of them, and implement one of them in Arena, report the results, and comment on the system performance.

c. Suppose that the call centre decided to change the way they direct the premium customers upon arrival. Instead of dividing them probabilistically, they started a system based on queue length. When a premium customer arrives, the queue lengths of experienced and rookie servers are checked, and the customer is directed to shortest queue. Change your model according to this procedure and simulate the system again. Report the required statistics and comment on the system performance. Has the system improved?

Table 1

6.161	7.746	6.270	5.918	7.186
8.891	6.727	6.298	5.562	8.178
8.138	7.007	8.318	6.029	5.537
5.891	7.073	7.165	8.903	5.462
6.264	7.600	7.832	6.920	8.161
6.215	6.640	5.759	6.174	6.717
6.636	7.422	5.926	8.680	6.174
9.117	5.884	5.686	8.497	5.586
8.722	9.457	7.570	6.923	7.469
9.203	7.380	6.810	8.027	6.096

Report Specifications

Bear in mind that this is an individual coursework. The word limit is 2000 words ± 10%. You may want to include any relevant content (e.g., details that should not go into the main body) in the appendices. Please report the count of the words on top of your essay, as well as your name. Please also submit the coursework submission sheet along with your submission. The report can be an MS Word or a pdf file, to be submitted along with Arena files. Please label the submission files indicating your student number, i.e., '1234578.pdf'. Use Arena Help for guidance on the use of modules. You do not need to submit other Arena files created during a run; only submit Arena files with .doe extension. Late submission will be penalized as university policy suggests:

- up to 5 days late, the mark will be at most 40,
- more than 5 days late, the mark will be zero.

In modelling the system and transforming to ARENA,

- Create the flowchart that demonstrates what customers undergo in the call centre.
- Include animation and plots of your choice to enhance the analysis.

The report should be addressed to the managers of the centre, and its format and language are important aspects in its evaluation. The report must include the following:

- Assumptions and limitations of the simulation model. Discuss whether the system description of this call centre is realistic or not. For the parts you find unrealistic, propose modifications, and briefly discuss how it would be modelled in ARENA.
- Tables summarizing key results, mean values and confidence intervals for the output performance measures.
- Interpretation of all numerical results in tables by stating what they mean in terms of the system.

Assessment Criteria:

Good report	Poor report	Mark %
A suitable simulation model has been developed.	The ARENA file with the model is missing.	30%
A thorough listing and discussion of the assumptions and limitations of your model.	There is no discussion on the assumptions and limitations of the model. The limitations and/or assumptions are not valid.	20%
Relevant analytical techniques have been demonstrated to explain the data and the results, and all questions have been answered properly.	Suitable analytical techniques have not been applied for interpreting the data provided. The questions have not been answered.	30%
Format, quality of expression, clarity of ideas.	The format is not clear and the structure of the document is not easy to understand and follow.	20%