Project 5, Group 5: Jeans store management

Call center staffing

Introduction

You are in charge of the management of the call center of a credit card company. The call center receives various types of calls in different languages, and needs a number of employees with difference experience capable of treating specific types of calls in a given language.

The decisions that you have to make are:

- The number of operators to hire of each experience level and language, and how to construct their shifts

- The call response strategy to employ.

The aim of the "Simulation Project" is to develop a discrete event simulation that represents the system and to evaluate the performance of two customer service designs.

During the "Optimization Project", the discrete event simulation is expanded, and the optimal solution in terms of service level, operation cost and shift structure is identified by an optimization algorithm.

Develop the discrete event simulation with a modular structure. It should be possible to modify the various components, such as shift start time, language and experience level, during the "Optimization Project".

Project description

We consider the call center of a credit card company. It operates 11 hours a day, from 6:00 to 17:00. Calls arrive following a non-homogenous poison process with rate $\lambda(t)$ [calls per hour]. The arrival rates can be grouped into homogeneous segments: 6:00-8:00 $\lambda(t) = 200$, 8:00-12:00 $\lambda(t) = 400$, 12:00-13:00 $\lambda(t) = 200$ and 13:00-17:00 with $\lambda(t) = 300$. No calls after 17:00 are processed. The customer waiting in the queue are processed until 18:00. Each customer requires service in a specific language. 35% of them speaks French, 45% German and 20% Italian. The company also classifies the type of call as (1) a general inquiry (2) an accounting inquiry and (3) a lost-stolen report. Out of all received calls, on average 50% are general inquiries, 35% are accounting inquiries and 15% are lost-stolen reports. The distributions of the language and the type of call are independent. For each arrival, the language and the type of call are drawn according to the percentage specification above. The call duration (in minutes) follows a log-normal distribution with $\mu = 1.3$ (location) and $\sigma = 0.5$ (scale) which is independent of the type of call, language or agent. However, the duration of calls is limited to 20 min.

An agent can only answer calls in one language, i.e. French, German or Italian. The company employs the following types of agents:

1. *Supervisors.* They can serve all types of calls and receive 250 CHF per day.
2. *Seniors.* They can serve general inquiries and accounting inquiries. They receive 180 CHF per day.
3. *Juniors.* They are only able to serve general inquiries. They receive 120 CHF per day.

According to company rules, employees work 4-hour shifts. The call center operates three shifts: 06:00-

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10:00, 10:00-14:00 and 14:00-18:00. The company employs the same number of agents in each shift. A total of 20 agents work at the same time. 40% are supervisors, 30% seniors and 30% juniors. Within each group, 40% of the agents speak German, 30% French and 30% Italian.

To maintain a service level, the company aims to answer all calls within a waiting time of 10 minutes. Afterwards, the company considers a monetary value of 1 CHF per minute for those who wait between 10 and 15 minutes, which is increased to 5 CHF per minute after 15 minutes. For example, if a customer waits for 17 minutes before being served, the company considers a penalty of $5 \times 1 + 2 \times 5 = 15$ CHF. If a call is routed between several agents, the total waiting time is considered for penalty. A fine of 50 CHF is counted for each customer not processed by 18:00.

Simulation

For the simulation project, you are requested to:

- Develop a discrete event simulation to represent the described project.
- Define the metrics used to quantify the quality of the service
  - Remember that extreme cases are important; evaluate other metrics in addition to the mean. Moreover, the waiting time for different call types could have different impact on how your service is perceived.
  - Report the mean square error of your estimation using bootstrapping when necessary.
  - Use variance reduction techniques to reduce the computational time.
- Evaluate the call center performance in these two scenarios:
  - Calls enter a primary queue and are assigned to the first available agent on a first-come, first-served (FCFS) basis. If the agent cannot handle the call due to language or experience level mismatch, he/she reroutes the call to the secondary queue for the suitable pair of language and call type, which is also served on a FCFS basis by the suitable agents. The secondary queues take priority over the primary queue. That is, when an agent becomes available, he/she is assigned a call from the primary queue only if the secondary queue that pertains to him/her is empty.
  - Calls are first answered by an automatic machine and sorted by type of call and language. A queue is formed for each pair of language and call type, and handled on a FCFS basis by the suitable agents. Here, customers may make a mistake. On average, 20% of the time they do not select the correct call type. When this happens, the responding agent reroutes the call to the suitable pair of language and call type, where it joins at the end of the queue. The rerouting takes 1 minute.
- Make any necessary assumptions.

Optimization

The objective is to determine the required number of personnel for shift in order to minimize the cost and maximize the service. For the optimization project, you are requested to:

- Identify the decision variables.
- Design an optimization algorithm and apply it to solve the problem. The value of the objective function is evaluated though a discrete event simulation.

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- Like in the simulation project, the objective function can reflect various policies of the decision maker: whether they want to optimize over the average, best, worst, or certain percentile of the objective function distribution. Decide what your position is and justify it, or present results for several alternatives.
- Use your creativity and design a new call dispatching strategy that leads to a better management of the call center.
- Use your creativity and design a more flexible shift policy.