Restaurant design

Introduction

You are the owner of a restaurant, and, given the customer arrival, you have to choose the table arrangement and the seating policy to have a successful business.

The decisions that you have to make are:

- The table arrangement, i.e. number and type of tables.
- The seating policy, i.e. the rules that you apply to allocate customers to tables.

The aim of the "Simulation Project" is to develop a discrete event simulation that represents the system and to evaluate the performance of two solutions of table arrangement and seating policy.

During the "Optimization Project", the discrete event simulation is expanded, and the optimal solution in term of table arrangement and seating policy 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 the customer arrival rate, table configuration and seating policy, during the "Optimization Project".

Project description

The arrangement of the tables is made at the beginning of the opening time, and it cannot be modified after. The restaurant has space for up to 200 seats, independently from the table arrangement. The size of tables can vary. The available table sizes are for 2 customers, 3 customers, 4 customers and 5 customers. You can choose the number of tables for each size, such that the constraint in terms of number of seats is satisfied.

The customers arrive in groups with an arrival rate defined by c. Groups start arriving at 19:00, and no group arrives after 22:00. The group size is defined by g, and the dinner duration is defined by d. After a group leaves, the table is immediately available for the next customers. The bill per person is proportional to the time of the dinner. People that stay longer order more courses and consequently spend more. The bill per person is defined by b.

The restaurant seats groups of customers from 19:00 to 22:00. Eventual waiting groups are not seated after 22:00. A group as a whole has to sit together at the same table. You cannot split a group into different tables, and tables cannot be joined together to accommodate larger groups.

We assume the following distribution for the variables:

- The group arrival rate c is 60 groups per hour.
- The group size g is uniformly distributed between 1 and 5 people.
- The duration of the dinner d is minimum 40 minutes, plus an unknown time following an exponential distribution with a mean of 20 minutes. However, after 2 hours, the group is always requested to leave.

- The bill per person *b* can be calculated by multiplying a customer-specific consumption rate, defined by *r*, and the dinner duration *d*. The customer-specific consumption rate *r* is uniformly distributed between 0.5 €/minute and 1.2 €/minute.

Simulation

For the simulation project, you are requested to:

- Develop a discrete event simulation to represent the described project.
- Define the indexes used to quantify the success of the restaurant
    - Remember that extreme cases are important; evaluate other indexes in addition to the mean.
    - Report the mean square error of your estimation using bootstrapping when necessary.
    - Use variance reduction techniques to reduce the computational time.
- Decide the seating policy for your restaurant, i.e. the rules that you apply to assign groups to tables. For example, you could decide to have different queues for different group sizes, and to assign groups only at tables accommodating the exact size.
- Evaluate the success of the restaurant with two different table arrangements:
    - 40 tables for 5 customers
    - 50 tables for 2 customers and 20 tables for 5 customers
- Make any necessary assumptions.