ECS526 Barber Final Project

Fall 2018

Assume that your Study Group is a Consulting organization. You are currently working with a customer to improve his operation. Initially, the customer has a small barber shop (simulated via the OneBarber program) with a finite size Waiting Room. Subsequently, the customer wants to expand to a larger business operation, consisting of two barbers, and different options for the Waiting Room sizes (via ARENA TwoBarbers program).

Analysts are considering different configurations for improving said services and their performances. They want to assess how the new configurations affect customer service in order to calculate parameters such as number of barbers, wait room size, mean times, and also to establish pricing policies. Analysts also want to assess how the arrival and service mean times relate to server utilization, queue sizes, times in queue and system. In the last instance, your customers want to know how to best improve their organizations. In good English: how to make more money with less resources, while keeping everybody happy.

You will simulate these systems, providing your customers with guidance and advice. To start, invent some realistic cost values ($$) for your problem, reflecting salaries, cost of haircuts, of losing a customer, cost of renting larger space, and buying new equipment, of customer waiting times etc. Experiment with your simulator. Base your configuration and final decision on your simulation results, as is actually done in consulting. Make as much out of this project as you can (for it may provide good material for your job interview).

Analyses consist of implementing several experiments to develop the regressions and ANOVA equations that will be used in assessing improvements in system performance in configuration changes, etc. By substituting in these equations the proposed parameters (number of waiting room chairs, barbers, etc.) you can estimate system mean time, queue sizes and all other measures of interest under your proposed settings, and compare them.

Therefore, in addition to just mean time in the system, you also want to model several other performance measures and find the correlation among them. For example, obtain the correlation between responses times in the system, utilization of the servers, and (max and min) customers in Q, (max/min) times in the Qs, etc. Similarly, obtain the correlation between times in the system, and utilization of the barbers, of the size of the Waiting Room, etc. Obtain the correlation between time in queue and the number of barbers, etc. These are just ideas. Use your own, too.

Each Study Group will run their simulation program with five replications (batches) for each parameter combination in order to develop multivariate regression and an ANOVA models. Then, implement the work required to establish the model (including validation).

Run ARENA programs **OneBarber** and **TwoBarbers** to optimize the business operation, under the costs and schedules you come up with. This is an open-ended problem.

The following variables and values will be used in the simulation experimentation:

A) Waiting Room Sizes (no. of chairs)		**C) Inter-Arrival Mean Times: Exp (u_1)**
Groups 1, 2, 3:	3,10,16	15 & 20 min Plus 1/(Grp No)
Groups 4, 5, 6	4,12,18	**D) Service Time: Exp (u_2)**
Groups 7, 8:	5,14,20	M = 10 & 13 min + 1/(GrpNo)

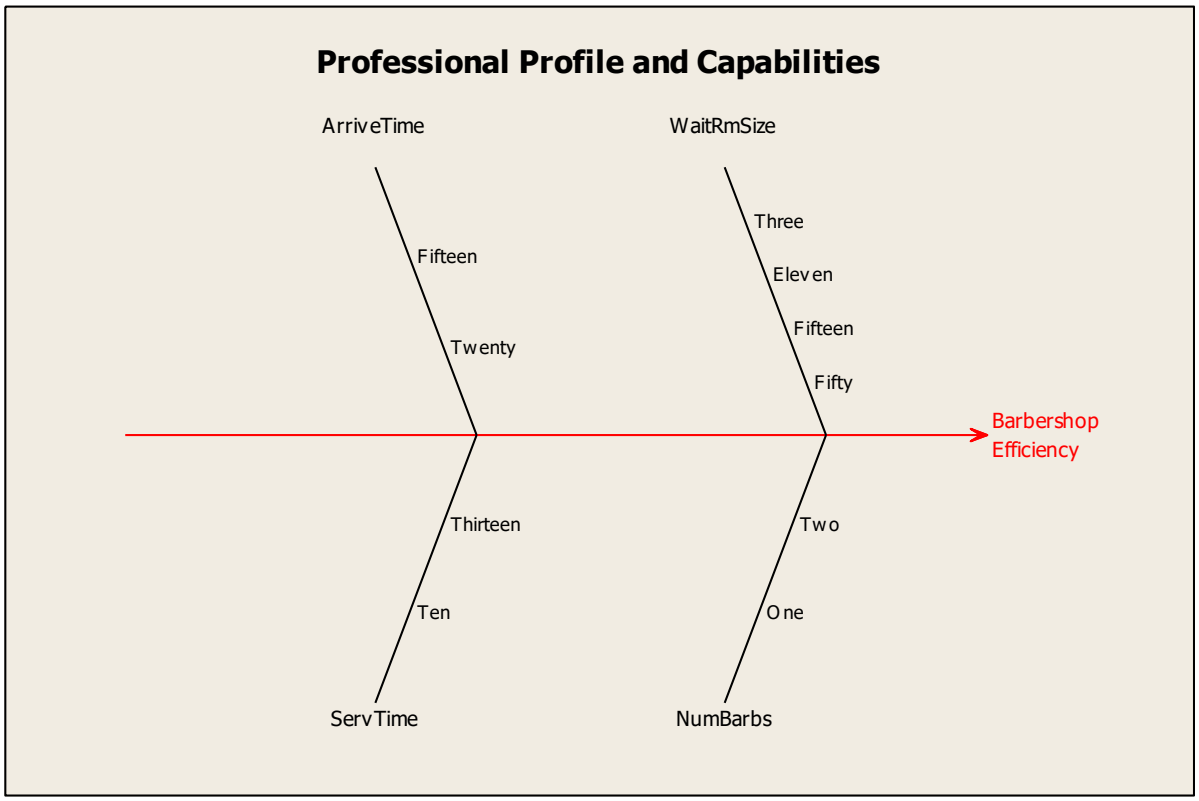
B) Number of Barbers (all Groups):

First, use One barber; then, two barbers.

Use the above four Factors to obtain the following simulation Results (Responses):

1. Obtain the **Regression**: Response = F(A,B,C,D); for the factors stated above
2. **Responses**: Cust. Waiting Time in Q; No. Cust. in Q; Cust. Lost; Barber Utilization
3. Obtain **ANOVA** of the Responses, on Factors A, B, C, D (and their Interactions).
4. **Factors**: **A**, Waiting Room Sizes; **B**, Number Barbers; **C & D** Arrival/Service Times
5. **Compare** the simulated results through an Excel Table: Test, Explain and Comment.

Responses: Average of **(1)** Customers Waiting Time in Q, & **(2)** of Number Customers in the waiting room Q, represent Efficiency; **(3)** Avg. Number of Customers Lost to lack of waiting room space; and **(4)** Barber Utilization represent a lack of efficiency. Each Group member analyzes a different response. Test for equality of means, of variances, and find interval estimations for the best cases found. Explain and Interpret. Below is a chart:



Factor Interpretation: Think of Factor A (waiting room sizes), as a small, medium and large saloon. Think of Factor B (number of barbers), as having a small, or medium size organization. Think of Factor C (inter-arrival times), as two customer rates of arrivals: on week days (slow), or weekends (busy). Think of Factor D, as having two rates of cutting hair: with an old (slower), or a new and more expensive (faster), hair cutting machine.

You will create the following Excel matrix:

Barbershop Simulation Take Home Final **Simulation Results** **XI/14/18**

Each combination of factors A, B, C, D has Five replications, that will be included below

Grp No.	Arr. Mean	Service Mean	Wait Rm Sz	Num. Barbers	Wait in Q	No. in Q	Cust. Lost	Utilization

The total number of runs each Student Group shall make is:

Runs = AxBxCxD = 3 x 2 x 2 x 2 = **24** (From the FOUR **Factors** A,B,C,D)

Each Run will have FIVE replications, from five batches. Take the Four **Responses.**

Each Group Member will analyze one Response. The statistical analysis procedures are the same for all Responses and Factor combinations. Consultation among group members regarding how to implement the statistical procedures is allowed. Work is individual.

Deliver an Excel sheet with all the ARENA Simulation results and the statistical analysis. Do not deliver the outputs of the 34 ARENA runs; submit one, as a sample of such runs.

Remember that this is NOT an exercise in running computer programs. These are run only to obtain the data. The objective of this assignment is to see how you organize and analyze these data, and how you interpret their results.

Deliver a hard copy, and an electronic file, with these results.

Updated: November 14, 2018.