IE 324 Term Project

Spring 2022

Acacia Taxi Co. is a small company trying to get into the transportation mobility industry in New Jersey. They are aware that this sector is currently dominated by other Taxi & Limousine Services and ride hailing companies such as Uber and Lyft. Due to tough competitors and being new in this industry, it is decided to initialize their business in Hoboken, NJ (Figure 1). Further, Acacia aims to give passengers a smooth experience of travelling, as they are known for the comfort and privacy they provide for the clients who are glad to prefer them for local transportation. Although the company has been receiving positive feedback from clients lately, they realized that corresponding excessive demand is a major problem which might damage their reputation if it is not resolved. Since the company is undesirous of losing the majority of customers, they asked for your team's help and expect you to tackle this problem by improving the service.

Figure 1: Hoboken Map

Hoboken, located across the river from New York City, has a rich history being the birthplace of Frank Sinatra, the location in which the first baseball game was played in the US, is one of the most densely populated municipalities in New Jersey. It also houses employees who commute to work to NYC via its two commuting options which are NY Waterway Ferries at 14^{th} Street Ferry Station and Path Trains at Hoboken Train Terminal. These locations are more likely preferred to travel since people use these services to a great extent for commuting to NYC. Moreover, in figure 2 you are given a sketch of Hoboken that represents all potential demand and destination points. The city is divided into **14x17** blocks formed by the intersection of named and numbered streets shaped as a Manhattan-like grid. The vertical length of each block is 3 times as long as its horizontal length which is taken as one unit block in terms of distance. Since the population density and transportation need is not homogeneous across the city, the company forms three regions for the possible demand/destination points as the Ferry Station, the Train Terminal and all other locations.

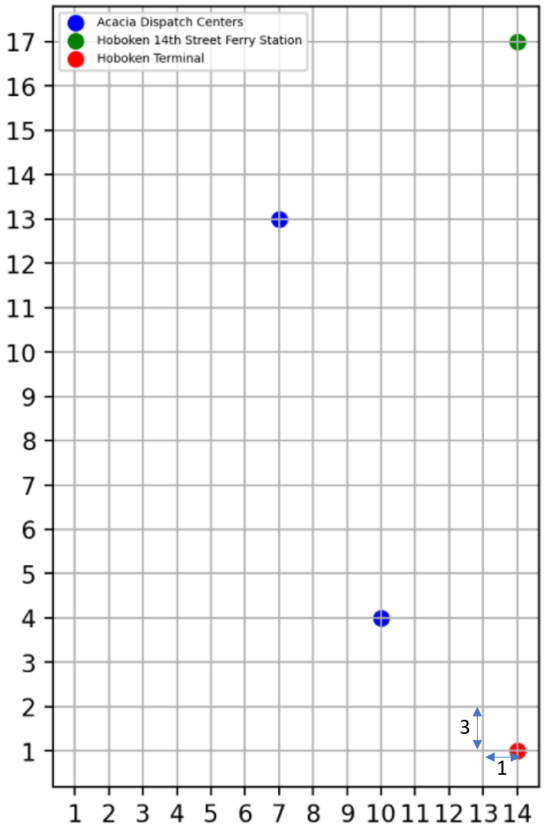

Figure 2: Dispatch Centers

Each region has its own demand. Hourly demand data for each location can be found in $demand\_region\_h_1\_h_2.txt$ and it is the same for all hours between h_1 and h_2. If the customer is in the Ferry Station or the Train Terminal, their desired destination can be anywhere else in the city. In other words, from these pick up locations customer may travel any other point in the city. However, if a customer calls for a ride from the other pick up locations, their destination would be the Train Terminal with 55% probability, the Ferry Station with 25% probability and anywhere else in the city with 20% probability.

Currently, Acacia has **2** dispatch centers in the city and **40** vehicles with capacity of **4** in each center. These vehicles wait at the centers until a customer calls for a ride. Sometimes, within these calls, customers demand more than one vehicle since they want to travel as a party of more than **4** people. In this case, all vehicles for a group call must be sent from the same dispatch center. Thus, the amount of vehicles required to be sent should be determined right after the call. If there are sufficient amount of idle vehicles at the nearest center, they are sent to the demand point to pick up the customers. When there is no idle vehicle in the nearest center, a vehicle is sent to the customer from the other center if there is an idle one in that center. If there is not enough vehicles in both of the centers, the vehicles are sent to the customer once the **nearest center** has sufficiently many idle vehicles. Then, customers wait for the vehicle to arrive at their location, and then they are transported to their desired location. After that, the vehicle returns back to its center. According to Acacia, a customer is satisfied if the vehicle arrives earlier than the promised time which is **10** minutes after the customer calls. A customer is partially satisfied **(0.5)** if they wait for **10-15** minutes. In this case the customers are not charged for trip although they are transported to their destination. The company loses the customer if they are not picked up for some time. A customer is considered as dissatisfied if they are not picked up in for more than **15** minutes and the customer is considered as a lost customer. In addition to this, the customer cancels a ride with 70% probability if all vehicles are busy at the time of the call which is also considered as dissatisfaction.

Traffic density in the city changes hourly. It is found out that each four hour long section of the day has the same hourly traffic density. Although there is no available data for the traffic density, Acacia records the hourly average speed of vehicles in terms of unit block per minute and shares it with you. You may assume that there are no capacity issues restricting the traffic flow at any city block. Also, they give you the data related to recent trips, costs and revenues.

Average Speed (Block unit/min.)	Hour Interval
6.5	$1-4$
4.5	$5-8$
4.5	$9-12$
2.5	$13-16$
4.5	$17-20$
5.5	$21-24$

Costs and Revenues	Value
Fuel cost per one unit block for each vehicle	\$0.5
Revenue per one unit block for each vehicle	\$1.5
Daily Leasing Cost for each vehicle	\$1000

According to the given information, Acacia seeks a better allocation of the current system and asks you to increase the profit while having at least **80%** customer satisfaction rate by changing the location of the centers if necessary, each costing **\$2000** to move, the allocation of the vehicles at each center since the company does not have the enough budget for new vehicles. You are free to change the way the transportation process is handled as long as you justify your assumptions.

What you need to do and Submission Details

First Round (20%)

Use the Input Analyzer tool to find the distributions for:

1. **Interarrival times for each region**
2. **Party size**

Specify the distributions mentioned above and report the parameters. Simply putting a screenshot of the result of the input analyzer is not enough, you should also explain your reasoning briefly. Blindly selecting the best fit in input anaylzer may not provide a correct result. **Submit** Input Analyzer files and a short report (.pdf) about your analysis you need support your decision in your report.

Deadline for first round: Apr. 8 at 23:59

Second Round (55% model, 5 % animation)

The correct distributions will be shared with you after the deadline of the first round. Using these distributions build your model in Arena simulation with animation. Animation part will be graded based on effort (considering all the other groups). Your model should also be capable of calculating **all statistics needed** to perform the analyses in the **third round**. You are expected to simulate your system for seven days. While doing all these, **do not forget to use version Arena 14.5. Submit** your simulation model file (.doe file) with **all statistics** and a report (.pdf) containing the logic of your model, the extra assumptions you made and the average values of the statistics (profit, number of satisfied, partially satisfied and unsatisfied customers, the time a vehicle spends between the dispatch center and the pick up point, the time a vehicle spends between pick up points and destination points, the time a vehicle spends between destination points and the dispatch center).

Deadline for second round: Apr. 25 at 23:59

Third Round (20%)

You need to carry-out a profit optimization for your existing model considering the satisfaction constraint. You need to determine the allocation and number of vehicles per each center and the location of the centers on the city grid. Report the all the details. Submit an OptQuest and/or Process Analyzer file, and a detailed report (.pdf) containing optimization details. You need to specify how you have done your optimization.

Deadline for third round: May 20 at 23:59