Rockaway Beach Scootershare Model

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Objective

During sunny summer weekends, Rockaway beach is an exciting place to be. Unfortunately, it is notoriously difficult to find parking due to the volume of people visiting, as many as 5.5 million in 2018, and the inadequate parking facilities near the beach. One way to deal with this would be to have a large parking lot away from the beach, and a scooter share, where a person can park their car in the lot and use the scooter to go to the beach and back. This will reduce the stress on parking near the beach. To avoid running out of scooters at a location, scootles can be shuttled whenever a certain threshold is crossed. This would be called the Rockaway Beach Scootershare Model. What makes this different from other models is the use of shuttles. Therefore, it is important to focus on it and see what happens when we vary the inputs for it. We would want to find the average number of shuttles that were made per day while varying the number of scooters per each shuttle.

Methodology

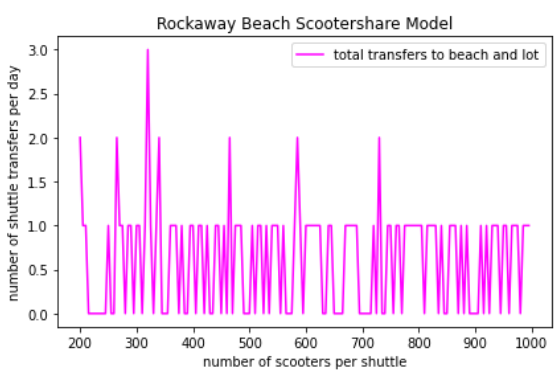
Before working on the simulation, we had to decide the segment and nature of time. We considered 6am-6pm as the beach is only open to the public from sunrise to sunset. We also decided that all the scooters at the beach would be brought to the lot at the end of the day. This meant we did not need to carry results from one day to the next. The biggest assumption we made was the probability of demand. We split the day into 4 sections: 6am-8am, 8am-12 noon, 12 noon-4pm, 4pm-6pm. For the lot, probability of demand would be high from 6am-12 noon, low at 12 noon-4pm, and non-existent at 4pm-6pm. For the beach, there will be no demand at 6am-8am, low probability of demand at 8am-12 noon, and high at 12 noon-6pm. Taking one minute as a moment, we had 720 such moments for any day. We decided to have 2,000 scooters for this scooter share, taking into account that the beach already has limited parking options.

Taking the figure of 5.5 million visitors in 2018, and there being 28 weekend days in summer (further assuming most people will go during the weekend), we divided 5.5 million by 28 to get approximately 200,000 per day. We took 1%, 2%, 5%, and 10% (2,000, 4,000, 10,000, 20,000) of this figure to represent demand ranging from low to high. This meant that in order for the number used for demand to be more accurate, the number of unique customers using the scooters must be closer to one of the four numbers listed earlier. To build the simulation, we had to model: i) scooters going to the beach and the lot, ii) shuttles initiated when scooters were below the threshold and there was demand, iii) probability of demand of the scooters, iv) the variance of probability of demand at both locations over the course of a day, v) the impact of number of scooters per transfer on the average number of transfers per day, and vi) the number of unique customers using the scooters. Rather than varying the probability of demand, we kept it constant for specific times.

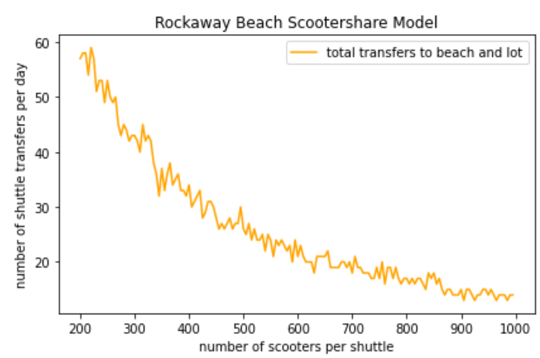
We determined the threshold of the number of scooters to initiate a transfer by multiplying the number of scooters demanded for in a minute by 2.5. This avoided the model running out of scooters at any location as the location would have enough scooters to fulfill the demand for that minute and the next (and still be left with ½ of that figure). The transfer was assumed to be instantaneous. We divided the total number of times the probability of demand was true over the course of the day (720 minutes) by two to get the number of unique customers who used the scooters (as we assumed that a unique customer would use the scooter twice, once going from the lot to the beach, and then going from the beach to the lot). We let the number of scooters per transfer range, starting from 200, increasing 5 scooters at a time until we had 1,000 scooters (representing 10%-50% of the scooter population).

Results

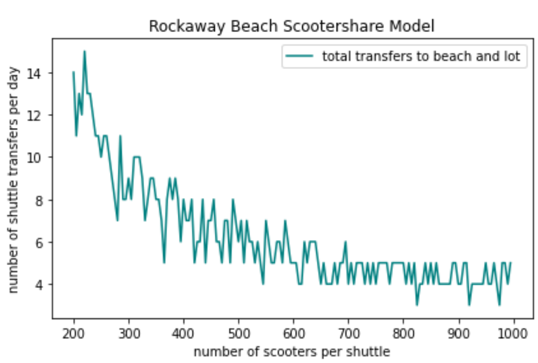
Each of the graphs below show the number of shuttles that were made per day when the probability of demand was varied. Independent variable was the number of scooters per shuttle, while the dependent variable was the number of shuttle transfers per day. The graphs are followed by the probability of demand and the resultant unique number of customers that day.



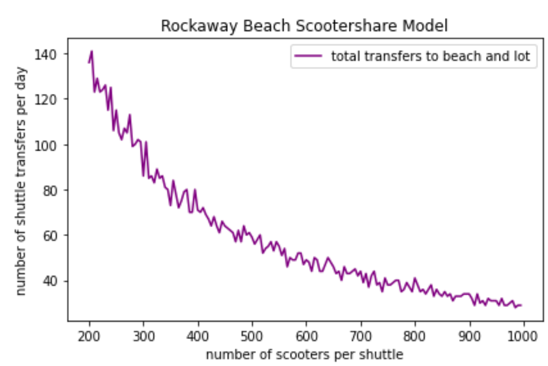
Probability of demand: 10, Unique: 2,195.



Probability of demand: 46, Unique 9,683.



Probability of demand: 18, Unique: 4,032.



Probability of demand: 90, Unique 20,610.

The graphs demonstrate the amount of scooters in each shuttle depending on how many shuttles are transferred each day. The results showed that the number of shuttles transferred per day decreased as the number of scooters per shuttle increased. The range of the transfers per demand were: 90 (30-140), 46 (10-60), 18 (3-15), and 10 (0-3). There also appears to be an increase in elasticity as the probability of demand increased

Analysis

The results showed that with only 2,000 scooters, there was generally an inverse relationship between the number of scooters per transfer and the number of shuttles per day. The number of transfers per day varied, with high demand yielding an unrealistic 30-140 while low demand yielding 0-3 transfers. The elasticity of the graphs increased as we increased the probability of demand. The model is further limited by keeping the probability of demand constant for sections of the day, which we assumed based on personal experiences at the beach and figures from 2018.

Although the model matches our expectations, a model based on this will be difficult to implement. Even with small increases in demand, a high number of transfers are needed. The model can improve if we vary the probability of demand. We do not think the number of total scooters should increase as that would increase the cost of this model, with parking space at the beach already being limited.

Further research could be made in regards to i) varying other variables, specifically demand, number of total scooters, ii) analyzing the relationship between the threshold selected to initiate a transfer and the total number of shuttle transfers per day, iii) having more realistic non-instantaneous transfers, for instance a transfer will happen a few minutes after a location has scooters below a certain threshold, and iv) and determining why the graphs become more elastic as the probability of demand increases. While our model represents an unrealistic scenario, making the model more complex by increasing the number of locations and the number of parking lots at the beach could create more realistic results in order to better implement the Rockaway Beach Scootershare Model.