UBER SUPPLY-DEMAND GAP FOR AIRPORT TRIPS

CASE STUDY SUBMISSION

Course: 2   Module:4

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Business Understanding and Objective:

For a taxi aggregator like Uber, supply shortages caused either by driver induced request cancellations and non-availability of cars leads to loss of potential revenue. Considering inputs from customer tickets and operations, it was identified that there are issues with customers securing trips to and from the airport. This case study is focussed toward the analysis of demand and supply levels for airport trips (either city to airport or vice-versa). From the results of the analysis, we must identify probable root causes and hypothesise recommendations to resolve the problem.

Data Understanding:

The input dataset has the following six attributes:

[1] Request ID: A unique token representing a customer request.

[2] Pickup point: Customer pickup point with two levels based on customer's location (City-represents customers to be picked up at the city and dropped to the airport; Airport-represents customers to be picked up from the airport and dropped to the city).

[3] Driver ID: Unique identification number of a driver.

[4] Status: It represents the customer request status and may take up one of three possible values; trip completed, cancelled or no cars available.

[5] Request Timestamp: Contains date and time information at which the request was registered.

[6] Drop Timestamp: Contains date and time information at which the trip was completed.

This Case Study progresses in three stages:

[a] Data Cleaning and Formatting [Addressed in R-Code]   [b] Assumptions and Reasoning   [c] Data Analysis and Reporting

Assumptions and Reasoning

[1] Day-Wise Variation: There is minimal variation in the number of requests generated with respect to the days of the week[Figure 1]. Therefore each day can be viewed as a cycle and there are five cycles of data in our dataset.

[2] Driver Idle Time Calculation: As this dataset contains information only with respect to trips made to and from the airport, and the discrepancy with respect to registering information for certain trips [For example for numerous Driver ID's the city to airport is registered on the 11th and the subsequent trip is again registered as city to airport on 12th]. Considering the scope of our analysis, driver idle time at the airport is not calculated as calculating idle time with missing information will generate misleading insights.

[3] Driver based Cancellation Trend: From the data set the driver ID's showing extremely high number of cancelled requests have been shown in Fig. 2. However, this figure might be misleading as we do not have any information with respect to the total number of trips made by these driver. (Example a driver may cancel 10 trips but may make very high number of overall trips in which case the proportion of cancelled trips to total trips is low.)

[4] Demand Definition: Demand is defined as the total number of requests received within a given period.
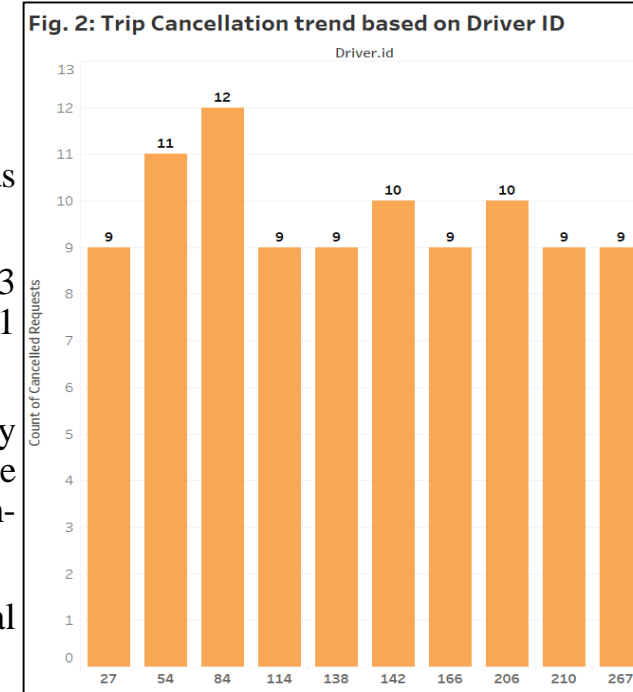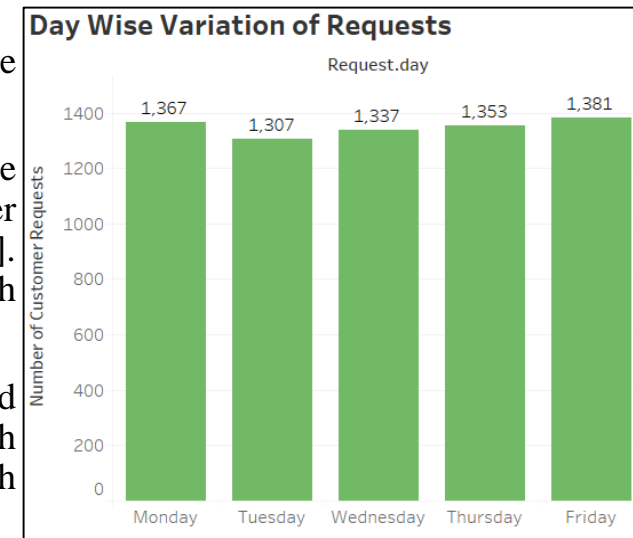
[5] Supply Definition: Supply refers to the total number of requests for which the trip status is completed.

[6] Gap Definition: This refers to the number of requests for which there were no cars available or designated driver has cancelled the requests. As an expression it can be defined as Net Demand-Net Supply.

[7] Request Hour: For the scope of our analysis, we can group the request time stamps into 24 distinct groups (0-23 hours) relating to when the request was initiated by the customer. For example, any request generated between 14:00:01 to 14:59:59 will be assigned the request hour attribute 14. This will facilitate swift grouping and analysis.

[8] Time Slots: The 24 distinct request hour attributes have been grouped into 5 time slot categories to study the supply and demand variations through different parts of the day. This grouping is not hard-coded and is open to the interpretation of the analyst. For the analysis; 5am to 10am-Morning Peak Hour, 10am to 2pm-Late Noon, 2pm to 6pm-Early Evening, 6pm to 11pm-Late Evening Rush and 11pm to 5am-Night-Midnight

[9] Trip Times are Neglected: The average trip times for city to airport with respect to request hours has minimal variation and an average of 52 minutes, similarly airport to city is 52 minutes, therefore trip times are neglected.

Day Wise Variation of Requests
Request.day

Monday	Tuesday	Wednesday	Thursday	Friday
1,367	1,307	1,337	1,353	1,381

Fig. 2: Trip Cancellation trend based on Driver ID
Driver.id

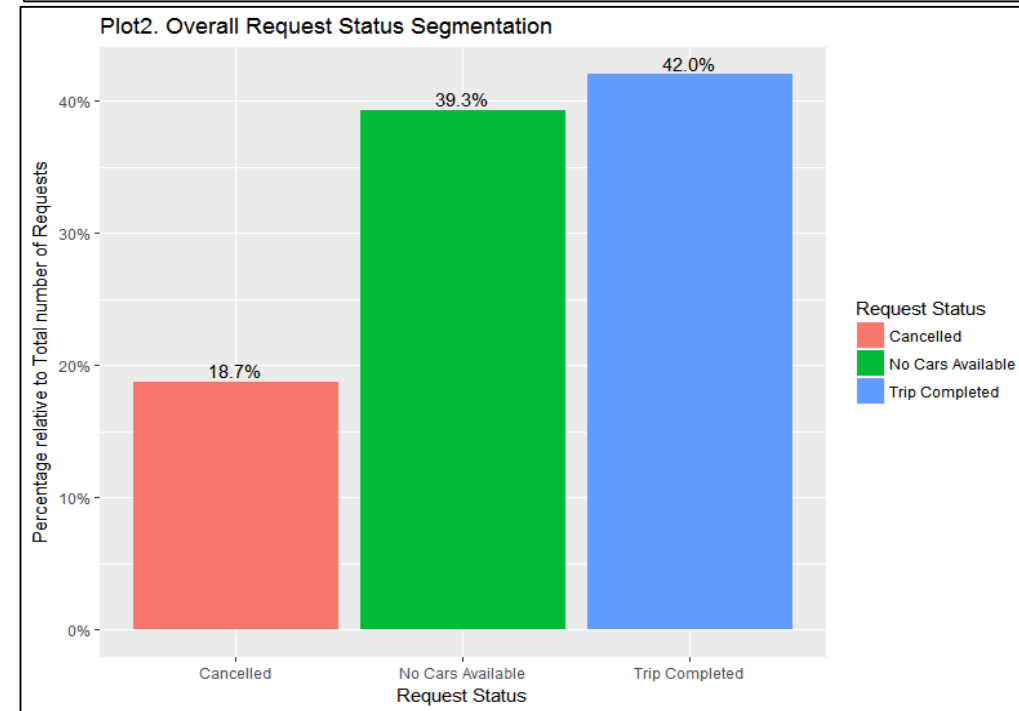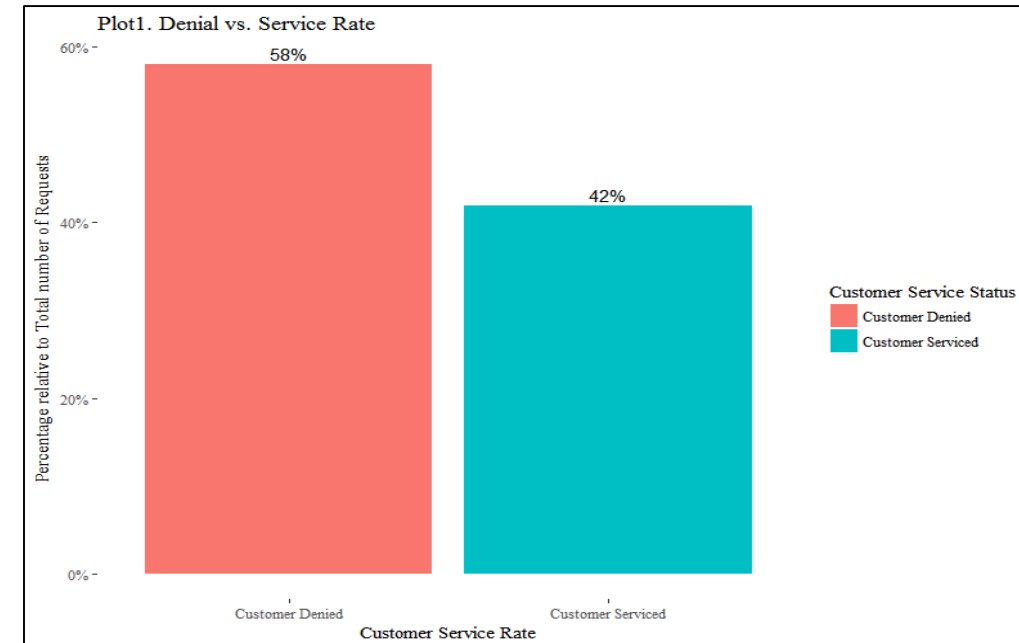| 27	54	84	114	138	142	166	206	210	267
9	11	12	9	9	10	9	10	9	9

Identifying Pressing Problems
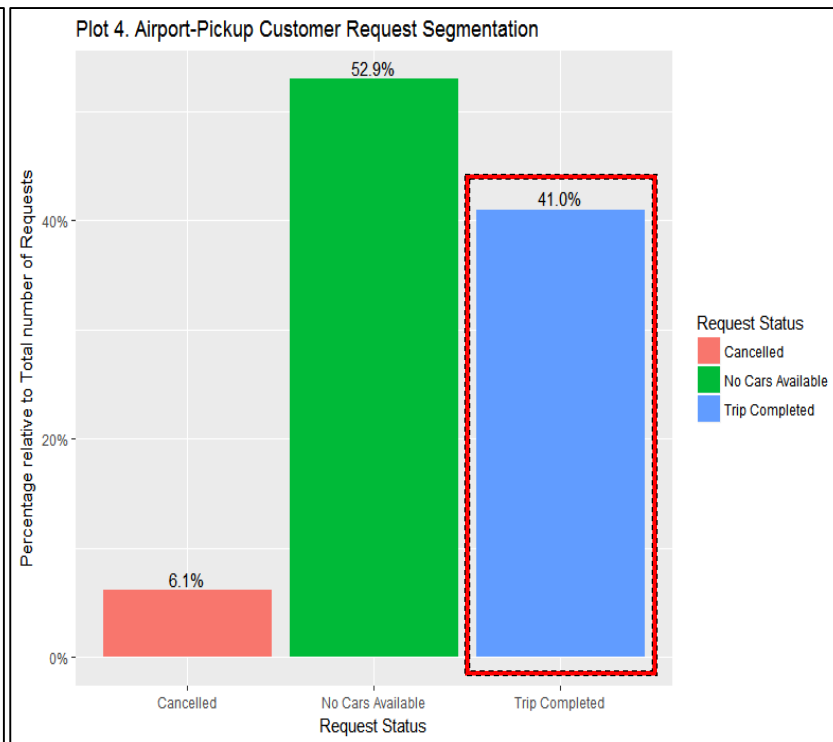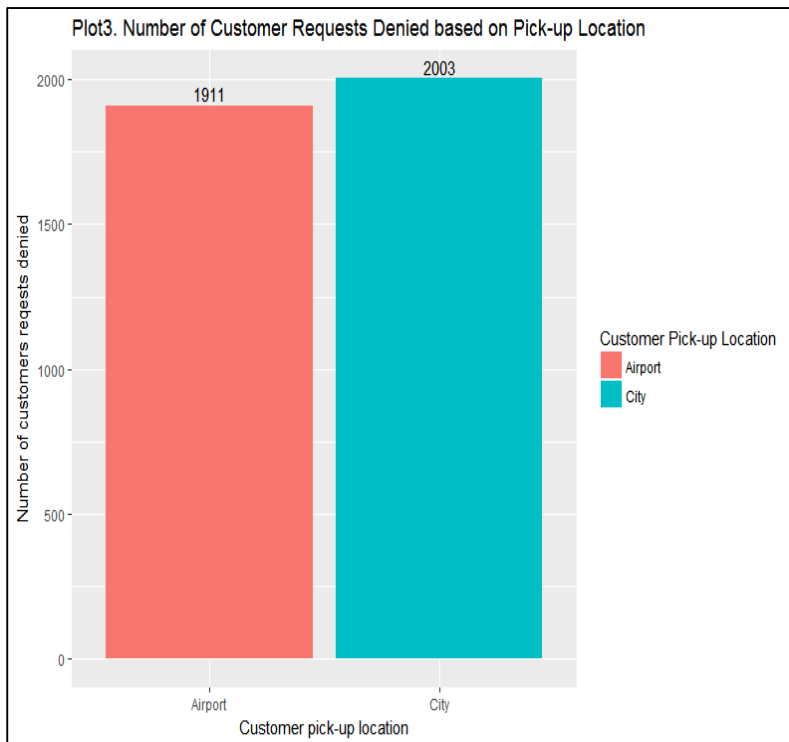
Analysis over overall performance:

[1] With the performance index of trips completed relative to the total requests received, Plot1. shows the percentage of customers serviced and the percentage of customers denied with respect to the total number of requests received. 58% of all customers requesting trips either to or from the airport are denied service either due requests being cancelled by drivers or no cars available at the time of booking. Therefore, we must look further into why the service requests were denied.

[Customer Service Rate: Customers Serviced=42% ; Customers Denied =58%]

[2] Plot2. Shows the breakdown of the 58% of customer requests that were denied. Of which, 39.3% corresponds to no cars available at the time of customer request and 18.7% corresponds to requests that were cancelled by the driver.

Conclusion: These two plots clarify the customer service rate and the contribution of each factor top overall customer request denial.

Identifying Most Problematic Type of Request [Airport or City]

Plot3. Number of Customer Requests Denied based on Pick-up Location

Plot 4. Airport-Pickup Customer Request Segmentation

Plot5. City-Pickup Customer Request Segmentation

Service Rate customers with pick-up requests from the city [1.9%] > Service Rate customers with pick-up requests from the city

[3] Plot3. shows us that a higher number of requests are denied with customer-pickup location as city than that of airport. However, when we check the percentage of total customer requests serviced with respect to customer pick-up location, we find that service requests made from the city is 1.9% higher than the service requests made from the airport. (Seen from Plot4 and Plot5).

Therefore a higher percentage of customers booking an Uber taxi from the airport are denied service. Hence, customer requests with pick-up location specified as airport are more problematic and are more likely to be denied service.
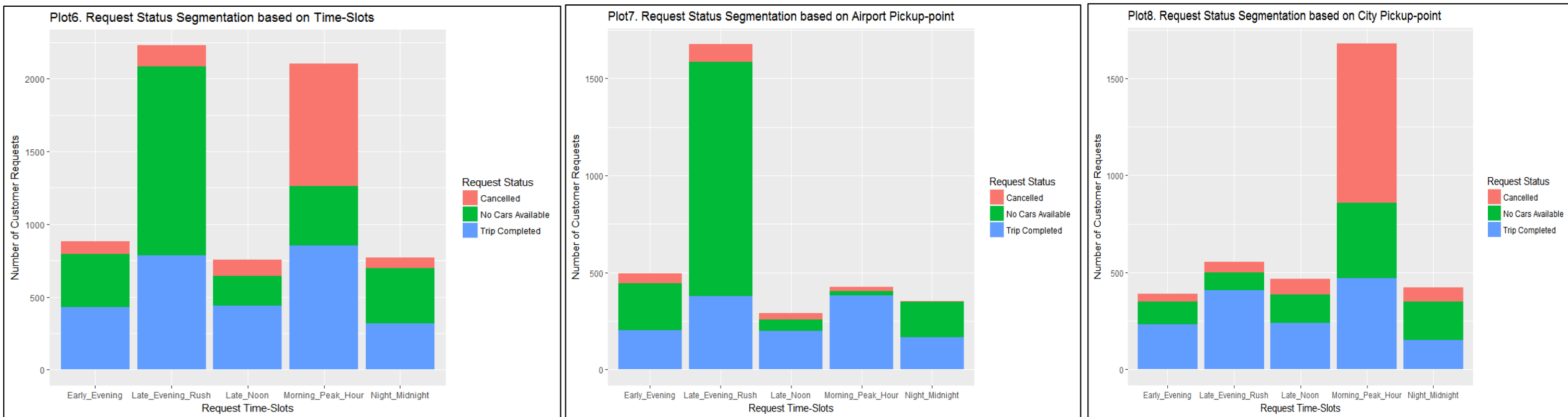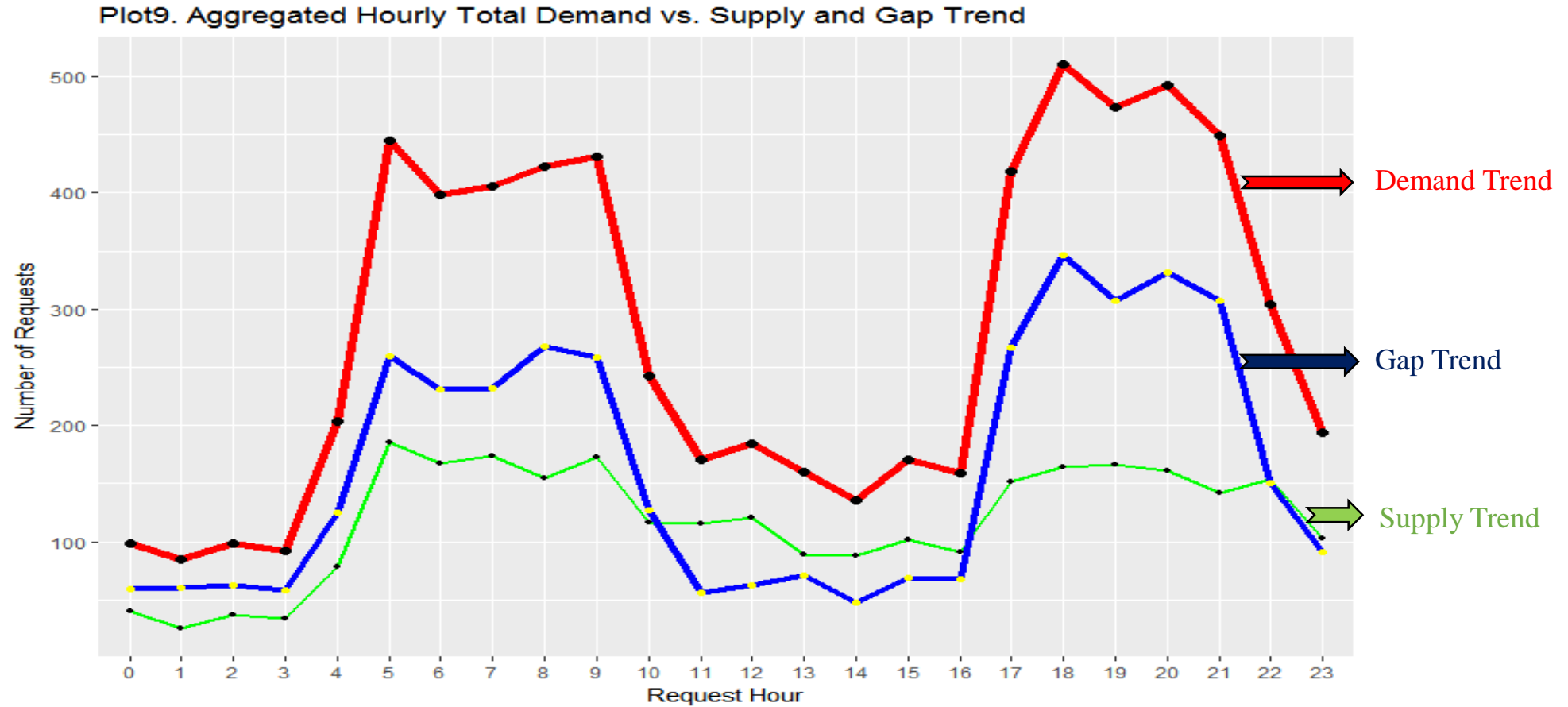
[4] Plot6. Clearly shows that the 'Moring Peak Hour' and 'Late Evening Rush' time slots are the most problematic segments contributing to the highest gap in overall service and demand. When we further inspect the cause of this supply gap by analyzing the contribution of customer pickup location we generate Plot 7 for customers booking taxis from Airport to the city. Plot 8 represents customers booking a taxi from city to the airport.
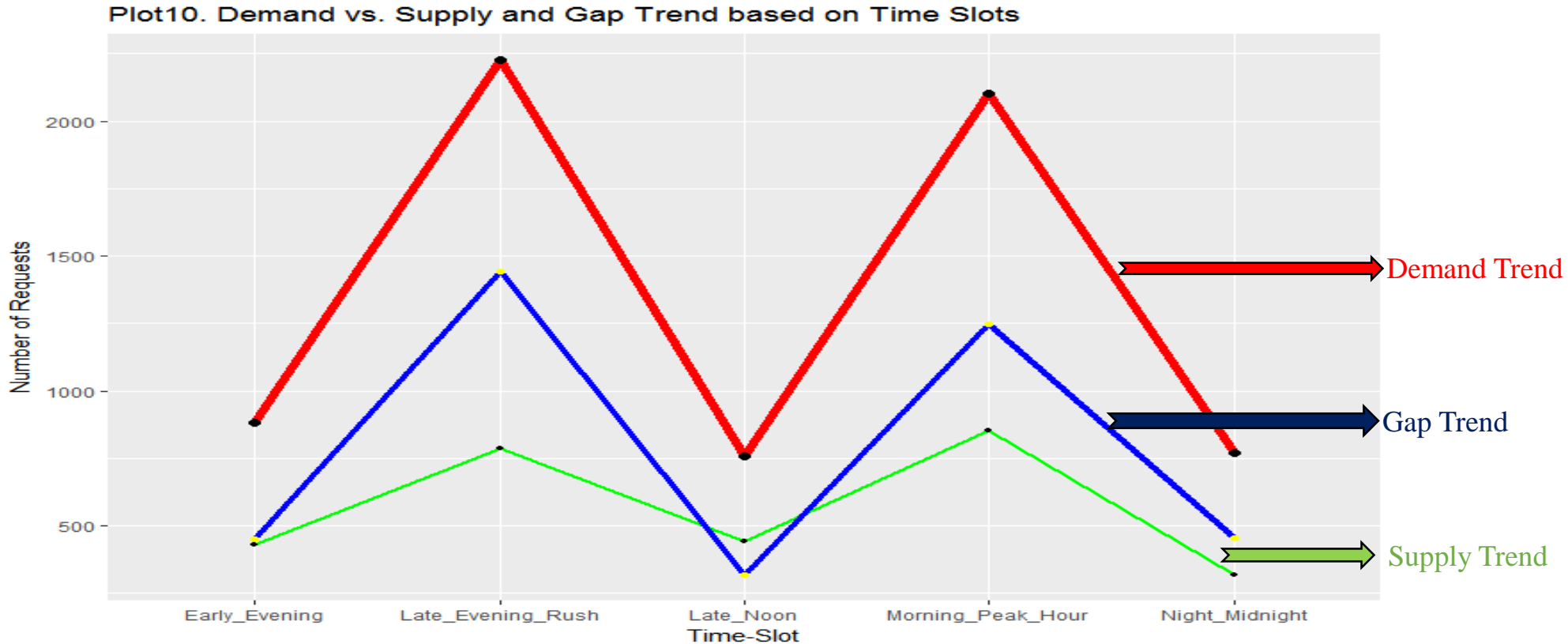
Problem Prognosis:

[1] The Morning Peak Hour Time slot shows excessively high number of customer requests for taxi, cancelled by the driver. This mainly impacts customers booking a taxi from the city to the airport. This forms our prognosis for relevant business Problem1.

[2] The Late Evening Rush Time slot shows excessively high number of customer requests denied due to lack of organic flow, i.e. No cars available. This mainly impacts customers booking a taxi from airport towards the city. This forms our prognosis for relevant business Problem2.

Hourly Gap Between Supply and Demand

Plot9. Aggregated Hourly Total Demand vs. Supply and Gap Trend

[5] Plot 9. Shows the hourly trend of demand versus supply and the gap variation throughout the day. It can be observed that the demand remains fairly constant between 100 to 200 requests per hour with a sudden surge from 5am to 10am ['Morning Peak Hour'], followed by a return to normal range and surges again between 5pm to 10pm ['Late Evening Rush Hour']. Let us observe this gap further through Time Slots.

Time Slot Based Gap Between Supply and Demand

Plot10. Demand vs. Supply and Gap Trend based on Time Slots

Request Time Slot	Total_Demand	Total_Supply	Supply_Gap
Late_Evening_Rush	2228	787	1441
Morning_Peak_Hour	2103	854	1249
Early_Evening	884	432	452
Night_Midnight	772	317	455
Late_Noon	758	441	317

Plot 10 and the table clearly show us that the time slot with the highest gap between demand and supply are:
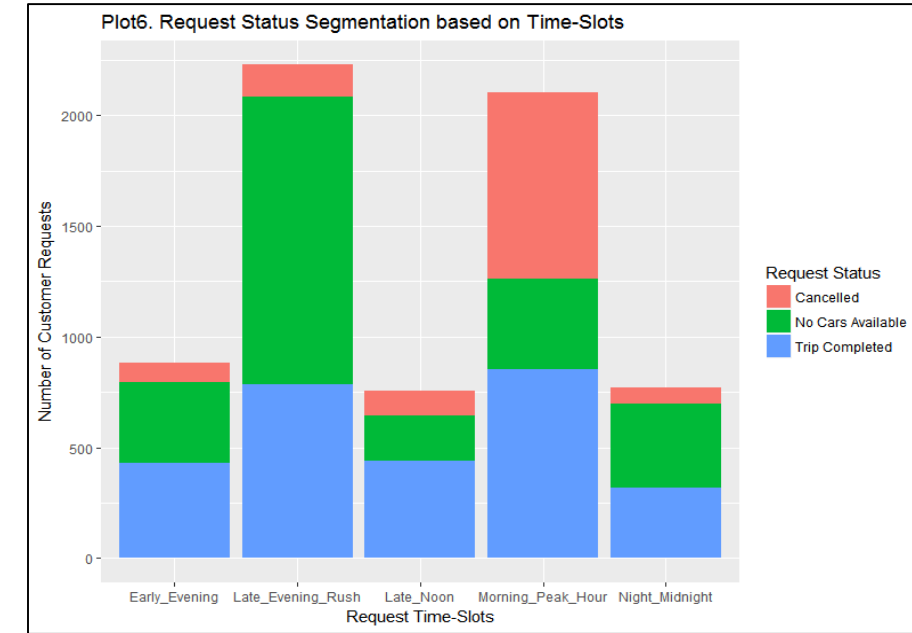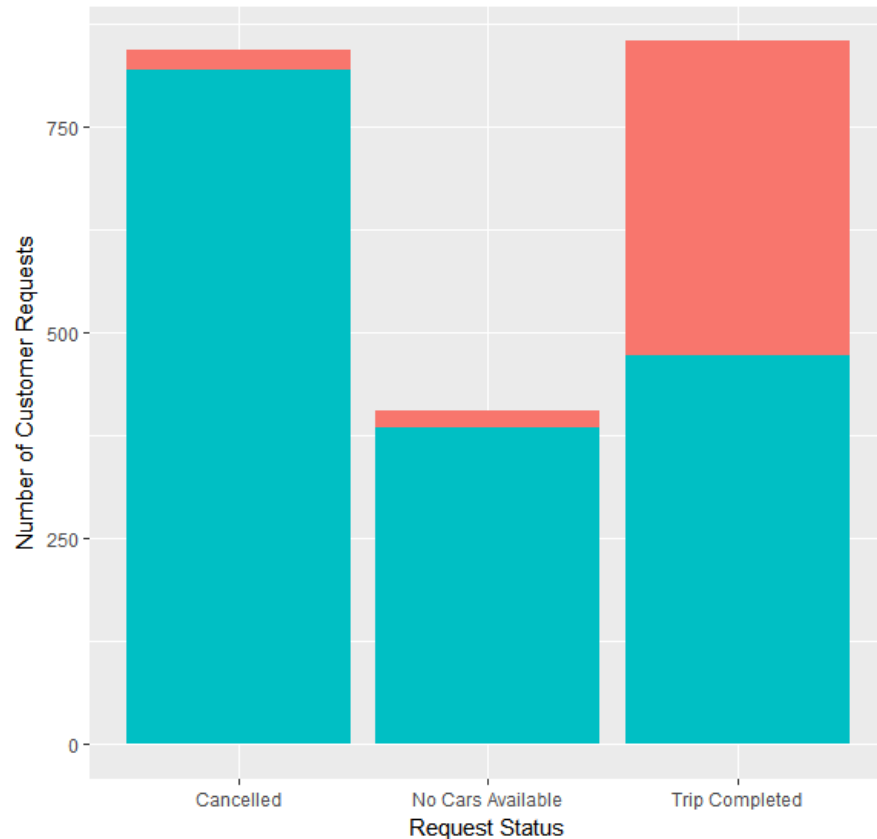
[b] Morning Peak Hour

[a] Late Evening Rush Hour

With these two time-slots being our focal problem area, we have formulated problem statements 1 and Problem Statement 2 to study the contribution of type of request (city-airport or airport to city) for which the gap is most severe.

Problem Statement #1 : High number of customer requests are cancelled during Morning Peak Hour.

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Plot6. from Slide#6 clearly shows the service gap issue with respect to Morning Peak hour due to high number of requests cancelled by the drivers. Let us analyze if the problem is more severe for pick-up requests made from the airport or the city.

Plot6. Request Status Segmentation based on Time-Slots

Plot11. Morning Peak Hour Analysis

Customer Pickup Location
- Airport
- City

Percentage Contribution to Total Issue [Based on Pickup Location]	
City	**96.48%**
Airport	3.52%

Morning Peak Hour Demand vs. Supply Analysis for requests from City	
Number of Trip Requests Made from City [Demand]	1677
Number of Trips Completed from City to Airport [Supply]	472
Demand vs. Supply Gap	1205

From this analysis it is clear that the Demand vs. Supply gap for Morning Peak Hour is most severe for requests from city to airport being cancelled

Considering the additional information sourced from a newspaper and attached below, it shows the hourly number of flights departing and arriving at Mumbai Airport on a Friday.

Hypothesized Reason:

The image reveals the general trend that there are significantly more outgoing flights than incoming flights during the morning to noon hours. For a driver who makes a trip from the city to the airport has to inadvertently wait for a longer duration to receive a return trip request. Consequently this will lead to increase in driver idle time, which could have been utilized for other trips if he chose not to accept a city to airport request during morning hours. In some cases the driver might have to return back to the city without a customer, therefore incurring a loss and waste of fuel. This might be the reason contributing to the high number of city-airport requests cancelled by the driver contributing to the large supply and demand gap.

Recommendations to Uber:

[1] Increasing the profit margin for drivers making trips from the city to the airport during Morning Peak Hours thereby encouraging the driver to take up more city-airport trips during this time slot.

[2] Surge pricing, by increasing the rate charged to the customer we can increase the revenue generated instead of changing the profit margin with normal prices. The benefit of the surge charge can be passed on to the drivers making this trip.

[3] Maintaining transparency with respect to the surge charging of customers during Morning Peak Hours.
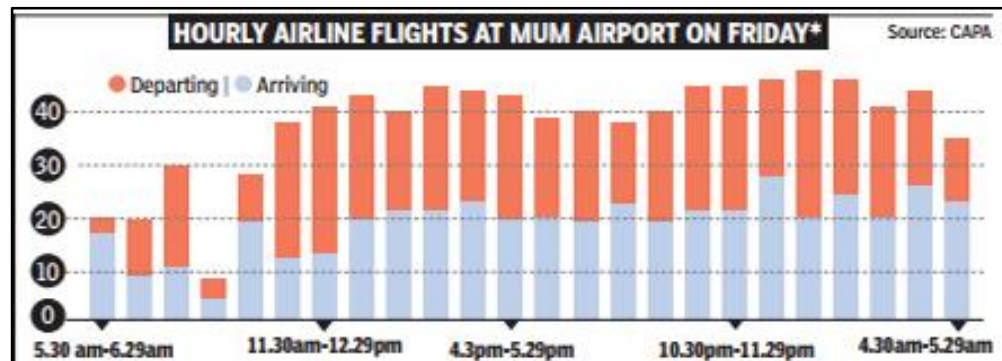
Problem Statement #2 : High number of customer requests are denied due to no cars available during Late Evening Rush Hour.

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Let us analyze if the problem is more severe for pick-up requests made from the airport or the city.

Plot12. Late Evening Rush Hour Analysis

Plot6. Request Status Segmentation based on Time-Slots
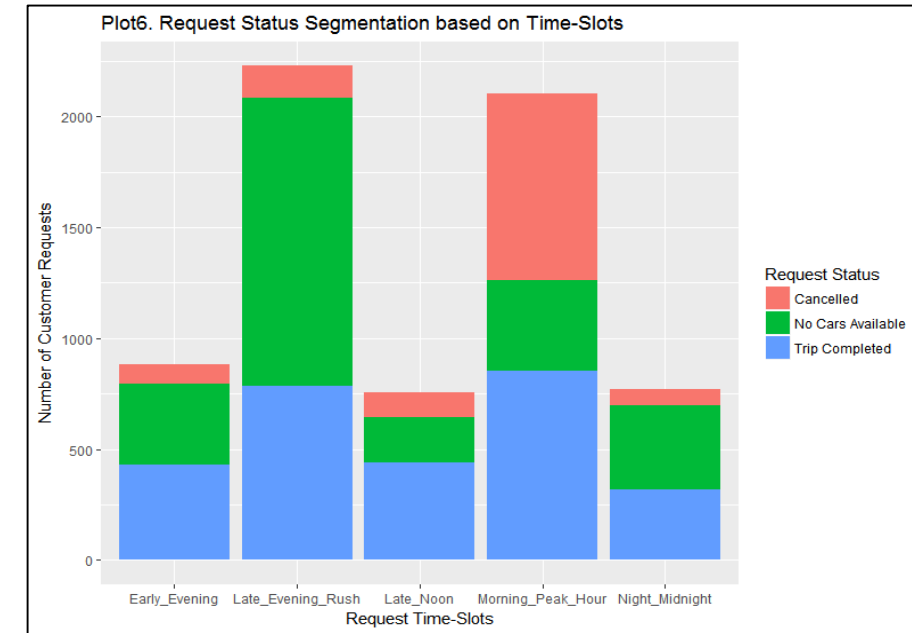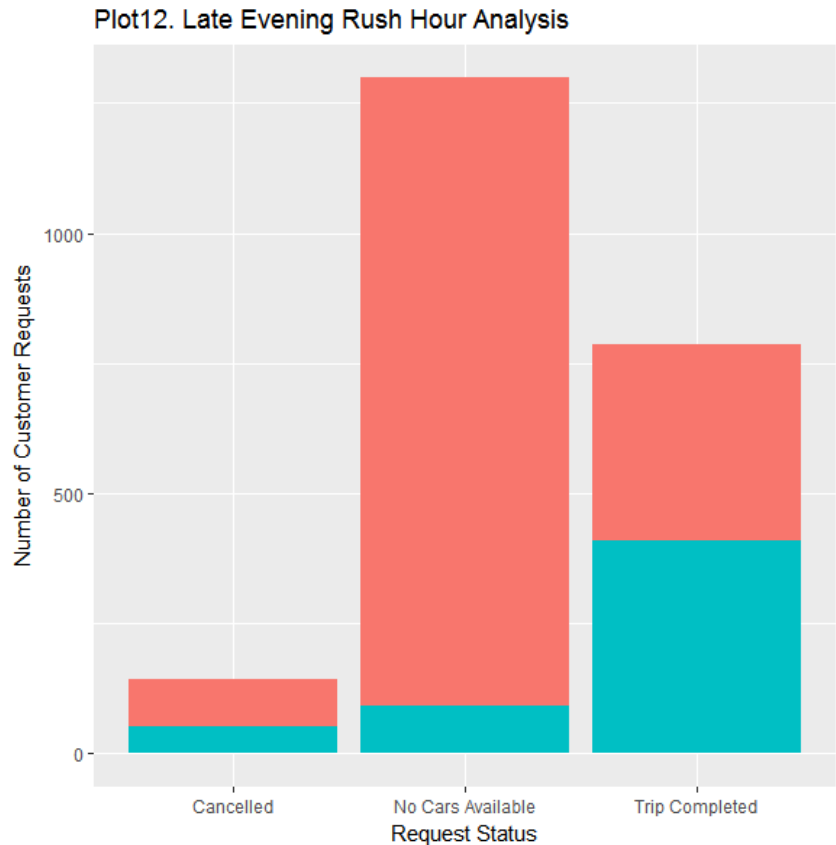
Percentage Contribution to Total Issue [Based on Pickup Location]	
City	10.57%
Airport	**89.43%**

Late Evening Rush Hour Demand vs. Supply Analysis for requests from Airport	
Number of Trip Requests Made from City [Demand]	1437
Number of Trips Completed from City to Airport [Supply]	379
Demand vs. Supply Gap	1058

From this analysis it is clear that the Demand vs. Supply gap for Late Evening Rush Hour is most severe for requests from airport to city due to no cars available.

Considering the additional information sourced from a newspaper and attached below, it shows the hourly number of flights departing and arriving at Mumbai Airport on a Friday.

Hypothesized Reason:

The image reveals the general trend that there are significantly more incoming flights than outgoing flights during the Late Evening Rush Hour. This may be due to the high number of international flights landing during the late evening to night time. Therefore, there is significant reduction in natural supply of taxi's to the airport during the late evening rush hour. This imbalance leads to a surge in the demand for cars from customers desiring to leave the airport. The increased demand and insufficient supply contributes to the significant supply-demand gap at the airport during the Late Evening Rush Hour.

Recommendations to Uber:

[1] Encourage ride-sharing or Taxi pooling for customers leaving the airport during the Late Evening Rush Hour. This will improve the number of customers serviced through fewer supply of taxis.

[2] Surge Charge the customer for late evening trips from the airport to encourage more drivers to initiate a trip toward the airport during the late evening rush hour.

[3] Maintaining transparency with respect to the surge charging of customers during Late Evening Rush Hour.

HOURLY AIRLINE FLIGHTS AT MUM AIRPORT ON FRIDAY* Source: CAPA
Departing | Arriving