ATAL INDORE CITY TRANSPORT

Project Report

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EXECUTIVE SUMMARY

The case study focuses on the Bus Rapid Transit System(BRTS) in Indore, which aims to provide a faster, more efficient, and environmentally friendly transportation system. The BRT system consists of dedicated bus lanes, modern buses, etc to improve the quality of transportation. The system is currently facing the challenge of determining the number of buses required.

The main objective of the project is to determine the optimal number of buses that are required to transport passengers from the Rajiv Gandhi bus stop to Niranjanpur Square bus stop and vice-versa for peak and non-peak hours while keeping the constraints in mind.

The study provides data on peak and non-peak hours along with the constraints on bus capacity, travel distance, bus speed, etc. It also analyzes the cost it would take number of kilometers a bus travels each week. We also have information about the time taken for each trip(45 minutes), and the queuing system for the buses.

However, to ensure efficient transportation, we also need to consider other factors such as the frequency of buses(headway) and their timings while maintaining an optimal speed limit. Based on the constraints and analysis, we have concluded that we would recommend at least 56 buses(10 more than the available 46 buses) to be active during peak hours and 14 buses to be active during non-peak hours where all of the requirements were completely met. We've also considered a headway of 3 minutes since it gave us the best results. These numbers analyzed together gave us a total trip count i.e., 106 trips for peak hours and 28 trips for non-peak hours to satisfy the demand. These decisions were made considering all constraints, safety, and cost factors to the service.

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INTRODUCTION TO THE CASE

BRT, which stands for Bus Rapid Transit, was prevalent in medium-sized cities globally as the primary form of public transportation. The method used a distinct infrastructure that included dedicated lanes, busways, and stations, an efficient fare collection system, fast and frequent bus services, and convenient boarding and alighting options for passengers.

Indore, a city in central India's Madhya Pradesh state, which is both a commercial and educational center, faced significant traffic challenges due to inadequate road infrastructure, unpredictable traffic patterns, and insufficient public transportation options. The growth of commercial and trade activities has led to a significant increase in population, which in turn has created a need for dependable and effective public transportation.

The Atal Indore Transport Case study is a comprehensive analysis of the Bus Rapid Transit System(BRTS) in Indore, India. It is an innovative transportation system designed to address the growing traffic congestion and pollution in the city. This case provides insights into the planning, implementation, and operation of the BRTS system in Indore and its impact on the city.

The Indore BRTS system commenced its operations from Rajiv Gandhi, positioned in the central-southern part of the city, and concluded at Niranjanpur Square, a neighborhood situated in the north of Indore. The AB Road, which linked significant commercial and residential areas, was the path that the system followed. Due to its strategic importance and high volume of traffic, this route was crucial for the city. The entire corridor stretched across 11.57 kilometers and featured 21 bus stops. The BRT buses traveled along a single route in two directions, from Niranjanpur Square to Rajiv Gandhi and vice versa from Rajiv Gandhi to Niranjanpur Square.

A team was dedicated to managing the schedules of BRTS buses which operated between 6:00 am and 10:00 pm. Five buses were dispatched from each end of the route at 6:00 am, and during operational hours, a minimum of 25-35 buses were in use. The remaining buses were utilized to ensure smooth operations. Some of the buffer buses were kept at intermediate stops to substitute for any bus that went out of service. All buses were equipped with a GPS for navigation and RFID for identification purposes. Live cameras installed at each bus stop allowed the schedulers to track the buses continuously from the control station. During peak hours, a headway of approximately 3-5 minutes was maintained, while during non-peak hours, it was 7-10 minutes.

The Indore BRTS employed two sets of bus drivers - one group worked 12-hour shifts, while the other worked 8-hour shifts. The drivers on the 12-hour shifts usually started their day at 8:00 am to cover the peak hours, while the 8-hour shift drivers began at 6:00 am for most days. The drivers worked approximately six days per week and were entitled to four days of leave each month. As per the agreement between the BRTS and the bus leasing agency, each bus was allowed to cover up to 1,200 kilometers per week.

PURPOSE OF THE CASE

India's economy had a GDP growth rate of 5.024 percent per year, making it one of the fastest-growing economies in the world. Indore, located in Madhya Pradesh, was a rapidly expanding industrial city and the only metropolitan city in the state. As urbanization continued to increase, the need for improved public transportation became a priority, particularly as private vehicle ownership also rose, resulting in city congestion and pollution. Buses were identified as the most efficient and accessible mode of transportation in urban areas.

In 2004, a Comprehensive Traffic and Transportation Plan for Indore (CTTPI) was prepared, estimating the travel demand to be 5.5 million person trips per day by 2025. Indore City Transport Services Limited (ICTSL) was established after the CTTPI, and in a short period of time, introduced innovative schemes to improve the city's bus services.

To meet the high demand and improve bus capacity and productivity, ICTSL proposed and implemented the Bus Rapid Transit System (BRTS) in Indore. The BRTS was introduced and implemented to address issues such as rapid city growth, increasing mobility, high travel demand, congestion, delays, energy conservation, environmental quality, and other related problems and objectives.

As addressed above- The main objective of the project is to determine the optimal number of buses that are required to transport passengers from Rajiv Gandhi bus stop to Niranjanpur Square bus stop and vice-versa for peak and non-peak hours. Since there were 46 buses in the system, our aim was to find -

- Number of passengers using the BRT system.
- The number of buses to be added or used (out of 46) to keep costs to a minimum while accommodating all passengers.
- Determine the frequency and headway of the buses for smooth running
- Determine the wait time and capacity of the bus

METHODOLOGY USED

We first started by analyzing the origin-destination demand matrix for peak hours. We've taken a cumulative sum for each stop starting with Rajiv Gandhi. Our calculations told us that the total number of people who would be on the bus at this stop is 702. Moving on to the next stop, Mata Gujri, the number of people who are going to be added is 358 subtracted by the number of people who will get off i.e., 7. So, in total, we will have 1053 people on the bus at this point who will be continuing their journey.

Bus Stop Name	Rajiv Gandhi	Mata Gujri	Vishnupuri	Bhanwarkuan Square	Holkar Subway	Navlakha Square	Indra Pratima	GPO	Shivaji Vatika	AICTSL	Geeta Bhawan	Palasiya	Industry House	LIG	Press Complex	MR-9	Vijay Nagar	Satya Sai	Shalimar Township	Scheme No. 78	Niranjanpur Square
Distance (in km)	0.00	0.75	1.20	1.70	2.00	3.00	3.30	3.70	4.40	4.90	5.40	6.10	6.60	7.20	7.50	8.20	8.90	9.50	10.40	10.90	11.40
Rajiv Gandhi	0	7	5	52	19	30	16	71	24	40	100	80	30	61	16	50	39	9	13	16	23
Mata Gujri	15	0	4	43	8	24	14	24	15	15	43	37	12	23	5	30	22	8	9	11	10
Vishnupuri	8	6	0	21	10	17	9	25	8	16	45	31	0	20	6	21	16	5	4	4	8

Similarly, we took a cumulative sum of all the stops. We've found out that the maximum number of people who will be on a bus at a stop while traveling from Rajiv Gandhi to Niranjanpur Square is 4835 which was at the GPO stop and 5343 for coming back from Niranjanpur Square to Rajiv Gandhi which was seen at the stops LIG and Industry house . *[The numbers are seen in Table 1 and visually in Graph 1 in the Appendix.]*

We ran the numbers for non-peak hours and the maximum number of people who will be on the bus going from Rajiv Gandhi to Niranjanpur Square turned out to be 1239 with the highest number of people at Geeta Bhavan (Stop 11) and 1319 for Niranjanpur Square to Rajiv Gandhi, also at Geeta Bhavan. It has become our objective at this point to accommodate these numbers and find out the number of buses required for it. It is important to note that based on the origin- demand matrix, coming back from Niranjanpur Square to Rajiv Gandhi had a higher number of people to accommodate in both peak and non-peak hours. *[The numbers are seen in Table 2 and visually in Graph 2 in the Appendix .]*

Once we had the numbers, the objective was to find the optimal number of buses required to meet the demand while accounting for uncertainty, keeping in mind that at the start of the day 5 buses are deployed from both ends at the same time which is a total of 10 buses and at any given time 25-35 buses are in operation.

MONTE CARLO SIMULATION

There were 4 Monte Carlo Simulations run because the passengers travelling were not same.

1. Going from Rajiv Gandhi to Niranjanpur Square in Peak Hours
2. Coming from Niranjanpur Square to Rajiv Gandhi in Peak Hours
3. Going from Rajiv Gandhi to Niranjanpur Square in Non- Peak Hours
4. Coming from Niranjanpur Square to Rajiv Gandhi in Non- Peak Hours

The purpose of our code was to simulate a transportation system by generating a random number of people to transport, calculating the number of buses needed to transport them, and repeating this process multiple times to generate a distribution of the number of buses required.

Example- Going from Rajiv Gandhi to Niranjanpur Square in Peak Hours

```
def calculate_number_buses(people, headway=3, time=240, speed=15, trip_distance=11.57, buses = 120):

  trips = pd.DataFrame(columns=["Bus number", "Number of trips"])
  trip_time = trip_distance / (speed / 60)


  for i in range(0, buses):
    x = int(time/trip_time)
    time = time - headway

    dict1 = {'Bus number': [i+1], 'Number of trips': [x]}
    df2 = pd.DataFrame(dict1)
    trips = pd.concat([trips, df2], ignore_index = True)

    trips.reset_index(drop = True)

  sum1 = 0
  for i, row in trips.iterrows():
    sum1 = sum1 + (row["Number of trips"] *51)
    if sum1 > people:
      return(row["Bus number"])
  return(row["Bus number"])
```

```
num_iterations = 1000
results = []
mean = 4835
mean_hourly= mean/4
std_dev = mean_hourly*0.20

for i in range(num_iterations):
    # generate a random number of total_people based on the mean and standard deviation
    total_people = int(np.random.normal(mean_hourly, std_dev))
    total_people = total_people*4

    # calculate the optimal number of trips based on the random total_people value
    num_buses = calculate_number_buses(total_people, headway=3, time=240, speed=15, trip_distance=11.57)

    # append the result to the results list
    results.append(int(num_buses))
    # results.append(total_people)
print(results)
```

The simulation generates a random number of people per hour, based on a mean and standard deviation, and multiplies it by four to simulate a four-hour period. Here, we have taken the mean to be the maximum number of passengers in the bus which we had found to be 4835.

This was divided by 4 to get the hourly mean and then the hourly mean (1209). The standard deviation was 20% of the hourly mean which was around 241.8. Therefore, the random demand generated could go up or down 3 standard deviations of the mean. Therefore, we took the maximum value of 4835 as the mean so all people could be accommodated.

For each iteration, the function calculate_number_buses was called with the randomly generated number of people (1000 iterations), along with fixed values for headway, time, speed, trip distance, and the number of buses available. We took headway of 3 minutes since more headway would mean more buses. Speed was taken to be 15 km/hour and distance was 11.57km. The average time taken to go end to end was 45 minutes and the total operational peak window was taken to be 240 minutes(4 hours).

The function returned the optimal number of buses required to transport the given number of people. The number of buses required was then stored in a list for each iteration(1000). After all iterations were complete, the list of the number of buses required for each iteration was printed.

```
print(results)

[24, 33, 33, 24, 21, 18, 21, 31, 21, 29, 22, 26, 34, 24, 16, 17, 25, 23, 24, 33, 12, 23, 18, 24, 20, 31, 24, 33, 31, 29, 23, 21, 24, 24, 30, 27, 13, 23,

[ ] round(np.mean(results))

25
```

When the mean of all the 1000 iterations was taken, it came out to be 25 buses for one side which means a total of 50 buses running from both sides could carry 4835 people.

The same code was run for the other 3 scenarios which gave us the following result-

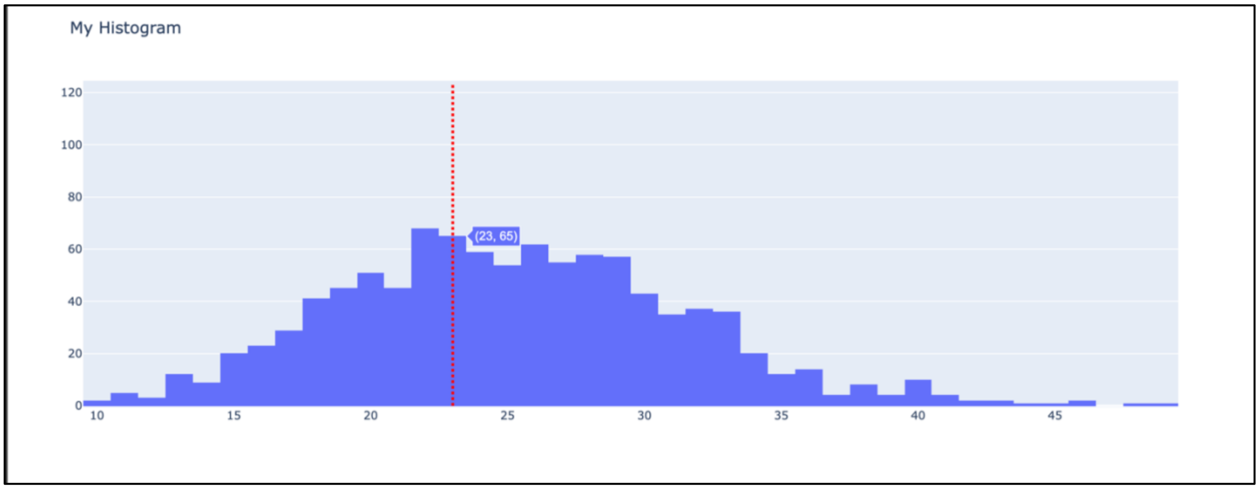
Scenario	**Number of Passengers**	**Number of Buses (One side)**	**Total Buses**
Going Peak	4835	25	50
Coming Peak	5343	28	56
Going Non-Peak	1239	6	12
Coming Non-Peak	1319	7	14

It could be concluded that the 46 buses in the system currently will not be able to fulfill the demand for all the passengers in the peak hours. Non-Peak hours worked perfectly for the current system.

SUCCESSFUL COMPLETION GIVEN EXISTING BUSES

We then wanted to know the number of times the demand was met based on the number of buses in the system. To find this out, we created a histogram to showcase it. We plotted the 1000 results for the number of buses we got from the Monte Carlo Simulation and used the 23 buses on one side (Total 46 buses) as a marker line.

Example- Going from Rajiv Gandhi to Niranjanpur Square in Peak Hours



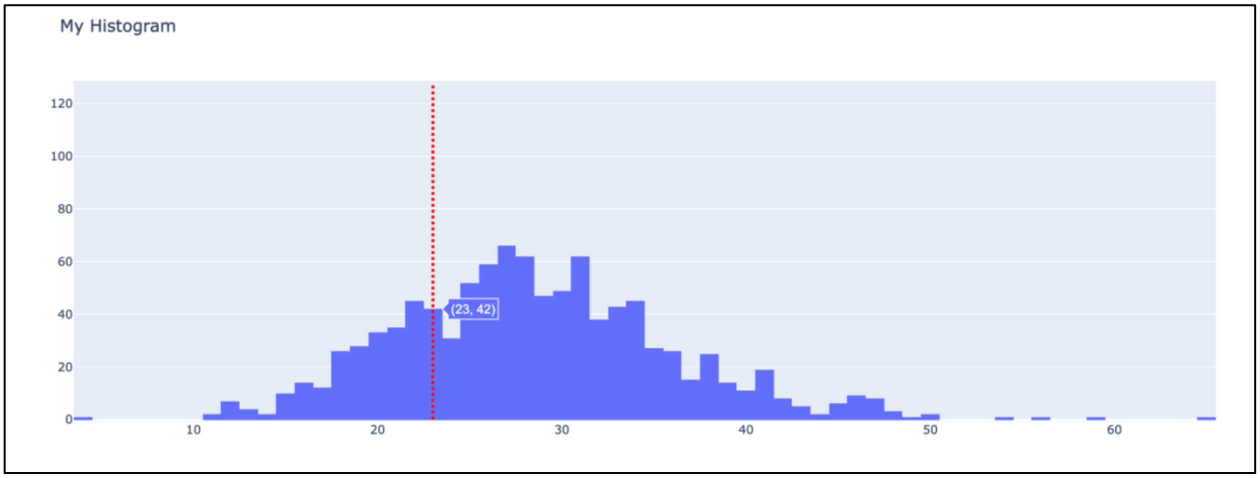
The above graph clearly shows 25 to be the mean point of the histogram which is the number of buses we got travelling from Rajiv Gandhi to Niranjanpur Square from one side.

The X-axis shows the number of buses, and the Y-axis shows the count as to how many times those numbers were generated out of 1000. The left side of the graph from the red line shows the number of times 23 or less buses were used to transport the mean passengers. For example, the label shows that 65 out of 1000 times, 23 buses were required to meet the demand. In total, it was seen that during peak hours, the system was able to achieve demand within 46 buses, 425 out of the 1000 times.

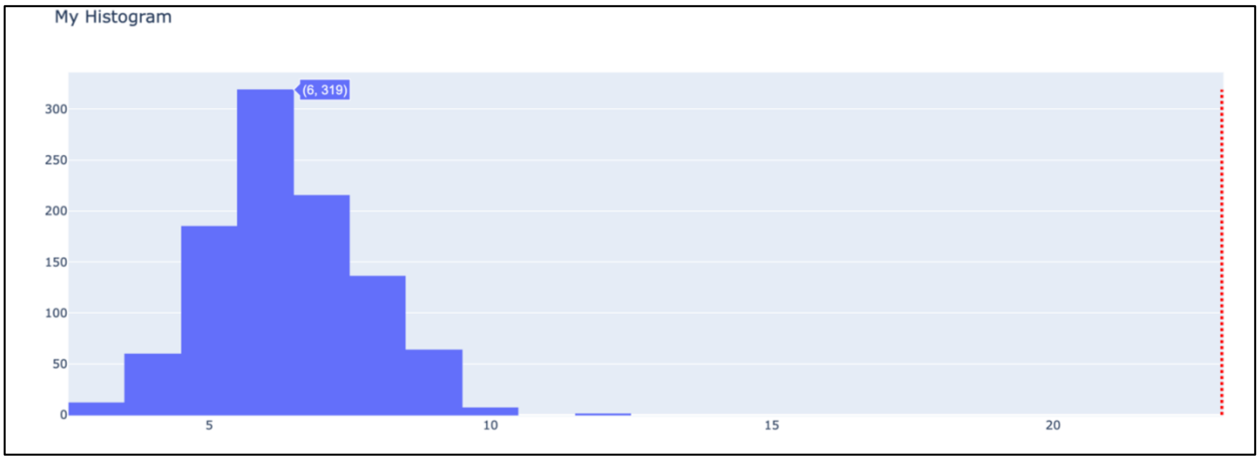
This process was repeated for all the scenarios and the results were as follows-

Scenario	Passengers	Number of Iterations	Success Cases given 46 buses
Going Peak	4835	1000	425
Coming Peak	5343	1000	244
Going Non-Peak	1239	1000	1000
Coming Non-Peak	1319	1000	1000

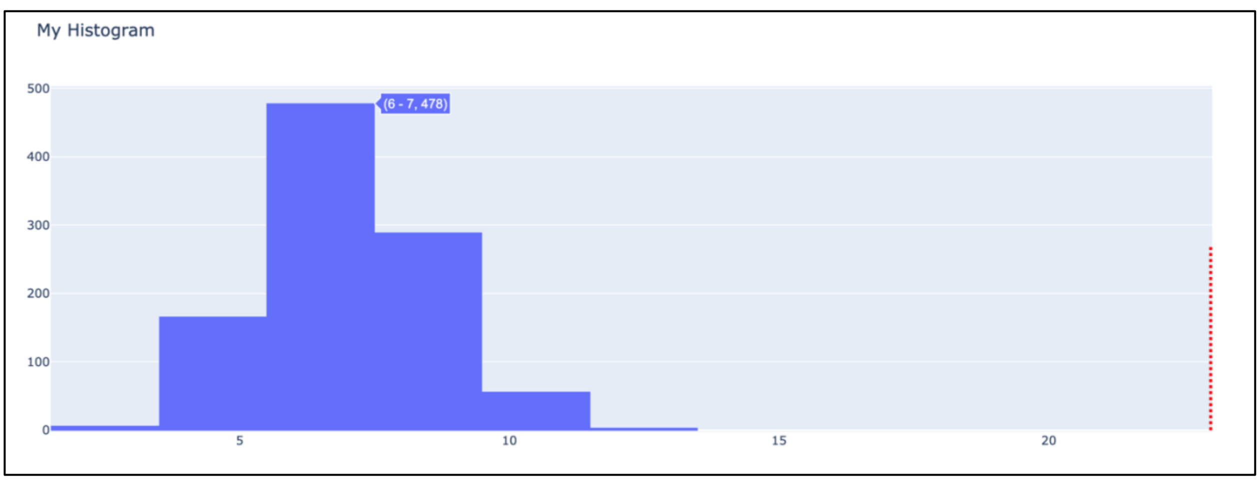
Niranjanpur Square to Rajiv Gandhi during Peak Hours



Rajiv Gandhi to Niranjanpur Square in Non- Peak Hours



Niranjanpur Square to Rajiv Gandhi during Non- Peak Hours



NUMBER OF TRIPS TAKEN

Since we had a constraint of a bus only being able to travel 1200 km/hour we decided to find the number of rounds a bus could make in a day to stay within the 171.8km limit of a day.

Example- Going from Rajiv Gandhi to Niranjanpur Square in Peak Hours

The trip time was calculated using the formula trip_distance/(speed/60), which gave us the time required to complete one trip. The variable number_of_trips was initialized as an empty list. Then, for each bus, the optimal number of trips required to transport passengers within the fixed time was calculated using a for loop. The loop calculated the number of trips for each bus using the formula int(time/trip_time) and subtracted the headway from the total time for each bus. After calculating the number of trips for all buses, a for loop was iterated through the "trips" data frame to calculate the total number of trips required to transport all passengers. The number of trips for each bus was multiplied by the capacity of the bus, which is 51. As seen in the code, the number of buses is taken as 25 (Monte Carlo Mean) and Number of Passengers is 4835.

```python
headway = 3
time = 240
speed = 15
trip_distance = 11.57
trip_time = trip_distance/(speed/60)

number_of_trips = []

buses = 25
total_people = 4835
trips = pd.DataFrame(columns=["Bus number", "Number of trips"])

for i in range(0, buses):
  x = int(time/trip_time)
  time = time - headway

  dict1 = {'Bus number': [i+1], 'Number of trips': [x]}
  df2 = pd.DataFrame(dict1)
  trips = pd.concat([trips, df2], ignore_index = True)

  trips.reset_index(drop = True)

sum1 = 0
for i, row in trips.iterrows():
  print(row)
  sum1 = sum1 + (row["Number of trips"]*51)
  print(sum1)
  number_of_trips.append(int(row["Number of trips"]))
  if sum1 > total_people:
    print(row["Bus number"])
    break

# print(trips.head(20))
print(sum(number_of_trips))
```

The above code gave us the following result-

```
Bus number          25
Number of trips      3
Name: 24, dtype: object
4947
25
97
```

This shows that Bus number 25th deployed (starting from Bus 1) is where our loop ends. Therefore, a total of 50 buses can carry a total of 4947 (encompasses our demand of 4835) people by making 97 rounds.

The results for the other scenarios are as follows-

Scenario	**No. of Passengers (Dd)**	**No. of Passengers Taken**	**Trips**	**No. of Buses Required (Both sides)**
Going Peak	4835	4947	97	50
Coming Peak	5343	5406	106	56
Going Non-Peak	1239	1275	25	12
Coming Non-Peak	1319	1428	28	14

PASSENGER DISTRIBUTION

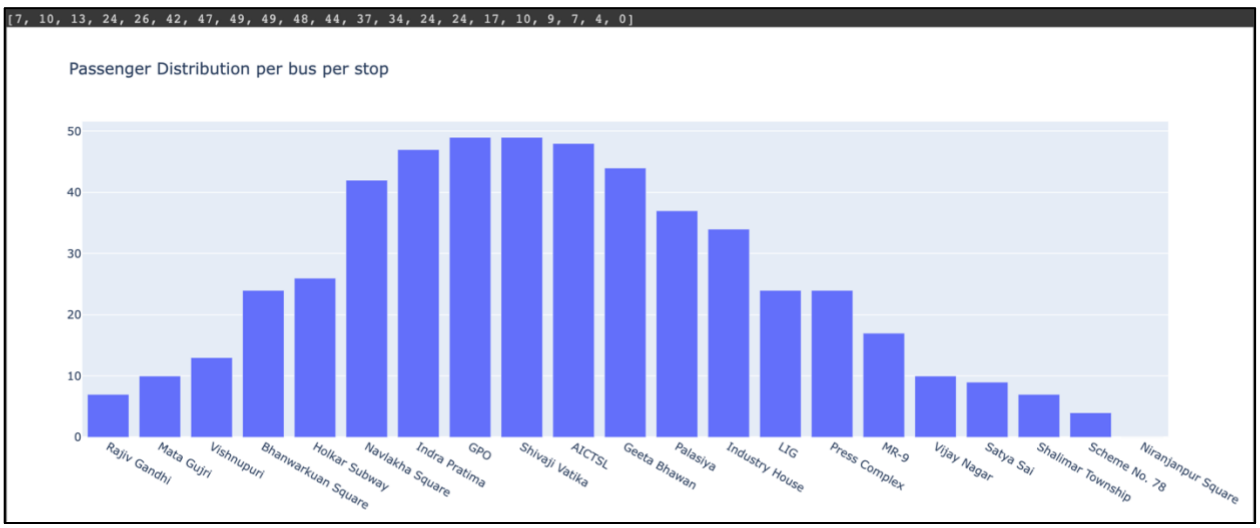
We also calculated the passenger distribution for each bus per stop and created histograms to showcase this as well since we assumed that not all buses would have 51 people on it at each time and filling a bus at 100% is often inconvenient for the people as well.

From the previous section we knew the total number of trips that the buses make and from the cumulative sum that we found before we knew the number of people getting on a bus from each stop. Therefore, to calculate the passenger distribution for peak hours we-

(Cumulative)People on each station / Total number of trips

For Eg- 702/106= 6.62

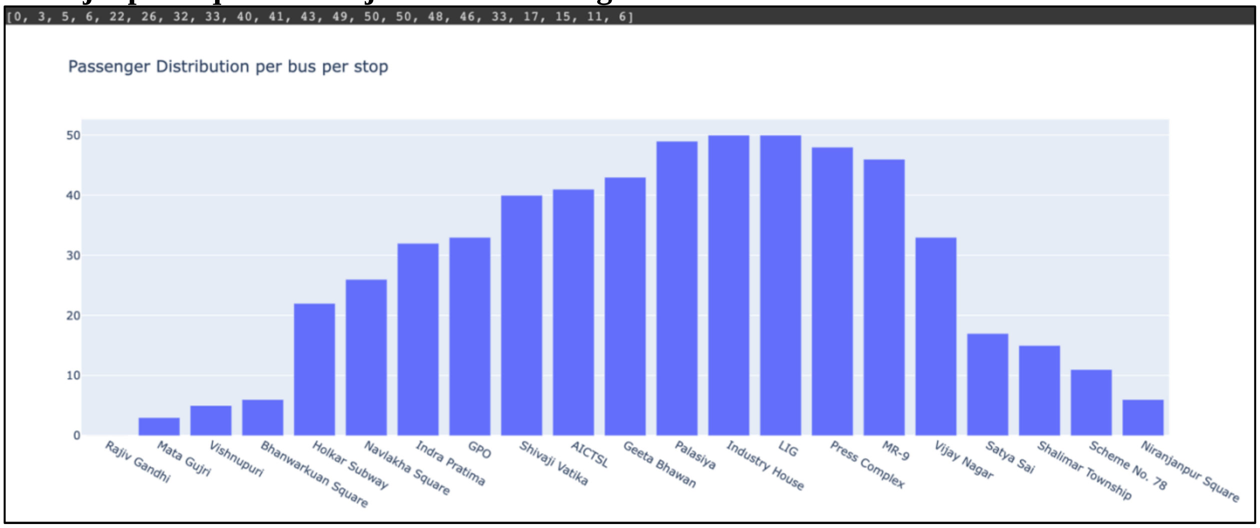
1053/106= 9.93 and so on.



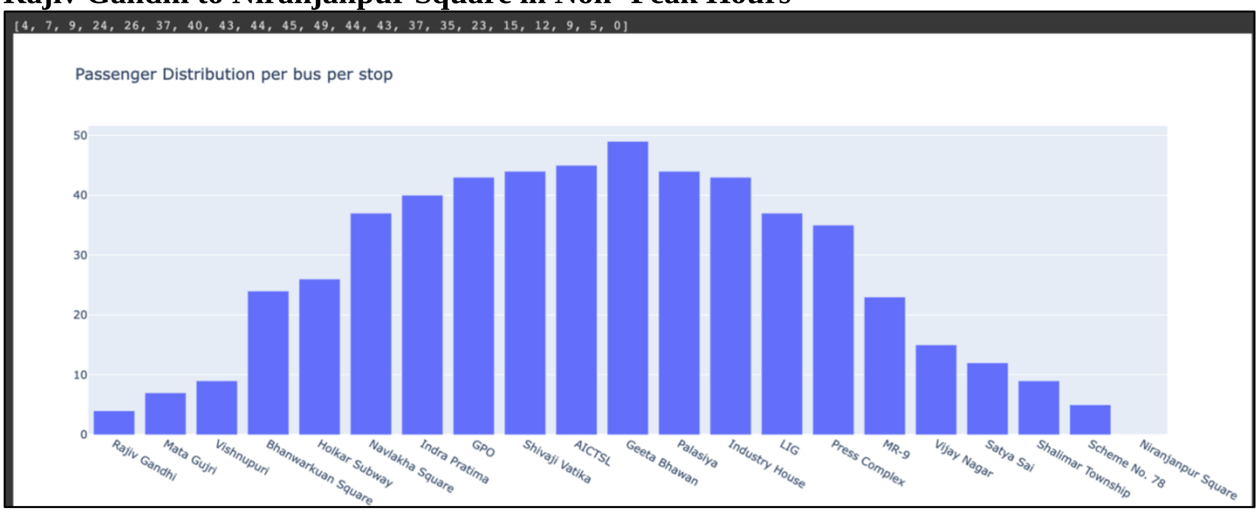
We use 106 trips for peak because we are recommending the system to have the higher number of buses which is 56 buses (28 on each side).

The above graph is for Rajiv Gandhi to Niranjanpur Square in peak hours. As seen, the maximum capacity load of the bus were GPO and Shivaji Vatika at 49 passengers per bus. Each of the 25 buses will follow this distribution to meet the demand.

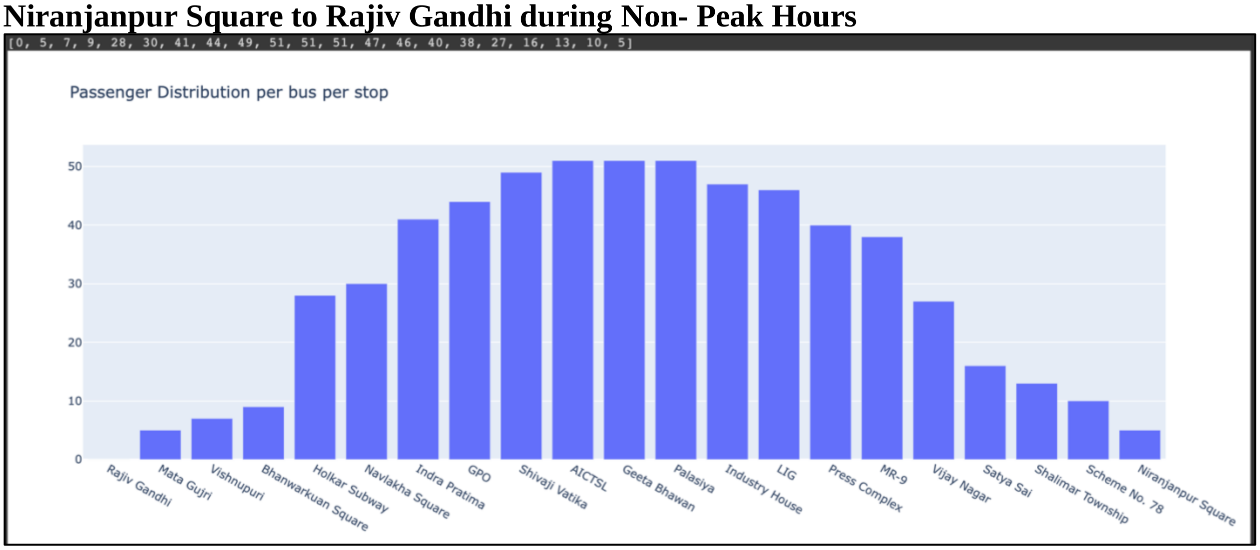
Niranjanpur Square to Rajiv Gandhi during Peak Hours



Rajiv Gandhi to Niranjanpur Square in Non- Peak Hours



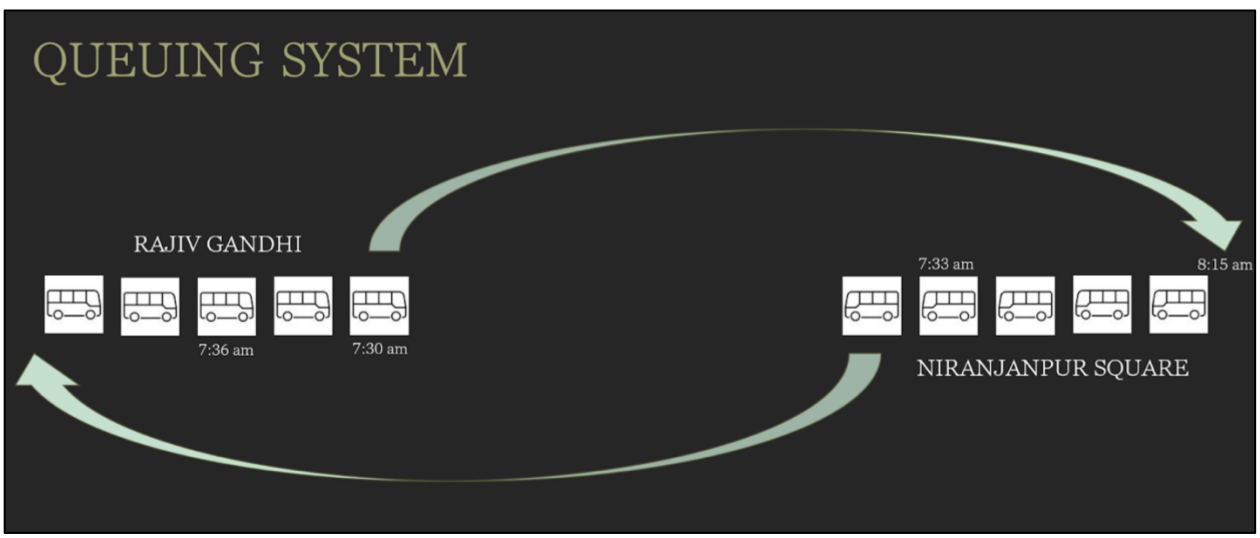
Niranjanpur Square to Rajiv Gandhi during Non- Peak Hours



QUEUE

Considering the 3 minute headway for peak hours, we implemented a queuing system where we start off with 15 buses on each side. Each bus has a headway of 3 minutes. The first bus starts at 7:30 am from the Niranjanpur Square bus stop and will reach the Rajiv Gandhi bus stop at 8:15 am. Similarly, the first bus will start at 7:30 am from the Rajiv Gandhi bus stop and will reach the Niranjanpur Square bus stop at 8:15 am. Once we have all 15 buses leave from both the start points, we will be implementing 13 new buses on each side.

The first new bus will be the 16th bus on each side. The first bus that travels from each side will be added to the end of the queue on the opposite side. Since we would be adding 13 new buses on each side, this will create a wait time of for the existing 15 buses by 39 minutes for each bus(3-minute headway for each bus * 13 new buses). We have a total number of 28 buses on each side for peak hours and each bus will take multiple trips until 11:30 am(end of peak time). These trips will be scheduled based on the maximum number of kilometers each bus can travel, i.e., 171 kilometers per day(1200 per week at max) while making sure the bus capacity does not exceed 51 passengers per trip.



The system was changed for the 7 min headway for Non-peak hours respectively.

OUR INSIGHT

From our analysis above, we've drawn some conclusions and we recommend that for both ways during peak hours, we would need more than 46 buses to satisfy the demand. We need 50 buses to successfully transport all passengers from the Rajiv Gandhi bus stop to the Niranjanpur Square bus stop, and we would need 56 buses to successfully transport all passengers from the Niranjanpur Square bus stop to the Rajiv Gandhi bus stop. Therefore, the number of buses we recommend using in the system is **56**.

For Non-peak hours, we need 12 buses to successfully transport all passengers from the Rajiv Gandhi bus stop to the Niranjanpur Square bus stop, and we would need 14 buses to successfully transport all passengers from the Niranjanpur Square bus stop to the Rajiv Gandhi bus stop. Therefore, the number of buses we recommend using in the system is **14**. However, we need 25 - 30 buses active at the any point of time so then the buses can be increased with number of people being taken in each bus being reduced.

It is important to remember that We have equal number of buses running from both sides because we cannot assume that one side will always have higher demand so to find a solution with lower risk, we will take the higher number of buses. If we increase the headway, these numbers will increase.

COST ANALYSIS

The cost analysis involved research and estimation of the cost of fuel/gas along with the wage rate for each driver. In the service sector it is a fact that more service means more cost. Below are our findings and conclusions:

COST OF FUEL

The distance covered by a bus during peak hours - 21.9 km (106 trips)

The distance covered by a bus during non-peak hours - 23.14 km (28 trips)

Cost of CNG(the BRT buses use only CNG) - Rs. 56/kg

Mileage of bus per kg of CNG - 5km

Fuel cost per day - (distance traveled per day) * (price of CNG per kg) / mileage of bus per kg of CNG

During peak hours, the cost was **Rs. 245.28** ((21.9 * Rs. 56) / 5)

During non-peak hours, the cost was **Rs. 259.168** ((23.14 * Rs. 56) / 5)

The total fuel cost for 56 buses operating during peak hours is **Rs. 13,735.68** (Rs. 245.68 * 56)

The total fuel cost for 14 buses operating during non-peak hours is **Rs. 3,628.352** (Rs. 259.168 * 14)

COST OF WAGES

The average wage for drivers working in peak hours in Rs. 15,000 and the average wage for drivers working in non-peak hours is Rs. 13,000. This helps us further break it down into the wage cost per day, per hour, and total salary expense for both peak and non-peak.

Per day salary of a driver working in peak hours - Rs. 500

Hourly salary of a driver working in peak hours (12 Hour shift) - Rs. 41.66

Total number of drivers working in peak hours - 56

Total salary expense of drivers working in peak hours - **Rs. 27,995.52**

Per day salary of a driver working in non-peak hours - Rs. 433.33

Hourly salary of a driver working in non-peak hours (8 Hour shift) - Rs. 54.16

Total number of drivers working in non-peak hours -14

Total salary expense of drivers working in non-peak hours - **Rs. 6,065.92**

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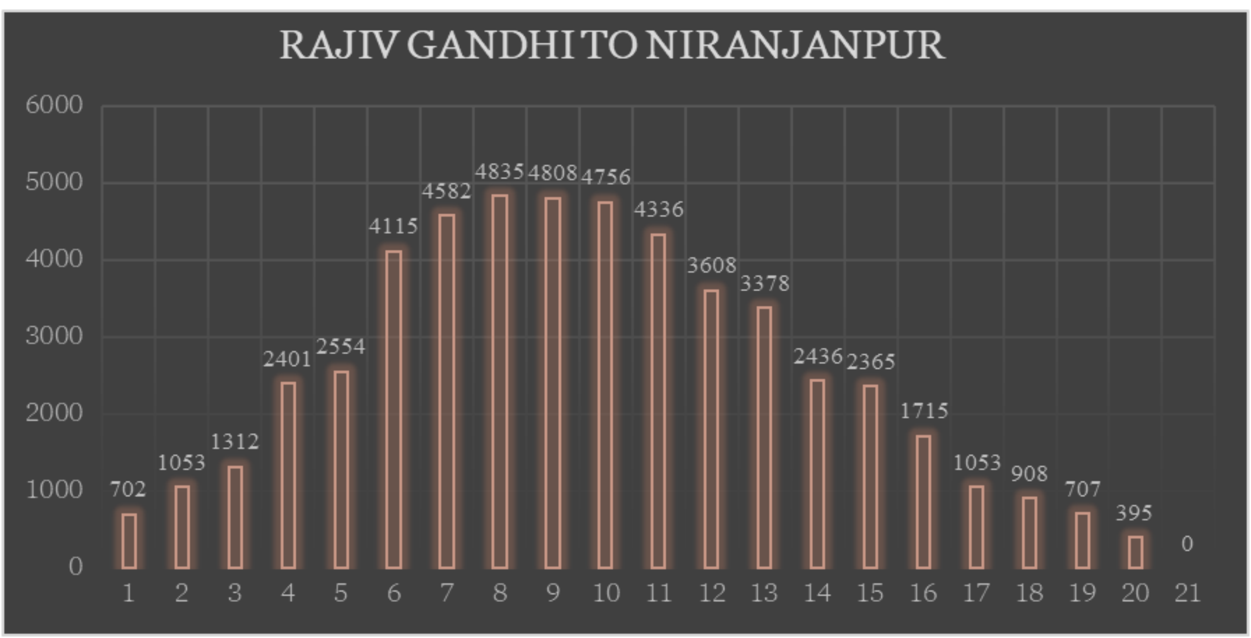
APPENDIX

TOTAL PEOPLE AT EACH BUS STOP (GOING FROM RAJIV GANDHI TO NIRANJANPUR	NUMBER OF PASSENGERS IN THE BUS AT THE RESPECTIVE STOP	TOTAL PEOPLE AT EACH BUS STOP (COMING BACK FROM NIRANJANPUR TO RAJIV GANDHI)	NUMBER OF PASSENGERS IN THE BUS AT THE RESPECTIVE STOP
702	702	0	0
358	1053	15	359
269	1312	14	538
1206	2401	41	674
213	2554	45	2423
1697	4115	294	2788
604	4582	176	3432
725	4835	271	3585
147	4808	105	4288
262	4756	198	4457
659	4336	609	4657
454	3608	882	5301
109	3378	275	5343
239	2436	879	5343
98	2365	382	5192
267	1715	1695	4904
132	1053	1713	3514
32	908	319	1918
24	707	423	1623
22	395	629	1231
0	0	628	628

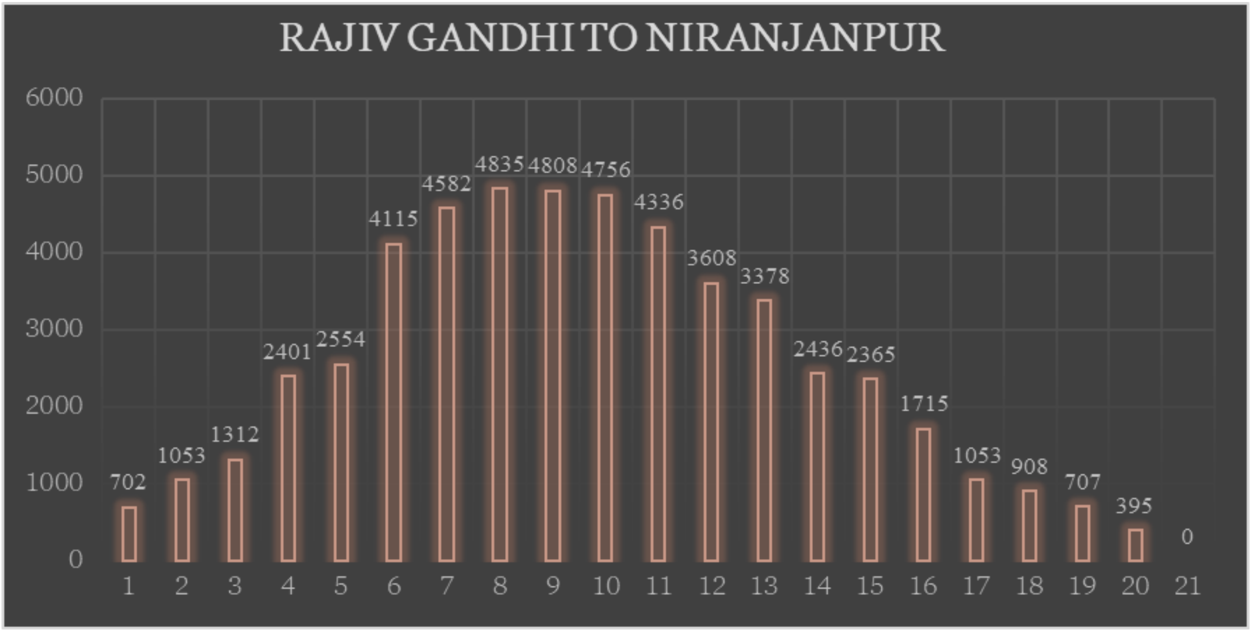
Table 1. Cumulative Sum for Peak Hours

TOTAL PEOPLE AT EACH BUS STOP (GOING FROM RAJIV GANDHI TO NIRANJANPUR	NUMBER OF PASSENGERS IN THE BUS AT THE RESPECTIVE STOP	TOTAL PEOPLE AT EACH BUS STOP (COMING BACK FROM NIRANJANPUR TO RAJIV GANDHI)	NUMBER OF PASSENGERS IN THE BUS AT THE RESPECTIVE STOP
119	119	0	0
69	185	2	136
53	235	2	196
400	615	24	240
66	669	15	695
323	935	84	748
108	1001	45	1032
196	1099	101	1113
57	1126	38	1254
82	1141	61	1278
286	1239	237	1319
122	1113	288	1296
40	1084	86	1197
92	932	269	1162
26	888	70	1020
66	603	360	973
21	381	300	673
5	323	70	403
3	238	87	340
5	122	126	259
0	0	138	138

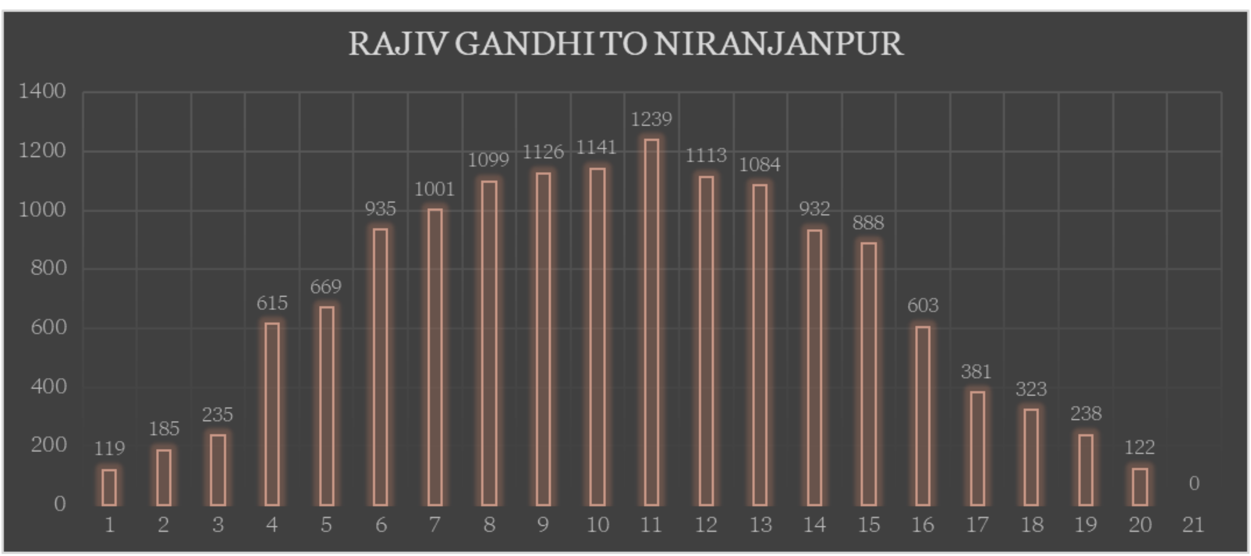
Table 2. Cumulative Sum for Non-Peak Hours



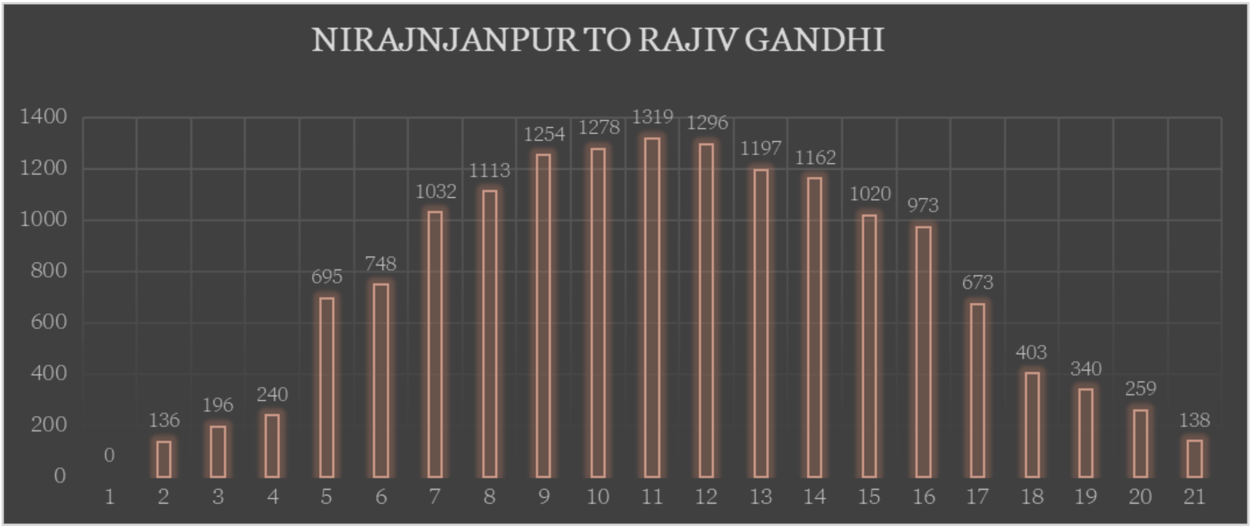
Graph 1. Origin - Destination Cumulative for Peak Hours (Going)



Graph 2. Origin - Destination Cumulative for Peak Hours (Coming)



Graph 3. Origin - Destination Cumulative for Non-Peak Hours (Going)



Graph 4. Origin - Destination Cumulative for Non-Peak Hours (Coming)

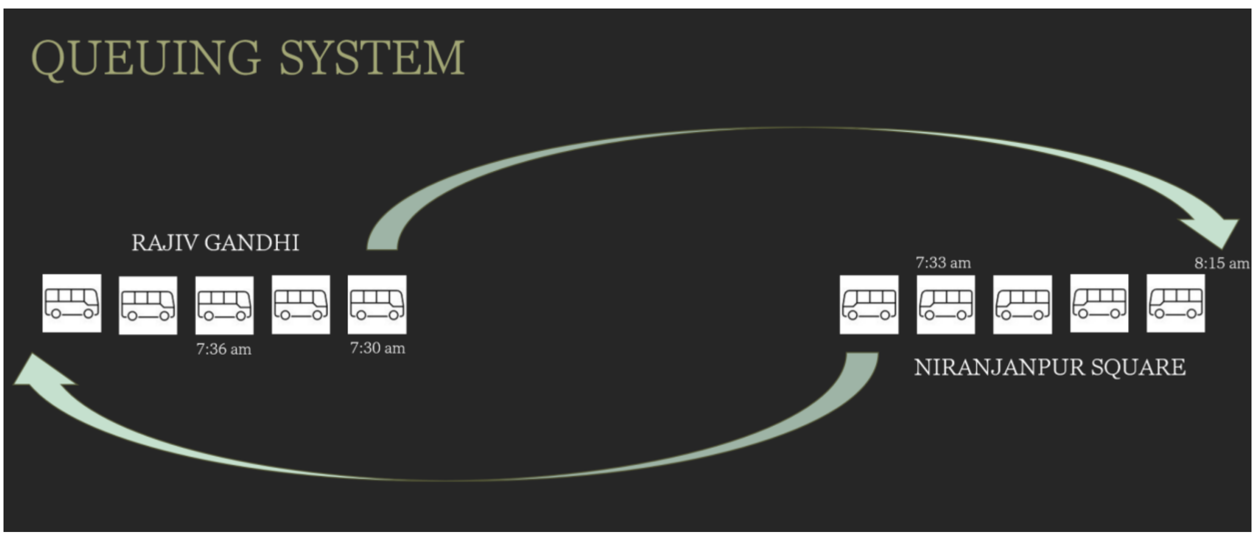


Chart 1. Queuing System

	Start	A to B	B to A	A to B	B to A				Start	B to A	A to B	B to A	A to B
Bus 1	7:30	8:15	9:39	10:24	11:09				7:30	8:15	9:39	10:24	11:09
Bus 2	7:33	8:18	9:42	10:27	11:12				7:33	8:18	9:42	10:27	11:12
Bus 3	7:36	8:21	9:45	10:30	11:15				7:36	8:21	9:45	10:30	11:15
Bus 4	7:39	8:24	9:48	10:33	11:18				7:39	8:24	9:48	10:33	11:18
Bus 5	7:42	8:27	9:51	10:36	11:21				7:42	8:27	9:51	10:36	11:21
Bus 6	7:45	8:30	9:54	10:39	11:24				7:45	8:30	9:54	10:39	11:24
Bus 7	7:48	8:33	9:57	10:42	11:27				7:48	8:33	9:57	10:42	11:27
Bus 8	7:51	8:36	10:00	10:45	11:30				7:51	8:36	10:00	10:45	11:30
Bus 9	7:54	8:39	10:03	10:48	11:33				7:54	8:39	10:03	10:48	11:33
Bus 10	7:57	8:42	10:06	10:51	11:36				7:57	8:42	10:06	10:51	11:36
Bus 11	8:00	8:45	10:09	10:54	11:39				8:00	8:45	10:09	10:54	11:39
Bus 12	8:03	8:48	10:12	10:57	11:42				8:03	8:48	10:12	10:57	11:42
Bus 13	8:06	8:51	10:15	11:00	11:45				8:06	8:51	10:15	11:00	11:45
Bus 14	8:09	8:54	10:18	11:03	11:48				8:09	8:54	10:18	11:03	11:48
Bus 15	8:12	8:57	10:21	11:06	11:51				8:12	8:57	10:21	11:06	11:51
Bus 16	8:15	9:00	10:24	11:09	11:54				8:15	9:00	10:24	11:09	11:54
Bus 17	8:18	9:03	10:27	11:12	11:57				8:18	9:03	10:27	11:12	11:57
Bus 18	8:21	9:06	10:30	11:15	12:00				8:21	9:06	10:30	11:15	12:00
Bus 19	8:24	9:09	10:33	11:18	12:03				8:24	9:09	10:33	11:18	12:03
Bus 20	8:27	9:12	10:36	11:21	12:06				8:27	9:12	10:36	11:21	12:06
Bus 21	8:30	9:15	10:39	11:24	12:09				8:30	9:15	10:39	11:24	12:09
Bus 22	8:33	9:18	10:42	11:27	12:12				8:33	9:18	10:42	11:27	12:12
Bus 23	8:36	9:21	10:45	11:30	12:15				8:36	9:21	10:45	11:30	12:15
Bus 24	8:39	9:24	10:48	11:33	12:18				8:39	9:24	10:48	11:33	12:18
Bus 25	8:42	9:27	10:51	11:36	12:21				8:42	9:27	10:51	11:36	12:21
Bus 26	8:45	9:30	10:54	11:39	12:24				8:45	9:30	10:54	11:39	12:24
Bus 27	8:48	9:33	10:57	11:42	12:27				8:48	9:33	10:57	11:42	12:27
Bus 28	8:51	9:36	11:00	11:45	12:30				8:51	9:36	11:00	11:45	12:30