Bicycle Sharing Systems in India: A Case Study of Chennai

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INTRODUCTION

- Public transportation in Indian cities faces two persisting challenges: Declining Ridership and poor First and last-mile connectivity.

- Historically, Non-motorized transport modes such as walking and cycling played a significant role in connecting users to public transport.

- The Industrial Revolution brought significant changes.

- Rapid change in vehicle ownership has changed the scenarios, and in the recent decade, the urban population has gradually shifted to private, motorized vehicles.
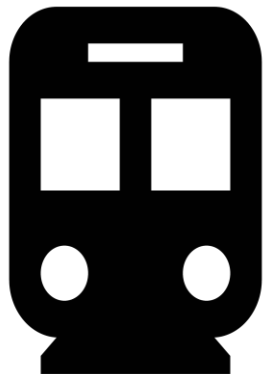
INTRODUCTION (Continued…)

- To achieve sustainable development goals, the Indian government took various policy initiatives.
    - Jawahar Lal Nehru Urban Renewal Mission (2005)
    - National Urban Transport Policy (2014)
    - Smart Cities Mission (2015)

- Smart Cities Mission gave a major push to the cities and allocated a significant portion of funds for sustainable goals.

- Pilot projects focusing on sustainable mobility commenced due to such funding support, and the Bicycle Sharing System was one such initiative.

OBJECTIVE & DATA

- To analyze the functioning of the Bicycle-Sharing System.

- To estimate the service catchment of the bicycle-sharing station based on trip data.

- The study is based on trip data from a bicycle-sharing system operating in Chennai (SmartBike Mobility).

Bike Station

DATA ANALYSIS

- The study is based on trip data shared by the SmartBike Mobility team. The data was collected from Jan 2021 to Aug 2022.

- The data had attributes that captured the start and end time of the trip, start and end station of the trip, device type used for booking the ride, distance covered, ride time, and pause time.

- The original dataset had 197689 trip records.

- We filtered the dataset based on two sets of thresholds-
    - Lower Level: Remove records where Rental Time < 3min and distance covered <300m
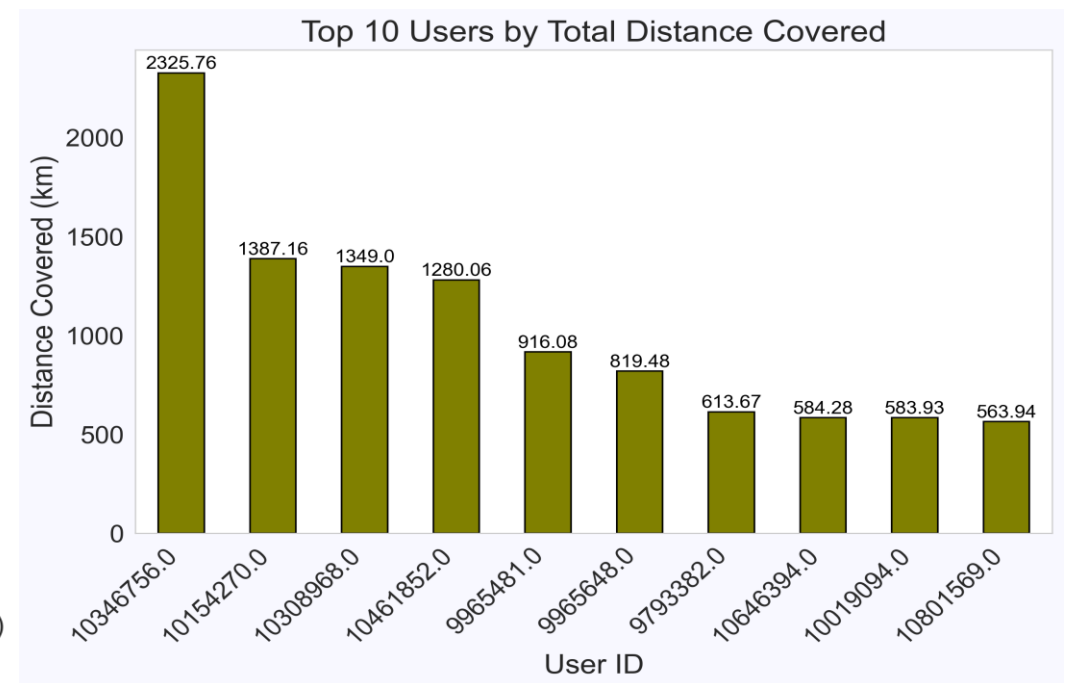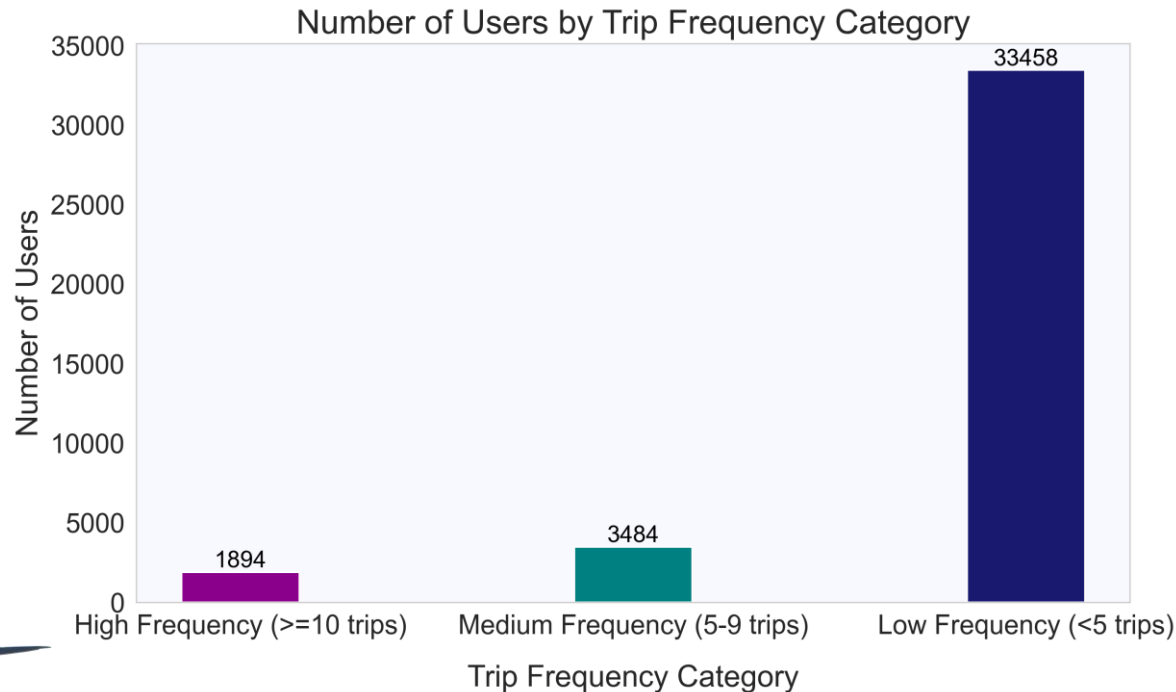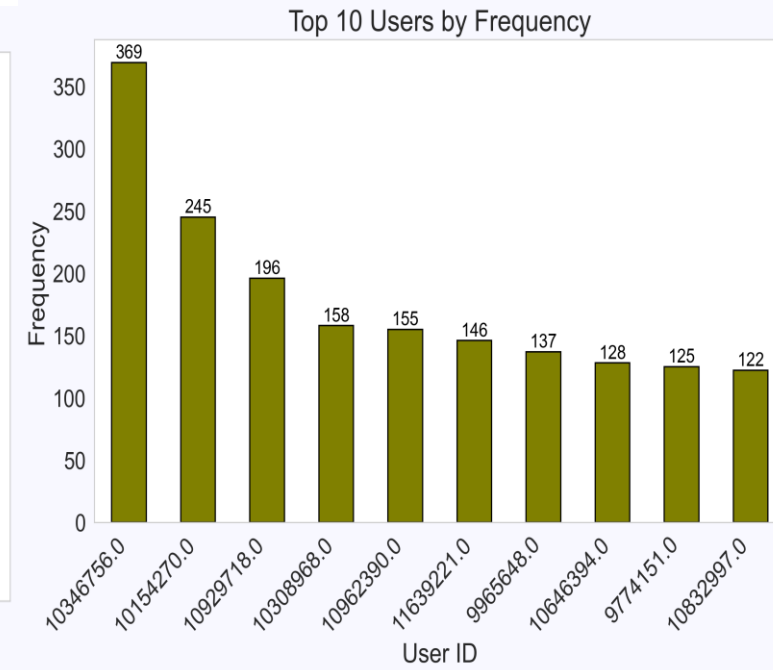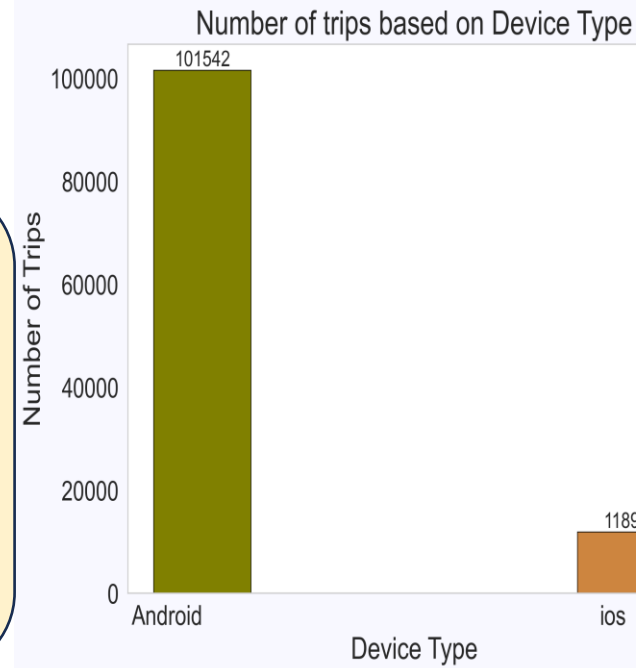   - Upper Level: Considering the 99 percentile of the data.

User Characteristics

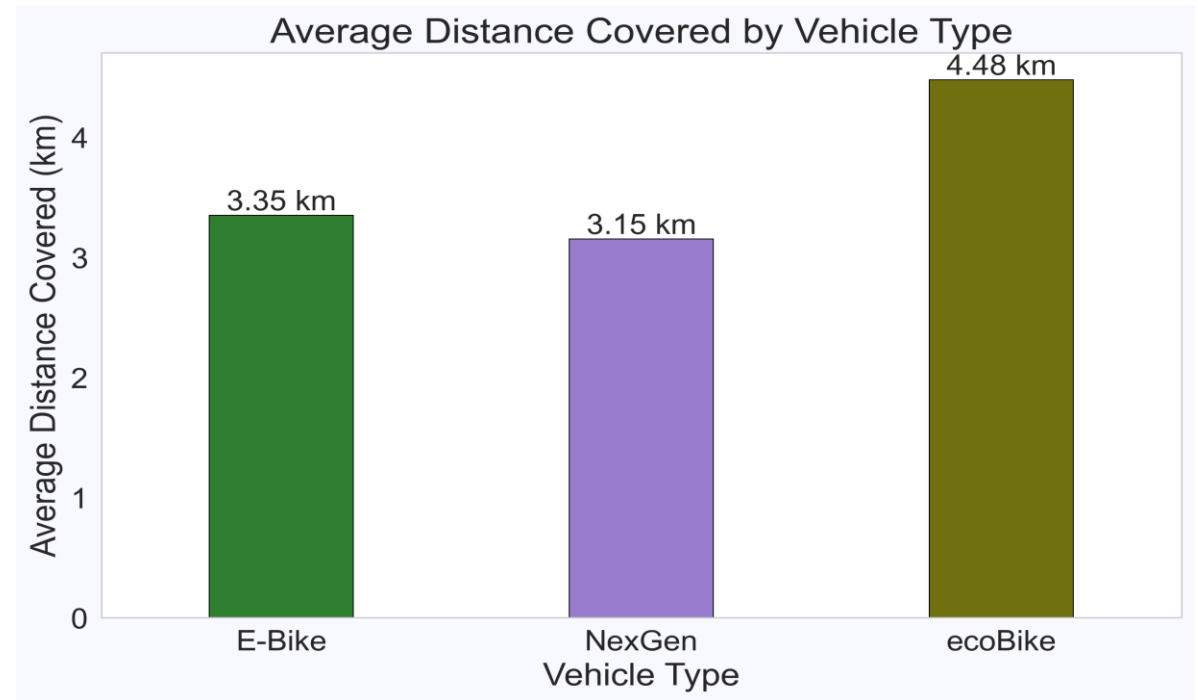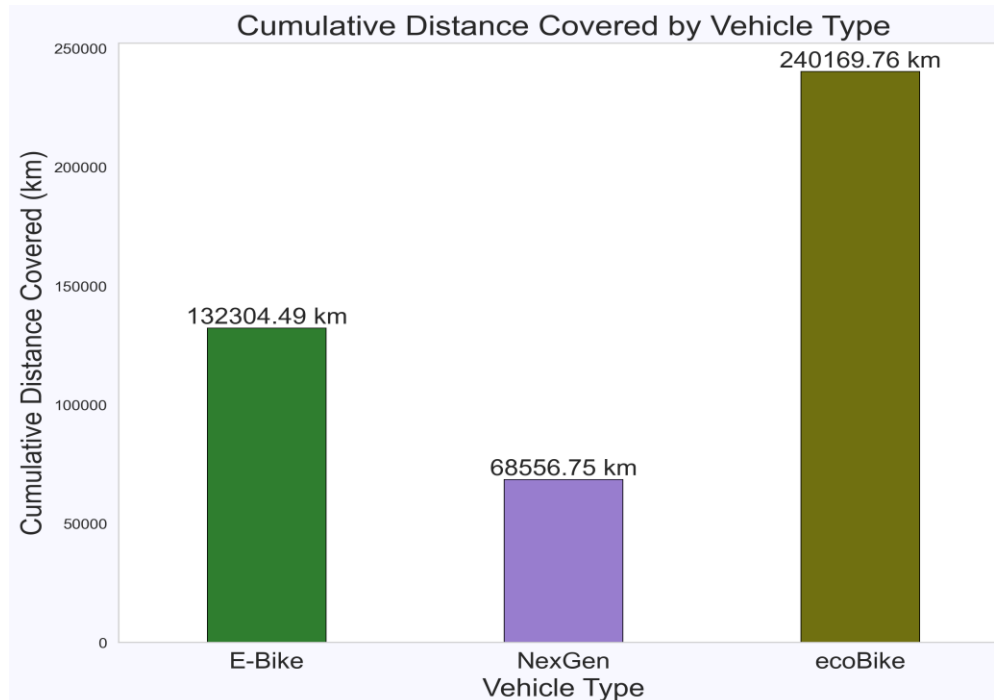**High-frequency users**: Having used bike share more than 10 times.
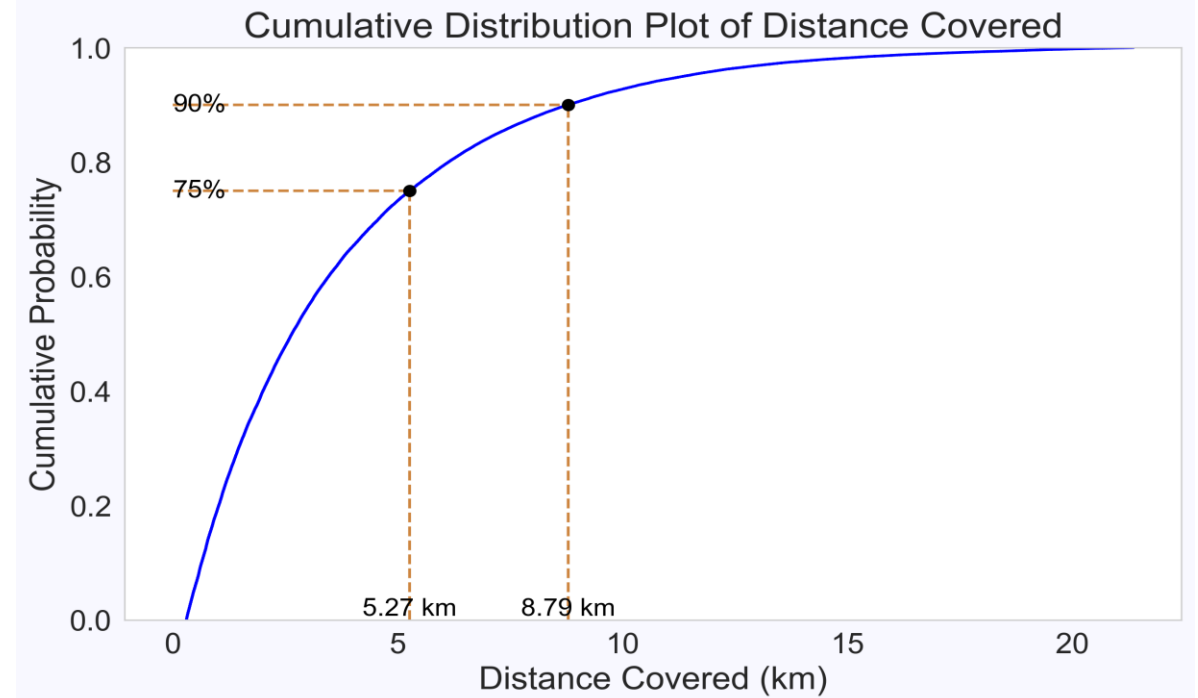**Medium-frequency users**: Having used bike share 5 to 10 times.
Low-frequency users: Having used bike share less than 5 times

Distance Covered

- The total distance covered on the bicycle from the pickup station to the drop station

Cumulative Distribution Plot of Distance Covered

Cumulative Distance Covered by Vehicle Type

Average Distance Covered by Vehicle Type

Rental Time

- The total ride time and pause time are considered as the rental time, and the user is charged for this duration.

Cumulative Distribution Plot of Rental Time

Cumulative Rental Time by User Frequency and Vehicle Type

Average Rental Time by Vehicle Type
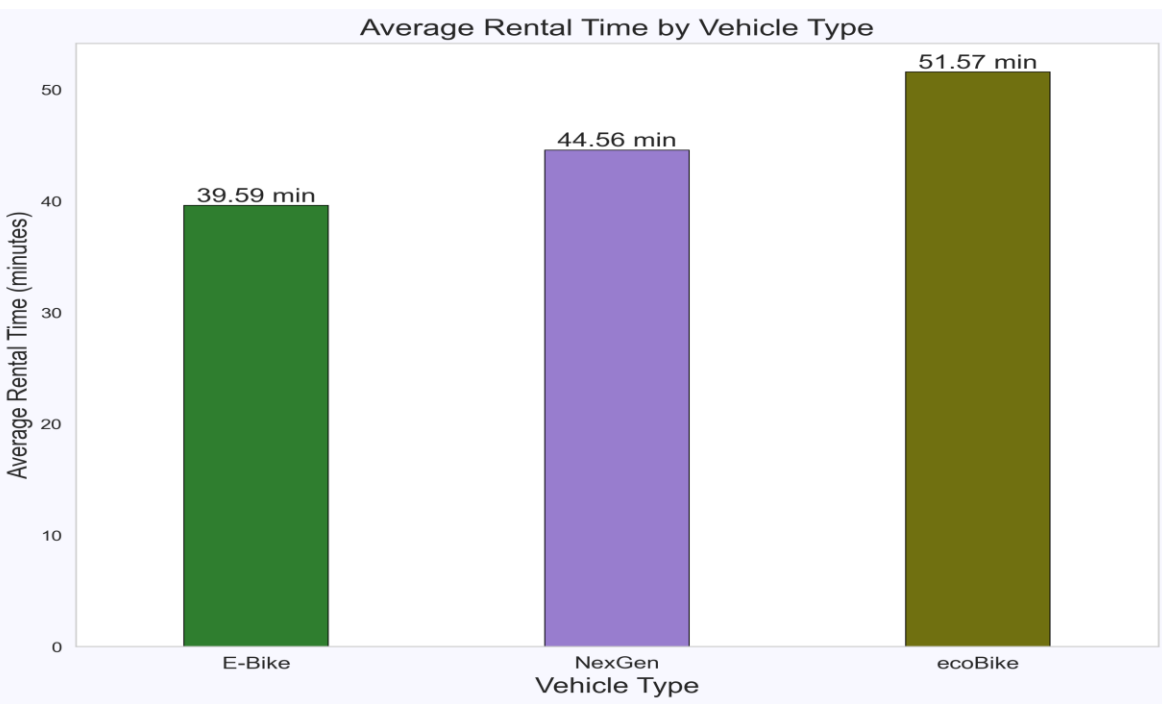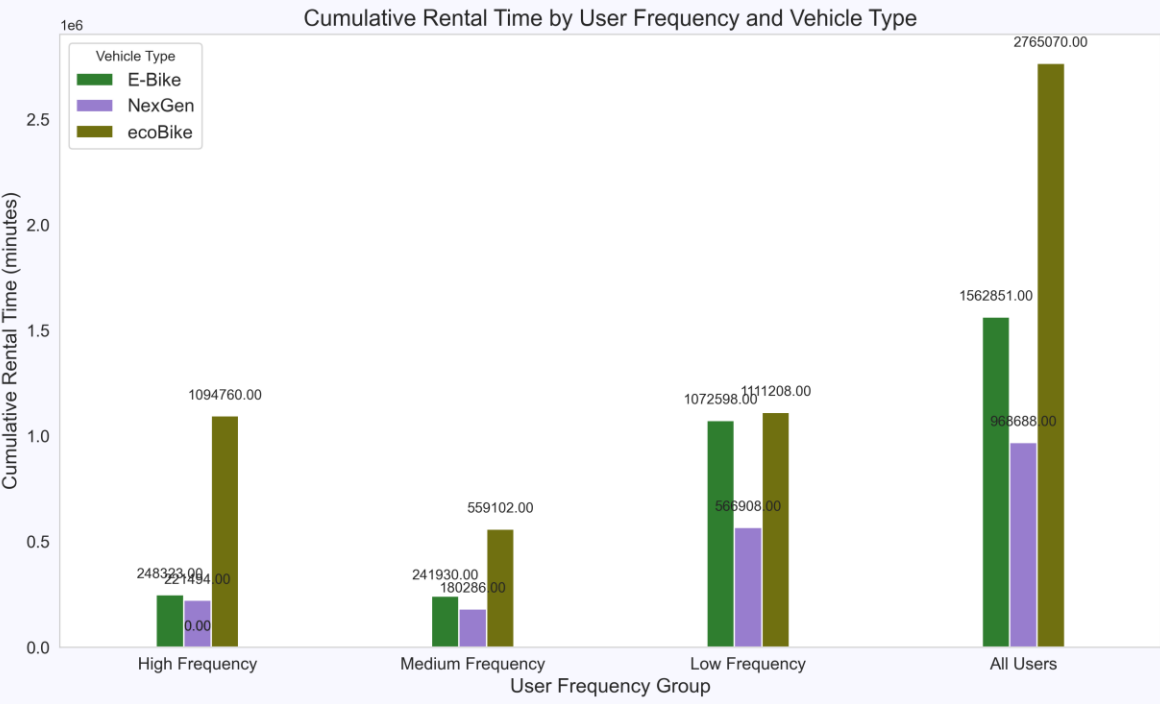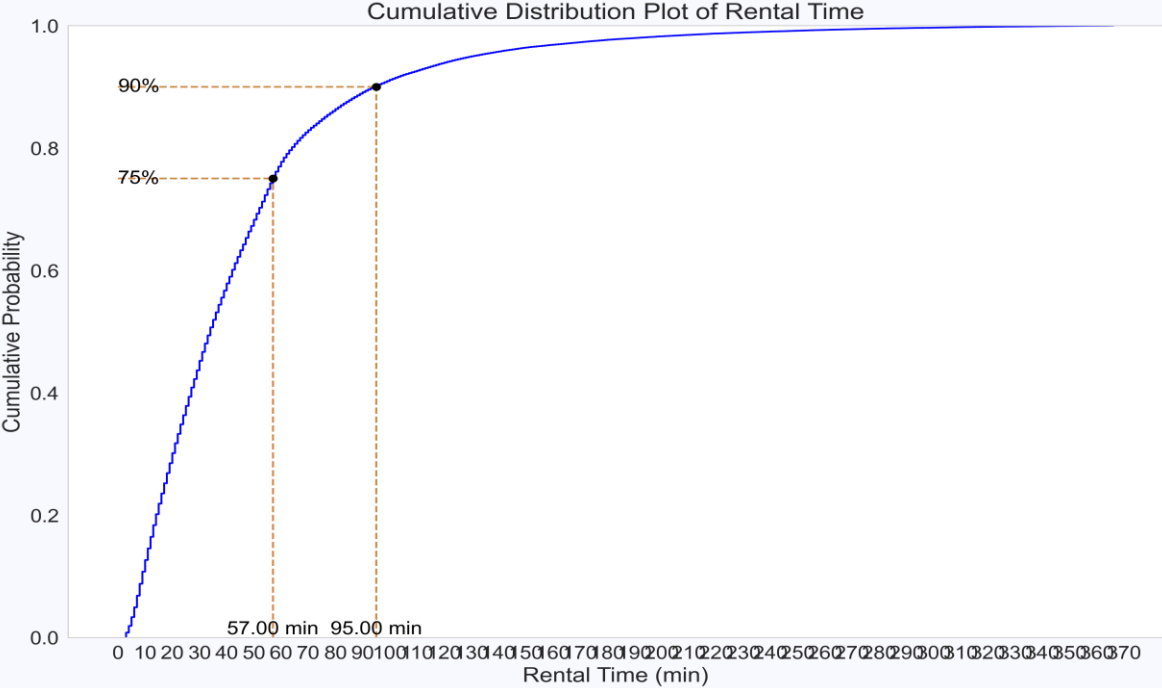
Pause Time

- 'Pause Time' captures the inactive part of the trip when the bicycle is locked and some other activity is performed.
- A trip with a higher 'Pause Time' may be associated with shopping purposes or some other reason requiring the rider to invest longer.

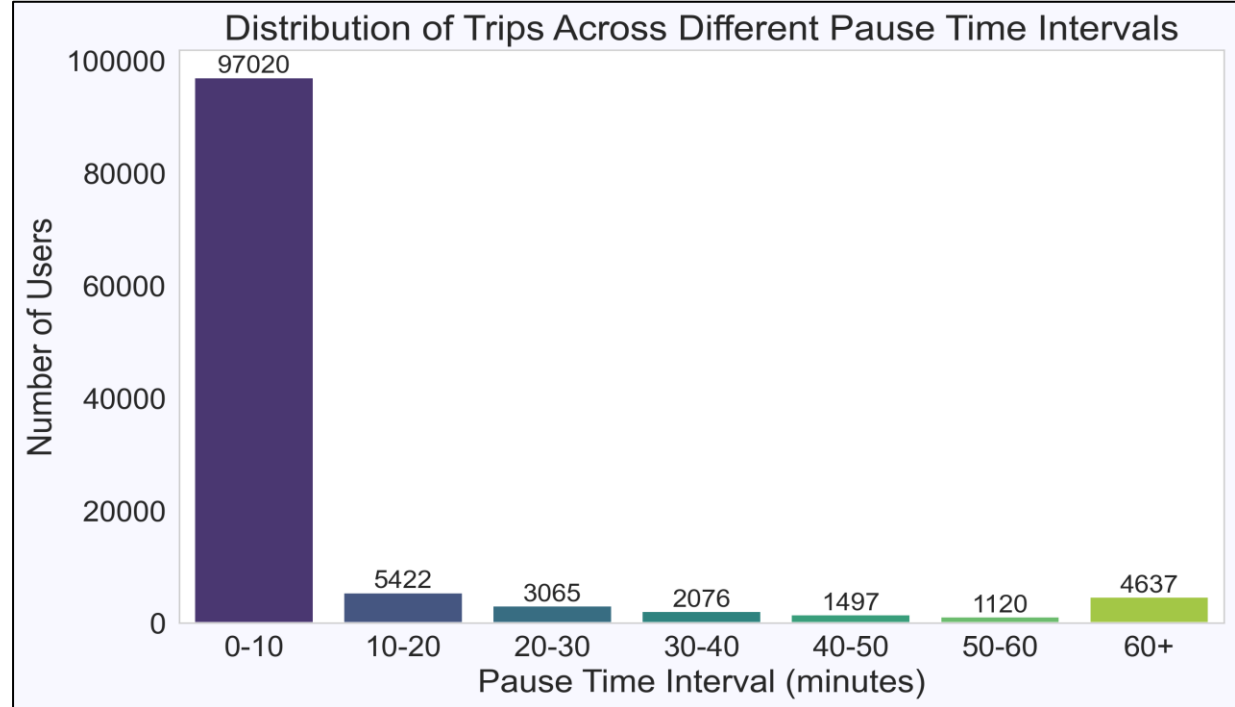Cumulative Distribution Plot of Pause Time

75th Percentile: 2.00 minutes

90th Percentile: 22.00 minutes

Number of Users in Each Pause Time Interval by User Frequency Category

User Frequency Category
- High Frequency Group
- Medium Frequency Group
- Low Frequency Group

Distribution of Trips Across Different Pause Time Intervals
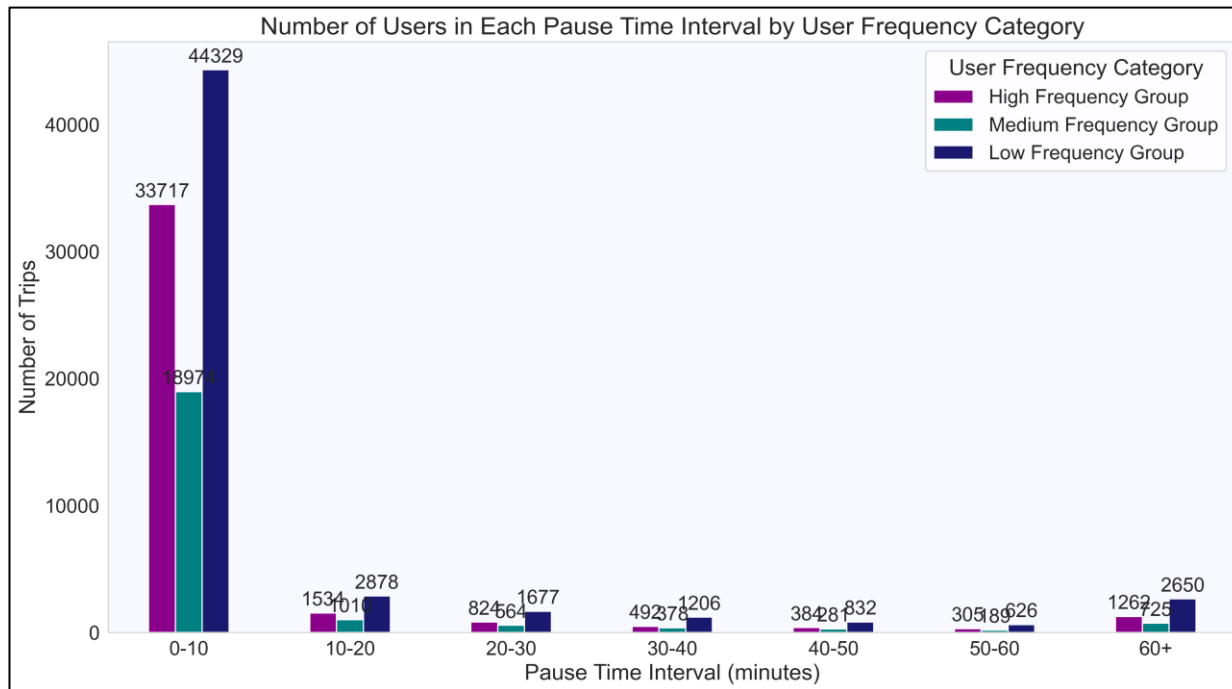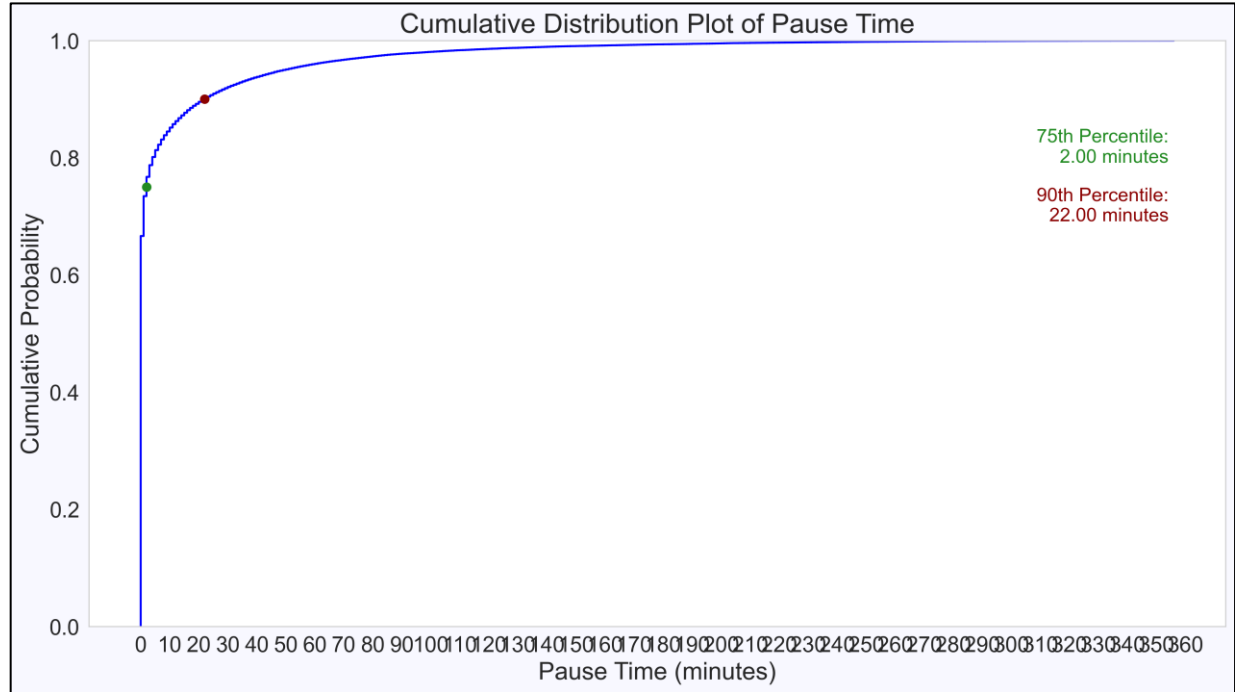
Comparing trips with and without 'Pause Time'

Mean Comparison

- Mean Distance Covered (km)
- Mean Ride Time (min)
- Mean Rental Time (min)

Median Comparison

- Median Distance Covered (km)
- Median Ride Time (min)
- Median Rental Time (min)
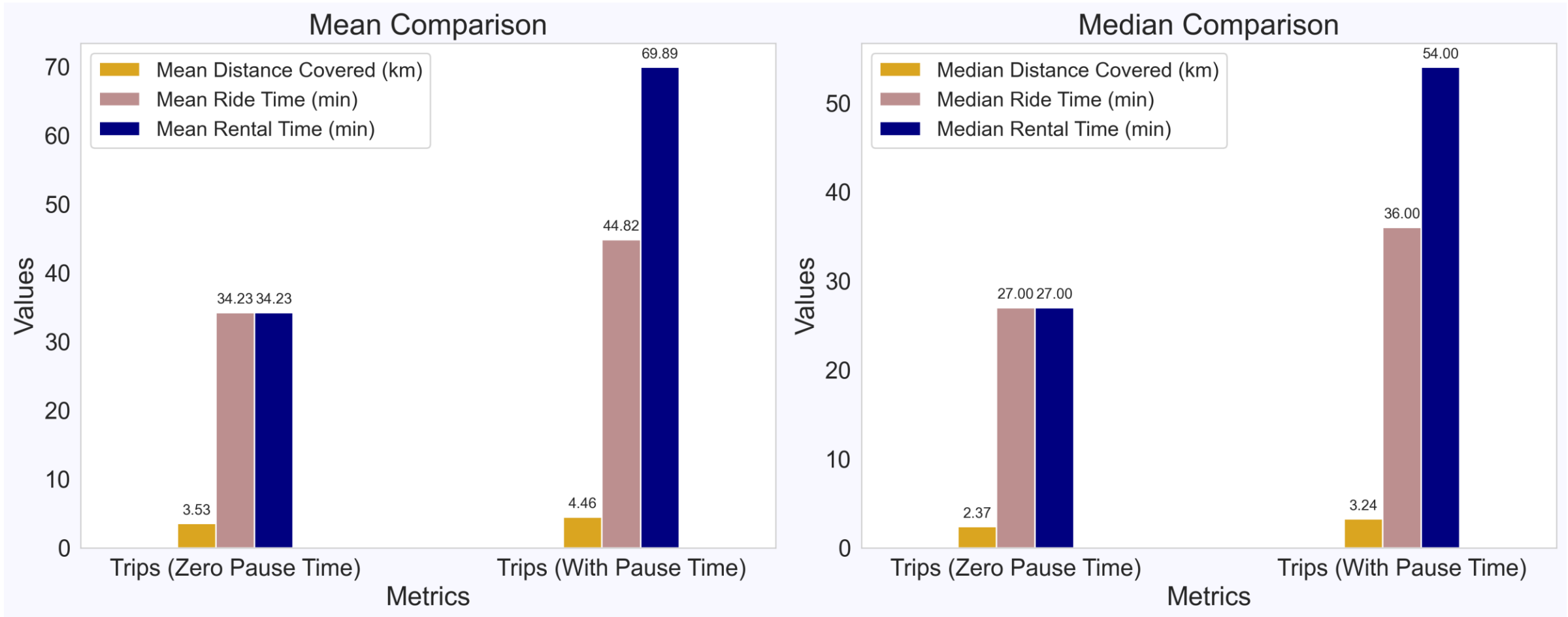
It was found that the average speed of trips with zero pause time and with some positive pause time were: 7.93 km/hr and 7.84 km/hr respectively.

Temporal Variation
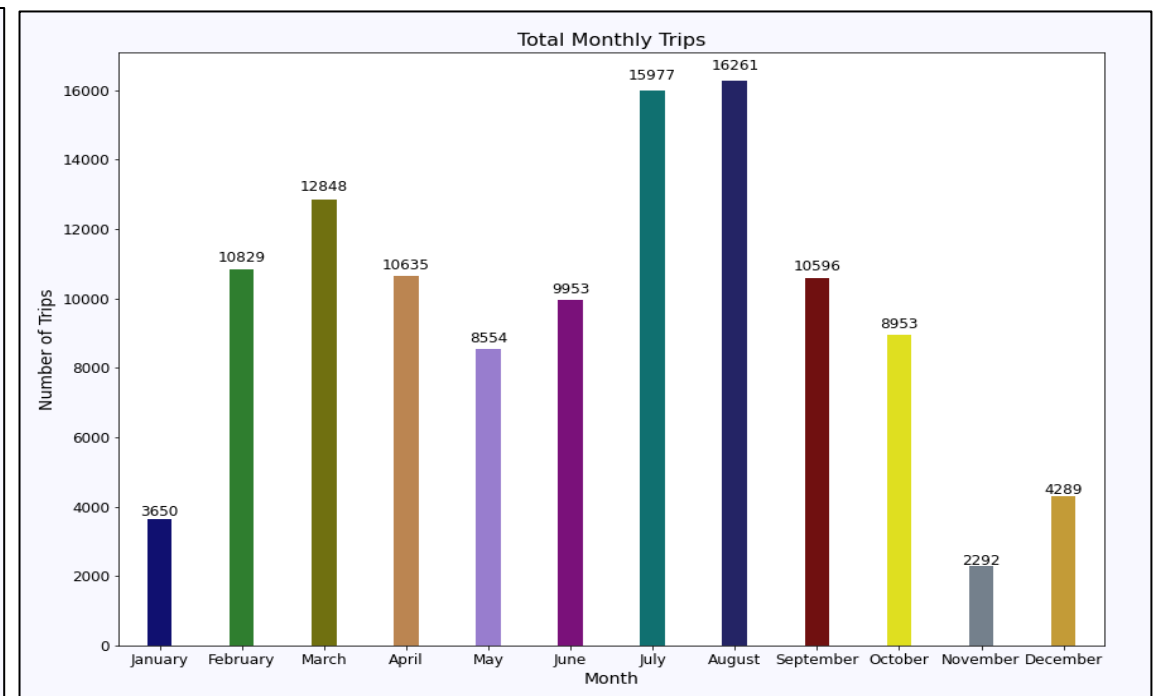
- It was found that the system saw the highest use on the weekends, and apart from that, it was also found that the average rental time and average distance covered on weekends was also higher.
  - The system saw a major dip in usage on Monday

Daily Hourly Variation of Trips

Average Distance Covered and Rental Time per Day of the Week

Total Monthly Trips
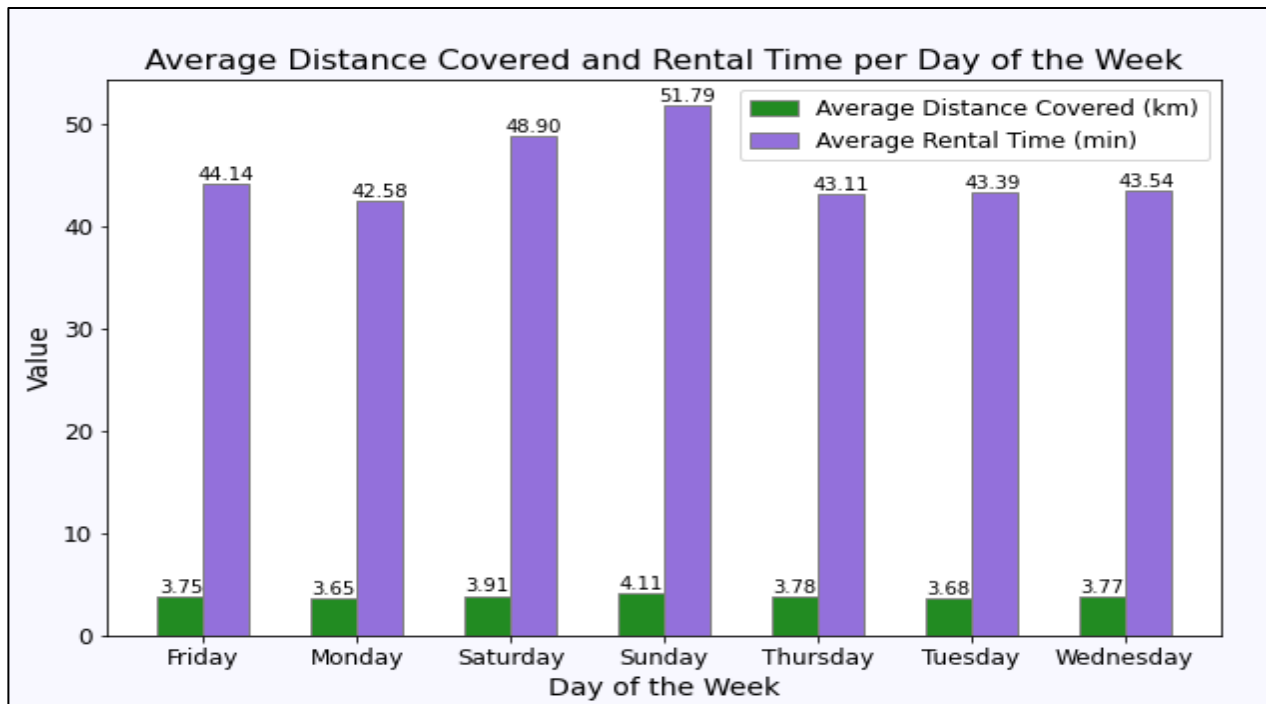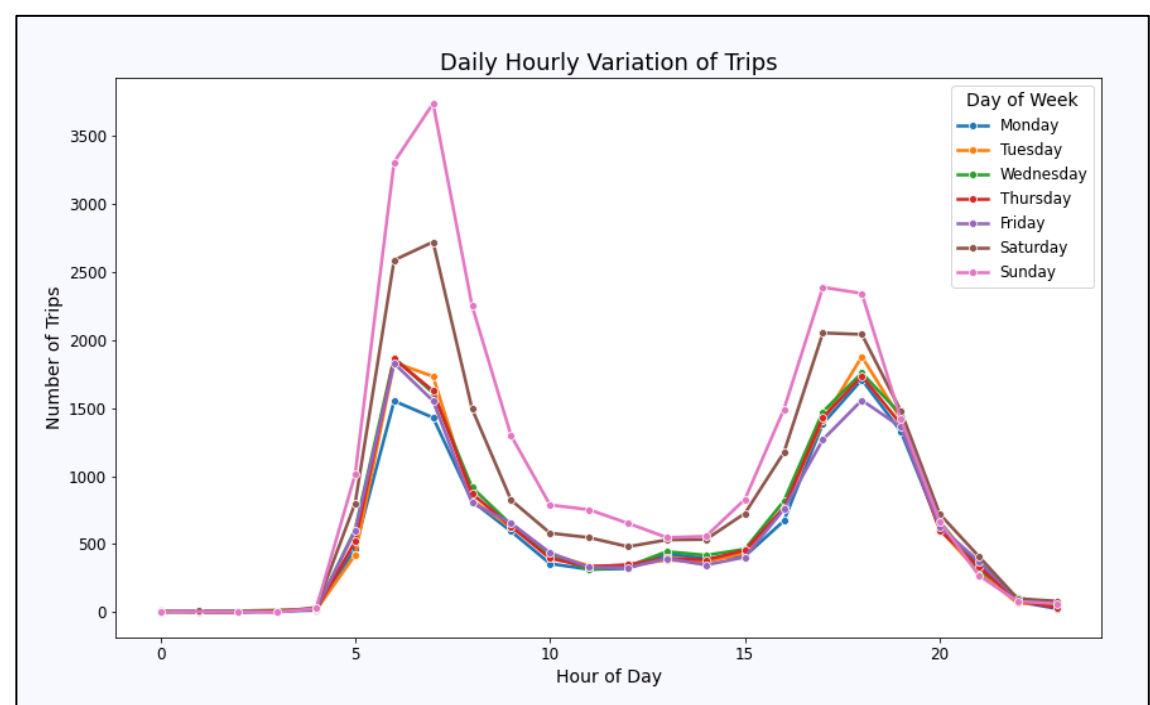
Loop Trips

- A trip that starts and ends at the same stations is classified as a loop trip.

- It was found that the data had 51186 records of loop trips, which came out to be 44.57%.

- The average estimates of distance covered, ride time, and rental time were 3.77 km, 42.6 min, and 52.1 min, respectively.

- Further, we found that the loop trips were higher in Commercial, Institutional, and Recreational spaces.

Daily Hourly Variation of Loop Trips

Distribution of Loop Trips by Day of Week
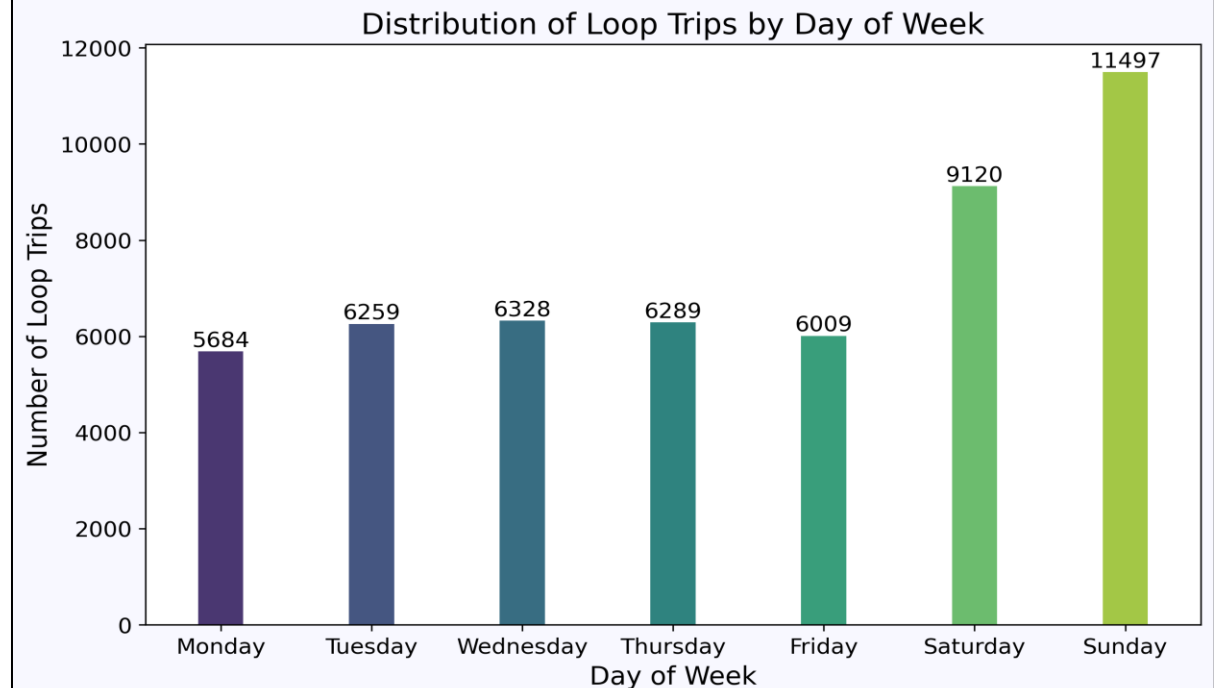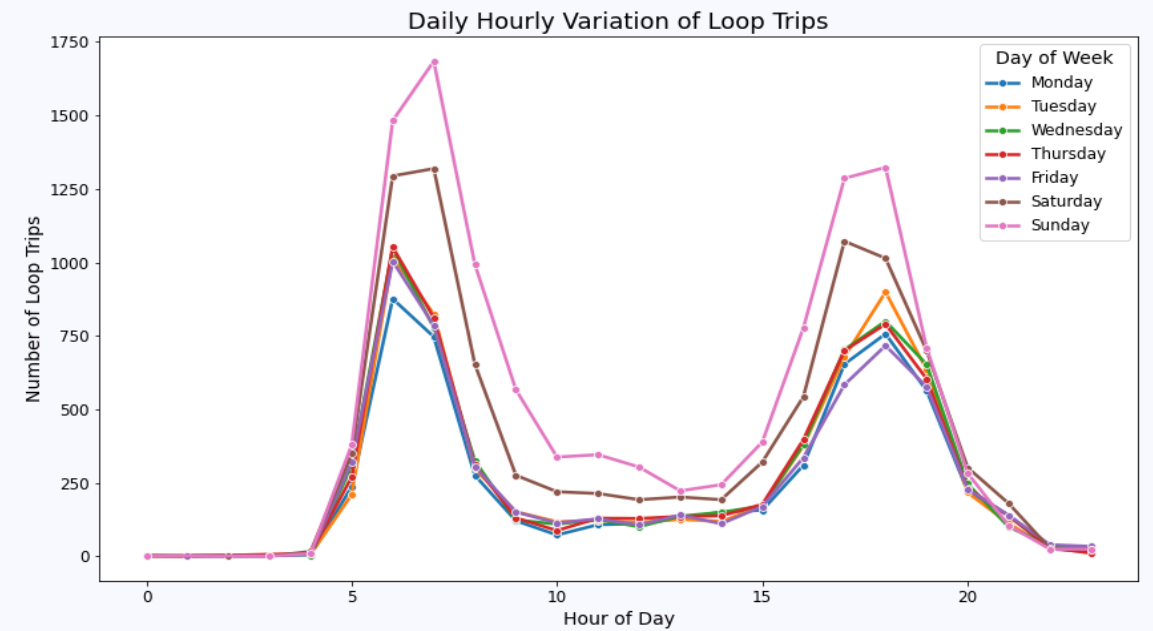
Catchment Estimation

"**Production Distance**": Considering a rental from a bike station, the production distance is the 85th percentile of all the trips starting from that station.

"**Attraction Distance**": Considering all the trips that end at a bicycle station, the attraction distance is the 85th percentile of all the trips that end at that station
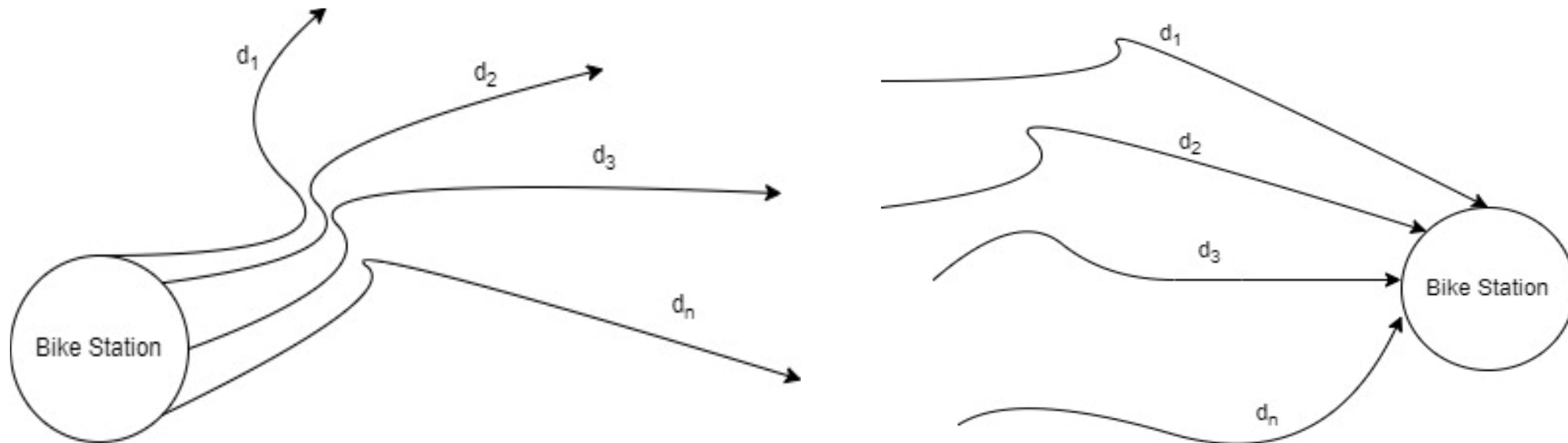
CONCLUSIONS

- The average trip length was found to be 3.84 km, and the average rental time was 46.12 min.

- 75% of the trips were found to be within a range of 5.2 km.

- The system's pricing policy, which varied across the three bike types, influenced user preferences. The ecoBike, being the most economical option, attracted the majority of trips, followed by the premium E-Bike, which is battery-powered and requires only occasional pedaling.

- Data revealed that 44.57% of all valid trips were loop trips, further suggesting that many users did not use the system for commuting.

- Temporal usage patterns revealed a bimodal distribution, with higher usage on weekends (Saturday and Sunday) than on weekdays. This reinforces the idea that the system is primarily used for recreational purposes by occasional users. Monthly usage trends declined during November, December, and January, likely due to the retreating monsoon, which brings rainfall to the city during these months.

- The mean production distance was 6.28 km, while the mean attraction distance was 6.22 km. Production distances ranged from 2.47 km to 10.67 km, while attraction distances ranged from 2.07 km to 10.66 km.

LIMITATIONS & FUTURE SCOPE

- One of the major limitations of the study was that we were not aware of the purpose of the trips.

- The pause time captured in the data is aggregate in nature, and with the current data, we are not aware of the purpose for which the user stops.

- The future scope of the study includes similar analysis based on trip data along with survey-based data, which can capture the demographics of the users and trip purposes
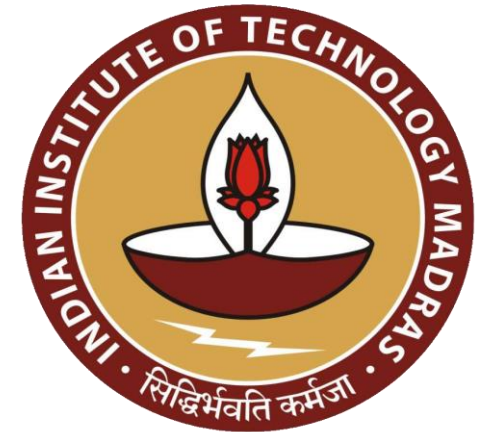
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