Taxi & Weather Insights: Understanding Taxi Demand Trends and Weather Impact

Dhaval Mulani (23230953)

Introduction

Understanding how weather affects travel demand is critical to improving urban transport and resource allocation. This study examines the effect of weather conditions—temperature, humidity, wind speed, and visibility—on taxi demand in New York City. The study aims to determine how these factors affect the frequency and duration of taxi rides, providing insights that can be used to improve the quality of transport services.

Used Data

Taxi Data

- **Source:** Kaggle
- **Description:** Contains details on daily aggregated taxi trips, including total trips, passenger counts, and average trip durations for 2019.
- **License:** Open Data Commons Public Domain Dedication and License (PDDL).
- **Structure:** 365 rows representing daily data, with columns for trip count, passenger count, and average trip time.

Weather Data

- **Source:** Visual Crossing
- **Description:** Daily weather metrics including temperature, humidity, wind speed, and visibility for New York City in 2019.
- **License:** Visual Crossing grants free academic use, provided proper credit is given.
- **Structure:** 365 rows with columns for temperature (min/max), humidity, wind speed, and visibility.

Compliance

Weather data provided by Visual Crossing (`https://www.visualcrossing.com/`).

Analysis

The analysis began with the cleaning and editing of the data: the 2019 taxi data was extracted and added to the weather data using a common date format. Missing weather data were inserted in the foreground to maintain accuracy. Exploratory analysis, including summary statistics and visualization, was conducted to identify patterns.

Weekday vs. Weekend Trends

The Figures 1 and 2 showed that the demand for taxis is higher on weekdays. This reflects their reliance on taxis to get to work. A few trips were recorded on weekends, but trips were on average longer, possibly due to leisure trips. Figures 1 and 2 illustrate these patterns, highlighting the dominance of weekday demand.

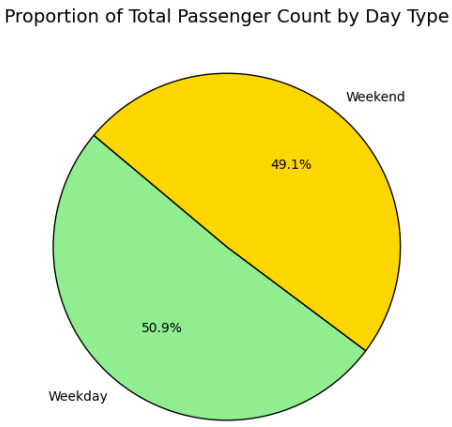

Figure 1: Total Passenger Count by Day Type

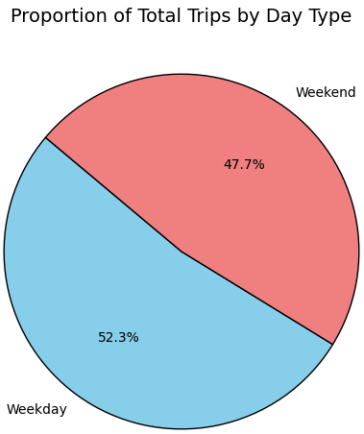

Figure 2: Total Trips by Day Type

Weather Impact Analysis

- **Temperature:** Mild temperatures (10–20°C) had the highest number of passengers, while extreme cold or heat reduced demand.
- **Wind speed:** Low wind speeds (< 15 km/h) encouraged the use of taxis, while strong winds (> 25 km/h) discouraged them. These features can be seen in Figures 3 and 4, which show clear peaks in good weather.

Correlation Analysis

A heat map (Figure 5) showed a significant relationship between weather conditions and taxi demand. Warmer days and better visibility had a positive effect on passenger numbers, while strong winds and cold water had the opposite effect.

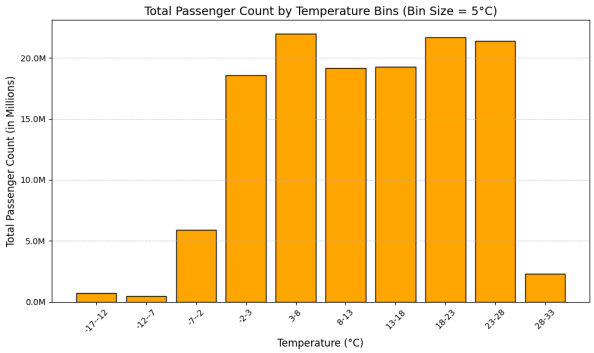

Figure 3: Total Passenger Count by Temperature

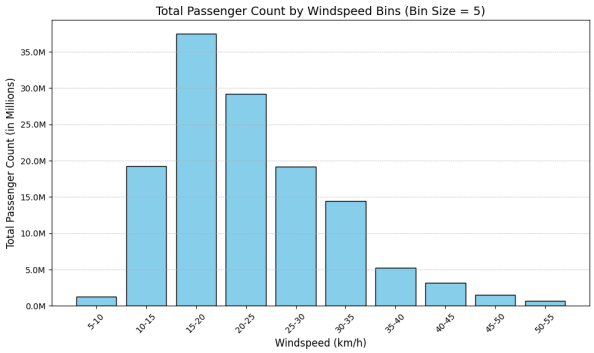

Figure 4: Total Passenger Count by Windspeed

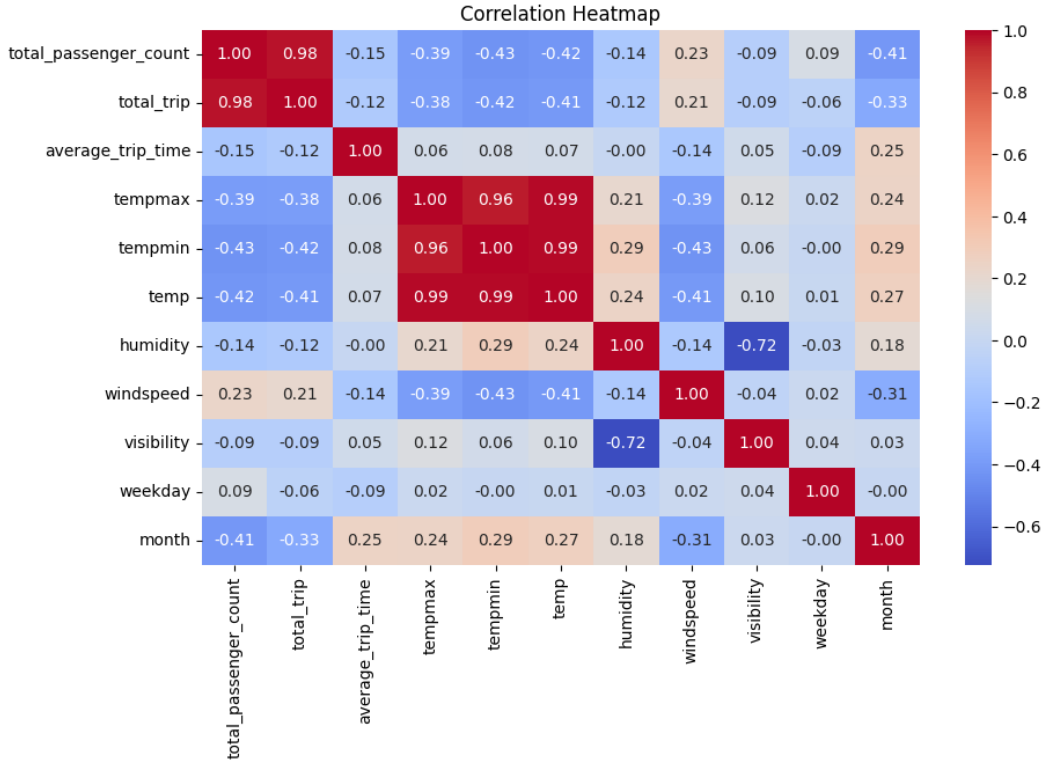

Figure 5: Correlation Heatmap

Seasonal and Monthly Patterns

The monthly trends Taxi passenger numbers are high in January, drop in February, and then rise again, peaking in October. The temperature steadily increases from January, reaching its highest in July, and then drops toward December. Surprisingly, even though temperatures are high in summer (July and August), passenger numbers go down, possibly because people take vacations or travel less for work. This shows that weather affects taxi demand, but other factors like work and holidays also play a role.

Trip Duration Trends

Average travel duration was shortest in January, increased throughout the year, and peaked in September. This trend continued during the last months of the year, and may have been influenced by seasonal events or changes in transportation patterns. Figure 7 shows these examples.

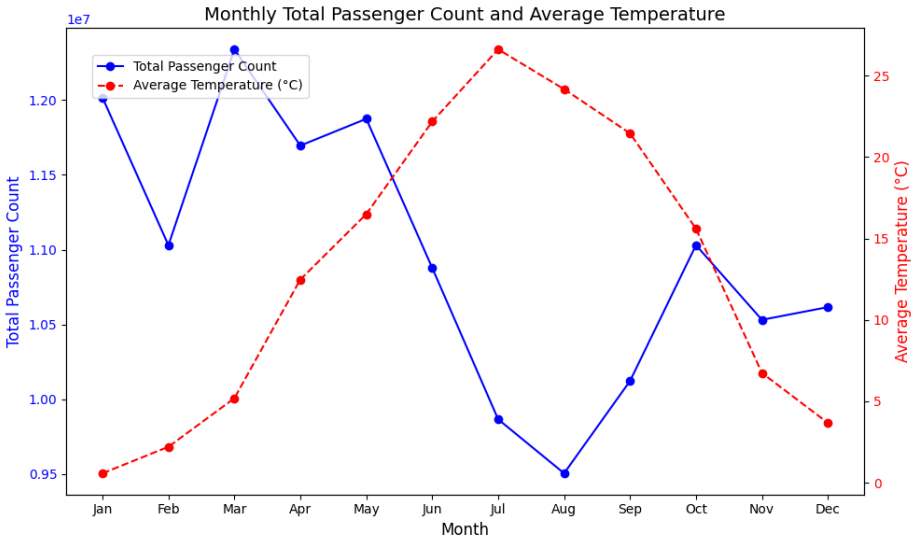

Figure 6: Monthly Total Passenger Count and Average Temperature

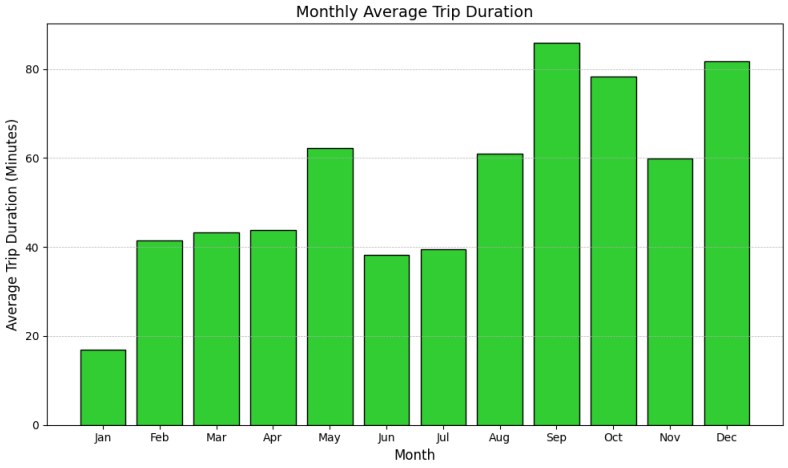

Figure 7: Monthly Average Trip Duration

Conclusions

Weather greatly affects the demand for taxis. Moderate temperatures (10–20°C) and wind speeds < 15 km/h encourage higher usage. Conversely, extreme weather conditions, such as extreme heat and strong winds, reduce demand. While weather is an important factor, other influences such as schedules and holidays also play a role in the demand.

Future research could combine other variables such as public holidays or traffic congestion to gain a more detailed understanding of taxi demand dynamics.