Capital Bikeshare Demand Analysis: Optimize for Better Resource Allocation

Sharaf Makahleh

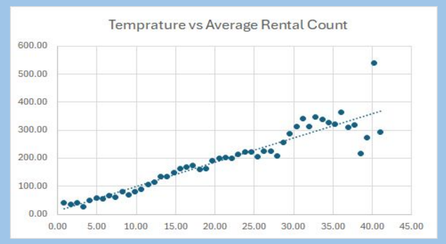
Highlights

- Understanding environmental and temporal effects is key to optimizing bike-sharing operations.
- Exploratory Data Analysis (EDA) reveals clear usage patterns influenced by weather, day of the week, and season.
- Findings can drive smarter resource allocation, improve customer satisfaction, and reduce operational costs.

Background

Urban bike-sharing systems need dynamic strategies for distributing bikes, staffing personnel, and maximizing user satisfaction. Understanding when and under what conditions rentals peak is crucial for operational efficiency and profitability.

Weather and time-of-day are strong demand drivers for cycling rentals, suggesting dynamic resource allocation can have a significant impact on operations.



Data

The dataset contains hourly rental records from Capital Bikeshare (2011–2012), with features such as: datetime, weather info, rider type, etc…

Model

The analysis itself was not predictive modeling but focused largely on Exploratory Data Analysis (EDA). The decision to use EDA was deliberate, prioritizing interpretability, transparency, and actionability over predictive performance. The main performance goals were to identify obvious patterns, trends, and correlations between bike usage versus weather, time of day, and season, which can guide follow-on predictive modeling or operational strategy

Data

Capital Bikeshare system, 2011–2012 hourly rental data (Washington, D.C.)

Key variables:

Time-based

- Hour of day Day of week, Seasor, Holiday

Weather

- Temperature, Humidity Windspeed, Weather situation

User Type

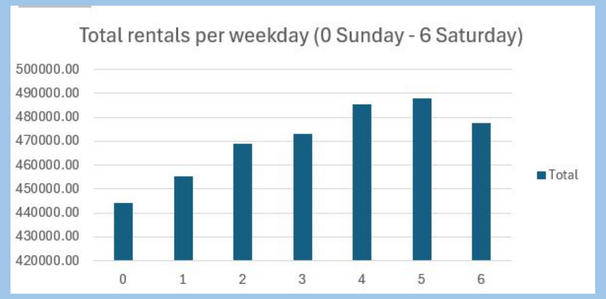
- Cleaned missing values
- Created visualizations

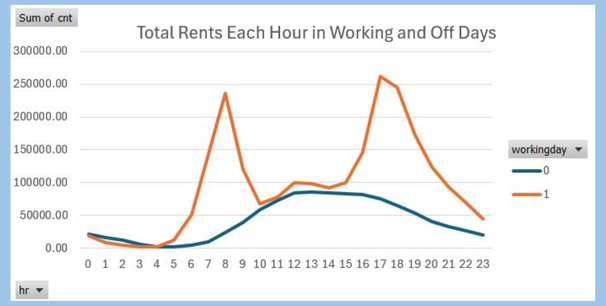
Key Findings

User Behavior Insights:
Registered users are commute-focused
Casual users: recreational

Operational Recommendations
Allocate more bikes during morning and evening rush (weekday registered user)
Prepare for higher casual demand during weekends and good weather

Business Value
Improve bike availability based on weather/time patterns and service planning





People rent bikes much more often when the weather is good, especially during warmer seasons. The working days shows much more traffic in a bimodal distribution around the time of work commute.