

Data-Driven Market Analysis for Bike Rental Promotions

Introduction

The primary objective of this analysis is to leverage Seoul Bike rental data to uncover insights into customer behaviour, identify seasonal patterns, and assess the impact of weather conditions on bike rentals. By answering key analytical questions related to bike rentals, this report aims to provide actionable insights that can guide operational and strategic decisions for enhancing the bike rental system. By analyzing the rental data, a fair understanding on d how customers interact with the service, identify peak usage periods, and quantify how external factors, such as weather conditions, influence rental patterns.

Data Overview

Data set was acquired from Seoul Bike Sharing Demand [Dataset]. (2020). UCI Machine Learning Repository. <https://doi.org/10.24432/C5F62R>.

The dataset provides valuable information on bike rentals, weather conditions, seasons, holidays, and functioning days.

Purpose of Date Conversion and Feature Extraction

The date conversion and feature extraction process is a critical step in enhancing the analytical capabilities of the dataset. By transforming the original Date column into specific time-related features, we enable a deeper understanding of temporal patterns within the data. This systematic breakdown supports a range of analytical objectives and offers the following benefits:

1. Understanding Weekly Patterns:

Extracting the day of the week provides valuable insights into recurring weekly cycles. By analyzing trends across weekdays and weekends, we can identify whether certain days exhibit higher activity levels or unique behavioral patterns, such as peak usage during workdays or increased demand over weekends.

2. Tracking Monthly and Annual Trends:

Isolating month and year components allows for the exploration of seasonal and long-term trends. This approach is particularly effective in identifying fluctuations that may align with external factors such as weather changes, holidays, or other cyclical events, providing a comprehensive view of time-driven variations.

3. Simplifying Data for Targeted Analysis:

The decomposition of the Date column into separate, easily interpretable features enhances the clarity and usability of the dataset. This granularity enables focused

analyses on specific time intervals, such as comparing weekday versus weekend activity or examining seasonal peaks and troughs.

Through these transformations, we establish a robust foundation for time-based analysis, enabling the identification of meaningful patterns and trends. These insights are pivotal in understanding user behaviour, optimizing operations, and informing strategic decisions.

1. Inspect the Date Column:

The format of the Date column is examined to ensure it aligns with expected standards (e.g., YYYY-MM-DD). This step confirms the data's readiness for conversion.

2. Convert the Date Column to a Datetime Object:

The Date column is converted into a datetime object using `pd.to_datetime()`. This transformation allows for efficient extraction of temporal features such as year, month, day, and weekday.

3. Extract Time-Related Features:

New columns, such as Year, Month, Day, Weekday, and Day_Name, are created from the datetime object:

- Year captures annual trends.
- Month identifies seasonal patterns.
- Day isolates daily fluctuations.
- Weekday distinguishes weekdays from weekends and captures weekly cycles.
- Day_Name provides a human-readable format for easier interpretation.

4. Add Additional Features (Optional):

Additional features, like `Is_Weekend`, are derived to categorize weekdays and weekends, supporting specific analyses on customer behavior during these intervals.

5. Inspect the Updated Dataset:

The updated dataset is reviewed to confirm that all new features have been added correctly and are ready for analysis.

6. Aggregate Data for Analysis:

The dataset is grouped and analyzed by the extracted features to uncover trends:

- Weekly trends, identifying high and low activity days.
- Monthly patterns, revealing seasonal fluctuations.

These steps substantiate the value of date conversion and feature extraction, laying the groundwork for meaningful time-based insights.

Understanding the Impact of Weather Conditions on Bike Rentals

Purpose:

This analysis aims to explore how temperature influences bike rental demand by identifying

patterns across different temperature categories (e.g., "Too Cold," "Moderate," "Too Hot"). By segmenting temperature ranges and examining average bike rentals in each range, we can uncover actionable insights into customer preferences under varying weather conditions.

Analysis Approach

1. Binning Temperature Data:

To simplify interpretation, temperature values will be segmented into bins representing small, consistent intervals. This segmentation facilitates the detection of trends in bike rentals across different temperature ranges, offering a granular view of the data.

2. Categorizing Temperature Ranges:

Temperature bins will be grouped into broader categories, such as:

- **"Too Cold"**: Extremely low temperatures likely to deter bike rentals.
- **"Moderate"**: Comfortable conditions expected to encourage high demand.
- **"Too Hot"**: High temperatures that may discourage rentals.

These categories provide a context for understanding customer comfort levels and their effects on rental behavior.

3. Calculating Average Rentals per Temperature Bin:

The dataset will be aggregated to compute the mean number of bike rentals within each temperature bin. Focusing on averages minimizes the influence of outliers and highlights general trends in rental demand for different temperature ranges.

4. Color-Coding and Visualizing Results:

To enhance visual clarity:

- A bar chart will be used, with distinct colors representing each temperature category (e.g., blue for "Too Cold," green for "Moderate," and red for "Too Hot").
- A legend will be included to simplify interpretation and enable quick comparisons between categories.

5. Adjusting Tick Labels for Readability:

To ensure the chart remains clear:

- The number of x-axis tick labels will be reduced and rotated, making them more readable.
- Data labels indicating average rentals will be added on top of each bar, allowing immediate insights without further calculations.

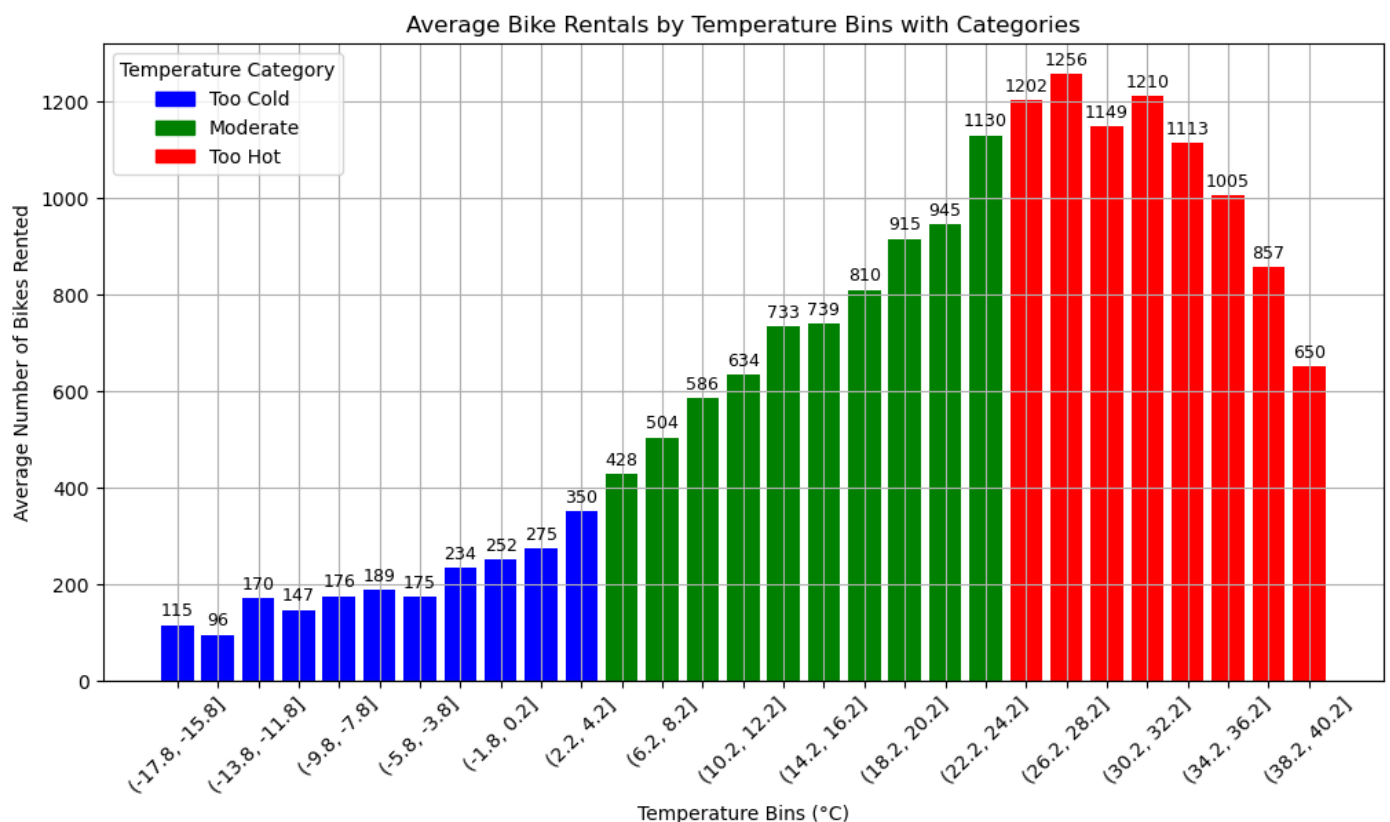
This structured analysis is expected to reveal:

- **Optimal Conditions**: Temperature ranges associated with the highest bike rental demand.
- **Demand Drops**: Thresholds at which extreme weather conditions (cold or hot) begin to deter customers.

- **Seasonal Trends:** Correlations between temperature-driven patterns and seasonal usage behaviors.

These insights will offer valuable guidance for:

- **Operational Strategies:** Adjusting bike availability and maintenance schedules to align with demand.
- **Marketing Campaigns:** Promoting services during temperature conditions with peak demand.
- **Inventory Planning:** Ensuring adequate resources are allocated during favorable weather conditions.



Understanding the Impact of Weather (Temperature and Rainfall) on Bike Rentals

This analysis investigates the effects of temperature and rainfall on bike rental demand, aiming to identify behavioral patterns under varying weather conditions. By categorizing these weather variables into meaningful bins and calculating average rentals within each category, we aim to uncover insights that can inform operational and strategic decisions.

Analysis Approach

1. Temperature Analysis:

- **Binning Temperature Data:**

Temperature values are grouped into predefined bins representing categories such as "Too Cold," "Moderate," and "Too Hot." These categories provide a framework for understanding comfort levels and their influence on rental activity.

- **Calculating Average Rentals per Temperature Bin:**

By aggregating data within each temperature bin and computing the mean rentals, the analysis highlights trends while reducing the impact of outliers.

2. Rainfall Analysis:

- **Binning Rainfall Data:**

Rainfall is segmented into four intuitive categories:

- **No Rain:** No measurable precipitation.
- **Light Rain:** Minimal precipitation, unlikely to disrupt outdoor activities.
- **Moderate Rain:** Noticeable precipitation, potentially impacting comfort.
- **Heavy Rain:** Significant precipitation, likely to deter rentals.

- **Calculating Average Rentals by Rainfall Category:**

Mean bike rentals are computed for each rainfall category, revealing the typical rental volume associated with each precipitation level.

Why Use the Average as a Metric?

The **average** is an ideal metric for this analysis due to its ability to:

- **Reduce Noise from Outliers:** By smoothing fluctuations caused by extreme weather events, averages provide a stable representation of typical behavior.
- **Highlight Central Trends:** Averages reveal the general rental behavior under each weather condition, making it easier to identify key patterns.
- **Facilitate Category Comparisons:** Consistent averages across categories (e.g., "Moderate Rain" vs. "Heavy Rain") support clear and actionable insights.
- **Aid Operational Planning:** Averages allow planners to anticipate rental demand under typical conditions, guiding decisions on resource allocation and promotions.

By exploring temperature and rainfall's influence on bike rentals, the analysis is expected to uncover:

- **Optimal Conditions:** Weather conditions, such as "Moderate Temperature" and "No Rain," associated with peak rental demand.
- **Demand Drops:** Conditions like "Too Hot," "Too Cold," or "Heavy Rain," where rentals decline significantly.
- **Actionable Strategies:** Insights for targeted promotions and operational adjustments, such as increasing bike availability during favorable weather or offering incentives during less favorable conditions.

Weekly Bike Rental Demand Analysis

Grouping by Weekday:

- The dataset is aggregated by days of the week to calculate the total number of bike rentals for each day.
- Days are ordered chronologically from Monday to Sunday for improved readability and consistency with calendar patterns.
- This grouping allows us to observe trends in bike rental demand across the week, identifying peak and low-demand days.

2. Categorizing Demand Levels:

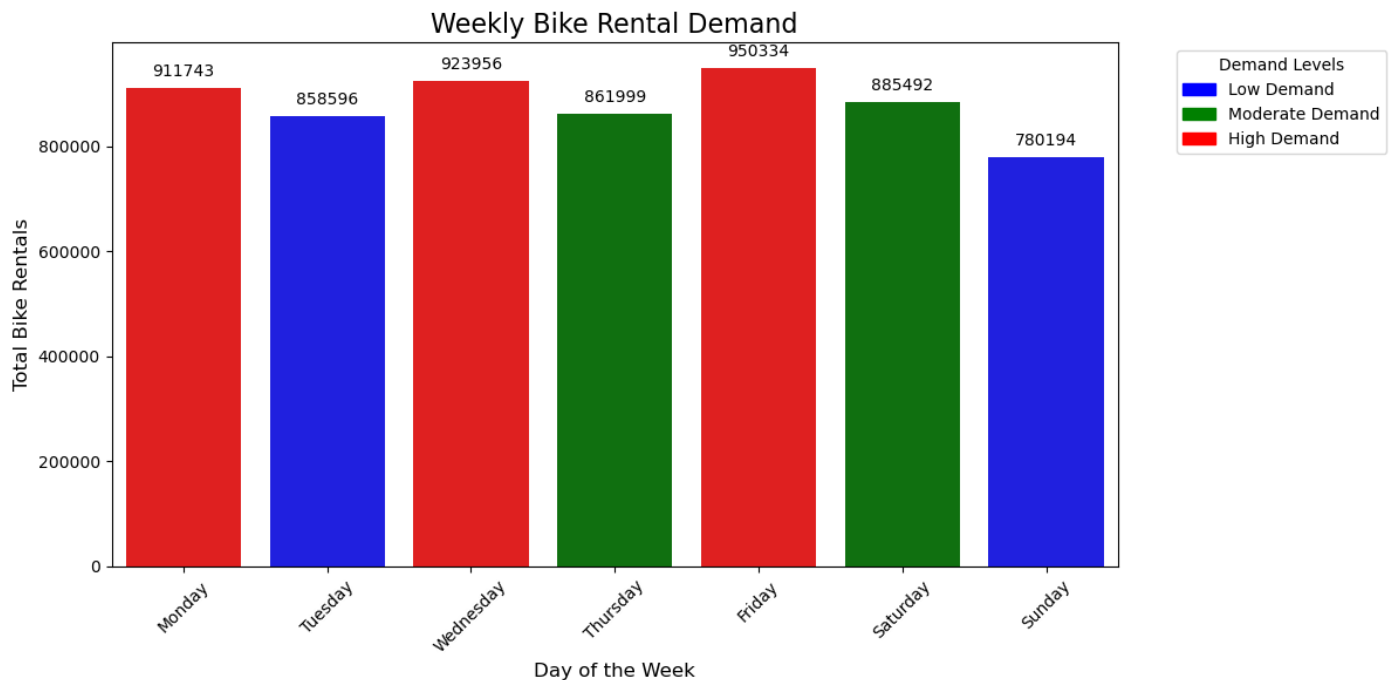
- Each weekday is classified into one of three demand categories based on predefined rental thresholds:
 - Low Demand: Days with rentals below the lower threshold.
 - Moderate Demand: Days with rentals within a typical range, between the lower and upper thresholds.
 - High Demand: Days with rentals exceeding the upper threshold, indicating peak usage.

Visualization

- **Bar Chart:**
 - A bar chart will display total rentals for each day of the week, with bars color-coded by demand category.
 - The x-axis will represent days of the week (Monday to Sunday).
 - The y-axis will show the total number of bike rentals.
 - Adding numerical labels above each bar ensures quick insights into the exact rental numbers for each day.
- **Legend:**
 - A legend will clarify the meaning of each color (Blue, Green, Red), making the chart intuitive and easy to interpret.
- **Operational Planning:**
 - Increase bike availability on high-demand days and optimize fleet distribution.
 - Schedule maintenance during low-demand days to minimize service disruptions.
- **Promotional Campaigns:**
 - Target marketing efforts on low-demand days to boost rentals.

- Offer weekday discounts to attract commuters or weekend packages for leisure riders.

This approach provides a comprehensive view of weekly rental demand, supporting both operational efficiency and customer satisfaction.



Seasonal Bike Rental Trends

Data Analysis Approach

1. Grouping by Season:

- The dataset is aggregated by seasons to calculate the total number of bike rentals within each season.
- Seasons are arranged in chronological order for clarity and better alignment with the annual cycle:
 - Autumn
 - Spring
 - Summer
 - Winter
- This grouping enables the identification of broad seasonal patterns in rental demand.

2. Categorizing Seasonal Demand Levels:

- Each season is classified into one of three demand categories based on predefined thresholds for total rentals:

- Low Demand: Total rentals fall below the lower threshold, reflecting less favorable conditions for biking.
- Moderate Demand: Rentals fall within a typical range, indicating balanced demand.
- High Demand: Rentals exceed the upper threshold, signaling peak demand periods.

3. Assigning Colors for Visualization:

- To enhance visual representation, each demand category is assigned a specific color:
 - Blue: Low Demand
 - Green: Moderate Demand
 - Red: High Demand

