Seoul Smart Mobility

Weather Impact and Rental Trend Analysis

Project Title- Seoul Smart Mobility: Weather Impact and Rental Trend Analysis

Project Summary-

This project focuses on analyzing Seoul's public bike-sharing system using Power BI. The goal is to uncover key insights about bike rental patterns across different seasons, weather conditions, and time periods. The dataset includes information such as date, hour, temperature, humidity, rainfall, and rental count. Through this analysis, the project aims to help city planners and transport departments understand when and why people rent bikes more, and how factors like temperature, humidity, and rainfall influence public bike usage.
Interactive dashboards and KPIs are used to provide a clear, data-driven view of the overall rental behavior throughout the year.

Problem Statement-

The Seoul city government provides public bikes for sustainable urban mobility. However, understanding how external factors (like weather and time) affect bike rentals is difficult using raw data.
The main problem is identifying patterns and relationships between environmental conditions and rental demand — without an analytical dashboard, decision-makers cannot easily determine:

- Which seasons or hours have peak demand
- How weather impacts the number of rentals
- Which days show lower or zero activity

Therefore, there is a need for a visual and analytical dashboard that provides meaningful insights for better planning and management.

Objective-

The primary objectives of this Power BI project are:

1. To analyze and visualize **bike rental patterns** by day, hour, and season.
2. To study the **impact of temperature, humidity, and rainfall** on total bike rentals.
3. To identify **peak rental hours** and functioning days.
4. To compare **seasonal trends** and understand weather influence on demand.

5. To create an **interactive Power BI dashboard** that supports data-driven decision-making.

Abstract

This project presents a comprehensive analysis of the Seoul Bike Sharing System using Microsoft Power BI. The aim is to explore how different factors such as season, temperature, humidity, rainfall, and time affect the number of rented bikes in Seoul city.

The dataset contains hourly rental records along with various weather conditions. The data was cleaned, transformed, and enriched using Power Query, and several DAX measures were created for deeper insights.

Interactive dashboards were designed to visualize trends such as seasonal performance, hourly usage, weather impact, and functioning days. The report highlights that bike rentals increase during summer and moderate temperatures, while rainy and colder days show a decline in usage.

Overall, this Power BI dashboard helps in understanding the relationship between weather and rental demand, which can assist city planners and transportation departments in improving resource management, bike availability, and promoting eco-friendly travel.

Conclusion –

This project demonstrates the power of data visualization in converting raw datasets into meaningful, actionable insights.

Tools and Technologies Used

This project was developed using the following tools and technologies:

Tool / Technology	Purpose / Use
Microsoft Power BI	The main tool used for data visualization, dashboard creation, data transformation (Power Query), and DAX-based calculations.
Microsoft Excel	Used for initial data inspection, understanding the dataset, and verifying basic data values before importing into Power BI.
CSV File (Dataset)	The dataset containing Seoul bike rental information was provided in CSV format and imported into Power BI for analysis.
Microsoft Word	Used for preparing the final project documentation and report.

The complete analysis, data modeling, and dashboard design were performed in **Power BI**.
Excel was used only for checking the data quality, while **Word** was used to create the final written report.

Data Description and Preparation

Dataset Overview-

The dataset used in this project is the Seoul Bike Sharing Data, which contains hourly records of bike rentals along with weather-related information such as temperature, humidity, wind speed, visibility, rainfall, and more.
The dataset originally contained 8,760 rows (representing each hour of the year) and 14 columns before transformation.
The primary objective of this dataset is to analyze how environmental and seasonal factors affect the number of rented bikes across different time periods.

Column Details-

This section explains how the original dataset's columns were refined during data preparation. It compares the raw data (before transformation) with the cleaned and structured data (after transformation).
It highlights renamed columns, added calculated fields (like Month_Name, Day_Name, Year), and removed unnecessary ones (like Snowfall).
This helps to understand how raw CSV data was converted into analysis-ready form.

Before Transformation	**Description / Purpose**	**After Transformation**	**Description / Purpose**
Date	Represents the date when bike rentals were recorded. Used for time-series and trend analysis.	ID	Unique identifier for each record.
Rented Bike Count	Number of bikes rented during the given hour. This is the main measure for analysis.	Date	Date of rental activity.
Hour	Indicates the hour of the day (0–23). Helps	Bike_Count	Total number of rented bikes.

	identify peak and off-peak rental hours.		
Temperature(°C)	Air temperature in degrees Celsius. Used to analyze how temperature affects rental demand.	Hour	Represents the hour of the day.
Humidity(%)	Relative humidity percentage. Used to study the effect of moisture level on rentals.	Temperature_C	Temperature in °C.
Wind speed (m/s)	Speed of wind in meters per second. Used to see if wind affects bike usage.	Humidity	Humidity percentage.
Visibility (10m)	Visibility level measured in 10-meter units.	Wind_Speed_mps	Wind speed in meters per second.
Dew point temperature(°C)	Temperature at which dew forms. Indicates air moisture.	Visibility_10m	Visibility value.
Solar Radiation (MJ/m2)	Solar energy received per square meter.	DewPoint_C	Dew point temperature.
Rainfall(mm)	Rainfall amount in millimeters. Used to understand impact of rain on rentals.	Rainfall_mm	Rainfall in millimeters.
Snowfall (cm)	Snowfall in centimeters. (Removed as not relevant for this	Season	Represents the season (Winter, Spring, Summer,

	dataset.)		Autumn).
Seasons	Indicates the current season.	Holiday	Whether the day was a holiday or not.
Holiday	Indicates whether the day was a holiday.	Functioning_Day	Whether the rental system was working (Yes/No).
Functioning Day	Shows if the bike system was operational that day.	Day_Name, Month_Name, Year, Weekday_Weekday	Added calculated columns for time-based analysis.

Data Cleaning Summary-

This section describes all cleaning actions performed in Power Query before loading data into Power BI.
It includes steps like removing null values, deleting duplicate rows, handling errors, removing unwanted columns, and adding new calculated columns.
The summary also shows how many rows or columns changed after each step — ensuring data accuracy and consistency.

Sr. No.	Applied Step	Rows Before	Rows After	Effect (Rows)	Columns Before	Columns After	Effect (Columns)
1	Extract Data from CSV	8760	8760	0	14	14	0
2	Remove Errors	8760	8760	0	14	14	0
3	Remove Blank Rows	8760	8760	0	14	14	0
4	Remove Duplicates	8760	8760	0	14	14	0
5	Remove Column (Snowfall)	8760	8760	0	14	13	-1
6	Add Column (Day_Name)	8760	8760	0	13	14	+1
7	Add Column (Month_Name)	8760	8760	0	14	15	+1

8	Add Column (Year)	8760	8760	0	15	16	+1
9	Add Column (Weekday_Weekday)	8760	8760	0	16	17	+1

Data Transformation and Wrangling Steps-

This part focuses on how data was further transformed to make it suitable for visual analysis.
It includes operations like adding new columns (e.g., Month_Name, Year, Weekday), creating calculated measures, grouping or merging fields, and preparing relationships.
These transformations help uncover deeper insights such as seasonal patterns and hourly rental behavior.

Sr. No.	Column Name	Performed Activity
1	Snowfall (cm)	Removed as the data was mostly null.
2	Day_Name	Added custom column using Date function (Date.DayOfWeekName).
3	Month_Name	Added column to categorize records by month name.
4	Year	Extracted year from the Date column.
5	Weekday_Weekday	Added column to mark weekdays/weekends.

Storytelling KPIs and Visuals-

Key Performance Indicators (KPIs) are the main measurable values used to evaluate the overall performance of the bike rental system. They help in identifying important trends and understanding how different factors like weather, season, and time affect bike rentals.

- **Key KPIs-**

This section highlights the main measurable metrics used to analyze the bike rental data.
Examples include **Total Bike Rentals**, **Average Temperature**, **Average Humidity**, and **Total Rainfall**.
KPIs help in quickly understanding the business performance and weather impact on rentals.

Sr. No.	KPI Name	Description	Formula (DAX)
1	Total Bike Rentals	Total number of bikes rented.	SUM([Bike_Count])
2	Average Temperature (°C)	Average weather condition.	AVERAGE([Temperature_C])
3	Average Humidity (%)	Measures air moisture level.	AVERAGE([Humidity])
4	Total Rainfall (mm)	Total rainfall recorded.	SUM([Rainfall_mm])
5	Functioning Days	Number of active operating days.	DISTINCTCOUNT([Date]) (with Functioning_Day = "Yes")

- **Dashboard Visuals-**

This section contains all visual charts and graphs created in Power BI to represent insights from the dataset.
It includes visuals like line charts for rental trends, column charts for season-wise comparison, scatter plots for temperature impact, and heatmaps for hourly or weekday analysis.
Each visual is designed to tell a clear story based on data.

Sr. No.	Chart Name	Columns Used	Visual Type	Purpose / Insight
1	Rentals Over Time	Date, Bike_Count	Line Chart	Shows trend across the year.
2	Rentals by Season	Season, Bike_Count	Column Chart	Compare seasonal rental patterns.
3	Rentals by Month	Month_Name, Bike_Count	Column Chart	Analyze monthly performance.
4	Rentals by Day of Week	Day_Name, Bike_Count	Bar Chart	Compare weekday vs weekend usage.
5	Rentals vs Temperature	Temperature_C, Bike_Count	Scatter Chart	Shows how temperature affects rentals.
6	Weather Impact	Weather_Type, Bike_Count	Pie/Column Chart	Compare rainy vs clear days.
7	Hourly Rentals	Hour, Bike_Count	Line/Area Chart	Identify morning and evening peaks.

- **Advanced Visuals-**

These are specialized or combined visuals that provide deeper insights beyond basic charts.

Examples include:

1. Heatmaps for hour vs day pattern detection
2. Scatter plots for weather correlation
3. Matrix visuals for season-temperature relationships

Such visuals enhance analytical storytelling and make the dashboard more interactive.

Sr. No.	Chart Name	Columns Used	Visual Type	Insight / Purpose
1	Season + Temperature	Season, Temperature_C (grouped), Avg Bike_Count	Matrix / Heatmap	Identify best temperature range per season.
2	Hour vs Day Name	Day_Name, Hour, Bike_Count	Heatmap	See which days and hours have high usage.
3	Correlation Visualization	Humidity, Bike_Count, Temperature, Rainfall	Scatter Chart	Check correlation between humidity and rentals.
4	Functioning vs Non-Functioning Day	Functioning_Day, Bike_Count	Clustered Bar	Compare operational vs non-operational days.

- **Filters / Slicers-**

Filters and slicers were added in the dashboard to make the report dynamic and user-interactive.

Users can filter the data by Season, Holiday, or Month to explore rentals under different conditions.

These slicers help viewers analyze data from multiple perspectives easily.

Sr. No.	Slicer Name	Used Column	Purpose
1	Season	Season	Filter data season-wise.
2	Holiday	Holiday	Show difference between holidays and

			normal days.
3	Month	Month_Name	Filter data for specific months.

Dashboard Screenshots-

To provide a better understanding of the Power BI dashboard and its analytical visuals, the following screenshots have been added. These images represent the complete view of the project, including both key KPIs and advanced insights.

The first screenshot highlights the **main KPI section**, showing metrics such as *Total Bike Rentals*, *Average Temperature*, *Average Humidity*, *Total Rainfall*, and *Functioning Days*. These KPIs provide an overall summary of the dataset and help in understanding general trends.

The second screenshot displays the **Advanced Analysis section**, which includes detailed visualizations like *Season vs Temperature Heatmap*, *Hourly Rental Patterns*, *Correlation Analysis*, and *Functioning Day Comparison*. These visuals help uncover deeper insights and patterns in the bike rental behavior based on weather and time factors.

Figure 1: Power BI Dashboard – Key KPIs and Summary View

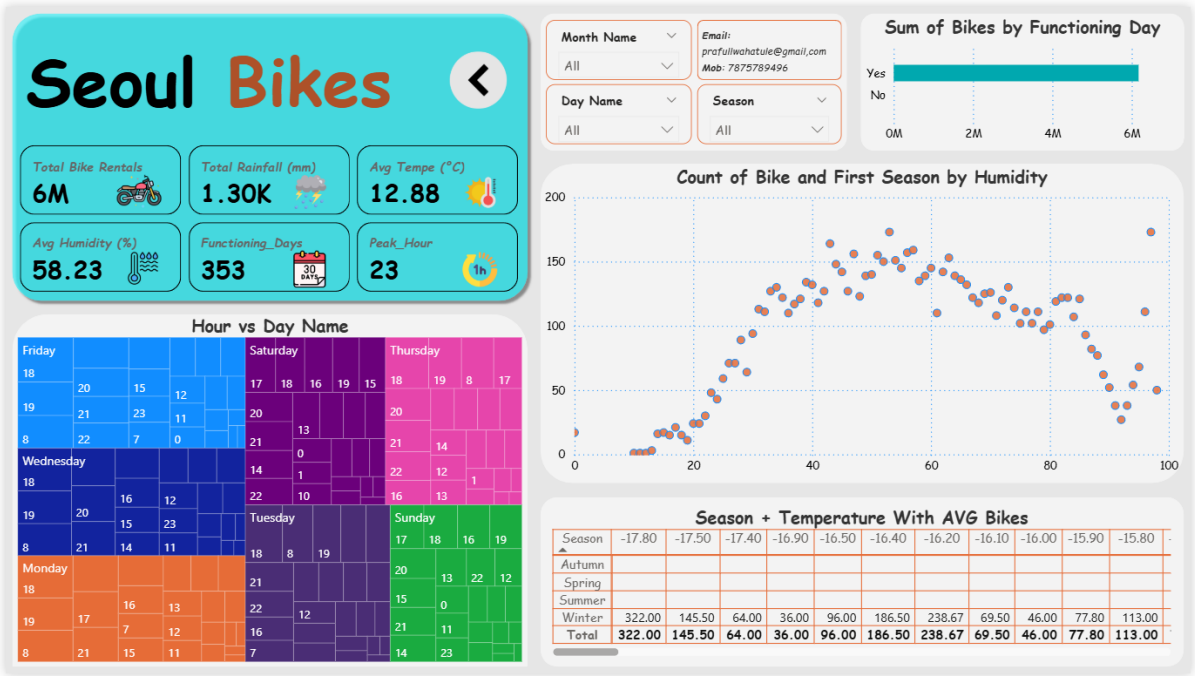

Figure 2: Power BI Dashboard – Advanced Analysis and Insights View

Insights & Findings

After analyzing the Seoul Bike Sharing dataset in Power BI, several important insights were discovered from the dashboards and visuals. These findings help us understand the key factors that affect the number of bike rentals and user behavior patterns.

1. Seasonal Impact:
   Bike rentals are highly influenced by seasons. The number of rentals was highest during Summer and Autumn, while it dropped significantly in Winter due to low temperature and unfavorable weather conditions.
2. Hourly Patterns:
   Rentals show clear time-based trends — the highest activity occurs during morning (8–9 AM) and evening (5–7 PM) hours, which indicates strong usage during office commute times.
3. Day-wise Trends:
   Weekdays, especially Monday to Friday, have a higher rental count compared to weekends. However, on some weekends with good weather, the rentals increase, showing that weather conditions can override day patterns.
4. Temperature Relationship:
   A moderate temperature (between 20°C to 28°C) shows the highest bike usage. Rentals decrease when the temperature is too low or too high.
5. Weather and Rainfall Effect:
   Days with rainfall recorded significantly lower rentals, proving that rainy conditions directly reduce usage. Clear weather days are the most active in terms of bike demand.
6. Humidity and Correlation:
   A negative correlation was seen between Humidity and Bike Count, meaning that higher humidity slightly reduces the rental count.
7. Functioning Days:
   Almost all data days were functioning, showing consistent system performance, with a few non-functioning days having negligible effect on total rentals.

Overall, these insights help in understanding user preferences, environmental effects, and operational performance for better decision-making and service optimization.

Conclusion

The analysis of the Seoul Bike Sharing dataset through Power BI provided meaningful conclusions about urban mobility, weather influence, and rental demand patterns. The dashboard effectively summarizes large datasets into interactive visuals, allowing easy exploration of trends and correlations.
The findings clearly show that bike usage depends strongly on temperature, season, and rainfall. Rentals increase during warm and pleasant seasons and decrease in extreme weather conditions. The clear hourly and daily usage trends highlight how the bike-sharing service is primarily used for daily commuting.
This Power BI project demonstrates the power of data visualization and analytical storytelling. By combining KPIs, charts, and advanced visuals, it delivers a complete understanding of how weather and time factors influence bike rental behavior.

In real-world applications, such insights can help city planners, transportation departments, and bike-sharing companies to optimize resource allocation, plan maintenance schedules, and improve customer experience.
Thus, this project successfully fulfills its objective — to extract meaningful insights from raw data and present them through an interactive and visually engaging Power BI dashboard.