BIKE RENTAL SERVICE

A Project by Prasenjit

Introduction to Bike Rental Analysis Project :

This project focuses on analyzing bike rental data to uncover trends, optimize fleet management, and enhance business strategies. Through detailed demand analysis that will help improve decision-making for bike rental companies.

Key areas of focus include:

1.Demand Analysis – Understanding peak rental times, seasonal trends, and the impact of weather conditions on rental demand.

2.Customer Behavior – Identifying how holidays, temperature, and wind conditions affect casual and registered user behavior.

3.Business Optimization – Optimizing fleet availability and ensuring the right number of bikes are available based on demand.

4.Revenue and Growth Opportunities – Measuring trends over the years, identifying growth patterns, and pinpointing high-rental months for inventory and workforce management.

5.Operational Efficiency – Evaluating bike usage patterns to ensure fleet utilization is maximized, avoiding understocking or oversupply.

Dataset Overview:

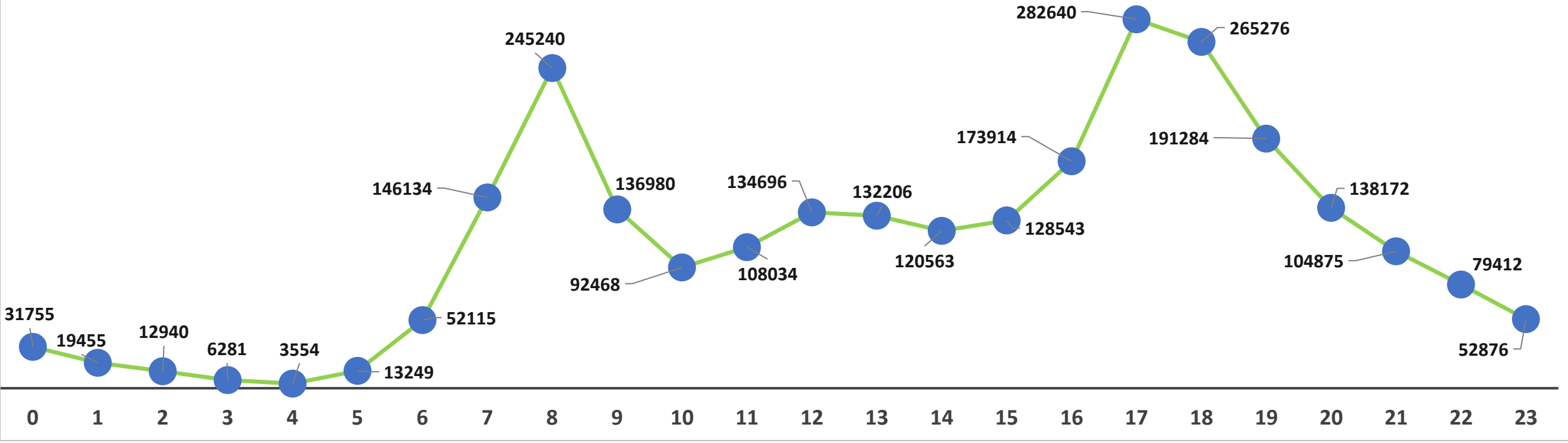
Data Sources: The dataset includes two key files: **hour.csv** and **day.csv**, with time-based data for bike rentals recorded at an hourly and daily level.

- **Key Fields:**
  - **Date & Time Information**: Includes **dteday** (date), **hr** (hour), **mnth** (month), **weekday** (day of the week), and **yr** (year).
  - **Weather & Environmental Data**: Contains **temp** (temperature), **atemp** (feels-like temperature), **hum** (humidity), **windspeed** (wind speed), and **weathersit** (weather condition).
  - **User Types**: Divided into **casual** (non-registered) and **registered** (returning) users, with **cnt** representing total rentals (sum of casual and registered).
  - **Seasonal & Holiday Information**: Includes **season** (spring, summer, fall, winter), **holiday** (whether the day is a holiday), and **workingday** (indicating if the day is a workday or weekend).

- **Purpose:** The dataset is designed to analyze bike rental demand trends, customer behavior, and the impact of various factors like weather, time, and holidays on bike rentals.

- **Use Cases:** It enables the analysis of peak rental hours, seasonal variations, the effect of weather on rentals, and business optimization for fleet management and marketing strategies.

Peak Hours for Rentals




```sql
select
    hr as Peak_Hours,
    sum(registered) as Total_Bikes_Booked
from hours
group by hr
order by Total_Bikes_Booked desc;
```

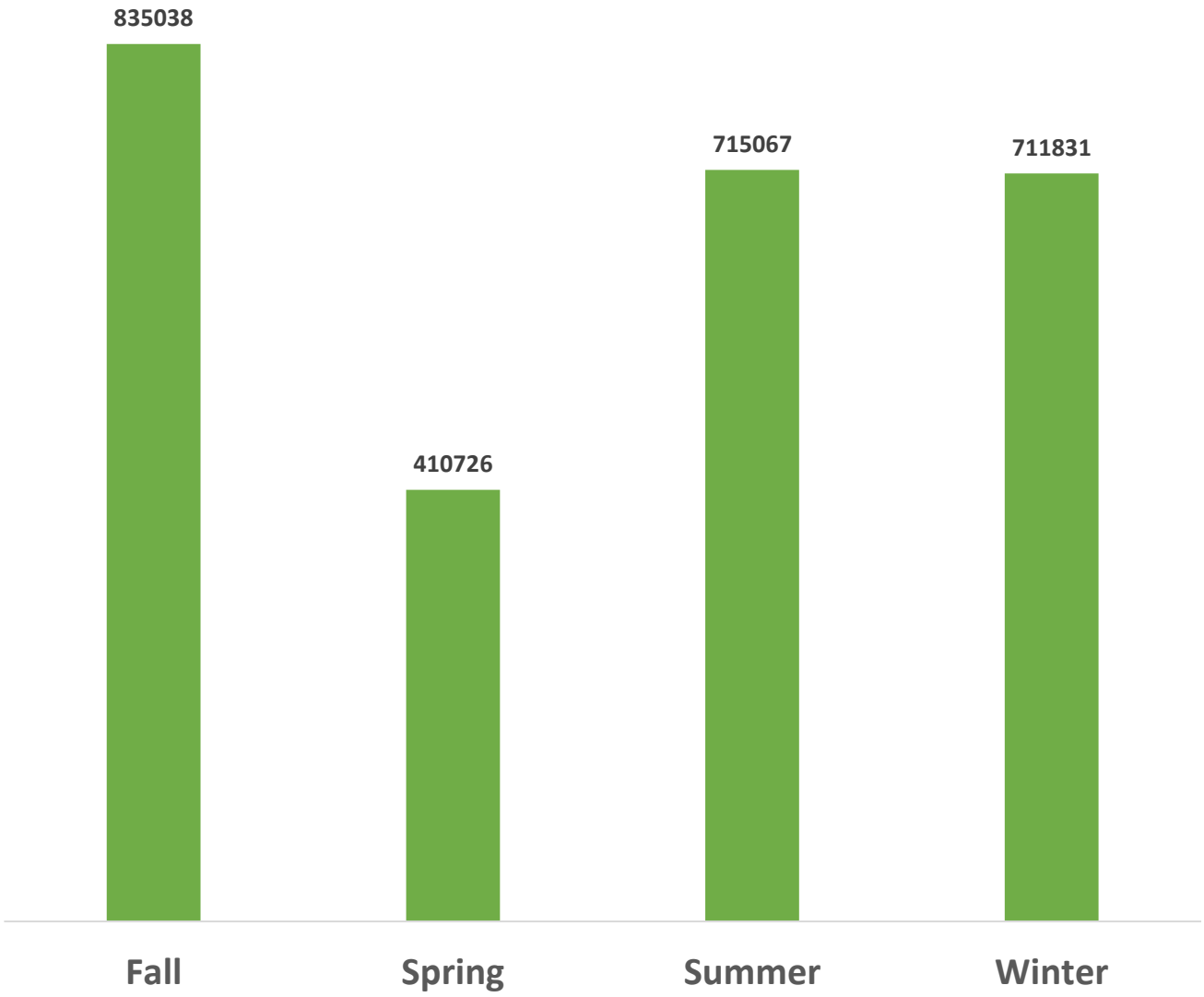
Insights –

The highest bike rentals occur **during morning (8-9 AM) and evening (5-7 PM) rush hours**, aligning with commuting times.

Action: Ensure enough bikes are available during these peak hours.

Seasonal Variations in Bike Rentals

```sql
select
    case
        when season = "1" then "Spring"
        when season = "2" then "Summer"
        when season = "3" then "Fall"
        when season = "4" then "Winter"
    end as Seasons,
        sum(registered) as Total_Bikes_Booked
from hours
group by seasons
order by Total_Bikes_Booked desc;
```



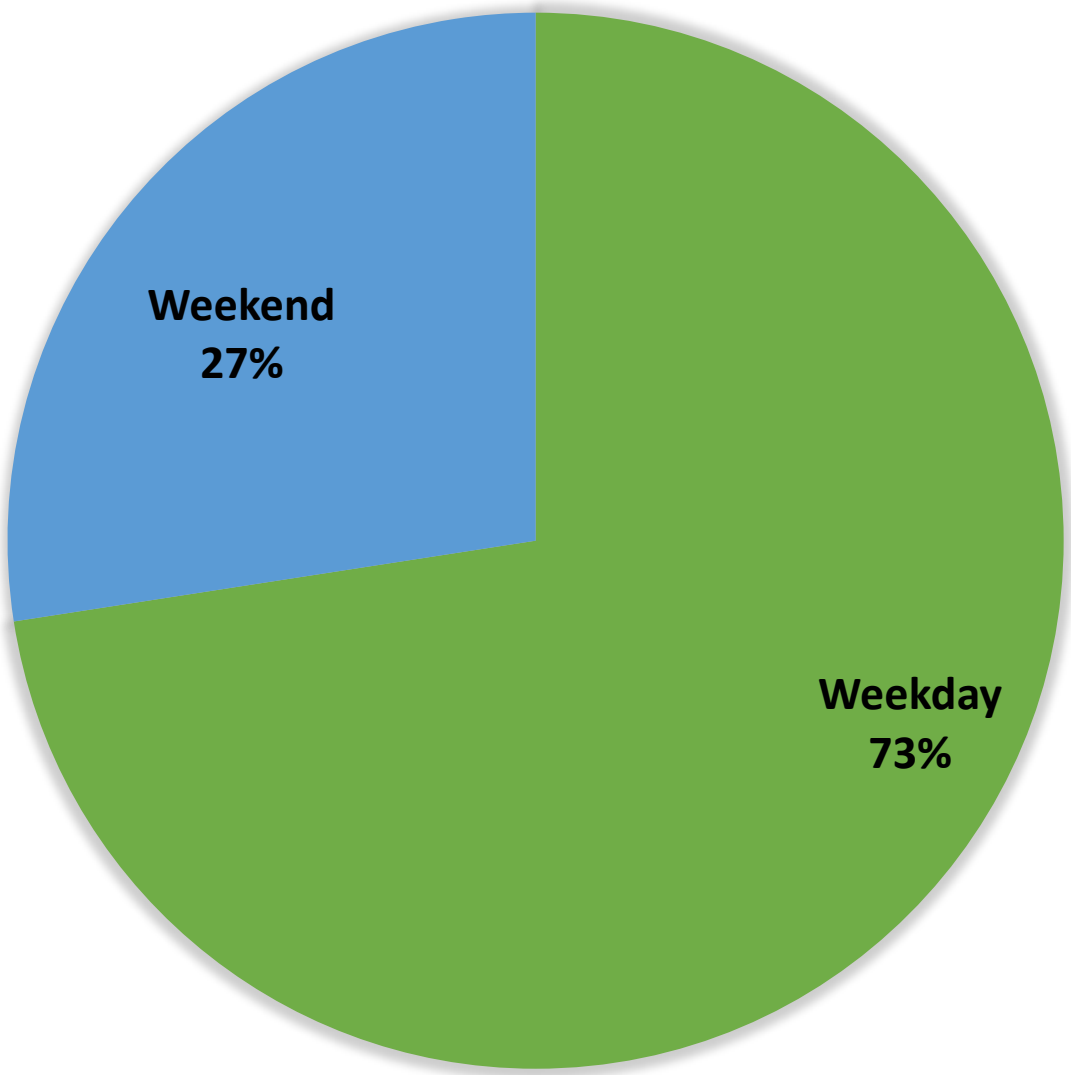
Insights :

•Fall and Summer have the highest rentals, while Winter has the least, indicating weather plays a crucial role in demand.

•Action: Increase bike supply and marketing efforts in high-demand seasons; offer promotions or indoor cycling alternatives in winter.

Weekday vs. Weekend Usage Trends

```sql
select
case
    when weekday between 0 and 4  Then "Weekday"
    else "Weekend"
    end as Weekday_Name,
sum(registered) as Total_Bikes_Booked
from day
group by weekday_Name
order by Total_Bikes_Booked desc;
```



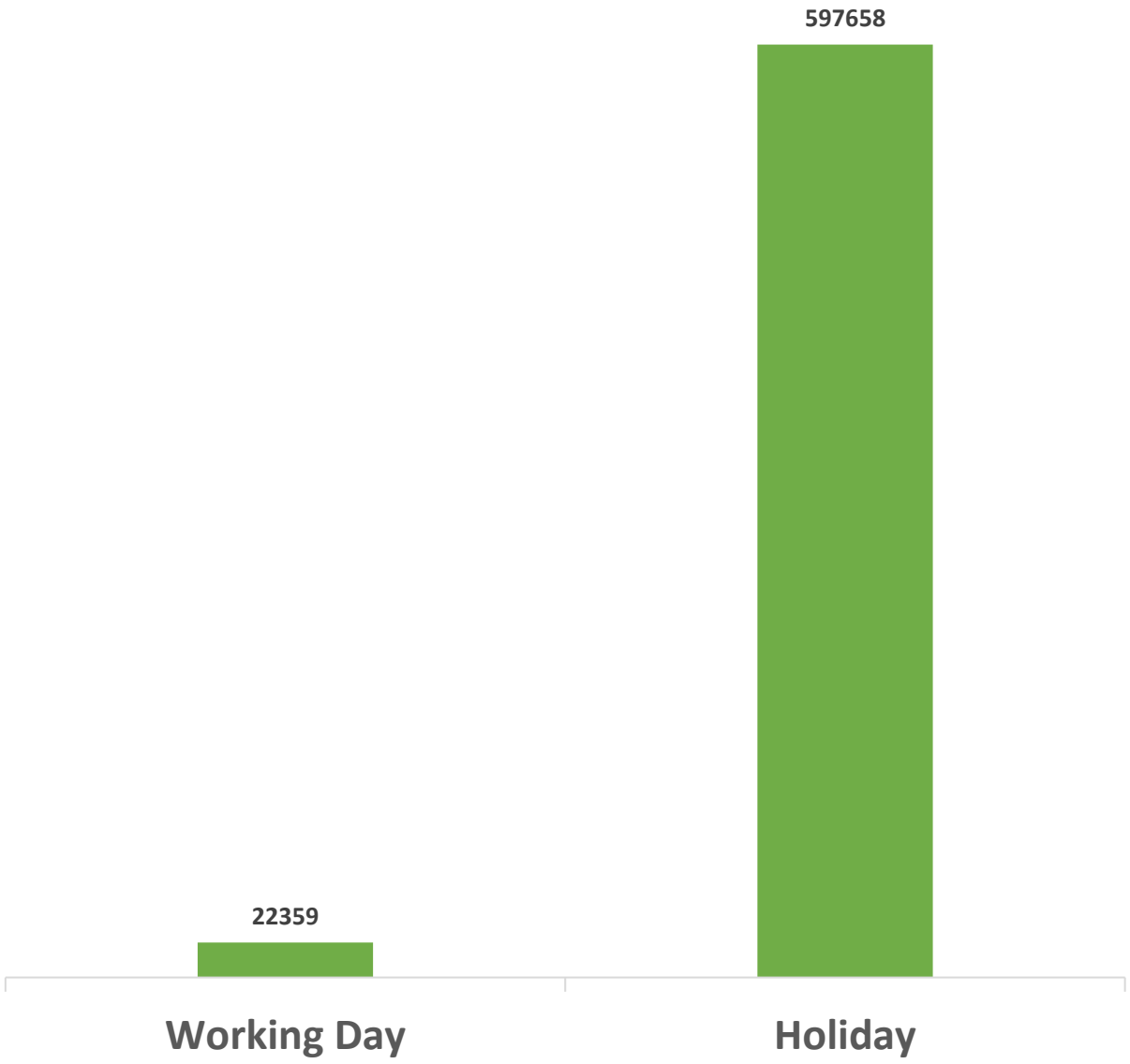
Insights :

• Weekday rentals are significantly higher, indicating a strong work commute usage.

• Action: Develop weekday-focused subscription plans and expand weekend leisure-based promotions.

Casual Users & Holiday Rentals

```
select case
    when holiday = 0 then "Holiday"
    when holiday = 1 then "Working Day"
    end as Holiday_WorkingDay,
sum(casual) as Total_Casual_Bookings
from day
group by Holiday_WorkingDay
order by Total_Casual_Bookings;
```



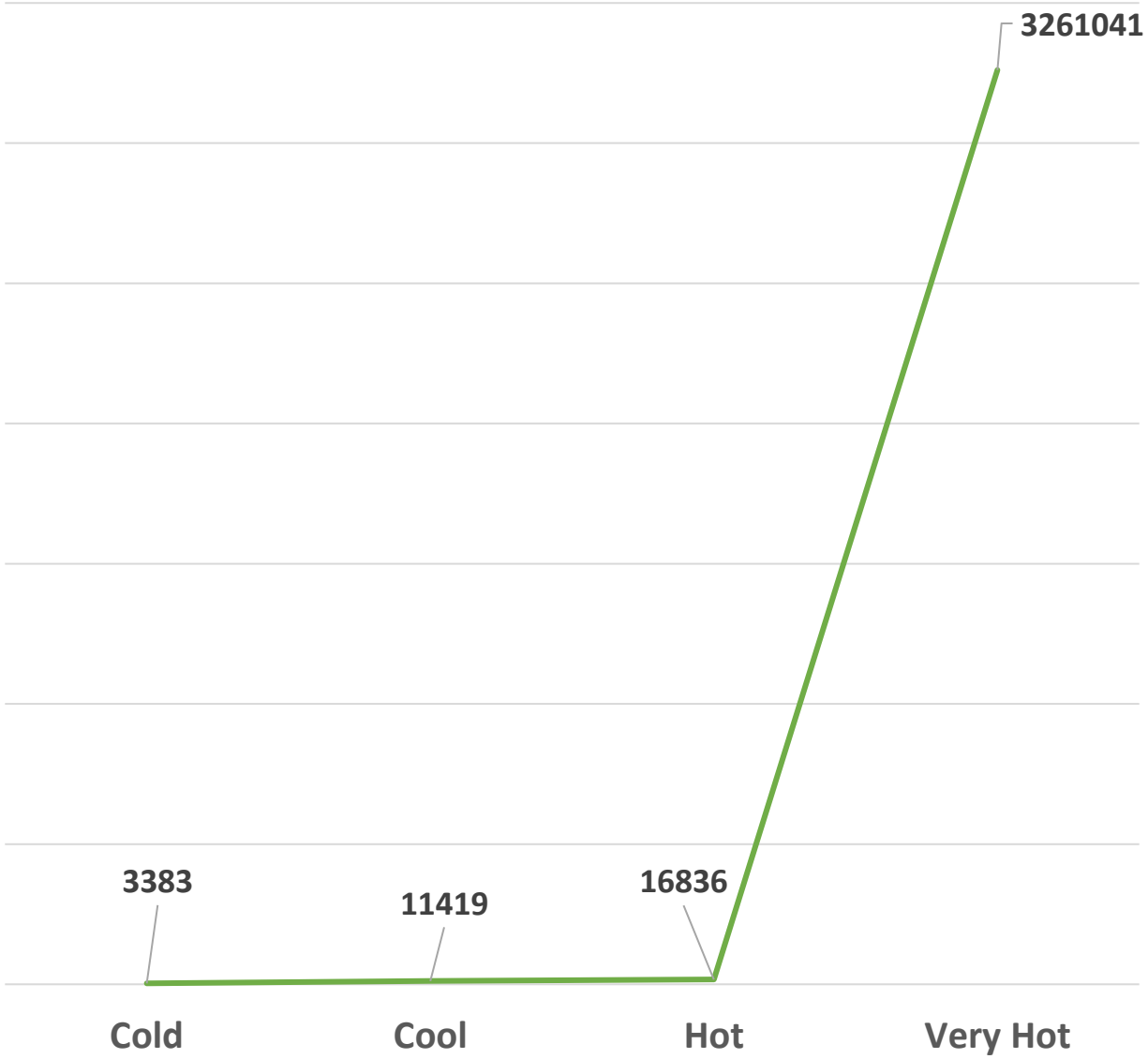
Insights :

•Casual users rent more on holidays than working days, indicating they use bikes for leisure rather than commuting.

•Action: Offer special holiday discounts and targeted marketing for casual riders.

Impact of Temperature on Rentals

```sql
select case
   WHEN temp > 0.18 THEN 'Very Hot'
        WHEN temp BETWEEN 0.16 AND 0.18 THEN 'Hot'
        WHEN temp BETWEEN 0.21 AND 0.30 THEN 'Warm'
        WHEN temp BETWEEN 0.10 AND 0.20 THEN 'Cool'
        ELSE 'Cold'
    end as Temperature_Range,
sum(cnt) as Total_Bookings
from day
group by Temperature_Range
order by Total_Bookings desc;
```



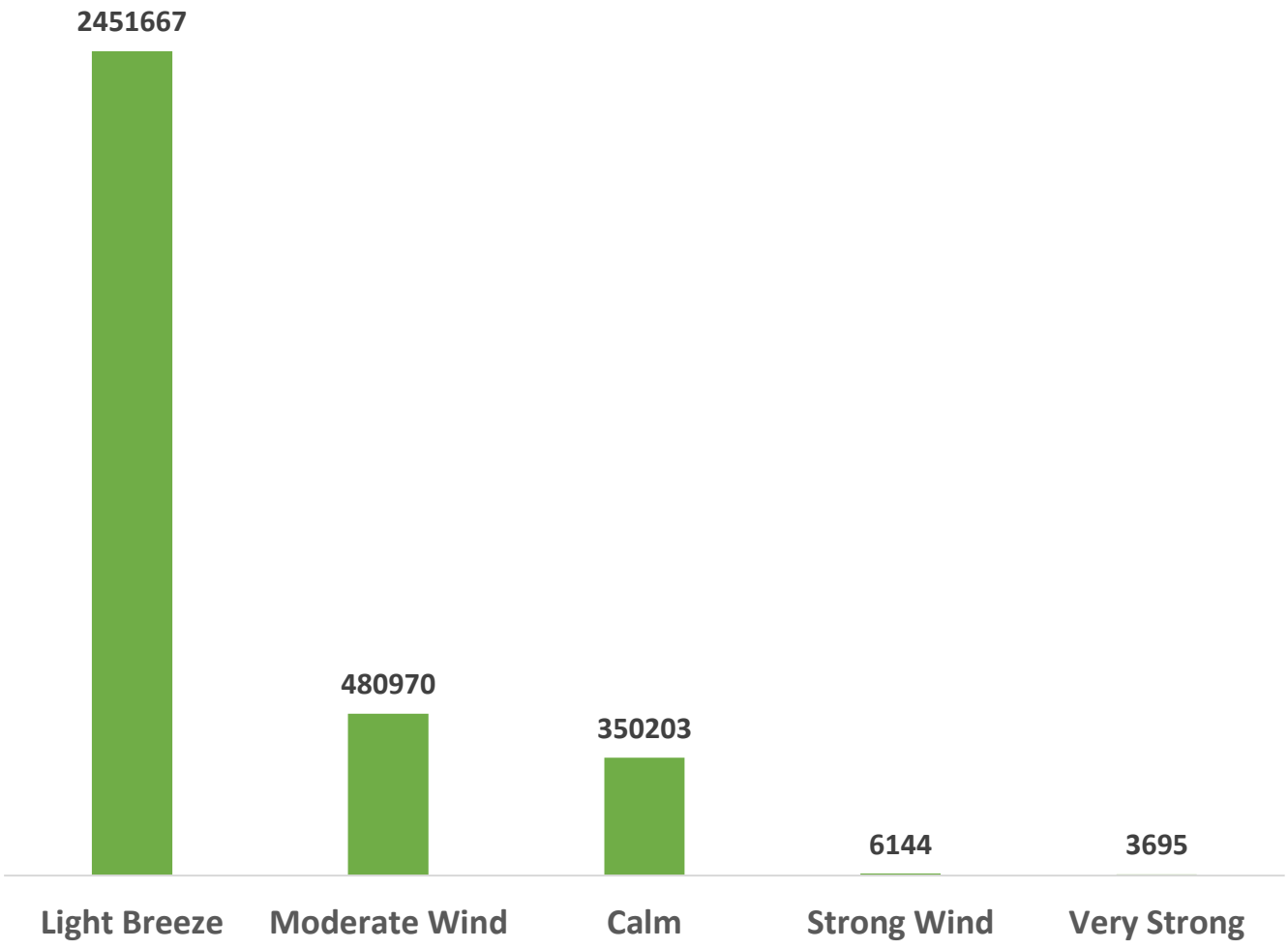
Insights :

•Rentals increase with warmer temperatures but drop in extreme heat or cold.

•Action: Adjust marketing strategies and offer weather-based discounts or promotions during extreme conditions.

Effect of Wind Speed on Rentals

```sql
select
case
    when (windspeed*(67-0))+0 between 0 and 5 then "Calm"
    when (windspeed*(67-0))+0 between 6 and 20 then "Light Breeze"
    when (windspeed*(67-0))+0 between 21 and 40 then "Moderate Wind"
    when (windspeed*(67-0))+0 between 41 and 60 then "Strong Wind"
    else "Very Strong"
    end as Wind_Category,
sum(cnt) as Total_Bookings
from hours
group by Wind_Category
order by Total_Bookings desc ;
```



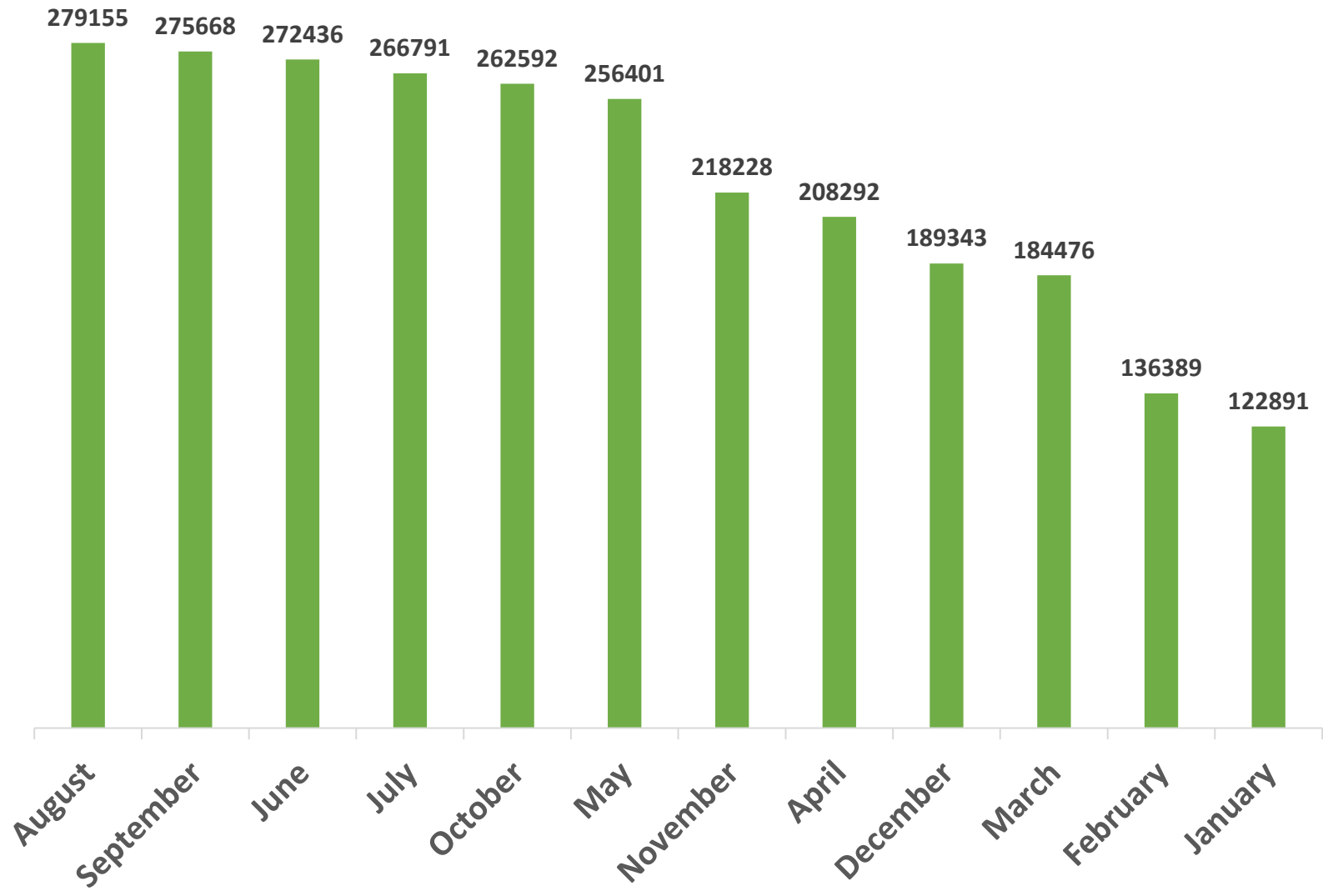
Insights :

•High wind speeds negatively impact rentals, indicating that riders prefer cycling in calmer conditions.

•Action: Communicate weather conditions in advance and offer discounts on low-demand days.

Top-Performing Months

```sql
select
    case
    when mnth = 1 then "January"
    when mnth = 2 then "February"
    when mnth = 3 then "March"
    when mnth = 4 then "April"
    when mnth = 5 then "May"
    when mnth = 6 then "June"
    when mnth = 7 then "July"
    when mnth = 8 then "August"
    when mnth = 9 then "September"
    when mnth = 10 then "October"
    when mnth = 11 then "November"
    when mnth = 12 then "December"
end as Months,
       sum(registered) as Total_Registerd_Bikes
from hours
group by Months;
```



Insights :

•Summer and Fall months see the highest rentals, reinforcing seasonal demand patterns.

•Action: Scale up bike availability, workforce, and maintenance operations accordingly

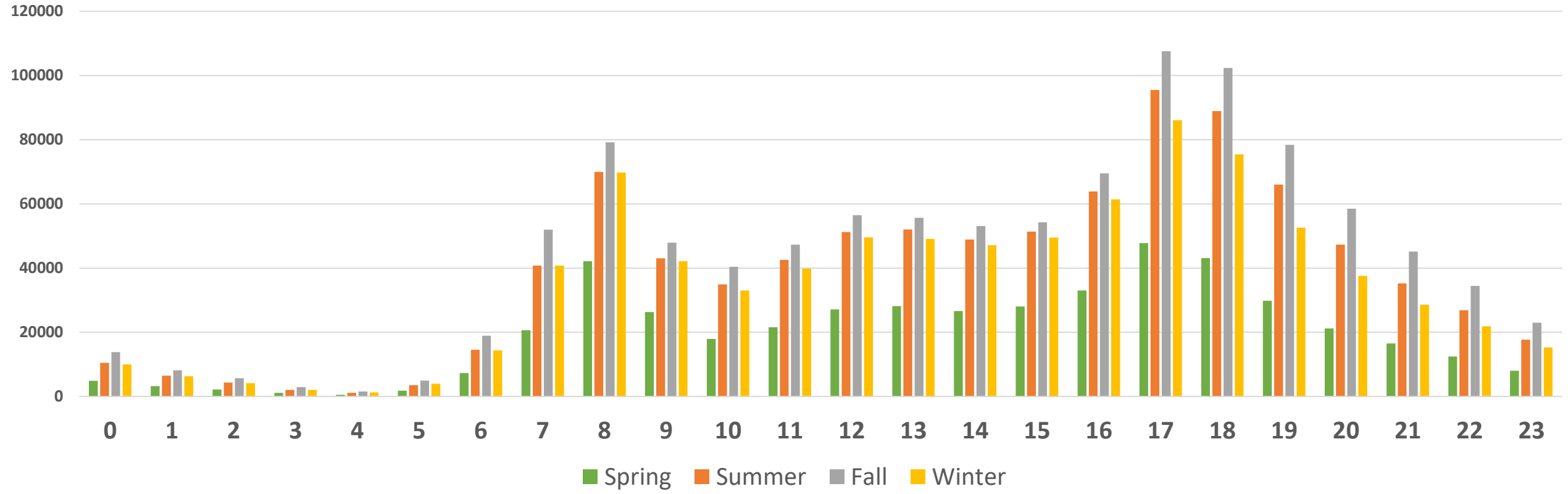
Year-over-Year Growth

```sql
select
    sum(case when yr = 0 then cnt else 0 end) as Total_Bookings_Of_Year2011,
    sum(case when yr = 1 then cnt else 0 end) as Total_Bookings_Of_Year2012,
    (sum(case when yr = 1 then casual + registered end)-
     sum(case when yr = 0 then casual + registered end))/
     sum(case when yr = 0 then casual + registered end) * 100  as Growth_Percentage
from hours;
```

Total_Bookings_Of_Year 2011	Total_Bookings_Of_Year 2012	Growth_Percentage
1243103	2049576	64.88

- Insights :
- The rental service has seen a positive YOY growth trend, reflecting increased adoption.
- Action: Expand operations and invest in marketing for continued growth.

Peak Hour by Season




```sql
select hr as Hour,
    sum(case when season = 1 then cnt else 0 end) as Spring,
    sum(case when season = 2 then cnt else 0 end) as Summer,
    sum(case when season = 3 then cnt else 0 end) as Fall,
    sum(case when season = 4 then cnt else 0 end) as Winter
    from hours
group by Hour;
```

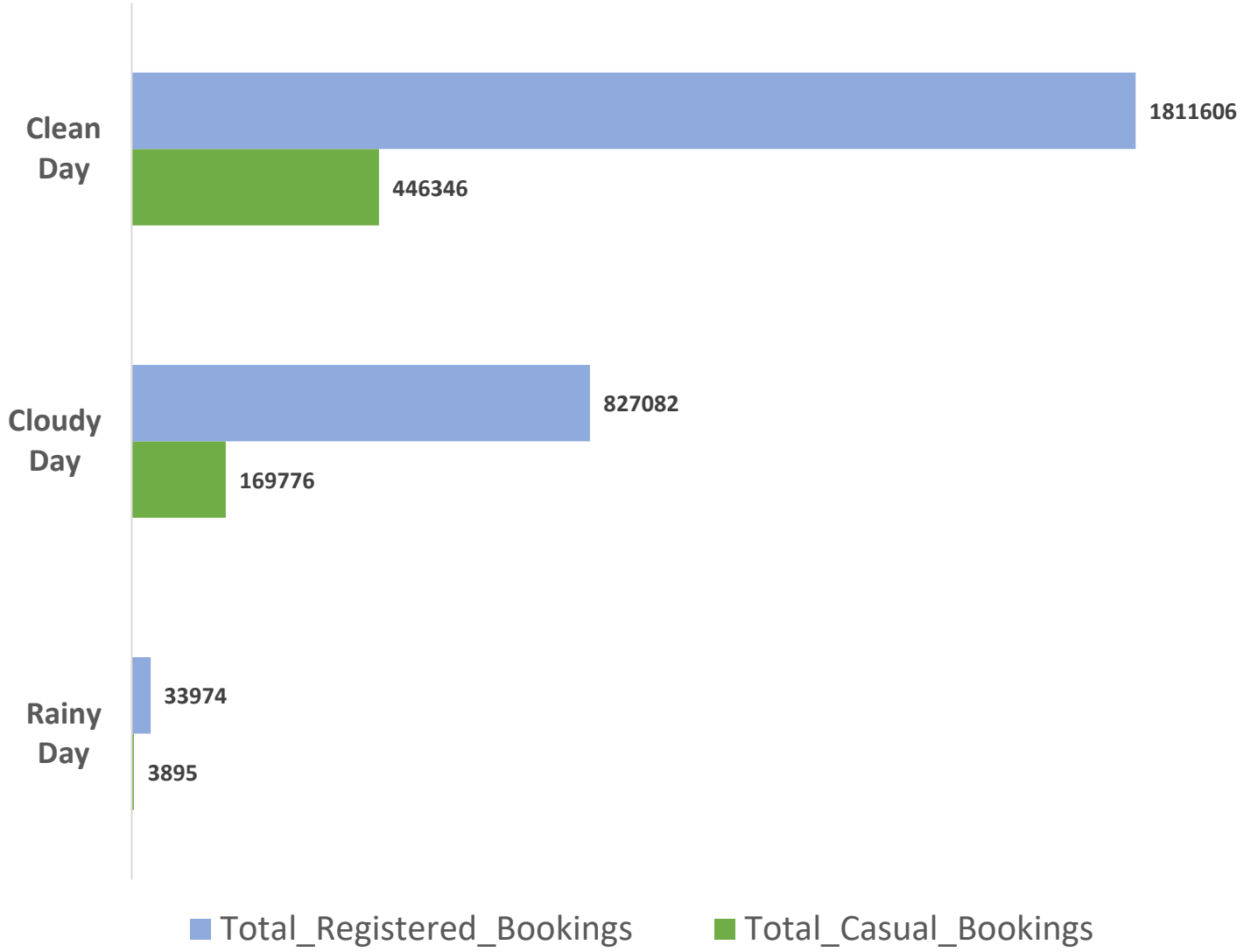
Insights :

•Each season has different peak hours, emphasizing the need for seasonal demand forecasting.

•Action: Allocate more bikes strategically based on season-specific demand.

Impact of Bad Weather on Casual vs. Registered Users

```sql
select
    case
        when weathersit = 1 then "Clean Day"
        when weathersit = 2 then "Cloudy Day"
        when weathersit = 3 then "Rainy Day"
    end as Weather_Status,
sum(casual) as Total_Casual_Bookings,
sum(registered) as Total_Registered_Bookings
from day
group by Weather_Status
order by Total_Casual_Bookings,Total_Registered_Bookings;
```



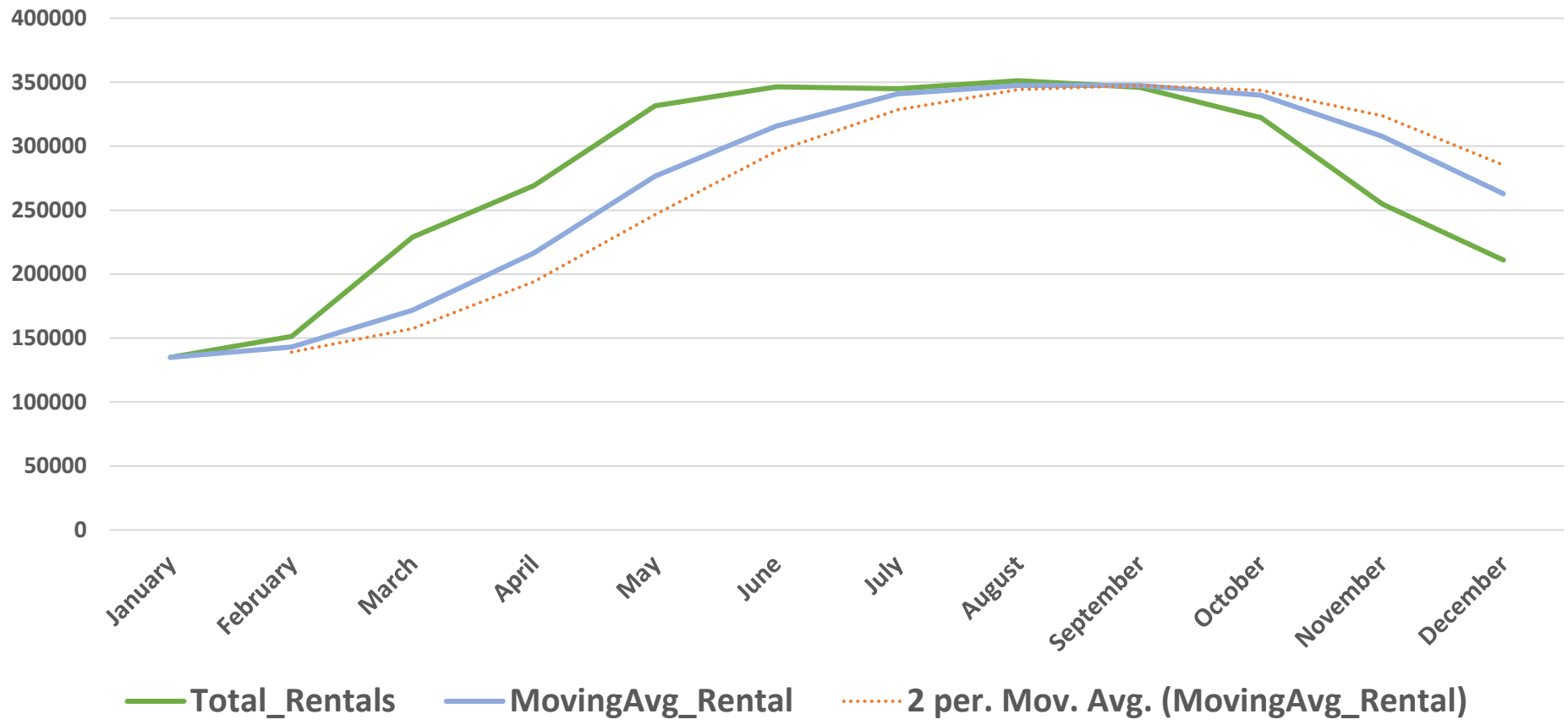
•Insights :

•Casual users rent significantly less on rainy/cloudy days compared to registered users.

•Action: Offer discounts on bad weather days to encourage casual users.

Monthly Rental Trends with Moving Average

```sql
select
    case
    when mnth = 1 then "January"
    when mnth = 2 then "February"
    when mnth = 3 then "March"
    when mnth = 4 then "April"
    when mnth = 5 then "May"
    when mnth = 6 then "June"
    when mnth = 7 then "July"
    when mnth = 8 then "August"
    when mnth = 9 then "September"
    when mnth = 10 then "October"
    when mnth = 11 then "November"
    when mnth = 12 then "December"
end as Months,
 sum(cnt) as Total_Rentals,
 round(avg(sum(cnt))over
(order by mnth rows between 2 preceding and current row),2)
as MovingAvg_Rental
from  day
group by mnth
order by mnth;
```



•Insights :

•A moving average smooths out fluctuations, revealing sustained growth in rentals.

•Action: Use these insights for long-term demand forecasting and resource planning.

Best Marketing Time

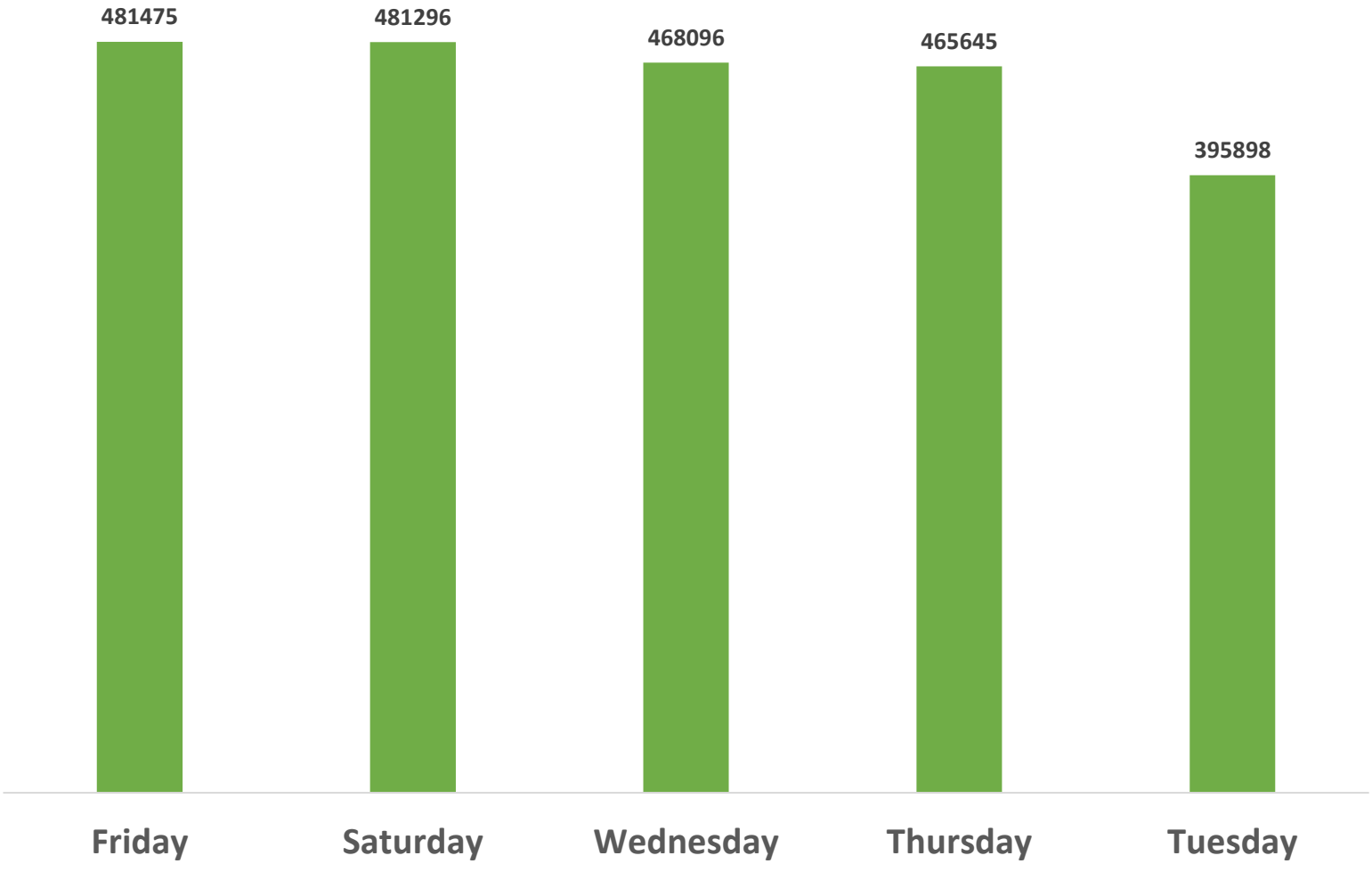
```
select
    case
        when weathersit = 1 then "Clean Day"
        when weathersit = 2 then "Cloudy Day"
        when weathersit = 3 then "Rainy Day"
    end as Weather_Status,
hr as Hour_Of_Day,sum(registered) as Total_Registered_Bookings
from hours
group by Weather_Status,Hour_Of_Day
order by Total_Registered_Bookings desc
limit 1;
```

Weather_Status	Hour_Of_Day	Total_Registered_Bookings
Clean Day	17	212401

•Insights :
•The highest rentals occur on clean-weather days during peak hours.
•Action: Target promotions and ad campaigns around these ideal rental conditions

Highest Rental Day on a Working Day

```sql
select
    case -- 2nd case
        when weekday = 0 then "Monday"
        when weekday = 1 Then "Tuesday"
        when weekday = 2 Then "Wednesday"
        when weekday = 3 Then "Thursday"
        when weekday = 4 Then "Friday"
        when weekday = 5 Then "Saturday"
        when weekday = 6 Then "Sunday"
    end as Weekday,
sum(cnt) as Total_rentals
from day
where workingday = 1
group by weekday
order by Total_rentals;
```



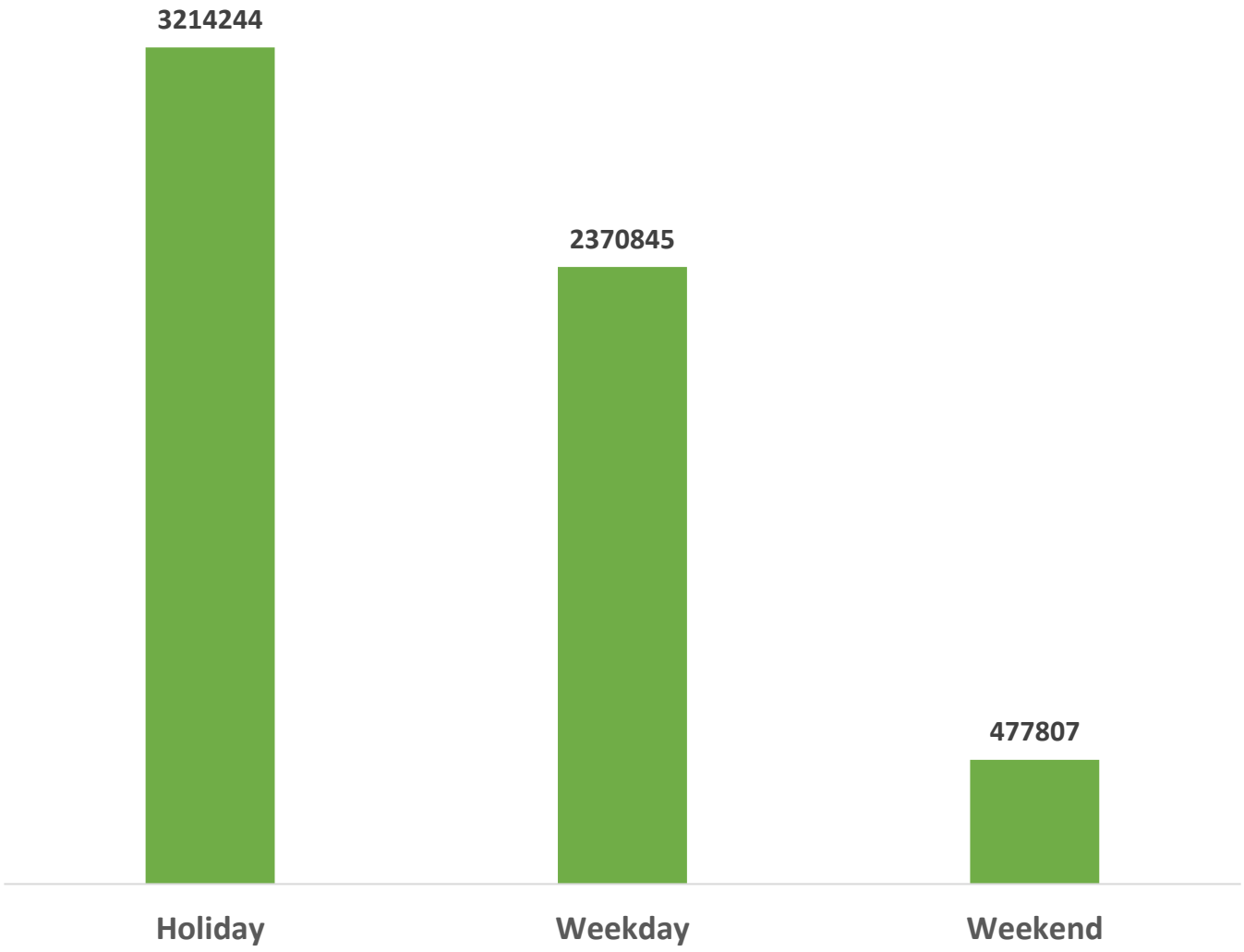
Insights :

•The busiest working day may coincide with specific events, holidays, or peak commuter patterns.

•Action: Align corporate partnerships and subscription-based plans accordingly.

Comparing Bookings on Weekdays, Weekends, and Holidays

```sql
select
    sum(case when holiday = 0 then cnt else 0 end)
    as Holiday,
    sum(case when weekday between 1 and 5 then
    cnt else 0 end) as Weekday,
    sum(case when weekday between 6 and 7 then
    cnt else 0 end) as Weekend
from day;
```



Insights :

•Holidays have the highest bookings, followed by weekdays, while Weekends have the least.

•Action: Differentiate pricing models for weekdays and weekends to maximize revenue.

Key Takeaways :

This slide presents the most important insights from the analysis.

1.Peak rentals occur during morning & evening commute hours:

1. Rental demand **spikes** in the early **morning (7 AM - 9 AM)** and **evening (5 PM - 7 PM)**, aligning with work commute times.
2. Businesses should ensure **more bikes are available during these hours**.

2.Summer & Fall see the highest demand:

1. Warmer months (**June - October**) have the **highest rentals**.
2. Winter months see a **drop** in bike rentals due to harsh weather conditions.

3.Casual users prefer holidays, while registered users rent daily:

1. **Casual riders** (non-subscribers) are more likely to rent bikes on **weekends and holidays**.
2. **Registered users** (subscribers) rent bikes **regularly** throughout the week, mainly for commuting

4.Weather impacts rental behavior:

1. **Hot weather = Higher rentals**, as biking is more comfortable in warm conditions.
2. **Windy or rainy conditions = Lower rentals**, as harsh weather discourages biking.

5.Rental business grew by 64.87% YoY (Year-over-Year):

1. Significant growth from **2011 to 2012**, indicating an **increasing adoption of bike rentals**.
2. Suggests that bike-sharing is becoming more **popular and profitable**.

Business Recommendations :

This Project presents actionable recommendations based on the analysis.

✓ Adjust fleet distribution to peak rental hours:

•Increase bike availability during **morning (7-9 AM) and evening (5-7 PM) peak hours**.

•Implement **dynamic bike reallocation** strategies to ensure bikes are available at **high-demand locations**.

✓ Launch seasonal promotions (e.g., discounts during winter):

•Offer **discounted pricing in winter** to encourage ridership despite cold weather.

•Introduce **special summer passes** for frequent users.

✓ Target weekday commuters vs. weekend casual riders differently:

•**Weekday strategy:** Focus on **subscription models** for daily commuters.

•**Weekend strategy:** Offer **hourly or tourist-friendly rental packages** for casual users.

✓ Optimize pricing & subscription models for weather-sensitive users:

•Create **flexible subscription plans** that adjust for weather conditions.

•Offer **incentives (e.g., discounts) on low-demand days** to maintain steady rentals.

✓ Scale inventory during peak seasons (Summer & Fall):

•Increase the number of bikes available during **June - October**.

•Expand **service areas or bike docking stations** in high-demand locations.

Final Thoughts:

🚴 **Data-driven decision-making is key to success.**

•This analysis provides **critical insights** into customer behavior, seasonal trends, and fleet optimization.

•Businesses can use these insights to **increase profitability, enhance customer satisfaction, and reduce operational inefficiencies**.

Strategic Recommendations:

🔹 **Demand Forecasting:**

•Use historical rental data to predict future demand trends.

•Optimize fleet size and station placement accordingly.

🔹 **Pricing Strategy:**

•Introduce **flexible pricing models** to maximize revenue during high-demand periods.

•Offer **discounts & promotions** to increase ridership during low-demand times.

🔹 **Marketing Campaigns:**

•Promote **holiday and weekend special offers** to attract casual riders.

•Target **commuters with subscription incentives** to increase weekday usage.

Thank You For Your Time