Capstone Project

Seoul Bike Sharing Demand Prediction

Team

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AlmaBetter

Problem Statement

Currently Rental bikes are introduced in many urban cities for the enhancement of mobility comfort. It is important to make the rental bike available and accessible to the public at the right time as it lessens the waiting time. Eventually, providing the city with a stable supply of rental bikes becomes a major concern. The crucial part is the prediction of bike count required at each hour for the stable supply of rental bikes.

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Data Description

Dependent variable:

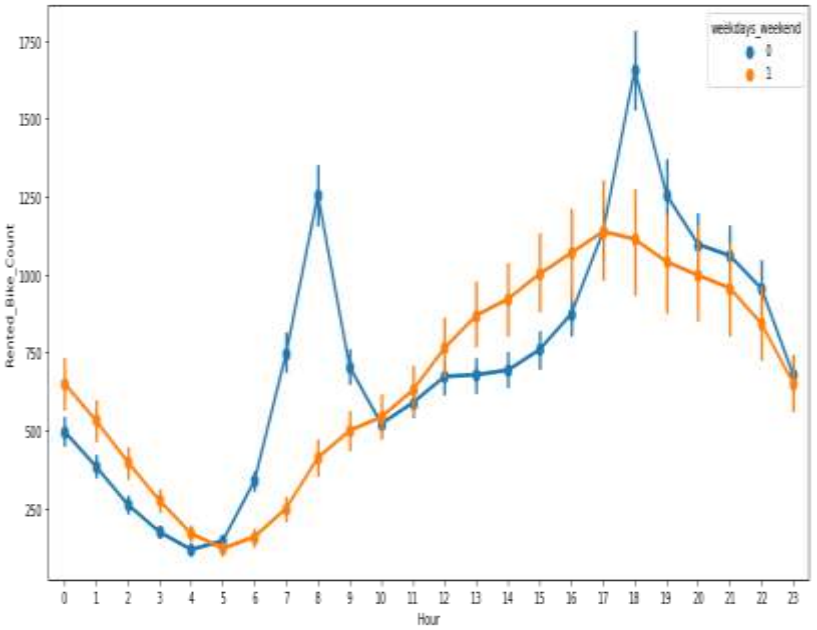
- Rented Bike count - Count of bikes rented at each hour

Independent variables:

- Date : year-month-day
- Hour - Hour of he day
- Temperature-Temperature in Celsius
- Humidity - %
- Windspeed - m/s
- Visibility - 10 m
- Dew point temperature - Celsius
- Solar radiation - MJ/m2
- Rainfall - mm
- Snowfall - cm
- Seasons - Winter, Spring, Summer, Autumn
- Holiday - Holiday/No holiday
- Functional Day - NoFunc(Non Functional Hours), Fun(Functional hours)

Exploratory Data Analysis

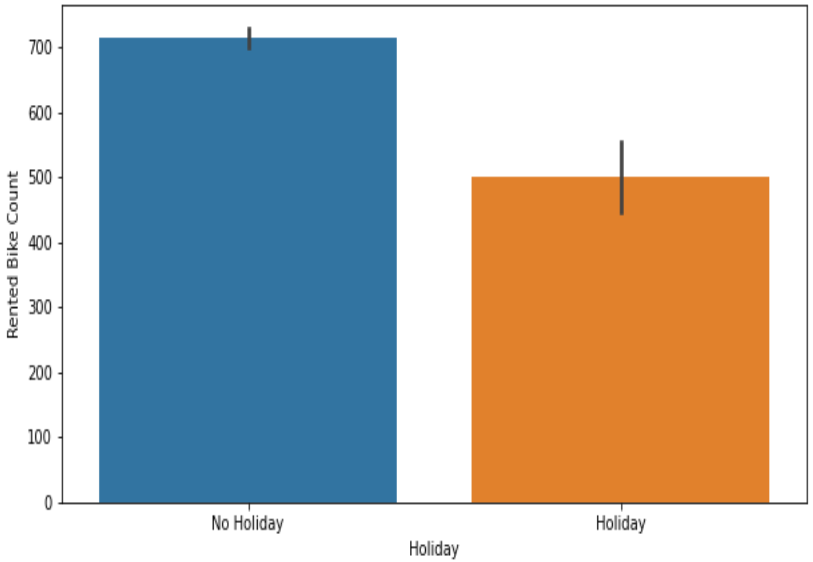
Analysing Categorical Variables (week days & weekends)



- Usage of rented bikes are more during weekdays than weekends.
- During weekdays from 5 am to 10 am and evening from 4 pm to 8 pm the renting is highest
- During weekends the renting is very low during morning but gradually the rented numbers increases being maximum around 5 pm(orange line).

Exploratory Data Analysis

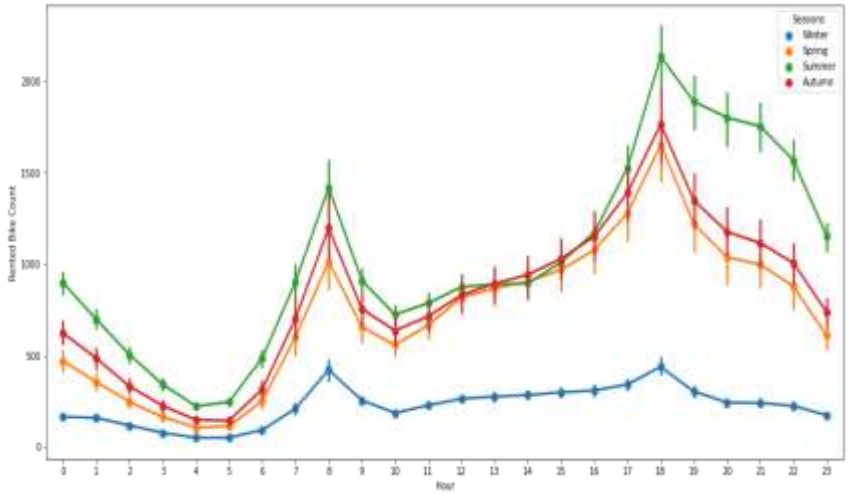
Analysing Categorical Variables (Holiday)



- The higher number of Renting is done on weekdays and lower on Holidays.
- It can also be inferred that a good percentage of bike are rented for office usage of people.

Exploratory Data Analysis

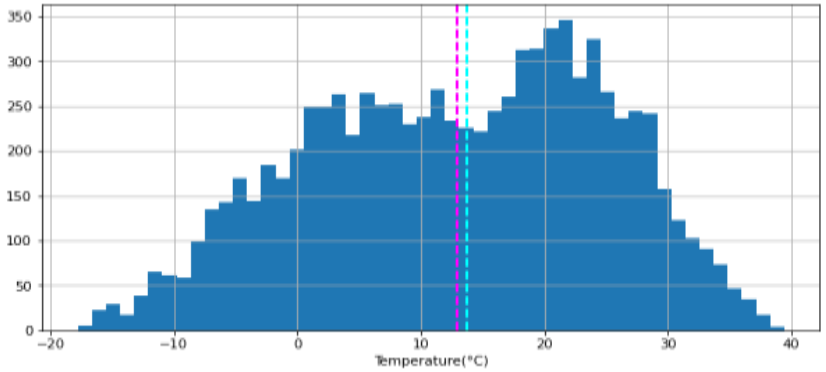
Analysing Categorical Variables (Seasons/day Trend of renting)

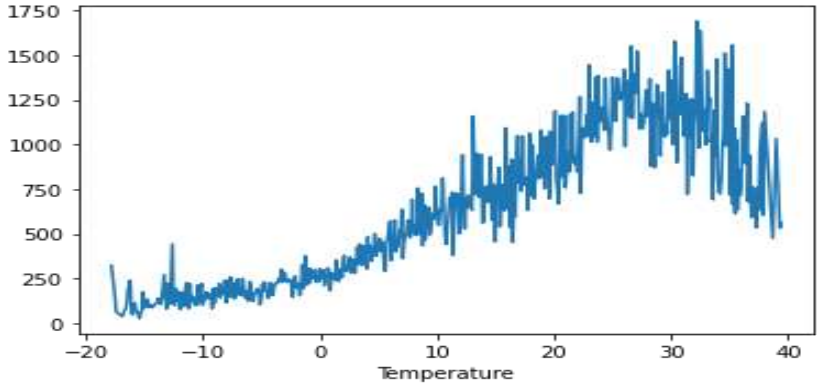


- The trend of renting is similar for Summer , Autumn and Spring , which shows peak renting from 6 am to 9 am & from 4 Pm to 10 Pm.
- The renting is lowest in Winter season.

Exploratory Data Analysis

Analysis on Numerical Variables (Temperature)

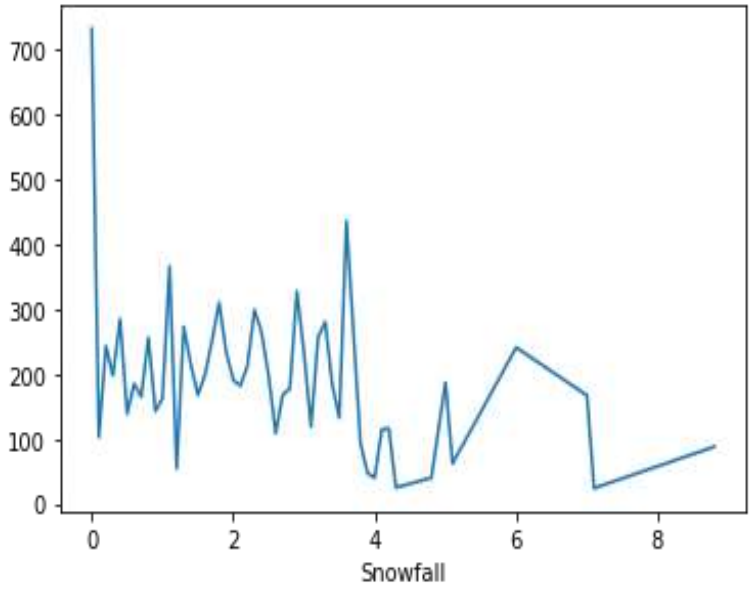




- The peak renting happens between 18 degrees to 25 degrees centigrade.
- Below 2 degrees and above 28 degrees there is a steep reduction is renting numbers.

Exploratory Data Analysis

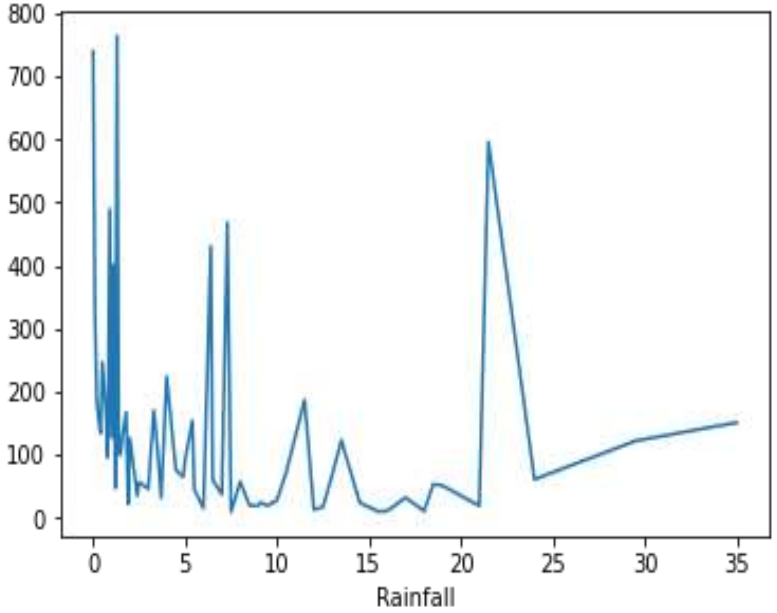
Analysis on Numerical Variables (Snow Fall)



- It can be analysed that renting of the bikes are maximum when there is no Snow but it decreases drastically after 4 cms of snowfall.
- Snowfall hinders renting a lot and reduces renting by around half.

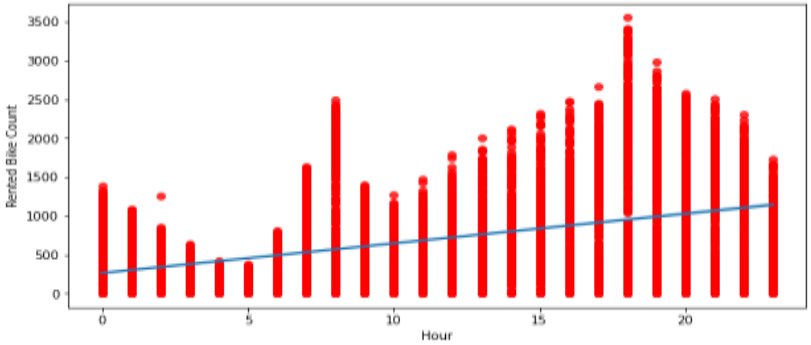
Exploratory Data Analysis

Analysis on Numerical Variables (Rain Fall)

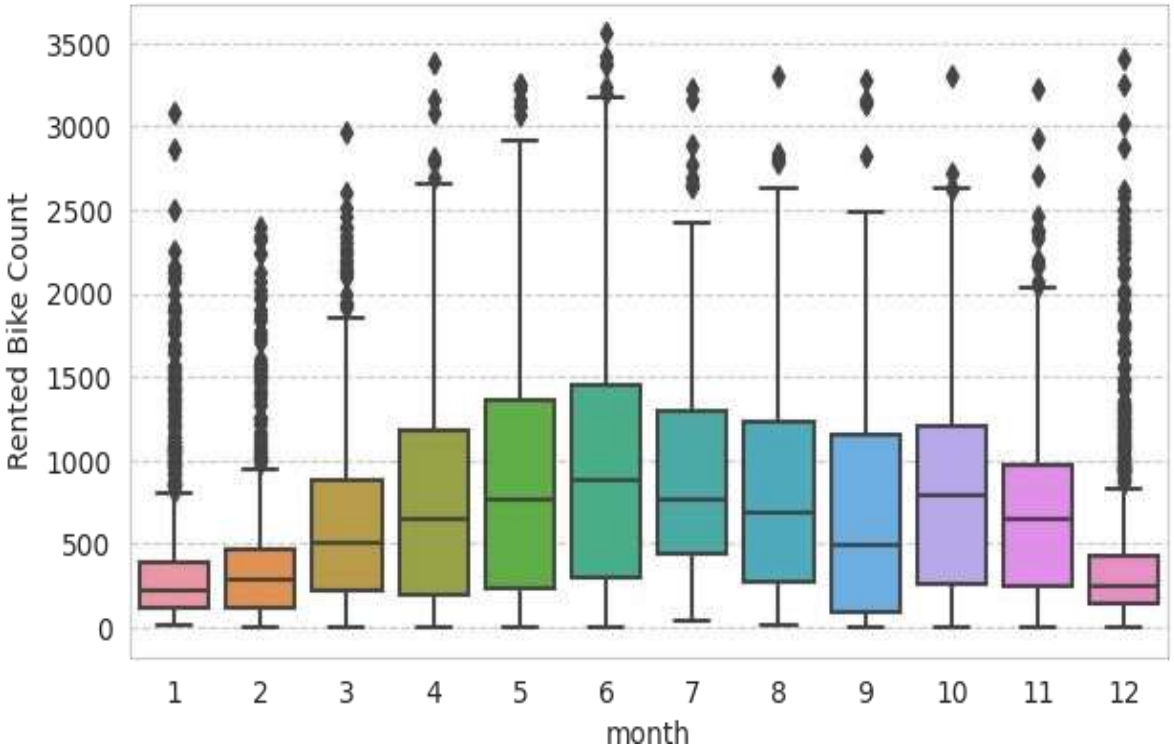


- It can be seen than opposite of expected , there is no decrease in the renting of the bikes even if its raining , intermittently there are surges in the renting numbers .

Regression Plot showing Linear Relationship with Target Variables



- Variables like Temperature , Hour ,wind speed ,visibility ,dew point temperature & solar radiation are Positively correlated to our Dependent variable (Rented bike count).
- Variables like Snow fall , Rain fall & Humidity are Negatively correlated .

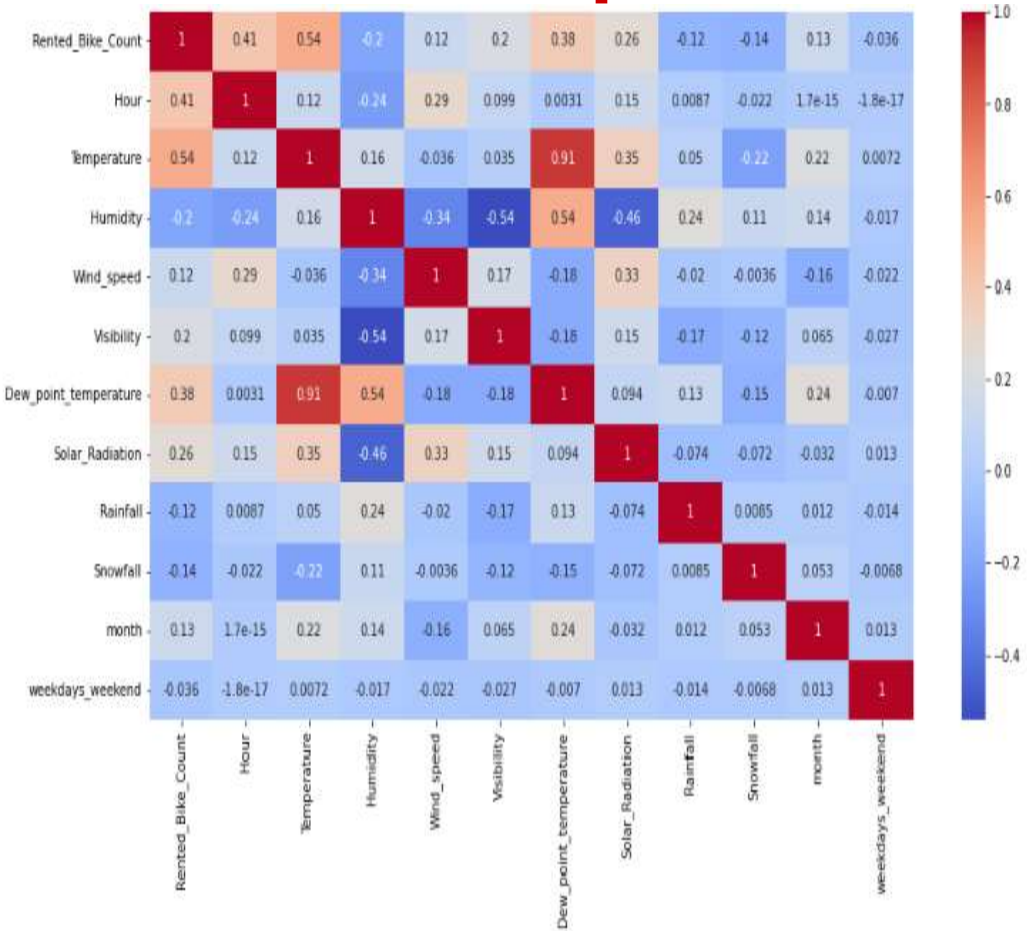


- We can see that there less demand of Rented bike in the month of December, January, February i.e. during winter seasons

- Also demand of bike is maximum during May, June, July i.e Summer seasons

Analysis on : Correlation Heat map

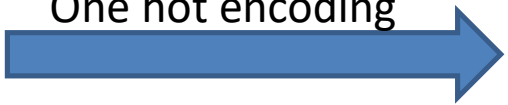
- From the Heatmap we can see that the temperature and Dew_point_ temperature have high correlation i.e, 0.91.
- Humidity is moderately correlated with Solar Radiation and Visibility



Feature Transformation

Due to the presence of categorical features we can't feed our data directly in ML algorithm. We need to transform categorical features that have string datatype to numerical data type . For which we have used One-hot encoding and label encoding for categorical features.

Seasons
Summer
Winter
Autumn
Spring



Summer	Winter	Autumn	Spring
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

Applying ML Algorithms
Machine Learning Model – Regression

Since we have to predict the count of rented bikes required per hour. Hence, we have to use regression algorithm.

Algorithms that we will use are:

- **Linear Regression**
- **Decision Tree**
- **Random Forest**
- **Elastic Net Regression**

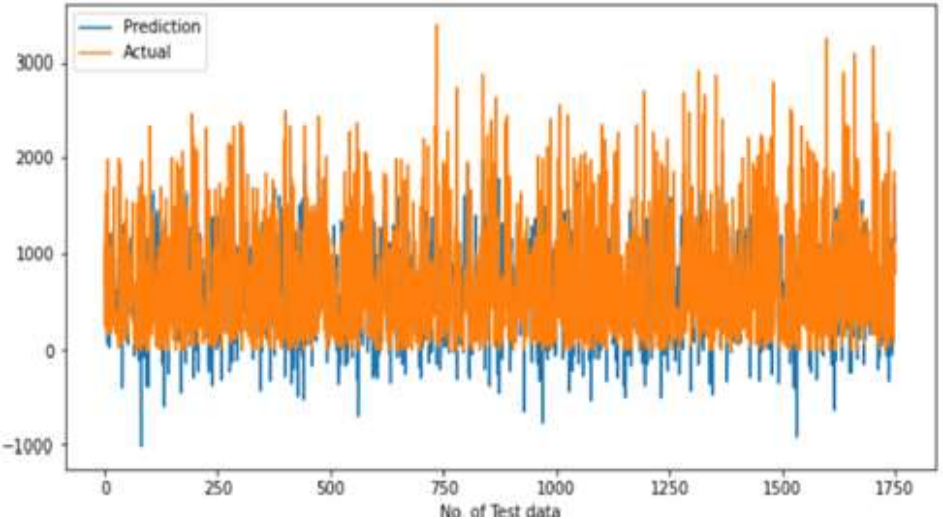
Linear Regression

Train Set Result

```
MSE: 140206.61624939015
RMSE: 374.44173945941196
MAE : 282.480522260274
R2_Score: 0.6638417466299076
```

Test Set Result

```
MSE: 136823.99994832542
RMSE: 369.8972829696447
MAE : 278.93567479799873
R2_score: 0.6673417356182685
```



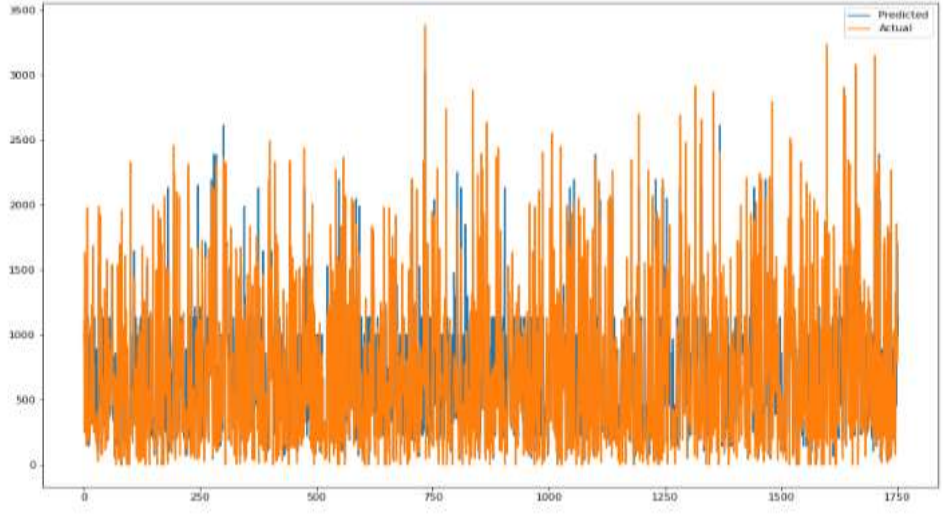
Decision Tree

Train Set Result

```
Model score: 0.5757435377609246
MSE: 176951.07109861638
RMSE: 420.6555254583213
MAE : 288.42324530629
R2_score: 0.5757435377609246
```

Test Set Result

```
MSE : 192208.7355797449
RMSE : 438.41616710580473
MAE : 304.7141588337355
R2 : 0.53268560777997
```



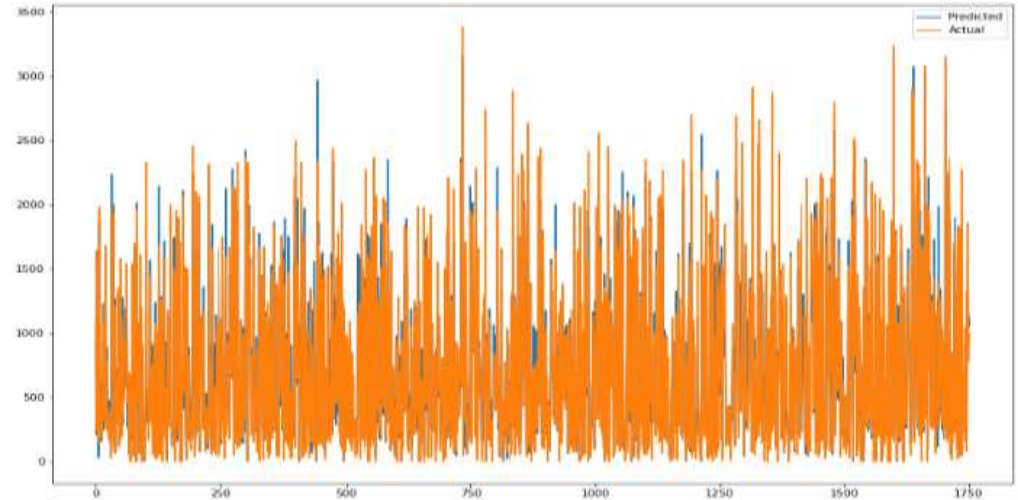
Random Forest

Train Set Result

```
Model Score: 0.9873599030046023
MSE: 5271.99677836758
RMSE: 72.60851725774036
MAE : 41.69463470319635
R2_score: 0.9873599030046023
```

Test Set Result

```
MSE : 32425.597170890414
RMSE : 180.07108921448332
MAE : 111.38534246575342
R2_Score : 0.9211641022007586
```



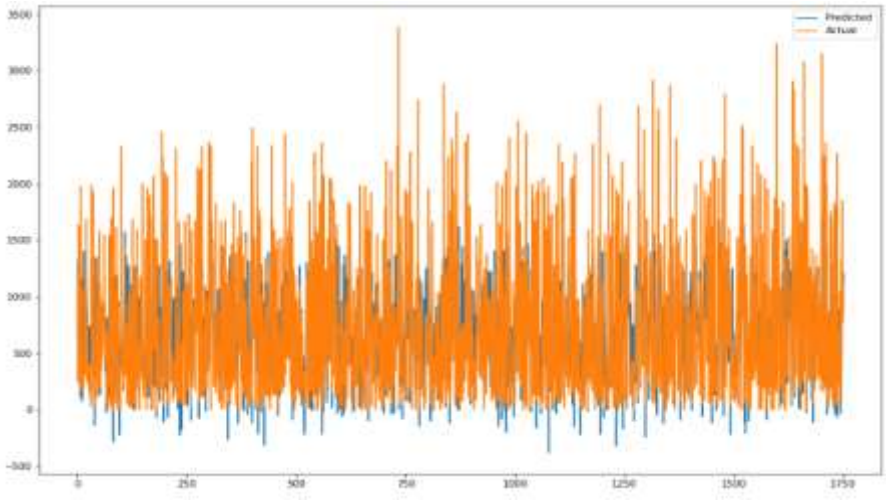
Elastic Net

Train Set Result

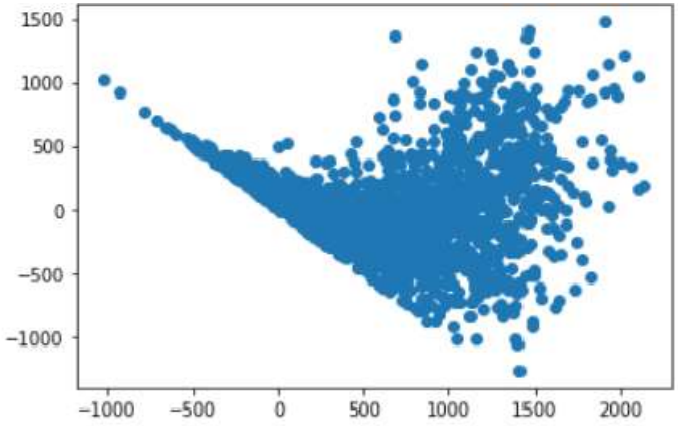
```
MSE : 177834.94694853635
RMSE : 421.704810203223
MAE : 309.0419441515174
R2 : 0.5736243641452045
```

Test Set Result

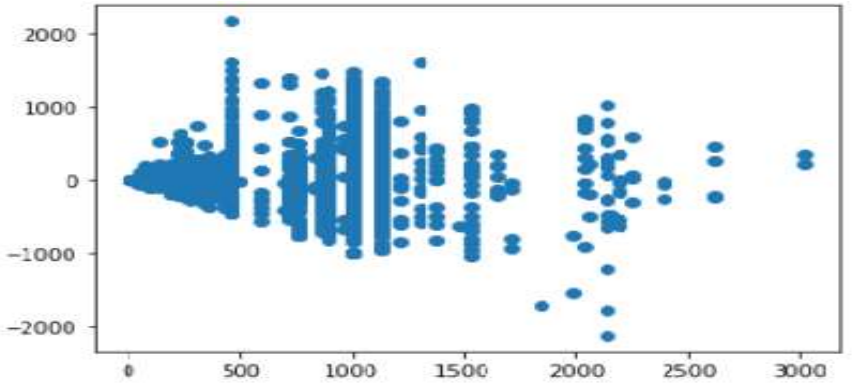
```
MSE : 175442.3949535531
RMSE : 418.8584426194046
MAE : 309.43682474292893
R2 : 0.5734493756485335
```



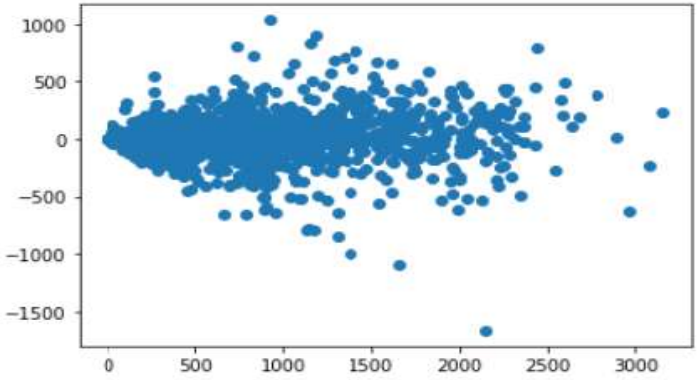
Heteroskedasticity Plot



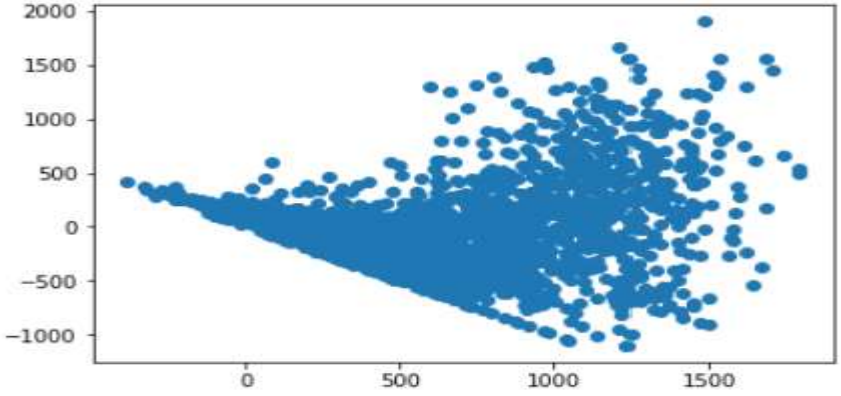
Linear Regression



Decision



Random



Elastic Net

Evaluating Models

Model	Train data-MSE	Test data-MSE	Train data-R2-Score	Test data-R2-Score
Linear Regression	187719.254	180420.863	0.553	0.552
Decision Tree	97693.175	101601.425	0.767	0.747
Random Forest	4273.174	27202.862	0.989	0.932
Elastic Net	199423.564	189394.369	0.525	0.531

Conclusion & Recommendations

- We implemented 4 Machine Learning algorithm Linear Regression, Decision Tree, Random Forest, Elastic Net.
- Random Forest Regressor gives highest R2 Score of around 99% for train set and 93% for test set
- Elastic net gives the lowest R2 Score of 52% for train set and 52% for test set.
- If there will be on an average of 1800-2000 number of Bikes in Seoul, then their 99% of demand , can be met with , considering any season like Summer, Winter , Autumn ,Spring or any weather like rain ,snowfall etc.