# HOUSE PRICE PREDICTION USING MACHINE LEARNING

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# Abstract

House price forecasting is an important topic of real estate. The literature attempts to derive useful knowledge from historical data of property markets. Machine learning techniques are applied to analyze historical property transactions in India to discover useful models for house buyers and sellers. Revealed is the high discrepancy between house prices in the most expensive and most affordable suburbs in the city of Mumbai. Moreover, experiments demonstrate that the Multiple Linear Regression that is based on mean squared error measurement is a competitive approach.

# INTRODUCTION

In recent years, the real estate market has witnessed substantial growth and complexity, making it challenging for both buyers and sellers to accurately determine property values. Traditional methods of property valuation often rely on subjective assessments or historical trends, which may not capture the intricate dynamics of the market. With the advent of machine learning, there is an opportunity to enhance the accuracy of house price predictions by leveraging advanced algorithms and data- driven models.

This project aims to employ machine learning techniques to predict house prices based on a set of relevant features. By utilizing historical sales data, property characteristics, and other influential factors, the model will learn patterns and correlations to make predictions on unseen data. The ultimate goal is to create a reliable and efficient tool for real estate stakeholders, providing them with valuable insights into property values.

## Aim

**These are the Parameters on which we will evaluate ourselves-**

- Create an effective price prediction model
- Validate the model’s prediction accuracy

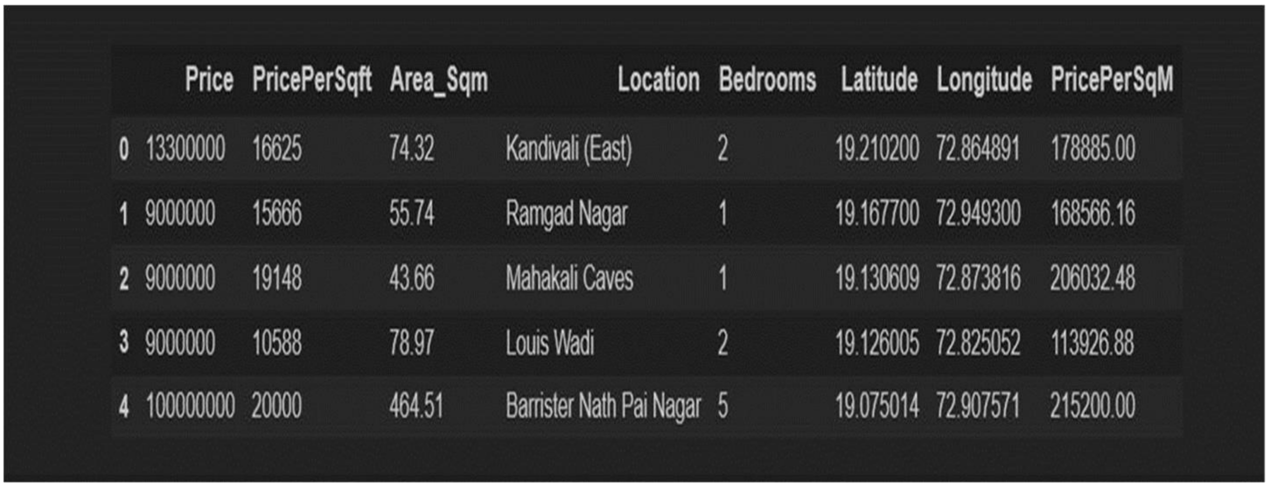
Identify the important home price attributes which feed the model’s predictive power.

# DATASET

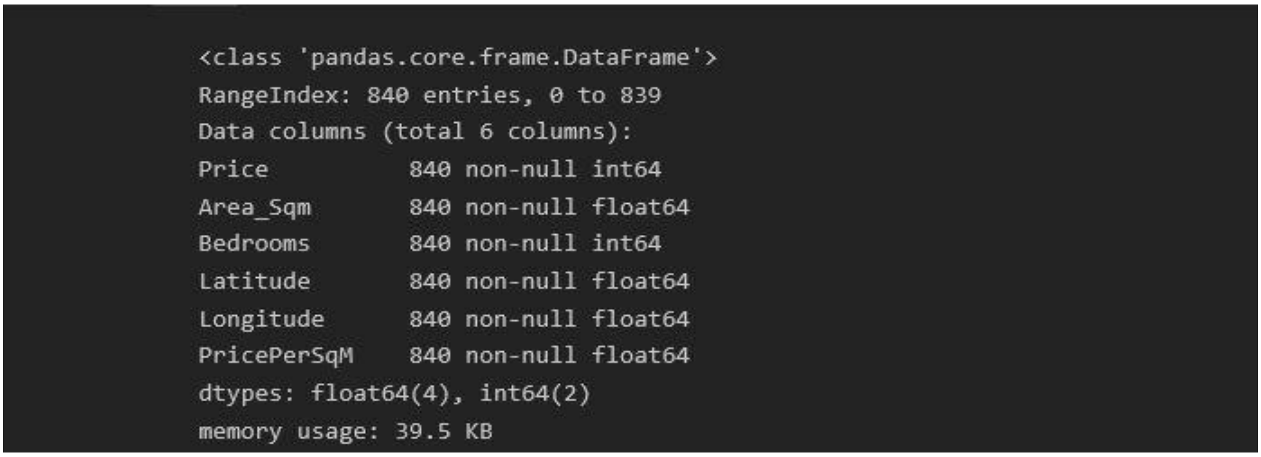
Here we have web scrapped the Data from 99acres.com website which is one of the leading real estate websites operating in INDIA.

Our Data contains Bombay Houses only.

## Dataset looks as follows-



| | Price | PricePerSqft | Area_Sqm | Location | Bedrooms | Latitude | Longitude | PricePerSqM |
|---|---|---|---|---|---|---|---|---|
| 0 | 13300000 | 16625 | 74.32 | Kandivali (East) | 2 | 19.210200 | 72.864891 | 178885.00 |
| 1 | 9000000 | 15666 | 55.74 | Ramgad Nagar | 1 | 19.167700 | 72.949300 | 168566.16 |
| 2 | 9000000 | 19148 | 43.66 | Mahakali Caves | 1 | 19.130609 | 72.873816 | 206032.48 |
| 3 | 9000000 | 10588 | 78.97 | Louis Wadi | 2 | 19.126005 | 72.825052 | 113926.88 |
| 4 | 100000000 | 20000 | 464.51 | Barrister Nath Pai Nagar | 5 | 19.075014 | 72.907571 | 215200.00 |



```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 840 entries, 0 to 839
Data columns (total 6 columns):
Price          840 non-null int64
Area_Sqm       840 non-null float64
Bedrooms       840 non-null int64
Latitude       840 non-null float64
Longitude      840 non-null float64
PricePerSqM    840 non-null float64
dtypes: float64(4), int64(2)
memory usage: 39.5 KB
```

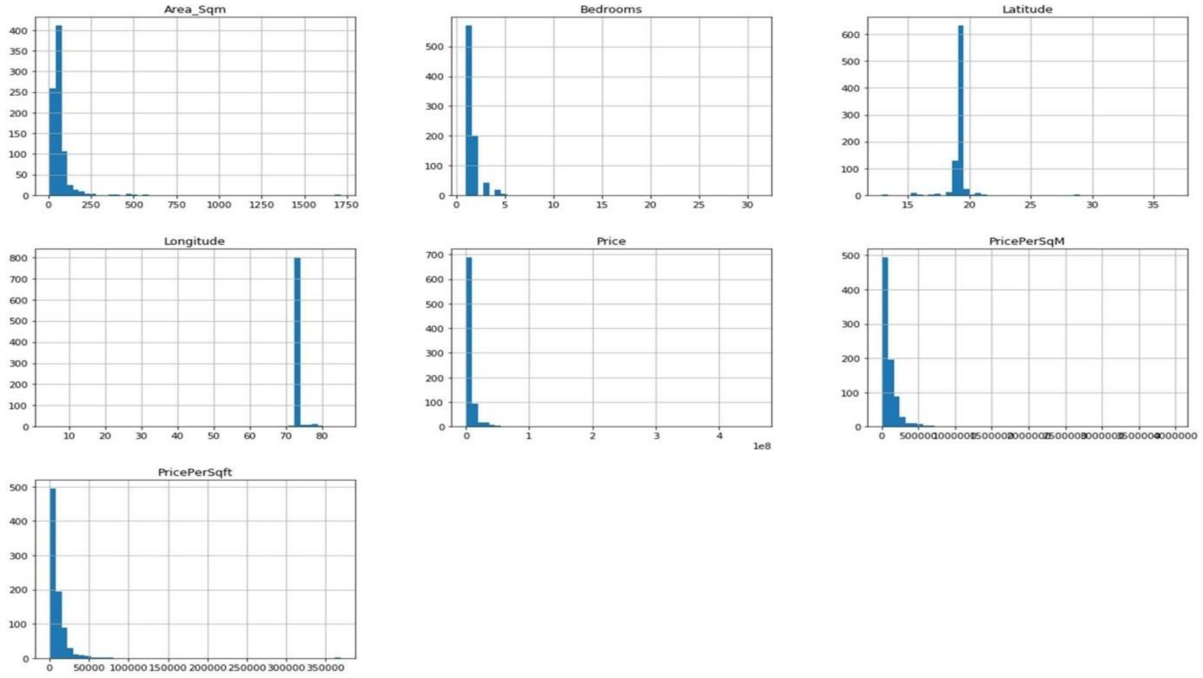
# Data Exploration

Data exploration is the first step in data analysis and typically involves summarizing the main characteristics of a data set, including its size, accuracy, initial patterns in the data and other attributes. It is commonly conducted by data analysts using visual analytics tools, but it can also be done in more advanced statistical software, Python. Before it can conduct analysis on data collected by multiple data sources and stored in data warehouses, an organization must know how many cases are in a data set, what variables are included, how many missing values there are and what general hypotheses the data is likely to support. An initial exploration of the data set can help answer these questions by familiarizing analysts with the data with which they are working.

We divided the data 9:1 for Training and Testing purpose respectively.

# Data Visualization

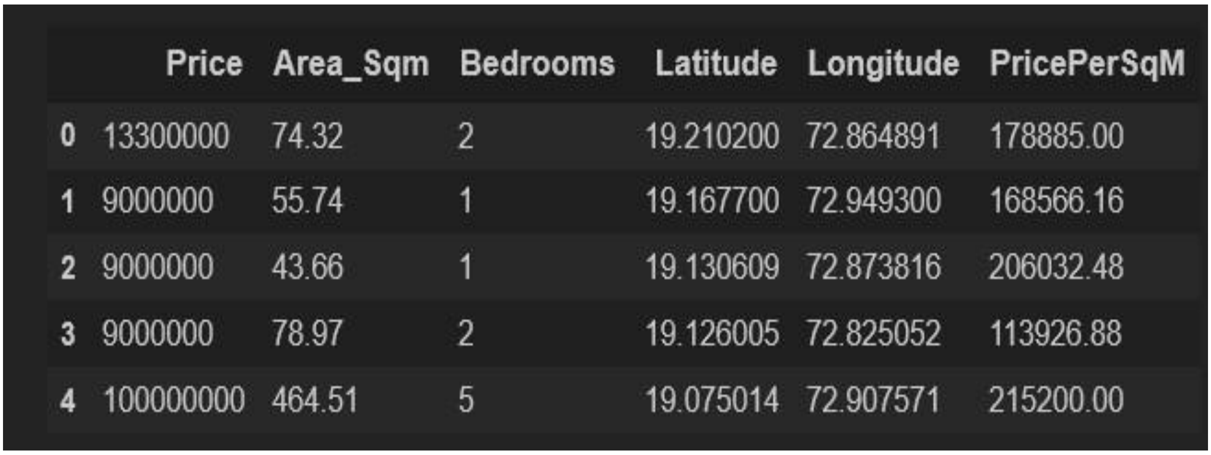
Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data. In the world of Big Data, data visualization tools and technologies are essential to analyse massive amounts of information and make data-driven decisions.



# Data Selection

Data selection is defined as the process of determining the appropriate data type and source, as well as suitable instruments to collect data. Data selection precedes the actual practice of data collection. This definition distinguishes data selection from selective data reporting (selectively excluding data that is not supportive of a research hypothesis) and interactive/active data selection (using collected data for monitoring activities/events, or conducting secondary data analyses). The process of selecting suitable data for a research project can impact data integrity.

The primary objective of data selection is the determination of appropriate data type, source, and instrument(s) that allow investigators to adequately answer research questions. This determination is often discipline-specific and is primarily driven by the nature of the investigation, existing literature, and accessibility to necessary data sources.



| | Price | Area_Sqm | Bedrooms | Latitude | Longitude | PricePerSqM |
|---|---|---|---|---|---|---|
| 0 | 13300000 | 74.32 | 2 | 19.210200 | 72.864891 | 178885.00 |
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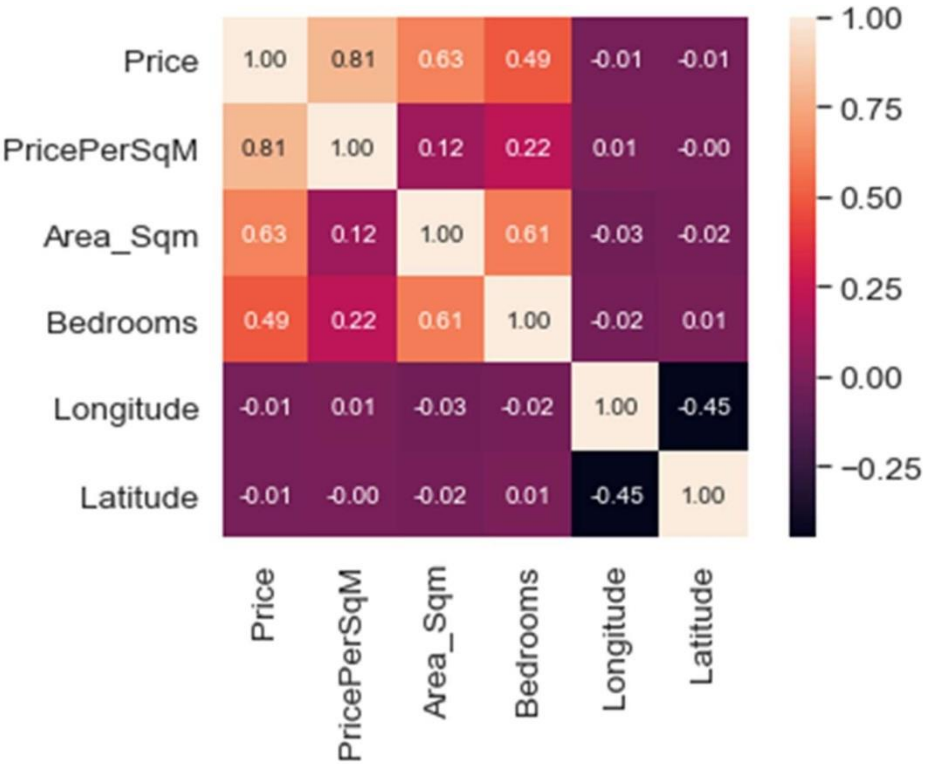
| 3 | 9000000 | 78.97 | 2 | 19.126005 | 72.825052 | 113926.88 |
| 4 | 100000000 | 464.51 | 5 | 19.075014 | 72.907571 | 215200.00 |

## Correlation Heatmap

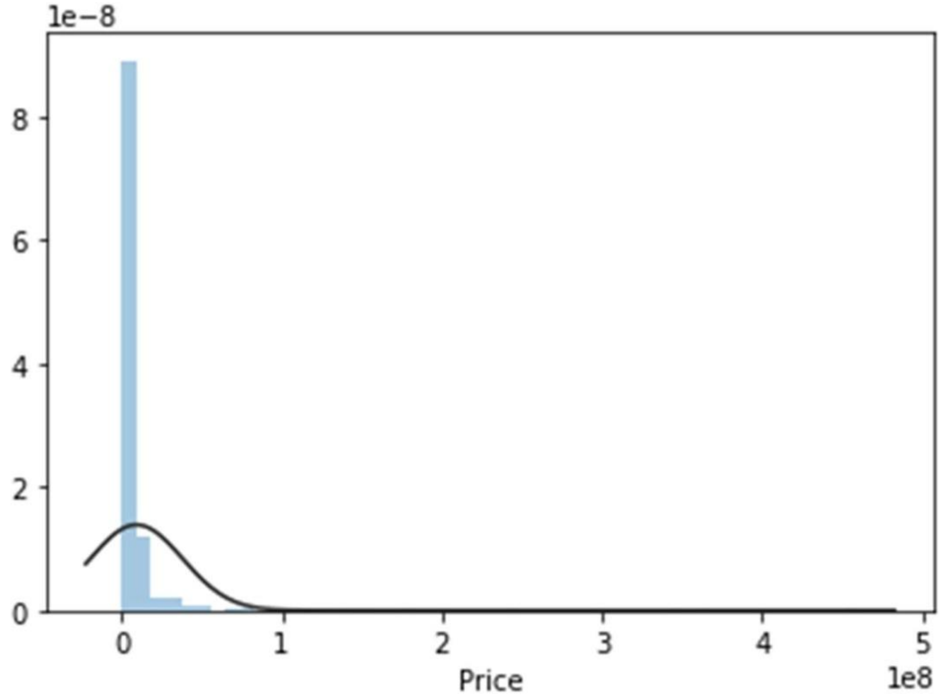


# Data Transformation

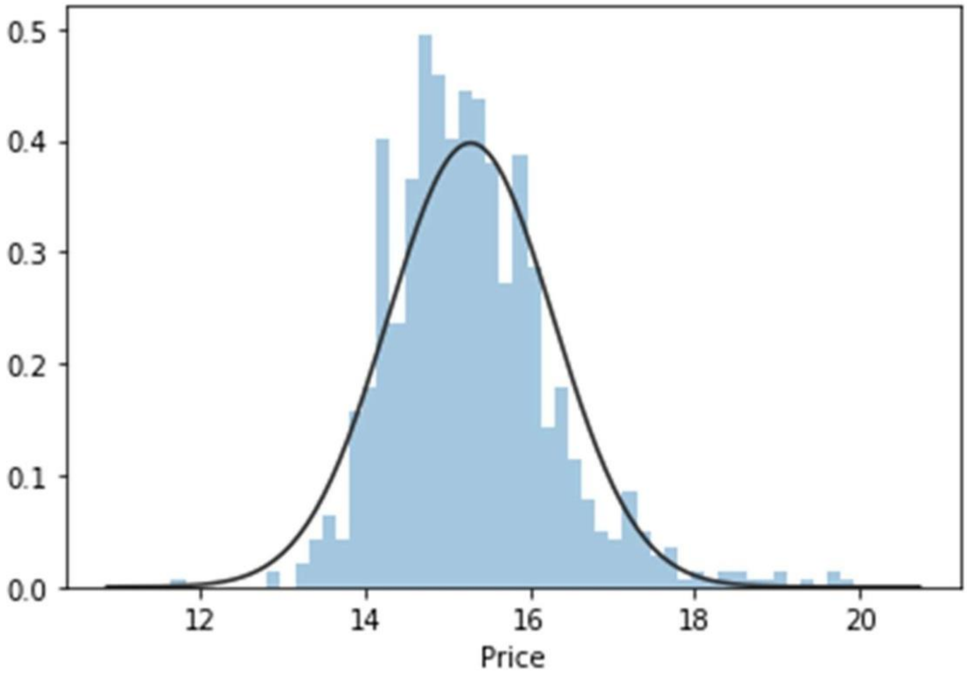
The log transformation can be used to make highly skewed distributions less skewed. This can be valuable both for making patterns in the data more interpretable and for helping to meet the assumptions of inferential statistics.

It is hard to discern a pattern in the upper panel whereas the strong relationship is shown clearly in the lower panel. The comparison of the means of log-transformed data is actually a comparison of geometric means. This occurs because, as shown below, the anti-log of the arithmetic mean of log-transformed values is the geometric mean.

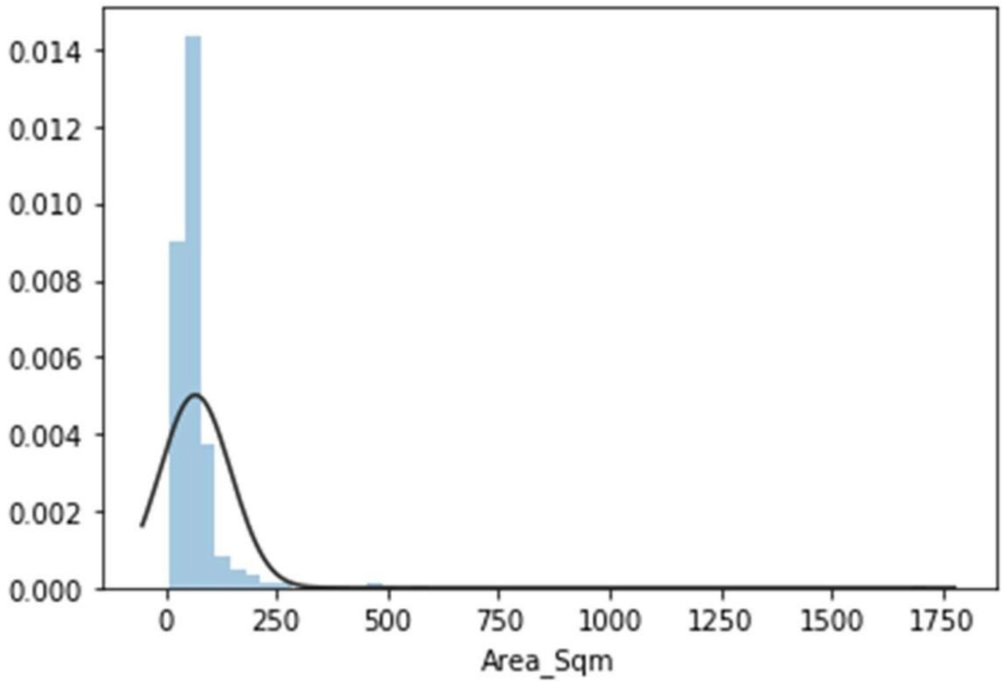
## Skewed Price



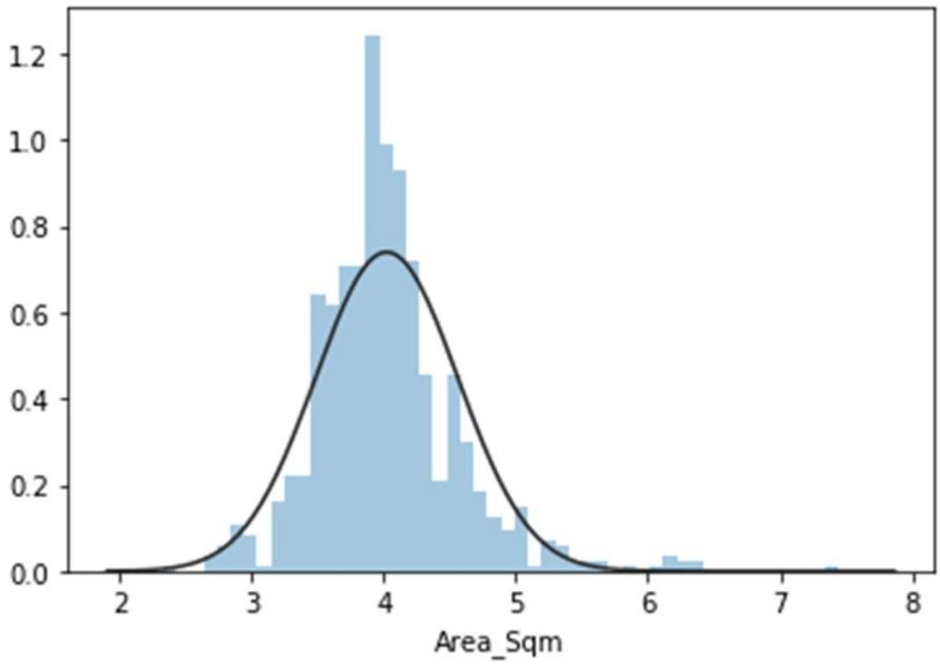
## Normal Price



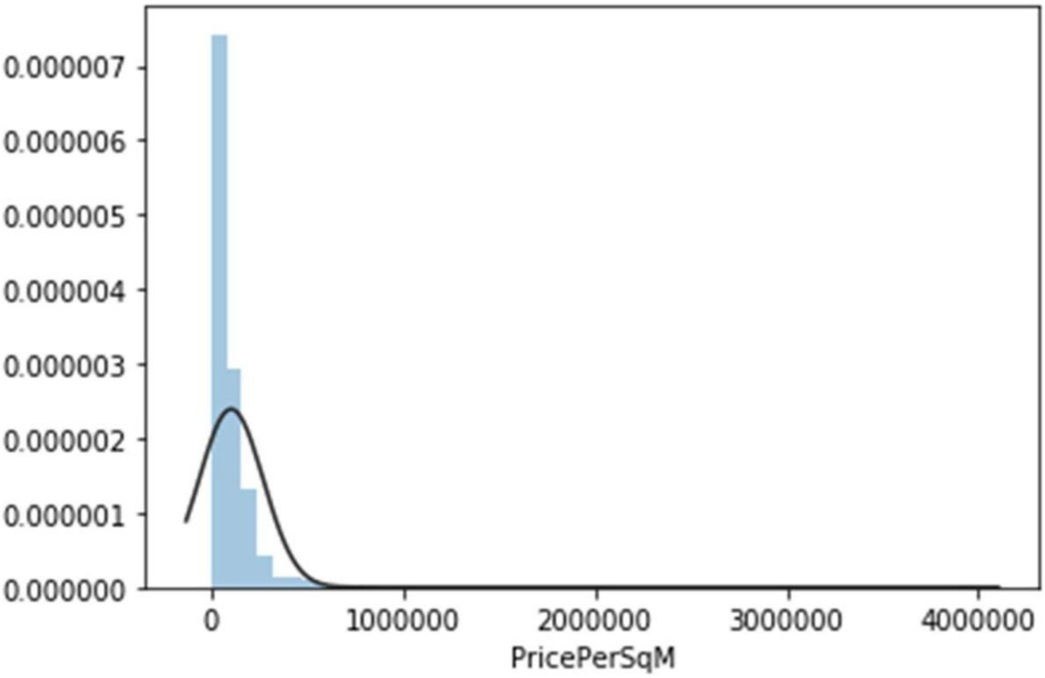
## Skewed Area



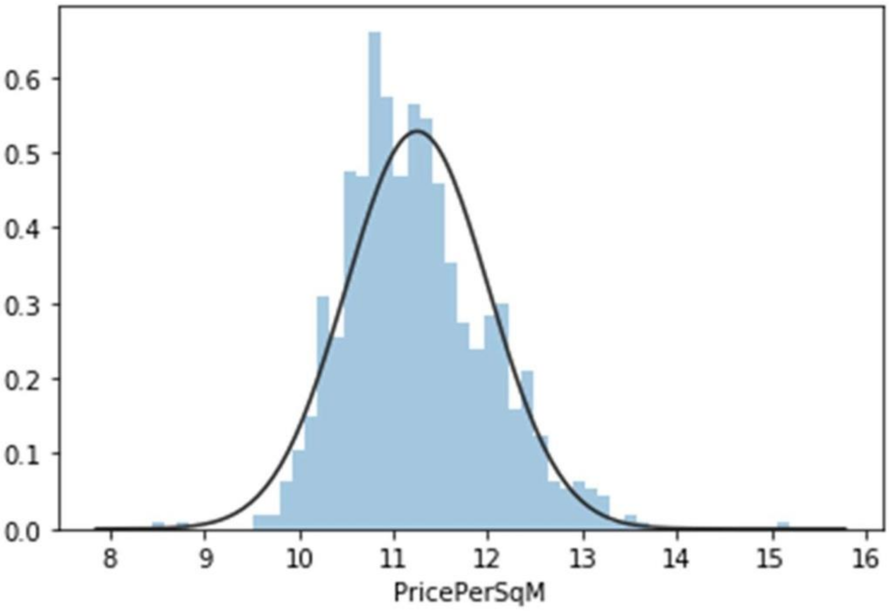
## Normal Area



**Skewed Price/Sq.**



**Normal Price/Sq.**



# LANGUAGE AND MODELS USED

## Python

Python is widely used in scientific and numeric computing:

- SciPy is a collection of packages for mathematics, science, and engineering.
- Pandas is a data analysis and modelling library.
- IPython is a powerful interactive shell that features easy editing and recording of a work session, and supports visualizations and parallel computing.
- The Software Carpentry Course teaches basic skills for scientific computing, running bootcamps and providing open-access teaching materials.

## Libraries Used for this Project include –

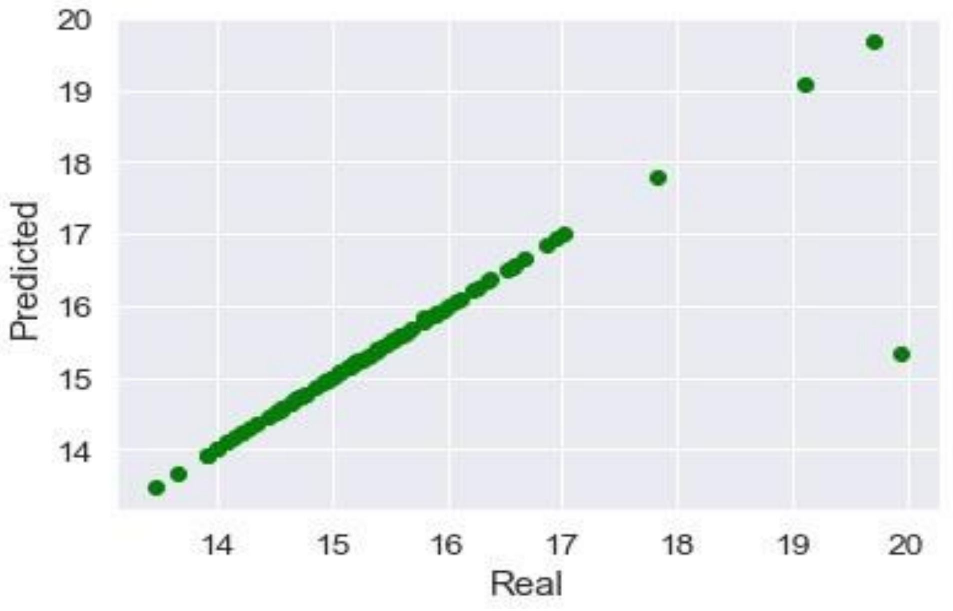
- **Pandas**
- **NumPy**
- **Matplotlib**
- **Seaborn**
- **Scikit Learn**
- **XG Boost**

# MODELS USED

## Regression Model

- Linear Regression is a machine learning algorithm based on supervised learning.
- It performs a regression task. Regression models a target prediction value based on independent variables.
- It is mostly used for finding out the relationship between variables and forecasting.

### Real Vs Predicted



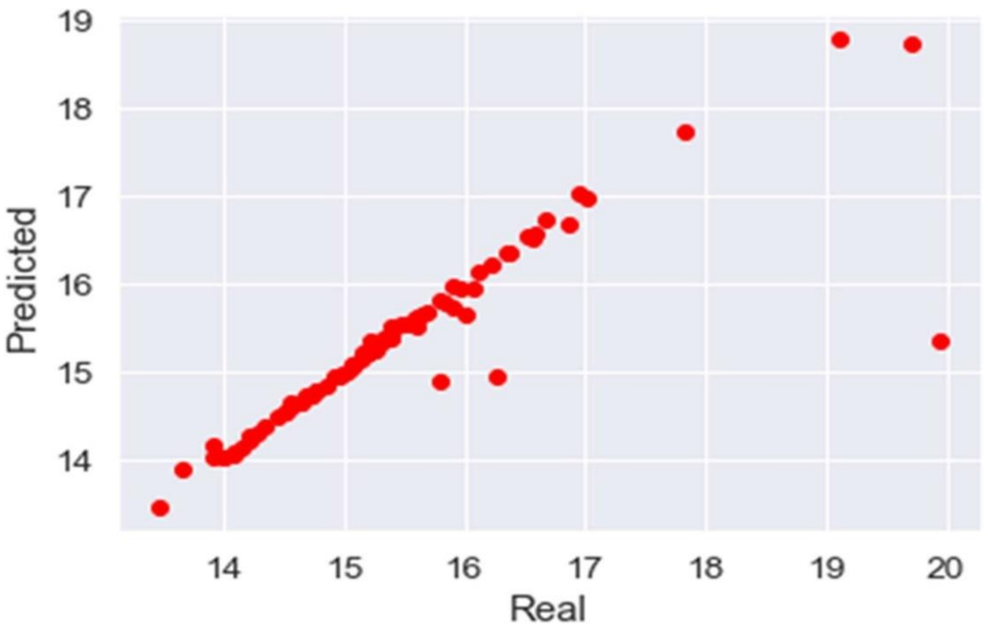
# Random Forest Regression Model

- A Random Forest is an ensemble technique capable of performing both regression and classification tasks with the use of multiple decision trees and a technique called Bootstrap Aggregation, commonly known as bagging.

- Bagging, in the Random Forest method, involves training each decision tree on a different data sample where sampling is done with replacement.

- The basic idea behind this is to combine multiple decision trees in determining the final output rather than relying on individual decision trees.

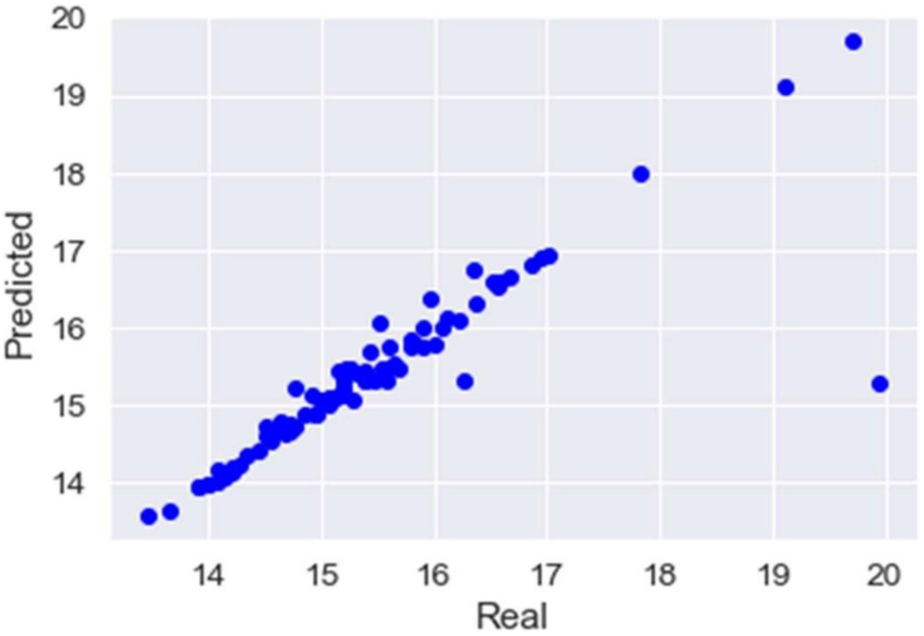
## Real Vs Predicted



# XG Boost Regressor Model

- XG Boost stands for eXtreme Gradient Boosting.
- The XG Boost library implements the gradient boosting decision tree algorithm.
- Boosting is an ensemble technique where new models are added to correct the errors made by existing models.
- Models are added sequentially until no further improvements can be made.

## Real Vs Predicted



# RESULTS AND DISCUSSIONS

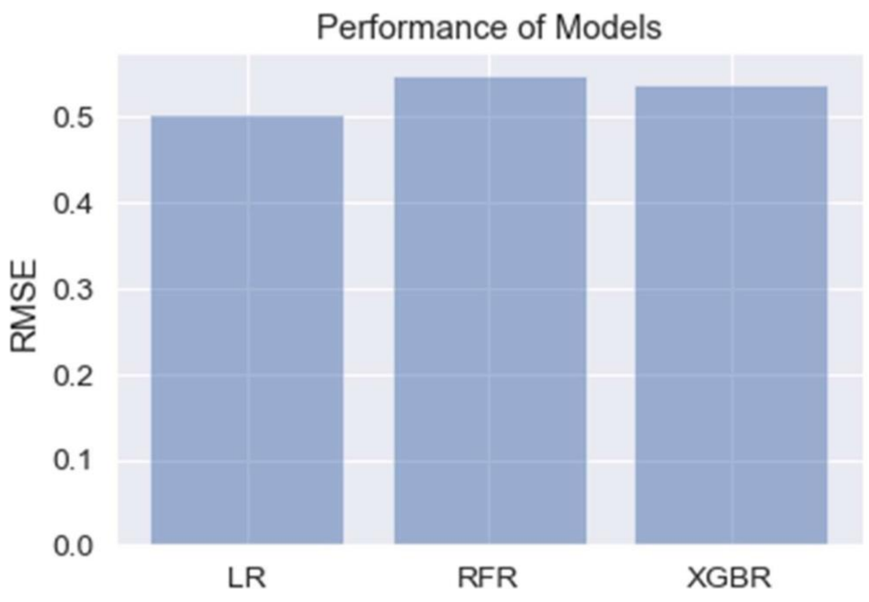
## Best Suited Model

So, our study showed that……..

Linear Regression displayed the best performance for this Dataset and can be used for deploying purposes.

Random Forest Regressor and XGBoost Regressor are far behind, so can’t be recommended for further deployment purposes.

## RMSE Bar Graph



# Conclusion

So, our Aim is achieved as we have successfully ticked all our parameters as mentioned in our Aim Column. It is seen that circle rate is the most effective attribute in predicting the house price and that the Linear Regression is the most effective model for our Dataset with RMSE score of **0.5025658262899986**.