Arnav Singh

Applied Data Science

Assignment 3

1. Download the dataset: https://drive.google.com/file/d/1NtOKehSz8SiVnk0cPZX5TFndug4SYL5T/view

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import OneHotEncoder, StandardScaler
from sklearn.compose import ColumnTransformer
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
```

2. Load the dataset into the tool.

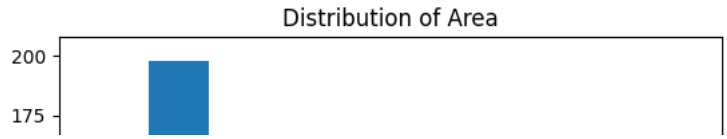
```
data_frame = pd.read_csv('Housing.csv')
data_frame.head()
```

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnishin
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	f
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	f
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	semi-f
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	f
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	f

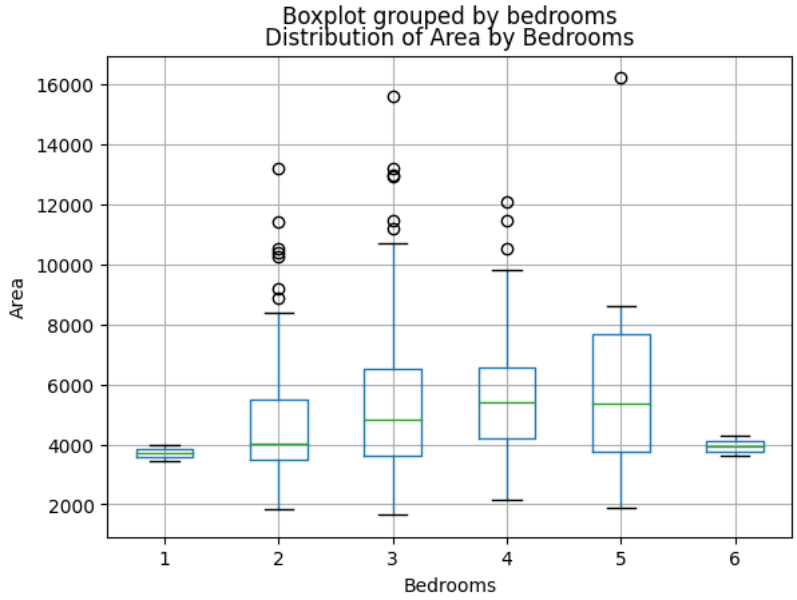
3. Perform Below Visualizations.

- Univariate Analysis
- Bi - Variate Analysis
- Multi - Variate Analysis

```
# Univariate Analysis
# Distribution of age
plt.hist(data_frame['area'])
plt.xlabel('Area')
plt.ylabel('Frequency')
plt.title('Distribution of Area')
plt.show()
```

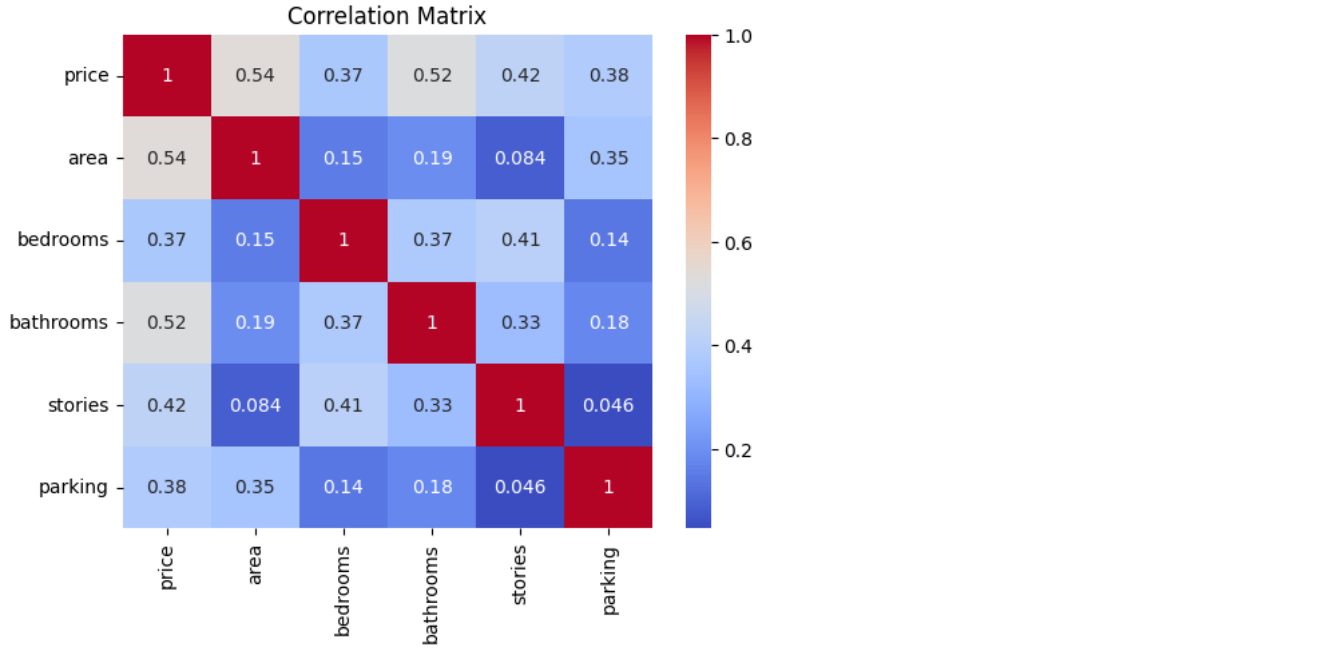



```
#Bivariate Analysis:
data_frame.boxplot(column='area', by='bedrooms')
plt.xlabel('Bedrooms')
plt.ylabel('Area')
plt.title('Distribution of Area by Bedrooms')
plt.show()
```




```
#Multivariate Analysis:
corr_matrix = data_frame.corr()
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```

```
<ipython-input-58-7bd7e32c7603>:2: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future ve
  corr_matrix = data_frame.corr()
```



4. Perform descriptive statistics on the dataset.

```
#Numerical variables
data_frame.describe()
```

	price	area	bedrooms	bathrooms	stories	parking
count	5.450000e+02	545.000000	545.000000	545.000000	545.000000	545.000000
mean	4.766729e+06	5150.541284	2.965138	1.286239	1.805505	0.693578
std	1.870440e+06	2170.141023	0.738064	0.502470	0.867492	0.861586
min	1.750000e+06	1650.000000	1.000000	1.000000	1.000000	0.000000
25%	3.430000e+06	3600.000000	2.000000	1.000000	1.000000	0.000000
50%	4.340000e+06	4600.000000	3.000000	1.000000	2.000000	0.000000
75%	5.740000e+06	6360.000000	3.000000	2.000000	2.000000	1.000000
max	1.330000e+07	16200.000000	6.000000	4.000000	4.000000	3.000000

```
#Categorical variables
data_frame.describe(include='object')
```

	mainroad	guestroom	basement	hotwaterheating	airconditioning	furnishingstatus
count	545	545	545	545	545	545
unique	2	2	2	2	2	3
top	yes	no	no	no	no	semi-furnished
freq	468	448	354	520	373	227

5. Handle the Missing values.

```
data_frame.isnull().sum()
```

```
price             0
area              0
bedrooms          0
bathrooms         0
stories           0
mainroad          0
guestroom         0
basement          0
hotwaterheating   0
airconditioning   0
parking           0
furnishingstatus  0
dtype: int64
```

No missing value.

6. Find the outliers and replace the outliers

```
# Define a function to identify and replace outliers using Z-score
def replace_outliers_zscore(data, column, threshold):
    z_scores = (data_frame[column] - data_frame[column].mean()) / data_frame[column].std()
    data_frame[column] = np.where(abs(z_scores) > threshold, data_frame[column].median(), data_frame[column])

# Specify the columns to check for outliers and the threshold value
columns_to_check = ['area', 'price']
z_score_threshold = 3

# Replace outliers using Z-score method
for column in columns_to_check:
    replace_outliers_zscore(data_frame, column, z_score_threshold)

# Print the updated dataset with replaced outliers
print(data_frame)
```

```
         price    area  bedrooms  bathrooms  stories mainroad guestroom  \
0    4340000.0  7420.0         4          2        3      yes        no
1    4340000.0  8960.0         4          4        4      yes        no
2    4340000.0  9960.0         3          2        2      yes        no
3    4340000.0  7500.0         4          2        2      yes        no
4    4340000.0  7420.0         4          1        2      yes       yes
..         ...     ...       ...        ...      ...      ...       ...
540  1820000.0  3000.0         2          1        1      yes        no
541  1767150.0  2400.0         3          1        1       no        no
542  1750000.0  3620.0         2          1        1      yes        no
543  1750000.0  2910.0         3          1        1       no        no
```

```
544  1750000.0  3850.0         3          1        2      yes        no

    basement hotwaterheating airconditioning  parking furnishingstatus
0         no              no             yes        2        furnished
1         no              no             yes        3        furnished
2        yes              no              no        2   semi-furnished
3        yes              no             yes        3        furnished
4        yes              no             yes        2        furnished
..       ...             ...             ...      ...              ...
540      yes              no              no        2      unfurnished
541       no              no              no        0   semi-furnished
542       no              no              no        0      unfurnished
543       no              no              no        0        furnished
544       no              no              no        0      unfurnished

[545 rows x 12 columns]
```

7. Check for Categorical columns and perform encoding.

```
data_frame['mainroad'] = data_frame['mainroad'].astype('category')
data_frame['mainroad'] = data_frame['mainroad'].cat.codes

data_frame['guestroom'] = data_frame['guestroom'].astype('category')
data_frame['guestroom'] = data_frame['guestroom'].cat.codes

data_frame['basement'] = data_frame['basement'].astype('category')
data_frame['basement'] = data_frame['basement'].cat.codes

data_frame['hotwaterheating'] = data_frame['hotwaterheating'].astype('category')
data_frame['hotwaterheating'] = data_frame['hotwaterheating'].cat.codes

data_frame['airconditioning'] = data_frame['airconditioning'].astype('category')
data_frame['airconditioning'] = data_frame['airconditioning'].cat.codes


code_mapping_furniture = {'unfurnished':0, 'semi-furnished':1, 'furnished':2}
data_frame['furnishingstatus'] = data_frame['furnishingstatus'].astype('category')
data_frame['furnishingstatus'] = data_frame['furnishingstatus'].map(code_mapping_furniture)
data_frame
```

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furni
0	4340000.0	7420.0	4	2	3	1	0	0	0	1	2	
1	4340000.0	8960.0	4	4	4	1	0	0	0	1	3	
2	4340000.0	9960.0	3	2	2	1	0	1	0	0	2	
3	4340000.0	7500.0	4	2	2	1	0	1	0	1	3	
4	4340000.0	7420.0	4	1	2	1	1	1	0	1	2	
...	...	...	...	...	...	...	...	...	...	...	...	
540	1820000.0	3000.0	2	1	1	1	0	1	0	0	2	
541	1767150.0	2400.0	3	1	1	0	0	0	0	0	0	
542	1750000.0	3620.0	2	1	1	1	0	0	0	0	0	
543	1750000.0	2910.0	3	1	1	0	0	0	0	0	0	
544	1750000.0	3850.0	3	1	2	1	0	0	0	0	0	

545 rows × 12 columns

8. Split the data into dependent and independent variables.

```
x = data_frame.drop(columns = 'price')
y = data_frame['price']
y_max = max(data_frame['price'])
print(y_max)
```

```
10150000.0
```

9. Scale the independent variables

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
X_scaled = X.copy()
X_scaled[numerical_cols] = scaler.fit_transform(X[numerical_cols])
```

```
numerical_cols = X.select_dtypes(include=['int64', 'float64']).columns
X_scaled
```

	area	bedrooms	bathrooms	stories	parking	mainroad_no	mainroad_yes	guestroom_no	guestroom_yes	basement_no	baseme
0	1.237672	1.403419	1.421812	1.378217	1.517692	0	1	1	0	1	
1	2.036247	1.403419	5.405809	2.532024	2.679409	0	1	1	0	1	
2	2.554802	0.047278	1.421812	0.224410	1.517692	0	1	1	0	0	
3	1.279156	1.403419	1.421812	0.224410	2.679409	0	1	1	0	0	
4	1.237672	1.403419	-0.570187	0.224410	1.517692	0	1	0	1	0	
...	...	...	...	...	...	...	...	...	...	...	
540	-1.054343	-1.308863	-0.570187	-0.929397	1.517692	0	1	1	0	0	
541	-1.365476	0.047278	-0.570187	-0.929397	-0.805741	1	0	1	0	1	
542	-0.732839	-1.308863	-0.570187	-0.929397	-0.805741	0	1	1	0	1	
543	-1.101013	0.047278	-0.570187	-0.929397	-0.805741	1	0	1	0	1	
544	-0.613571	0.047278	-0.570187	0.224410	-0.805741	0	1	1	0	1	

545 rows × 18 columns

10. Split the data into training and testing

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X_scaled,y, test_size = 0.3, random_state = 0)
print("Done")
```

```
Done
```

11. Build the Model and 12. Train the Model

```
model = LinearRegression()
model.fit(x_train, y_train)
print("Done")
```

```
Done
```

```
model = LinearRegression()
model.fit(x_train, y_train)
print("Done")
```

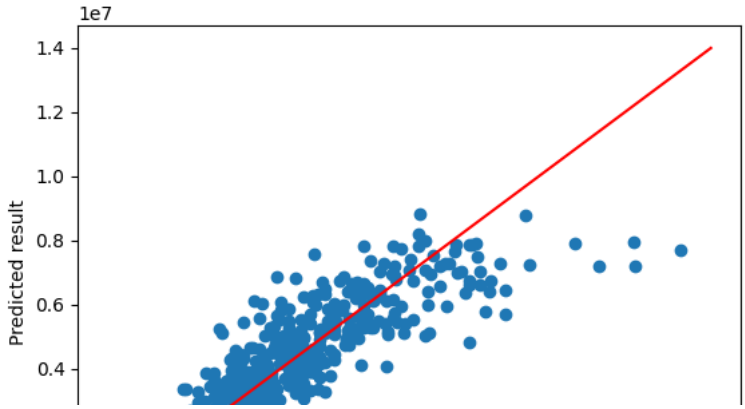
```
Done
```

```
y_pred_train = model.predict(x_train)
print("Done")
```

```
Done
```

```
import matplotlib.pyplot as plt
plt.scatter(y_train, y_pred_train)
plt.xlabel("Actual result")
plt.ylabel("Predicted result")
x_point = np.array([0,14000000])
y_point = np.array([0,14000000])
# max value of y is around 13 million
plt.plot(x_point, y_point, c = 'r')
print("RESULT WITH TRAINED DATA")
print("Number of data train: ", len(x_train))
plt.show()
```

```
RESULT WITH TRAINED DATA
Number of data train:  381
```



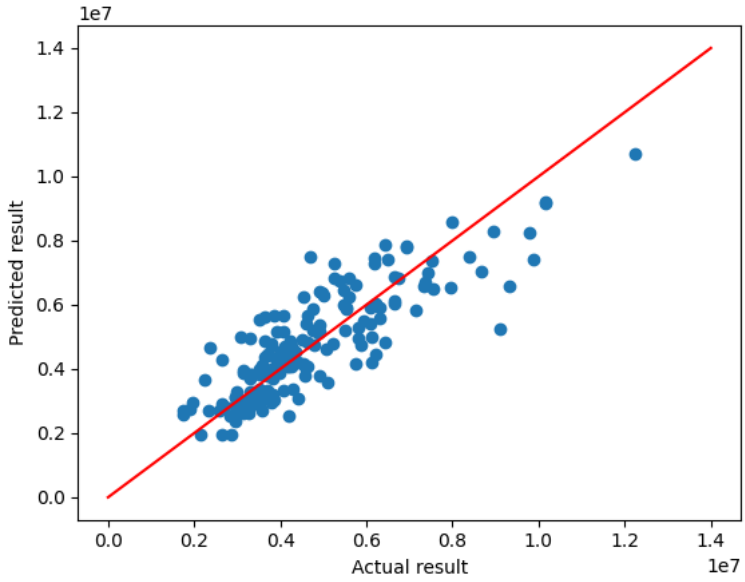
13. Test the Model

```
y_pred_test = model.predict(x_test)
print("Done")
```

```
Done
```

```
import matplotlib.pyplot as plt
plt.scatter(y_test, y_pred_test)
plt.xlabel("Actual result")
plt.ylabel("Predicted result")
x_point = np.array([0,14000000])
y_point = np.array([0,14000000])
plt.plot(x_point, y_point, c = 'r')
print("RESULT WITH TESTED DATA")
print("Number of data test: ", len(x_test))
plt.show()
```

```
RESULT WITH TESTED DATA
Number of data test:  164
```



14. Measure the performance using Metrics.

```
from sklearn.metrics import r2_score
r2_score_with_test = r2_score(y_test, y_pred_test)
print(r2_score_with_test)
```

```
0.5988502150753243
```

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