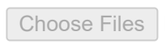
Dataset Link:

```
from google.colab import files
uploaded = files.upload()
```




```
Saving House_Rent_Dataset.csv to House_Rent_Dataset.csv
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api  as sm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,confusion_matrix
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
```

Importing Data:

Randomly shuffle the dataset by taking a random seed of “42”. Create a testing set from the last 1000 rows of the dataframe (these must be the same for all the students). The remaining rows will be the training + validation set, with training : validation ratio of 80% : 20%. Determine

A) number of rows in training, validation and test sets, along with the structure, datatypes and value counts of the dataframes.

```
df=pd.read_csv('House_Rent_Dataset.csv')
X=df[['Size','BHK','Bathroom','City','Area Type']]
Y=df['Rent']
X_train,X_test,Y_train,Y_test=train_test_split(X,Y, test_size=0.2, train_size=0.8, random_state=42 ,shuffle=True, stratify=None)
print("Size(rows) of training data is",len(X_train))
print("Size(rows) of testing data is",len(X_test))
print("Data types of training data(X) are ",X_train.dtypes)
print("                            ")
print("Exploring training data as(X) : ",X_train.describe())
print("Data types of testing data(X) are ",X_test.dtypes)
print("                            ")
print("Exploring testing data as(X) : ",X_test.describe())
```

```
Size(rows) of training data is 3796
Size(rows) of testing data is 950
Data types of training data(X) are  Size          int64
BHK           int64
Bathroom      int64
City         object
Area Type    object
dtype: object

Exploring training data as(X) :                Size          BHK     Bathroom
```

```
count  3796.000000  3796.000000  3796.000000
mean    967.095627     2.090358     1.968388
std     635.144783     0.838784     0.886468
min      10.000000     1.000000     1.000000
25%     550.000000     2.000000     1.000000
50%     850.000000     2.000000     2.000000
75%    1200.000000     3.000000     2.000000
max    8000.000000     6.000000    10.000000
Data types of testing data(X) are  Size          int64
BHK           int64
Bathroom      int64
City         object
Area Type    object
dtype: object

Exploring testing data as(X) :               Size         BHK    Bathroom
count   950.000000  950.000000  950.000000
mean    969.069474    2.057895    1.955789
std     630.753003    0.805550    0.877144
min      48.000000    1.000000    1.000000
25%     572.500000    2.000000    1.000000
50%     850.000000    2.000000    2.000000
75%    1200.000000    3.000000    2.000000
max    7000.000000    5.000000    7.000000
```

Data Cleaning:

1. Analyse the data and identify which columns are not relevant for house rent prediction task. Drop those columns from the dataframes.

```
new_df=df.drop(['Posted On','Point of Contact','Area Locality','Floor'], axis=1)
new_df
```

	BHK	Rent	Size	Area Type	City	Furnishing Status	Tenant Preferred	Bathroom
0	2	10000	1100	Super Area	Kolkata	Unfurnished	Bachelors/Family	2
1	2	20000	800	Super Area	Kolkata	Semi-Furnished	Bachelors/Family	1
2	2	17000	1000	Super Area	Kolkata	Semi-Furnished	Bachelors/Family	1
3	2	10000	800	Super Area	Kolkata	Unfurnished	Bachelors/Family	1
4	2	7500	850	Carpet Area	Kolkata	Unfurnished	Bachelors	1
...	...	...	...	...	...	...	...	...
4741	2	15000	1000	Carpet Area	Hyderabad	Semi-Furnished	Bachelors/Family	2
4742	3	29000	2000	Super Area	Hyderabad	Semi-Furnished	Bachelors/Family	3
4743	3	35000	1750	Carpet Area	Hyderabad	Semi-Furnished	Bachelors/Family	3
4744	3	45000	1500	Carpet Area	Hyderabad	Semi-Furnished	Family	2
4745	2	15000	1000	Carpet Area	Hyderabad	Unfurnished	Bachelors	2

4746 rows × 8 columns

2. Check for missing values and logically impute the dataset.

```
print("Misssing values in original data : ")
print(new_df.isnull().sum())
print("                                  ")
print("Missing values in training data")        # no  missing values in orginal data and training and testing data
print(X_train.isnull().sum())
```

```
Misssing values in original data :
BHK                 0
Rent                0
Size                0
Area Type           0
City                0
Furnishing Status   0
Tenant Preferred    0
Bathroom            0
dtype: int64

Missing values in training data
Size         0
BHK          0
Bathroom     0
City         0
Area Type    0
dtype: int64
```

3. Identify any categorical valued columns (non-numeric) and convert them to numeric.

```
print("Number of duplicates values", new_df.duplicated().sum())
```

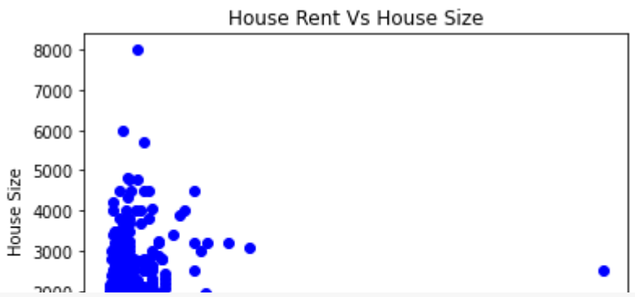
```
Number of duplicates values 277
```

Exploratory Analysis (On training set):

1. Plot the house rents against the dependent variable of “size”. See if there is a uniform linear trend between the dependent and independent variables. Make accurate axis and legend. Save the plot in a png file.

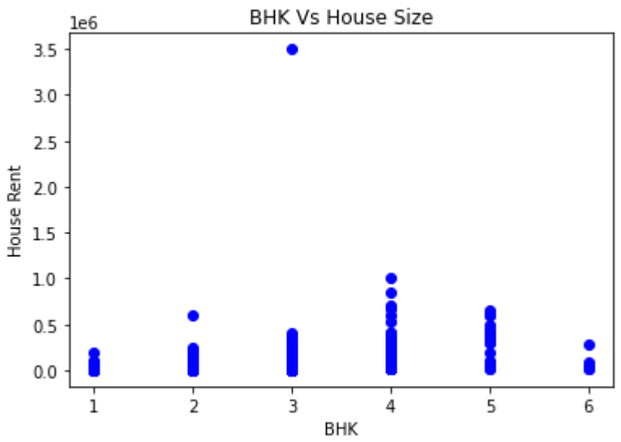
```
plt.scatter(Y_train,X_train['Size'],color='blue')
plt.title("House Rent Vs House Size")
plt.ylabel("House Size")
plt.xlabel("House Rent")
```

```
Text(0.5, 0, 'House Rent')
```



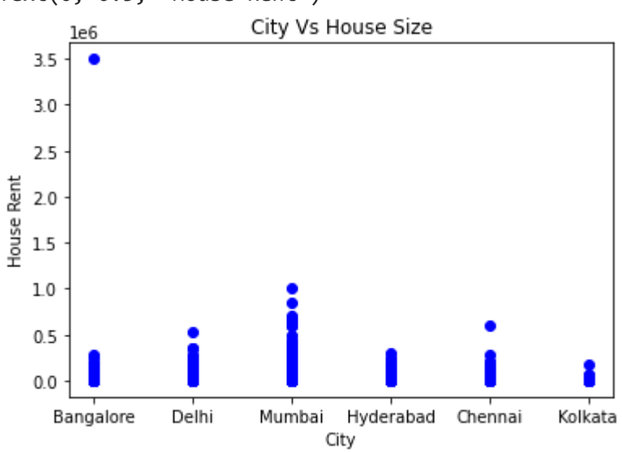

```
plt.scatter(X_train['BHK'],Y_train,color='blue')
plt.title("BHK Vs House Size")
plt.xlabel("BHK")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```



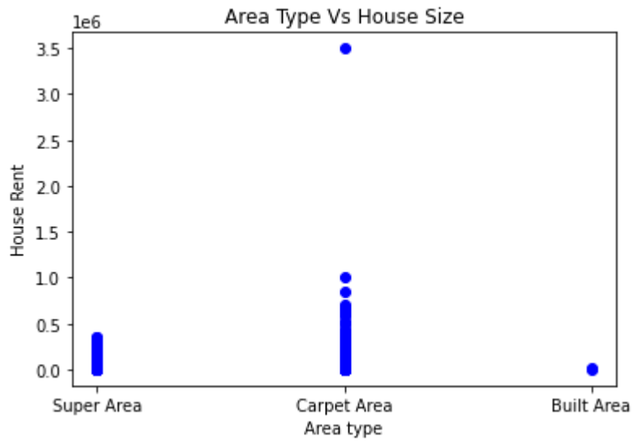

```
plt.scatter(X_train['City'],Y_train,color='blue')
plt.title("City Vs House Size")
plt.xlabel("City")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```



```
plt.scatter(X_train['Area Type'],Y_train,color='blue')
plt.title("Area Type Vs House Size")
plt.xlabel("Area type")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```



2. Find average rent prices in different cities and report which city has the highest average rent.

```
w=new_df.groupby("City")['Rent'].mean().round(decimals=3)
w
```

```
City
Bangalore    24966.366
Chennai      21614.092
Delhi        29461.983
Hyderabad    20555.048
Kolkata      11645.174
Mumbai       85321.205
Name: Rent, dtype: float64
```

```
w.plot.bar(rot=0,color='red')
plt.xlabel("City")
plt.ylabel("Average Rent")
```

```
Text(0, 0.5, 'Average Rent')
```


```
f=new_df.corr()
f
sns.heatmap(f,annot=True,)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f3b58e71ad0>
```

Regression:

1. Train a linear regression model on the training set partition by taking only one dependent variable of “size”. Calculate the error on the validation set.

```
a=LinearRegression()
a.fit(X_train[['Size']],Y_train)
Y_pred=a.predict(X_test[['Size']])
s=a.coef_
c=a.intercept_
print("Coefficient is = " ,s)
print("Intercept is  = " ,c)
mse=mean_squared_error(Y_test,Y_pred)
rmse=np.sqrt(mse)
print("Root Mean Square valuue is = ",rmse)
pd.DataFrame({'Actual Rent': Y_test, 'Predicted Rent': Y_pred})
```

```
Coefficient is =  [49.45643895]
Intercept is  =  -12677.58950320886
Root Mean Square valuue is =  52161.29135909078
```

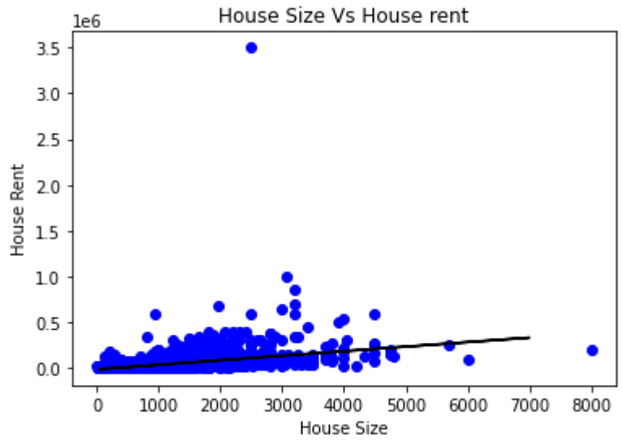
	Actual Rent	Predicted Rent
1566	16000	41724.493344
3159	12000	26887.561658
538	28000	12940.845874
2630	8000	61507.068925
4418	46000	97857.551554

```
Y_test
```

```
1566    16000
3159    12000
538     28000
2630     8000
4418    46000
        ...
4124    18000
3400    25000
1941    14000
3679    26000
2531    11000
Name: Rent, Length: 950, dtype: int64
```

```
plt.scatter(X_train['Size'], Y_train,color='blue')
plt.plot(X_test['Size'], Y_pred,color='k')
plt.title("House Size Vs House rent")
plt.xlabel("House Size")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```




```
# with more than one independent variable
a=LinearRegression()
```

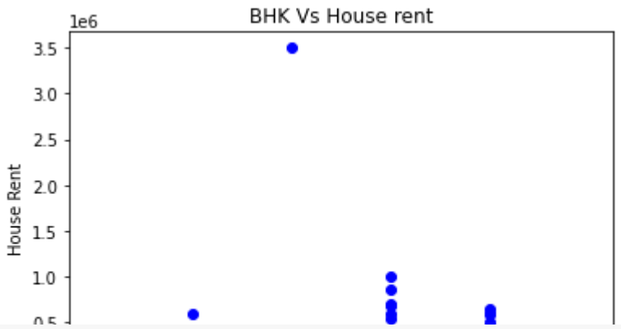
```
a.fit(X_train[['Size','BHK','Bathroom']],Y_train)
Y_pred=a.predict(X_test[['Size','BHK','Bathroom']])
s=a.coef_
c=a.intercept_                                # Equation of regresssion line is 21.053x1-269.1315x2+27624.563x3-39022
X_train1=X_train[['Size','BHK','Bathroom']]
coeff=pd.DataFrame(a.coef_,X_train1.columns,columns=['Coefficents'])
print("Intercept is  = " ,c)
mse=mean_squared_error(Y_test,Y_pred)
rmse=np.sqrt(mse)
print("Root Mean Square valuue is = ",rmse)
t=pd.DataFrame({'Actual Rent': Y_test, 'Predicted Rent': Y_pred})
print(coeff)
t
X_test,Y_test
```

```
Intercept is  =  -39022.92849685526
Root Mean Square valuue is =  50544.789811069684
           Coefficents
Size         21.053941
BHK        -269.131569
Bathroom  27624.563039
(      Size  BHK  Bathroom       City    Area Type
 1566  1100    2         2  Bangalore   Super Area
 3159   800    2         2    Chennai   Super Area
 538    518    2         2     Mumbai  Carpet Area
 2630  1500    3         3      Delhi  Carpet Area
 4418  2235    3         5  Hyderabad  Carpet Area
 ...    ...  ...       ...        ...          ...
 4124  1248    2         2  Hyderabad  Carpet Area
 3400  1100    3         2    Chennai   Super Area
 1941   950    2         2  Bangalore   Super Area
 3679  1125    3         2    Chennai   Super Area
 2531   500    1         1      Delhi   Super Area

 [950 rows x 5 columns], 1566    16000
 3159    12000
 538     28000
 2630     8000
 4418    46000
         ...
 4124    18000
 3400    25000
 1941    14000
 3679    26000
 2531    11000
 Name: Rent, Length: 950, dtype: int64)
```

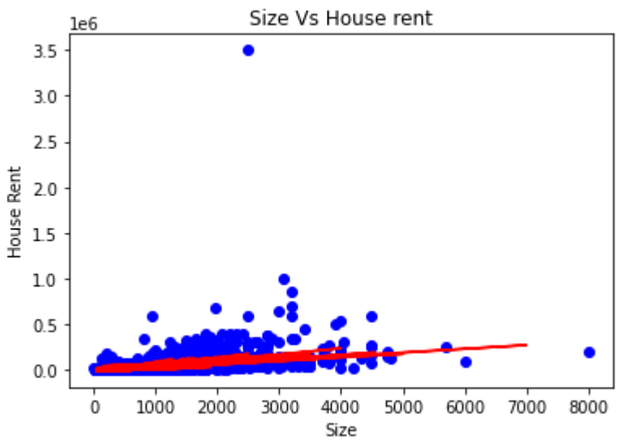
```
plt.scatter(X_train['BHK'], Y_train,color='blue')
plt.plot(X_test['BHK'], Y_pred,color='red')
plt.title("BHK Vs House rent")
plt.xlabel("BHK")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```




```
plt.scatter(X_train['Size'], Y_train,color='blue')
plt.plot(X_test['Size'], Y_pred,color='red')
plt.title("Size Vs House rent")
plt.xlabel("Size")
plt.ylabel("House Rent")
```

```
Text(0, 0.5, 'House Rent')
```




```
from sklearn.linear_model import LogisticRegression
```

```
model=LogisticRegression(max_iter=10,solver='liblinear')
```

```
model.fit(X_train[['Size','BHK','Bathroom']],Y_train)
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/svm/_base.py:1208: ConvergenceWarning: Liblinear failed to converge, increase the number of iterations.
  ConvergenceWarning,
LogisticRegression(max_iter=10, solver='liblinear')
```

```
b=model.predict(X_train[['Size','BHK','Bathroom']])
c=accuracy_score(b,Y_train)
mse=mean_squared_error(Y_test,Y_pred)
#print(mse)
rmse=np.sqrt(mse)
print(rmse)
```

```
print("Accuracy score of training model = ",c)
```

```
50544.789811069684
Accuracy score of training model =  0.05769230769230769
```

```
b=model.predict(X_test[['Size','BHK','Bathroom']])
c=accuracy_score(b,Y_test)
print("Accuracy score of testing  model = ",c)
```

```
Accuracy score of testing  model =  0.05578947368421053
```

```
new_df['Purchase'] = [1 if i>9000  else 0 for i in new_df['Rent']]
new_df
```

	BHK	Rent	Size	Area Type	City	Furnishing Status	Tenant Preferred	Bathroom	Purchase
0	2	10000	1100	Super Area	Kolkata	Unfurnished	Bachelors/Family	2	1
1	2	20000	800	Super Area	Kolkata	Semi-Furnished	Bachelors/Family	1	1
2	2	17000	1000	Super Area	Kolkata	Semi-Furnished	Bachelors/Family	1	1
3	2	10000	800	Super Area	Kolkata	Unfurnished	Bachelors/Family	1	1
4	2	7500	850	Carpet Area	Kolkata	Unfurnished	Bachelors	1	0
...	...	...	...	...	...	...	...	...	...
4741	2	15000	1000	Carpet Area	Hyderabad	Semi-Furnished	Bachelors/Family	2	1
4742	3	29000	2000	Super Area	Hyderabad	Semi-Furnished	Bachelors/Family	3	1
4743	3	35000	1750	Carpet Area	Hyderabad	Semi-Furnished	Bachelors/Family	3	1
4744	3	45000	1500	Carpet Area	Hyderabad	Semi-Furnished	Family	2	1
4745	2	15000	1000	Carpet Area	Hyderabad	Unfurnished	Bachelors	2	1

4746 rows × 9 columns