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Practical No:- 4

Q) Create a Linear Regression Model using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through
different parameters. There are 506 samples and 14 feature variables in this dataset.
The objective is to predict the value of prices of the house using the given features

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Import libraries

```
In [1]: import pandas as pd
        import numpy as np import matplotlib.pyplot as plt import seaborn as
        sns from sklearn.model_selection import train_test_split from
        sklearn.linear_model import LinearRegression from sklearn.metrics
        import mean_squared_error, mean_absolute_error from
        sklearn.preprocessing import StandardScaler
```

```
In [2]: boston = pd.read_csv(r"C:\Users\aades\Desktop\Data Science Um\boston.csv") boston.head()
```

Out[2]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33	36.2

```
In [3]: x = boston.drop(columns=["MEDV"], axis=1) y = boston.MEDV
In [4]: x.head()
```

Out[4]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33

```
In [5]: x.shape, y.shape
Out[5]:  ((506, 13), (506,))

In [6]: x.info()

        <class 'pandas.core.frame.DataFrame'>
        RangeIndex: 506 entries, 0 to 505
        Data columns (total 13 columns):
         #   Column   Non-Null Count  Dtype  -
        --  ------   --------------  -----   0
        CRIM     506 non-null    float64
```

```
1   ZN       506 non-null    float64
2   INDUS    506 non-null    float64
3   CHAS     506 non-null    int64
4   NOX      506 non-null    float64
5   RM       506 non-null    float64
6   AGE      506 non-null    float64
7   DIS      506 non-null    float64
8   RAD      506 non-null    int64
9   TAX      506 non-null    int64
10  PTRATIO  506 non-null    float64
11  B        506 non-null    float64
12  LSTAT    506 non-null    float64
    dtypes: float64(10), int64(3)
    memory usage: 51.5 KB
```

In [7]:
```
x.describe()
```

Out[7]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD
count	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000
mean	3.613524	11.363636	11.136779	0.069170	0.554695	6.284634	68.574901	3.795043	9.549407
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.105710	8.707259
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.129600	1.000000
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	45.025000	2.100175	4.000000
50%	0.256510	0.000000	9.690000	0.000000	0.538000	6.208500	77.500000	3.207450	5.000000
75%	3.677083	12.500000	18.100000	0.000000	0.624000	6.623500	94.075000	5.188425	24.000000
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.126500	24.000000

In [8]:
```
y.info()
```

```
<class 'pandas.core.series.Series'>
RangeIndex: 506 entries, 0 to 505
Series name: MEDV
Non-Null Count  Dtype
--------------  -----
506 non-null    float64
dtypes: float64(1)
memory usage: 4.1 KB
```

In [9]:
```
y.describe()
```

Out[9]:
```
count    506.000000
mean      22.532806
std        9.197104
min        5.000000
25%       17.025000
50%       21.200000 75%
25.000000 max
50.000000 Name: MEDV,
dtype: float64
```

In [10]:
```
x.isnull().sum()
```

```
Out[10]: CRIM       0
         ZN         0
         INDUS      0
         CHAS       0
         NOX        0
         RM         0
         AGE        0
         DIS        0
         RAD        0
         TAX        0
         PTRATIO    0
         B          0
         LSTAT      0
         dtype: int64
```

```
In [11]: y.isnull().sum()
Out[11]: 0
```

```
In [12]: df = x df["target"]
           = y df.head()
```

Out[12]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	target
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.98	24.0
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.14	21.6
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.03	34.7
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.94	33.4
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	5.33	36.2

Considering only 'RM' and 'LSTAT' by considering correlation and multi-collinearity of other Features

```
In [13]: df =  df[['RM', 'LSTAT', 'target']]
In [14]: x =  df[['RM', 'LSTAT']]
         y =  df['target']
```

Scale the data

```
In [15]: scaler = StandardScaler()
In [16]:  x = scaler.fit_transform(x)
```

Split the data

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, shuffle=True)
x_train.shape, x_test.shape, y_train.shape, y_test.shape
((354, 2), (152, 2), (354,), (152,))
```

Linear Regression Modelling

```
model = LinearRegression(n_jobs=-1)
model.fit(x_train, y_train)
```

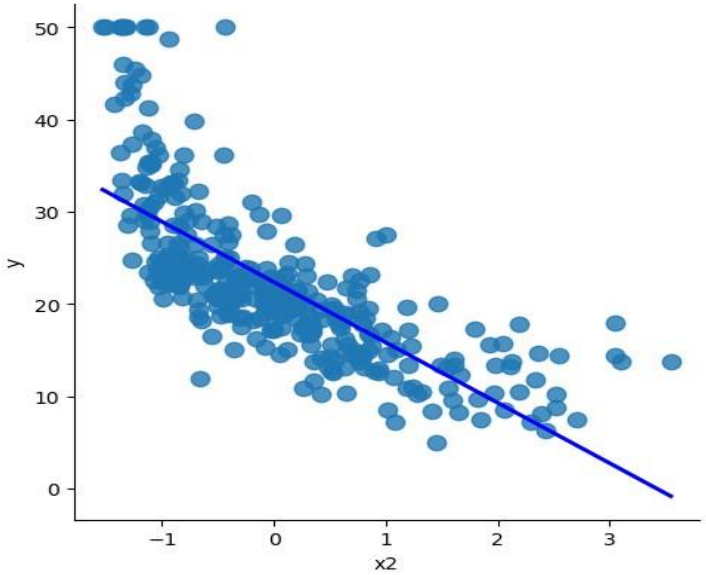
```
LinearRegression

LinearRegression(n_jobs=-1)
```

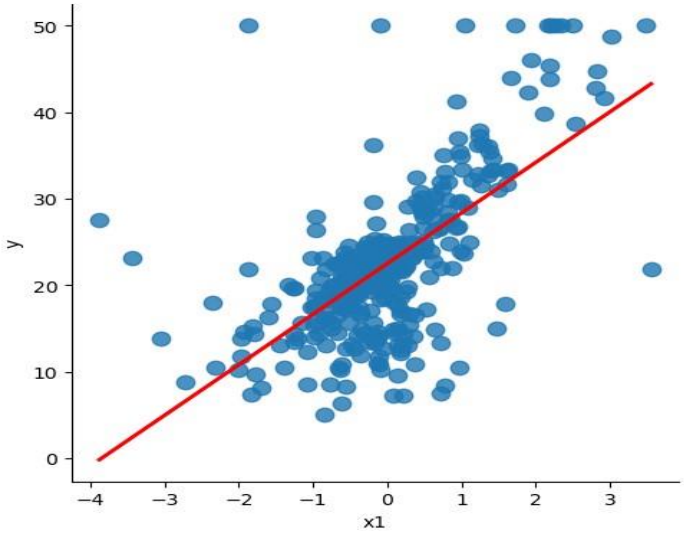
Make predictions

```
In [21]: y_pred = model.predict(x_test)
In [22]: mean_absolute_error(y_test, y_pred)
Out[22]: 3.855448758403843
In [23]: mean_squared_error(y_test, y_pred)
Out[23]: 30.827415858815243
```

In [26]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
# Assuming x_train[0], x_train[1], and y_train are your variables
# Create a DataFrame containing your variables
data = {'x1': x_train[:,0], 'x2': x_train[:,1], 'y': y_train}
df = pd.DataFrame(data)
# Plot the regression line for y vs x1 and x2
sns.lmplot(x='x1', y='y', data=df, ci=None, scatter_kws={"s": 80}, line_kws={"color": "red"})
```




```
sns.lmplot(x='x2', y='y', data=df, ci=None, scatter_kws={"s": 80}, line_kws={"color": "blue"})
plt.show()
```



In [27]:
```
df.head()
```

Out[27]:

	x1	x2	y
109	-0.079260	0.406075	19.4
245	-0.968247	0.813980	18.5
374	-3.058221	3.548771	13.8
151	-1.254603	0.087880	19.6
145	-0.220301	2.123203	13.8