Practical No. : 04

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

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\shreyash\Documents\DSBDA\A4\boston.csv")
boston.head()
```

Out[2]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	BLACK	LSTAT	MEDV
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296.0	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	242.0	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	242.0	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	222.0	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	222.0	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	BLACK	LSTAT
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296.0	15.3	396.90	4.98
1	0.02731	0.0	7.07	0	0.469	6.421	78.9	4.9671	2	242.0	17.8	396.90	9.14
2	0.02729	0.0	7.07	0	0.469	7.185	61.1	4.9671	2	242.0	17.8	392.83	4.03
3	0.03237	0.0	2.18	0	0.458	6.998	45.8	6.0622	3	222.0	18.7	394.63	2.94
4	0.06905	0.0	2.18	0	0.458	7.147	54.2	6.0622	3	222.0	18.7	396.90	5.33

In [5]:
```
x.shape, y.shape
```

Out[5]:
```
((506, 13), (506,))
```

Basic stats

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    float64
 10  PTRATIO  506 non-null    float64
 11  BLACK    506 non-null    float64
 12  LSTAT    506 non-null    float64
dtypes: float64(11), int64(2)
memory usage: 51.5 KB
```

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

Out[7]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX
count	506.000000	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	408.237154
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.105710	8.707259	168.537116
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.129600	1.000000	187.000000
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	45.025000	2.100175	4.000000	279.000000
50%	0.256510	0.000000	9.690000	0.000000	0.538000	6.208500	77.500000	3.207450	5.000000	330.000000
75%	3.677083	12.500000	18.100000	0.000000	0.624000	6.623500	94.075000	5.188425	24.000000	666.000000
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.126500	24.000000	711.000000

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
BLACK      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	BLACK	LSTAT	target
0	0.00632	18.0	2.31	0	0.538	6.575	65.2	4.0900	1	296.0	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	242.0	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	242.0	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	222.0	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	222.0	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

In [17]:
```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, shuffle=True)
```

In [18]:
```
x_train.shape, x_test.shape, y_train.shape, y_test.shape
```

Out[18]: ((354, 2), (152, 2), (354,), (152,))

Linear Regression Modelling

In [19]:
```
model = LinearRegression(n_jobs=-1)
```

In [20]:
```
model.fit(x_train, y_train)
```

Out[20]:

LinearRegression

LinearRegression(n_jobs=-1)

Make predictions

In [21]:
```
y_pred = model.predict(x_test)
```

In [22]:
```
mean_absolute_error(y_test, y_pred)
```

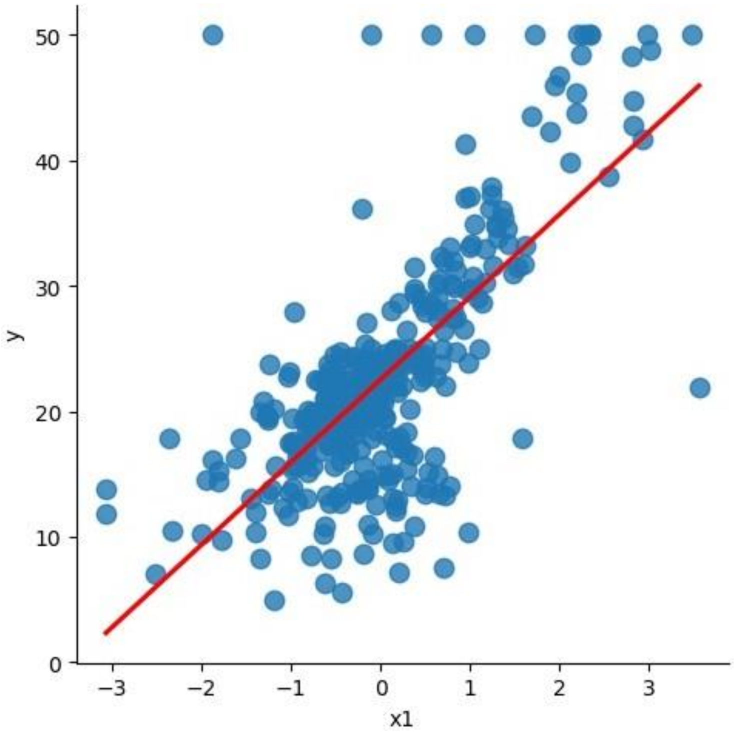
Out[22]: 3.951764544904325

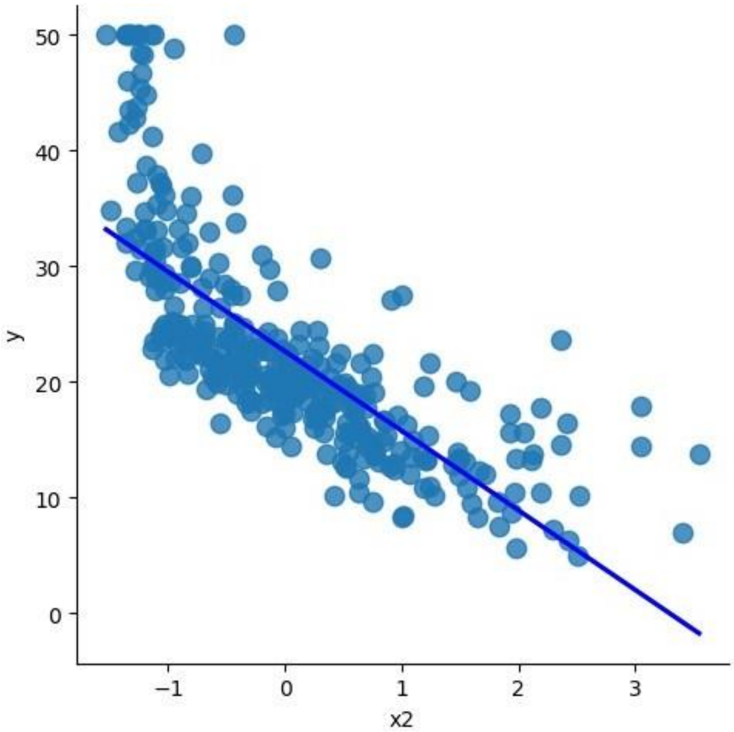
In [23]:
```
mean_squared_error(y_test, y_pred)
```

Out[23]: 30.569387567982456

In [24]:
```
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 [25]:

```
df.head()
```

Out[25]:

	x1	x2	y
364	3.555044	-1.032108	21.9
40	1.053344	-1.496084	34.9
449	0.188576	0.933128	13.0
179	0.990659	-1.067152	37.2
189	1.282714	-1.018091	34.9

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