In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [26]:
```
df = pd.read_csv('C:/Users/prajw/Desktop/Indexs/DSBDA print/DSBDA4/HousingData.csv')
```

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

Out[27]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
0	0.00632	18.0	2.31	0.0	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	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	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	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	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	NaN	36.2

In [28]:
```
df.tail()
```

Out[28]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
501	0.06263	0.0	11.93	0.0	0.573	6.593	69.1	2.4786	1	273	21.0	391.99	NaN	22.4
502	0.04527	0.0	11.93	0.0	0.573	6.120	76.7	2.2875	1	273	21.0	396.90	9.08	20.6
503	0.06076	0.0	11.93	0.0	0.573	6.976	91.0	2.1675	1	273	21.0	396.90	5.64	23.9
504	0.10959	0.0	11.93	0.0	0.573	6.794	89.3	2.3889	1	273	21.0	393.45	6.48	22.0
505	0.04741	0.0	11.93	0.0	0.573	6.030	NaN	2.5050	1	273	21.0	396.90	7.88	11.9

In [29]:
```
df.describe()
```

Out[29]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO
count	486.000000	486.000000	486.000000	486.000000	506.000000	506.000000	486.000000	506.000000	506.000000	506.000000	506.000000
mean	3.611874	11.211934	11.083992	0.069959	0.554695	6.284634	68.518519	3.795043	9.549407	408.237154	18.455534
std	8.720192	23.388876	6.835896	0.255340	0.115878	0.702617	27.999513	2.105710	8.707259	168.537116	2.164946
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.129600	1.000000	187.000000	12.600000
25%	0.081900	0.000000	5.190000	0.000000	0.449000	5.885500	45.175000	2.100175	4.000000	279.000000	17.400000
50%	0.253715	0.000000	9.690000	0.000000	0.538000	6.208500	76.800000	3.207450	5.000000	330.000000	19.050000
75%	3.560263	12.500000	18.100000	0.000000	0.624000	6.623500	93.975000	5.188425	24.000000	666.000000	20.200000
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.126500	24.000000	711.000000	22.000000

In [30]:
```
df.shape
```

Out[30]:
```
(506, 14)
```

In [31]:
```
df.dtypes
```

Out[31]:
```
CRIM       float64
ZN         float64
INDUS      float64
CHAS       float64
NOX        float64
RM         float64
AGE        float64
DIS        float64
RAD          int64
TAX          int64
PTRATIO    float64
B          float64
LSTAT      float64
MEDV       float64
dtype: object
```

In [32]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 506 entries, 0 to 505
Data columns (total 14 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   CRIM     486 non-null    float64
 1   ZN       486 non-null    float64
 2   INDUS    486 non-null    float64
 3   CHAS     486 non-null    float64
 4   NOX      506 non-null    float64
 5   RM       506 non-null    float64
 6   AGE      486 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    486 non-null    float64
 13  MEDV     506 non-null    float64
dtypes: float64(12), int64(2)
memory usage: 55.5 KB
```

In [37]:
```
df.isna().sum()
```

Out[37]:
```
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
MEDV       0
dtype: int64
```

In [34]:
```
mean_value = df['CRIM'].mean()
```

In [35]:
```
means = df.mean()
df.fillna(value=means, inplace=True)
print(df.isnull().sum())
```

```
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
MEDV       0
dtype: int64
```

In [36]:
```
target_feature = 'MEDV'
```

In [38]:
```
x = df.drop(target_feature, axis=1)
y = df[target_feature]
```

In [39]:
```
x.head()
```

Out[39]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.980000
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.140000
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.030000
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.940000
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	12.715432

In [40]:
```
y.head()
```

Out[40]:
```
0    24.0
1    21.6
2    34.7
3    33.4
4    36.2
Name: MEDV, dtype: float64
```

In [46]:
```
from sklearn.model_selection import train_test_split                                    #!pip install scikit-learn
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=0)
```

In [47]:
```
from sklearn.linear_model import LinearRegression
regression = LinearRegression()
```

In [48]:
```
regression.fit(x_train, y_train)
```

Out[48]:
```
LinearRegression()
```

In [49]:
```
train_score=round(regression.score(x_train,y_train)*100,2)
print('Train score of Linear Regression:',train_score)
```

```
Train score of Linear Regression: 76.49
```

In [50]:
```
print('Coefficients" ', regression.coef_)
```

```
Coefficients"  [-1.26194005e-01  3.76363553e-02 -6.26295345e-02  2.70382928e+00
 -1.45015824e+01  4.08006958e+00 -2.11509464e-02 -1.41798662e+00
  1.96343241e-01 -8.70651696e-03 -1.01396225e+00  8.29504244e-03
 -4.19861039e-01]
```

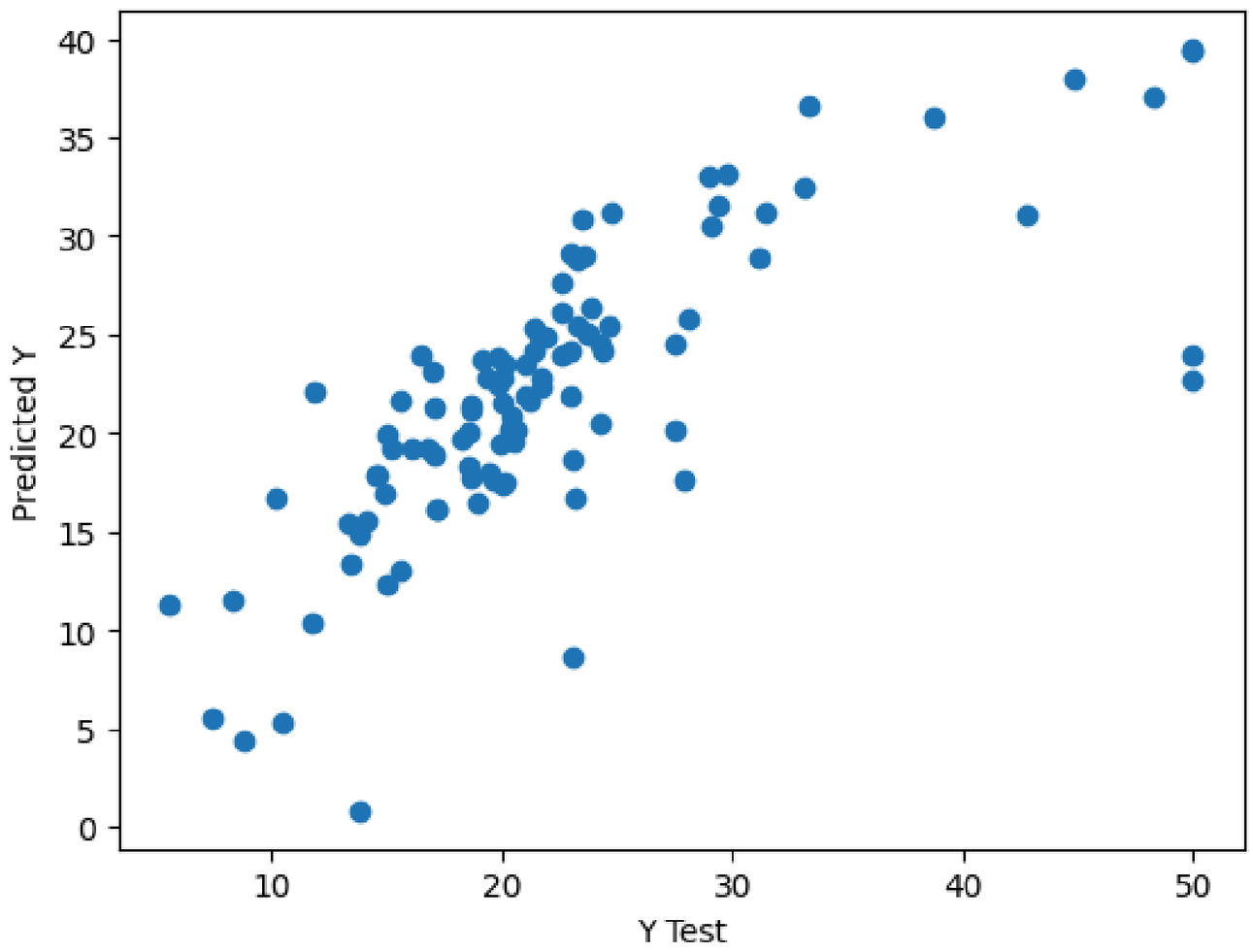
In [51]:
```
predictions = regression.predict(x_test)
```

In [52]:
```
predictions
```

Out[52]:
```
array([26.175296  , 22.64747588, 29.1456294 , 11.52971235, 21.65312134,
       19.42320699, 20.18413017, 21.46914355, 19.1985363 , 19.98228162,
        4.32483046, 16.16891668, 16.87682404,  5.31232373, 39.36827861,
       33.09358732, 21.9152876 , 36.61918436, 31.52676377, 23.52713482,
       24.96022461, 23.69866912, 20.88033802, 30.55074901, 22.74081741,
        8.66805959, 17.65119072, 17.93088633, 36.01223185, 21.16299556,
       17.83464361, 17.43306603, 19.5240167 , 23.50605522, 28.97262793,
       19.21808862, 11.23997435, 23.94256597, 17.86786717, 15.40849806,
       26.3630836 , 21.5193299 , 23.78733694, 14.84041522, 23.9445175 ,
       24.97067627, 20.11366175, 23.08636158, 10.42208266, 24.52832122,
       21.60847326, 18.66228165, 24.53362832, 31.03502944, 12.97457826,
       22.38536236, 21.34822822, 16.10928673, 12.37477824, 22.78596712,
       18.28714824, 21.91802045, 32.49771603, 31.21256855, 17.47867791,
       33.18861907, 19.17896285, 19.94662594, 20.17142015, 23.90228857,
       22.81288844, 24.17911208, 30.83402844, 28.87481037, 25.14581721,
        5.55072029, 37.0183454 , 24.15428003, 27.67587636, 19.63884644,
       28.74874123, 18.83204358, 17.63305678, 37.97947167, 39.49507972,
       24.17228966, 25.33605088, 16.75044819, 25.43224687, 16.65089426,
       16.49186628, 13.37283452, 24.81689254, 31.21188699, 22.0891919 ,
       20.49360168,  0.8229737 , 25.5004737 , 15.5481509 , 17.72901193,
       25.77663998, 22.43131323])
```

In [53]:
```
plt.scatter(y_test, predictions)
plt.xlabel('Y Test')
plt.ylabel('Predicted Y')
```

Out[53]:
```
Text(0, 0.5, 'Predicted Y')
```



In [54]:
```
from sklearn.metrics import r2_score
score = round(r2_score(y_test,predictions)*100,2)
print("r_2 score:", score)
```

```
r_2 score: 57.03
```

In [55]:
```
round(regression.score(x_test, y_test)*100,2)
```

Out[55]: 57.03

In [56]:
```
from sklearn import metrics
print('Mean Absolute Error on test data of Linear Regression: ',metrics.mean_absolute_error(y_test, predictions))
print('Mean Squared Error on test data of Linear Regression: ',metrics.mean_squared_error(y_test, predictions))
print('Root Mean Squared Error on test data of Linear Regression: ',np.sqrt(metrics.mean_squared_error(y_test, predictions)))
```

```
Mean Absolute Error on test data of Linear Regression:  3.9616211239591186
Mean Squared Error on test data of Linear Regression:  34.98738954423878
Root Mean Squared Error on test data of Linear Regression:  5.915013909048632
```

In [57]:
```
df1 = pd.DataFrame({'Actual':y_test, 'Predicted':predictions, 'Variance':y_test-predictions})
df1.head()
```

Out[57]:

	Actual	Predicted	Variance
329	22.6	26.175296	-3.575296
371	50.0	22.647476	27.352524
219	23.0	29.145629	-6.145629
403	8.3	11.529712	-3.229712
78	21.2	21.653121	-0.453121

In [58]:
```
df.head(15)
```

Out[58]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LSTAT	MEDV
0	0.00632	18.0	2.31	0.000000	0.538	6.575	65.2	4.0900	1	296	15.3	396.90	4.980000	24.0
1	0.02731	0.0	7.07	0.000000	0.469	6.421	78.9	4.9671	2	242	17.8	396.90	9.140000	21.6
2	0.02729	0.0	7.07	0.000000	0.469	7.185	61.1	4.9671	2	242	17.8	392.83	4.030000	34.7
3	0.03237	0.0	2.18	0.000000	0.458	6.998	45.8	6.0622	3	222	18.7	394.63	2.940000	33.4
4	0.06905	0.0	2.18	0.000000	0.458	7.147	54.2	6.0622	3	222	18.7	396.90	12.715432	36.2
5	0.02985	0.0	2.18	0.000000	0.458	6.430	58.7	6.0622	3	222	18.7	394.12	5.210000	28.7
6	0.08829	12.5	7.87	0.069959	0.524	6.012	66.6	5.5605	5	311	15.2	395.60	12.430000	22.9
7	0.14455	12.5	7.87	0.000000	0.524	6.172	96.1	5.9505	5	311	15.2	396.90	19.150000	27.1
8	0.21124	12.5	7.87	0.000000	0.524	5.631	100.0	6.0821	5	311	15.2	386.63	29.930000	16.5
9	0.17004	12.5	7.87	0.069959	0.524	6.004	85.9	6.5921	5	311	15.2	386.71	17.100000	18.9
10	0.22489	12.5	7.87	0.000000	0.524	6.377	94.3	6.3467	5	311	15.2	392.52	20.450000	15.0
11	0.11747	12.5	7.87	0.000000	0.524	6.009	82.9	6.2267	5	311	15.2	396.90	13.270000	18.9
12	0.09378	12.5	7.87	0.000000	0.524	5.889	39.0	5.4509	5	311	15.2	390.50	15.710000	21.7
13	0.62976	0.0	8.14	0.000000	0.538	5.949	61.8	4.7075	4	307	21.0	396.90	8.260000	20.4
14	0.63796	0.0	8.14	0.069959	0.538	6.096	84.5	4.4619	4	307	21.0	380.02	10.260000	18.2

In [59]:
```
regression.predict([[0.62976,0.0,8.14,0.0,0.538,5.949,61.8,4.7075,4,307,21.0,396.60,8.26]])
```

```
C:\Users\prajw\AppData\Local\Programs\Python\Python312\Lib\site-packages\sklearn\utils\validation.py:2739: UserWarning: X does n
ot have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

Out[59]:
```
array([19.58009845])
```

In [61]:
```
regression.intercept_
```

Out[61]:
```
np.float64(35.040166029487466)
```

In [62]:
```
regression.coef_
```

Out[62]:
```
array([-1.26194005e-01,  3.76363553e-02, -6.26295345e-02,  2.70382928e+00,
       -1.45015824e+01,  4.08006958e+00, -2.11509464e-02, -1.41798662e+00,
        1.96343241e-01, -8.70651696e-03, -1.01396225e+00,  8.29504244e-03,
       -4.19861039e-01])
```

In [63]:
```
lr_coefficient = pd.DataFrame()
lr_coefficient["columns"] = x_train.columns
lr_coefficient['Coefficient Estimate'] = pd.Series(regression.coef_)
print(lr_coefficient)
```

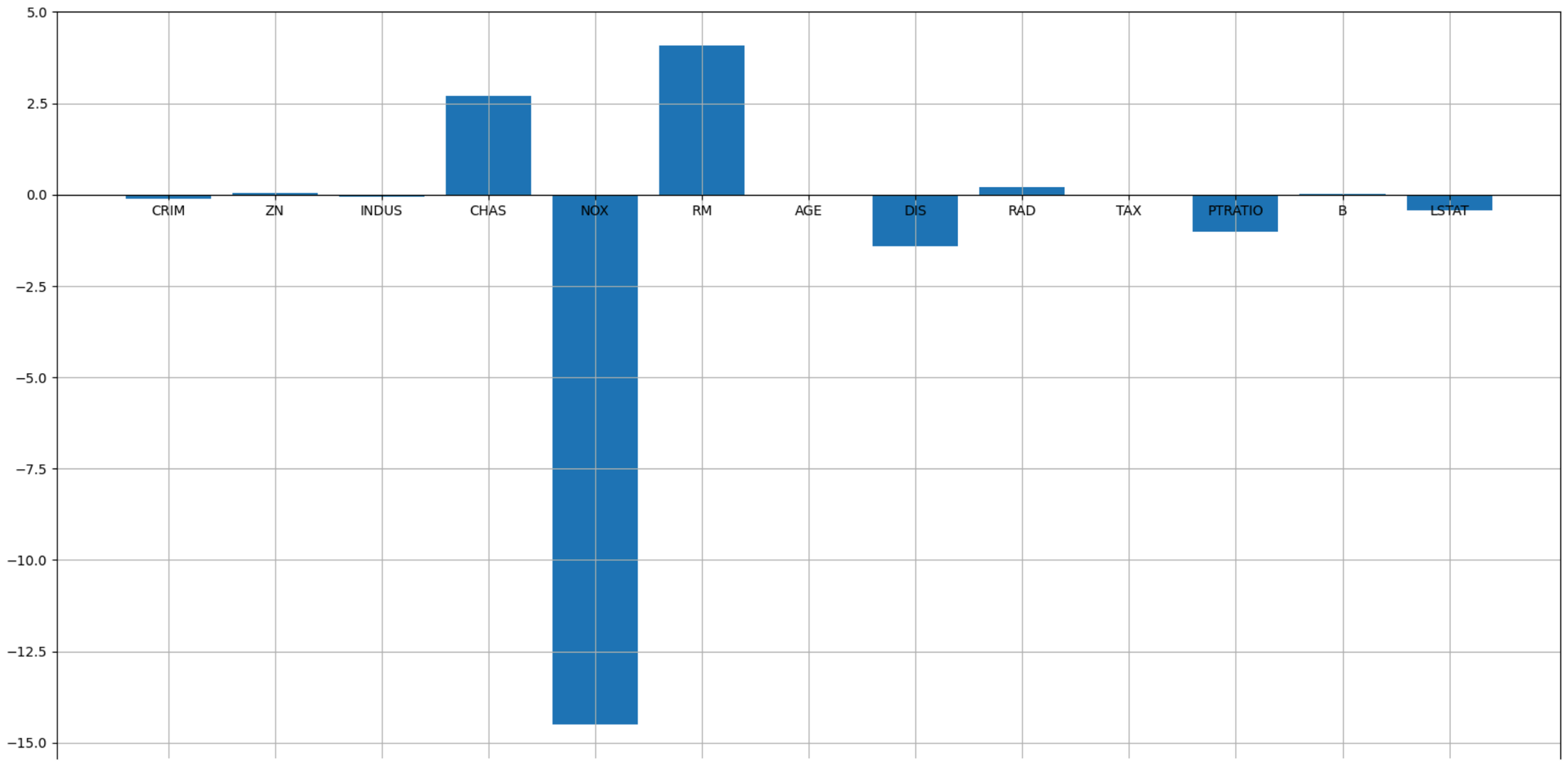
```
    columns  Coefficient Estimate
0      CRIM             -0.126194
1        ZN              0.037636
2     INDUS             -0.062630
3      CHAS              2.703829
4       NOX            -14.501582
5        RM              4.080070
6       AGE             -0.021151
7       DIS             -1.417987
8       RAD              0.196343
9       TAX             -0.008707
10  PTRATIO             -1.013962
11        B              0.008295
12    LSTAT             -0.419861
```

In [64]:
```
fig, ax = plt.subplots(figsize =(20, 10))

ax.bar(lr_coefficient["columns"],
lr_coefficient['Coefficient Estimate'])

ax.spines['bottom'].set_position('zero')

plt.style.use('ggplot')
plt.grid()
plt.show()
```

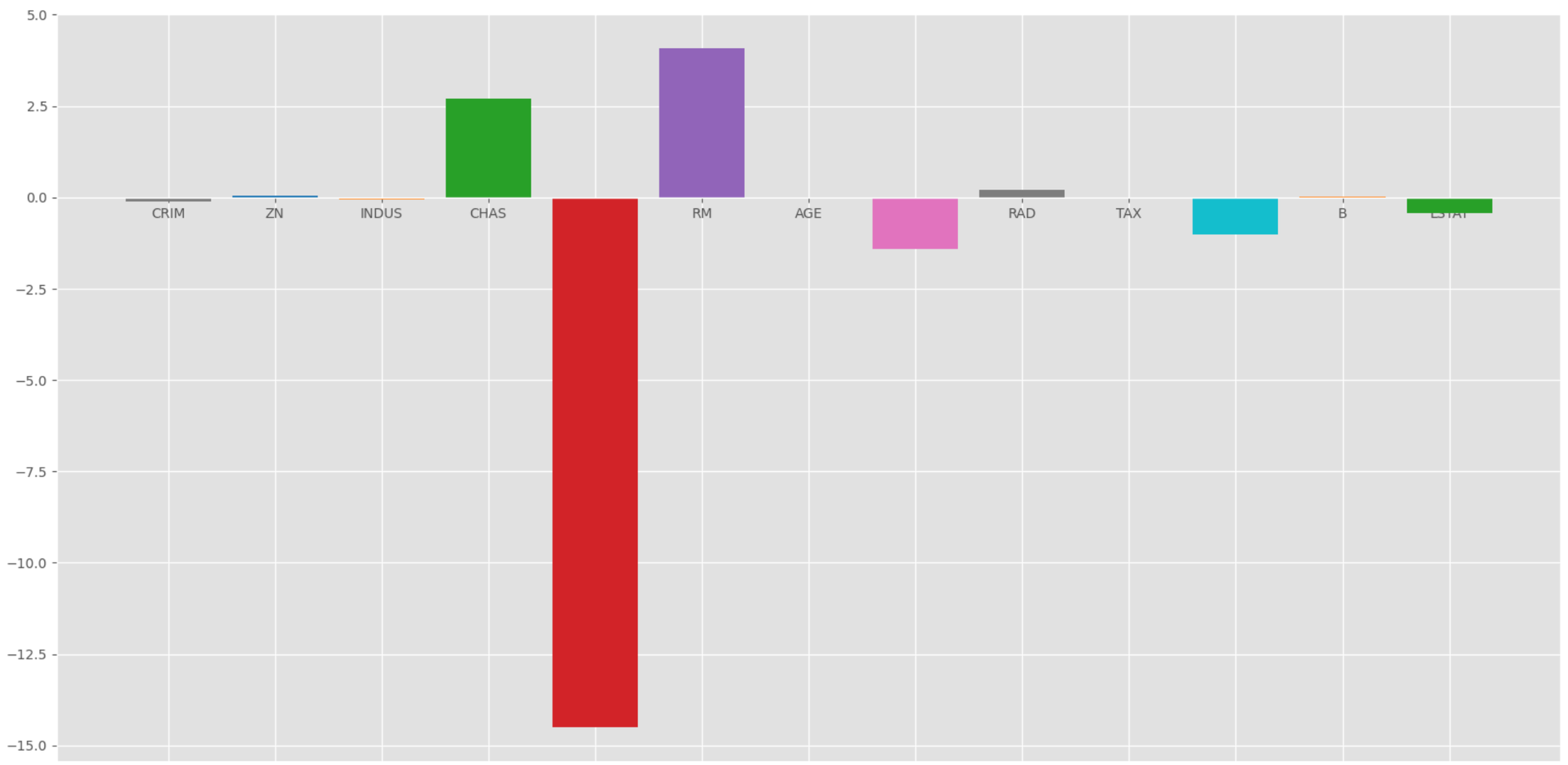


In [65]:
```
fig, ax = plt.subplots(figsize =(20, 10))

color = ['tab:gray', 'tab:blue', 'tab:orange', 'tab:green', 'tab:red', 'tab:purple', 'tab:brown', 'tab:pink', 'tab:gray', 'tab:
ax.bar(lr_coefficient["columns"],
lr_coefficient['Coefficient Estimate'],color = color)

ax.spines['bottom'].set_position('zero')

plt.style.use('ggplot')
plt.show()
```



In [ ]: