Assignment 5

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Class: AIDS A

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Batch: C

Linear Regression

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

```
/home/admin1/anaconda3/lib/python3.9/site-packages/scipy/
__init__.py:132: UserWarning: A NumPy version >=1.21.6 and <1.28.0 is
required for this version of SciPy (detected version 1.21.5)
  warnings.warn(f"A NumPy version >={np_minversion} and
<{np_maxversion}"
```

```
df=pd.read_csv("BostonHousing.csv")
df
```

```
        crim    zn  indus  chas    nox     rm   age     dis  rad  tax
\
0    0.00632  18.0   2.31     0  0.538  6.575  65.2  4.0900    1  296

1    0.02731   0.0   7.07     0  0.469  6.421  78.9  4.9671    2  242

2    0.02729   0.0   7.07     0  0.469  7.185  61.1  4.9671    2  242

3    0.03237   0.0   2.18     0  0.458  6.998  45.8  6.0622    3  222

4    0.06905   0.0   2.18     0  0.458  7.147  54.2  6.0622    3  222

..       ...   ...    ...   ...    ...    ...   ...     ...  ...  ...

501  0.06263   0.0  11.93     0  0.573  6.593  69.1  2.4786    1  273

502  0.04527   0.0  11.93     0  0.573  6.120  76.7  2.2875    1  273

503  0.06076   0.0  11.93     0  0.573  6.976  91.0  2.1675    1  273

504  0.10959   0.0  11.93     0  0.573  6.794  89.3  2.3889    1  273

505  0.04741   0.0  11.93     0  0.573  6.030  80.8  2.5050    1  273
```

```
     ptratio       b  lstat  medv
0       15.3  396.90   4.98  24.0
1       17.8  396.90   9.14  21.6
2       17.8  392.83   4.03  34.7
3       18.7  394.63   2.94  33.4
4       18.7  396.90   5.33  36.2
..       ...     ...    ...   ...
501     21.0  391.99   9.67  22.4
502     21.0  396.90   9.08  20.6
503     21.0  396.90   5.64  23.9
504     21.0  393.45   6.48  22.0
505     21.0  396.90   7.88  11.9

[506 rows x 14 columns]
```

```
df.shape
```

```
(506, 14)
```

```
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     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       501 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
 13  medv     506 non-null    float64
dtypes: float64(11), int64(3)
memory usage: 55.5 KB
```

```
df.isnull()
```

```
      crim     zn  indus   chas    nox     rm    age    dis    rad  
tax  \
0    False  False  False  False  False  False  False  False  False  
False   
1    False  False  False  False  False  False  False  False  False  
False   
```

```
2    False  False  False  False  False  False  False  False  False
False
3    False  False  False  False  False  False  False  False  False
False
4    False  False  False  False  False  False  False  False  False
False
..     ...    ...    ...    ...    ...    ...    ...    ...    ...
...
501  False  False  False  False  False  False  False  False  False
False
502  False  False  False  False  False  False  False  False  False
False
503  False  False  False  False  False  False  False  False  False
False
504  False  False  False  False  False  False  False  False  False
False
505  False  False  False  False  False  False  False  False  False
False

     ptratio      b  lstat   medv
0      False  False  False  False
1      False  False  False  False
2      False  False  False  False
3      False  False  False  False
4      False  False  False  False
..       ...    ...    ...    ...
501    False  False  False  False
502    False  False  False  False
503    False  False  False  False
504    False  False  False  False
505    False  False  False  False

[506 rows x 14 columns]
```

```
df.describe()
```

```
             crim          zn       indus        chas         nox
rm  \
count  506.000000  506.000000  506.000000  506.000000  506.000000
501.000000
mean     3.613524   11.363636   11.136779    0.069170    0.554695
6.284341
std      8.601545   23.322453    6.860353    0.253994    0.115878
0.705587
min      0.006320    0.000000    0.460000    0.000000    0.385000
3.561000
25%      0.082045    0.000000    5.190000    0.000000    0.449000
5.884000
50%      0.256510    0.000000    9.690000    0.000000    0.538000
6.208000
```

```
75%      3.677083   12.500000   18.100000    0.000000    0.624000
6.625000
max     88.976200  100.000000   27.740000    1.000000    0.871000
8.780000

              age         dis         rad         tax     ptratio
b  \
count  506.000000  506.000000  506.000000  506.000000  506.000000
506.000000
mean    68.574901    3.795043    9.549407  408.237154   18.455534
356.674032
std     28.148861    2.105710    8.707259  168.537116    2.164946
91.294864
min      2.900000    1.129600    1.000000  187.000000   12.600000
0.320000
25%     45.025000    2.100175    4.000000  279.000000   17.400000
375.377500
50%     77.500000    3.207450    5.000000  330.000000   19.050000
391.440000
75%     94.075000    5.188425   24.000000  666.000000   20.200000
396.225000
max    100.000000   12.126500   24.000000  711.000000   22.000000
396.900000

            lstat        medv
count  506.000000  506.000000
mean    12.653063   22.532806
std      7.141062    9.197104
min      1.730000    5.000000
25%      6.950000   17.025000
50%     11.360000   21.200000
75%     16.955000   25.000000
max     37.970000   50.000000
```

```
df.head()
```

```
      crim    zn  indus  chas    nox     rm   age     dis  rad  tax
ptratio  \
0  0.00632  18.0   2.31     0  0.538  6.575  65.2  4.0900    1  296
15.3
1  0.02731   0.0   7.07     0  0.469  6.421  78.9  4.9671    2  242
17.8
2  0.02729   0.0   7.07     0  0.469  7.185  61.1  4.9671    2  242
17.8
3  0.03237   0.0   2.18     0  0.458  6.998  45.8  6.0622    3  222
18.7
4  0.06905   0.0   2.18     0  0.458  7.147  54.2  6.0622    3  222
18.7

        b  lstat  medv
```

```
0  396.90   4.98  24.0
1  396.90   9.14  21.6
2  392.83   4.03  34.7
3  394.63   2.94  33.4
4  396.90   5.33  36.2
```

```
df.dtypes
```

```
crim       float64
zn         float64
indus      float64
chas         int64
nox        float64
rm         float64
age        float64
dis        float64
rad          int64
tax          int64
ptratio    float64
b          float64
lstat      float64
medv       float64
dtype: object
```

```
df.tail()
```

```
        crim   zn  indus  chas    nox     rm   age     dis  rad  tax
ptratio  \
501  0.06263  0.0  11.93     0  0.573  6.593  69.1  2.4786    1  273
21.0
502  0.04527  0.0  11.93     0  0.573  6.120  76.7  2.2875    1  273
21.0
503  0.06076  0.0  11.93     0  0.573  6.976  91.0  2.1675    1  273
21.0
504  0.10959  0.0  11.93     0  0.573  6.794  89.3  2.3889    1  273
21.0
505  0.04741  0.0  11.93     0  0.573  6.030  80.8  2.5050    1  273
21.0

          b  lstat  medv
501  391.99   9.67  22.4
502  396.90   9.08  20.6
503  396.90   5.64  23.9
504  393.45   6.48  22.0
505  396.90   7.88  11.9
```

```
df.notnull()
```

```
     crim    zn  indus  chas   nox    rm   age   dis   rad   tax
ptratio  \
0    True  True   True  True  True  True  True  True  True  True
```

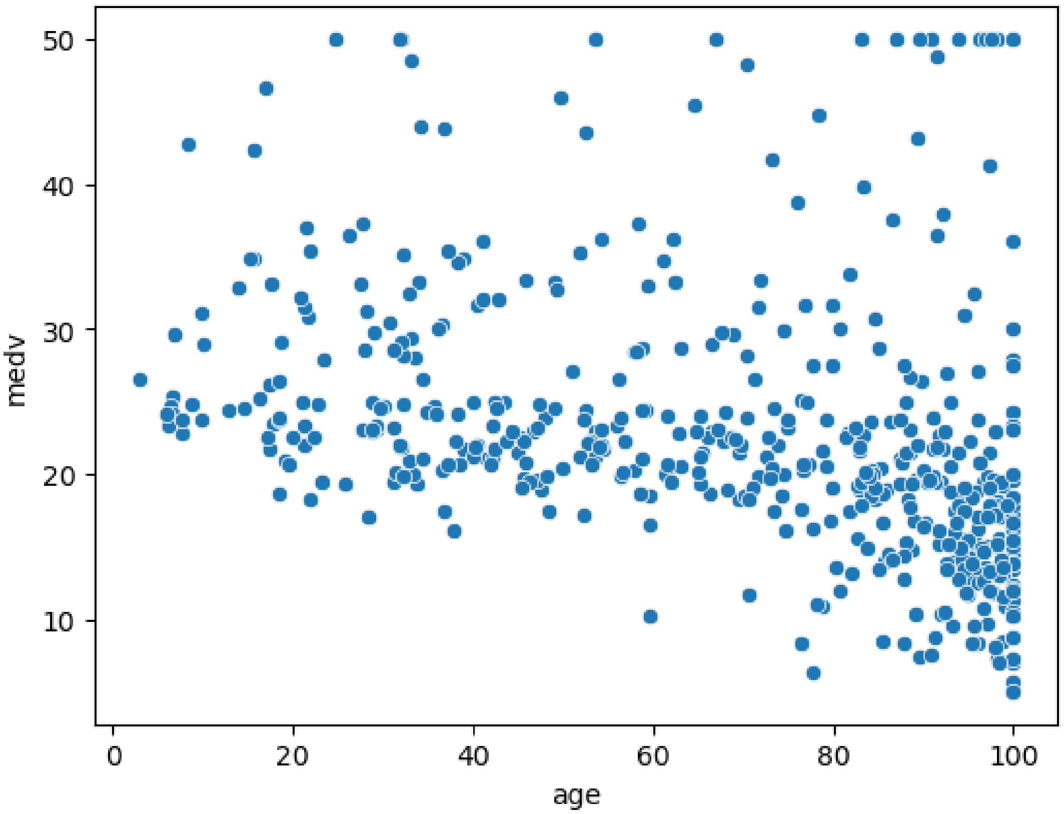
```
True
1    True  True   True  True  True  True  True  True  True  True
True
2    True  True   True  True  True  True  True  True  True  True
True
3    True  True   True  True  True  True  True  True  True  True
True
4    True  True   True  True  True  True  True  True  True  True
True
..    ...   ...    ...   ...   ...   ...   ...   ...   ...   ...
...
501  True  True   True  True  True  True  True  True  True  True
True
502  True  True   True  True  True  True  True  True  True  True
True
503  True  True   True  True  True  True  True  True  True  True
True
504  True  True   True  True  True  True  True  True  True  True
True
505  True  True   True  True  True  True  True  True  True  True
True

        b  lstat  medv
0    True   True  True
1    True   True  True
2    True   True  True
3    True   True  True
4    True   True  True
..    ...    ...   ...
501  True   True  True
502  True   True  True
503  True   True  True
504  True   True  True
505  True   True  True

[506 rows x 14 columns]
```

```
sns.scatterplot(x=df['age'],y=df['medv'])
```

```
<Axes: xlabel='age', ylabel='medv'>
```



```
x=df['medv'].drop
y=df['medv']

x

<bound method Series.drop of 0      24.0
1      21.6
2      34.7
3      33.4
4      36.2
       ...
501    22.4
502    20.6
503    23.9
504    22.0
505    11.9
Name: medv, Length: 506, dtype: float64>

y

0      24.0
1      21.6
2      34.7
3      33.4
4      36.2
```

```
       ...
501    22.4
502    20.6
503    23.9
504    22.0
505    11.9
Name: medv, Length: 506, dtype: float64
```

```
from sklearn import linear_model
```

```
lr=linear_model.LinearRegression()
lr
```

```
LinearRegression()
```

```
x=df.drop(columns=['medv'])
y=df['medv']
```

```
from sklearn.model_selection import train_test_split
```

```
x_train, x_test, y_train, y_test = train_test_split(x, y,
train_size=0.8, test_size=0.2, random_state=5)
```

```
len(x_train)
```

```
404
```

```
len(y_test)
```

```
102
```

```
X_cleaned = x.dropna()
y_cleaned = y[X_cleaned.index]
```

```
lr.fit(x_test,y_test)
```

```
LinearRegression()
```

```
y_predict=lr.predict(x_test)
```

```
y_predict
```

```
array([38.6519417 , 29.30271169, 26.47847516,  8.03513159,
37.42476358,
       10.78384061, 27.22276743, 30.21226213, 26.61253562,
21.06652464,
       34.02779035, 20.21309397, 21.71723439, 33.40530263,
27.62503723,
       16.47311571,  4.98046603, 16.03843732, 14.40028301,
18.32973666,
        7.2078973 , 19.95611372, 40.62816672, 24.36936464,
33.29161476,
       13.46962143, 23.79116653, 22.67376479, 21.5233983 ,
21.23433839,
       20.2741073 , 10.42265123, 16.56437975, 25.66102109,
28.75403451,
       19.66675985, 28.81834008, 13.36087535, 44.14506966,
32.54607535,
       18.5855062 ,  8.45539158, 28.06191383, 12.75079081,
28.17291196,
       30.48034899,  4.63763795, 21.93115392, 21.31022511,
17.76197326,
       20.14192739, 20.33332662, 23.87349206, 16.79357584,
17.43706481,
       23.77962221, 37.77957524, 17.22313246, 29.70530794,
22.13612898,
       19.92467917, 24.32205673, 14.97385835, 32.11376975,
18.1217244 ,
       13.19370126, 20.76593993, 25.11864473, 21.92814514,
17.86530713,
       20.64138587, 24.31057453, 18.11694057, 23.38517598,
15.47640546,
       25.4734131 , 22.33367259, 16.75472738, 36.06092324,
16.03235008,
       20.00420155, 44.21358346, 24.84747351, 16.34231002,
23.02251201,
       18.15512877, 16.78925331,  9.07444408, 21.23859601,
16.5220274 ,
       38.18286199, 17.4568254 , 20.5909679 , 17.26019255,
24.63250975,
       27.59841206, 14.00680196, 24.37225018, 22.46185284,
13.1520875 ,
       20.74853494, 22.00255808])
```

```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(x_test, y_test)
```

```
LinearRegression()
```

```
lr.fit(x_test,y_test)
```

```
LinearRegression()
```

```
x_predict=lr.predict(x_test)
```

```
test_score = model.score(x_test, y_test)
```

```
print("Accuracy score:", test_score)
```

```
Accuracy score: 0.8177826690284403
```

```
from sklearn.metrics import
mean_squared_error,mean_absolute_error,r2_score
mse=mean_squared_error(y_test,x_predict)
mse
```

```
14.266499786743381
```

```
r2=r2_score(y_test,x_predict)
r2
```

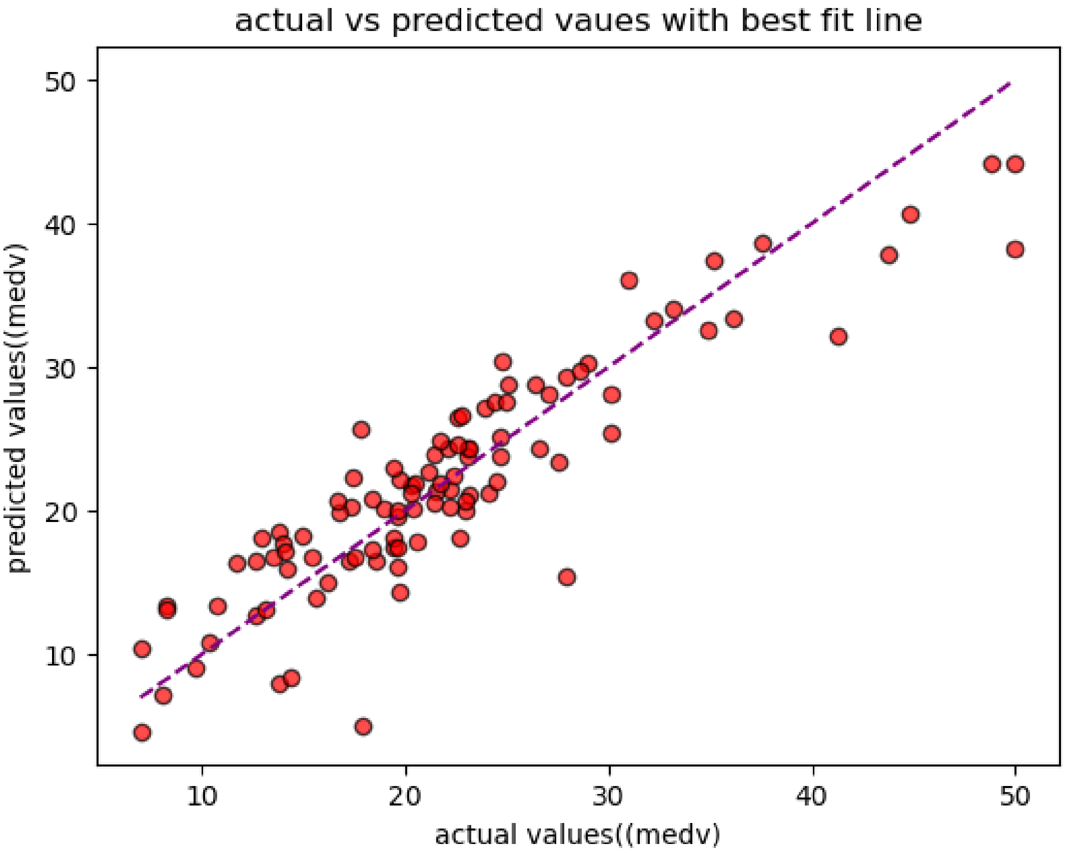
```
0.8177826690284403
```

```
mae=mean_absolute_error(y_test,x_predict)
mae
```

```
2.8858058614979654
```

```
import matplotlib.pyplot as plt
```

```
plt.scatter(y_test,x_predict,color='red',edgecolor='k',alpha=0.7)
plt.plot([min(y_test),max(y_test)],
[min(y_test),max(y_test)],color='purple',linestyle="--")
plt.xlabel("actual values((medv)")
plt.ylabel("predicted values((medv)")
plt.title("actual vs predicted vaues with best fit line")
plt.show()
```


actual vs predicted vaues with best fit line
predicted values((medv)
actual values((medv)
10
20
30
40
50
10
20
30
40
50