Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

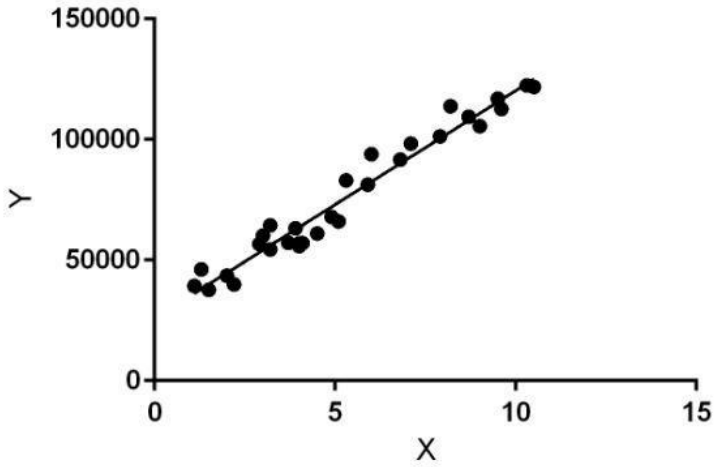
Experiment No. 1
Analyze the Boston Housing dataset and apply appropriate Regression Technique
Date of Performance:
Date of Submission:

Aim: Analyze the Boston Housing dataset and apply appropriate Regression Technique.

Objective: Ablility to perform various feature engineering tasks, apply linear regression on the given dataset and minimise the error.

Theory:

Linear Regression is a machine learning algorithm based on supervised learning. It performs a regression task. Regression models a target prediction value based on independent variables. It is mostly used for finding out the relationship between variables and forecasting. Different regression models differ based on – the kind of relationship between dependent and independent variables they are considering, and the number of independent variables getting used.



Linear regression performs the task to predict a dependent variable value (y) based on a given independent variable (x). So, this regression technique finds out a linear relationship between x (input) and y(output). Hence, the name is Linear Regression.

In the figure above, X (input) is the work experience and Y (output) is the salary of a person. The regression line is the best fit line for our model.

Dataset:

The Boston Housing Dataset

The Boston Housing Dataset is a derived from information collected by the U.S. Census Service concerning housing in the area of Boston MA. The following describes the dataset columns:

CRIM - per capita crime rate by town
ZN - proportion of residential land zoned for lots over 25,000 sq.ft.
INDUS - proportion of non-retail business acres per town.
CHAS - Charles River dummy variable (1 if tract bounds river; 0 otherwise)
NOX - nitric oxides concentration (parts per 10 million)
RM - average number of rooms per dwelling
AGE - proportion of owner-occupied units built prior to 1940
DIS - weighted distances to five Boston employment centres
RAD - index of accessibility to radial highways
TAX - full-value property-tax rate per $10,000
PTRATIO - pupil-teacher ratio by town
B - 1000(Bk - 0.63)^2 where Bk is the proportion of blacks by town
LSTAT - % lower status of the population
MEDV - Median value of owner-occupied homes in $1000's

Code:

Conclusion:

The features chosen to estimate house prices include attributes that is CRIM, ZN, INDUS, CHAS, NOX, RM, AGE, DIS, RAD, TAX, PTRATIO, B, LSTAT: These columns contain various attributes of the towns that might have an impact on the median home value. crime rate, proportion of residential land, nitric oxide concentration, average number of rooms, accessibility to highways, property-tax rate, etc., which can all influence the desirability and the value of homes in a neighborhood.

The 'MEDV' column is the target variable because these features can predict the median value of homes.

The Mean Squared Error (MSE) of 33.45 indicates the average squared difference between predicted and actual house prices in the model. Comparing this value to the range of actual house prices determines the model's predictions are accurate enough

```
import numpy as np
import pandas as pd
data=pd.read_csv('housing.csv')
print(data)
```

```
            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
...........   ...
50121.0  391.99   9.67  22.4
50221.0  396.90   9.08  20.6
50321.0  396.90   5.64  23.9
50421.0  393.45   6.48  22.0
50521.0  396.90   7.88  11.9

[506 rows x 14 columns]
```

```
print(np.shape(data))
```

```
(506, 14)
```

```
 print(data.describe())
```

```
                CRIM          ZN       INDUS        CHAS         NOX          RM  \
count   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
std       8.601545   23.322453    6.860353    0.253994    0.115878    0.702617
min       0.006320    0.000000    0.460000    0.000000    0.385000    3.561000
25%       0.082045    0.000000    5.190000    0.000000    0.449000    5.885500
50%       0.256510    0.000000    9.690000    0.000000    0.538000    6.208500
75%       3.677083   12.500000   18.100000    0.000000    0.624000    6.623500
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
```

```
from sklearn.metrics import mean_squared_error
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import seaborn as sns
```

```
x = data.drop(['MEDV'], axis=1)
y = data['MEDV']
```

```
print(x)
```

```
          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
0        15.3 396.90   4.98
1        17.8 396.90   9.14
2        17.8 392.83   4.03
3        18.7 394.63   2.94
4       18.7  396.90   5.33
...........
50121.0  391.99   9.67
50221.0  396.90   9.08
50321.0  396.90   5.64
50421.0  393.45   6.48
50521.0  396.90   7.88

[506 rows x 13 columns]
```

```
print(y)
```

```
0      24.0
1      21.6
2      34.7
3      33.4
436.2
       ...
50122.4
50220.6
50323.9
50422.0
50511.9
Name: MEDV, Length: 506, dtype: float64
```

```
from sklearn.model_selection import train_test_split
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size =0.2, random_state = 0)

print("xtrain shape : ", xtrain.shape)
print("xtest shape  : ", xtest.shape)
print("ytrain shape : ", ytrain.shape)
print("ytest shape  : ", ytest.shape)
```

```
xtrain shape :  (404, 13)
xtest shape  :  (102, 13)
ytrain shape :  (404,)
ytest shape  :  (102,)
```

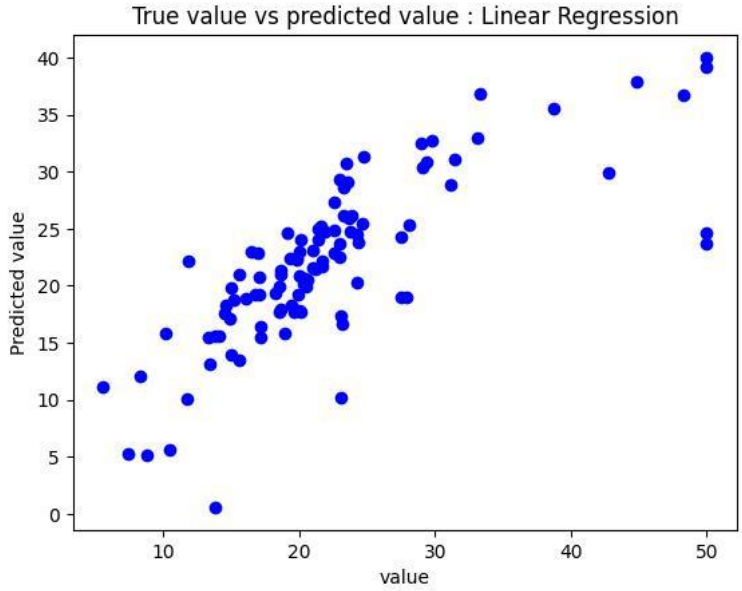
```
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(xtrain, ytrain)

y_pred = regressor.predict(xtest)
```

```
from sklearn.metrics import mean_squared_error, mean_absolute_error
mse = mean_squared_error(ytest, y_pred)
mae = mean_absolute_error(ytest,y_pred)
print("Mean Square Error : ", mse)
print("Mean Absolute Error : ", mae)
```

```
Mean Square Error :  33.44897999767639
Mean Absolute Error :  3.8429092204444983
```

```
plt.scatter(ytest, y_pred, c = 'blue')
plt.xlabel("value")
plt.ylabel("Predicted value")
plt.title("True value vs predicted value : Linear Regression")
plt.show()
```



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