# Aim: Implement linear regression in Python on a given dataset.

In [117…
```
import pandas as pd
import numpy as np

import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
```

# Simple linear Regression

In [118…
```
#data_no=pd.read_csv('Automobile.csv')
#df = pd.DataFrame()
d = pd.read_csv("Automobile.csv")
```

In [119…
```
d
```

Out[119…

| | name | mpg | cylinders | displacement | horsepower | weight | acceleration | model |
|---|---|---|---|---|---|---|---|---|
| **0** | chevrolet chevelle malibu | 18.0 | 8.0 | 307.0 | 130.0 | 3504.0 | 12.0 | |
| **1** | buick skylark 320 | 15.0 | 8.0 | 350.0 | 165.0 | 3693.0 | 11.5 | |
| **2** | plymouth satellite | 18.0 | 8.0 | 318.0 | 150.0 | 3436.0 | 11.0 | |
| **3** | amc rebel sst | 16.0 | 8.0 | 304.0 | 150.0 | 3433.0 | 12.0 | |
| **4** | ford torino | 17.0 | 8.0 | 302.0 | 140.0 | 3449.0 | 10.5 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | |
| **393** | ford mustang gl | 27.0 | 4.0 | 140.0 | 86.0 | 2790.0 | 15.6 | |
| **394** | vw pickup | 44.0 | 4.0 | 97.0 | 52.0 | 2130.0 | 24.6 | |
| **395** | dodge rampage | 32.0 | 4.0 | 135.0 | 84.0 | 2295.0 | 11.6 | |
| **396** | ford ranger | 28.0 | 4.0 | 120.0 | 79.0 | 2625.0 | 18.6 | |
| **397** | chevy s-10 | 31.0 | 4.0 | 119.0 | 82.0 | 2720.0 | 19.4 | |

398 rows × 9 columns

In [120…

```
d.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 398 entries, 0 to 397
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   name          398 non-null    object 
 1   mpg           397 non-null    float64
 2   cylinders     397 non-null    float64
 3   displacement  393 non-null    float64
 4   horsepower    391 non-null    float64
 5   weight        393 non-null    float64
 6   acceleration  396 non-null    float64
 7   model_year    396 non-null    object 
 8   origin        397 non-null    object 
dtypes: float64(6), object(3)
memory usage: 28.1+ KB
```

In [ ]:

In [121…
```
d.isnull().sum()
```

Out[121…
```
name            0
mpg             1
cylinders       1
displacement    5
horsepower      7
weight          5
acceleration    2
model_year      2
origin          1
dtype: int64
```

In [122…
```
X = d.iloc[:,3:4]
Y = d.iloc[:,4:5]
```

In [123…
```
X=X.fillna(192.393130)
Y=Y.fillna(104.524297)
```

In [124…
```
Y.shape
```

Out[124…
```
(398, 1)
```

In [125…
```
X.shape
```

Out[125…
```
(398, 1)
```

In [126…
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.4, random_
```

In [127…
```
Y_test.shape
```

Out[127…
```
(160, 1)
```

In [128…
```
X_test
```

Out[128...

| | displacement |
|---|---|
| **94** | 440.0 |
| **32** | 98.0 |
| **279** | 98.0 |
| **178** | 120.0 |
| **354** | 100.0 |
| **...** | ... |
| **23** | 121.0 |
| **241** | 146.0 |
| **1** | 350.0 |
| **169** | 232.0 |
| **39** | 400.0 |

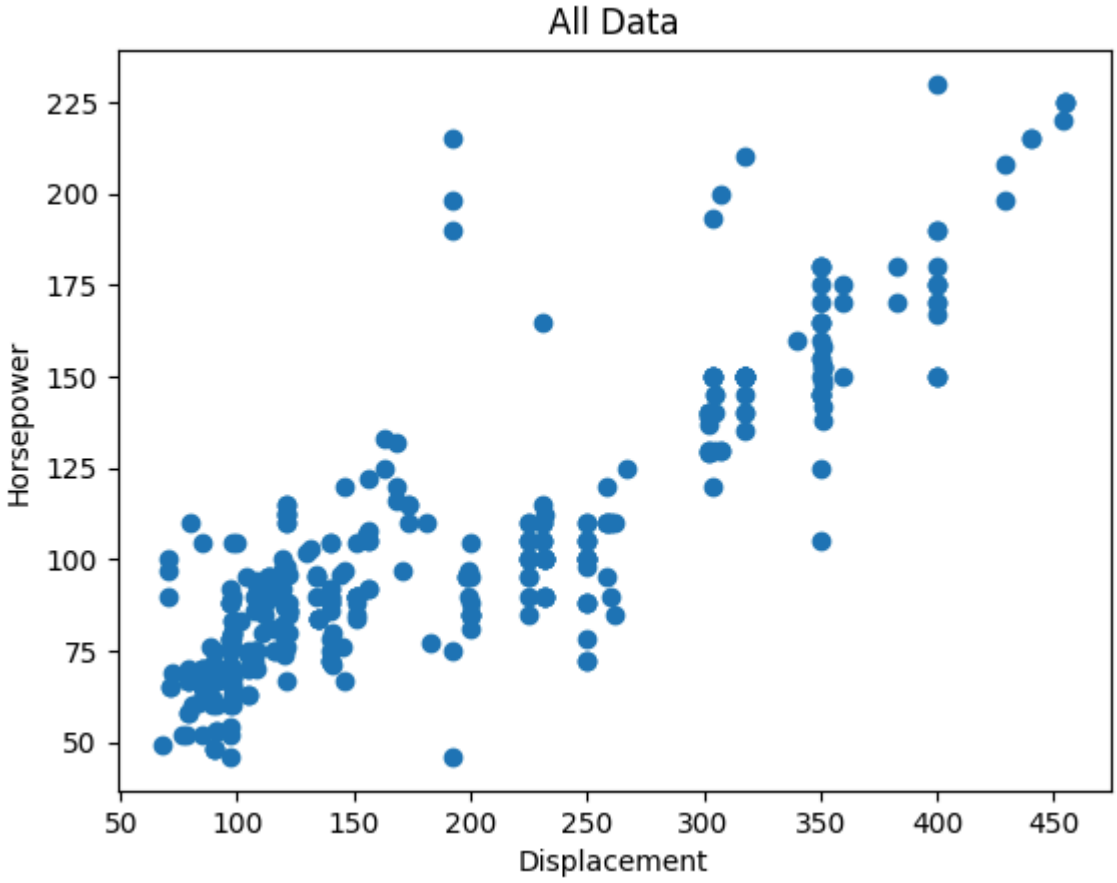
160 rows × 1 columns

In [129...
```
d.describe()
```

Out[129...

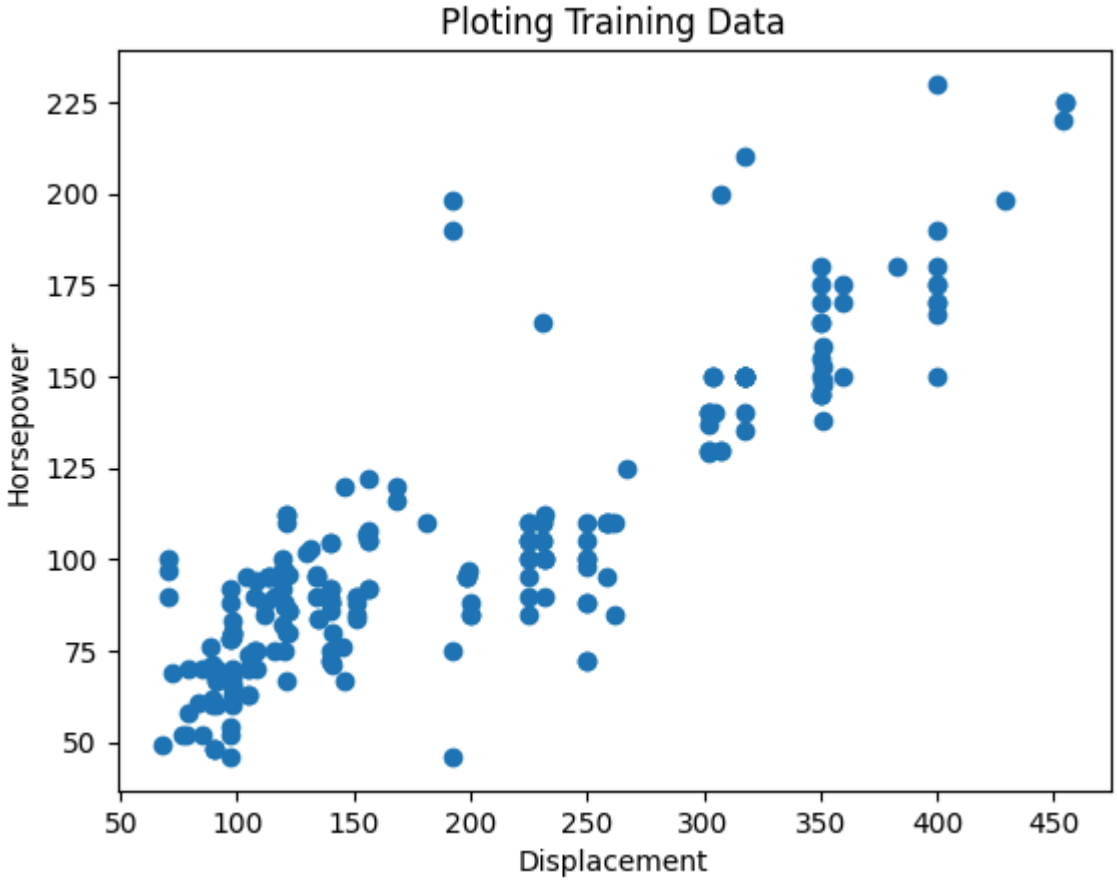
| | mpg | cylinders | displacement | horsepower | weight | acceleration |
|---|---|---|---|---|---|---|
| **count** | 397.000000 | 397.000000 | 393.000000 | 391.000000 | 393.000000 | 396.000000 |
| **mean** | 23.538539 | 5.458438 | 192.393130 | 104.524297 | 2949.053435 | 15.671970 |
| **std** | 7.811191 | 1.701577 | 103.205814 | 38.525101 | 851.576054 | 3.961926 |
| **min** | 9.000000 | 3.000000 | 68.000000 | 46.000000 | 15.000000 | 0.500000 |
| **25%** | 17.500000 | 4.000000 | 105.000000 | 75.000000 | 2220.000000 | 13.775000 |
| **50%** | 23.000000 | 4.000000 | 146.000000 | 94.000000 | 2790.000000 | 15.500000 |
| **75%** | 29.000000 | 8.000000 | 260.000000 | 127.000000 | 3570.000000 | 17.225000 |
| **max** | 46.600000 | 8.000000 | 455.000000 | 230.000000 | 5140.000000 | 70.000000 |

In [130...
```
plt.scatter(X,Y)
 # naming the x axis
plt.xlabel('Displacement')
# naming the y axis
plt.ylabel('Horsepower')
# giving a title to graph
plt.title('All Data')
# function to show the plot
plt.show()
#plotting X & Y data on graph
```




In [131…

```
# naming the x axis
plt.xlabel('Displacement')
# naming the y axis
plt.ylabel('Horsepower')
# giving a title to graph
plt.title('Ploting Training Data')
#plotting X & Y data on graph
plt.scatter(X_train,Y_train)
plt.show()
#plotting training data on graph
```




In [132…

```
#plotting Testing data on graph

# naming the x axis
plt.xlabel('Displacement')
# naming the y axis
plt.ylabel('Horsepower')
# giving a title to graph
plt.title('Ploting Testing Data')
#plotting X & Y data on graph
plt.scatter(X_test,Y_test)
plt.show()
```


In [133…
```
from sklearn import linear_model
lr = linear_model.LinearRegression()
lr.fit(X_train,Y_train)

intercept=lr.intercept_
intercept
```

Out[133…
```
array([40.45473373])
```

In [134…
```
coef=lr.coef_
coef
```

Out[134…
```
array([[0.33128207]])
```

In [135…
```
Y_pred = lr.predict(X_test)
```

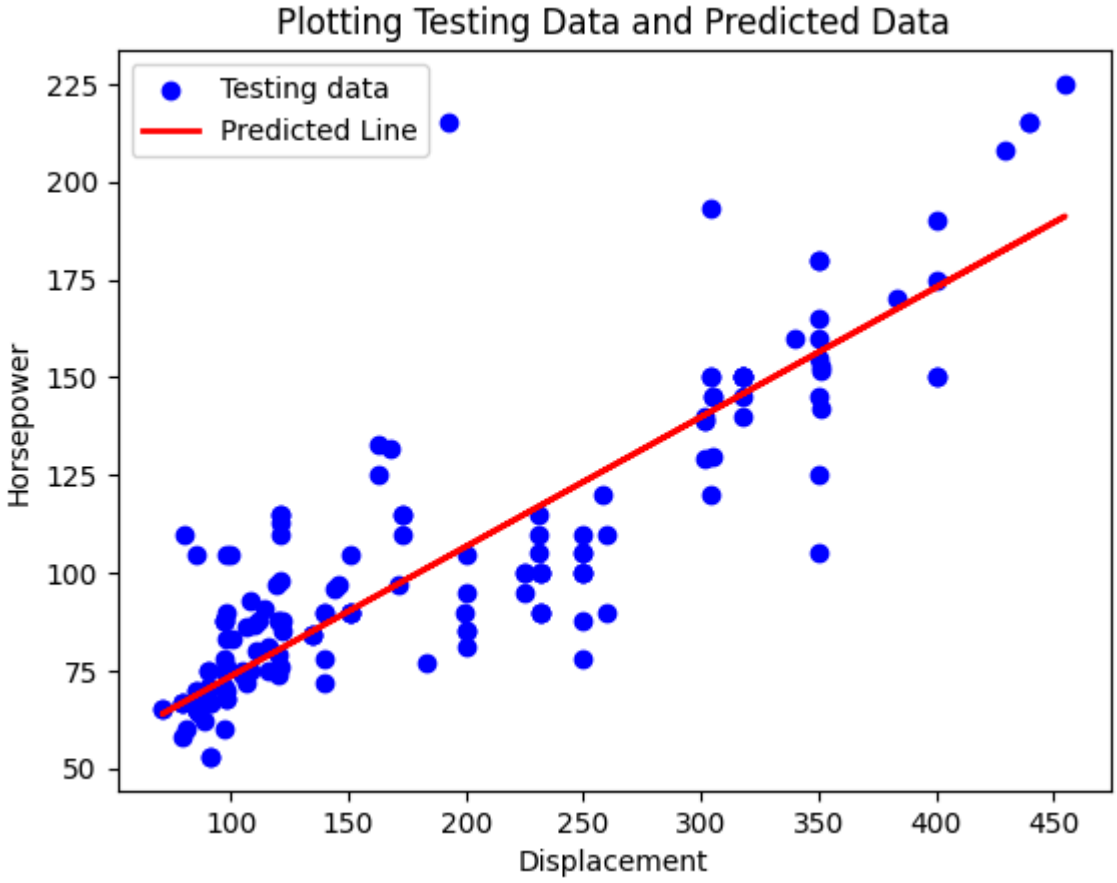
In [136…
```
# Plotting the scatter plot
plt.scatter(X_test, Y_test, color='blue', label='Testing data')

# Plotting the regression line with predicted values
plt.plot(X_test, Y_pred, color='red', linewidth=2, label='Predicted Line')

plt.xlabel('Displacement')
plt.ylabel('Horsepower')
plt.title('Plotting Testing Data and Predicted Data')

plt.legend()

plt.show()
```




In [137…
```
lr.score(X_train, Y_train)
```

Out[137…
```
0.7579028942658471
```

In [138…
```
Y_pred=lr.predict(X_test)
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squ
mean_absolute_error(Y_test, Y_pred)
```

Out[138…
```
13.070989131325026
```

In [139…
```
mean_squared_error(Y_test, Y_pred)
```

Out[139…
```
367.74996277773056
```

In [140…
```
root_mean_squared_error(Y_test, Y_pred)
```

Out[140…
```
19.176807940262908
```

In [141…
```
r2=r2_score(Y_test, Y_pred)
r2
```

Out[141…
```
0.7345525423105541
```

In [142…
```
n=398
k=1
adj_r2score = 1 - (((1-r2)*(10-n))/ (10-n-k))
print(adj_r2score)
```

```
0.7352349265205527
```

# Mutivalue linear Regression

In [143…
```
#data_no=pd.read_csv('Automobile.csv')
#df = pd.DataFrame()
M2 = pd.read_csv("Automobile.csv")
```

In [144…
```
M2.isnull().sum()
```

Out[144…
```
name            0
mpg             1
cylinders       1
displacement    5
horsepower      7
weight          5
acceleration    2
model_year      2
origin          1
dtype: int64
```

In [145…
```
d.describe()
```

Out[145…

| | mpg | cylinders | displacement | horsepower | weight | acceleration |
|---|---|---|---|---|---|---|
| **count** | 397.000000 | 397.000000 | 393.000000 | 391.000000 | 393.000000 | 396.000000 |
| **mean** | 23.538539 | 5.458438 | 192.393130 | 104.524297 | 2949.053435 | 15.671970 |
| **std** | 7.811191 | 1.701577 | 103.205814 | 38.525101 | 851.576054 | 3.961926 |
| **min** | 9.000000 | 3.000000 | 68.000000 | 46.000000 | 15.000000 | 0.500000 |
| **25%** | 17.500000 | 4.000000 | 105.000000 | 75.000000 | 2220.000000 | 13.775000 |
| **50%** | 23.000000 | 4.000000 | 146.000000 | 94.000000 | 2790.000000 | 15.500000 |
| **75%** | 29.000000 | 8.000000 | 260.000000 | 127.000000 | 3570.000000 | 17.225000 |
| **max** | 46.600000 | 8.000000 | 455.000000 | 230.000000 | 5140.000000 | 70.000000 |

In [146…
```
X = M2.iloc[:,2:4]
Y = M2.iloc[:,4:5]
```

In [147…
```
X.isnull().sum()
```

Out[147…
```
cylinders       1
displacement    5
dtype: int64
```

In [148…
```
Y.isnull().sum()
```

Out[148…
```
horsepower    7
dtype: int64
```

In [149…
```
# Replace null values in the 'cylinders' column with a specific value
X['cylinders'] = X['cylinders'].fillna(value=5.458438)

# Replace null values in the 'displacement' column with a different value
X['displacement'] = X['displacement'].fillna(value=192.393130)
```

```
Y=Y.fillna(104.524297)
```

In [150…
```
X.isnull().sum()
```

Out[150…
```
cylinders       0
displacement    0
dtype: int64
```

In [151…
```
X.shape
```

Out[151…
```
(398, 2)
```

In [152…
```
Y.shape
```

Out[152…
```
(398, 1)
```

In [153…
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.4, random_
```

In [154…
```
Y_test.shape
```

Out[154…
```
(160, 1)
```

In [155…
```
X_test.shape
```

Out[155…
```
(160, 2)
```

In [156…
```
from sklearn import linear_model
lr = linear_model.LinearRegression()
lr.fit(X_train,Y_train)

intercept=lr.intercept_
intercept
```

Out[156…
```
array([28.39757549])
```

In [157…
```
coef_cylinders, coef_displacement = lr.coef_[0]
print(coef_cylinders, coef_displacement)
```

```
4.982040075188673 0.25333950531970395
```

In [158…
```
coef=lr.coef_
coef
```

Out[158…
```
array([[4.98204008, 0.25333951]])
```

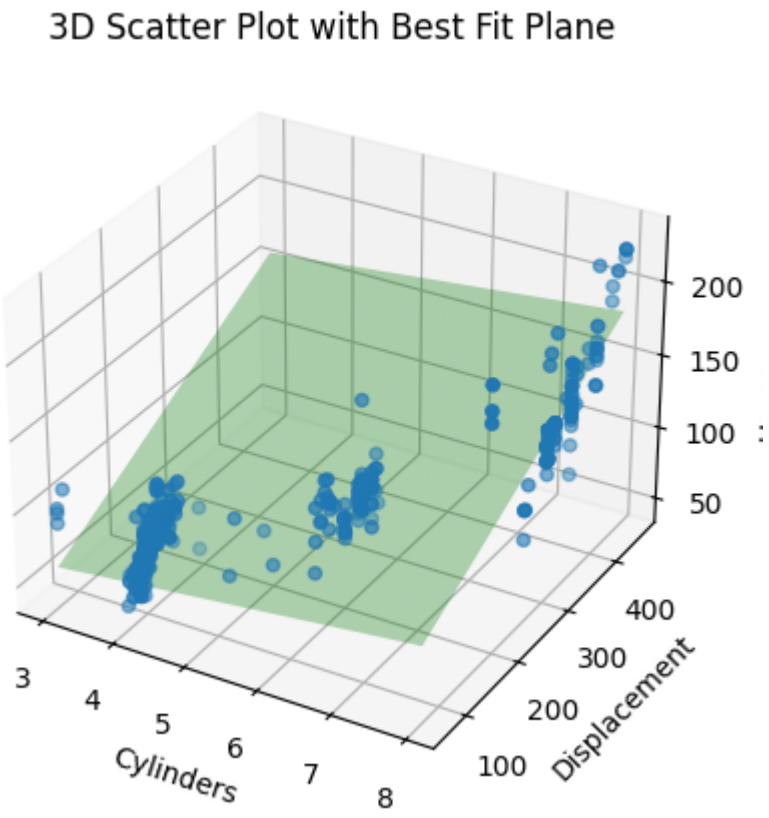
In [159…
```
Y_pred = lr.predict(X_test)
```

In [160…
```
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import numpy as np
```

In [161…
```
# Creating a meshgrid for the plane
x_values = np.linspace(min(X["cylinders"]), max(X["cylinders"]), 10)
y_values = np.linspace(min(X["displacement"]), max(X["displacement"]), 10)
x_mesh, y_mesh = np.meshgrid(x_values, y_values)
```

In [162…
```
# Calculating z values for the plane using the plane equation
z_mesh = coef_cylinders * x_mesh + coef_displacement * y_mesh + intercept
```

In [163…
```
 # Plotting the scatter plot
 fig = plt.figure()
 ax = fig.add_subplot(projection='3d')
 ax.scatter(X["cylinders"], X["displacement"], Y)
 # Plotting the best fit plane
 ax.plot_surface(x_mesh, y_mesh, z_mesh, alpha = 0.3, color='green')
 ax.set_xlabel('Cylinders')
 ax.set_ylabel('Displacement')
 ax.set_zlabel('Horsepower')
 ax.set_title('3D Scatter Plot with Best Fit Plane')
# ax.legend()
 plt.show()
```




In [164…
```
Y_pred=lr.predict(X_test)
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squ
mean_absolute_error(Y_test, Y_pred)
```

Out[164… 13.34665612540907

In [165…
```
mean_squared_error(Y_test, Y_pred)
```

Out[165… 363.8637958562596

In [166…
```
root_mean_squared_error(Y_test, Y_pred)
```

Out[166… 19.075214175894846

In [167…
```
r2=r2_score(Y_test, Y_pred)
r2
```

Out[167… 0.7373576360804337

In [168…
```
Y_test.shape
```

Out[168… (160, 1)

In [169…
```
n=160
k=2
adj_r2score = 1 - (((1-r2)*(10-n))/ (10-n-k))
print(adj_r2score)
```

```
0.7408134566583227
```

# More than 2 Mutivalue linear Regression

In [170…
```
#data_no=pd.read_csv('Automobile.csv')
#M4 = pd.DataFrame()
M4 = pd.read_csv("Automobile.csv")
```

In [171…
```
M4
```

Out[171…

| | name | mpg | cylinders | displacement | horsepower | weight | acceleration | model |
|---|---|---|---|---|---|---|---|---|
| **0** | chevrolet chevelle malibu | 18.0 | 8.0 | 307.0 | 130.0 | 3504.0 | 12.0 | |
| **1** | buick skylark 320 | 15.0 | 8.0 | 350.0 | 165.0 | 3693.0 | 11.5 | |
| **2** | plymouth satellite | 18.0 | 8.0 | 318.0 | 150.0 | 3436.0 | 11.0 | |
| **3** | amc rebel sst | 16.0 | 8.0 | 304.0 | 150.0 | 3433.0 | 12.0 | |
| **4** | ford torino | 17.0 | 8.0 | 302.0 | 140.0 | 3449.0 | 10.5 | |
| **...** | ... | ... | ... | ... | ... | ... | ... | |
| **393** | ford mustang gl | 27.0 | 4.0 | 140.0 | 86.0 | 2790.0 | 15.6 | |
| **394** | vw pickup | 44.0 | 4.0 | 97.0 | 52.0 | 2130.0 | 24.6 | |
| **395** | dodge rampage | 32.0 | 4.0 | 135.0 | 84.0 | 2295.0 | 11.6 | |
| **396** | ford ranger | 28.0 | 4.0 | 120.0 | 79.0 | 2625.0 | 18.6 | |
| **397** | chevy s-10 | 31.0 | 4.0 | 119.0 | 82.0 | 2720.0 | 19.4 | |

398 rows × 9 columns

In [172…
```
M4.isnull().sum()
```

Out[172…
```
name            0
mpg             1
cylinders       1
displacement    5
horsepower      7
weight          5
acceleration    2
model_year      2
origin          1
dtype: int64
```

In [173…
```
M4.describe()
```

Out[173...

| | mpg | cylinders | displacement | horsepower | weight | acceleration |
|---|---|---|---|---|---|---|
| **count** | 397.000000 | 397.000000 | 393.000000 | 391.000000 | 393.000000 | 396.000000 |
| **mean** | 23.538539 | 5.458438 | 192.393130 | 104.524297 | 2949.053435 | 15.671970 |
| **std** | 7.811191 | 1.701577 | 103.205814 | 38.525101 | 851.576054 | 3.961926 |
| **min** | 9.000000 | 3.000000 | 68.000000 | 46.000000 | 15.000000 | 0.500000 |
| **25%** | 17.500000 | 4.000000 | 105.000000 | 75.000000 | 2220.000000 | 13.775000 |
| **50%** | 23.000000 | 4.000000 | 146.000000 | 94.000000 | 2790.000000 | 15.500000 |
| **75%** | 29.000000 | 8.000000 | 260.000000 | 127.000000 | 3570.000000 | 17.225000 |
| **max** | 46.600000 | 8.000000 | 455.000000 | 230.000000 | 5140.000000 | 70.000000 |

In [174...
```
M4.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 398 entries, 0 to 397
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   name          398 non-null    object 
 1   mpg           397 non-null    float64
 2   cylinders     397 non-null    float64
 3   displacement  393 non-null    float64
 4   horsepower    391 non-null    float64
 5   weight        393 non-null    float64
 6   acceleration  396 non-null    float64
 7   model_year    396 non-null    object 
 8   origin        397 non-null    object 
dtypes: float64(6), object(3)
memory usage: 28.1+ KB
```

In [175...
```
from sklearn.preprocessing import LabelEncoder
encoder = LabelEncoder()
```

In [176...
```
# new_Crash_data=pd.DataFrame()
M4['name'] = encoder.fit_transform(M4['name'])
# new_Crash_data=pd.DataFrame()
M4['model_year'] = encoder.fit_transform(M4['model_year'])
# new_Crash_data=pd.DataFrame()
M4['origin'] = encoder.fit_transform(M4['origin'])
```

In [177...
```
M4
```

Out[177…

| | name | mpg | cylinders | displacement | horsepower | weight | acceleration | model_ye |
|---|---|---|---|---|---|---|---|---|
| **0** | 49 | 18.0 | 8.0 | 307.0 | 130.0 | 3504.0 | 12.0 | |
| **1** | 36 | 15.0 | 8.0 | 350.0 | 165.0 | 3693.0 | 11.5 | |
| **2** | 231 | 18.0 | 8.0 | 318.0 | 150.0 | 3436.0 | 11.0 | |
| **3** | 14 | 16.0 | 8.0 | 304.0 | 150.0 | 3433.0 | 12.0 | |
| **4** | 161 | 17.0 | 8.0 | 302.0 | 140.0 | 3449.0 | 10.5 | |
| **…** | … | … | … | … | … | … | … | |
| **393** | 153 | 27.0 | 4.0 | 140.0 | 86.0 | 2790.0 | 15.6 | |
| **394** | 301 | 44.0 | 4.0 | 97.0 | 52.0 | 2130.0 | 24.6 | |
| **395** | 119 | 32.0 | 4.0 | 135.0 | 84.0 | 2295.0 | 11.6 | |
| **396** | 159 | 28.0 | 4.0 | 120.0 | 79.0 | 2625.0 | 18.6 | |
| **397** | 69 | 31.0 | 4.0 | 119.0 | 82.0 | 2720.0 | 19.4 | |

398 rows × 9 columns

In [178…

```
import pandas as pd

X = pd.concat([M4.iloc[:,0:4], M4.iloc[:,5:9]], axis=1)
```

In [179…

```
M4.isnull().sum()
```

Out[179…

```
name            0
mpg             1
cylinders       1
displacement    5
horsepower      7
weight          5
acceleration    2
model_year      0
origin          0
dtype: int64
```

In [180…

```
X
```

Out[180…

| | name | mpg | cylinders | displacement | weight | acceleration | model_year | origin |
|---|---|---|---|---|---|---|---|---|
| **0** | 49 | 18.0 | 8.0 | 307.0 | 3504.0 | 12.0 | 0 | 2 |
| **1** | 36 | 15.0 | 8.0 | 350.0 | 3693.0 | 11.5 | 0 | 2 |
| **2** | 231 | 18.0 | 8.0 | 318.0 | 3436.0 | 11.0 | 0 | 2 |
| **3** | 14 | 16.0 | 8.0 | 304.0 | 3433.0 | 12.0 | 0 | 2 |
| **4** | 161 | 17.0 | 8.0 | 302.0 | 3449.0 | 10.5 | 0 | 2 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... |
| **393** | 153 | 27.0 | 4.0 | 140.0 | 2790.0 | 15.6 | 12 | 2 |
| **394** | 301 | 44.0 | 4.0 | 97.0 | 2130.0 | 24.6 | 12 | 0 |
| **395** | 119 | 32.0 | 4.0 | 135.0 | 2295.0 | 11.6 | 12 | 2 |
| **396** | 159 | 28.0 | 4.0 | 120.0 | 2625.0 | 18.6 | 12 | 2 |
| **397** | 69 | 31.0 | 4.0 | 119.0 | 2720.0 | 19.4 | 12 | 2 |

398 rows × 8 columns

In [181…

```
X.describe()
```

Out[181…

| | name | mpg | cylinders | displacement | weight | acceleration | mo |
|---|---|---|---|---|---|---|---|
| **count** | 398.000000 | 397.000000 | 397.000000 | 393.000000 | 393.000000 | 396.000000 | 39 |
| **mean** | 148.550251 | 23.538539 | 5.458438 | 192.393130 | 2949.053435 | 15.671970 | |
| **std** | 89.495880 | 7.811191 | 1.701577 | 103.205814 | 851.576054 | 3.961926 | |
| **min** | 0.000000 | 9.000000 | 3.000000 | 68.000000 | 15.000000 | 0.500000 | |
| **25%** | 65.250000 | 17.500000 | 4.000000 | 105.000000 | 2220.000000 | 13.775000 | |
| **50%** | 150.000000 | 23.000000 | 4.000000 | 146.000000 | 2790.000000 | 15.500000 | |
| **75%** | 225.750000 | 29.000000 | 8.000000 | 260.000000 | 3570.000000 | 17.225000 | |
| **max** | 304.000000 | 46.600000 | 8.000000 | 455.000000 | 5140.000000 | 70.000000 | 1 |

In [182…

```
X['mpg'] = X['mpg'].fillna(value=23.538539)
# Replace null values in the 'cylinders' column with a specific value
X['cylinders'] = X['cylinders'].fillna(value=5.458438)

# Replace null values in the 'displacement' column with a different value
X['displacement'] = X['displacement'].fillna(value=192.393130)

X['weight'] = X['weight'].fillna(value=192.393130)

X['acceleration'] = X['acceleration'].fillna(value=192.393130)

Y=Y.fillna(104.524297)
```

In [183…
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.4, random_
```

In [184…
```
from sklearn import linear_model
lr = linear_model.LinearRegression()
lr.fit(X_train,Y_train)

intercept=lr.intercept_
intercept
```

Out[184… array([64.13840453])

In [185…
```
coef=lr.coef_
coef
```

Out[185…
```
array([[-0.01040342, -0.91356548,  2.70751266,  0.18423884,  0.00718577,
        -0.10747737, -0.361584  , -2.82215043]])
```

In [186…
```
coef_name, coef_mpg, coef_cylinders, coef_displacement, coef_weight, coef_accele
print(coef_mpg, coef_cylinders, coef_displacement)
```

```
-0.9135654830247643 2.707512656282228 0.18423883622165788
```

In [187…
```
Y_pred = lr.predict(X_test)
```

In [188…
```
Y_pred=lr.predict(X_test)
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squ
mean_absolute_error(Y_test, Y_pred)
```

Out[188… 13.295338700617416

In [189…
```
mean_squared_error(Y_test, Y_pred)
```

Out[189… 341.332185874115

In [190…
```
root_mean_squared_error(Y_test, Y_pred)
```

Out[190… 18.475177560015897

In [191…
```
r2=r2_score(Y_test, Y_pred)
r2
```

Out[191… 0.7536212912613462

In [192…
```
n=160
k=3
adj_r2score = 1 - (((1-r2)*(10-n))/ (10-n-k))
print(adj_r2score)
```

```
0.7584522463346531
```

# Removing origin column

In [193…
```
# column_to_drop = "origin"
X = X.drop('origin', axis=1)
```

In [194...
```
X
```

Out[194...

| | name | mpg | cylinders | displacement | weight | acceleration | model_year |
|---|---|---|---|---|---|---|---|
| **0** | 49 | 18.0 | 8.0 | 307.0 | 3504.0 | 12.0 | 0 |
| **1** | 36 | 15.0 | 8.0 | 350.0 | 3693.0 | 11.5 | 0 |
| **2** | 231 | 18.0 | 8.0 | 318.0 | 3436.0 | 11.0 | 0 |
| **3** | 14 | 16.0 | 8.0 | 304.0 | 3433.0 | 12.0 | 0 |
| **4** | 161 | 17.0 | 8.0 | 302.0 | 3449.0 | 10.5 | 0 |
| **...** | ... | ... | ... | ... | ... | ... | ... |
| **393** | 153 | 27.0 | 4.0 | 140.0 | 2790.0 | 15.6 | 12 |
| **394** | 301 | 44.0 | 4.0 | 97.0 | 2130.0 | 24.6 | 12 |
| **395** | 119 | 32.0 | 4.0 | 135.0 | 2295.0 | 11.6 | 12 |
| **396** | 159 | 28.0 | 4.0 | 120.0 | 2625.0 | 18.6 | 12 |
| **397** | 69 | 31.0 | 4.0 | 119.0 | 2720.0 | 19.4 | 12 |

398 rows × 7 columns

In [195...
```
X['mpg'] = X['mpg'].fillna(value=23.538539)
# Replace null values in the 'cylinders' column with a specific value
X['cylinders'] = X['cylinders'].fillna(value=5.458438)

# Replace null values in the 'displacement' column with a different value
X['displacement'] = X['displacement'].fillna(value=192.393130)

X['weight'] = X['weight'].fillna(value=192.393130)

X['acceleration'] = X['acceleration'].fillna(value=192.393130)

Y=Y.fillna(104.524297)
```

In [196...
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.4, random_
```

In [197...
```
from sklearn import linear_model
lr = linear_model.LinearRegression()
lr.fit(X_train,Y_train)

intercept=lr.intercept_
intercept
```

Out[197...
```
array([58.6808647])
```

In [198...
```
coef=lr.coef_
coef
```

Out[198...
```
array([[-0.00420697, -0.84155477,  2.78998424,  0.17328983,  0.0075213 ,
        -0.10418774, -0.48523644]])
```

In [199…
```
coef_name, coef_mpg, coef_cylinders, coef_displacement, coef_weight, coef_accele
print(coef_mpg, coef_cylinders, coef_displacement)
```

```
-0.8415547657354356 2.7899842356934568 0.17328982724531156
```

In [200…
```
Y_pred = lr.predict(X_test)
```

In [201…
```
Y_pred=lr.predict(X_test)
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squ
mean_absolute_error(Y_test, Y_pred)
```

Out[201…
```
13.35629564001081
```

In [202…
```
r2=r2_score(Y_test, Y_pred)
r2
```

Out[202…
```
0.7464578917754212
```

# Removing Acceleration Column

In [203…
```
# column_to_drop = "origin"
X = X.drop('acceleration', axis=1)
```

In [204…
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.4, random_
```

In [205…
```
from sklearn import linear_model
lr = linear_model.LinearRegression()
lr.fit(X_train,Y_train)
```

Out[205…

▾ LinearRegression

```
LinearRegression()
```

In [208…
```
Y_pred = lr.predict(X_test)
```

In [209…
```
Y_pred=lr.predict(X_test)
from sklearn.metrics import mean_absolute_error,mean_squared_error,root_mean_squ
mean_absolute_error(Y_test, Y_pred)
r2=r2_score(Y_test, Y_pred)
r2
```

Out[209…
```
0.7420533440568693
```

In [ ]: