Mielage Prediction with Regression Analysis (Machine learning)

Objective

To develop an Machine Learning Model to predict mileage using Linear Regression method

Data Source

This dataset was taken from the github library which is maintained at YBI Foundation. This dataset was used in the 1983 American Statistical Association Exposition.

Import Library

```
import pandas as pd
```

```
import numpy as np
```

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

```
import seaborn as sns
```

Import Data

```
df = pd.read_csv("https://github.com/YBI-Foundation/Dataset/raw/main/MPG.csv")
```

Describe Data

```
df.head()
```

	mpg	cylinders	displacement	horsepower	weight	acceleration	model_year	origin	name
0	18.0	8	307.0	130.0	3504	12.0	70	usa	chevrolet chevelle malibu
1	15.0	8	350.0	165.0	3693	11.5	70	usa	buick skylark 320
2	18.0	8	318.0	150.0	3436	11.0	70	usa	plymouth satellite
3	16.0	8	304.0	150.0	3433	12.0	70	usa	amc rebel sst
4	17.0	8	302.0	140.0	3449	10.5	70	usa	ford torino

```
df.nunique()
```

```
mpg             129
cylinders         5
displacement     82
horsepower       93
weight          351
acceleration     95
model_year       13
origin            3
name            305
dtype: int64
```

Data Preprocessing

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 398 entries, 0 to 397
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   mpg           398 non-null    float64
 1   cylinders     398 non-null    int64  
 2   displacement  398 non-null    float64
 3   horsepower    392 non-null    float64
 4   weight        398 non-null    int64  
 5   acceleration  398 non-null    float64
 6   model_year    398 non-null    int64  
 7   origin        398 non-null    object 
 8   name          398 non-null    object 
dtypes: float64(4), int64(3), object(2)
memory usage: 28.1+ KB
```

```
df.describe()
```

	mpg	cylinders	displacement	horsepower	weight	acceleration	model_year
count	398.000000	398.000000	398.000000	392.000000	398.000000	398.000000	398.000000
mean	23.514573	5.454774	193.425879	104.469388	2970.424623	15.568090	76.010050
std	7.815984	1.701004	104.269838	38.491160	846.841774	2.757689	3.697627
min	9.000000	3.000000	68.000000	46.000000	1613.000000	8.000000	70.000000
25%	17.500000	4.000000	104.250000	75.000000	2223.750000	13.825000	73.000000
50%	23.000000	4.000000	148.500000	93.500000	2803.500000	15.500000	76.000000
75%	29.000000	8.000000	262.000000	126.000000	3608.000000	17.175000	79.000000
max	46.600000	8.000000	455.000000	230.000000	5140.000000	24.800000	82.000000

```
df.corr()
```

```
<ipython-input-10-2f6f6606aa2c>:1: FutureWarning: The default value of numeric_only in DataFrame.corr i
  df.corr()
```

	mpg	cylinders	displacement	horsepower	weight	acceleration	model_year
mpg	1.000000	-0.775396	-0.804203	-0.778427	-0.831741	0.420289	0.579267
cylinders	-0.775396	1.000000	0.950721	0.842983	0.896017	-0.505419	-0.348746
displacement	-0.804203	0.950721	1.000000	0.897257	0.932824	-0.543684	-0.370164
horsepower	-0.778427	0.842983	0.897257	1.000000	0.864538	-0.689196	-0.416361
weight	-0.831741	0.896017	0.932824	0.864538	1.000000	-0.417457	-0.306564
acceleration	0.420289	-0.505419	-0.543684	-0.689196	-0.417457	1.000000	0.288137
model_year	0.579267	-0.348746	-0.370164	-0.416361	-0.306564	0.288137	1.000000

```
df = df.dropna()
```

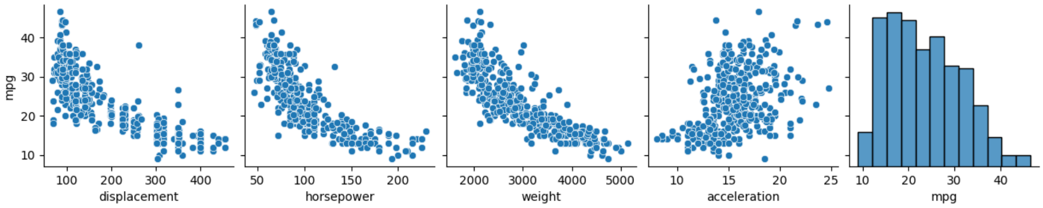
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 392 entries, 0 to 397
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   mpg           392 non-null    float64
 1   cylinders     392 non-null    int64  
 2   displacement  392 non-null    float64
 3   horsepower    392 non-null    float64
 4   weight        392 non-null    int64  
 5   acceleration  392 non-null    float64
 6   model_year    392 non-null    int64  
 7   origin        392 non-null    object 
 8   name          392 non-null    object 
dtypes: float64(4), int64(3), object(2)
memory usage: 30.6+ KB
```

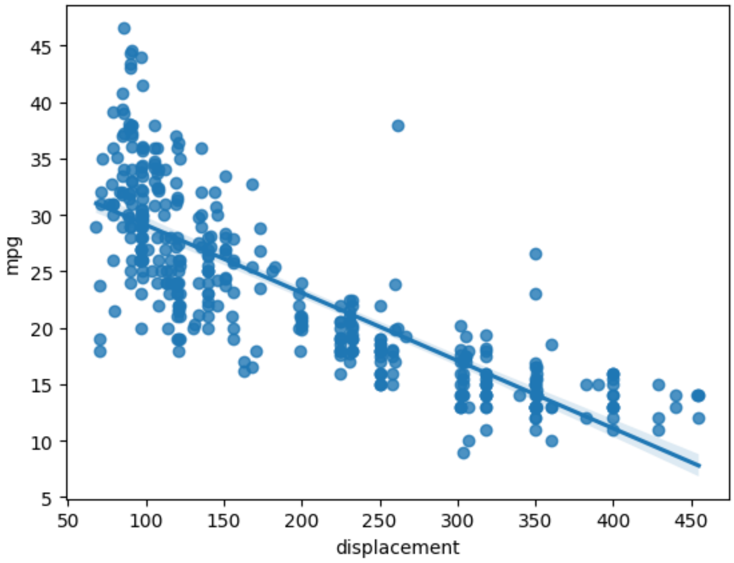
Data Visualization

```
sns.pairplot(df, x_vars=['displacement', 'horsepower', 'weight', 'acceleration','mpg'], y_vars=['mpg'])
```

```
<seaborn.axisgrid.PairGrid at 0x7f3b3bf35180>
```



```
sns.regplot(x = 'displacement',y = 'mpg', data = df);
```



Define Target Variable (y) and Feature Variables (X)

```
df.columns
```

```
Index(['mpg', 'cylinders', 'displacement', 'horsepower', 'weight',
       'acceleration', 'model_year', 'origin', 'name'],
      dtype='object')
```

```
y = df['mpg']
```

```
y.shape
```

```
(392,)
```

```
x = df[['displacement', 'horsepower', 'weight','acceleration']]
```

```
x.shape
```

```
(392, 4)
```

```
x
```

	displacement	horsepower	weight	acceleration
0	307.0	130.0	3504	12.0
1	350.0	165.0	3693	11.5
2	318.0	150.0	3436	11.0
3	304.0	150.0	3433	12.0

Train Test Split

Scaling Data

```
from sklearn.preprocessing import StandardScaler
```

```
ss = StandardScaler()
```

```
x = ss.fit_transform(x)
```

```
x
```

```
array([[ 1.07728956,  0.66413273,  0.62054034, -1.285258  ],
       [ 1.48873169,  1.57459447,  0.84333403, -1.46672362],
       [ 1.1825422 ,  1.18439658,  0.54038176, -1.64818924],
       ...,
       [-0.56847897, -0.53247413, -0.80463202, -1.4304305 ],
       [-0.7120053 , -0.66254009, -0.41562716,  1.11008813],
       [-0.72157372, -0.58450051, -0.30364091,  1.40043312]])
```

```
pd.DataFrame(x).describe()
```

	0	1	2	3
count	3.920000e+02	3.920000e+02	3.920000e+02	3.920000e+02
mean	-7.250436e-17	-1.812609e-16	-1.812609e-17	4.350262e-16
std	1.001278e+00	1.001278e+00	1.001278e+00	1.001278e+00
min	-1.209563e+00	-1.520975e+00	-1.608575e+00	-2.736983e+00
25%	-8.555316e-01	-7.665929e-01	-8.868535e-01	-6.410551e-01
50%	-4.153842e-01	-2.853488e-01	-2.052109e-01	-1.499869e-02
75%	7.782764e-01	5.600800e-01	7.510927e-01	5.384714e-01
max	2.493416e+00	3.265452e+00	2.549061e+00	3.360262e+00

After Standardization Mean is Zero and Standard Deviation is One

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

```
x_train, x_test, y_train, y_test = train_test_split (x, y, train_size=0.7, random_state = 2529)
```

```
x_train.shape, x_test.shape, y_train.shape, y_test.shape
```

```
((274, 4), (118, 4), (274,), (118,))
```

Modeling

```
from sklearn.linear_model import LinearRegression
```

```
model = LinearRegression()
```

```
model.fit (x_train, y_train)
```

```
▾ LinearRegression
LinearRegression()
```

Model Evaluation

```
model.intercept_
```

```
    23.485738559737584
```

```
model.coef_
```

```
    array([-1.05767743, -1.68734727, -4.10787617, -0.11495177])
```

Mileage = 23.4 - 1.05Dispalcement + error , Mileage = 23.4 - 1.68Horsepower + error, Mileage = 23.4 - 4.10Weight + error, Mileage = 23.4 - 0.11Acceleration + error

Prediction

```
y_pred = model.predict(x_test)
```

```
y_pred
```

```
    array([18.51865637, 15.09305675, 14.30128789, 23.6753321 , 29.7546115 ,
           23.68796629, 26.61066644, 24.56692437, 15.06260986, 11.94312046,
           24.08050053, 27.96518468, 31.66130278, 31.01309132, 18.32428976,
           19.32795009, 28.08847536, 32.1506879 , 31.15859692, 27.15792144,
           18.82433097, 22.54580176, 26.15598115, 32.36393869, 20.74377679,
            8.78027518, 22.19699435, 18.20614294, 25.00052718, 15.26421552,
           23.13441082, 17.10542257,  9.87180062, 30.00790415, 20.41204655,
           29.11860245, 24.4305187 , 21.72601835, 10.51174626, 13.12426391,
           21.41938406, 19.96113872,  6.19146626, 17.79025345, 22.5493033 ,
           29.34765021, 13.4861847 , 25.88852083, 29.40406946, 22.41841964,
           22.07684766, 16.46575802, 24.06290693, 30.12890046, 10.11318121,
            9.85011438, 28.07543852, 23.41426617, 20.08501128, 30.68234133,
           20.92026393, 26.78370281, 22.9078744 , 14.15936872, 24.6439883 ,
           26.95515832, 15.25709393, 24.11272087, 30.80980589, 14.9770217 ,
           27.67836372, 24.2372919 , 10.92177228, 30.22858779, 30.88687365,
           27.33992044, 31.18447082, 10.8873597 , 27.63510608, 16.49231363,
           25.63229888, 29.49776285, 14.90393439, 32.78670687, 30.37325244,
           30.9262743 , 14.71702373, 27.09633246, 26.69933806, 29.06424799,
           32.45810182, 29.44846898, 31.61239999, 31.57891837, 21.46542321,
           31.76739191, 26.28605476, 28.96419915, 31.09628395, 24.80549594,
           18.76490961, 23.28043777, 23.04466919, 22.14143162, 15.95854367,
           28.62870918, 25.58809869, 11.4040908 , 25.73334842, 30.83500051,
           21.94176255, 15.34532941, 30.37399213, 28.7620624 , 29.3639931 ,
           29.10476703, 20.44662365, 28.11466839])
```

Model Accuracy

```
from sklearn.metrics import mean_absolute_percentage_error, r2_score
```

```
mean_absolute_percentage_error(y_test, y_pred)
```

```
    0.14713035779536746
```

```
r2_score(y_test, y_pred)
```

```
    0.7031250746717691
```

Explaination

mean_absolute_percentage_error = 0.14 =14% of error

therefore accuracy of our model is 100 -14 = 86%

r2_score is used to evaluate the performance of the machine learning model

here, r2_score = 0.70

which is close to 1

if r2 value is 1, it means our model is well trained for unseen data

if r2 value is o, it means our model is badly trained for unseen data hence our machine learning model for mileage prediction is 86% accurate

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