Importing Libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

Reading dataset

```
dataset = pd.read_csv("Car_Price_dataset.csv")
dataset
```

```
     car_ID  symboling                   CarName fueltype 
aspiration  \
0         1          3        alfa-romero giulia      gas        std   

1         2          3       alfa-romero stelvio      gas        std   

2         3          1  alfa-romero Quadrifoglio      gas        std   

3         4          2               audi 100 ls      gas        std   

4         5          2                audi 100ls      gas        std   

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

200     201         -1           volvo 145e (sw)      gas        std   

201     202         -1               volvo 144ea      gas      turbo   

202     203         -1               volvo 244dl      gas        std   

203     204         -1                 volvo 246   diesel      turbo   

204     205         -1               volvo 264gl      gas      turbo   


    doornumber      carbody drivewheel enginelocation  wheelbase  ...  
\
0          two  convertible        rwd          front       88.6  ...   

1          two  convertible        rwd          front       88.6  ...   

2          two    hatchback        rwd          front       94.5  ...   
```

```
3          four        sedan         fwd          front        99.8  ...

4          four        sedan         4wd          front        99.4  ...

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

200        four        sedan         rwd          front       109.1  ...

201        four        sedan         rwd          front       109.1  ...

202        four        sedan         rwd          front       109.1  ...

203        four        sedan         rwd          front       109.1  ...

204        four        sedan         rwd          front       109.1  ...


     enginesize  fuelsystem  boreratio  stroke compressionratio
horsepower  \
0           130        mpfi       3.47    2.68              9.0
111
1           130        mpfi       3.47    2.68              9.0
111
2           152        mpfi       2.68    3.47              9.0
154
3           109        mpfi       3.19    3.40             10.0
102
4           136        mpfi       3.19    3.40              8.0
115
..          ...         ...        ...     ...              ...
...
200         141        mpfi       3.78    3.15              9.5
114
201         141        mpfi       3.78    3.15              8.7
160
202         173        mpfi       3.58    2.87              8.8
134
203         145         idi       3.01    3.40             23.0
106
204         141        mpfi       3.78    3.15              9.5
114

     peakrpm citympg  highwaympg    price
0       5000    21.0        27.0  13495.0
1       5000    21.0        27.0  16500.0
2       5000     NaN        26.0  16500.0
3       5500    24.0        30.0  13950.0
4       5500    18.0        22.0  17450.0
..       ...     ...         ...      ...
200     5400    23.0        28.0  16845.0
```

```
201     5300    19.0         25.0  19045.0
202     5500    18.0         23.0  21485.0
203     4800    26.0         27.0  22470.0
204     5400    19.0         25.0  22625.0

[205 rows x 26 columns]
```

```
dataset.dtypes
```

```
car_ID                int64
symboling             int64
CarName              object
fueltype             object
aspiration           object
doornumber           object
carbody              object
drivewheel           object
enginelocation       object
wheelbase           float64
carlength           float64
carwidth            float64
carheight           float64
curbweight          float64
enginetype           object
cylindernumber       object
enginesize            int64
fuelsystem           object
boreratio           float64
stroke              float64
compressionratio    float64
horsepower            int64
peakrpm               int64
citympg             float64
highwaympg          float64
price               float64
dtype: object
```

```
dataset.isna().sum()
```

```
car_ID              0
symboling           0
CarName             0
fueltype            0
aspiration          0
doornumber          0
carbody             0
drivewheel          0
enginelocation      0
wheelbase           5
carlength           0
```

```
carwidth            3
carheight           3
curbweight          1
enginetype          0
cylindernumber      0
enginesize          0
fuelsystem          0
boreratio           4
stroke              1
compressionratio    2
horsepower          0
peakrpm             0
citympg             3
highwaympg          2
price               0
dtype: int64
```

```
dataset.describe()
```

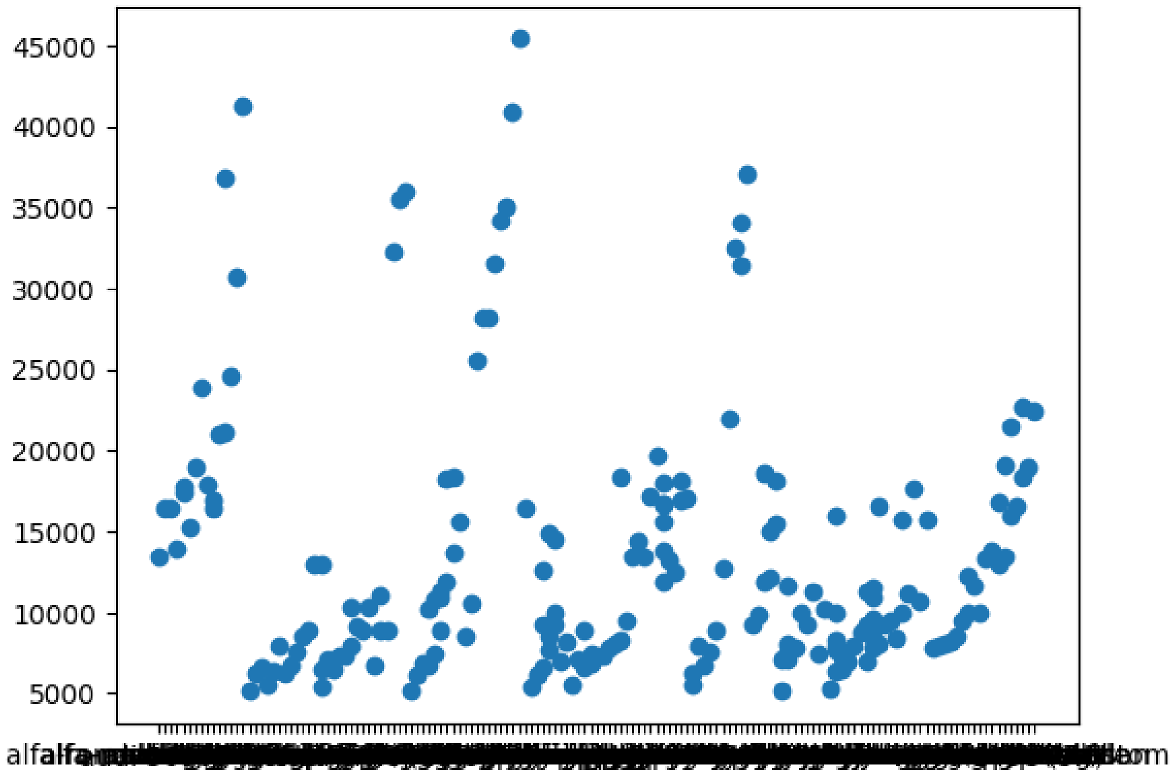
```
           car_ID   symboling   wheelbase   carlength    carwidth
carheight  \
count  205.000000  205.000000  200.000000  205.000000  202.000000
202.000000
mean   103.000000    0.834146   98.816500  174.049268   65.928218
53.731683
std     59.322565    1.245307    6.079414   12.337289    2.152159
2.451801
min      1.000000   -2.000000   86.600000  141.100000   60.300000
47.800000
25%     52.000000    0.000000   94.500000  166.300000   64.125000
52.000000
50%    103.000000    1.000000   97.000000  173.200000   65.500000
54.100000
75%    154.000000    2.000000  102.400000  183.100000   66.900000
55.500000
max    205.000000    3.000000  120.900000  208.100000   72.300000
59.800000

        curbweight  enginesize   boreratio      stroke
compressionratio  \
count   204.000000  205.000000  201.000000  204.000000
203.000000
mean   2554.808824  126.907317    3.330100    3.254412
10.155271
std     521.847984   41.642693    0.272101    0.314039
3.989187
min    1488.000000   61.000000    2.540000    2.070000
7.000000
25%    2145.000000   97.000000    3.150000    3.110000
8.600000
```

```
50%    2414.000000  120.000000    3.310000    3.290000
9.000000
75%    2939.250000  141.000000    3.580000    3.410000
9.400000
max    4066.000000  326.000000    3.940000    4.170000
23.000000

       horsepower       peakrpm      citympg  highwaympg         price
count  205.000000   205.000000  202.000000  203.000000    205.000000
mean   104.117073  5125.121951   25.277228   30.822660  13276.710571
std     39.544167   476.985643    6.515376    6.880744   7988.852332
min     48.000000  4150.000000   13.000000   16.000000   5118.000000
25%     70.000000  4800.000000   19.000000   25.000000   7788.000000
50%     95.000000  5200.000000   24.000000   30.000000  10295.000000
75%    116.000000  5500.000000   30.000000   35.000000  16503.000000
max    288.000000  6600.000000   49.000000   54.000000  45400.000000
```

Replacing missing values

```
for column, content in dataset.items():
    if pd.isna(content).sum():
        content.fillna(content.mean(), inplace=True)

dataset.isna().sum()

car_ID              0
symboling           0
CarName             0
fueltype            0
aspiration          0
doornumber          0
carbody             0
drivewheel          0
enginelocation      0
wheelbase           0
carlength           0
carwidth            0
carheight           0
curbweight          0
enginetype          0
cylindernumber      0
enginesize          0
fuelsystem          0
boreratio           0
stroke              0
compressionratio    0
horsepower          0
peakrpm             0
```

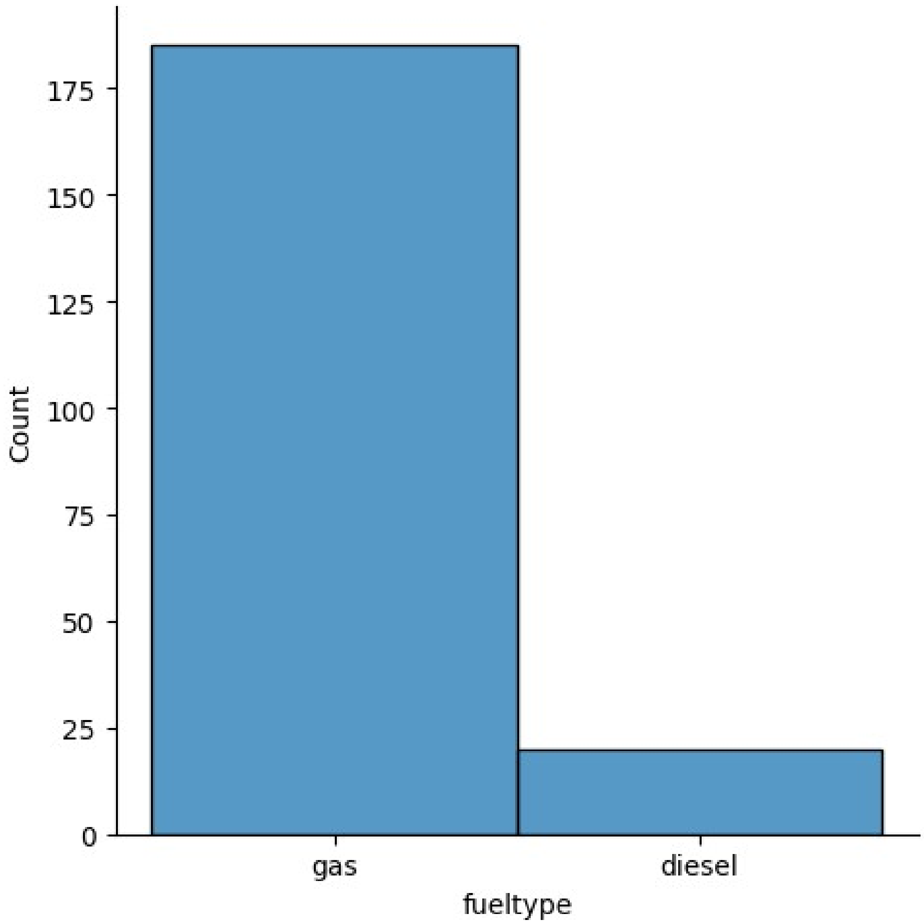
```
citympg              0
highwaympg           0
price                0
dtype: int64

plt.scatter(x=dataset.CarName, y=dataset.price)
#plt.scatter(dataset.CarName, dataset.price)

<matplotlib.collections.PathCollection at 0x16412bc20>
```



Plotting graphs

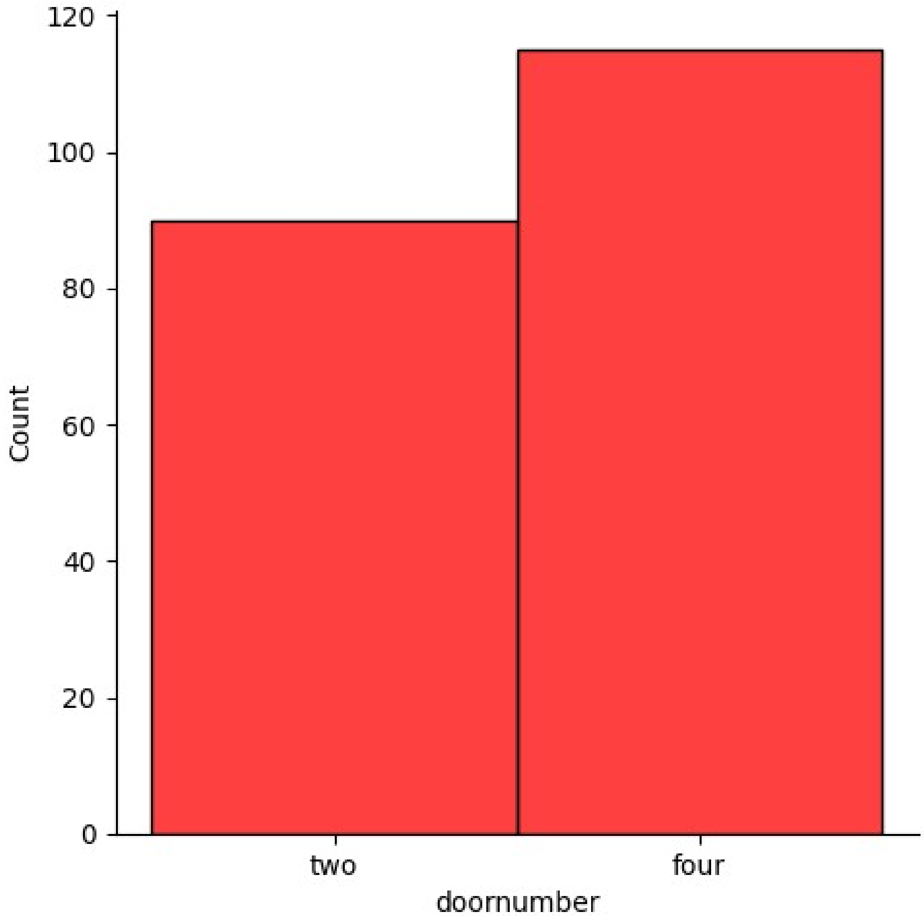
1. FuelType
2. DoorNo
3. EngineLocation
4. CarBody

```
sns.displot(dataset,x='fueltype')

<seaborn.axisgrid.FacetGrid at 0x16410b170>
```



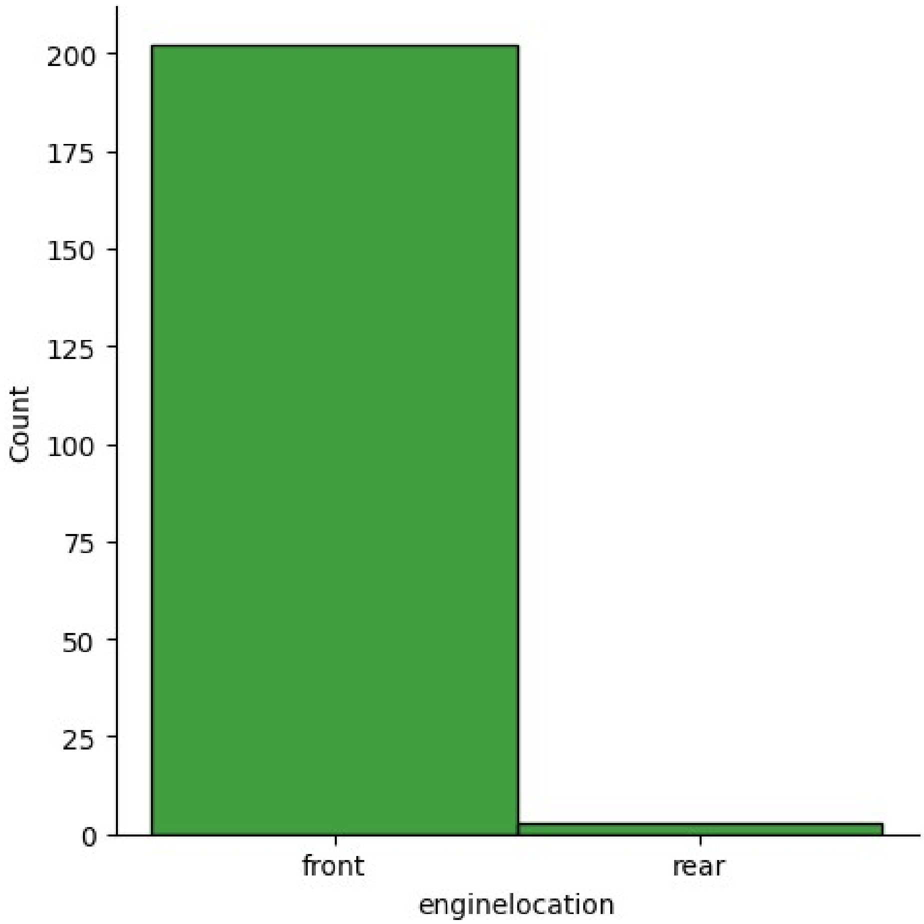

```
sns.displot(dataset, x='doornumber', color='red')
```

```
<seaborn.axisgrid.FacetGrid at 0x1653272f0>
```



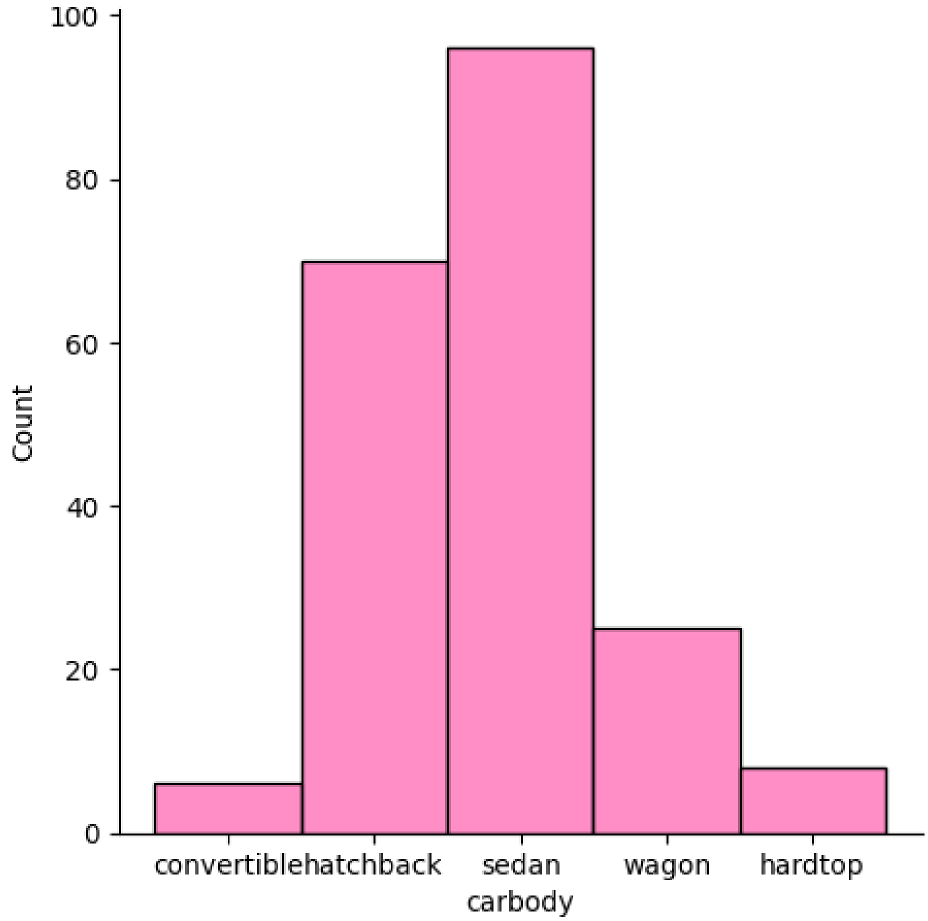

```
sns.displot(dataset, x='enginelocation', color='green')
```

```
<seaborn.axisgrid.FacetGrid at 0x165536210>
```




```
sns.displot(dataset, x='carbody', color='hotpink')
```

```
<seaborn.axisgrid.FacetGrid at 0x164684a40>
```




```
data = pd.DataFrame(dataset, columns=['enginesize', 'price'])
data.cov()
```

	enginesize	price
enginesize	1734.113917	2.908082e+05
price	290808.157690	6.382176e+07

Making changes in the dataset

```
dataset.drop("car_ID", axis=1)
```

```
     symboling                    CarName fueltype aspiration
doornumber  \
0            3        alfa-romero giulia      gas        std
two
1            3       alfa-romero stelvio      gas        std
two
2            1  alfa-romero Quadrifoglio      gas        std
two
```

```
3           2                 audi 100 ls      gas       std
four
4           2                  audi 100ls      gas       std
four
..        ...                         ...      ...       ...         ..
.
200        -1             volvo 145e (sw)      gas       std
four
201        -1                 volvo 144ea      gas     turbo
four
202        -1                 volvo 244dl      gas       std
four
203        -1                   volvo 246   diesel     turbo
four
204        -1                 volvo 264gl      gas     turbo
four

         carbody drivewheel enginelocation  wheelbase  carlength  ...
\
0    convertible        rwd          front       88.6      168.8  ...

1    convertible        rwd          front       88.6      168.8  ...

2      hatchback        rwd          front       94.5      171.2  ...

3          sedan        fwd          front       99.8      176.6  ...

4          sedan        4wd          front       99.4      176.6  ...

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

200        sedan        rwd          front      109.1      188.8  ...

201        sedan        rwd          front      109.1      188.8  ...

202        sedan        rwd          front      109.1      188.8  ...

203        sedan        rwd          front      109.1      188.8  ...

204        sedan        rwd          front      109.1      188.8  ...


     enginesize  fuelsystem  boreratio stroke compressionratio
horsepower  \
0           130        mpfi       3.47   2.68              9.0
111
1           130        mpfi       3.47   2.68              9.0
111
2           152        mpfi       2.68   3.47              9.0
154
```

```
3           109        mpfi       3.19   3.40                10.0
102
4           136        mpfi       3.19   3.40                 8.0
115
..          ...         ...        ...    ...                 ...
...
200         141        mpfi       3.78   3.15                 9.5
114
201         141        mpfi       3.78   3.15                 8.7
160
202         173        mpfi       3.58   2.87                 8.8
134
203         145         idi       3.01   3.40                23.0
106
204         141        mpfi       3.78   3.15                 9.5
114

    peakrpm    citympg  highwaympg    price
0      5000  21.000000        27.0  13495.0
1      5000  21.000000        27.0  16500.0
2      5000  25.277228        26.0  16500.0
3      5500  24.000000        30.0  13950.0
4      5500  18.000000        22.0  17450.0
..      ...        ...         ...      ...
200    5400  23.000000        28.0  16845.0
201    5300  19.000000        25.0  19045.0
202    5500  18.000000        23.0  21485.0
203    4800  26.000000        27.0  22470.0
204    5400  19.000000        25.0  22625.0

[205 rows x 25 columns]
```

Mapping different fueltypes wrt price

```
data = pd.DataFrame(dataset, columns=['fueltype', 'price'])
data = dataset.fueltype.eq('gas').mul(1)
data
```

```
0      1
1      1
2      1
3      1
4      1
      ..
200    1
201    1
202    1
203    0
```

```
204    1
Name: fueltype, Length: 205, dtype: int64
```

dataset

```
     car_ID  symboling                   CarName fueltype 
aspiration  \
0         1          3        alfa-romero giulia      gas        std

1         2          3       alfa-romero stelvio      gas        std

2         3          1  alfa-romero Quadrifoglio      gas        std

3         4          2               audi 100 ls      gas        std

4         5          2                audi 100ls      gas        std

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

200     201         -1           volvo 145e (sw)      gas        std

201     202         -1               volvo 144ea      gas      turbo

202     203         -1               volvo 244dl      gas        std

203     204         -1                 volvo 246   diesel      turbo

204     205         -1               volvo 264gl      gas      turbo


    doornumber      carbody drivewheel enginelocation  wheelbase  ...  
\
0          two  convertible        rwd          front       88.6  ...

1          two  convertible        rwd          front       88.6  ...

2          two    hatchback        rwd          front       94.5  ...

3         four        sedan        fwd          front       99.8  ...

4         four        sedan        4wd          front       99.4  ...

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

200       four        sedan        rwd          front      109.1  ...

201       four        sedan        rwd          front      109.1  ...

202       four        sedan        rwd          front      109.1  ...

203       four        sedan        rwd          front      109.1  ...
```

```
204       four        sedan        rwd            front      109.1  ...


     enginesize  fuelsystem  boreratio  stroke compressionratio
horsepower  \
0           130        mpfi       3.47    2.68              9.0
111
1           130        mpfi       3.47    2.68              9.0
111
2           152        mpfi       2.68    3.47              9.0
154
3           109        mpfi       3.19    3.40             10.0
102
4           136        mpfi       3.19    3.40              8.0
115
..          ...         ...        ...     ...              ...
...
200         141        mpfi       3.78    3.15              9.5
114
201         141        mpfi       3.78    3.15              8.7
160
202         173        mpfi       3.58    2.87              8.8
134
203         145         idi       3.01    3.40             23.0
106
204         141        mpfi       3.78    3.15              9.5
114

     peakrpm    citympg  highwaympg    price
0       5000  21.000000        27.0  13495.0
1       5000  21.000000        27.0  16500.0
2       5000  25.277228        26.0  16500.0
3       5500  24.000000        30.0  13950.0
4       5500  18.000000        22.0  17450.0
..       ...        ...         ...      ...
200     5400  23.000000        28.0  16845.0
201     5300  19.000000        25.0  19045.0
202     5500  18.000000        23.0  21485.0
203     4800  26.000000        27.0  22470.0
204     5400  19.000000        25.0  22625.0

[205 rows x 26 columns]
```

```
data.value_counts()
```

```
fueltype
1    185
0     20
Name: count, dtype: int64
```

Splitting data in labels and feature

Uni-variate

```
X = pd.DataFrame(dataset, columns=['enginesize'])
y = pd.DataFrame(dataset, columns=['price'])


X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.25)

reg = LinearRegression()
reg.fit(X_train, y_train)

y_preds = reg.predict(X_test)
```

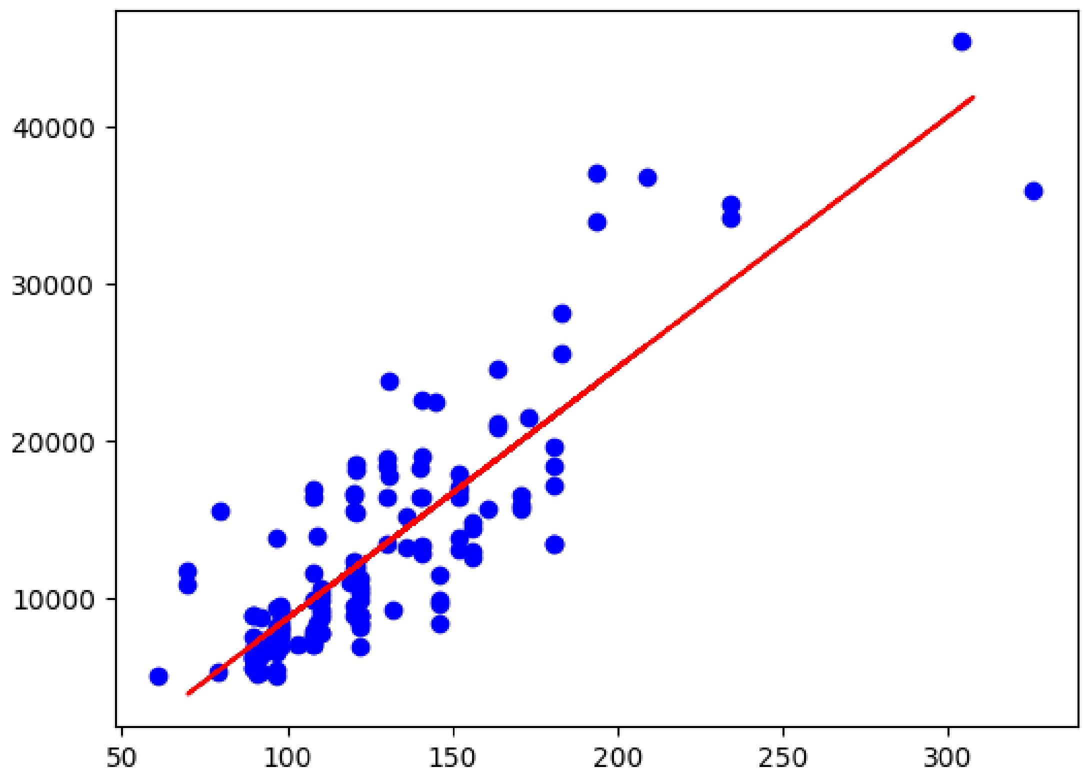
Evaluating the model

```
from sklearn.metrics import mean_squared_error, r2_score,
mean_absolute_error, accuracy_score

mae = mean_absolute_error(y_test, y_preds)
r2 = r2_score(y_test, y_preds)
mse = mean_squared_error(y_test, y_preds)

mae, r2, mse
```

```
(2890.5524675075594, 0.8114416757838671, 17215055.277613536)
```

```
plt.scatter(X_train, y_train, c='blue')
plt.plot(X_test, y_preds, c='red')
```

```
[<matplotlib.lines.Line2D at 0x166032120>]
```



Predicting on random input

```
y_random = y_test.iloc[12]
x_random = X_test.iloc[12]

y_random_pred = reg.predict(x_random.to_numpy().reshape(-1,1))
print(f"Predicted: {y_random_pred}, Og {y_random}")
```

```
Predicted: [[14474.49963978]], Og price    17710.0
Name: 6, dtype: float64
```

```
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/
site-packages/sklearn/base.py:493: UserWarning: X does not have valid
feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

Multi-variate

```
X = pd.DataFrame(dataset, columns=['enginesize', 'boreratio',
'stroke'])
y = pd.DataFrame(dataset, columns=['price'])
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.25)

multi_reg = LinearRegression()
multi_reg.fit(X_train, y_train)
y_preds = multi_reg.predict(X_test)

mae = mean_absolute_error(y_test, y_preds)
r2 = r2_score(y_test, y_preds)
mse = mean_squared_error(y_test, y_preds)

mae, r2, mse
#(2755.219116212158, 0.7459019410391048, 15174421.15204328)
```

```
(3176.2263393213525, 0.7137335022864753, 17049992.555727363)
```

```
y_random = y_test.iloc[13]
x_random = pd.DataFrame(X_test).iloc[13]
y_random_pred = reg.predict(x_random.to_numpy().reshape(-1,1))
print(f"Predicted: {y_random_pred[0]}, Og {y_random}")
```

```
Predicted: [20053.3502221], Og price    15998.0
Name: 179, dtype: float64
```

```
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/
site-packages/sklearn/base.py:493: UserWarning: X does not have valid
feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

OneHotEncoder

```
dataset.dtypes
```

```
car_ID                int64
symboling             int64
CarName              object
fueltype             object
aspiration           object
doornumber           object
carbody              object
drivewheel           object
enginelocation       object
wheelbase           float64
carlength           float64
carwidth            float64
carheight           float64
curbweight          float64
enginetype           object
cylindernumber       object
```

```
enginesize            int64
fuelsystem           object
boreratio           float64
stroke              float64
compressionratio    float64
horsepower            int64
peakrpm               int64
citympg             float64
highwaympg          float64
price               float64
dtype: object
```

```
dataset = pd.read_csv("Car_Price_dataset.csv")
dataset
```

```
     car_ID  symboling                   CarName fueltype
aspiration  \
0         1          3        alfa-romero giulia      gas         std

1         2          3       alfa-romero stelvio      gas         std

2         3          1  alfa-romero Quadrifoglio      gas         std

3         4          2               audi 100 ls      gas         std

4         5          2                audi 100ls      gas         std

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

200     201         -1           volvo 145e (sw)      gas         std

201     202         -1               volvo 144ea      gas       turbo

202     203         -1               volvo 244dl      gas         std

203     204         -1                 volvo 246   diesel       turbo

204     205         -1               volvo 264gl      gas       turbo


    doornumber      carbody drivewheel enginelocation  wheelbase  ...
\
0          two  convertible        rwd          front       88.6  ...

1          two  convertible        rwd          front       88.6  ...

2          two    hatchback        rwd          front       94.5  ...

3         four        sedan        fwd          front       99.8  ...

4         four        sedan        4wd          front       99.4  ...
```

```
..          ...          ...         ...            ...        ...  ...
200        four        sedan         rwd          front      109.1  ...
201        four        sedan         rwd          front      109.1  ...
202        four        sedan         rwd          front      109.1  ...
203        four        sedan         rwd          front      109.1  ...
204        four        sedan         rwd          front      109.1  ...

     enginesize  fuelsystem  boreratio  stroke compressionratio
horsepower  \
0           130        mpfi       3.47    2.68              9.0
111
1           130        mpfi       3.47    2.68              9.0
111
2           152        mpfi       2.68    3.47              9.0
154
3           109        mpfi       3.19    3.40             10.0
102
4           136        mpfi       3.19    3.40              8.0
115
..          ...         ...        ...     ...              ...
...
200         141        mpfi       3.78    3.15              9.5
114
201         141        mpfi       3.78    3.15              8.7
160
202         173        mpfi       3.58    2.87              8.8
134
203         145         idi       3.01    3.40             23.0
106
204         141        mpfi       3.78    3.15              9.5
114

     peakrpm citympg  highwaympg    price
0       5000    21.0        27.0  13495.0
1       5000    21.0        27.0  16500.0
2       5000     NaN        26.0  16500.0
3       5500    24.0        30.0  13950.0
4       5500    18.0        22.0  17450.0
..       ...     ...         ...      ...
200     5400    23.0        28.0  16845.0
201     5300    19.0        25.0  19045.0
202     5500    18.0        23.0  21485.0
203     4800    26.0        27.0  22470.0
```

```
204     5400    19.0        25.0  22625.0

[205 rows x 26 columns]
```

```
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import ColumnTransformer

text_features = ["CarName", "doornumber", "cylindernumber"]
oneHot = OneHotEncoder()

transformer = ColumnTransformer([('oneHot', oneHot, text_features)])
X = transformer.fit_transform(dataset)
y = dataset['price']

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.25)
reg = LinearRegression()
reg.fit(X_train, y_train)
y_preds = reg.predict(X_test)

mae = mean_absolute_error(y_test, y_preds)
r2 = r2_score(y_test, y_preds)
mse = mean_squared_error(y_test, y_preds)

mae, r2, mse
#(2755.219116212158, 0.7459019410391048, 15174421.15204328)
#(2357.083638592613, 0.8334032631319556, 11006688.483041983)
```

```
(4615.984445080328, 0.45784338089448595, 46032922.96933926)
```

```
dataset.dtypes
```

```
car_ID                int64
symboling             int64
CarName              object
fueltype             object
aspiration           object
doornumber           object
carbody              object
drivewheel           object
enginelocation       object
wheelbase           float64
carlength           float64
carwidth            float64
carheight           float64
curbweight          float64
enginetype           object
cylindernumber       object
enginesize            int64
fuelsystem           object
boreratio           float64
```

```
stroke                 float64
compressionratio    float64
horsepower             int64
peakrpm                int64
citympg              float64
highwaympg           float64
price                float64
dtype: object
```

```
dataset.enginetype
```

```
0      dohc
1      dohc
2      ohcv
3       ohc
4       ohc
       ...
200     ohc
201     ohc
202    ohcv
203     ohc
204     ohc
Name: enginetype, Length: 205, dtype: object
```

```
from sklearn.preprocessing import LabelEncoder

le = LabelEncoder()

X = le.fit_transform(dataset.enginetype)
X
```

```
array([0, 0, 5, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 2, 3, 3,
3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 3, 0, 0, 5, 3, 3, 3, 3, 3, 6, 6, 6, 6, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 3, 3, 3, 5, 5, 5, 5, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 5, 5, 5, 5, 5, 5, 2, 2,
2,
       2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 3, 3, 4, 4, 4, 1, 3,
3,
       3, 3, 3, 3, 0, 0, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 3, 3, 3,
3,
       3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 0, 0, 3, 3, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 0, 0, 0, 0, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3,
3,
       3, 3, 3, 3, 5, 3, 3])
```