In [2]:
```
import pandas as pd
```

In [3]:
```
data=pd.read_csv("/home/placement/Downloads/fiat500.csv")
```

In [4]:
```
data.describe()
```

Out[4]:

	ID	engine_power	age_in_days	km	previous_owners	lat	lon	price
count	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000	1538.000000
mean	769.500000	51.904421	1650.980494	53396.011704	1.123537	43.541361	11.563428	8576.003901
std	444.126671	3.988023	1289.522278	40046.830723	0.416423	2.133518	2.328190	1939.958641
min	1.000000	51.000000	366.000000	1232.000000	1.000000	36.855839	7.245400	2500.000000
25%	385.250000	51.000000	670.000000	20006.250000	1.000000	41.802990	9.505090	7122.500000
50%	769.500000	51.000000	1035.000000	39031.000000	1.000000	44.394096	11.869260	9000.000000
75%	1153.750000	51.000000	2616.000000	79667.750000	1.000000	45.467960	12.769040	10000.000000
max	1538.000000	77.000000	4658.000000	235000.000000	4.000000	46.795612	18.365520	11100.000000

In [5]:
```
data.head()
```

Out[5]:

	ID	model	engine_power	age_in_days	km	previous_owners	lat	lon	price
0	1	lounge	51	882	25000	1	44.907242	8.611560	8900
1	2	pop	51	1186	32500	1	45.666359	12.241890	8800
2	3	sport	74	4658	142228	1	45.503300	11.417840	4200
3	4	lounge	51	2739	160000	1	40.633171	17.634609	6000
4	5	pop	73	3074	106880	1	41.903221	12.495650	5700

In [6]:
```
data1=data.drop(['lat','lon','ID'],axis=1)
```

In [7]:
```
data1
```

Out[7]:

	model	engine_power	age_in_days	km	previous_owners	price
0	lounge	51	882	25000	1	8900
1	pop	51	1186	32500	1	8800
2	sport	74	4658	142228	1	4200
3	lounge	51	2739	160000	1	6000
4	pop	73	3074	106880	1	5700
...	...	...	...	...	...	...
1533	sport	51	3712	115280	1	5200
1534	lounge	74	3835	112000	1	4600
1535	pop	51	2223	60457	1	7500
1536	lounge	51	2557	80750	1	5990
1537	pop	51	1766	54276	1	7900

1538 rows × 6 columns

In [8]:
```
data2=pd.get_dummies(data1)
data2
```

Out[8]:

	engine_power	age_in_days	km	previous_owners	price	model_lounge	model_pop	model_sport
0	51	882	25000	1	8900	1	0	0
1	51	1186	32500	1	8800	0	1	0
2	74	4658	142228	1	4200	0	0	1
3	51	2739	160000	1	6000	1	0	0
4	73	3074	106880	1	5700	0	1	0
...	...	...	...	...	...	...	...	...
1533	51	3712	115280	1	5200	0	0	1
1534	74	3835	112000	1	4600	1	0	0
1535	51	2223	60457	1	7500	0	1	0
1536	51	2557	80750	1	5990	1	0	0
1537	51	1766	54276	1	7900	0	1	0

1538 rows × 8 columns

In [9]:
```
data2.shape
```

Out[9]: (1538, 8)

In [10]:
```
#predicted value we removed from data frame
y=data2['price']
x=data2.drop('price',axis=1)
```

In [11]:
```
y
```

Out[11]:
```
0       8900
1       8800
2       4200
3       6000
4       5700
        ...
1533    5200
1534    4600
1535    7500
1536    5990
1537    7900
Name: price, Length: 1538, dtype: int64
```

In [12]:
```
#divide the data int0 testing & training
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.33,random_state=42)
```

In [13]:
```
#to show starting rows
x_test.head()
```

Out[13]:

	engine_power	age_in_days	km	previous_owners	model_lounge	model_pop	model_sport
481	51	3197	120000	2	0	1	0
76	62	2101	103000	1	0	1	0
1502	51	670	32473	1	1	0	0
669	51	913	29000	1	1	0	0
1409	51	762	18800	1	1	0	0

In [14]:
```
x_train.head()
```

Out[14]:

	engine_power	age_in_days	km	previous_owners	model_lounge	model_pop	model_sport
527	51	425	13111	1	1	0	0
129	51	1127	21400	1	1	0	0
602	51	2039	57039	1	0	1	0
331	51	1155	40700	1	1	0	0
323	51	425	16783	1	1	0	0

In [15]:
```
y_test.head()
```

Out[15]:
```
481     7900
76      7900
1502    9400
669     8500
1409    9700
Name: price, dtype: int64
```

In [16]:
```
y_train.head()
```

Out[16]:
```
527    9990
129    9500
602    7590
331    8750
323    9100
Name: price, dtype: int64
```

In [17]:
```
#linear regression
from sklearn.linear_model import LinearRegression
reg=LinearRegression()
reg.fit(x_train,y_train)
```

Out[17]:
```
LinearRegression()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

In [18]:
```
#prediction price
y_pred=reg.predict(x_test)
y_pred
```

Out[18]:
```
array([ 5867.6503378 ,  7133.70142341,  9866.35776216,  9723.28874535,
       10039.59101162,  9654.07582608,  9673.14563045, 10118.70728123,
        9903.85952664,  9351.55828437, 10434.34963575,  7732.26255693,
        7698.67240131,  6565.95240435,  9662.90103518, 10373.20344286,
        9599.94844451,  7699.34400418,  4941.33017994, 10455.2719478 ,
       10370.51555682, 10391.60424404,  7529.06622456,  9952.37340054,
        7006.13845729,  9000.1780961 ,  4798.36770637,  6953.10376491,
        7810.39767825,  9623.80497535,  7333.52158317,  5229.18705519,
        5398.21541073,  5157.65652129,  8948.63632836,  5666.62365159,
        9822.1231461 ,  8258.46551788,  6279.2040404 ,  8457.38443276,
        9773.86444066,  6767.04074749,  9182.99904787, 10210.05195479,
        8694.90545226, 10328.43369248,  9069.05761443,  8866.7826029 ,
        7058.39787506,  9073.33877162,  9412.68162121, 10293.69451263,
       10072.49011135,  6748.5794244 ,  9785.95841801,  9354.09969973,
        9507.9444386 , 10443.01608254,  9795.31884316,  7197.84932877,
       10108.31707235,  7009.6597206 ,  9853.90699412,  7146.87414965,
        6417.69133992,  9996.97382441,  9781.18795953,  8515.83255277,
        8456.30006203,  6499.76668237,  7768.57829985,  6832.86406122,
        8347.96113362, 10439.02404036,  7356.43463051,  8562.56562053,
        9820.78555199, 10035.83571539,  7370.77198022,  9411.45894006,
```

In [19]:
```
from sklearn.metrics import r2_score
r2_score(y_test,y_pred)
```

Out[19]:
```
0.8415526986865394
```

In [20]:
```
from sklearn.metrics import mean_squared_error #calculating MSE
mean_squared_error(y_pred,y_test)
```

Out[20]: 581887.727391353

In [ ]:

ridge regression

In [21]:
```
from sklearn.model_selection import GridSearchCV
from sklearn.linear_model import Ridge
alpha=[1e-15,1e-10,1e-8,1e-4,1e-3,1e-2,1,5,10,20,30]
ridge=Ridge()
parameters = {'alpha':alpha}
ridge_regressor = GridSearchCV(ridge,parameters)
ridge_regressor.fit(x_train,y_train)
```

```
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=5.56109e-26): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.70876e-26): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=6.91585e-23): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.08003e-23): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.01022e-23): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.57959e-23): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.24161e-23): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=6.92759e-21): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.09091e-21): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.02112e-21): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.57414e-21): result may not be accurate.
```

```
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.23284e-21): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=6.9277e-17): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.09099e-17): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.02123e-17): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.57407e-17): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_ridge.py:216: LinAlgWarning: I
ll-conditioned matrix (rcond=7.23274e-17): result may not be accurate.
  return linalg.solve(A, Xy, assume_a="pos", overwrite_a=True).T
```

Out[21]:

```
GridSearchCV(estimator=Ridge(),
             param_grid={'alpha': [1e-15, 1e-10, 1e-08, 0.0001, 0.001, 0.01, 1,
                                   5, 10, 20, 30]})
```

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In [22]:

```
ridge_regressor.best_params_
```

Out[22]:

```
{'alpha': 30}
```

In [23]:

```
ridge=Ridge(alpha=30)
ridge.fit(x_train,y_train)
y_pred_ridge=ridge.predict(x_test)
```

In [24]:
```
from sklearn.metrics import mean_squared_error
Ridge_Error=mean_squared_error(y_pred_ridge,y_test)
Ridge_Error
```

Out[24]: 579521.7970897449

In [25]:
```
from sklearn.metrics import r2_score
r2_score(y_test,y_pred_ridge)
```

Out[25]: 0.8421969385523054

In [ ]:

elasticnet regression

In [26]:
```
from sklearn.linear_model import ElasticNet
from sklearn.model_selection import GridSearchCV
elastic=ElasticNet()
parameters={'alpha':[1e-15,1e-10,1e-8,1e-4,1e-3,1e-2,1,5,10,20]}
elastic_regressor=GridSearchCV(elastic,parameters)
elastic_regressor.fit(x_train,y_train)
```

```
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_coordinate_descent.py:631: C
onvergenceWarning: Objective did not converge. You might want to increase the number of iterations, check
the scale of the features or consider increasing regularisation. Duality gap: 2.345e+08, tolerance: 3.149
e+05
  model = cd_fast.enet_coordinate_descent(
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_coordinate_descent.py:631: C
onvergenceWarning: Objective did not converge. You might want to increase the number of iterations, check
the scale of the features or consider increasing regularisation. Duality gap: 2.357e+08, tolerance: 3.129
e+05
  model = cd_fast.enet_coordinate_descent(
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_coordinate_descent.py:631: C
onvergenceWarning: Objective did not converge. You might want to increase the number of iterations, check
the scale of the features or consider increasing regularisation. Duality gap: 2.418e+08, tolerance: 3.204
e+05
  model = cd_fast.enet_coordinate_descent(
/home/placement/anaconda3/lib/python3.10/site-packages/sklearn/linear_model/_coordinate_descent.py:631: C
onvergenceWarning: Objective did not converge. You might want to increase the number of iterations, check
the scale of the features or consider increasing regularisation. Duality gap: 2.411e+08, tolerance: 3.065
e+05
```

In [27]:
```
elastic_regressor.best_params_
```

Out[27]:
```
{'alpha': 0.01}
```

In [29]:
```
elastic=ElasticNet(alpha=0.1)
elastic.fit(x_train,y_train)
y_pred_elastic=elastic.predict(x_test)
```

In [30]:
```
from sklearn.metrics import r2_score
r2_score(y_test,y_pred_elastic)
```

Out[30]:
```
0.8425222843073693
```

In [33]:
```
from sklearn.metrics import mean_squared_error
elastic_Error=mean_squared_error(y_pred_elastic,y_test)
elastic_Error
```

Out[33]: 578326.9853103004

In [ ]:
```

```