## multiml

## September 24, 2024

```
[3]: import pandas as pd
     import math
     import matplotlib.pyplot as plt
[4]: df=pd.read_csv("CarPrice_Assignment.csv")
     df.head(5)
[4]:
                 symboling
                                               CarName fueltype aspiration doornumber
        car_ID
     0
             1
                          3
                                   alfa-romero giulia
                                                              gas
                                                                          std
                                                                                      two
             2
                          3
     1
                                  alfa-romero stelvio
                                                                          std
                                                                                      two
                                                              gas
     2
              3
                          1
                             alfa-romero Quadrifoglio
                                                              gas
                                                                          std
                                                                                     two
     3
              4
                          2
                                           audi 100 ls
                                                                          std
                                                                                    four
                                                              gas
             5
                         2
                                            audi 1001s
                                                              gas
                                                                          std
                                                                                    four
            carbody drivewheel enginelocation
                                                  wheelbase
                                                                  enginesize
     0
        convertible
                             rwd
                                           front
                                                        88.6
                                                                          130
     1
        convertible
                             rwd
                                           front
                                                        88.6
                                                                          130
     2
          hatchback
                                                        94.5
                             rwd
                                           front
                                                                          152
                                                                          109
     3
               sedan
                             fwd
                                           front
                                                        99.8
     4
               sedan
                             4wd
                                           front
                                                        99.4
                                                                          136
        fuelsystem
                     boreratio
                                 stroke compressionratio horsepower
                                                                        peakrpm citympg
     0
                           3.47
                                   2.68
                                                       9.0
                                                                            5000
              mpfi
                                                                   111
                                                                                       21
     1
               mpfi
                           3.47
                                   2.68
                                                       9.0
                                                                   111
                                                                            5000
                                                                                       21
     2
               mpfi
                           2.68
                                   3.47
                                                       9.0
                                                                   154
                                                                            5000
                                                                                       19
     3
                           3.19
                                   3.40
                                                      10.0
                                                                   102
                                                                                       24
               mpfi
                                                                            5500
                                                       8.0
     4
                           3.19
                                   3.40
                                                                   115
                                                                            5500
                                                                                       18
               mpfi
        highwaympg
                       price
     0
                 27
                     13495.0
                 27
                     16500.0
     1
     2
                 26
                     16500.0
     3
                     13950.0
                 30
                 22
                     17450.0
     [5 rows x 26 columns]
```

```
[5]: df.dtypes==object
[5]: car_ID
                          False
     symboling
                          False
     CarName
                           True
     fueltype
                           True
     aspiration
                           True
     doornumber
                           True
                           True
     carbody
     drivewheel
                           True
     enginelocation
                           True
     wheelbase
                          False
     carlength
                          False
     carwidth
                          False
     carheight
                          False
                          False
     curbweight
     enginetype
                           True
     cylindernumber
                           True
                          False
     enginesize
     fuelsystem
                           True
     boreratio
                          False
     stroke
                          False
     compressionratio
                          False
                          False
     horsepower
                          False
     peakrpm
                          False
     citympg
                          False
     highwaympg
     price
                          False
     dtype: bool
[6]: df["enginetype"].unique()
[6]: array(['dohc', 'ohcv', 'ohc', 'l', 'rotor', 'ohcf', 'dohcv'], dtype=object)
[7]: df["carbody"].unique()
[7]: array(['convertible', 'hatchback', 'sedan', 'wagon', 'hardtop'],
           dtype=object)
[8]: df=pd.get_dummies(df,columns=['fueltype'])
[9]:
    df.drop("fueltype_gas",axis=1)
[9]:
                                                CarName aspiration doornumber
          car_ID
                  symboling
     0
               1
                           3
                                    alfa-romero giulia
                                                                std
                                                                           two
               2
                           3
     1
                                   alfa-romero stelvio
                                                                std
                                                                           two
     2
               3
                             alfa-romero Quadrifoglio
                                                                std
                                                                           two
```

3	4	2	aud	li 100 ls	std	four	
4	5	2	au	di 100ls	std	four	
	•••	•••		•••	•••		
200	201	-1	volvo 1	.45e (sw)	std	four	
201	202	-1	vol	.vo 144ea	turbo	four	
202	203	-1	vol	vo 244dl	std	four	
203	204	-1	Ţ	olvo 246	turbo	four	
204	205	-1	vol	vo 264gl	turbo	four	
	carbody	${\tt drivewheel}$	enginelocati	on wheelbas	e carlength	ı \	
0	convertible	rwd	fro	ont 88.	6 168.8	3 <b></b>	
1	convertible	rwd	fro	ont 88.	6 168.8	3	
2	hatchback	rwd	fro	ont 94.	5 171.2	2	
3	sedan	fwd	fro	ont 99.	8 176.6	S	
4	sedan	4wd	fro	ont 99.	4 176.6	S	
	•••	•••	•••	***	*** ***		
200	sedan	rwd	fro	ont 109.	1 188.8	3	
201	sedan	rwd	fro	nt 109.	1 188.8	3 <b></b>	
202	sedan	rwd	fro	nt 109.	1 188.8	3 <b></b>	
203	sedan	rwd	fro	nt 109.	1 188.8	3 <b></b>	
204	sedan	rwd	fro	nt 109.	1 188.8	3 <b></b>	
	fuelsystem	boreratio	stroke compr	essionratio	horsepower	peakrpm	\
0	mpfi	3.47	2.68	9.0	111	5000	
1	mpfi	3.47	2.68	9.0	111	5000	
1 2	mpfi mpfi	3.47 2.68	2.68 3.47	9.0 9.0	111 154	5000 5000	
	_						
2	mpfi	2.68	3.47	9.0	154	5000	
2 3	mpfi mpfi	2.68 3.19	3.47 3.40	9.0 10.0	154 102 115	5000 5500	
2 3 4	mpfi mpfi mpfi	2.68 3.19	3.47 3.40	9.0 10.0 8.0	154 102 115	5000 5500	
2 3 4	mpfi mpfi mpfi 	2.68 3.19 3.19	3.47 3.40 3.40	9.0 10.0 8.0	154 102 115 	5000 5500 5500	
2 3 4  200	mpfi mpfi mpfi  mpfi	2.68 3.19 3.19  3.78	3.47 3.40 3.40 	9.0 10.0 8.0  9.5	154 102 115  114	5000 5500 5500 5400	
2 3 4  200 201	mpfi mpfi mpfi  mpfi mpfi	2.68 3.19 3.19  3.78 3.78	3.47 3.40 3.40  3.15 3.15	9.0 10.0 8.0  9.5 8.7	154 102 115  114 160	5000 5500 5500 5400 5300	
2 3 4  200 201 202	mpfi mpfi mpfi  mpfi mpfi mpfi	2.68 3.19 3.19  3.78 3.78 3.58	3.47 3.40 3.40  3.15 3.15 2.87	9.0 10.0 8.0  9.5 8.7 8.8	154 102 115  114 160 134	5000 5500 5500 5400 5300 5500	
2 3 4  200 201 202 203	mpfi mpfi mpfi  mpfi mpfi mpfi idi	2.68 3.19 3.19  3.78 3.78 3.58 3.01	3.47 3.40 3.40  3.15 3.15 2.87 3.40	9.0 10.0 8.0  9.5 8.7 8.8 23.0	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203	mpfi mpfi mpfi  mpfi mpfi mpfi idi mpfi	2.68 3.19 3.19  3.78 3.78 3.58 3.01 3.78	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15	9.0 10.0 8.0  9.5 8.7 8.8 23.0	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203	mpfi mpfi mpfi  mpfi mpfi mpfi idi mpfi	2.68 3.19 3.19  3.78 3.78 3.58 3.01 3.78	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204	mpfi mpfi mpfi mpfi mpfi mpfi idi mpfi citympg high	2.68 3.19 3.19  3.78 3.78 3.58 3.01 3.78	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204	mpfi mpfi mpfi mpfi mpfi mpfi idi mpfi citympg high	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78 awaympg I 27 134 27 165	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 rpe_diesel False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204	mpfi mpfi mpfi mpfi mpfi mpfi mpfi mpfi	2.68 3.19 3.19 3.78 3.58 3.01 3.78  awaympg	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 price fuelty	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 rpe_diesel False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204	mpfi mpfi mpfi mpfi mpfi mpfi mpfi idi mpfi idi 21 21 19	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  awaympg	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 Tpe_diesel False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3	mpfi mpfi mpfi  mpfi mpfi idi mpfi citympg high 21 21 21 19 24	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  awaympg	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 Tpe_diesel False False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3	mpfi mpfi mpfi mpfi mpfi mpfi mpfi idi mpfi idi 1 1 21 21 19 24 18	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  27 168 26 168 30 138 22 174	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 rpe_diesel False False False False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3 4 	mpfi mpfi mpfi  mpfi mpfi idi mpfi citympg high 21 21 19 24 18	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  awaympg	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0 950.0	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 Tpe_diesel False False False False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3 4  200	mpfi mpfi mpfi  mpfi mpfi idi mpfi idi 21 21 21 21 19 24 18 	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  27 168 26 168 30 138 22 174 28 168 25 190	3.47 3.40 3.40  3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0 500.0 450.0	9.0 10.0 8.0  9.5 8.7 8.8 23.0 9.5 Tpe_diesel False False False False False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3 4  200 201	mpfi mpfi mpfi  mpfi mpfi idi mpfi citympg high 21 21 19 24 18  23 19	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  27 168 26 168 30 138 22 174 28 168 25 190 23 214	3.47 3.40 3.40 3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0 950.0 450.0	9.0 10.0 8.0 9.5 8.7 8.8 23.0 9.5 The_diesel False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	
2 3 4  200 201 202 203 204 0 1 2 3 4  200 201 202	mpfi mpfi mpfi  mpfi mpfi mpfi idi mpfi citympg high 21 21 19 24 18  23 19 18	2.68 3.19 3.19 3.78 3.78 3.58 3.01 3.78  27 168 26 168 30 138 22 174 28 168 25 190 23 214 27 224	3.47 3.40 3.40 3.15 3.15 2.87 3.40 3.15 Price fuelty 495.0 500.0 500.0 950.0 450.0	9.0 10.0 8.0 9.5 8.7 8.8 23.0 9.5 Tpe_diesel False	154 102 115  114 160 134 106	5000 5500 5500 5400 5300 5500 4800	

[205 rows x 26 columns]

```
[10]: from sklearn import preprocessing
      from sklearn.model_selection import train_test_split
      from sklearn.linear_model import LinearRegression
      from sklearn.metrics import mean squared error, mean absolute error
      label_encoder = preprocessing.LabelEncoder()
[13]: df["enginetype"]=label_encoder.fit_transform(df["enginetype"])
      df["carbody"] = label encoder.fit transform(df["carbody"])
[14]: X=df[["horsepower", "fueltype_diesel", "enginesize", "enginetype", "carbody"]]
      Y=df[["price"]]
[15]: X
[15]:
           horsepower fueltype_diesel enginesize enginetype
                                                                 carbody
      0
                  111
                                 False
                                                130
      1
                  111
                                 False
                                                130
                                                              0
                                                                        0
      2
                  154
                                 False
                                                152
                                                              5
                                                                        2
      3
                                                               3
                  102
                                 False
                                                109
                                                                        3
      4
                                                136
                                                              3
                                                                        3
                  115
                                 False
                                                141
                                                              3
                                                                        3
      200
                  114
                                 False
      201
                  160
                                 False
                                                141
                                                              3
                                                                        3
      202
                  134
                                 False
                                                173
                                                              5
                                                                        3
      203
                                  True
                                                              3
                                                                        3
                  106
                                                145
      204
                  114
                                 False
                                                141
                                                               3
                                                                        3
      [205 rows x 5 columns]
[16]: X_train, X_test, Y_train, Y_test = train_test_split( X, Y, test_size=0.3)
[17]: model=LinearRegression()
      model.fit(X_train,Y_train)
[17]: LinearRegression()
[18]: y_pred=model.predict(X_test)
[19]: print('mean_squared_error : ', mean_squared_error(Y_test, y_pred))
      print('mean absolute error : ', mean absolute error(Y test, y pred))
      print('root_mean_squared_error : ', math.sqrt(mean_absolute_error(Y_test,__
       y_pred)))
```

mean\_squared\_error : 11878155.527813977

mean\_absolute\_error : 2550.549082589818
root\_mean\_squared\_error : 50.502961126946