Lab-02

January 18, 2026

1 Linear Regression Implementation-01

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
```

[2]:
```
df= pd.read_csv('dhaka homeprices.csv')
#df = pd.read_csv ('Shopping_cse15_16.csv')
```

[3]:
```
df
```

[3]:

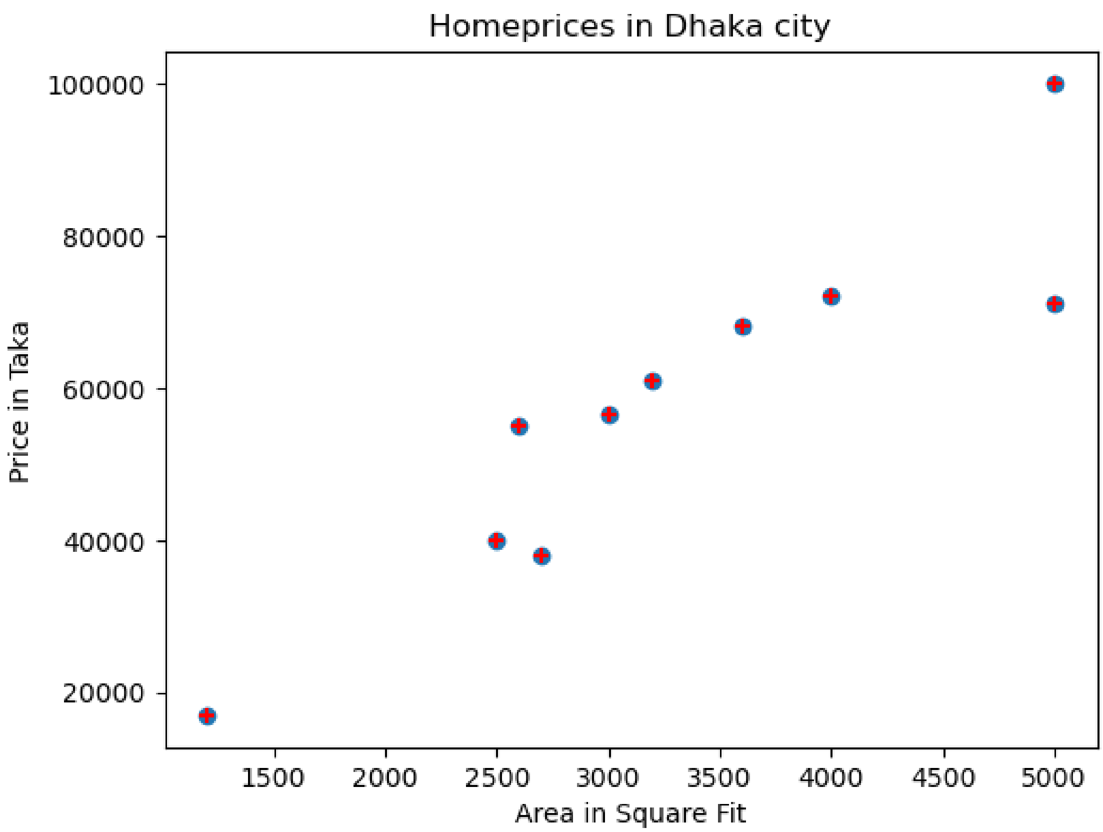
	area	price
0	2600	55000
1	3000	56500
2	3200	61000
3	3600	68000
4	4000	72000
5	5000	71000
6	2500	40000
7	2700	38000
8	1200	17000
9	5000	100000

[4]:
```
plt.xlabel('Area in Square Fit')
plt.ylabel('Price in Taka')

plt.scatter(df['area'],df['price'])
plt.scatter(df['area'], df['price'],color='red', marker='+')

plt.title('Homeprices in Dhaka city')
plt.plot()
```

[4]: []



[5]:
```
x = df[['area']]
y = df['price']
```

[6]:
```
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size = 0.40, random_state =1)

#xtest
#xtrain
```

[7]:
```
xtest


#xtrain
```

[7]:

	area
2	3200
9	5000
6	2500
4	4000

[8]:
```
xtrain
```

[8]:
```
   area
0  2600
3  3600
1  3000
7  2700
8  1200
5  5000
```

[9]:
```
ytest
```

[9]:
```
2     61000
9    100000
6     40000
4     72000
Name: price, dtype: int64
```

[10]:
```
from sklearn.linear_model import LinearRegression
```

[11]:
```
reg= LinearRegression ()
```

[12]:
```
reg.fit(xtrain,ytrain)
```

[12]:
```
LinearRegression()
```

[13]:
```
LinearRegression ()
```

[13]:
```
LinearRegression()
```

[14]:
```
reg.score(xtest,ytest)
```

[14]:
```
0.7182056168655753
```

[15]:
```
reg.predict([[3300]])
```

```
/usr/lib/python3/dist-packages/sklearn/utils/validation.py:2749: UserWarning: X
does not have valid feature names, but LinearRegression was fitted with feature
names
  warnings.warn(
```

[15]:
```
array([55021.66064982])
```

[16]:
```
reg.predict([[3200]])
```

```
/usr/lib/python3/dist-packages/sklearn/utils/validation.py:2749: UserWarning: X
does not have valid feature names, but LinearRegression was fitted with feature
names
  warnings.warn(
```

[16]: array([53572.839244])

[17]:
```
reg.predict([[2850]])
```

```
/usr/lib/python3/dist-packages/sklearn/utils/validation.py:2749: UserWarning: X
does not have valid feature names, but LinearRegression was fitted with feature
names
  warnings.warn(
```

[17]: array([48501.96432364])

2 Multiple Linear Regression Implementation-01

[18]:
```
import pandas as pd
import numpy as np
from sklearn import linear_model
```

[19]:
```
df = pd.read_csv("car data.csv")
```

[20]:
```
df
```

[20]:

	speed	car_age	experience	risk
0	200	15	5.0	85
1	90	17	13.0	20
2	165	12	4.0	93
3	110	20	NaN	60
4	140	5	3.0	82
5	115	2	8.0	10

[21]:
```
null_values = df.isnull().sum

# Print the result
# print(null_values)
```

[22]:
```
print(null_values)
```

```
<bound method DataFrame.sum of    speed  car_age  experience   risk
0   False    False       False  False
1   False    False       False  False
2   False    False       False  False
3   False    False        True  False
4   False    False       False  False
5   False    False       False  False>
```

[23]:
```
null_count = df.isnull().sum()

# Print the result
print(null_count)
```

```
speed         0
car_age       0
experience    1
risk          0
dtype: int64
```

[24]:
```
df.experience
```

[24]:
```
0     5.0
1    13.0
2     4.0
3     NaN
4     3.0
5     8.0
Name: experience, dtype: float64
```

[25]:
```
df.experience.mean()
```

[25]:
```
np.float64(6.6)
```

[26]:
```
df.experience.median()
```

[26]:
```
5.0
```

[27]:
```
exp_fit= df.experience.median()
```

[28]:
```
exp_fit
```

[28]:
```
5.0
```

[29]:
```
df.experience = df.experience.fillna(exp_fit)
```

[30]:
```
df.experience
```

[30]:
```
0     5.0
1    13.0
2     4.0
3     5.0
4     3.0
5     8.0
Name: experience, dtype: float64
```

[31]:
```
reg = linear_model.LinearRegression()
```

[32]:
```
print(df.columns)
```

```
Index(['speed ', 'car_age', 'experience', 'risk'], dtype='object')
```

```
[33]: #Strip Leading/Trailing Spaces from Column Names:
      #Sometimes column names may have invisible spaces. You can strip any leading/tr
      # from the column names using:Strip Leading/Trailing Spaces from Column Names:


      df.columns = df.columns.str.strip()
```

```
[34]: reg.fit(df[['speed', 'car_age', 'experience']], df['risk'])
```

```
[34]: LinearRegression()
```

```
[35]: #Predicting risk when speed,car_age and experience are given

      reg.predict([[160,10,5]])
```

```
/usr/lib/python3/dist-packages/sklearn/utils/validation.py:2749: UserWarning: X
does not have valid feature names, but LinearRegression was fitted with feature
names
  warnings.warn(
```

```
[35]: array([71.37146872])
```

```
[36]: reg.coef_
```

```
[36]: array([ 0.33059217,  1.61053246, -6.20772074])
```

```
[37]: reg.intercept_
```

```
[37]: np.float64(33.4100009104359)
```

```
[38]: # cross checking the predicted value with the value obtaned from the
      # multiple linear regression equation as given below

      160*0.33059217 + 10*1.61053246 + 5*-6.20772074 + 33.410000910435855
```

```
[38]: 71.37146901043586
```

2.0.1 Yes it is the same , Congratulations!!!

3 Multiple Linear Regression Implementation-02

```
[39]: import pandas as pd
      import matplotlib.pyplot as plt
      from sklearn.model_selection import train_test_split
```

```
[40]: df= pd.read_csv('insurance.csv')
```

```
[41]: df
```

[41]:
```
      age     sex     bmi  children smoker     region      charges
0      19  female  27.900         0    yes  southwest  16884.92400
1      18    male  33.770         1     no  southeast   1725.55230
2      28    male  33.000         3     no  southeast   4449.46200
3      33    male  22.705         0     no  northwest  21984.47061
4      32    male  28.880         0     no  northwest   3866.85520
…     …     …       …       …     …         …            …
1333   50    male  30.970         3     no  northwest  10600.54830
1334   18  female  31.920         0     no  northeast   2205.98080
1335   18  female  36.850         0     no  southeast   1629.83350
1336   21  female  25.800         0     no  southwest   2007.94500
1337   61  female  29.070         0    yes  northwest  29141.36030

[1338 rows x 7 columns]
```

3.1 converting categorical values to numeric values

[42]:
```
df['sex'] = df['sex'].astype('category')
df['sex'] = df['sex'].cat.codes
df
```

[42]:
```
      age  sex     bmi  children smoker     region      charges
0      19    0  27.900         0    yes  southwest  16884.92400
1      18    1  33.770         1     no  southeast   1725.55230
2      28    1  33.000         3     no  southeast   4449.46200
3      33    1  22.705         0     no  northwest  21984.47061
4      32    1  28.880         0     no  northwest   3866.85520
…     …    …     …       …     …         …            …
1333   50    1  30.970         3     no  northwest  10600.54830
1334   18    0  31.920         0     no  northeast   2205.98080
1335   18    0  36.850         0     no  southeast   1629.83350
1336   21    0  25.800         0     no  southwest   2007.94500
1337   61    0  29.070         0    yes  northwest  29141.36030

[1338 rows x 7 columns]
```

[43]:
```
df['smoker'] = df['smoker'].astype('category')
df['smoker'] = df['smoker'].cat.codes
df['region'] = df['region'].astype('category')
df['region'] = df['region'].cat.codes
df
```

[43]:
```
      age  sex     bmi  children  smoker  region      charges
0      19    0  27.900         0       1       3  16884.92400
1      18    1  33.770         1       0       2   1725.55230
2      28    1  33.000         3       0       2   4449.46200
3      33    1  22.705         0       0       1  21984.47061
```

```
4       32    1  28.880         0        0        1   3866.85520
…    …  …     …       …       …     …           …
1333    50    1  30.970         3        0        1  10600.54830
1334    18    0  31.920         0        0        0   2205.98080
1335    18    0  36.850         0        0        2   1629.83350
1336    21    0  25.800         0        0        3   2007.94500
1337    61    0  29.070         0        1        1  29141.36030

[1338 rows x 7 columns]
```

[44]:
```python
df.isnull().sum()
df
```

[44]:
```
       age  sex     bmi  children  smoker  region      charges
0       19    0  27.900         0       1       3  16884.92400
1       18    1  33.770         1       0       2   1725.55230
2       28    1  33.000         3       0       2   4449.46200
3       33    1  22.705         0       0       1  21984.47061
4       32    1  28.880         0       0       1   3866.85520
…    …  …     …       …       …     …           …
1333    50    1  30.970         3       0       1  10600.54830
1334    18    0  31.920         0       0       0   2205.98080
1335    18    0  36.850         0       0       2   1629.83350
1336    21    0  25.800         0       0       3   2007.94500
1337    61    0  29.070         0       1       1  29141.36030

[1338 rows x 7 columns]
```

[45]:
```python
x = df.drop(columns='charges')
```

[46]:
```python
x
```

[46]:
```
       age  sex     bmi  children  smoker  region
0       19    0  27.900         0       1       3
1       18    1  33.770         1       0       2
2       28    1  33.000         3       0       2
3       33    1  22.705         0       0       1
4       32    1  28.880         0       0       1
…    …  …     …       …       …     …
1333    50    1  30.970         3       0       1
1334    18    0  31.920         0       0       0
1335    18    0  36.850         0       0       2
1336    21    0  25.800         0       0       3
1337    61    0  29.070         0       1       1

[1338 rows x 6 columns]
```

[47]:
```
y = df['charges']
```

[48]:
```
y
```

[48]:
```
0       16884.92400
1        1725.55230
2        4449.46200
3       21984.47061
4        3866.85520
            …
1333    10600.54830
1334     2205.98080
1335     1629.83350
1336     2007.94500
1337    29141.36030
Name: charges, Length: 1338, dtype: float64
```

[49]:
```
xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size = 0.3,␣
↪random_state = 0)
```

[50]:
```
from sklearn.linear_model import LinearRegression
```

[51]:
```
lr= LinearRegression ()
```

[52]:
```
lr.fit(xtrain,ytrain)
```

[52]:
```
LinearRegression()
```

[53]:
```
c = lr.intercept_
```

[54]:
```
c
```

[54]:
```
np.float64(-11827.733141795718)
```

[55]:
```
m = lr.coef_
```

[56]:
```
m
```

[56]:
```
array([  256.5772619 ,   -49.39232379,   329.02381564,   479.08499828,
       23400.28378787,  -276.31576201])
```

3.1.1 Here in the above output , six coefficients for our six training features

[57]:
```
y_pred_train = lr.predict(xtrain)
```

[58]:
```
y_pred_train
```

```
[58]: array([ 2074.0645306 ,  8141.81393908, 18738.94132528,  7874.86959064,
        6305.12726989,  2023.19725425, 26861.18663021, 14932.93021746,
       10489.56733846, 16254.02800921, 11726.39324257, 11284.0092172 ,
       39312.16870908,  5825.91078917, 12314.92042527,  3164.68427134,
       15406.30681252,  4648.58167988,  5011.79585436,  6012.4796038 ,
       15349.49652486,  8970.97358853,  8780.43012222, 34229.60622887,
        6700.80932636, 26943.25864121, 27280.48004482, 15477.83837581,
        8825.62578924, 34394.38378457, 10177.85528603,  3901.18161227,
       15608.58732963, 29584.76846515, 29453.37088923, 28132.67012427,
       10003.22154888, 33049.08935397,  3963.45204974, 25461.54857001,
        5656.76892592, 27993.86773531,  7049.4472544 , 15100.38851758,
        2552.92266861, 35458.5756605 , 15250.90732084,  3190.28483443,
        1768.85441295, 10155.17603664,  9937.89476088, 11225.91583863,
       16776.25691816,  4332.14442527,  1904.56473771,  4169.01766783,
        5586.26152347,  6181.88067913, 26788.8656339 , 14126.13855797,
       11861.37395532,  7811.00983646, 14043.16898219,  2761.62716836,
       13245.886833  , 11768.08899683,  1979.53264953,  1004.70130715,
       36800.01548491,  7337.39948485,  9016.87626313,  2197.43885099,
       11522.76560606,  7722.68648352, 11766.49141567, 25673.41065575,
       27094.55413975,  8386.55039897,  7851.02612612,   340.5541035 ,
        4812.77154806,  7653.38621355,  3335.8737924 ,  8277.91415433,
        1727.07582017,  4469.3512268 , 33273.43493881,  5960.10203273,
       11514.72887612,  9076.67077562, 31445.7194256 , 11381.75279488,
       11464.45517614,  4744.19913099,  6959.16143068,  5558.39697169,
        5082.89311652,  9788.2815884 , 31360.93228849,  3182.21328435,
       37708.34391043, 10814.52053521,  8936.63917176,  3082.15463971,
       11928.53837714, 30612.08362018,  2768.14633037,  5859.36717165,
       11271.63384986, 10014.30225729,  6043.73686629, 12975.42245732,
       12066.96034099, 28052.15863473, 11361.56357043, 11060.29810116,
       14348.98304548, 12312.23589186, 28147.75655535, 11823.51072484,
       12848.87384573, 15178.13163272,  4197.13873747, 28308.19263972,
        8971.99085308, 28732.62186124, 11179.06619869,  6579.03176313,
       13059.30213716, 14726.65831226,  9783.6398503 ,  2444.05494314,
        5724.67349993,  2786.36526883,  5696.67137344, -1003.82184963,
       14605.31776434,  3995.13441381, 10503.83704955, 13075.10394921,
       11394.53019512,  9261.88891647, 13608.73784577,  1042.57486857,
       11340.66753684,  9273.62568527,  8281.21400296, 14977.26865395,
       12554.43628217, 29821.10868267, 17471.58043595, 10459.61280091,
        9389.23502709, 12782.30564709,  5788.18196996, 15693.65157911,
        7291.38867849,  5634.70792056, 31414.11538842, 13661.85253666,
       12990.82789567, 12116.96433071, 12483.56884527,  5245.19260841,
        2720.97048488,  3967.45298094,  5831.18485508,   336.78003257,
        8327.6083617 ,  7788.78193696,  5978.53780791, 14780.22108067,
        4154.59712226,  7660.7596099 ,  4986.40913178,   808.63142297,
        6347.28680981,  6028.99252197,  3002.31581222, 30358.06082481,
       10242.8271406 , 12160.459422  , 36713.30683683,  5484.52486596,
       13900.01813071,  1032.83264035,  7075.58814557, 25622.72563058,
```

```
10388.5347597 ,  5748.21820814, 15638.72505346,  8412.71678181,
33607.43410022, 12873.4767783 ,  9089.752017  , 11495.39625664,
29552.08877794,  4833.05771099,  8535.10872516, 10379.54084243,
 2480.53742917, 33644.40927286, 26048.49780558, 12539.77833076,
 7288.62030409,  6523.97395347, 33590.95177474, 34304.29013204,
10903.83077465, 28227.37382203, 33047.75080641,  4484.39001642,
33279.27378584,  9131.498238  , 33409.39957307, 26078.36522976,
13348.90616834, 12332.40769064,  5643.77644808, 15413.40505405,
10751.99223385,  4512.13100449, 14657.52748835, 16829.95674466,
 2761.72430528,  7501.05082023, 34047.62899298, -2007.51465386,
 4961.00911327, 11317.6348311 , 14807.90116752,  9435.27403931,
 -174.72351449, 37372.501456  ,  3762.34340068, 15752.87879474,
 4533.80783189,  2098.27922285, 10611.76084205, 11035.74435668,
15662.70306033,  8452.46307921, 38420.53380273, 10153.96721241,
11949.02953257,  4513.62352998, 12416.5499223 , 26496.89917632,
 9790.09769801,  6000.9083136 , 10006.79989424, 25365.92932362,
10336.38146363, 10881.45558102,  8959.58819878, 15429.29849108,
 3007.7593242 , -1527.1369542 ,   595.0082712 , 28619.70924858,
 5735.13445102, 13970.64440894,  3305.77699221, 34409.46642665,
 3043.17108273,  9053.67241541,  8038.69942437, 13921.55865666,
 8610.49602819, -1661.86948091,  7849.37339028, 12779.93729567,
11037.97419828,  5255.92758077, 27495.79302831, 17224.77382277,
18593.63259562,  2746.80146262,  5275.27563221, 11085.22524556,
 6570.01359126,  8302.25598465,  5367.40939532, 13799.54616716,
 2045.94198386,  7402.89767646,  3764.4410032 ,  1760.64721451,
 9363.07450189,  6140.38557298,  1314.37779181, 11671.78227335,
 8736.5725223 , 39286.25467818, 13249.36687172, 30803.50766988,
24424.72359513, 13298.04012908,  7847.50609887,  4020.34673658,
 6470.53340058,  8103.13157642, 17572.38934907,  5463.80240816,
 1720.72220413,  4483.63471429, 11235.6798057 ,  4871.80772605,
 9599.55423169, 10504.32504824, 10086.4072409 , 11529.5329541 ,
35005.12140493, 10147.62707077, 10703.7386335 , 28556.89108092,
 1869.72444194,   875.61483071, 10028.75005365,  4457.93180971,
 6874.73842656,  3154.99749978,  7407.75407908, 23047.8677789 ,
11941.32287211,  5679.85229684,  3962.30629893, 17379.22814439,
 7399.8475945 ,  1220.25651548,  1129.73035709,  7875.37201881,
 8723.40864086,  6913.75960144,  9128.65976282,  8758.06405861,
11131.81608651, 34937.02999535,  5430.86984699,  3487.3144824 ,
10685.02032677,  6036.76635438,  8038.75071512,  9348.7407623 ,
 9517.12218624, 10281.87645397,  6180.09405404,  9625.27921867,
27611.14409316, 22788.54080536, 10608.81341111,  8996.37360704,
 -558.16181714, 24628.92851588,  5865.38954851,  2007.1668902 ,
 5697.77720309, 28148.35347362, 16246.80713907, 38680.33998848,
16153.55207819, 14308.20748622,  3608.9664882 , 25485.86708084,
10486.72886328, 13810.33483707, 13482.47816538,  3816.33829804,
 9835.63469515, 38393.62988914, 25686.53285693,  4480.81828534,
14174.70048894, 31679.26284821,  6536.16893229, 28213.86609471,
```

```
 6511.88155615, 11748.28032857,  8378.82241274, 12138.97948989,
 3899.8430647 , 12455.56775743, 13407.92219028,  4314.22620068,
12606.33253837, 16817.53373587, 25600.61877905, 13254.55530136,
27856.96498955, 26774.1696515 ,  8299.11875315, 11924.78780417,
36037.02555559, 11753.51147713,  9612.83188791, 11739.85825097,
10857.95138337,  8260.13988411,  5201.97267194,  1414.13238067,
27489.15709534, 11915.98981091, 13498.35913048, -1151.92131812,
 7634.13406195,  5086.2804916 , 13266.85964902, 10251.31617551,
 8209.36805295, 31277.78662118,  9396.65937063,  2914.69041458,
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```
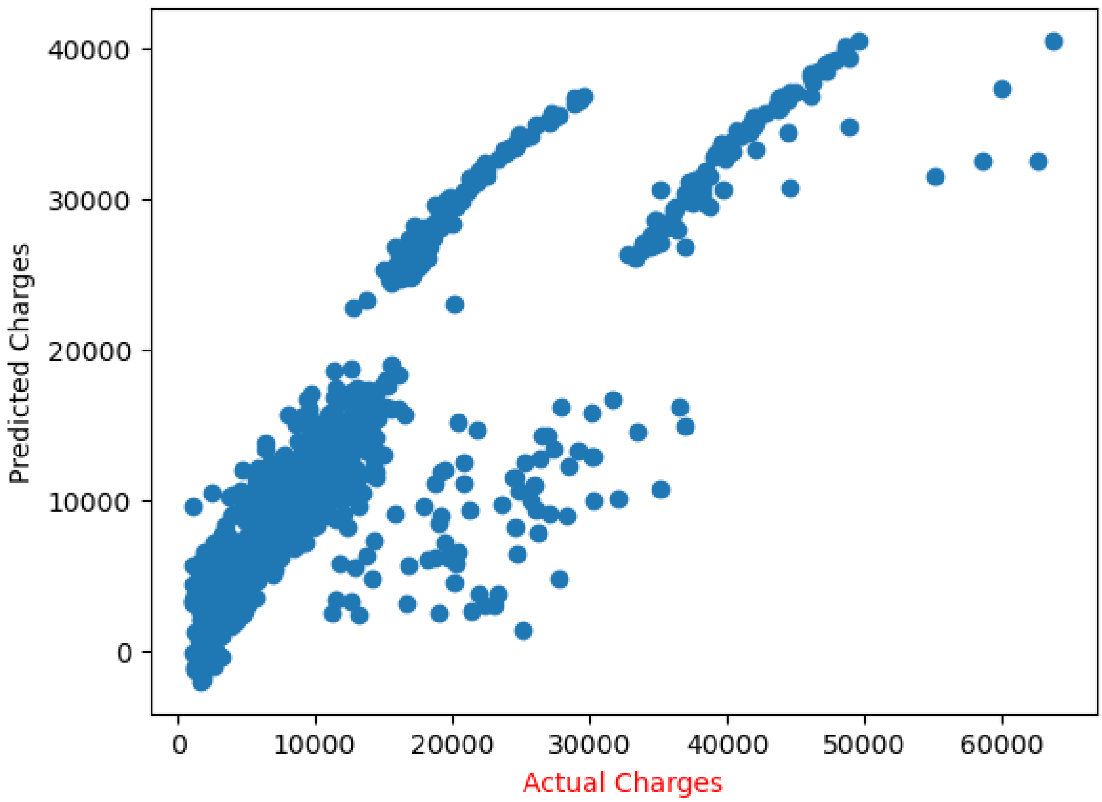
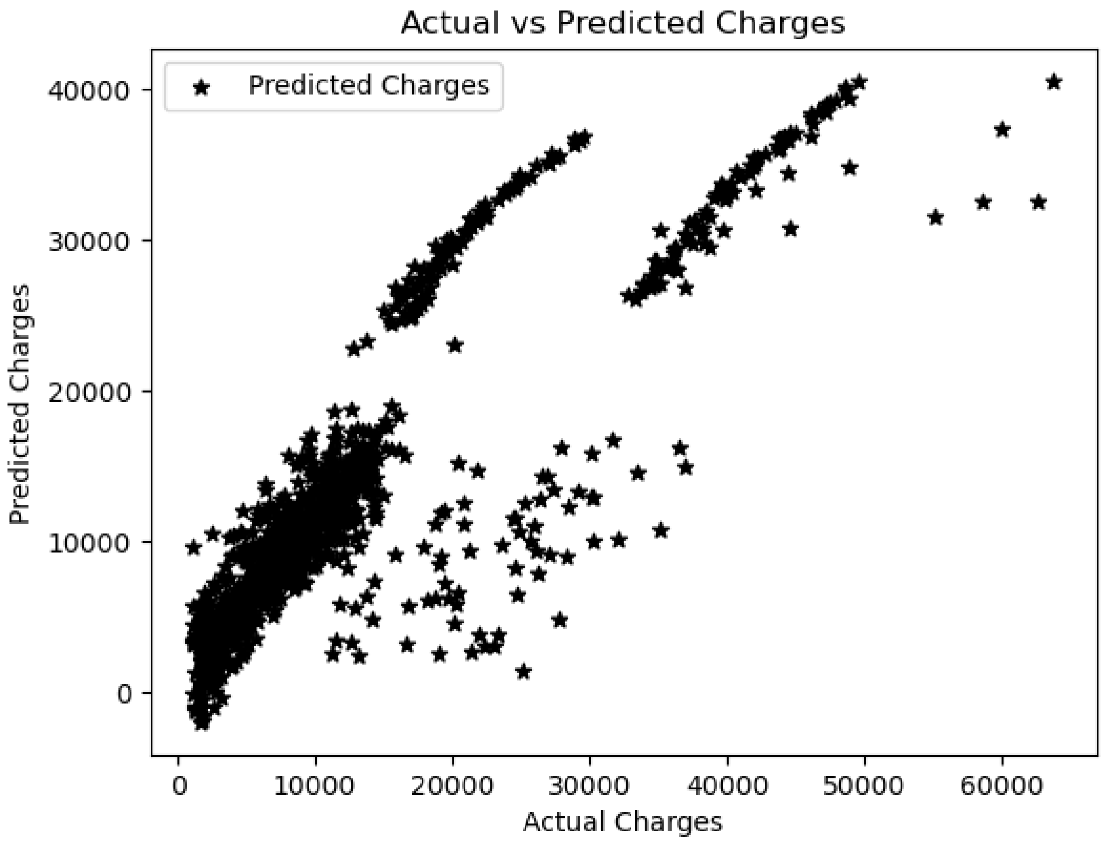

[59]:
```
import matplotlib.pyplot as plt
plt.scatter(ytrain,y_pred_train)
#plt.xlabel('Actual Charges')
#plt.ylabel('Predicted Charges')
plt.xlabel('Actual Charges', color='red')
plt.ylabel('Predicted Charges', color='black')
plt.show()
```



[60]:
```
# Plot 'ytrain' using '*'
# plt.scatter(ytrain, ytrain, marker='*', label='Actual Charges', color='blue')

# Plot 'y_pred_train' using '+'
plt.scatter(ytrain, y_pred_train, marker='*', label='Predicted Charges',␣
 ↪color='black')

plt.xlabel('Actual Charges')
plt.ylabel('Predicted Charges')
plt.title('Actual vs Predicted Charges')

# Add legend to differentiate between actual and predicted charges
plt.legend()
```

```
plt.show()
```



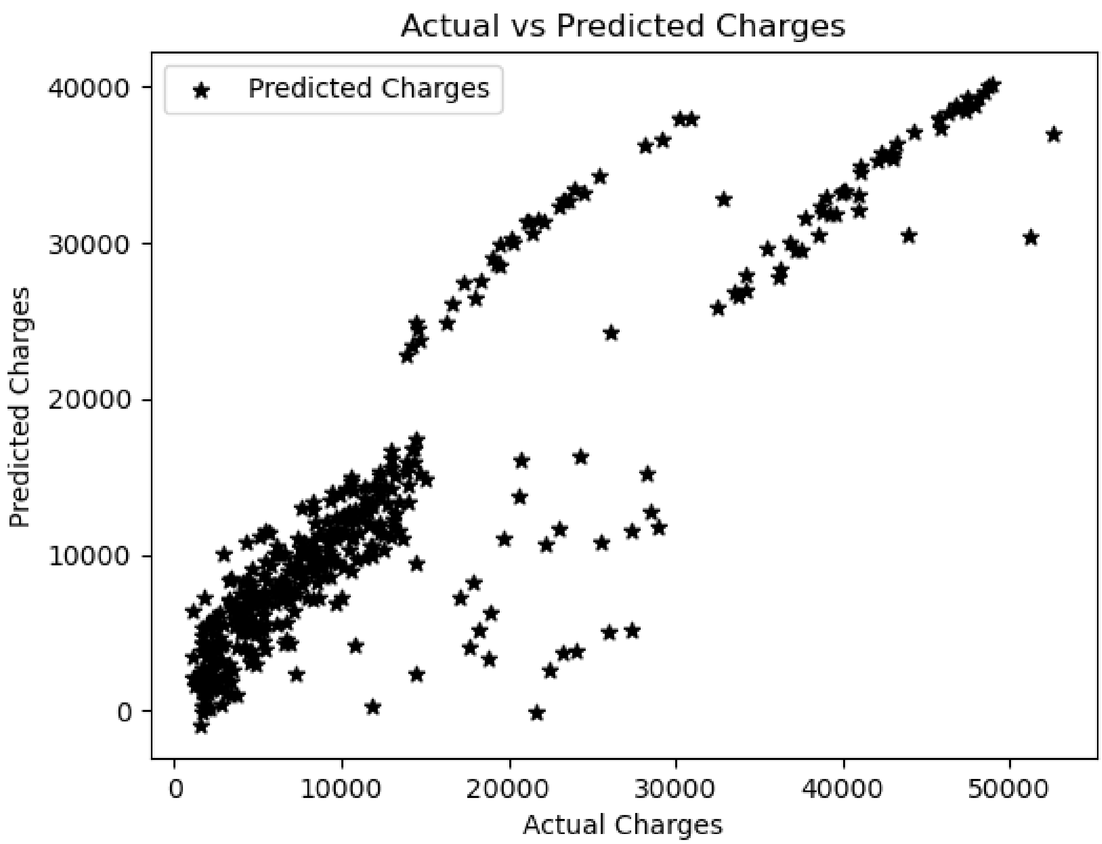
[61]:
```
from sklearn.metrics import r2_score
r2_score (ytrain, y_pred_train)
```

[61]: 0.7306840408360217

[62]:
```
y_pred_test = lr.predict(xtest)
```

[63]:
```
# Plot 'ytest' using '*'
#plt.scatter(ytest, ytest, marker='*', label='Actual Charges', color='blue')

# Plot 'y_pred_train' using '+'
plt.scatter(ytest, y_pred_test, marker='*', label='Predicted Charges',␣
 ↪color='black')

plt.xlabel('Actual Charges')
plt.ylabel('Predicted Charges')
plt.title('Actual vs Predicted Charges')
```

```
# Add legend to differentiate between actual and predicted charges
plt.legend()

plt.show()
```

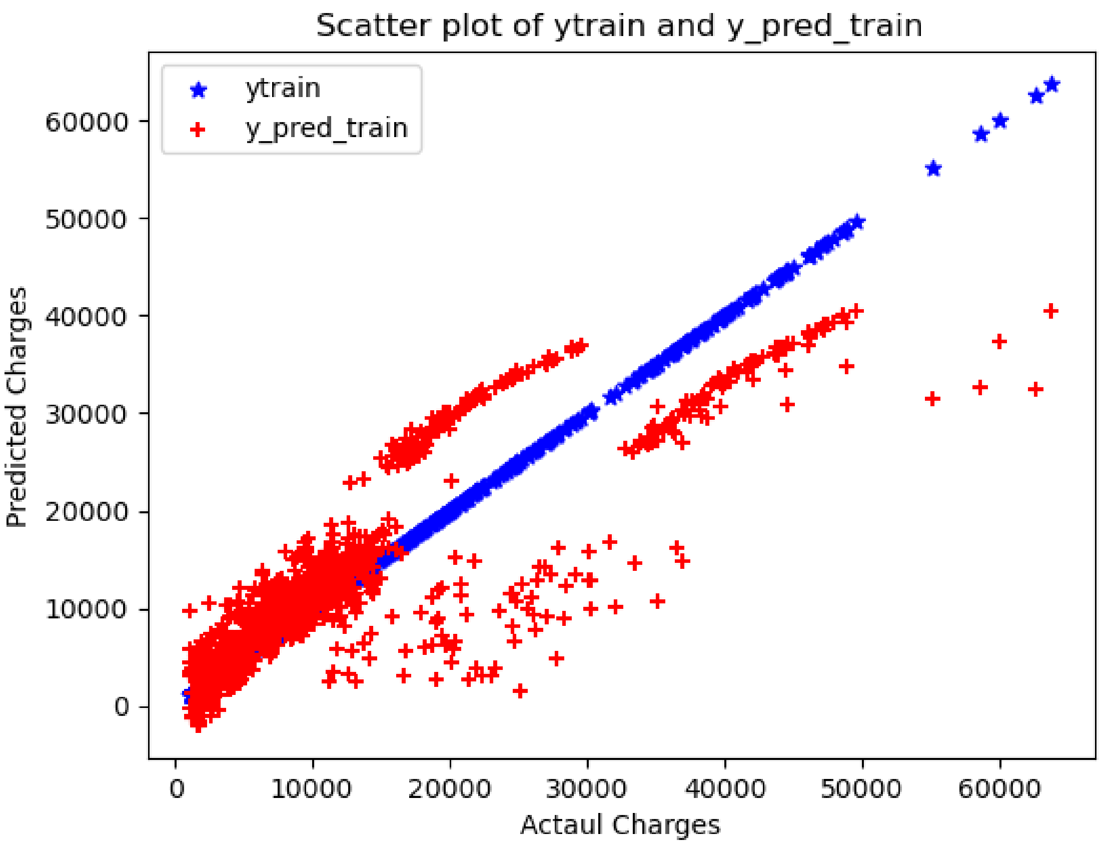


[64]:
```
r2_score (ytest, y_pred_test)
```

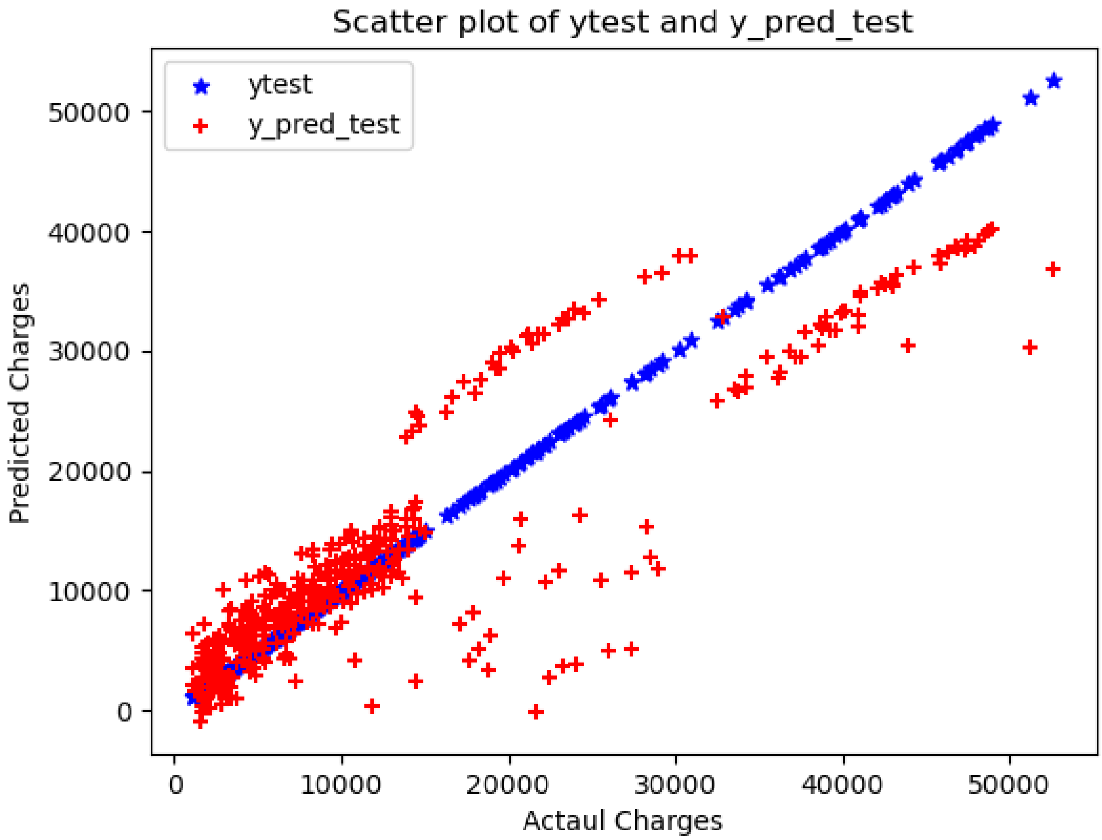
[64]: 0.7911113876316933

[65]:
```
# Create scatter plot
plt.scatter(ytrain, ytrain, marker='*', label='ytrain', color='blue') # ytrain w
plt.scatter(ytrain, y_pred_train, marker='+', label='y_pred_train',␣
↪color='red') # y_p

# Add labels and legend
plt.xlabel('Actaul Charges')
plt.ylabel('Predicted Charges')
plt.title('Scatter plot of ytrain and y_pred_train')
plt.legend()
```

```
# Show plot
plt.show()
```



[66]:
```
# Create scatter plot
plt.scatter(ytest, ytest, marker='*', label='ytest', color='blue') # ytrain with
plt.scatter(ytest, y_pred_test, marker='+', label='y_pred_test', color='red') #␣
↪y_pred

# Add labels and legend
plt.xlabel('Actaul Charges')
plt.ylabel('Predicted Charges')
plt.title('Scatter plot of ytest and y_pred_test')
plt.legend()

# Show plot
plt.show()
```


Scatter plot of ytest and y_pred_test
ytest
y_pred_test
Predicted Charges
Actaul Charges
0
10000
20000
30000
40000
50000