linear-regression

October 16, 2023

[1]:
```
import os
#current working dir
os.getcwd()
```

[1]:
```
'D:\\ML\\Assignments\\Linear Regression'
```

[2]:
```
#import all lib at once
import pandas as pd, matplotlib.pyplot as plt
```

[3]:
```
#change current directory
os.chdir('D:\\ML\\04. Linear Regression')
```

[4]:
```
#current working directory
os.getcwd()
```

[4]:
```
'D:\\ML\\04. Linear Regression'
```

[5]:
```
x = [60,40,40,50,52]
df = pd.DataFrame(x,columns=['Salary (k)'])
df
```

[5]:

	Salary (k)
0	60
1	40
2	40
3	50
4	52

[6]:
```
#Loading dataframe
df = pd.read_csv('Height-Weight Data.csv')
```

[7]:
```
#first 5 rows
df.head()
```

[7]:

	Height	Weight
0	73.847017	241.893563
1	68.781904	162.310473

```
2  74.110105  212.740856
3  71.730978  220.042470
4  69.881796  206.349801
```

[8]:
```
#last 5 rows
df.tail()
```

[8]:
```
          Height      Weight
3496  69.296830  185.649086
3497  70.542201  210.198845
3498  73.912549  202.429960
3499  67.396021  144.277671
3500  72.738970  187.222909
```

[9]:
```
#total Rows and columns
df.shape
```

[9]:
```
(3501, 2)
```

[10]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3501 entries, 0 to 3500
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype  
---  ------  --------------  -----  
 0   Height  3501 non-null   float64
 1   Weight  3501 non-null   float64
dtypes: float64(2)
memory usage: 54.8 KB
```

[11]:
```
#checking null values
df.isnull()
```

[11]:
```
      Height  Weight
0      False   False
1      False   False
2      False   False
3      False   False
4      False   False
…      …     …
3496   False   False
3497   False   False
3498   False   False
3499   False   False
3500   False   False
```

```
[3501 rows x 2 columns]
```

[12]:
```
#Total null values
df.isnull().sum()
```

[12]:
```
Height    0
Weight    0
dtype: int64
```

[13]:
```
#dataframe columns
df.columns
```

[13]:
```
Index(['Height', 'Weight'], dtype='object')
```

[14]:
```
#single column
df.Height    #or df['Height']
```

[14]:
```
0       73.847017
1       68.781904
2       74.110105
3       71.730978
4       69.881796
          …
3496    69.296830
3497    70.542201
3498    73.912549
3499    67.396021
3500    72.738970
Name: Height, Length: 3501, dtype: float64
```

[15]:
```
df.Weight.head()
```

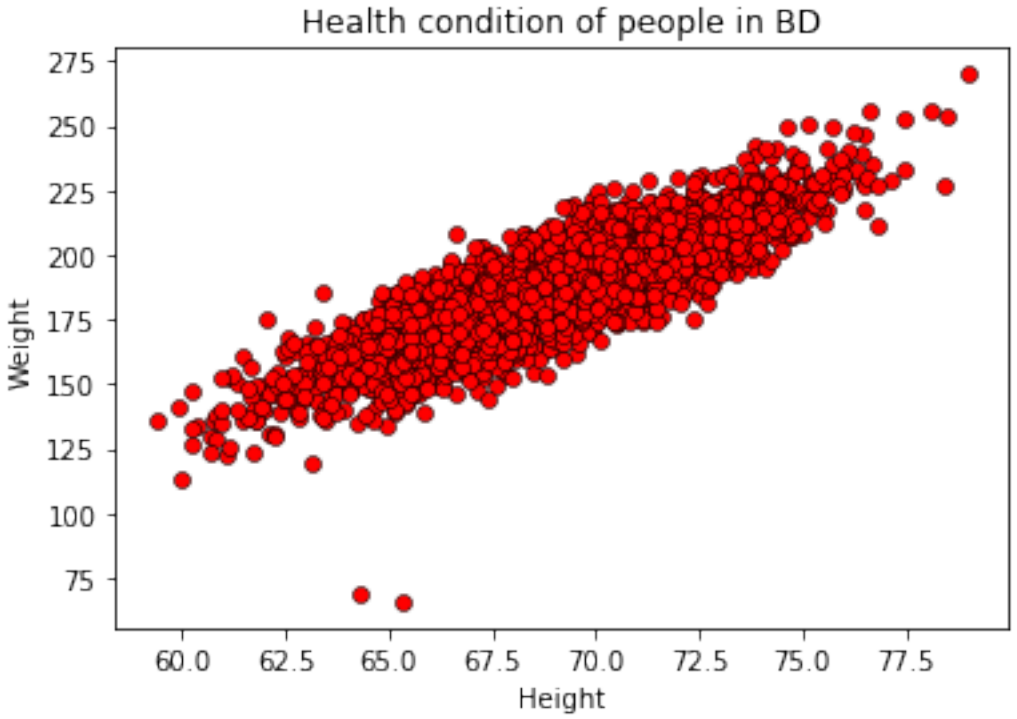
[15]:
```
0    241.893563
1    162.310473
2    212.740856
3    220.042470
4    206.349801
Name: Weight, dtype: float64
```

[16]:
```
#descriptive statistics
df.describe()
```

[16]:
```
            Height       Weight
count  3501.000000  3501.000000
mean     69.024411   186.891258
std       2.858583    19.903132
min      59.380650    65.780000
```

```
25%       67.193523   173.896237
50%       69.044211   187.308370
75%       70.976491   200.356448
max       78.998742   269.989698
```

[17]:
```
#pyplot.scatter(x, y, s=None, c=None, marker=None, cmap=None, norm=None,␣
 ↪vmin=None, vmax=None, alpha=None, linewidths=None, *, edgecolors=None,␣
 ↪plotnonfinite=False, data=None, **kwargs)
plt.scatter(df.Height,df.
 ↪Weight,color='red',marker='o',edgecolors='black',linewidths=.5 )
plt.xlabel('Height')
plt.ylabel('Weight')
plt.title('Health condition of people in BD')
plt.show()
```



0.0.1 split dataset into train test dataset

[18]:
```
#df.drop(['col1,col2,col3',axis=1])          dropping multiple column
x = df.drop('Weight',axis=1)                 #Height in 2D after dropping weight
y = df[['Weight']]                           #Weight in 2D
```

[19]:
```
from sklearn.model_selection import train_test_split
```

```
#train_test_split(*arrays, test_size=None, train_size=None, random_state=None,␣
 ↪shuffle=True, stratify=None)[source]
xtrain,xtest,ytrain,ytest = train_test_split(x, y, train_size=.3,␣
 ↪random_state=1)
```

[20]:
```
xtrain
```

[20]:
```
          Height
3045  70.968528
2364  69.742642
2932  67.724936
2783  72.297584
2397  66.558114
…           …
2763  68.457061
905   66.539812
1096  75.999957
235   70.555244
1061  70.269360

[1050 rows x 1 columns]
```

[21]:
```
ytrain
```

[21]:
```
           Weight
3045  183.196713
2364  199.891272
2932  180.051856
2783  212.058247
2397  154.627588
…            …
2763  186.208566
905   175.093255
1096  224.440459
235   198.460249
1061  192.307027

[1050 rows x 1 columns]
```

[22]:
```
xtrain.shape
```

[22]:
```
(1050, 1)
```

[23]:
```
ytrain.shape
```

[23]:
```
(1050, 1)
```

0.0.2 Linear Regression

[24]:
```
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
```

[25]:
```
#train linear model
lr.fit(xtrain,ytrain)
```

[25]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

[26]:
```
#coefficient
m = lr.coef_
m
```

[26]:
```
array([[5.97605415]])
```

[27]:
```
#intercept
c = lr.intercept_
c
```

[27]:
```
array([-225.6877839])
```

[28]:
```
#first 10 rows
df.head(10)
```

[28]:

	Height	Weight
0	73.847017	241.893563
1	68.781904	162.310473
2	74.110105	212.740856
3	71.730978	220.042470
4	69.881796	206.349801
5	67.253016	152.212156
6	68.785081	183.927889
7	68.348516	167.971111
8	67.018950	175.929440
9	63.456494	156.399676

[29]:
```
x1 = 70.542201
y = m*x1+c
y
```

[29]:
```
array([[195.87622912]])
```

[30]:
```
lr.predict([[70.542201]])
```

[30]:
```
array([[195.87622912]])
```

[31]:
```
df['Predicted_value'] = lr.predict(x)
```

[32]:
```
df.head(10)
```

[32]:

	Height	Weight	Predicted_value
0	73.847017	241.893563	215.625989
1	68.781904	162.310473	185.356599
2	74.110105	212.740856	217.198219
3	71.730978	220.042470	202.980427
4	69.881796	206.349801	191.929612
5	67.253016	152.212156	176.219880
6	68.785081	183.927889	185.375586
7	68.348516	167.971111	182.766646
8	67.018950	175.929440	174.821088
9	63.456494	156.399676	153.531660

0.0.3 Accurecy Measurements

[33]:
```
#training accuracy (in percentage)
lr.score(xtrain,ytrain) * 100
```

[33]:
```
73.33630970543594
```

[34]:
```
#testing accuracy (in percentage)
lr.score(xtest,ytest) *100
```

[34]:
```
73.19318916534414
```

0.0.4 Error Measurements

[35]:
```
from sklearn.metrics import mean_squared_error,mean_absolute_error
```

[36]:
```
#training error
ytrain1 = lr.predict(xtrain)
ytrain1
```

[36]:
```
array([[198.42397972],
       [191.09802195],
       [179.0401008 ],
       …,
       [228.49207481],
       [195.95417336],
       [194.24571491]])
```

[37]:
```
#training error
mse = mean_squared_error(ytrain,ytrain1)
print('For Training Data:\nMean Squared Error (MSE) : ',mse)
```

```
mae = mean_absolute_error(ytrain,ytrain1)
print('Mean Absolute Error (MAE) : ',mae)
```

```
For Training Data:
Mean Squared Error (MSE) :  98.72889716385785
Mean Absolute Error (MAE) :  7.899089005943219
```

[38]:
```
ytest1 = lr.predict(xtest)
ytest1
```

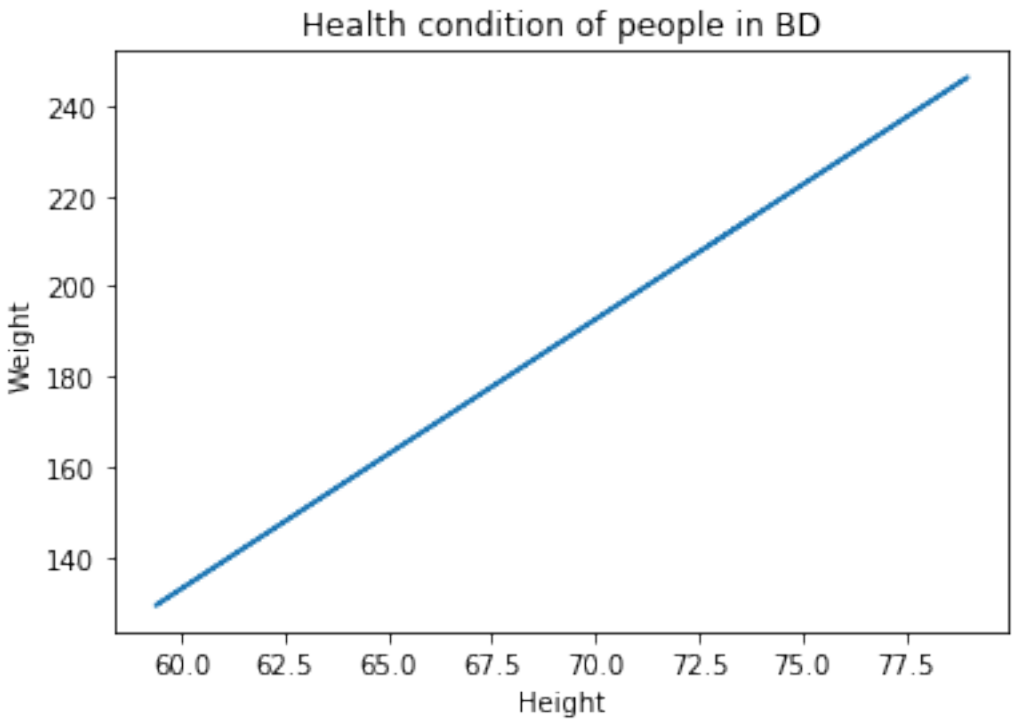
[38]:
```
array([[177.11512478],
       [190.00673937],
       [167.59581338],
       …,
       [215.43612225],
       [204.09988273],
       [180.29327069]])
```

[39]:
```
#testing error
mse = mean_squared_error(ytest,ytest1)
print('For Testing Data:\nMean Squared Error (MSE) : ',mse)
mae = mean_absolute_error(ytest,ytest1)
print('Mean Absolute Error (MAE) : ',mae)
```

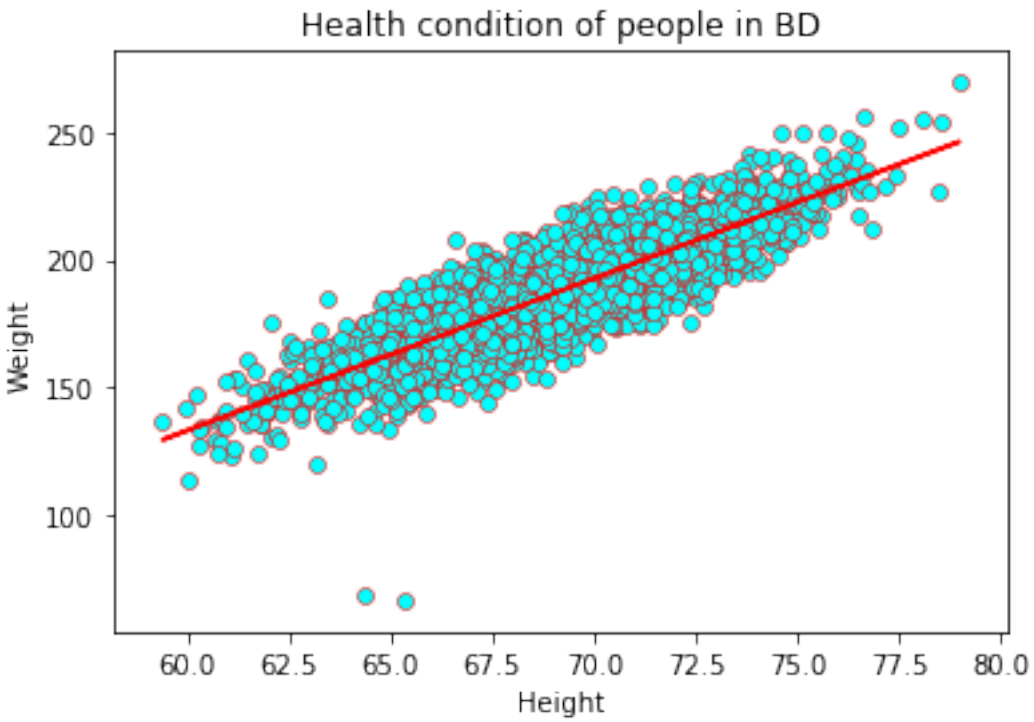
```
For Testing Data:
Mean Squared Error (MSE) :  109.11724434757244
Mean Absolute Error (MAE) :  8.144275364945507
```

0.0.5 Best Fit Line

[40]:
```
plt.plot(df.Height,lr.predict(x))
plt.xlabel('Height')
plt.ylabel('Weight')
plt.title('Health condition of people in BD')
plt.show()
```



[41]:
```
plt.plot(df.Height,lr.predict(x),c='red')
plt.scatter(df.Height,df.
  ↪Weight,c='cyan',marker='o',edgecolors='red',linewidths=.5 )
plt.xlabel('Height')
plt.ylabel('Weight')
plt.title('Health condition of people in BD')
plt.show()
```



[42]:
```
#mean value of Height
df.Height.mean()
```

[42]: 69.02441087268797

[43]:
```
#mean value of Weight
df.Weight.mean()
```

[43]: 186.89125797946284

[44]:
```
xtrain
```

[44]:

	Height
3045	70.968528
2364	69.742642
2932	67.724936
2783	72.297584
2397	66.558114
…	…
2763	68.457061
905	66.539812
1096	75.999957
235	70.555244

```
1061  70.269360

[1050 rows x 1 columns]
```

0.1 Import & Export Dataframe

[45]:
```
#export to csv
xtrain.to_csv('xtrain.csv')
df.to_csv('newdf.csv')
```

0.1.1 using pickle

[46]:
```
import pickle as pk
```

[47]:
```
# saving model to a binary file
with open('linear-regression','wb') as file:
    pk.dump(lr,file)             #or pk.dump(lr,open('linear-regression-copy.
 ↪ipynb','wb'))
```

[48]:
```
#load a binary file
with open('linear-regression','rb') as file:
    lr = pk.load(file)           #or pk.load(open('linear-regression-copy.
 ↪ipynb','rb'))
```

[49]:
```
lr.predict([[3000]])
```

[49]:
```
array([[17702.47466531]])
```

0.1.2 Using Joblib

[50]:
```
import joblib as jb
```

[51]:
```
#Saving model to a binary file
jb.dump(lr,'linear-regression')
```

[51]:
```
['linear-regression']
```

[52]:
```
#load a binary file
lr = jb.load('linear-regression')
```

[53]:
```
lr.predict([[3000]])
```

[53]:
```
array([[17702.47466531]])
```