Linear_Regression_feb14

August 19, 2022

1 Linear Regression

[1]:
```
import  pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[2]:
```
data=pd.read_csv("Advertising.csv")
data.head(5)
```

[2]:

	TV	radio	newspaper	sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4
2	17.2	45.9	69.3	9.3
3	151.5	41.3	58.5	18.5
4	180.8	10.8	58.4	12.9

[3]:
```
data.shape
```

[3]:
```
(200, 4)
```

[4]:
```
data.info()
```

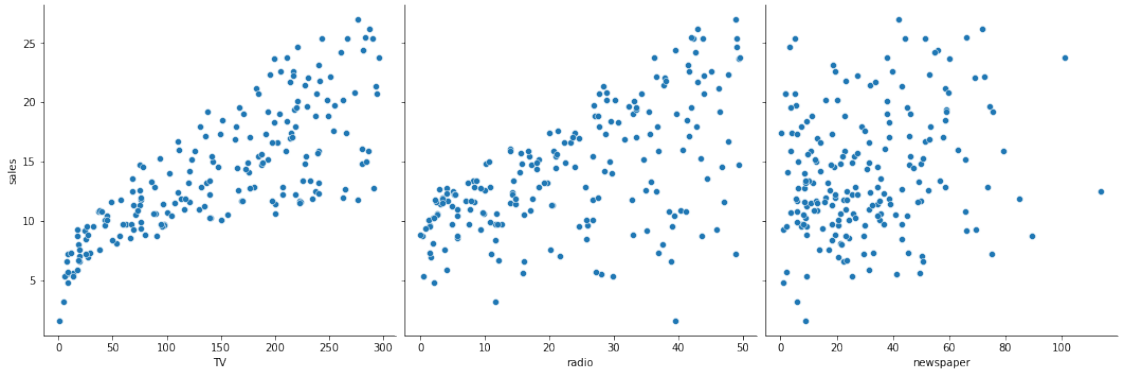
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   TV         200 non-null    float64
 1   radio      200 non-null    float64
 2   newspaper  200 non-null    float64
 3   sales      200 non-null    float64
dtypes: float64(4)
memory usage: 6.4 KB
```

[5]:
```
#sns.pairplot(data)# all analysis
```

```
sns.
 ↪pairplot(x_vars=["TV","radio","newspaper"],y_vars=["sales"],data=data,size=5)
```

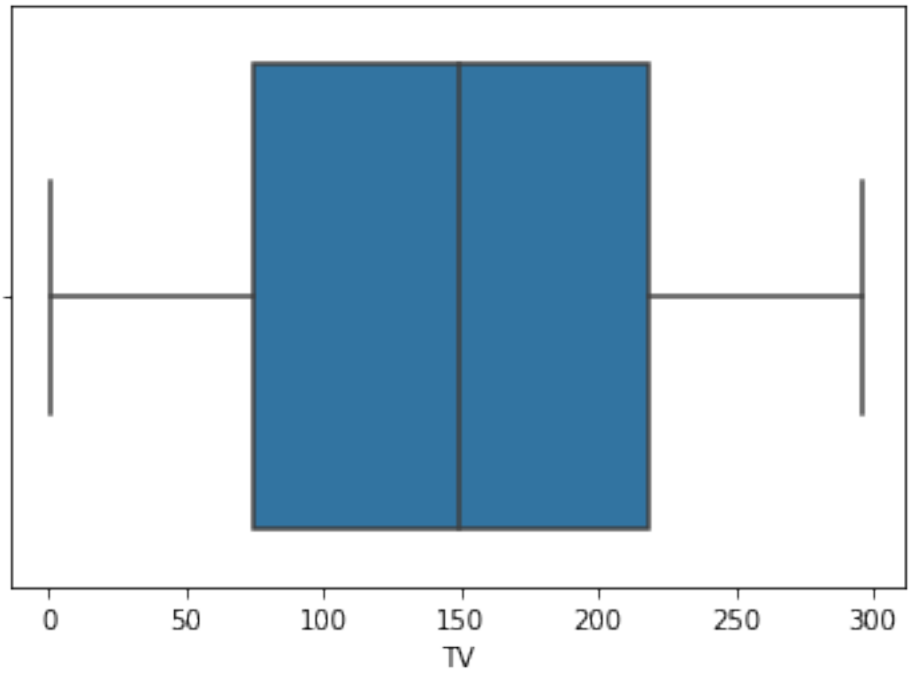
```
/usr/local/lib/python3.7/site-packages/seaborn/axisgrid.py:2076: UserWarning:
The `size` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```

[5]: <seaborn.axisgrid.PairGrid at 0x7f03641f6510>



[6]:
```
#box plot for all features
for i in data.columns:
    sns.boxplot(data[i])
    plt.show()
```

```
/usr/local/lib/python3.7/site-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variable as a keyword arg: x. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  FutureWarning
```




```
/usr/local/lib/python3.7/site-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variable as a keyword arg: x. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
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  FutureWarning
```
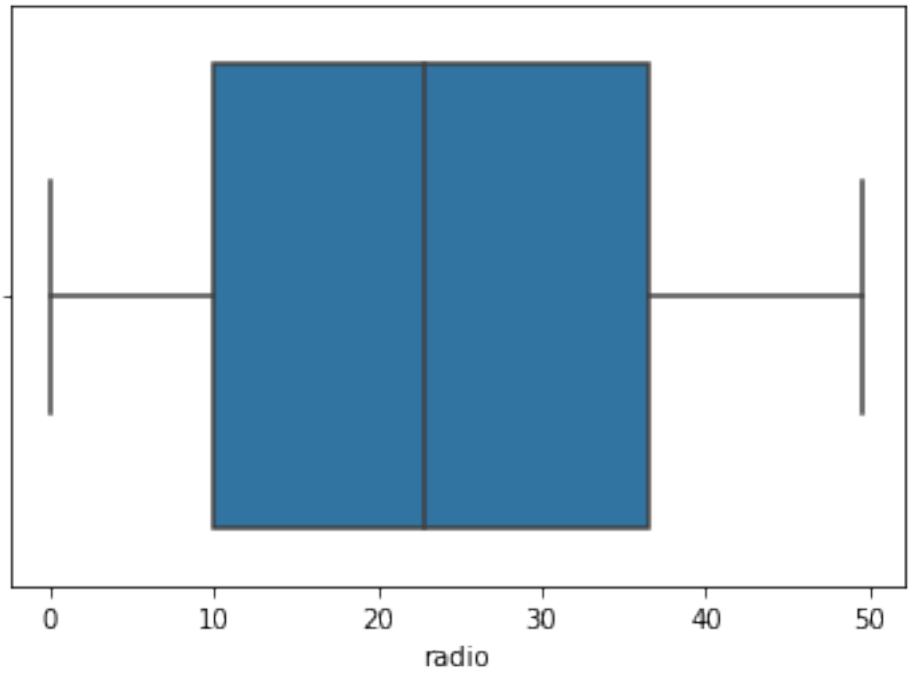
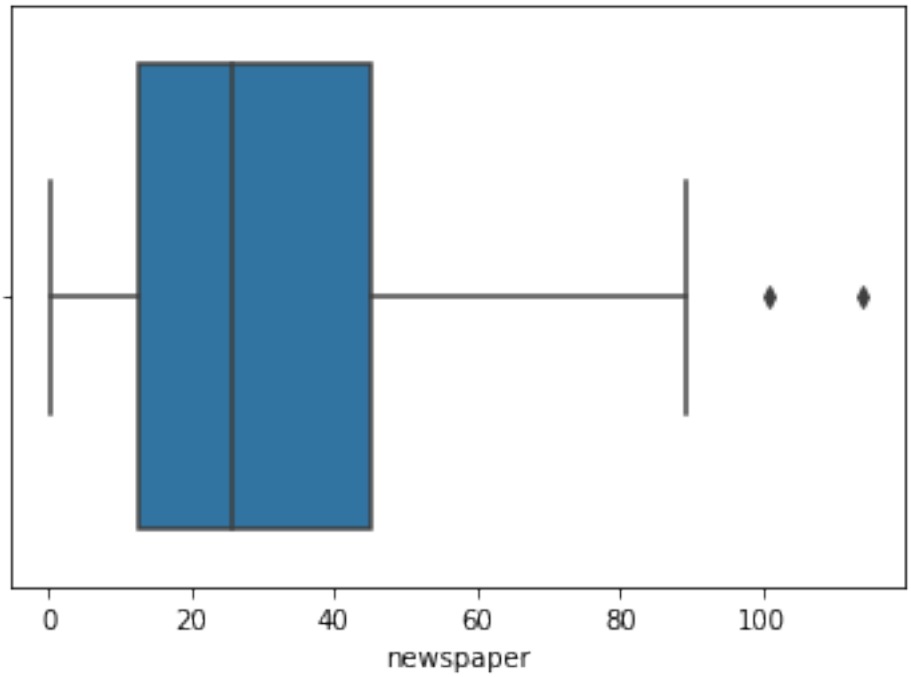
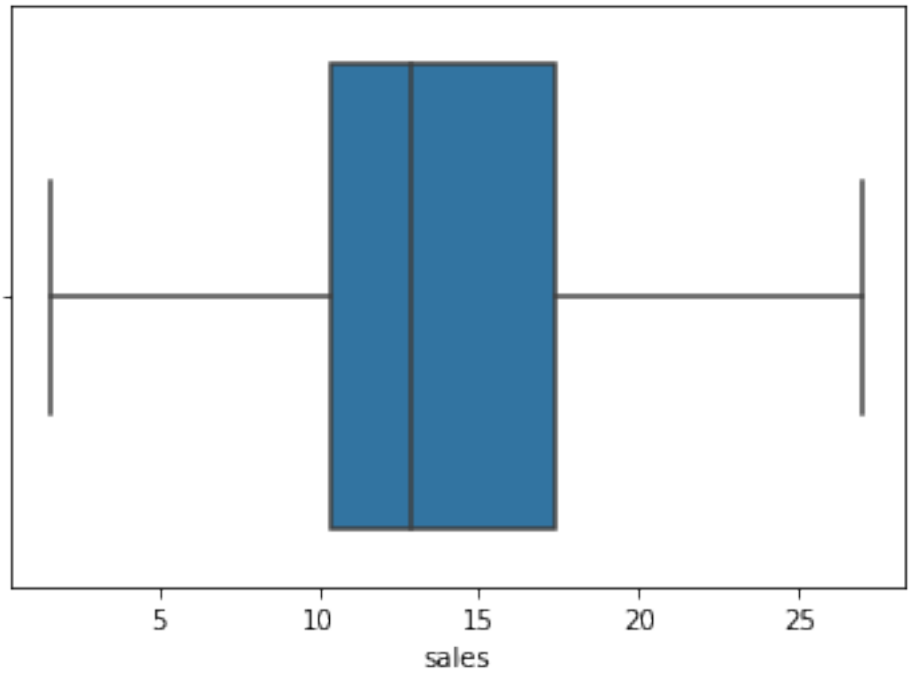



```
/usr/local/lib/python3.7/site-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variable as a keyword arg: x. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  FutureWarning
```




```
/usr/local/lib/python3.7/site-packages/seaborn/_decorators.py:43: FutureWarning:
Pass the following variable as a keyword arg: x. From version 0.12, the only
valid positional argument will be `data`, and passing other arguments without an
explicit keyword will result in an error or misinterpretation.
  FutureWarning
```



[7]:
```
# outlier Treatement
from scipy import stats
iqr=stats.iqr(data["newspaper"])
q1=stats.scoreatpercentile(data["newspaper"],25)
q3=stats.scoreatpercentile(data["newspaper"],75)
lowerbound=q1 -(1.5*iqr)
upperbound=q3+(1.5*iqr)
print(lowerbound)
print(upperbound)
outliers=data["newspaper"][((data["newspaper"]<lowerbound) | ␣
 ↪(data["newspaper"]>upperbound))]
print('outliers are',outliers)
```

```
-35.775000000000006
93.625
outliers are 16     114.0
101    100.9
Name: newspaper, dtype: float64
```

[8]:
```
median = np.median(data["newspaper"])# Replace with median

for i in outliers:
    data["newspaper"] = np.where(data["newspaper"]==i, median,␣
 ↪data["newspaper"])
```

[9]:
```
# Simple Linear Regression

# consider one features

# Tv as feature and sale as a label
```

[10]:
```
# split input and output features

X=data.loc[:,["TV"]]
y=data.loc[:,["sales"]]
```

[11]:
```
X.head()
```

[11]:

	TV
0	230.1
1	44.5
2	17.2
3	151.5
4	180.8

2 split the data for training and Testing

[31]:
```
# Scikit learn---------- it contain all machine learning realted libraries

from sklearn.model_selection import train_test_split

xtrain,xtest,ytrain,ytest=train_test_split(X,y,test_size=0.3,random_state=10)
```

[32]:
```
print(xtrain.shape)
print(xtest.shape)
print(ytrain.shape)
print(ytest.shape)
```

```
(140, 1)
(60, 1)
(140, 1)
(60, 1)
```

[33]:
```
# Build the Model
#process to import the linear regression model
from sklearn.linear_model import LinearRegression

# instantiate the obect

lr=LinearRegression()
```

[34]:
```
# fit the data  or train the data

lr.fit(xtrain,ytrain)
```

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

[35]:
```
# y=mx+c
lr.intercept_
```

[35]:
```
array([7.30826074])
```

[36]:
```
lr.coef_
```

[36]:
```
array([[0.04474675]])
```

[37]:
```
# Sales =  0.048 *[TV]  +  6.917
```

[38]:
```
#training performance
ypredtrain=lr.predict(xtrain)
```

[ ]:
```
#ypredtrain
```

[39]:
```
ypredtrain.shape
```

[39]:
```
(140, 1)
```

[40]:
```
ypredtrain
```

[40]:
```
array([[ 8.17634775],
       [17.41207755],
       [14.6154055 ],
       [16.56188925],
       [14.77201913],
       [17.93113989],
       [17.8013743 ],
       [10.80745682],
       [13.54148342],
       [ 8.71778346],
       [13.63097693],
       [ 9.23684579],
       [11.52340487],
       [11.14305747],
       [13.35802174],
       [16.15021912],
       [10.36893864],
       [ 8.10922762],
       [10.72691267],
```

```
[15.22843601],
[10.72691267],
[18.03853209],
[11.65764513],
[ 9.54559839],
[17.47472301],
[19.07218209],
[15.47901783],
[13.47883797],
[19.89999702],
[14.00684966],
[11.80083474],
[16.44107301],
[10.67769124],
[16.86169249],
[18.66498664],
[10.4673815 ],
[14.08739381],
[17.52394444],
[18.19067105],
[20.10583208],
[10.65084319],
[ 8.14502502],
[13.55043278],
[15.85936523],
[15.14341718],
[ 7.68413347],
[15.58193536],
[14.71832303],
[10.68664059],
[20.4459074 ],
[ 9.97516722],
[19.17509962],
[12.49888408],
[15.02707562],
[14.92415809],
[11.9887711 ],
[16.94671132],
[ 8.37323346],
[15.17026523],
[16.9153886 ],
[ 7.89891788],
[ 8.42692957],
[15.95333341],
[18.05195612],
[ 9.88119904],
[17.16597041],
```

```
[ 9.3084406 ],
[ 7.49172243],
[ 9.00863735],
[17.96693729],
[11.590525  ],
[ 7.89444321],
[16.24866198],
[ 8.95941593],
[11.61289837],
[13.58623018],
[15.39847367],
[17.14359704],
[ 8.43140424],
[16.15021912],
[18.42335417],
[18.44125287],
[ 9.46952891],
[14.6691016 ],
[14.31560225],
[12.22145421],
[12.93292759],
[ 8.07790489],
[15.22843601],
[19.55544702],
[16.85721782],
[ 9.82302826],
[12.11406201],
[12.72261785],
[19.86867429],
[14.84361394],
[18.53522105],
[10.40473604],
[18.05195612],
[19.2511691 ],
[13.40276849],
[12.36016915],
[10.39578669],
[10.59267241],
[12.22145421],
[ 7.83179775],
[20.41458467],
[10.72243799],
[17.04962885],
[15.97570678],
[ 7.65728542],
[14.97337952],
[11.67106915],
```

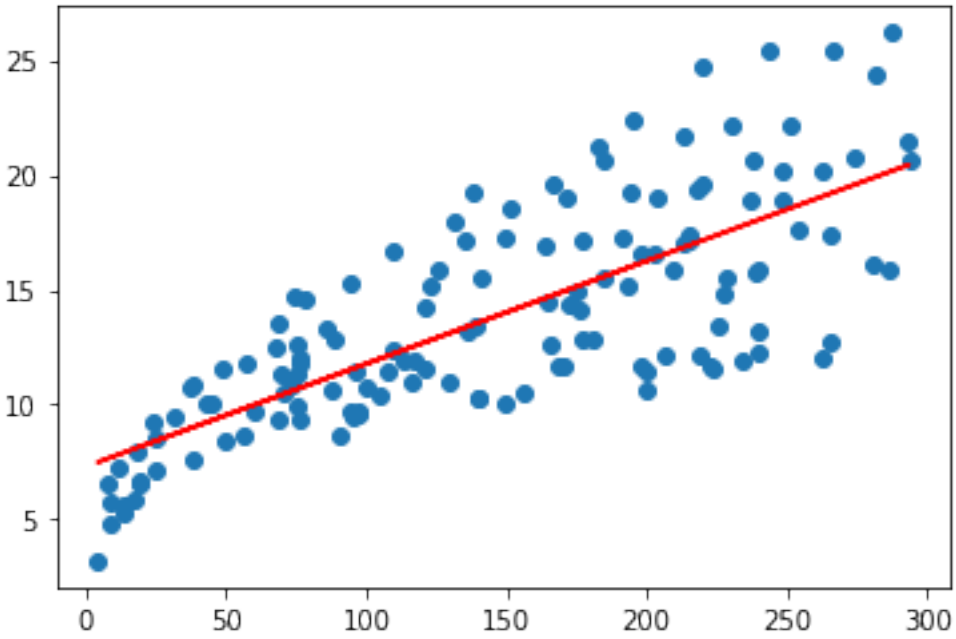
```
[12.70024447],
[17.08542626],
[20.17742688],
[19.19299832],
[18.01615872],
[17.3315334 ],
[11.35336721],
[11.25939903],
[19.06323274],
[15.58193536],
[17.25993859],
[10.34209059],
[10.66874189],
[12.55258019],
[16.36947821],
[17.60448859],
[13.09849057],
[ 7.69308282],
[ 9.0175867 ],
[14.01132433],
[11.50998084],
[12.81658603],
[16.68718016],
[13.17456005],
[16.05177626],
[11.2101776 ],
[16.24866198]])
```

[41]:
```
from sklearn.metrics import mean_squared_error
print("The Rms value is  training data")
print("----------------")
print(np.sqrt(mean_squared_error(ytrain,ypredtrain)))
```

```
The Rms value is  training data
----------------
3.0681028951223004
```

[42]:
```
plt.scatter(xtrain,ytrain)
plt.plot(xtrain,ypredtrain,color="red")
```

[42]: [<matplotlib.lines.Line2D at 0x7f031403e310>]



[43]:
```
# testing the data
ypredtest=lr.predict(xtest)
```

[44]:
```
ypredtest.shape
```

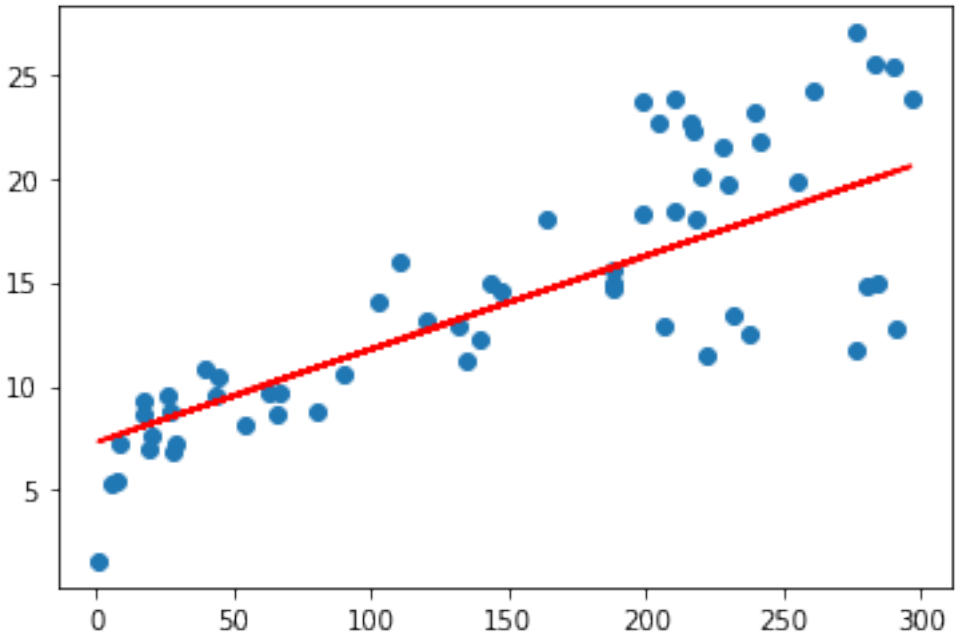
[44]: (60, 1)

[45]:
```
from sklearn.metrics import mean_squared_error
print("The Rms value is  test data")
print("----------------")
print(np.sqrt(mean_squared_error(ytest,ypredtest)))
```

```
The Rms value is  test data
----------------
3.6508293924109783
```

[46]:
```
plt.scatter(xtest,ytest)
plt.plot(xtest,ypredtest,color="red")
```

[46]: [<matplotlib.lines.Line2D at 0x7f0313fb6310>]



[47]:
```
from sklearn.metrics import r2_score
#r2score close to 1 is a good value
print(r2_score(ytest,ypredtest))
```

```
0.6447879078216139
```

[ ]:
```
# End of Simple Linear Regression
```

3 Multiple Linear Regression

[48]:
```
data.head(2)
```

[48]:

	TV	radio	newspaper	sales
0	230.1	37.8	69.2	22.1
1	44.5	39.3	45.1	10.4

[49]:
```
# splitted i/p and o/p

xnew=data.drop(["sales"],axis=1) #drop the column
ynew=data["sales"]
```

[ ]:
```
xnew.head(3)
```

[50]:
```
from sklearn.model_selection import train_test_split

xtrain,xtest,ytrain,ytest=train_test_split(xnew,ynew,test_size=0.
↪3,random_state=10)
```

[51]:
```
print(xtrain.shape)
print(xtest.shape)
```

```
(140, 3)
(60, 3)
```

[52]:
```
# build a mlr model
from sklearn.linear_model import LinearRegression

mlr=LinearRegression()

mlr.fit(xtrain,ytrain)
```

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

[53]:
```
print("intercept value",mlr.intercept_)
print("coefficent value",mlr.coef_)
```

```
intercept value 3.392597098985595
coefficent value [ 0.04304513  0.19298948 -0.00301967]
```

[ ]:
```
# sales= 0.043 [TV]+[0.193][radio]-[0.0038]newspaper+ 3.41
```

[54]:
```
# check the train performance

ypredtraining_mlr=mlr.predict(xtrain)
```

[55]:
```
df=pd.DataFrame({"Actual":ytrain,"predicted":ypredtraining_mlr})
df
```

[55]:

	Actual	predicted
119	6.6	7.248166
110	13.4	14.524089
95	16.9	16.360594
167	12.2	13.239294
193	19.6	18.667212
..	…	…
113	15.9	16.358129
64	18.0	17.208495
15	22.4	20.849473
125	10.6	9.345199
9	10.6	12.430770

```
[140 rows x 2 columns]
```

[56]:
```
from sklearn.metrics import mean_squared_error
print("The Rms value is  training data")
print("-----------------")
print(np.sqrt(mean_squared_error(ytrain,ypredtraining_mlr)))
```

```
The Rms value is  training data
-----------------
1.3332818533291317
```

[57]:
```
from sklearn.metrics import r2_score
#r2score close to 1 is a good value
print(r2_score(ytrain,ypredtraining_mlr))
```

```
0.920909492761702
```

[58]:
```
# Test performace

ypredtest_mlr=mlr.predict(xtest)
```

[59]:
```
pd.DataFrame({"Actual":ytest,"predicted":ypredtest_mlr}).head()
```

[59]:

	Actual	predicted
59	18.4	18.127313
5	7.2	12.977800
20	18.0	17.978211
198	25.5	23.505852
52	22.6	20.635645

[60]:
```
from sklearn.metrics import mean_squared_error
print("The Rms value is  test data")
print("-----------------")
print(np.sqrt(mean_squared_error(ytest,ypredtest_mlr)))
```

```
The Rms value is  test data
-----------------
2.314415304470104
```

[61]:
```
print(r2_score(ytest,ypredtest_mlr))
```

```
0.8572463405728885
```

[ ]:
```
# End of Linear regression
```

[ ]:
```

```