

```
In [1]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,18]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=LinearRegression()
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled)
```

Out[11]: LinearRegression()

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Compression 7 Mpa']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

```
Out[14]: 102.86923944332833
```

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[15]: 10.142447408950579
```

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Compression 7 Mpa
0	44.710066	50.07
1	39.889919	44.09
2	56.899279	50.33
3	46.652213	29.14
4	56.347492	50.53
5	60.231787	57.76
6	43.942064	51.37
7	43.419154	47.27
8	44.074289	64.56

```
In [17]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [18]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [19]: result['x_all']=result['x_all'].apply(joins)
```

```
In [20]: data['x_all']=data['x_all'].apply(joins)
```

```
In [21]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

```
Out[21]:
```

	y_pred	Compression 7 Mpa_x	x_all	Mix Design
0	44.710066	50.07	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	39.889919	44.09	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	56.899279	50.33	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8

	y_pred	Compression 7 Mpa_x	x_all	Mix Design
3	46.652213	29.14	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	56.347492	50.53	550,0.45,1.0,0,0,	VC5-M550W45S1
5	60.231787	57.76	550,0.35,1.0,0,0,	VC4-M550W35S1
6	43.942064	51.37	500,0.45,1.0,0,30,	LS-13
7	43.419154	47.27	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	44.074289	64.56	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

In []:

In []:

In []:

In [22]:

data

Out[22]:

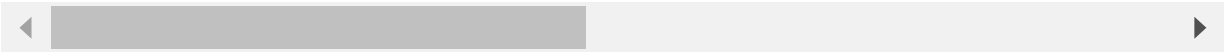
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W,5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [23]: y

Out[23]: array([39.12, 53.67, 53.76, 53.12, 55.98, 32.33, 59.55, 66.94, 65.25, 62.86, 64.82, 48.7, 61.53, 50.33, 61.17, 57.83, 50.49, 52.02, 64.56, 29.7, 29.13, 57.92, 52.79, 34.02, 44.82, 67.88, 57.76, 50.53, 42.37, 47.43, 45.64, 59.11, 56.45, 50.99, 39.92, 47.79, 50.44, 47.27, 11.84, 52.56, 61.12, 44.09, 15.32, 27.92, 21.24,

```
22.25, 15.97, 46.24, 34.43, 49.39, 50.07, 27.3, 29.14, 49.94,  
51.95, 51.37, 46.81, 40.47], dtype=object)
```

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,17]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=LinearRegression()
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled)
```

Out[11]: LinearRegression()

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```



```
result['Flextural 7 Mpa']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

```
Out[14]: 1.2559599651188524
```

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[15]: 1.1206961966201423
```

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Flextural 7 Mpa
0	7.086523	7.79
1	6.234340	5.88
2	8.421786	7.13
3	7.305325	8.26
4	8.354599	8.47
5	8.792202	8.61
6	6.509246	8.42
7	6.957048	6.38
8	7.041930	9.06

```
In [17]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [18]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [19]: result['x_all']=result['x_all'].apply(joins)
```

```
In [20]: data['x_all']=data['x_all'].apply(joins)
```

```
In [21]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

```
Out[21]:
```

	y_pred	Flextural 7 Mpa_x	x_all	Mix Design
0	7.086523	7.79	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	6.234340	5.88	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	8.421786	7.13	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8

	y_pred	Flextural 7 Mpa_x	x_all	Mix Design
3	7.305325	8.26	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	8.354599	8.47	550,0.45,1.0,0,0,	VC5-M550W45S1
5	8.792202	8.61	550,0.35,1.0,0,0,	VC4-M550W35S1
6	6.509246	8.42	500,0.45,1.0,0,30,	LS-13
7	6.957048	6.38	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	7.041930	9.06	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

In []:

In []:

In []:

In [22]:

data

Out[22]:

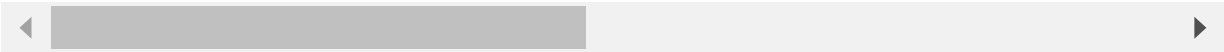
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W,5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...

	Mix Design	Matrix Volume	Water- Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
44	AS4- M500- W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500- S01 -W45- LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500- S01 -W45- LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500- S01 -W50- LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500- S01-W50- LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500- S01 -W50- FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500- S01 -W50- FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500- S01 -W45- FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500- S01 -W45- FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [23]: y

Out[23]: array([7.51, 7.37, 7.51, 6.7, 6.97, 4.84, 9.56, 7.54, 9.09, 8.1, 9.96, 8.42, 8.39, 7.13, 8.28, 8.17, 7.58, 7.29, 9.06, 7.5, 2.96, 8.94, 7.27, 6.87, 6.44, 10.8, 8.61, 8.47, 6.4, 7.12, 6.87, 9.35, 8.02, 7.81, 5.81, 7.32, 7.45, 6.38, 2.38, 8.65, 8.49, 5.88, 2.81, 4.84, 5.31, 4.7, 2.83, 6.57, 4.6, 8.03, 7.79, 7.9, 8.26, 7.89, 7.95, 8.42, 7.13, 5.81], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,13]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=LinearRegression()
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled)
```

Out[11]: LinearRegression()

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Flow Table']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

```
Out[14]: 4.038745058977727
```

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[15]: 2.00966292173034
```

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Flow Table
0	18.673594	19.13
1	15.858675	11.83
2	11.332037	12.2
3	16.059499	14.51
4	19.319708	21.67
5	14.091518	11.29
6	12.635547	14.01
7	10.983621	10.38
8	12.646976	13.71

```
In [17]: data['x_all']=x.tolist()
```

```
In [18]: result['x_all']=x_test.tolist()
```

```
In [19]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [20]: result['x_all']=result['x_all'].apply(joins)
```

```
In [21]: data['x_all']=data['x_all'].apply(joins)
```

```
In [22]: final=pandas.merge(result,data,how='inner',on='x_all')
```

```
In [23]: final.iloc[:,4]
```

```
Out[23]:
```

	y_pred	Flow Table	x_all	Mix Design
--	--------	------------	-------	------------

	y_pred	Flow Table	x_all		Mix Design
0	18.673594	19.13	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5	
1	15.858675	11.83	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20	
2	11.332037	12.2	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8	
3	16.059499	14.51	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5	
4	19.319708	21.67	550,0.45,1.0,0,0,	VC5-M550W45S1	
5	14.091518	11.29	550,0.35,1.0,0,0,	VC4-M550W35S1	
6	12.635547	14.01	500,0.45,1.0,0,30,	LS-13	
7	10.983621	10.38	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5	
8	12.646976	13.71	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10	

In []:

In []:

In []:

In [24]:

data

Out[24]:

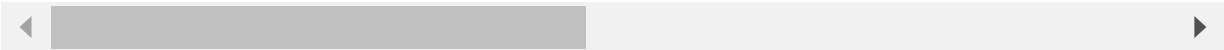
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...

	Mix Design	Matrix Volume	Water- Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
41	AS1- M500- W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500- W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500- W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500- W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500- S01 -W45- LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500- S01 -W45- LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500- S01 -W50- LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500- S01-W50- LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500- S01 -W50- FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500- S01 -W50- FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500- S01 -W45- FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500- S01 -W45- FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



y

```
Out[25]: array([19.0, 17.25, 17.15, 16.75, 16.5, 10.0, 15.46, 18.0, 18.75, 21.0,
                20.0, 13.56, 17.48, 12.2, 14.25, 17.52, 19.5, 22.46, 13.71, 12.36,
                9.8, 13.02, 12.14, 11.73, 11.76, 11.02, 11.29, 21.67, 30.0, 16.98,
                19.37, 12.38, 19.1, 17.75, 10.58, 17.52, 15.51, 10.38, 9.9, 17.7,
                14.75, 11.83, 9.9, 10.92, 10.83, 10.2, 9.8, 13.56, 10.56, 16.9,
                19.13, 18.12, 14.51, 16.78, 14.19, 14.01, 12.69, 10.86],
                dtype=object)
```

In []:

In []:

In []:

In []:

In []:

In []:

```
In [45]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [46]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [47]: data=pandas.read_csv('Python_data.csv')
```

```
In [48]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,15]
```

```
In [49]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [50]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [51]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [52]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [53]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [54]: model=LinearRegression()
```

```
In [55]: model.fit(x_train_scaled,y_train_scaled)
```

```
Out[55]: LinearRegression()
```

```
In [56]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [57]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Green strength 0 min']=y_test
```

```
In [58]: mean_squared_error(y_test,y_pred)
```

```
Out[58]: 49.07276492100511
```

```
In [59]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[59]: 7.005195566221197
```

```
In [60]: result
```

```
Out[60]:
```

	y_pred	Green strength 0 min
0	4.336466	2.62
1	12.246914	20.02
2	20.106849	21.82
3	10.797144	9.27
4	2.284984	0
5	15.206340	31
6	19.598005	17
7	22.705171	31
8	20.322633	13.78

```
In [61]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [62]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [63]: result['x_all']=result['x_all'].apply(joins)
```

```
In [64]: data['x_all']=data['x_all'].apply(joins)
```

```
In [65]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

```
Out[65]:
```

	y_pred	Green strength 0 min	x_all	Mix Design
0	4.336466	2.62	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	12.246914	20.02	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	20.106849	21.82	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8

	y_pred	Green strength 0 min	x_all			Mix Design
3	10.797144	9.27	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5		
4	2.284984	0	550,0.45,1.0,0,0,	VC5-M550W45S1		
5	15.206340	31	550,0.35,1.0,0,0,	VC4-M550W35S1		
6	19.598005	17	500,0.45,1.0,0,30,	LS-13		
7	22.705171	31	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5		
8	20.322633	13.78	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10		

In []:

In []:

In []:

In [66]:

data

Out[66]:

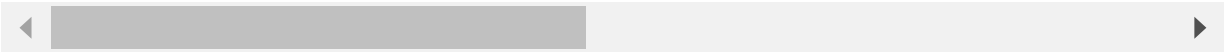
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W,5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In []:

In []:

In []:

9.6.2021

Linear Regression-for Green strength 0 min

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [70]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [71]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [72]: data=pandas.read_csv('Python_data.csv')
```

```
In [73]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,16]
```

```
In [74]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [75]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [76]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [77]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [78]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [79]: model=LinearRegression()
```

```
In [80]: model.fit(x_train_scaled,y_train_scaled)
```

```
Out[80]: LinearRegression()
```

```
In [81]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [82]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Green strength 15 min']=y_test
```

```
In [83]: mean_squared_error(y_test,y_pred)
```

```
Out[83]: 62.41482707055761
```

```
In [84]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[84]: 7.900305504887618
```

```
In [85]: result
```

```
Out[85]:
```

	y_pred	Green strength 15 min
0	5.614779	2.72
1	13.663696	31
2	24.303206	28.82
3	12.692329	14.02
4	4.028557	0
5	18.183657	31
6	22.100221	20.17
7	25.768168	31
8	22.435362	18.07

```
In [86]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [87]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [88]: result['x_all']=result['x_all'].apply(joins)
```

```
In [89]: data['x_all']=data['x_all'].apply(joins)
```

```
In [90]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

```
Out[90]:
```

	y_pred	Green strength 15 min	x_all	Mix Design
0	5.614779	2.72	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	13.663696	31	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	24.303206	28.82	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8

	y_pred	Green strength 15 min			x_all	Mix Design
3	12.692329	14.02	500,0.45,1.0,5,0,			AC4 - M500-S01 -W45-FA5
4	4.028557	0	550,0.45,1.0,0,0,			VC5-M550W45S1
5	18.183657	31	550,0.35,1.0,0,0,			VC4-M550W35S1
6	22.100221	20.17	500,0.45,1.0,0,30,			LS-13
7	25.768168	31	450,0.4,1.0,5,0,			AV1- W4S1-M450-FA5
8	22.435362	18.07	500,0.4,1.0,10,0,			FA-1-M500-W,4-S.1-FA-10

In []:

In []:

In []:

In [91]:

data

Out[91]:

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W,5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [92]:

y

Out[92]:

array([2.09, 2.14, 4.37, 6.2, 3.74, 31.0, 13.76, 2.77, 2.54, 2.74, 3.25, 22.45, 4.49, 28.82, 13.73, 5.48, 2.06, 3.08, 18.07, 31.0, 31.0, 19.07, 31.0, 22.76, 19.84, 31.0, 31.0, 0.0, 0.0, 6.11, 3.17, 21.0, 4.08, 4.34, 31.0, 5.64, 13.85, 31.0, 31.0, 2.92, 11.94, 31.0, 31.0, 31.0, 31.0, 17.26, 31.0, 5.05, 2.72, 2.88, 14.02, 7.41, 18.9, 20.17, 31.0, 31.0], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,19]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=LinearRegression()
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled)
```

Out[11]: LinearRegression()

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Setting time']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

```
Out[14]: 3590.0893719910487
```

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

```
Out[15]: 59.9173545142895
```

```
In [16]: r2_score(y_test,y_pred)
```

```
Out[16]: 0.4994090765979231
```

```
In [17]: math.sqrt(r2_score(y_test,y_pred))
```

```
Out[17]: 0.7066888117112957
```

```
In [18]: result
```

```
Out[18]:
```

	y_pred	Setting time
0	345.450265	374.923
1	266.505601	141.397
2	186.145917	173.256
3	297.494644	272.503
4	344.816060	378.661
5	248.904819	134.226
6	193.474386	216.536
7	216.614345	228.154
8	235.142285	241.263

```
In [19]: data['x_all']=x.tolist()  
result['x_all']=x_test.tolist()
```

```
In [20]: def joins(s):  
          a=''  
          for i in s:  
              a=a+str(i)+", "  
          return a
```

```
In [21]: result['x_all']=result['x_all'].apply(joins)
```

```
In [22]: data['x_all']=data['x_all'].apply(joins)
```

```
In [23]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

Out[23]:

	y_pred	Setting time_x	x_all	Mix Design
0	345.450265	374.923	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	266.505601	141.397	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	186.145917	173.256	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	297.494644	272.503	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	344.816060	378.661	550,0.45,1.0,0,0,	VC5-M550W45S1
5	248.904819	134.226	550,0.35,1.0,0,0,	VC4-M550W35S1
6	193.474386	216.536	500,0.45,1.0,0,30,	LS-13
7	216.614345	228.154	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	235.142285	241.263	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

```
In [ ]:
```

```
In [ ]:
```

```
In [ ]:
```

```
In [24]: data
```

Out[24]:

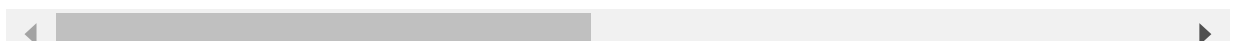
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 -FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 -FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 -FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 -FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [25]:

y

Out[25]:

array([325.452, 315.3141, 280.1816, 266.1293, 225.0896, 277.314, 264.7983, 346.6958, 334.9493, 359.3326, 365.2114, 220.8124, 278.01599999999996, 173.2562, 248.6476, 273.9883, 374.9588, 393.5633, 241.2632, 178.1782, 206.5071, 205.6, 206.4, 180.0323, 282.2275, 140.0052, 134.2258, 378.6608, 414.7862, 306.0, 404.0, 196.0, 454.0, 269.6111, 160.4751, 244.4083, 128.3227, 228.15398969999998, 277.382696, 330.3542829, 284.4696273, 141.3965985, 204.1454501, 124.6389388, 147.3282508, 150.37293290000002, 130.8405683, 156.20176569999998, 112.91652749999999, 303.7310404, 374.9226128, 320.89117200000004, 272.5030145, 325.82843199999996, 268.74767819999994, 216.53568399999997, 177.3134865, 154.3959942], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
```

```
result['Sylinder ΔH']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

Out[14]: 484.2020838115784

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[15]: 22.00459233459185

```
In [16]: result
```

Out[16]:

	y_pred	Sylinder ΔH
0	50.886126	15
1	39.362593	5
2	12.589932	0.3
3	36.725919	22
4	51.634888	80
5	23.314474	3
6	25.705909	13
7	13.922032	2
8	16.300421	17

```
In [17]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [18]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [19]: result['x_all']=result['x_all'].apply(joins)
```

```
In [20]: data['x_all']=data['x_all'].apply(joins)
```

```
In [21]: final=pandas.merge(result,data,how='inner',on='x_all')
final.iloc[:,4]
```

Out[21]:

	y_pred	Sylinder ΔH	x_all	Mix Design
0	50.886126	15	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	39.362593	5	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	12.589932	0.3	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8

	y_pred	Sylinder ΔH	x_all			Mix Design
3	36.725919	22	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5		
4	51.634888	80	550,0.45,1.0,0,0,	VC5-M550W45S1		
5	23.314474	3	550,0.35,1.0,0,0,	VC4-M550W35S1		
6	25.705909	13	500,0.45,1.0,0,30,	LS-13		
7	13.922032	2	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5		
8	16.300421	17	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10		

In []:

In []:

In []:

In [22]:

data

Out[22]:

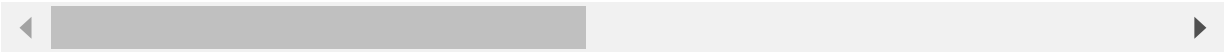
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W,5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In []:

In []:

In []:


```

In [47]: import pandas
import numpy
import math
from keras.models import Sequential
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from keras.layers import Dense
import matplotlib.pyplot as plt
import os
import random

In [48]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)

In [49]: data=pandas.read_csv('Python_data.csv')

In [50]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,17]

In [51]: x_scalar=StandardScaler()
y_scalar=StandardScaler()

In [52]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)

In [53]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)

In [54]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)

In [55]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)

In [56]: model=Sequential()
model.add(Dense(40,input_dim=5,activation='linear',kernel_initializer='normal', bias
model.add(Dense(20,activation='relu',kernel_initializer='normal', bias_initializer='
model.add(Dense(1,kernel_initializer='normal', bias_initializer='normal'))
model.compile(optimizer='adam',loss='mean_squared_error',metrics=['accuracy'])

In [57]: model.fit(x_train_scaled,y_train_scaled,batch_size=10,epochs=14,validation_data=(x_t

Epoch 1/14
5/5 [=====] - 0s 40ms/step - loss: 1.0884 - accuracy: 0.000
0e+00 - val_loss: 0.4740 - val_accuracy: 0.0000e+00
Epoch 2/14

```

```

5/5 [=====] - 0s 11ms/step - loss: 0.7777 - accuracy: 0.000
0e+00 - val_loss: 0.4707 - val_accuracy: 0.0000e+00
Epoch 3/14
5/5 [=====] - 0s 15ms/step - loss: 0.9863 - accuracy: 0.000
0e+00 - val_loss: 0.4692 - val_accuracy: 0.0000e+00
Epoch 4/14
5/5 [=====] - 0s 13ms/step - loss: 1.0278 - accuracy: 0.000
0e+00 - val_loss: 0.4672 - val_accuracy: 0.0000e+00
Epoch 5/14
5/5 [=====] - 0s 11ms/step - loss: 1.2033 - accuracy: 0.000
0e+00 - val_loss: 0.4658 - val_accuracy: 0.0000e+00
Epoch 6/14
5/5 [=====] - 0s 13ms/step - loss: 0.8406 - accuracy: 0.000
0e+00 - val_loss: 0.4628 - val_accuracy: 0.0000e+00
Epoch 7/14
5/5 [=====] - 0s 12ms/step - loss: 1.0132 - accuracy: 0.000
0e+00 - val_loss: 0.4591 - val_accuracy: 0.0000e+00
Epoch 8/14
5/5 [=====] - 0s 14ms/step - loss: 0.9361 - accuracy: 0.000
0e+00 - val_loss: 0.4532 - val_accuracy: 0.0000e+00
Epoch 9/14
5/5 [=====] - 0s 11ms/step - loss: 0.7649 - accuracy: 0.000
0e+00 - val_loss: 0.4447 - val_accuracy: 0.0000e+00
Epoch 10/14
5/5 [=====] - 0s 10ms/step - loss: 0.8819 - accuracy: 0.000
0e+00 - val_loss: 0.4362 - val_accuracy: 0.0000e+00
Epoch 11/14
5/5 [=====] - 0s 11ms/step - loss: 0.8887 - accuracy: 0.000
0e+00 - val_loss: 0.4268 - val_accuracy: 0.0000e+00
Epoch 12/14
5/5 [=====] - 0s 10ms/step - loss: 1.0401 - accuracy: 0.000
0e+00 - val_loss: 0.4145 - val_accuracy: 0.0000e+00
Epoch 13/14
5/5 [=====] - 0s 10ms/step - loss: 0.9164 - accuracy: 0.000
0e+00 - val_loss: 0.4054 - val_accuracy: 0.0000e+00
Epoch 14/14
5/5 [=====] - 0s 10ms/step - loss: 0.8435 - accuracy: 0.000
0e+00 - val_loss: 0.3941 - val_accuracy: 0.0000e+00

```

Out[57]: <tensorflow.python.keras.callbacks.History at 0x20c2b0ceca0>

```
In [58]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [59]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
result['Compression 7 Mpa']=y_test
```

```
In [60]: mean_squared_error(y_test,y_pred)
```

Out[60]: 1.3130374756337755

```
In [61]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[61]: 1.1458784733268077

```
In [62]: result
```

```
Out[62]:
```

	y_pred	Compression 7 Mpa
0	6.942729	7.79

	y_pred	Compression 7 Mpa
1	6.697134	5.88
2	7.576676	7.13
3	7.126271	8.26
4	7.400637	8.47
5	7.607285	8.61
6	6.752022	8.42
7	7.027445	6.38
8	7.163532	9.06

```
In [63]: data['x_all']=x.tolist()
         result['x_all']=x_test.tolist()
```

```
In [64]: def joins(s):
         a=''
         for i in s:
             a=a+str(i)+", "
         return a
```

```
In [65]: result['x_all']=result['x_all'].apply(joins)
         data['x_all']=data['x_all'].apply(joins)
```

```
In [66]: final=pandas.merge(result,data,how='inner',on='x_all')
```

```
In [67]: final.iloc[:, :4]
```

```
Out[67]:
```

	y_pred	Compression 7 Mpa_x	x_all	Mix Design
0	6.942729	7.79	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	6.697134	5.88	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	7.576676	7.13	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	7.126271	8.26	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	7.400637	8.47	550,0.45,1.0,0,0,	VC5-M550W45S1
5	7.607285	8.61	550,0.35,1.0,0,0,	VC4-M550W35S1
6	6.752022	8.42	500,0.45,1.0,0,30,	LS-13
7	7.027445	6.38	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	7.163532	9.06	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

```
In [ ]:
```

```
In [ ]:
```

```
In [68]: data
```

Out[68]:

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [69]:

y

Out[69]:

array([7.51, 7.37, 7.51, 6.7, 6.97, 4.84, 9.56, 7.54, 9.09, 8.1, 9.96, 8.42, 8.39, 7.13, 8.28, 8.17, 7.58, 7.29, 9.06, 7.5, 2.96, 8.94, 7.27, 6.87, 6.44, 10.8, 8.61, 8.47, 6.4, 7.12, 6.87, 9.35, 8.02, 7.81, 5.81, 7.32, 7.45, 6.38, 2.38, 8.65, 8.49, 5.88, 2.81, 4.84, 5.31, 4.7, 2.83, 6.57, 4.6, 8.03, 7.79, 7.9, 8.26, 7.89, 7.95, 8.42, 7.13, 5.81], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```

In [24]: import pandas
import numpy
import math
from keras.models import Sequential
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from keras.layers import Dense
import matplotlib.pyplot as plt
import os
import random

In [25]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)

In [26]: data=pandas.read_csv('Python_data.csv')

In [27]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,17]

In [28]: x_scalar=StandardScaler()
y_scalar=StandardScaler()

In [29]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)

In [30]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)

In [31]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)

In [32]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)

In [33]: model=Sequential()
model.add(Dense(40,input_dim=5,activation='linear',kernel_initializer='normal', bias
model.add(Dense(20,activation='relu',kernel_initializer='normal', bias_initializer='
model.add(Dense(1,kernel_initializer='normal', bias_initializer='normal'))
model.compile(optimizer='adam',loss='mean_squared_error',metrics=['accuracy'])

In [34]: model.fit(x_train_scaled,y_train_scaled,batch_size=10,epochs=14,validation_data=(x_t

Epoch 1/14
5/5 [=====] - 1s 39ms/step - loss: 1.0538 - accuracy: 0.000
0e+00 - val_loss: 0.5101 - val_accuracy: 0.0000e+00
Epoch 2/14

```

```

5/5 [=====] - 0s 12ms/step - loss: 0.8670 - accuracy: 0.000
0e+00 - val_loss: 0.5063 - val_accuracy: 0.0000e+00
Epoch 3/14
5/5 [=====] - 0s 14ms/step - loss: 0.9694 - accuracy: 0.000
0e+00 - val_loss: 0.5050 - val_accuracy: 0.0000e+00
Epoch 4/14
5/5 [=====] - 0s 14ms/step - loss: 1.2976 - accuracy: 0.000
0e+00 - val_loss: 0.5048 - val_accuracy: 0.0000e+00
Epoch 5/14
5/5 [=====] - 0s 11ms/step - loss: 0.9924 - accuracy: 0.000
0e+00 - val_loss: 0.5029 - val_accuracy: 0.0000e+00
Epoch 6/14
5/5 [=====] - 0s 13ms/step - loss: 0.9885 - accuracy: 0.000
0e+00 - val_loss: 0.5012 - val_accuracy: 0.0000e+00
Epoch 7/14
5/5 [=====] - 0s 15ms/step - loss: 0.7665 - accuracy: 0.000
0e+00 - val_loss: 0.4986 - val_accuracy: 0.0000e+00
Epoch 8/14
5/5 [=====] - 0s 14ms/step - loss: 1.1225 - accuracy: 0.000
0e+00 - val_loss: 0.4932 - val_accuracy: 0.0000e+00
Epoch 9/14
5/5 [=====] - 0s 11ms/step - loss: 0.7673 - accuracy: 0.000
0e+00 - val_loss: 0.4883 - val_accuracy: 0.0000e+00
Epoch 10/14
5/5 [=====] - 0s 10ms/step - loss: 0.6212 - accuracy: 0.000
0e+00 - val_loss: 0.4788 - val_accuracy: 0.0000e+00
Epoch 11/14
5/5 [=====] - 0s 10ms/step - loss: 0.7096 - accuracy: 0.000
0e+00 - val_loss: 0.4703 - val_accuracy: 0.0000e+00
Epoch 12/14
5/5 [=====] - 0s 11ms/step - loss: 0.8585 - accuracy: 0.000
0e+00 - val_loss: 0.4626 - val_accuracy: 0.0000e+00
Epoch 13/14
5/5 [=====] - 0s 10ms/step - loss: 0.6101 - accuracy: 0.000
0e+00 - val_loss: 0.4525 - val_accuracy: 0.0000e+00
Epoch 14/14
5/5 [=====] - 0s 9ms/step - loss: 0.6936 - accuracy: 0.0000
e+00 - val_loss: 0.4396 - val_accuracy: 0.0000e+00

```

Out[34]: <tensorflow.python.keras.callbacks.History at 0x1d41921a100>

```
In [35]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [36]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
result['Flextural 7 Mpa']=y_test
```

```
In [37]: mean_squared_error(y_test,y_pred)
```

Out[37]: 1.4649046801183614

```
In [38]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[38]: 1.210332466770334

```
In [39]: result
```

```
Out[39]:
```

	y_pred	Flextural 7 Mpa
0	6.790397	7.79

	y_pred	Flextural 7 Mpa
1	6.422942	5.88
2	7.605022	7.13
3	6.989513	8.26
4	7.425686	8.47
5	7.677598	8.61
6	6.494591	8.42
7	6.688487	6.38
8	6.989243	9.06

```
In [40]: data['x_all']=x.tolist()
         result['x_all']=x_test.tolist()
```

```
In [41]: def joins(s):
         a=''
         for i in s:
             a=a+str(i)+", "
         return a
```

```
In [42]: result['x_all']=result['x_all'].apply(joins)
         data['x_all']=data['x_all'].apply(joins)
```

```
In [43]: final=pandas.merge(result,data,how='inner',on='x_all')
```

```
In [44]: final.iloc[:, :4]
```

Out[44]:	y_pred	Flextural 7 Mpa_x	x_all	Mix Design
0	6.790397	7.79	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	6.422942	5.88	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	7.605022	7.13	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	6.989513	8.26	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	7.425686	8.47	550,0.45,1.0,0,0,	VC5-M550W45S1
5	7.677598	8.61	550,0.35,1.0,0,0,	VC4-M550W35S1
6	6.494591	8.42	500,0.45,1.0,0,30,	LS-13
7	6.688487	6.38	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	6.989243	9.06	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

```
In [ ]:
```

```
In [ ]:
```

In [45]:

data

Out[45]:

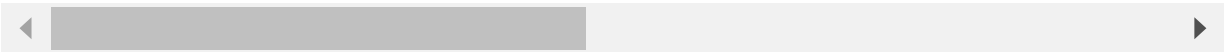
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [46]: y

Out[46]: array([7.51, 7.37, 7.51, 6.7, 6.97, 4.84, 9.56, 7.54, 9.09, 8.1, 9.96, 8.42, 8.39, 7.13, 8.28, 8.17, 7.58, 7.29, 9.06, 7.5, 2.96, 8.94, 7.27, 6.87, 6.44, 10.8, 8.61, 8.47, 6.4, 7.12, 6.87, 9.35, 8.02, 7.81, 5.81, 7.32, 7.45, 6.38, 2.38, 8.65, 8.49, 5.88, 2.81, 4.84, 5.31, 4.7, 2.83, 6.57, 4.6, 8.03, 7.79, 7.9, 8.26, 7.89, 7.95, 8.42, 7.13, 5.81], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from keras.models import Sequential
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from keras.layers import Dense
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,13]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=Sequential()
model.add(Dense(40,input_dim=5,activation='linear',kernel_initializer='normal', bias
model.add(Dense(20,activation='relu',kernel_initializer='normal', bias_initializer='
model.add(Dense(1,kernel_initializer='normal', bias_initializer='normal'))
model.compile(optimizer='adam',loss='mean_squared_error',metrics=['accuracy'])
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled,batch_size=10,epochs=14,validation_data=(x_t

Epoch 1/14
5/5 [=====] - 2s 294ms/step - loss: 0.8193 - accuracy: 0.00
00e+00 - val_loss: 0.7701 - val_accuracy: 0.0000e+00
Epoch 2/14
```

```

5/5 [=====] - 0s 13ms/step - loss: 0.8777 - accuracy: 0.000
0e+00 - val_loss: 0.7668 - val_accuracy: 0.0000e+00
Epoch 3/14
5/5 [=====] - 0s 14ms/step - loss: 0.8752 - accuracy: 0.000
0e+00 - val_loss: 0.7626 - val_accuracy: 0.0000e+00
Epoch 4/14
5/5 [=====] - 0s 10ms/step - loss: 0.9373 - accuracy: 0.000
0e+00 - val_loss: 0.7580 - val_accuracy: 0.0000e+00
Epoch 5/14
5/5 [=====] - 0s 11ms/step - loss: 0.8693 - accuracy: 0.000
0e+00 - val_loss: 0.7507 - val_accuracy: 0.0000e+00
Epoch 6/14
5/5 [=====] - 0s 13ms/step - loss: 1.1915 - accuracy: 0.000
0e+00 - val_loss: 0.7418 - val_accuracy: 0.0000e+00
Epoch 7/14
5/5 [=====] - 0s 11ms/step - loss: 1.0418 - accuracy: 0.000
0e+00 - val_loss: 0.7301 - val_accuracy: 0.0000e+00
Epoch 8/14
5/5 [=====] - 0s 12ms/step - loss: 1.0974 - accuracy: 0.000
0e+00 - val_loss: 0.7148 - val_accuracy: 0.0000e+00
Epoch 9/14
5/5 [=====] - 0s 11ms/step - loss: 0.7289 - accuracy: 0.000
0e+00 - val_loss: 0.6950 - val_accuracy: 0.0000e+00
Epoch 10/14
5/5 [=====] - 0s 10ms/step - loss: 0.7037 - accuracy: 0.000
0e+00 - val_loss: 0.6716 - val_accuracy: 0.0000e+00
Epoch 11/14
5/5 [=====] - 0s 10ms/step - loss: 1.0586 - accuracy: 0.000
0e+00 - val_loss: 0.6425 - val_accuracy: 0.0000e+00
Epoch 12/14
5/5 [=====] - 0s 10ms/step - loss: 0.8071 - accuracy: 0.000
0e+00 - val_loss: 0.6092 - val_accuracy: 0.0000e+00
Epoch 13/14
5/5 [=====] - 0s 9ms/step - loss: 0.6389 - accuracy: 0.0000
e+00 - val_loss: 0.5707 - val_accuracy: 0.0000e+00
Epoch 14/14
5/5 [=====] - 0s 10ms/step - loss: 0.7610 - accuracy: 0.000
0e+00 - val_loss: 0.5277 - val_accuracy: 0.0000e+00

```

Out[11]: <tensorflow.python.keras.callbacks.History at 0x1cd7f2b6580>

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
result['Flow Table']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

Out[14]: 8.866502994104184

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[15]: 2.977667374658255

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Flow Table
0	15.720798	19.13

	y_pred	Flow Table
1	14.634250	11.83
2	14.826246	12.2
3	14.967607	14.51
4	16.129992	21.67
5	14.965561	11.29
6	13.903876	14.01
7	13.378115	10.38
8	13.773870	13.71

In [17]:

```
data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

In [18]:

```
def joins(s):
    a=''
    for i in s:
        a=a+str(i)+", "
    return a
```

In [19]:

```
result['x_all']=result['x_all'].apply(joins)
data['x_all']=data['x_all'].apply(joins)
```

In [20]:

```
final=pandas.merge(result,data,how='inner',on='x_all')
```

In [21]:

```
final.iloc[:, :4]
```

Out[21]:

	y_pred	Flow Table	x_all	Mix Design
0	15.720798	19.13	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	14.634250	11.83	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	14.826246	12.2	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	14.967607	14.51	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	16.129992	21.67	550,0.45,1.0,0,0,	VC5-M550W45S1
5	14.965561	11.29	550,0.35,1.0,0,0,	VC4-M550W35S1
6	13.903876	14.01	500,0.45,1.0,0,30,	LS-13
7	13.378115	10.38	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	13.773870	13.71	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

In []:

In []:

In [22]:

data

Out[22]:

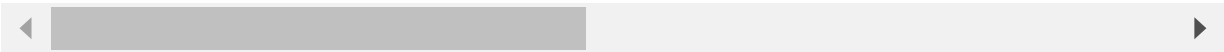
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 - FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 - FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 - FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 - FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [23]:

y

Out[23]:

array([19.0, 17.25, 17.15, 16.75, 16.5, 10.0, 15.46, 18.0, 18.75, 21.0, 20.0, 13.56, 17.48, 12.2, 14.25, 17.52, 19.5, 22.46, 13.71, 12.36, 9.8, 13.02, 12.14, 11.73, 11.76, 11.02, 11.29, 21.67, 30.0, 16.98, 19.37, 12.38, 19.1, 17.75, 10.58, 17.52, 15.51, 10.38, 9.9, 17.7, 14.75, 11.83, 9.9, 10.92, 10.83, 10.2, 9.8, 13.56, 10.56, 16.9, 19.13, 18.12, 14.51, 16.78, 14.19, 14.01, 12.69, 10.86], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from keras.models import Sequential
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from keras.layers import Dense
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,15]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=Sequential()
model.add(Dense(40,input_dim=5,activation='linear',kernel_initializer='normal', bias
model.add(Dense(20,activation='relu',kernel_initializer='normal', bias_initializer='
model.add(Dense(1,kernel_initializer='normal', bias_initializer='normal'))
model.compile(optimizer='adam',loss='mean_squared_error',metrics=['accuracy'])
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled,batch_size=10,epochs=14,validation_data=(x_t

Epoch 1/14
5/5 [=====] - 2s 283ms/step - loss: 0.9973 - accuracy: 0.00
00e+00 - val_loss: 0.8405 - val_accuracy: 0.0000e+00
Epoch 2/14
```

```

5/5 [=====] - 0s 13ms/step - loss: 1.0209 - accuracy: 0.000
0e+00 - val_loss: 0.8356 - val_accuracy: 0.0000e+00
Epoch 3/14
5/5 [=====] - 0s 14ms/step - loss: 0.9288 - accuracy: 0.000
0e+00 - val_loss: 0.8316 - val_accuracy: 0.0000e+00
Epoch 4/14
5/5 [=====] - 0s 12ms/step - loss: 0.8635 - accuracy: 0.000
0e+00 - val_loss: 0.8272 - val_accuracy: 0.0000e+00
Epoch 5/14
5/5 [=====] - 0s 12ms/step - loss: 0.9139 - accuracy: 0.000
0e+00 - val_loss: 0.8216 - val_accuracy: 0.0000e+00
Epoch 6/14
5/5 [=====] - 0s 13ms/step - loss: 0.9844 - accuracy: 0.000
0e+00 - val_loss: 0.8142 - val_accuracy: 0.0000e+00
Epoch 7/14
5/5 [=====] - 0s 16ms/step - loss: 0.9657 - accuracy: 0.000
0e+00 - val_loss: 0.8038 - val_accuracy: 0.0000e+00
Epoch 8/14
5/5 [=====] - 0s 17ms/step - loss: 0.9156 - accuracy: 0.000
0e+00 - val_loss: 0.7915 - val_accuracy: 0.0000e+00
Epoch 9/14
5/5 [=====] - 0s 11ms/step - loss: 0.8603 - accuracy: 0.000
0e+00 - val_loss: 0.7746 - val_accuracy: 0.0000e+00
Epoch 10/14
5/5 [=====] - 0s 10ms/step - loss: 0.9016 - accuracy: 0.000
0e+00 - val_loss: 0.7563 - val_accuracy: 0.0000e+00
Epoch 11/14
5/5 [=====] - 0s 10ms/step - loss: 0.8228 - accuracy: 0.000
0e+00 - val_loss: 0.7349 - val_accuracy: 0.0000e+00
Epoch 12/14
5/5 [=====] - 0s 10ms/step - loss: 0.7616 - accuracy: 0.000
0e+00 - val_loss: 0.7085 - val_accuracy: 0.0000e+00
Epoch 13/14
5/5 [=====] - 0s 10ms/step - loss: 0.8091 - accuracy: 0.000
0e+00 - val_loss: 0.6770 - val_accuracy: 0.0000e+00
Epoch 14/14
5/5 [=====] - 0s 10ms/step - loss: 0.7260 - accuracy: 0.000
0e+00 - val_loss: 0.6464 - val_accuracy: 0.0000e+00

```

Out[11]: <tensorflow.python.keras.callbacks.History at 0x137c6d56580>

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
         y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
         result['Green strength 0 min']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

Out[14]: 93.96240011175823

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[15]: 9.693420454708349

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Green strength 0 min
0	9.798713	2.62

	y_pred	Green strength 0 min
1	13.206105	20.02
2	11.390810	21.82
3	12.196282	9.27
4	9.255754	0
5	13.034969	31
6	15.518007	17
7	16.337568	31
8	15.964693	13.78

```
In [17]: data['x_all']=x.tolist()
result['x_all']=x_test.tolist()
```

```
In [18]: def joins(s):
a=''
for i in s:
a=a+str(i)+", "
return a
```

```
In [19]: result['x_all']=result['x_all'].apply(joins)
data['x_all']=data['x_all'].apply(joins)
```

```
In [20]: final=pandas.merge(result,data,how='inner',on='x_all')
```

```
In [21]: final.iloc[:,4]
```

```
Out[21]:
```

	y_pred	Green strength 0 min	x_all	Mix Design
0	9.798713	2.62	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	13.206105	20.02	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	11.390810	21.82	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	12.196282	9.27	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	9.255754	0	550,0.45,1.0,0,0,	VC5-M550W45S1
5	13.034969	31	550,0.35,1.0,0,0,	VC4-M550W35S1
6	15.518007	17	500,0.45,1.0,0,30,	LS-13
7	16.337568	31	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	15.964693	13.78	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

```
In [ ]:
```

```
In [ ]:
```

```
In [22]: data
```

Out[22]:

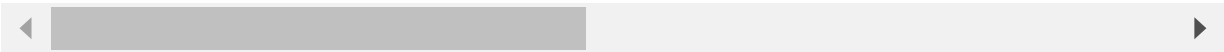
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 -FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 -FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 -FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 -FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [23]:

y

Out[23]:

array([0.0, 2.2, 4.41, 2.9, 3.66, 31.0, 8.16, 1.68, 2.78, 2.03, 1.73, 10.54, 2.23, 21.82, 12.22, 2.83, 2.72, 1.04, 13.78, 31.0, 31.0, 13.99, 28.58, 20.97, 18.45, 31.0, 31.0, 0.0, 0.0, 5.57, 3.1, 18.97, 2.35, 2.29, 28.31, 3.59, 7.86, 31.0, 31.0, 2.4, 6.67, 20.02, 31.0, 31.0, 31.0, 24.93, 31.0, 10.68, 31.0, 3.1, 2.62, 2.12, 9.27, 4.22, 8.94, 17.0, 25.27, 31.0], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

```
In [1]: import pandas
import numpy
import math
from keras.models import Sequential
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from keras.layers import Dense
import matplotlib.pyplot as plt
import os
import random
```

```
In [2]: os.environ['PYTHONHASHSEED'] = '0'
random.seed(123)
seed = 7
numpy.random.seed(seed)
```

```
In [3]: data=pandas.read_csv('Python_data.csv')
```

```
In [4]: data1_value=data.values
x=data1_value[:,1:6]
y=data1_value[:,16]
```

```
In [5]: x_scalar=StandardScaler()
y_scalar=StandardScaler()
```

```
In [6]: x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.15,random_state=123)
```

```
In [7]: x_train_scaled=x_scalar.fit_transform(x_train)
x_test_scaled=x_scalar.transform(x_test)
```

```
In [8]: y_train=y_train.reshape(-1,1)
y_test=y_test.reshape(-1,1)
```

```
In [9]: y_train_scaled=y_scalar.fit_transform(y_train)
y_test_scaled=y_scalar.transform(y_test)
```

```
In [10]: model=Sequential()
model.add(Dense(40,input_dim=5,activation='linear',kernel_initializer='normal', bias
model.add(Dense(20,activation='relu',kernel_initializer='normal', bias_initializer='
model.add(Dense(1,kernel_initializer='normal', bias_initializer='normal'))
model.compile(optimizer='adam',loss='mean_squared_error',metrics=['accuracy'])
```

```
In [11]: model.fit(x_train_scaled,y_train_scaled,batch_size=10,epochs=14,validation_data=(x_t

Epoch 1/14
5/5 [=====] - 1s 272ms/step - loss: 0.9796 - accuracy: 0.00
00e+00 - val_loss: 1.0633 - val_accuracy: 0.0000e+00
Epoch 2/14
```

```

5/5 [=====] - 0s 14ms/step - loss: 0.9677 - accuracy: 0.000
0e+00 - val_loss: 1.0588 - val_accuracy: 0.0000e+00
Epoch 3/14
5/5 [=====] - 0s 13ms/step - loss: 0.9495 - accuracy: 0.000
0e+00 - val_loss: 1.0522 - val_accuracy: 0.0000e+00
Epoch 4/14
5/5 [=====] - 0s 11ms/step - loss: 0.9809 - accuracy: 0.000
0e+00 - val_loss: 1.0465 - val_accuracy: 0.0000e+00
Epoch 5/14
5/5 [=====] - 0s 12ms/step - loss: 0.9343 - accuracy: 0.000
0e+00 - val_loss: 1.0395 - val_accuracy: 0.0000e+00
Epoch 6/14
5/5 [=====] - 0s 14ms/step - loss: 0.9068 - accuracy: 0.000
0e+00 - val_loss: 1.0303 - val_accuracy: 0.0000e+00
Epoch 7/14
5/5 [=====] - 0s 14ms/step - loss: 0.8216 - accuracy: 0.000
0e+00 - val_loss: 1.0200 - val_accuracy: 0.0000e+00
Epoch 8/14
5/5 [=====] - 0s 15ms/step - loss: 0.9547 - accuracy: 0.000
0e+00 - val_loss: 1.0070 - val_accuracy: 0.0000e+00
Epoch 9/14
5/5 [=====] - 0s 11ms/step - loss: 0.8535 - accuracy: 0.000
0e+00 - val_loss: 0.9943 - val_accuracy: 0.0000e+00
Epoch 10/14
5/5 [=====] - 0s 10ms/step - loss: 0.8502 - accuracy: 0.000
0e+00 - val_loss: 0.9812 - val_accuracy: 0.0000e+00
Epoch 11/14
5/5 [=====] - 0s 9ms/step - loss: 0.8076 - accuracy: 0.0000
e+00 - val_loss: 0.9635 - val_accuracy: 0.0000e+00
Epoch 12/14
5/5 [=====] - 0s 10ms/step - loss: 0.7858 - accuracy: 0.000
0e+00 - val_loss: 0.9427 - val_accuracy: 0.0000e+00
Epoch 13/14
5/5 [=====] - 0s 10ms/step - loss: 0.7989 - accuracy: 0.000
0e+00 - val_loss: 0.9172 - val_accuracy: 0.0000e+00
Epoch 14/14
5/5 [=====] - 0s 10ms/step - loss: 0.7104 - accuracy: 0.000
0e+00 - val_loss: 0.8850 - val_accuracy: 0.0000e+00

```

Out[11]: <tensorflow.python.keras.callbacks.History at 0x22f572d9580>

```
In [12]: y_pred_scaled=model.predict(x_test_scaled)
         y_pred=y_scalar.inverse_transform(y_pred_scaled)
```

```
In [13]: result=pandas.DataFrame(y_pred,columns=['y_pred'])
         result['Green strength 15 min']=y_test
```

```
In [14]: mean_squared_error(y_test,y_pred)
```

Out[14]: 126.97812397355591

```
In [15]: math.sqrt(mean_squared_error(y_test,y_pred))
```

Out[15]: 11.268457036061145

```
In [16]: result
```

```
Out[16]:
```

	y_pred	Green strength 15 min
0	10.845407	2.72

	y_pred	Green strength 15 min
1	13.863280	31
2	14.089982	28.82
3	13.400944	14.02
4	9.145871	0
5	13.845339	31
6	16.605181	20.17
7	17.790791	31
8	17.272158	18.07

```
In [17]: data['x_all']=x.tolist()
         result['x_all']=x_test.tolist()
```

```
In [18]: def joins(s):
         a=''
         for i in s:
             a=a+str(i)+", "
         return a
```

```
In [19]: result['x_all']=result['x_all'].apply(joins)
         data['x_all']=data['x_all'].apply(joins)
```

```
In [20]: final=pandas.merge(result,data,how='inner',on='x_all')
```

```
In [21]: final.iloc[:,4]
```

```
Out[21]:
```

	y_pred	Green strength 15 min	x_all	Mix Design
0	10.845407	2.72	500,0.5,1.0,5,0,	AC2 - M500-S01 -W50-FA5
1	13.863280	31	500,0.5,1.0,5,20,	AS1- M500-W50- S1 -FA5-LS20
2	14.089982	28.82	500,0.35,0.8,0,0,	WB-02-M500-W,35-S.8
3	13.400944	14.02	500,0.45,1.0,5,0,	AC4 - M500-S01 -W45-FA5
4	9.145871	0	550,0.45,1.0,0,0,	VC5-M550W45S1
5	13.845339	31	550,0.35,1.0,0,0,	VC4-M550W35S1
6	16.605181	20.17	500,0.45,1.0,0,30,	LS-13
7	17.790791	31	450,0.4,1.0,5,0,	AV1- W4S1-M450-FA5
8	17.272158	18.07	500,0.4,1.0,10,0,	FA-1-M500-W,4-S.1-FA-10

```
In [ ]:
```

```
In [ ]:
```

In [22]:

data

Out[22]:

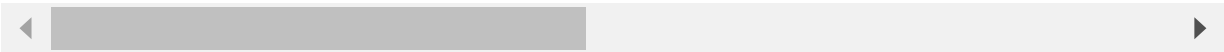
	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
0	LS-01-M500-W,5-S1-LS-10	500	0.50	1.0	0	10	1140.079	12.54087	114.008	10	...
1	LS-02-M500-W,5-S1-LS-20	500	0.50	1.0	0	20	1092.824	13.11389	218.565	20	...
2	LS-03-M500-W,5-S1-LS-30	500	0.50	1.0	0	30	1049.331	13.64130	314.799	30	...
3	LS-04-M500-W,5-S1-LS-40	500	0.50	1.0	0	40	1009.167	14.12834	403.667	40	...
4	LS-05-M500-W,5-S1-LS-50	500	0.50	1.0	0	50	971.964	14.57946	485.982	50	...
5	MV-02-M450-W,4-S1	450	0.40	1.0	0	0	1184.211	11.48200	0.000	0	...
6	MV-03-M500-W,4-S1	500	0.40	1.0	0	0	1354.653	13.54700	0.000	0	...
7	MV-04-M550-W,4-S1	550	0.40	1.0	0	0	1525.095	15.25100	0.000	0	...
8	MV-05-M600-W,4-S1	600	0.40	1.0	0	0	1695.537	16.95500	0.000	0	...
9	MV-06-M650-W,4-S1	650	0.40	1.0	0	0	1865.979	18.66000	0.000	0	...
10	MV-07-M700-W,4-S1	700	0.40	1.0	0	0	2036.421	20.36400	0.000	0	...
11	MV8-M475-W40-S1	475	0.40	1.0	0	0	1269.432	12.69400	0.000	0	...
12	MV9-M525-W40-S1	535	0.40	1.0	0	0	1439.874	14.39900	0.000	0	...
13	WB-02-M500-W,35-S.8	500	0.35	0.8	0	0	650.341	10.40500	0.000	0	...
14	WB-03-M500-W,4-S.8	500	0.40	0.8	0	0	1355.166	10.84100	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
15	WB-04-M500-W,45-S.8	500	0.45	0.8	0	0	1267.235	10.13800	0.000	0	...
16	WB-05-M500-W,5-S.8	500	0.50	0.8	0	0	1190.019	9.52000	0.000	0	...
17	WB-06-M500-W,55-S.8	500	0.55	0.8	0	0	1121.673	8.97300	0.000	0	...
18	FA-1-M500-W,4-S.1-FA-10	500	0.40	1.0	10	0	1269.320	14.10400	0.000	0	...
19	FA-2-M500-W,4-S.1-FA-20	500	0.40	1.0	20	0	1176.669	14.70800	0.000	0	...
20	FA-3-M500-W,4-S.1-FA-30	500	0.40	1.0	30	0	1075.715	15.36700	0.000	0	...
21	FA-5-M500-W,4-S.1-FA-5	500	0.40	1.0	5	0	1312.846	13.81900	0.000	0	...
22	FA-6-M500-W,4-S.1-FA-15	500	0.40	1.0	15	0	1223.967	14.40000	0.000	0	...
23	VC1-M450W45S1	450	0.45	1.0	0	0	1107.399	11.07400	0.000	0	...
24	VC2-M450W.5S1	450	0.50	1.0	0	0	1039.945	10.39900	0.000	0	...
25	VC3-M550W30S1	550	0.30	1.0	0	0	1770.739	17.70700	0.000	0	...
26	VC4-M550W35S1	550	0.35	1.0	0	0	1638.763	16.38800	0.000	0	...
27	VC5-M550W45S1	550	0.45	1.0	0	0	1426.172	14.26200	0.000	0	...
28	VC6-M550W.5S1	550	0.50	1.0	0	0	1339.301	13.39300	0.000	0	...
29	VC7-M475W.5-S1	475	0.50	1.0	0	0	1114.784	11.14800	0.000	0	...
30	VC8-M475W.55-S1	475	0.55	1.0	0	0	1050.779	10.50800	0.000	0	...
31	VC9-M525W.35-S1	525	0.35	1.0	0	0	1547.190	15.47200	0.000	0	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
32	VC11-M525W.45-S1	525	0.45	1.0	0	0	1346.479	13.46500	0.000	0	...
33	SV1-M450-W50-LS20-SP-1	450	0.50	1.0	0	20	955.325	11.46400	191.065	20	...
34	SV2-M450-W50-LS40-SP-1	450	0.50	1.0	0	40	882.194	12.35100	352.877	40	...
35	SV3-M550-W50-LS20-SP.5	550	0.50	0.5	0	20	1230.323	7.38200	246.065	20	...
36	SV4-M550-W50-LS40-SP.5	550	0.50	0.5	0	40	1136.140	7.95300	454.456	40	...
37	AV1- W4S1-M450-FA5	450	0.40	1.0	5	0	1147.664	12.08100	0.000	0	...
38	AV2- W4S1-M450-FA15	450	0.40	1.0	15	0	1069.968	12.58800	0.000	0	...
39	AV3- W4S1-M550-FA5	550	0.40	1.0	5	0	1478.028	15.55800	0.000	0	...
40	AV4- W4S1-M550-FA15	550	0.40	1.0	15	0	1377.966	16.21100	0.000	0	...
41	AS1- M500-W50- S1 -FA5-LS20	500	0.50	1.0	5	20	1061.023	0.00000	223.373	20	...
42	AS2- M500-W50- S1 -FA5-LS40	500	0.50	1.0	5	40	978.155	0.00000	411.854	40	...
43	AS3- M500-W50- S1 -FA15-LS20	500	0.50	1.0	15	20	993.030	0.00000	233.654	20	...
44	AS4- M500-W50- S1 -FA15-LS40	500	0.50	1.0	15	40	912.191	0.00000	429.266	40	...
45	SC1-M500-S01 -W45-LS20	500	0.45	1.0	0	20	1157.598	0.00000	231.520	20	...
46	SC2-M500-S01 -W45-LS40	500	0.45	1.0	0	40	1064.154	0.00000	425.662	40	...
47	SC3-M500-S01 -W50-LS20	500	0.50	1.0	0	20	1092.824	0.00000	218.565	20	...
48	SC4-M500-S01-W50-LS40	500	0.50	1.0	0	40	1009.167	0.00000	403.667	40	...

	Mix Design	Matrix Volume	Water-Binder (%)	SP (%)	Fly Ash (%)	Limestone %	Cement (gr)	SP (gr)	Calsined clay (gr)	Lime stone(gr)	...
49	AC1 - M500-S01 -W50-FA15	500	0.50	1.0	15	0	1087.641	12.79600	0.000	0	...
50	AC2 - M500-S01 -W50-FA5	500	0.50	1.0	5	0	1157.260	12.18200	0.000	0	...
51	AC3 - M500-S01 -W45-FA15	500	0.50	1.0	15	0	1230.153	12.94900	0.000	0	...
52	AC4 - M500-S01 -W45-FA5	500	0.45	1.0	5	0	1151.784	13.55000	0.000	0	...
53	LS-11	500	0.45	1.0	0	10	1210.757	13.31800	121.076	10	...
54	LS-12	500	0.45	1.0	0	20	1157.598	13.89100	231.520	20	...
55	LS-13	500	0.45	1.0	0	30	1108.911	14.41600	332.673	30	...
56	LS-14	500	0.45	1.0	0	40	1064.154	14.89800	425.662	40	...
57	LS-05	500	0.45	1.0	0	50	1022.870	15.34300	511.435	50	...

58 rows × 21 columns



In []:

In [23]:

y

Out[23]:

array([2.09, 2.14, 4.37, 6.2, 3.74, 31.0, 13.76, 2.77, 2.54, 2.74, 3.25, 22.45, 4.49, 28.82, 13.73, 5.48, 2.06, 3.08, 18.07, 31.0, 31.0, 19.07, 31.0, 22.76, 19.84, 31.0, 31.0, 0.0, 0.0, 6.11, 3.17, 21.0, 4.08, 4.34, 31.0, 5.64, 13.85, 31.0, 31.0, 2.92, 11.94, 31.0, 31.0, 31.0, 31.0, 31.0, 17.26, 31.0, 5.05, 2.72, 2.88, 14.02, 7.41, 18.9, 20.17, 31.0, 31.0], dtype=object)

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []:

In []: