CONCRETE DATA

This is the machine learning model on Concrete data to predict strength of cement.Its numerical regression dataset. LinearRegression is used create the model.

[26]
```
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
```

[27]
```
data = pd.read_csv("/content/concrete_data.csv")
data
```

	Cement	Blast Furnace Slag	Fly Ash	Water	Superplasticizer	Coarse Aggregate	Fine Aggregate	Age	Strength
0	540.0	0.0	0.0	162.0	2.5	1040.0	676.0	28	79.99
1	540.0	0.0	0.0	162.0	2.5	1055.0	676.0	28	61.89
2	332.5	142.5	0.0	228.0	0.0	932.0	594.0	270	40.27
3	332.5	142.5	0.0	228.0	0.0	932.0	594.0	365	41.05
4	198.6	132.4	0.0	192.0	0.0	978.4	825.5	360	44.30
...	...	...	...	...	...	...	...	...	...
1025	276.4	116.0	90.3	179.6	8.9	870.1	768.3	28	44.28
1026	322.2	0.0	115.6	196.0	10.4	817.9	813.4	28	31.18
1027	148.5	139.4	108.6	192.7	6.1	892.4	780.0	28	23.70

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sample_data
concrete_data.csv

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1030 rows × 9 columns

[28]
```
data.columns
```

```
Index(['Cement', 'Blast Furnace Slag', 'Fly Ash', 'Water', 'Superplasticizer',
       'Coarse Aggregate', 'Fine Aggregate', 'Age', 'Strength'],
      dtype='object')
```

[29]
```
data.corr()   #correlation between columns
```

	Cement	Blast Furnace Slag	Fly Ash	Water	Superplasticizer	Coarse Aggregate	Fine Aggregate	Age	Strength
Cement	1.000000	-0.275216	-0.397467	-0.081587	0.092386	-0.109349	-0.222718	0.081946	0.497832
Blast Furnace Slag	-0.275216	1.000000	-0.323580	0.107252	0.043270	-0.283999	-0.281603	-0.044246	0.134829
Fly Ash	-0.397467	-0.323580	1.000000	-0.256984	0.377503	-0.009961	0.079108	-0.154371	-0.105755
Water	-0.081587	0.107252	-0.256984	1.000000	-0.657533	-0.182294	-0.450661	0.277618	-0.289633
Superplasticizer	0.092386	0.043270	0.377503	-0.657533	1.000000	-0.265999	0.222691	-0.192700	0.366079
Coarse Aggregate	-0.109349	-0.283999	-0.009961	-0.182294	-0.265999	1.000000	-0.178481	-0.003016	-0.164935
Fine Aggregate	-0.222718	-0.281603	0.079108	-0.450661	0.222691	-0.178481	1.000000	-0.156095	-0.167241
Age	0.081946	-0.044246	-0.154371	0.277618	-0.192700	-0.003016	-0.156095	1.000000	0.328873
Strength	0.497832	0.134829	-0.105755	-0.289633	0.366079	-0.164935	-0.167241	0.328873	1.000000

[50]
```
sns.heatmap(data.corr())
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa09e420550>
```

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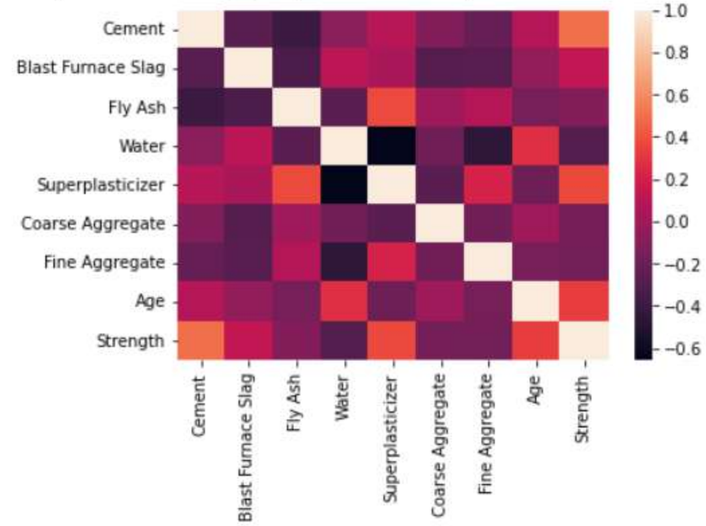
[29]	**Strength**	0.497832	0.134829	-0.105755	-0.289633	0.366079	-0.164935	-0.167241	0.328873	1.000000

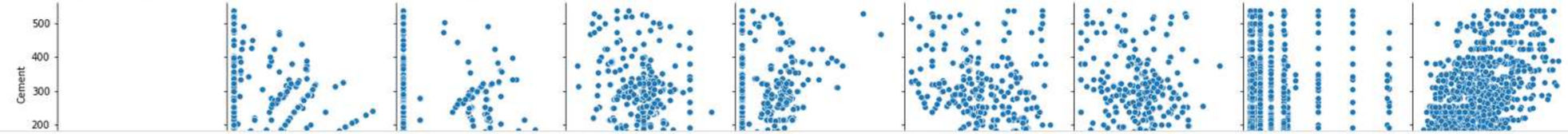
[50] `sns.heatmap(data.corr())`

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa09e420550>
```



[51] `sns.pairplot(data)`

```
<seaborn.axisgrid.PairGrid at 0x7fa09e348910>
```



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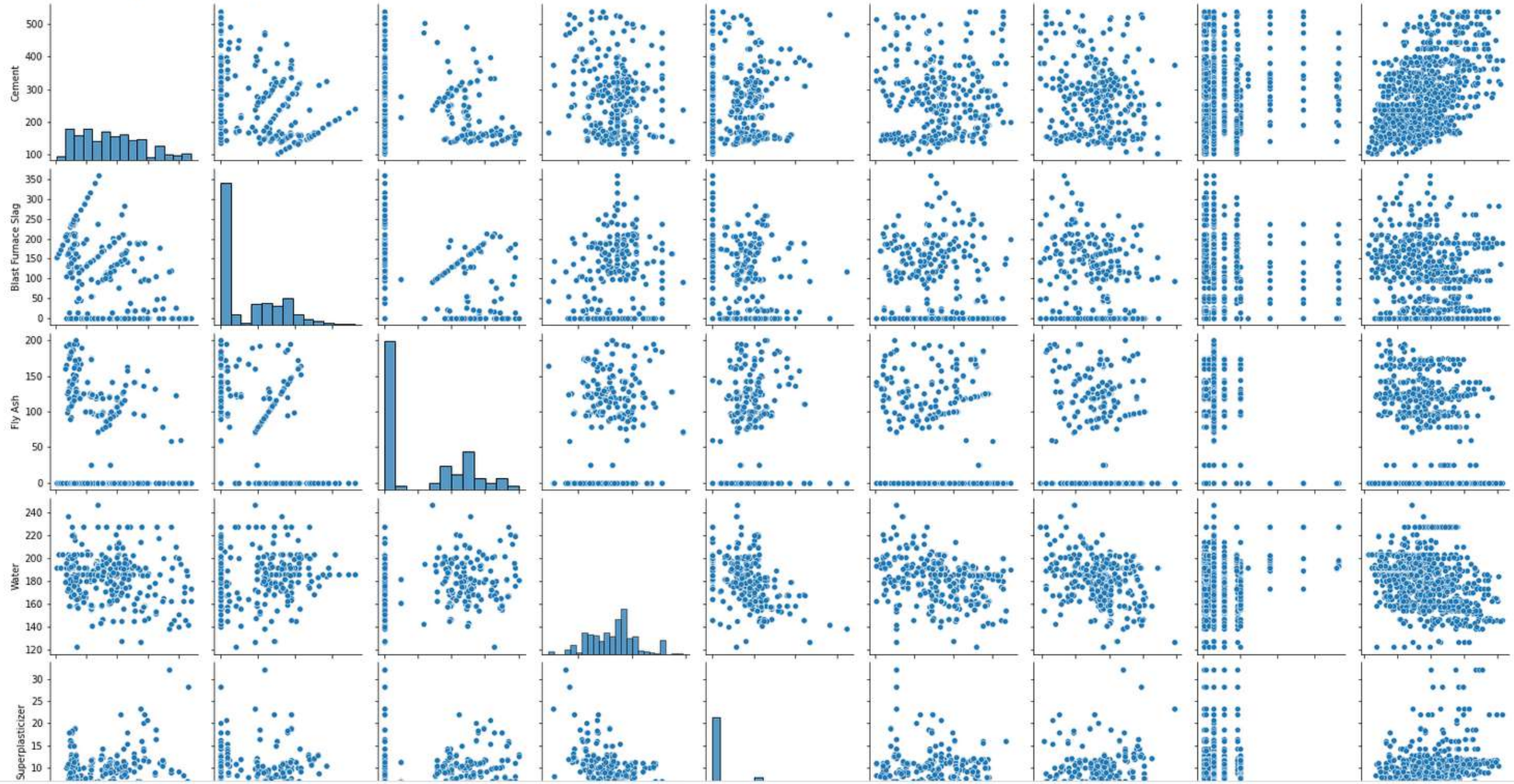
```
sns.pairplot(data)
```

[51] 43s

```
<seaborn.axisgrid.PairGrid at 0x7fa09e348910>
```



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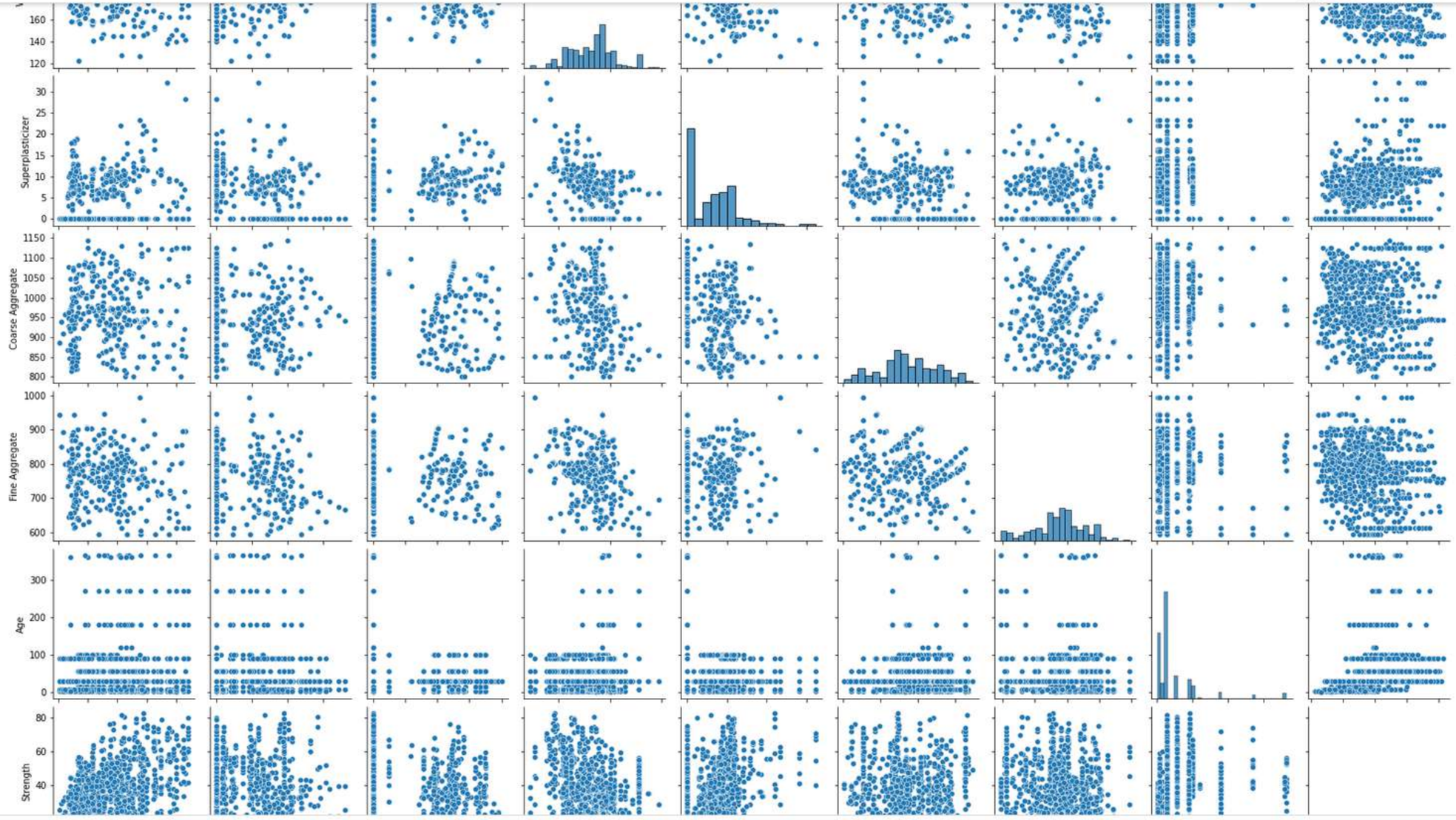
[51] 43s



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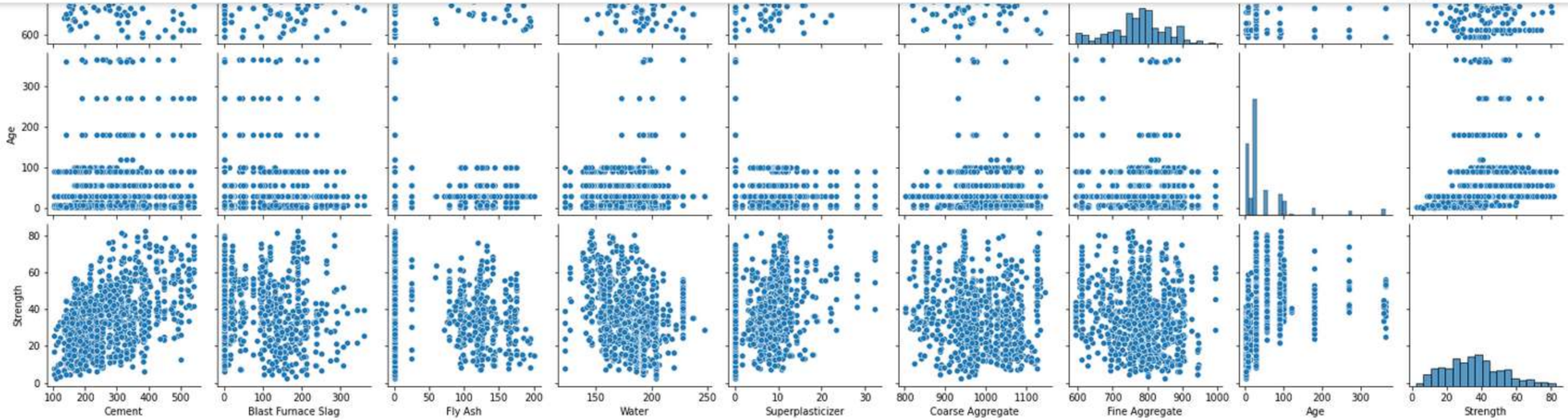


```
[32] x=data.iloc[:,:-1]
     x
```

	Cement	Blast Furnace Slag	Fly Ash	Water	Superplasticizer	Coarse Aggregate	Fine Aggregate	Age
0	540.0	0.0	0.0	162.0	2.5	1040.0	676.0	28
1	540.0	0.0	0.0	162.0	2.5	1055.0	676.0	28
2	332.5	142.5	0.0	228.0	0.0	932.0	594.0	270
3	332.5	142.5	0.0	228.0	0.0	932.0	594.0	365
4	198.6	132.4	0.0	192.0	0.0	978.4	825.5	360
...	...	...	...	...	...	...	...	...
1025	276.4	116.0	90.3	179.6	8.9	870.1	768.3	28

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[32]

1028	159.1	186.7	0.0	175.6	11.3	989.6	788.9	28
1029	260.9	100.5	78.3	200.6	8.6	864.5	761.5	28

1030 rows × 8 columns

[33]
```
y=data.iloc[:,-1]
y
```

```
0       79.99
1       61.89
2       40.27
3       41.05
4       44.30
        ...
1025    44.28
1026    31.18
1027    23.70
1028    32.77
1029    32.40
Name: Strength, Length: 1030, dtype: float64
```

[34]
```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.30,random_state=42)
```

[35]
```
x_train
```

```
x_test
```

```
y_train
```

[38] y_test

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[38] y_test

```
31     52.91
109    55.90
136    74.50
88     35.30
918    10.54
       ...
250    24.92
377    36.30
615    32.33
9      39.29
357    66.82
Name: Strength, Length: 309, dtype: float64
```

[39]
```
from sklearn.linear_model import LinearRegression
model=LinearRegression()
model.fit(x_train,y_train)
y_pred=model.predict(x_test)
y_pred
```

```
array([58.57559825, 52.45646315, 64.11894482, 52.00069556, 17.52416752,
       39.59237788, 26.65525924, 45.05182266, 30.0607746 , 37.56903968,
       27.90132545, 19.09017187, 68.0649994 , 52.75884153, 30.01094902,
       44.31367221, 29.17966162, 26.34627447, 32.16097688, 32.35848511,
       36.66341834, 31.60412862, 38.56312792, 25.05633822, 32.8134936 ,
       34.5774219 , 14.60054941, 40.05425989, 41.87492005, 21.03099827,
       35.29735411, 30.504642  , 43.38895117, 45.46161023, 31.11357345,
       29.08456081, 29.48841545, 38.62461077, 20.42793578, 38.7197513 ,
       21.28819958, 16.10817911, 31.15578325, 51.47669894, 20.87486449,
       57.93741262, 51.05519306, 59.75306328, 20.17206098, 19.32216244,
       40.38198993, 35.77907885, 29.86317187, 33.48220014, 46.53873549,
       51.89849202, 28.46558802, 15.78715013, 30.13328038, 18.20703499,
       38.37844006, 19.57892812, 31.92722861, 56.12294516, 22.88347876,
       21.32190153, 32.44785729, 16.79648193, 26.12833023, 26.10005873,
```

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```
[39]        27.21222714, 22.28471926, 36.65722192, 23.87954572, 30.76552969,
            55.31963157, 52.30307393, 31.72887444, 50.97337402, 27.89012864,
            30.33403228, 36.23362199, 15.16804729, 32.55769929, 24.53967605,
            32.52420732, 27.24157626, 26.32437485, 53.53898146, 57.05229354,
```

```
from sklearn.metrics import mean_absolute_error
print("Error is",mean_absolute_error(y_test,y_pred))
```

```
Error is 8.298580847947502
```

```
[47] from sklearn.metrics import mean_absolute_percentage_error
     print("Percentage error",mean_absolute_percentage_error(y_test,y_pred))
```

```
Percentage error 0.32187392953468447
```

```
from sklearn.metrics import mean_squared_error
print("Squared_error is",mean_squared_error(y_test,y_pred))
```

```
Squared_error is 109.75080797014404
```

```
[49] from sklearn.metrics import r2_score
     print("R2 score is",r2_score(y_test,y_pred))
```

```
R2 score is 0.5943782479239206
```

Minimized the error and comparitively R2 score is high for this model.

```
[ ]
```

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