Machine Learning project on

https://open-meteo.com/ to create a

"RAINFALL PREDICTION MODEL"

Done By

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ABSTRACT

In this project, I was asked to build a machine learning model with a real world dataset, and submit a report about the dataset, impurities or inconsistencies present in the dataset and use any machine learning algorithm used to build the model.

Parameters used in the dataset:

* temperature_2m - Air temperature at 2 meters above ground.
* relativehumidity_2m - Relative humidity at 2 meters above ground.
* dewpoint_2m - Dew point temperature at 2 meters above ground.
* surface_pressure - Atmospheric air pressure reduced to mean sea level (msl) or pressure at surface.
* rain - Only liquid precipitation of the preceding hour including local showers and rain from large scale systems.
* cloudcover - Total cloud cover as an area fraction.
* windspeed_10m - Wind speed at 10 or 100 meters above ground. Wind speed on 10 meters is the standard level.
* winddirection_10m - Wind direction at 10 or 100 meters above ground.
* soil_temperature_0_to_7cm - Average temperature of different soil levels below ground.

Importing the Libraries

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
```

Loading the dataset

```
df = pd.read_csv('Rainfall_Data.csv')
```

Exploratory Data Analysis

```
df.head() # to check the top 5 columns
```

```
                time  temperature_2m (°C)  relativehumidity_2m (%)  \
0  2020-01-01T00:00                 18.0                       96
1  2020-01-01T01:00                 18.1                       95
2  2020-01-01T02:00                 18.2                       94
3  2020-01-01T03:00                 19.7                       83
4  2020-01-01T04:00                 21.5                       73

   dewpoint_2m (°C)  surface_pressure (hPa)  rain (mm)  cloudcover (%)
\
0              17.3                   920.2        0.0             100

1              17.3                   920.9        0.0             100

2              17.3                   921.6        0.0             100

3              16.7                   922.9        0.0             100

4              16.6                   923.2        0.0             100
```

```
   windspeed_10m (km/h)  winddirection_10m (°)
soil_temperature_0_to_7cm (°C)
0                  10.1                    107
20.3
1                  10.4                    110
20.2
2                  13.0                    109
20.3
3                  15.5                    112
21.1
4                  15.6                    113
22.3

df.tail() # to check the bottom 5 columns

                   time  temperature_2m (°C)  relativehumidity_2m (%)
\
26299  2022-12-31T19:00                 16.1                       77

26300  2022-12-31T20:00                 15.5                       80

26301  2022-12-31T21:00                 14.9                       85

26302  2022-12-31T22:00                 14.4                       89

26303  2022-12-31T23:00                 13.9                       91


       dewpoint_2m (°C)  surface_pressure (hPa)  rain (mm)  cloudcover
(%)  \
26299              12.0                   922.7        0.0
0
26300              12.1                   921.9        0.0
0
26301              12.4                   921.4        0.0
0
26302              12.5                   920.9        0.0
0
26303              12.5                   920.4        0.0
0

       windspeed_10m (km/h)  winddirection_10m (°)  \
26299                   7.6                     93
26300                   7.6                     95
26301                   7.0                    102
26302                   7.1                    105
26303                   6.4                    106

       soil_temperature_0_to_7cm (°C)
```

```
26299                            18.3
26300                            17.8
26301                            17.4
26302                            17.0
26303                            16.6
```

```
df.shape  #Dimensions of dataset
```

```
(26304, 10)
```

```
df.info() #Basic information about columns
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 26304 entries, 0 to 26303
Data columns (total 10 columns):
 #   Column                           Non-Null Count  Dtype  
---  ------                           --------------  -----  
 0   time                             26304 non-null  object 
 1   temperature_2m (°C)              26304 non-null  float64
 2   relativehumidity_2m (%)          26304 non-null  int64  
 3   dewpoint_2m (°C)                 26304 non-null  float64
 4   surface_pressure (hPa)           26304 non-null  float64
 5   rain (mm)                        26304 non-null  float64
 6   cloudcover (%)                   26304 non-null  int64  
 7   windspeed_10m (km/h)             26304 non-null  float64
 8   winddirection_10m (°)            26304 non-null  int64  
 9   soil_temperature_0_to_7cm (°C)  26304 non-null  float64
dtypes: float64(6), int64(3), object(1)
memory usage: 2.0+ MB
```

```
df.describe() # Statistical Summary
```

```
       temperature_2m (°C)  relativehumidity_2m (%)  dewpoint_2m (°C)
\
count         26304.000000             26304.000000      26304.000000

mean             22.716735                72.138952         16.459082

std               3.964381                21.628971          3.901123

min              11.500000                13.000000         -2.600000

25%              20.000000                59.000000         14.600000

50%              22.100000                77.000000         18.000000

75%              25.200000                91.000000         19.100000

max              36.500000               100.000000         22.300000
```

```
       surface_pressure (hPa)     rain (mm)  cloudcover (%)  \
count            26304.000000  26304.000000    26304.000000
mean               918.009029      0.132592       51.748061
std                  2.558279      0.497593       35.907968
min                909.500000      0.000000        0.000000
25%                916.200000      0.000000       20.000000
50%                918.000000      0.000000       49.000000
75%                919.800000      0.000000       89.000000
max                927.000000     11.900000      100.000000

       windspeed_10m (km/h)  winddirection_10m (°)  \
count           26304.00000            26304.000000
mean               10.63834              181.308052
std                 4.96033               96.972286
min                 0.00000                1.000000
25%                 7.10000               98.000000
50%                 9.90000              181.000000
75%                13.40000              264.000000
max                36.90000              360.000000

       soil_temperature_0_to_7cm (°C)
count                   26304.000000
mean                       24.838728
std                         4.405825
min                        14.100000
25%                        21.800000
50%                        23.900000
75%                        27.000000
max                        40.800000
```

Null values or missing values to be checked

```
df.isnull().sum()
```

```
time                             0
temperature_2m (°C)              0
relativehumidity_2m (%)          0
dewpoint_2m (°C)                 0
surface_pressure (hPa)           0
rain (mm)                        0
cloudcover (%)                   0
windspeed_10m (km/h)             0
winddirection_10m (°)            0
soil_temperature_0_to_7cm (°C)   0
dtype: int64
```

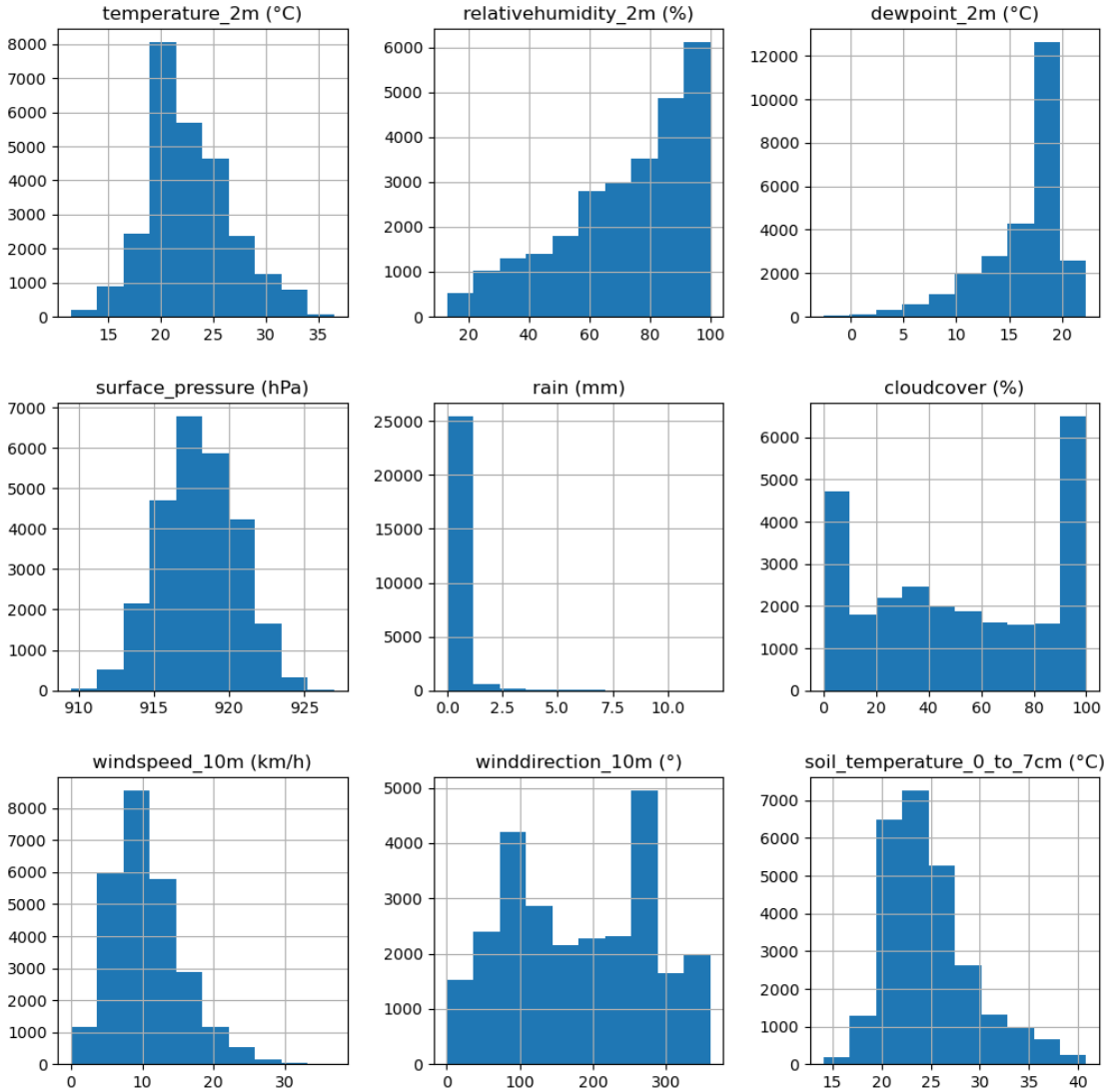
```
df.duplicated().sum()
```

```
0
```

There are no Duplicates and null values in the dataset. The dataset is clean and we can proceed further.

```
df.hist(figsize=(12,12))
```

```
array([[<AxesSubplot:title={'center':'temperature_2m (°C)'}>,
        <AxesSubplot:title={'center':'relativehumidity_2m (%)'}>,
        <AxesSubplot:title={'center':'dewpoint_2m (°C)'}>],
       [<AxesSubplot:title={'center':'surface_pressure (hPa)'}>,
        <AxesSubplot:title={'center':'rain (mm)'}>,
        <AxesSubplot:title={'center':'cloudcover (%)'}>],
       [<AxesSubplot:title={'center':'windspeed_10m (km/h)'}>,
        <AxesSubplot:title={'center':'winddirection_10m (°)'}>,
        <AxesSubplot:title={'center':'soil_temperature_0_to_7cm
(°C)'}>]],
      dtype=object)
```



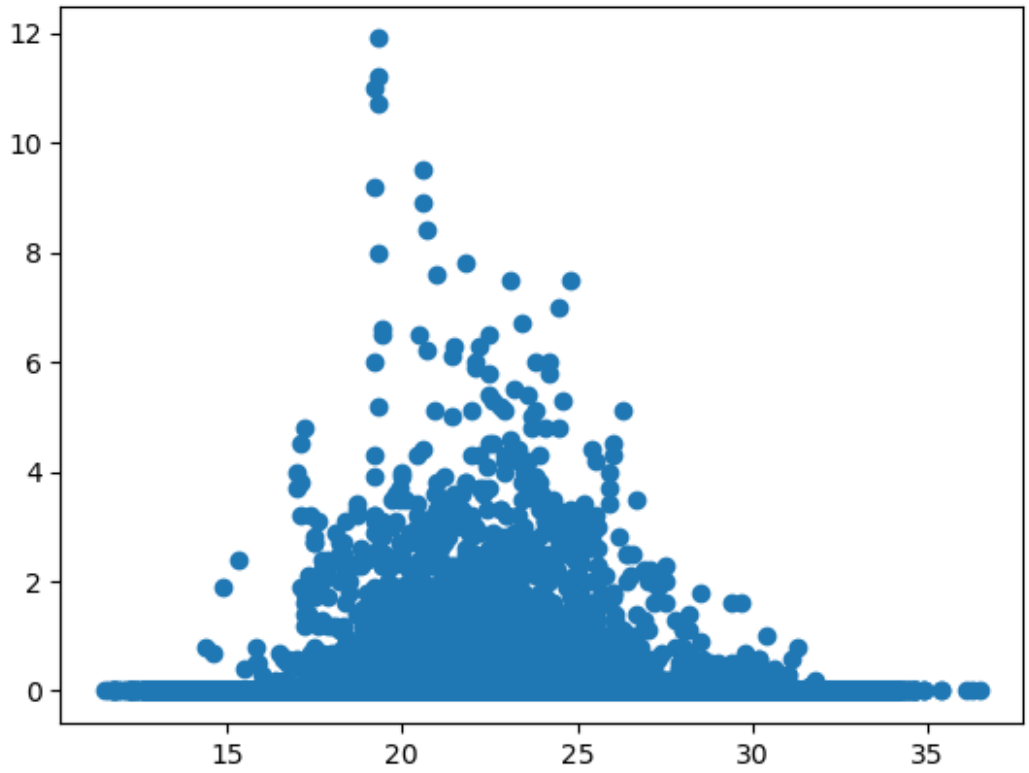

```
df["rain (mm)"].describe() # rainfall distribution
```

```
count    26304.000000
mean         0.132592
std          0.497593
min          0.000000
25%          0.000000
50%          0.000000
75%          0.000000
max         11.900000
Name: rain (mm), dtype: float64
```

Visualizing Rainfall with other columns to get better understanding

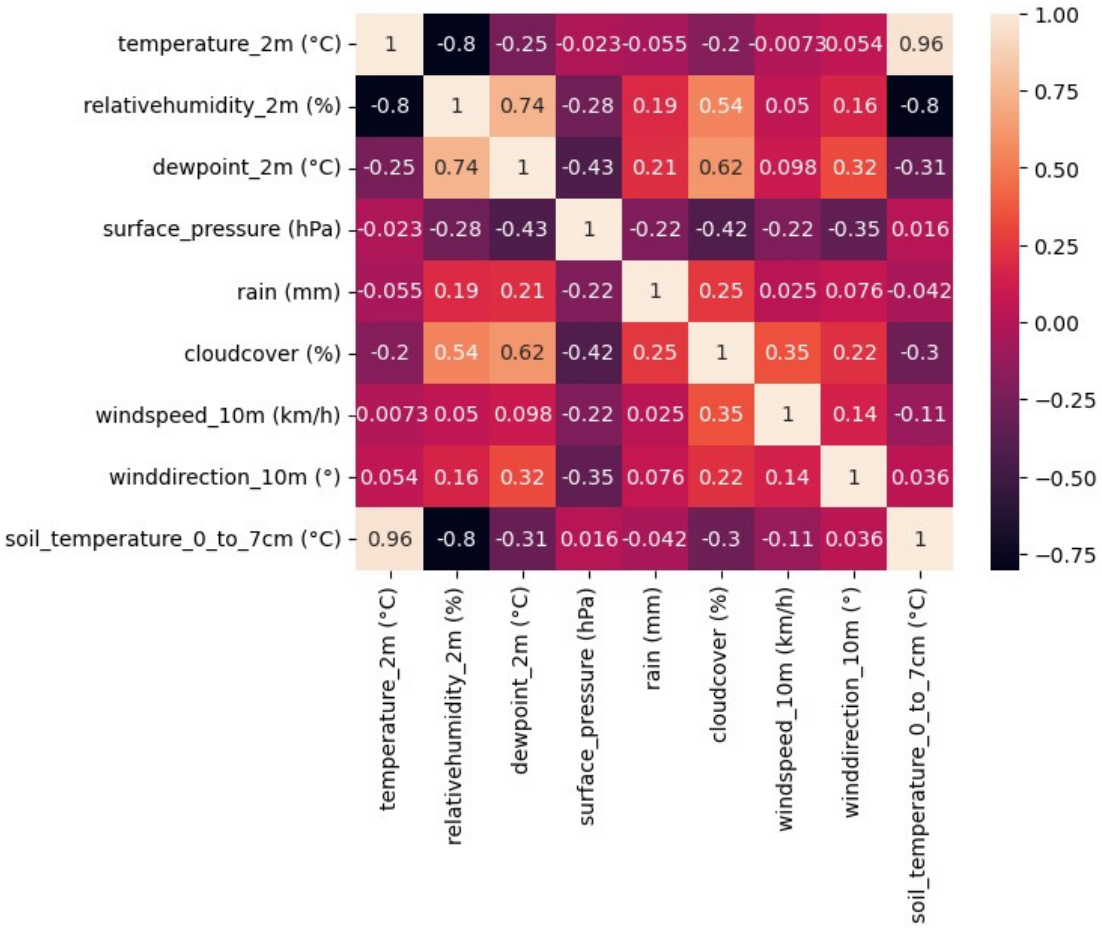
```
plt.scatter(df["temperature_2m (°C)"],df["rain (mm)"])
```

```
<matplotlib.collections.PathCollection at 0x203f6182880>
```




```
sns.heatmap(df.corr(), annot=True)
```

```
<AxesSubplot:>
```



Splitting the input and output data

```
Y = df['rain (mm)'] # Dependant variable

X = df.drop('rain (mm)', axis =1) # Independent variables

from sklearn.model_selection import train_test_split

X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
test_size=0.2, random_state=42)

np.shape(X_test)

(5261, 8)
```

Linear Regression Model

```
from sklearn.linear_model import LinearRegression

lm = LinearRegression()

# Train and fit the data
lm.fit(X_train,Y_train)

LinearRegression()
```

```
print('Coefficients: \n', lm.coef_)
```

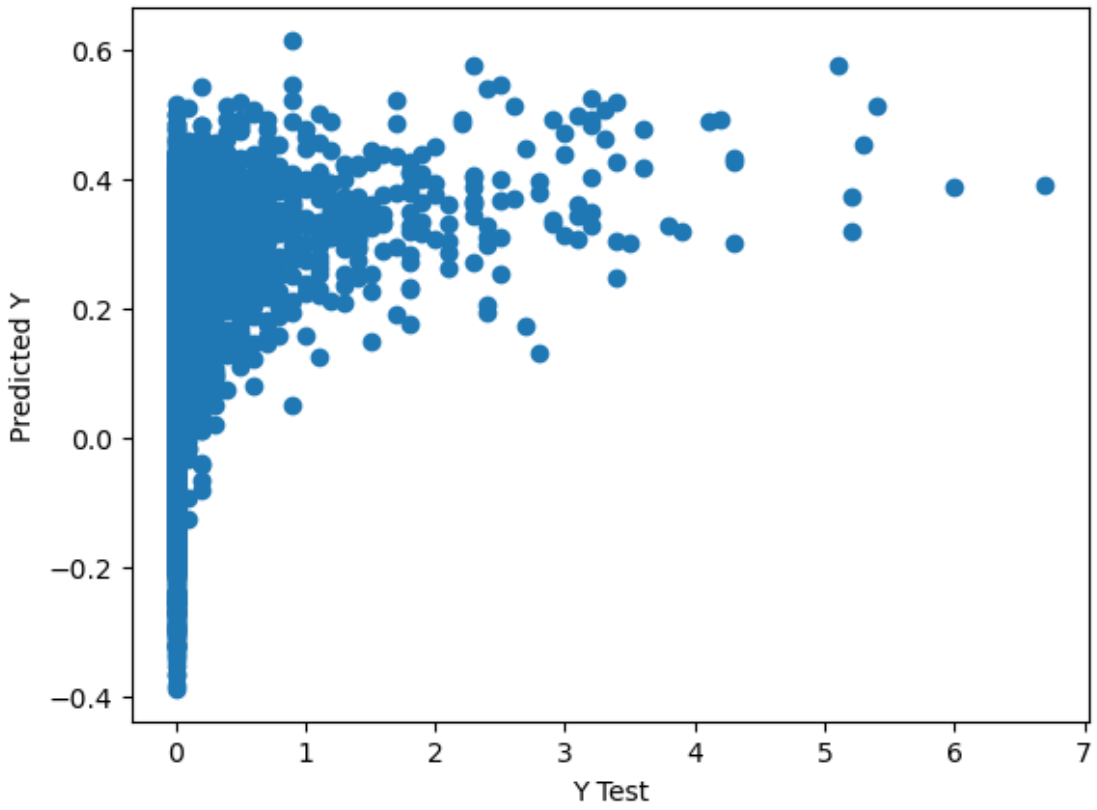
```
Coefficients:
 [-0.05924345  0.00299268  0.00063399 -0.02430277  0.00302714 -
0.00249099
 -0.00015145  0.06581022]
```

Predict the test data

```
predictions = lm.predict(X_test)
```

```
plt.scatter(Y_test,predictions)
plt.xlabel('Y Test')
plt.ylabel('Predicted Y')
```

```
Text(0, 0.5, 'Predicted Y')
```




```
mean_absolute_error(Y_test, predictions)
```

```
0.20810005817202304
```

Evaluating the Model

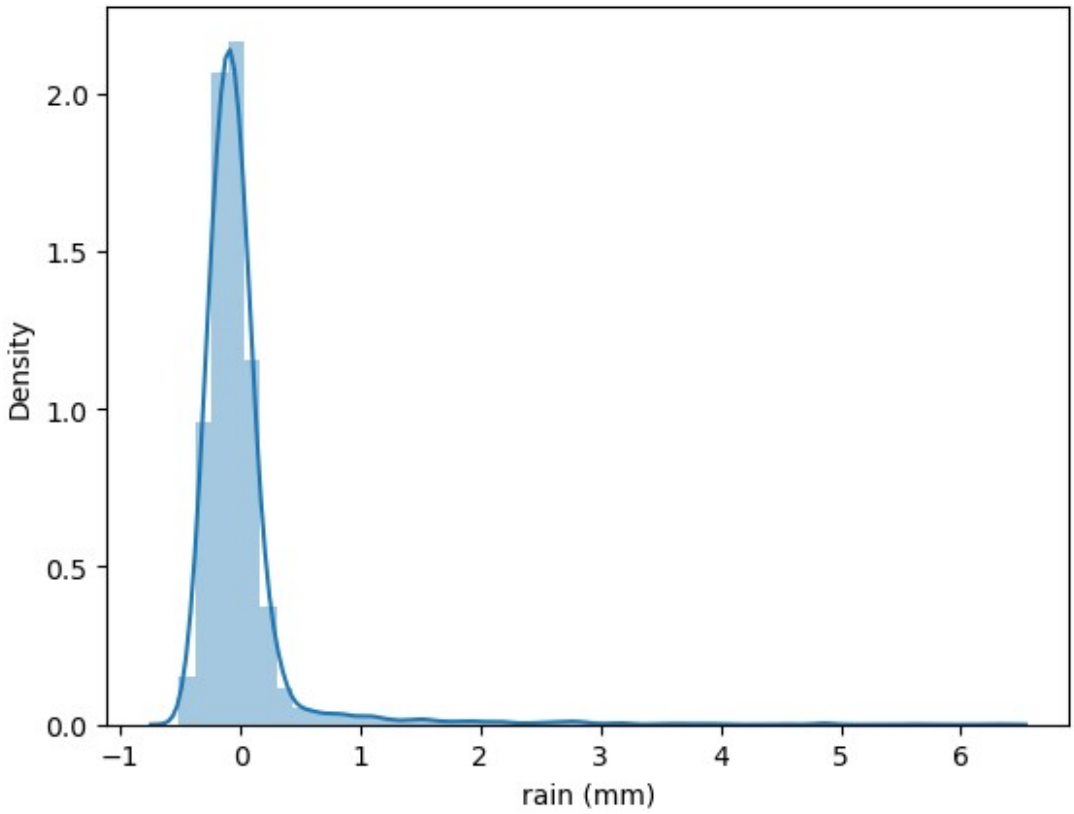
```
from sklearn import metrics
```

```
print('MAE:', metrics.mean_absolute_error(Y_test, predictions))
print('MSE:', metrics.mean_squared_error(Y_test, predictions))
```

```
print('RMSE:', np.sqrt(metrics.mean_squared_error(Y_test,
predictions)))
```

```
MAE: 0.20810005817202304
MSE: 0.18064832741735312
RMSE: 0.4250274431343853
```

```
sns.distplot((Y_test-predictions),bins=50);
```




```
from sklearn.metrics import r2_score #Testing accuracy
r2_score(Y_test,predictions)
```

```
0.12318327885371838
```

Random Forest Regressor

```
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error

rf = RandomForestRegressor(n_estimators = 100, max_depth=10, n_jobs=1)
rf.fit(X_train, Y_train)
Y_pred = rf.predict(X_test)
mean_absolute_error(Y_test, Y_pred)
```

```
0.14004834129248753
```

```
from sklearn.linear_model import Lasso
```

Lasso Regression

```
lrf = Lasso(alpha = 1.0, fit_intercept=True, normalize=False,
precompute=False, copy_X=True, max_iter=1000, tol=0.0001,
warm_start=False, positive=False, random_state=None)
lrf.fit(X_train, Y_train)
Y_pred = lrf.predict(X_test)
mean_absolute_error(Y_test, Y_pred)
```

```
0.1884720574906624
```