Libraries Import

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn import metrics
from sklearn.metrics import
mean_absolute_error,mean_squared_error,r2_score
from sklearn.metrics import accuracy_score,confusion_matrix
import warnings
warnings.filterwarnings("ignore")

data=pd.read_csv('/content/data.csv',encoding='unicode_escape')
```

Data Cleaning and Analysis

```
data.head()
```

```
  stn_code       sampling_date           state   location agency  \
0    150.0  February - M021990  Andhra Pradesh  Hyderabad    NaN
1    151.0  February - M021990  Andhra Pradesh  Hyderabad    NaN
2    152.0  February - M021990  Andhra Pradesh  Hyderabad    NaN
3    150.0     March - M031990  Andhra Pradesh  Hyderabad    NaN
4    151.0     March - M031990  Andhra Pradesh  Hyderabad    NaN

                                  type  so2   no2  rspm  spm  \
0  Residential, Rural and other Areas  4.8  17.4   NaN  NaN
1                     Industrial Area  3.1   7.0   NaN  NaN
2  Residential, Rural and other Areas  6.2  28.5   NaN  NaN
3  Residential, Rural and other Areas  6.3  14.7   NaN  NaN
4                     Industrial Area  4.7   7.5   NaN  NaN

  location_monitoring_station  pm2_5        date
0                         NaN    NaN  1990-02-01
1                         NaN    NaN  1990-02-01
2                         NaN    NaN  1990-02-01
3                         NaN    NaN  1990-03-01
4                         NaN    NaN  1990-03-01
```

```
data.tail()
```

```
       stn_code sampling_date                          state
location  \
435737     SAMP      24-12-15                    West Bengal  ULUBERIA

435738     SAMP      29-12-15                    West Bengal  ULUBERIA

435739      NaN           NaN  andaman-and-nicobar-islands       NaN

435740      NaN           NaN                    Lakshadweep       NaN

435741      NaN           NaN                        Tripura       NaN


                                           agency   type   so2   no2
rspm  \
435737  West Bengal State Pollution Control Board  RIRUO  22.0  50.0
143.0
435738  West Bengal State Pollution Control Board  RIRUO  20.0  46.0
171.0
435739                                        NaN    NaN   NaN   NaN
NaN
435740                                        NaN    NaN   NaN   NaN
NaN
435741                                        NaN    NaN   NaN   NaN
NaN

        spm        location_monitoring_station  pm2_5        date
435737  NaN  Inside Rampal Industries,ULUBERIA    NaN  2015-12-24
435738  NaN  Inside Rampal Industries,ULUBERIA    NaN  2015-12-29
435739  NaN                                NaN    NaN         NaN
435740  NaN                                NaN    NaN         NaN
435741  NaN                                NaN    NaN         NaN
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 435742 entries, 0 to 435741
Data columns (total 13 columns):
 #   Column                        Non-Null Count   Dtype
---  ------                        --------------   -----
 0   stn_code                      291665 non-null  object
 1   sampling_date                 435739 non-null  object
 2   state                         435742 non-null  object
 3   location                      435739 non-null  object
 4   agency                        286261 non-null  object
 5   type                          430349 non-null  object
 6   so2                           401096 non-null  float64
 7   no2                           419509 non-null  float64
 8   rspm                          395520 non-null  float64
```

```
 9   spm                             198355 non-null  float64
 10  location_monitoring_station  408251 non-null  object
 11  pm2_5                           9314 non-null    float64
 12  date                            435735 non-null  object
dtypes: float64(5), object(8)
memory usage: 43.2+ MB

data.shape

(435742, 13)

data.isnull()

        stn_code  sampling_date  state  location  agency   type    so2
no2  \
0          False          False  False     False    True  False  False
False
1          False          False  False     False    True  False  False
False
2          False          False  False     False    True  False  False
False
3          False          False  False     False    True  False  False
False
4          False          False  False     False    True  False  False
False
...          ...            ...    ...       ...     ...    ...    ...
...
435737     False          False  False     False   False  False  False
False
435738     False          False  False     False   False  False  False
False
435739      True           True  False      True    True   True   True
True
435740      True           True  False      True    True   True   True
True
435741      True           True  False      True    True   True   True
True

         rspm   spm  location_monitoring_station  pm2_5   date
0        True  True                          True   True  False
1        True  True                          True   True  False
2        True  True                          True   True  False
3        True  True                          True   True  False
4        True  True                          True   True  False
...       ...   ...                           ...    ...    ...
435737  False  True                         False   True  False
435738  False  True                         False   True  False
435739   True  True                          True   True   True
435740   True  True                          True   True   True
435741   True  True                          True   True   True
```

```
[435742 rows x 13 columns]
```

```
data.describe()
```

```
                so2             no2            rspm             spm
pm2_5
count  401096.000000  419509.000000  395520.000000  198355.000000
9314.000000
mean       10.829414      25.809623     108.832784     220.783480
40.791467
std        11.177187      18.503086      74.872430     151.395457
30.832525
min         0.000000       0.000000       0.000000       0.000000
3.000000
25%         5.000000      14.000000      56.000000     111.000000
24.000000
50%         8.000000      22.000000      90.000000     187.000000
32.000000
75%        13.700000      32.200000     142.000000     296.000000
46.000000
max       909.000000     876.000000    6307.033333    3380.000000
504.000000
```

```
data.isnull().sum()
```

```
stn_code                         144077
sampling_date                         3
state                                 0
location                              3
agency                           149481
type                               5393
so2                               34646
no2                               16233
rspm                              40222
spm                              237387
location_monitoring_station       27491
pm2_5                            426428
date                                  7
dtype: int64
```

```
data.nunique()
```

```
stn_code                          803
sampling_date                    5485
state                              37
location                          304
agency                             64
type                               10
so2                              4197
no2                              6864
```

```
rspm                             6065
spm                              6668
location_monitoring_station       991
pm2_5                             433
date                             5067
dtype: int64
```

```
null=data.isnull().sum().sort_values(ascending=False)
```

```
null
```

```
pm2_5                            426428
spm                              237387
agency                           149481
stn_code                         144077
rspm                              40222
so2                               34646
location_monitoring_station       27491
no2                               16233
type                               5393
date                                  7
sampling_date                         3
location                              3
state                                 0
dtype: int64
```

```
null_percent=(data.isnull().sum()/
data.isnull().count()*100).sort_values(ascending=False)
```

```
null_percent
```

```
pm2_5                            97.862497
spm                              54.478797
agency                           34.304933
stn_code                         33.064749
rspm                              9.230692
so2                               7.951035
location_monitoring_station       6.309009
no2                               3.725370
type                              1.237659
date                              0.001606
sampling_date                     0.000688
location                          0.000688
state                             0.000000
dtype: float64
```

```
null_data_with_percent = pd.concat([null, null_percent], axis=1,
keys=['Total','Percent'])
```

```
null_data_with_percent
```

```
                                Total    Percent
pm2_5                          426428  97.862497
spm                            237387  54.478797
agency                         149481  34.304933
stn_code                       144077  33.064749
rspm                            40222   9.230692
so2                             34646   7.951035
location_monitoring_station     27491   6.309009
no2                             16233   3.725370
type                             5393   1.237659
date                                7   0.001606
sampling_date                       3   0.000688
location                            3   0.000688
state                               0   0.000000
```

Unnecessary Columns

```
data.drop(['agency'],axis=1,inplace=True)
data.drop(['stn_code'],axis=1,inplace=True)
data.drop(['date'],axis=1,inplace=True)
data.drop(['sampling_date'],axis=1,inplace=True)
data.drop(['location_monitoring_station'],axis=1,inplace=True)

data.isnull().sum()
```

```
state            0
location         3
type          5393
so2          34646
no2          16233
rspm         40222
spm         237387
pm2_5       426428
dtype: int64
```

```
data['location']=data['location'].fillna(data['location'].mode()[0])
data['type']=data['type'].fillna(data['type'].mode()[0])
data.fillna(0, inplace=True)

data.isnull().sum()
```

```
state       0
location    0
type        0
so2         0
no2         0
rspm        0
spm         0
pm2_5       0
dtype: int64
```

```
data
```

```
                              state   location  \
0                     Andhra Pradesh  Hyderabad
1                     Andhra Pradesh  Hyderabad
2                     Andhra Pradesh  Hyderabad
3                     Andhra Pradesh  Hyderabad
4                     Andhra Pradesh  Hyderabad
...                              ...        ...
435737                   West Bengal   ULUBERIA
435738                   West Bengal   ULUBERIA
435739  andaman-and-nicobar-islands   Guwahati
435740                   Lakshadweep   Guwahati
435741                       Tripura   Guwahati

                                       type   so2   no2   rspm  spm
pm2_5
0       Residential, Rural and other Areas   4.8  17.4    0.0  0.0
0.0
1                           Industrial Area   3.1   7.0    0.0  0.0
0.0
2       Residential, Rural and other Areas   6.2  28.5    0.0  0.0
0.0
3       Residential, Rural and other Areas   6.3  14.7    0.0  0.0
0.0
4                           Industrial Area   4.7   7.5    0.0  0.0
0.0
...                                     ...   ...   ...    ...  ...
...
435737                               RIRUO  22.0  50.0  143.0  0.0
0.0
435738                               RIRUO  20.0  46.0  171.0  0.0
0.0
435739  Residential, Rural and other Areas   0.0   0.0    0.0  0.0
0.0
435740  Residential, Rural and other Areas   0.0   0.0    0.0  0.0
0.0
435741  Residential, Rural and other Areas   0.0   0.0    0.0  0.0
0.0

[435742 rows x 8 columns]
```

```
data['state'].value_counts()
```

```
Maharashtra                   60384
Uttar Pradesh                 42816
Andhra Pradesh                26368
Punjab                        25634
Rajasthan                     25589
Kerala                        24728
```

```
Himachal Pradesh                 22896
West Bengal                      22463
Gujarat                          21279
Tamil Nadu                       20597
Madhya Pradesh                   19920
Assam                            19361
Odisha                           19279
Karnataka                        17119
Delhi                             8551
Chandigarh                        8520
Chhattisgarh                      7831
Goa                               6206
Jharkhand                         5968
Mizoram                           5338
Telangana                         3978
Meghalaya                         3853
Puducherry                        3785
Haryana                           3420
Nagaland                          2463
Bihar                             2275
Uttarakhand                       1961
Jammu & Kashmir                   1289
Daman & Diu                        782
Dadra & Nagar Haveli               634
Uttaranchal                        285
Arunachal Pradesh                   90
Manipur                             76
Sikkim                               1
andaman-and-nicobar-islands          1
Lakshadweep                          1
Tripura                              1
Name: state, dtype: int64
```

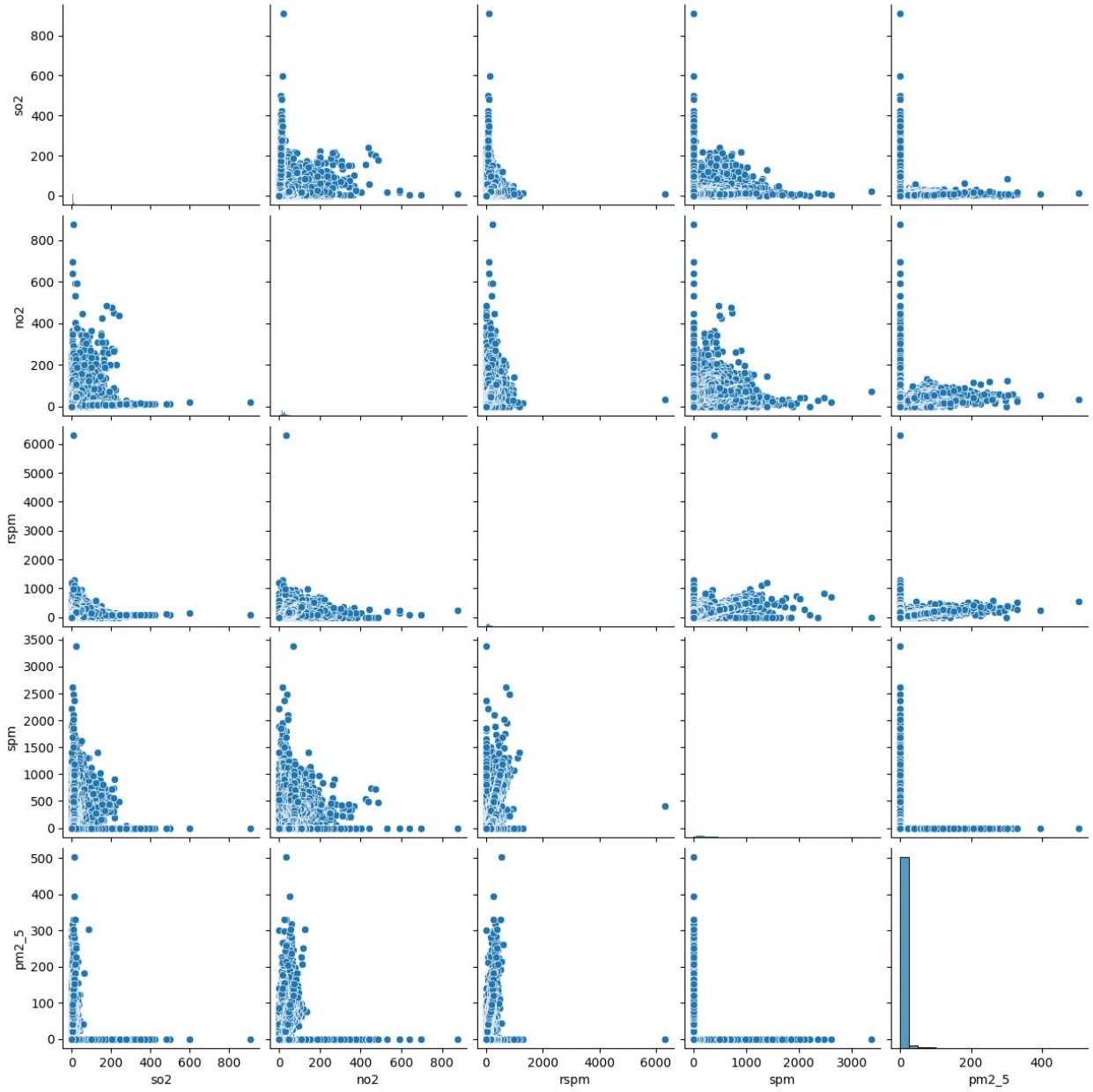
```
data['type'].value_counts()
```

```
Residential, Rural and other Areas    184407
Industrial Area                        96091
Residential and others                 86791
Industrial Areas                       51747
Sensitive Area                          8980
Sensitive Areas                         5536
RIRUO                                   1304
Sensitive                                495
Industrial                               233
Residential                              158
Name: type, dtype: int64
```

Data Visualization

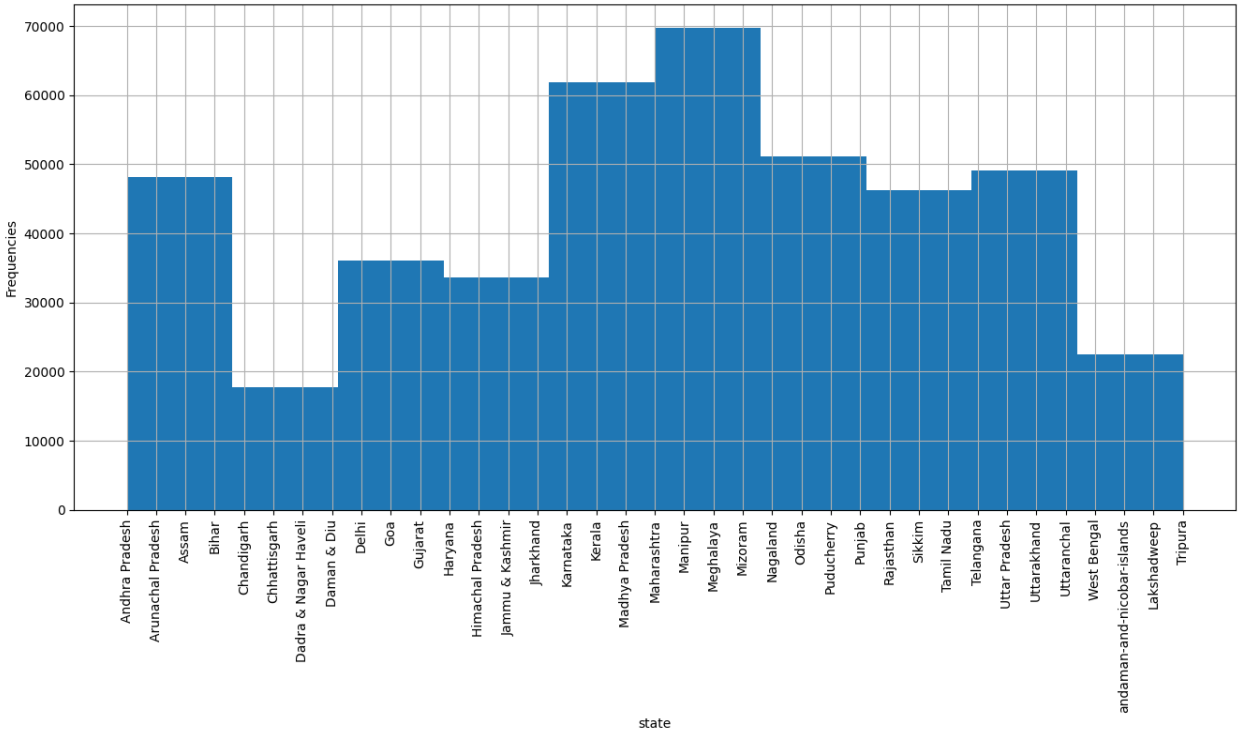
```
sns.pairplot(data=data)
```

```
<seaborn.axisgrid.PairGrid at 0x79b129e4b4f0>
```



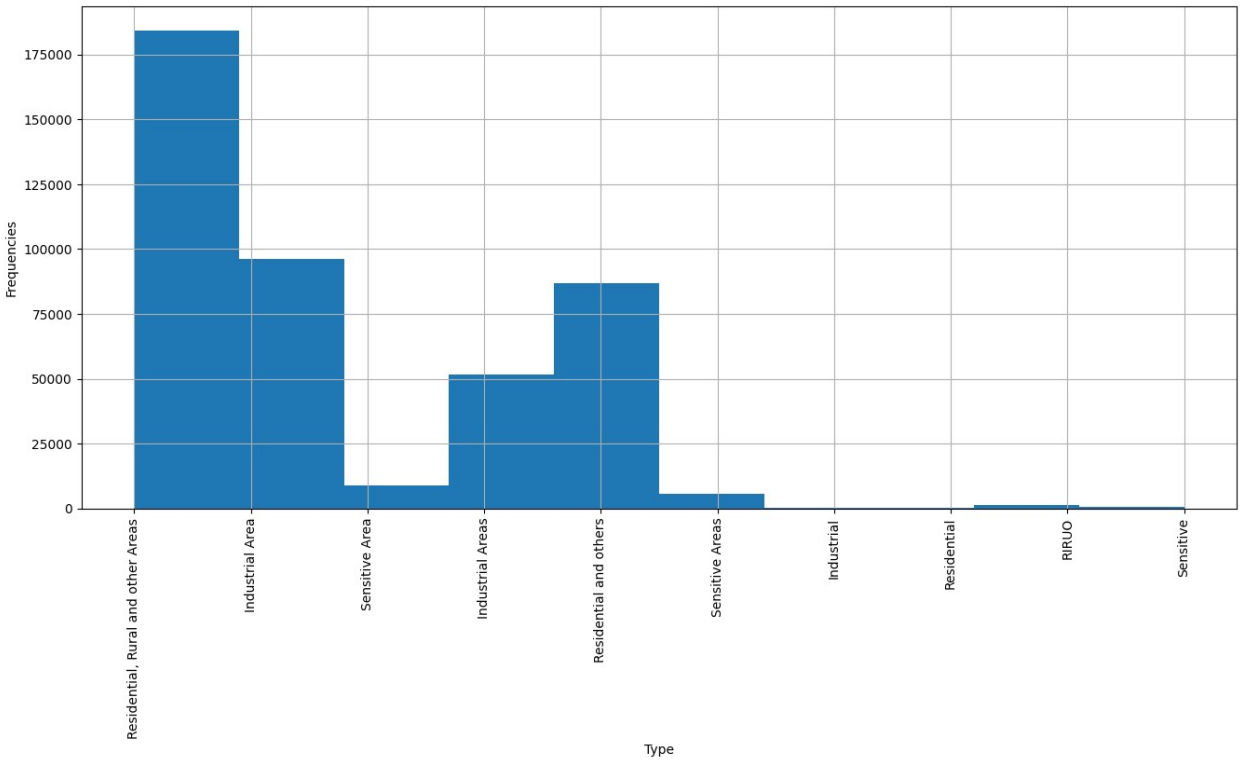

```
plt.figure(figsize=(16, 7))
plt.xticks(rotation=90)
data.state.hist()
plt.xlabel('state')
plt.ylabel('Frequencies')
plt.plot()
```

```
[]
```

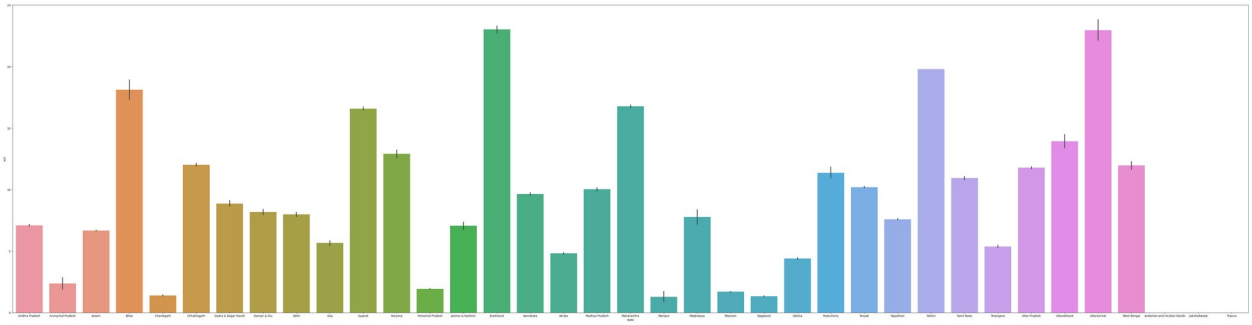



```
plt.figure(figsize=(16, 7))
plt.xticks(rotation=90)
data.type.hist()
plt.xlabel('Type')
plt.ylabel('Frequencies')
plt.plot()
```

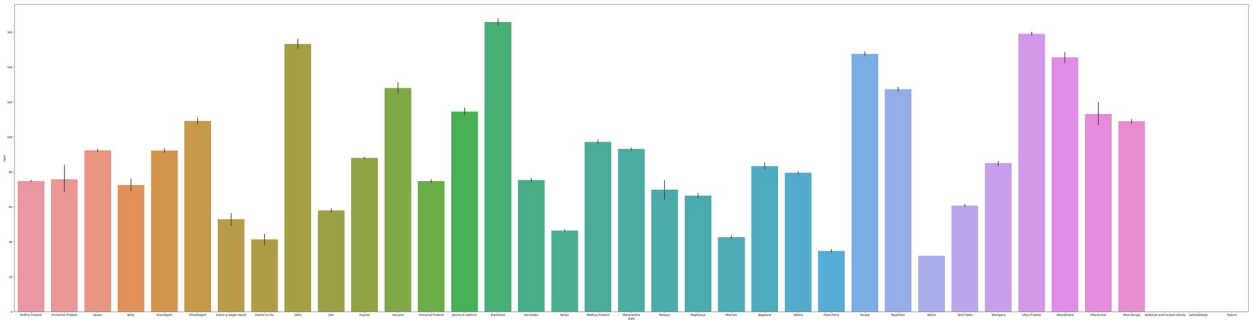
```
[]
```



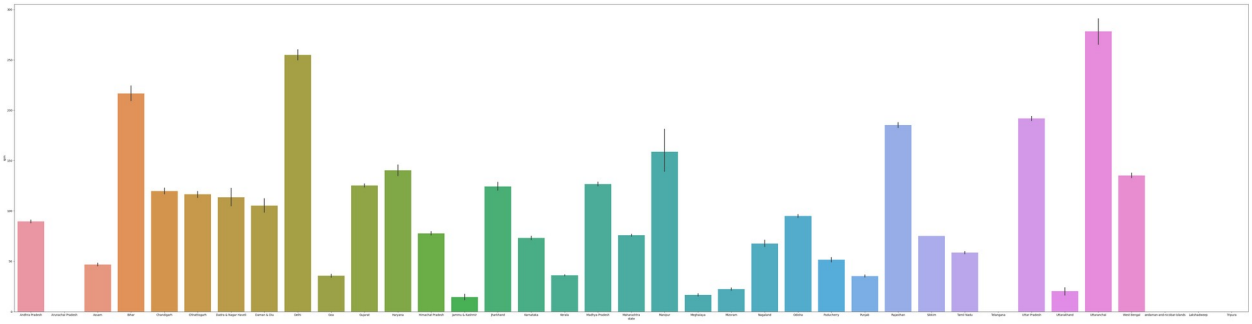

```
plt.figure(figsize=(80, 20))
sns.barplot(x='state',y='so2',data=data);
```



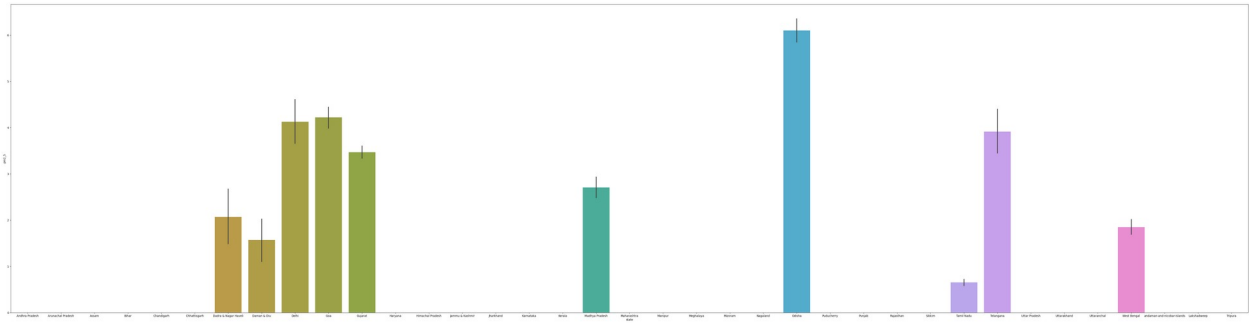
```
plt.figure(figsize=(80, 20))
sns.barplot(x='state',y='rspm',data=data);
```



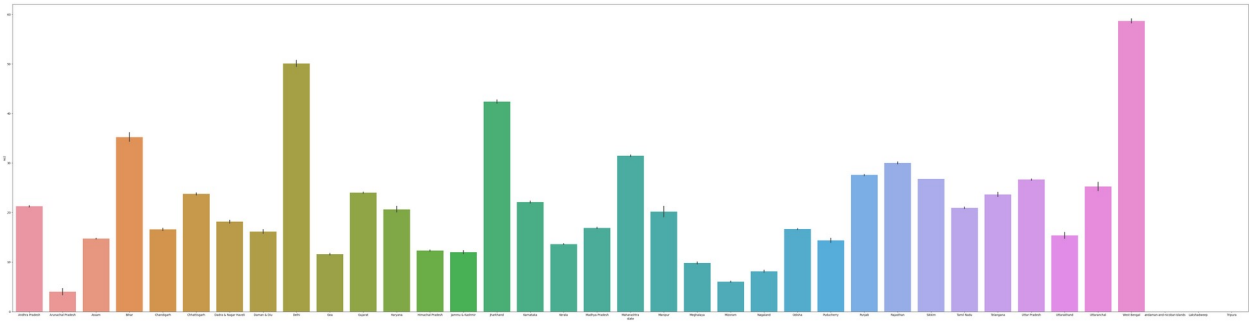
```
plt.figure(figsize=(80, 20))
sns.barplot(x='state',y='spm',data=data);
```



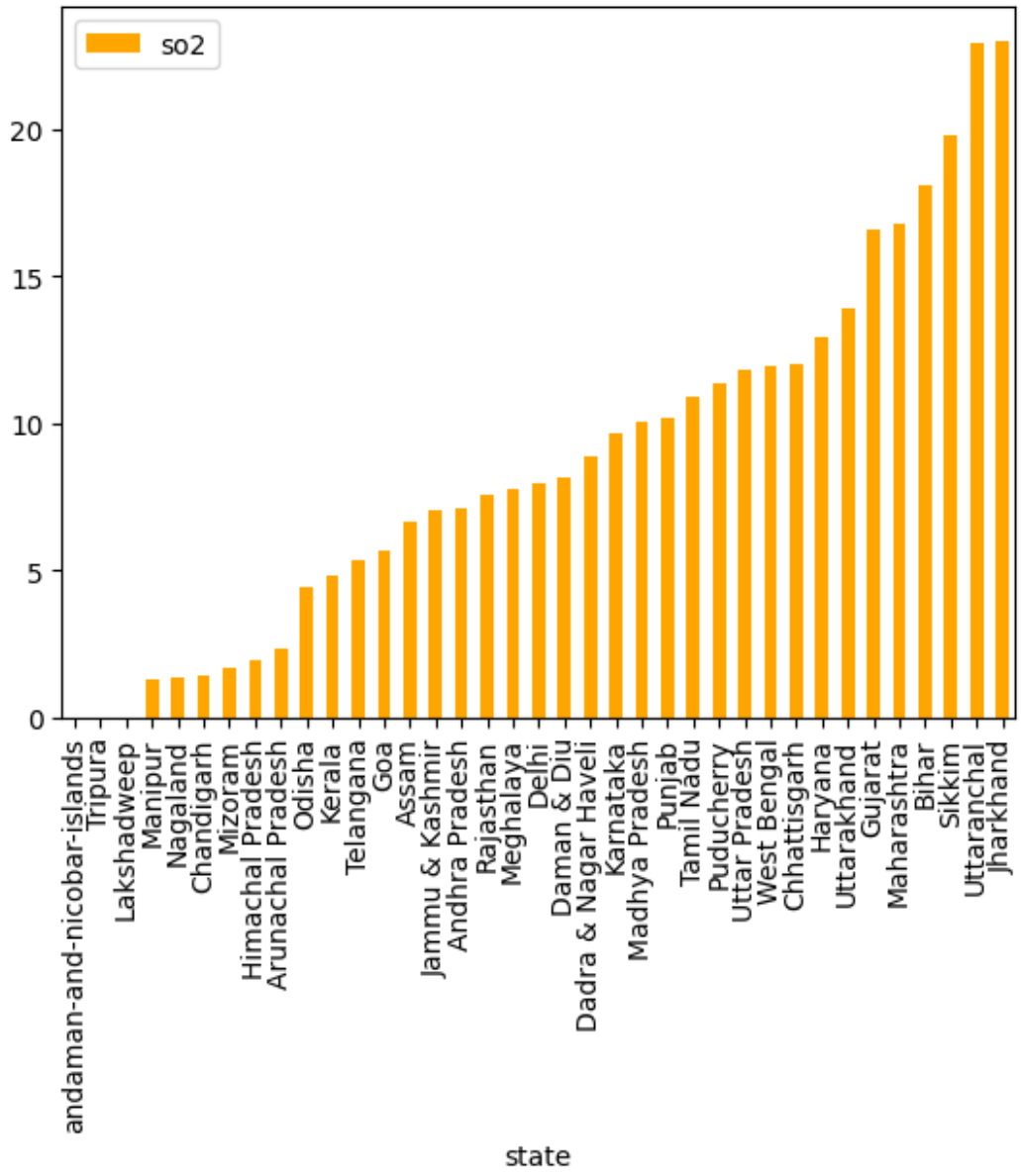
```
plt.figure(figsize=(80, 20))
sns.barplot(x='state',y='pm2_5',data=data);
```



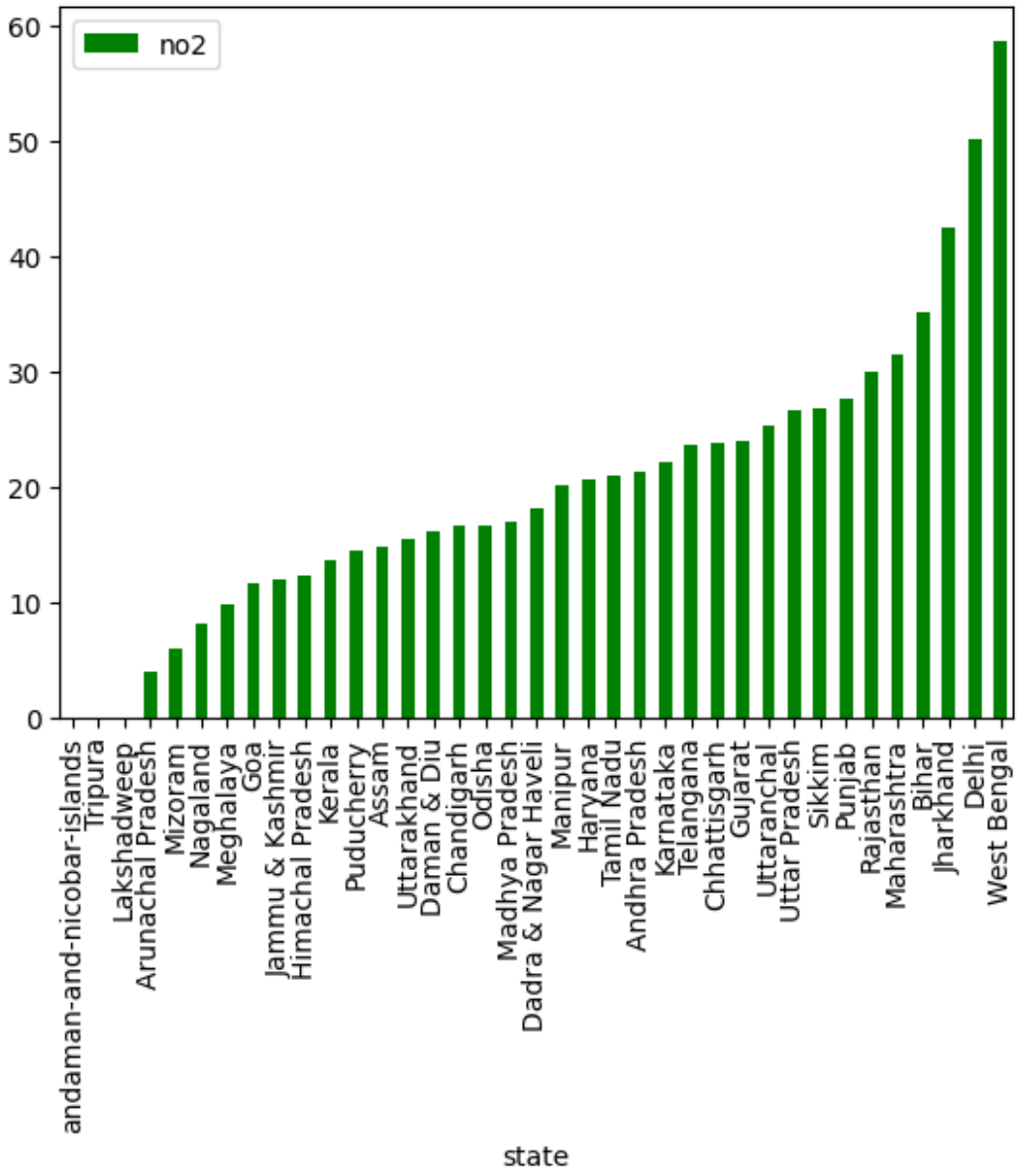
```
plt.figure(figsize=(80, 20))
sns.barplot(x='state',y='no2',data=data);
```



```
data[['so2','state']].groupby(["state"]).mean().sort_values(by='so2').
plot.bar(color='orange')
plt.show()
```




```
data[['no2','state']].groupby(["state"]).mean().sort_values(by='no2').
plot.bar(color='green')
plt.show()
```



Air Quality Index Calculation

```
def cal_SOi(so2):
    si=0
    if (so2<=40):
     si= so2*(50/40)
    elif (so2>40 and so2<=80):
     si= 50+(so2-40)*(50/40)
    elif (so2>80 and so2<=380):
     si= 100+(so2-80)*(100/300)
    elif (so2>380 and so2<=800):
     si= 200+(so2-380)*(100/420)
    elif (so2>800 and so2<=1600):
```

```
     si= 300+(so2-800)*(100/800)
    elif (so2>1600):
     si= 400+(so2-1600)*(100/800)
    return si
data['SOi']=data['so2'].apply(cal_SOi)
df= data[['so2','SOi']]
df.head()
```

```
   so2    SOi
0  4.8  6.000
1  3.1  3.875
2  6.2  7.750
3  6.3  7.875
4  4.7  5.875
```

```
def cal_NOi(no2):
    ni=0
    if(no2<=40):
     ni= no2*50/40
    elif(no2>40 and no2<=80):
     ni= 50+(no2-40)*(50/40)
    elif(no2>80 and no2<=180):
     ni= 100+(no2-80)*(100/100)
    elif(no2>180 and no2<=280):
     ni= 200+(no2-180)*(100/100)
    elif(no2>280 and no2<=400):
     ni= 300+(no2-280)*(100/120)
    else:
     ni= 400+(no2-400)*(100/120)
    return ni
data['NOi']=data['no2'].apply(cal_NOi)
df=data[['no2','NOi']]
df.head()
```

```
    no2     NOi
0  17.4  21.750
1   7.0   8.750
2  28.5  35.625
3  14.7  18.375
4   7.5   9.375
```

```
def cal_RSPMI(rspm):
  rpi=0
  if(rpi<=30):
    rpi=rpi*50/30
  elif(rpi>30 and rpi<=60):
    rpi=50+(rpi-30)*50/30
  elif(rpi>60 and rpi<=90):
    rpi=100+(rpi-60)*100/30
  elif(rpi>90 and rpi<=120):
```

```
    rpi=200+(rpi-90)*100/30
  elif(rpi>120 and rpi<=250):
    rpi=300+(rpi-120)*(100/130)
  else:
    rpi=400+(rpi-250)*(100/130)
  return rpi
data['Rpi']=data['rspm'].apply(cal_RSPMI)
df= data[['rspm','Rpi']]
df.head()
```

	rspm	Rpi
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0

```
def cal_SPMi(spm):
    spi=0
    if(spm<=50):
     spi=spm*50/50
    elif(spm>50 and spm<=100):
     spi=50+(spm-50)*(50/50)
    elif(spm>100 and spm<=250):
     spi= 100+(spm-100)*(100/150)
    elif(spm>250 and spm<=350):
     spi=200+(spm-250)*(100/100)
    elif(spm>350 and spm<=430):
     spi=300+(spm-350)*(100/80)
    else:
     spi=400+(spm-430)*(100/430)
    return spi
data['SPMi']=data['spm'].apply(cal_SPMi)
df= data[['spm','SPMi']]
df.head()
```

	spm	SPMi
0	0.0	0.0
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
4	0.0	0.0

```
def cal_aqi(si,ni,rspmi,spmi):
    aqi=0
    if(si>ni and si>rspmi and si>spmi):
     aqi=si
    if(ni>si and ni>rspmi and ni>spmi):
     aqi=ni
    if(rspmi>si and rspmi>ni and rspmi>spmi):
```

```
     aqi=rspmi
    if(spmi>si and spmi>ni and spmi>rspmi):
     aqi=spmi
    return aqi
data['AQI']=data.apply(lambda
x:cal_aqi(x['SOi'],x['NOi'],x['Rpi'],x['SPMi']),axis=1)
df= data[['state','SOi','NOi','Rpi','SPMi','AQI']]
df.head()
```

	state	SOi	NOi	Rpi	SPMi	AQI
0	Andhra Pradesh	6.000	21.750	0.0	0.0	21.750
1	Andhra Pradesh	3.875	8.750	0.0	0.0	8.750
2	Andhra Pradesh	7.750	35.625	0.0	0.0	35.625
3	Andhra Pradesh	7.875	18.375	0.0	0.0	18.375
4	Andhra Pradesh	5.875	9.375	0.0	0.0	9.375

```
def AQIrange(x):
    if x<=50:
        return "Good"
    elif x>50 and x<=100:
        return "Moderate"
    elif x>100 and x<=200:
        return "Poor"
    elif x>200 and x<=300:
        return "Unhealthy"
    elif x>300 and x<=400:
        return "Very unhealthy"
    elif x>400:
        return "Hazardous"
data['AQIrange'] = data['AQI'].apply(AQIrange)
data.head()
```

	state	location	type	so2	no2	\
0	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	4.8	17.4	
1	Andhra Pradesh	Hyderabad	Industrial Area	3.1	7.0	
2	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	6.2	28.5	
3	Andhra Pradesh	Hyderabad	Residential, Rural and other Areas	6.3	14.7	
4	Andhra Pradesh	Hyderabad	Industrial Area	4.7	7.5	

	rspm	spm	pm2_5	SOi	NOi	Rpi	SPMi	AQI	AQIrange
0	0.0	0.0	0.0	6.000	21.750	0.0	0.0	21.750	Good
1	0.0	0.0	0.0	3.875	8.750	0.0	0.0	8.750	Good
2	0.0	0.0	0.0	7.750	35.625	0.0	0.0	35.625	Good

```
3   0.0  0.0    0.0  7.875  18.375  0.0   0.0  18.375     Good
4   0.0  0.0    0.0  5.875   9.375  0.0   0.0   9.375     Good
```

```
data['AQIrange'].value_counts()
```

```
Good               219643
Poor                93272
Moderate            56571
Unhealthy           31733
Hazardous           18700
Very unhealthy      15823
Name: AQIrange, dtype: int64
```

```
X=data[['SOi','NOi','Rpi','SPMi']]
Y=data['AQI']
```

```
X.head()
```

```
     SOi     NOi  Rpi  SPMi
0  6.000  21.750  0.0   0.0
1  3.875   8.750  0.0   0.0
2  7.750  35.625  0.0   0.0
3  7.875  18.375  0.0   0.0
4  5.875   9.375  0.0   0.0
```

```
Y.head()
```

```
0    21.750
1     8.750
2    35.625
3    18.375
4     9.375
Name: AQI, dtype: float64
```

Dependent and Independent Columns

```
X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2,rando
m_state=70)
print(X_train.shape,X_test.shape,Y_train.shape,Y_test.shape)
```

```
(348593, 4) (87149, 4) (348593,) (87149,)
```

Linear Regression

```
LR=LinearRegression()
LR.fit(X_train,Y_train)
train_pred=LR.predict(X_train)
test_pred=LR.predict(X_test)

train=(np.sqrt(metrics.mean_squared_error(Y_train,train_pred)))
test=(np.sqrt(metrics.mean_squared_error(Y_test,test_pred)))
```

```
print("Training Data = ",str(train))
print("Test Data = ",str(test))
print('RSquared train = ',LR.score(X_train, Y_train))
print('RSquared test = ',LR.score(X_test, Y_test))
```

```
Training Data =  13.583424938613533
Test Data =  13.672937344789002
RSquared train =  0.9849533579250526
RSquared test =  0.9847286394495923
```

Decision Tree Regressor

```
DT=DecisionTreeRegressor()
DT.fit(X_train,Y_train)
train_preds=DT.predict(X_train)
test_preds=DT.predict(X_test)

train=(np.sqrt(metrics.mean_squared_error(Y_train,train_preds)))
test=(np.sqrt(metrics.mean_squared_error(Y_test,test_preds)))
print("Training Data = ",str(train))
print("Test Data = ",str(test))
print('RSquared train = ',DT.score(X_train, Y_train))
print('RSquared test = ',DT.score(X_test, Y_test))
```

```
Training Data =  2.2229525650430966e-13
Test Data =  1.2981180064739768
RSquared train =  1.0
RSquared test =  0.9998623480298214
```

Random Forest Regressor

```
RF=RandomForestRegressor().fit(X_train,Y_train)
train_preds=RF.predict(X_train)
test_preds=RF.predict(X_test)

train=(np.sqrt(metrics.mean_squared_error(Y_train,train_preds)))
test=(np.sqrt(metrics.mean_squared_error(Y_test,test_preds)))
print("Training Data = ",str(train))
print("Test Data = ",str(test))
print('RSquared train = ',RF.score(X_train, Y_train))
print('RSquared test = ',RF.score(X_test, Y_test))
```

```
Training Data =  0.4304601648808581
Test Data =  1.1722256443615848
RSquared train =  0.999984889217615
RSquared test =  0.999887752540722
```

Classification

```
X2=data[['SOi','NOi','Rpi','SPMi']]
Y2=data['AQIrange']

X_trains,X_tests,Y_trains,Y_tests=train_test_split(X2,Y2,test_size=0.3
3,random_state=70)
```

Logistic Regression

```
logistic_reg=LogisticRegression().fit(X_trains,Y_trains)
train_prediction=logistic_reg.predict(X_trains)
print("Accuracy train= ",accuracy_score(Y_trains,train_prediction))
test_prediction=logistic_reg.predict(X_tests)
print("Accuracy test= ",accuracy_score(Y_tests,test_prediction))
print("KappaScore=
",metrics.cohen_kappa_score(Y_tests,test_prediction))
```

```
Accuracy train=  0.7276012426913104
Accuracy test=  0.7271254216071491
KappaScore=  0.584377382981496
```

```
logistic_reg.predict([[4.1,13.3,22,51]])
```

```
array(['Poor'], dtype=object)
```

```
logistic_reg.predict([[16.4,6.3,51,107]])
```

```
array(['Unhealthy'], dtype=object)
```

```
logistic_reg.predict([[654,321,73,107]])
```

```
array(['Moderate'], dtype=object)
```

```
logistic_reg.predict([[734,327,71,100]])
```

```
array(['Good'], dtype=object)
```

Decision Tree Classifier

```
decision_tree=DecisionTreeClassifier().fit(X_trains,Y_trains)
train_prediction2=decision_tree.predict(X_trains)
print("Accuracy train= ",accuracy_score(Y_trains,train_prediction2))
test_prediction2=decision_tree.predict(X_tests)
print("Accuracy test= ",accuracy_score(Y_tests,test_prediction))
print("KappaScore=
",metrics.cohen_kappa_score(Y_tests,test_prediction2))
```

```
Accuracy train=  1.0
Accuracy test=  0.7271254216071491
KappaScore=  0.9997111966529943
```

```
decision_tree.predict([[24,32,21,45]])
```

```
array(['Good'], dtype=object)
```

```
decision_tree.predict([[654,321,73,107]])
```

```
array(['Very unhealthy'], dtype=object)
```

```
decision_tree.predict([[4.1,13.3,22,51]])
```

```
array(['Moderate'], dtype=object)
```

```
decision_tree.predict([[734,327,71,100]])
```

```
array(['Unhealthy'], dtype=object)
```

Random Forest Classifier

```
random_forest=RandomForestClassifier().fit(X_trains,Y_trains)
train_prediction3=random_forest.predict(X_trains)
print("Accuracy train= ",accuracy_score(Y_trains,train_prediction3))
test_prediction3=random_forest.predict(X_tests)
print("Accuracy test= ",accuracy_score(Y_tests,test_prediction3))
print("KappaScore=
",metrics.cohen_kappa_score(Y_tests,test_prediction3))
```

```
Accuracy train=  1.0
Accuracy test=  0.9998191870371014
KappaScore=  0.9997318272798166
```

```
random_forest.predict([[24,32,21,45]])
```

```
array(['Good'], dtype=object)
```

```
random_forest.predict([[654,321,73,107]])
```

```
array(['Unhealthy'], dtype=object)
```

```
random_forest.predict([[4.1,13.3,22,51]])
```

```
array(['Moderate'], dtype=object)
```

```
random_forest.predict([[734,327,71,100]])
```

```
array(['Unhealthy'], dtype=object)
```

K-Nearest Neighbours

```
KNN=KNeighborsClassifier().fit(X_trains,Y_trains)
train_prediction4=KNN.predict(X_trains)
print("Accuracy train= ",accuracy_score(Y_trains,train_prediction4))
test_prediction4=KNN.predict(X_tests)
print("Accuracy test= ",accuracy_score(Y_tests,test_prediction4))
```

```
print("KappaScore=
",metrics.cohen_kappa_score(Y_tests,test_prediction4))
```

```
Accuracy train=  0.9981640503242026
Accuracy test=  0.9967105949441913
KappaScore=  0.9951204869122668
```

```
KNN.predict([[6,17.8,100,156]])
```

```
array(['Poor'], dtype=object)
```