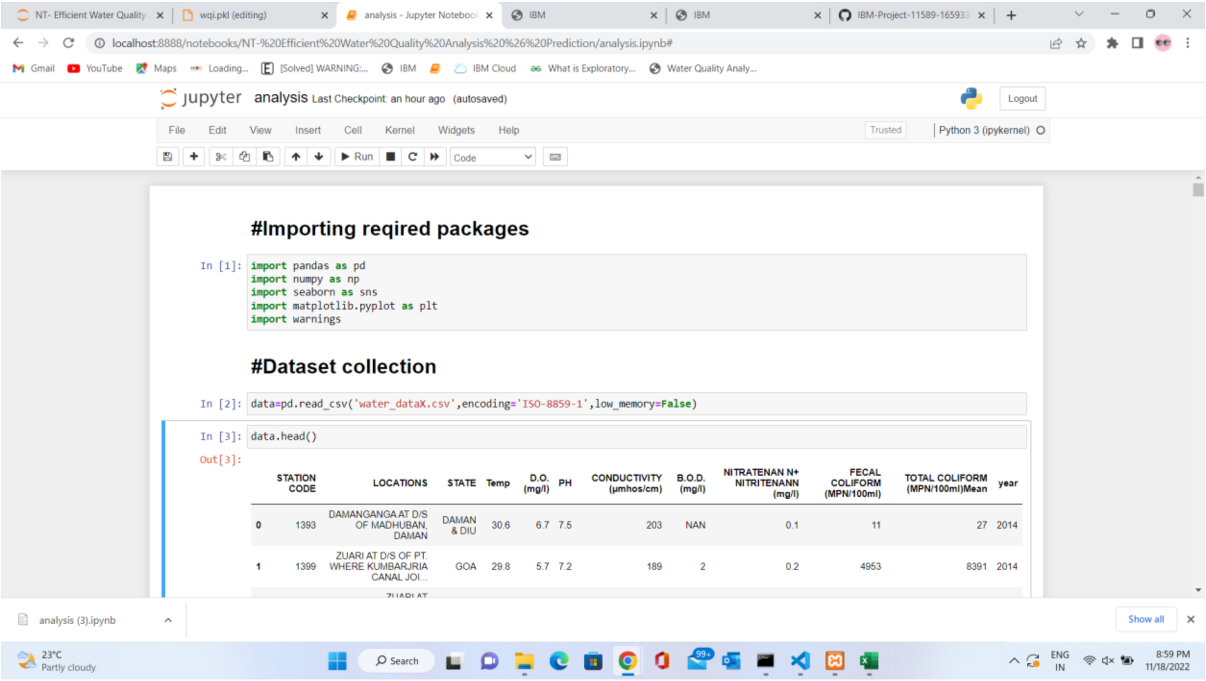


#Importing reqired packages

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

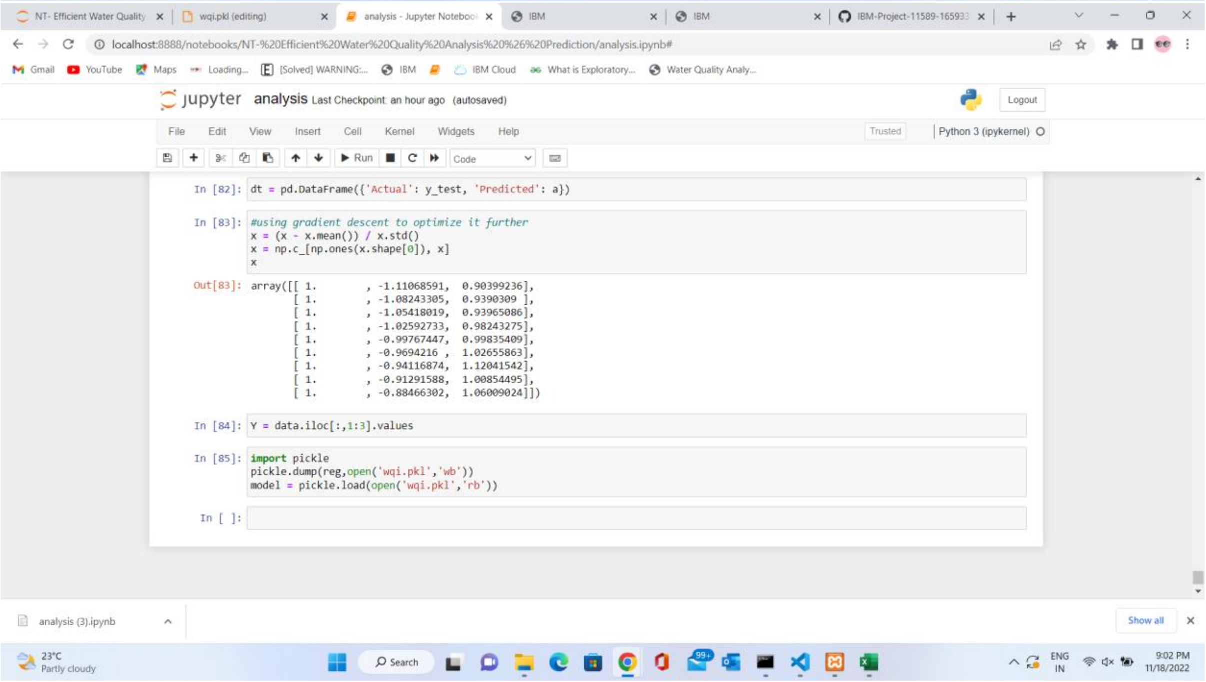
#Dataset collection

In [2]:
```
data=pd.read_csv('water_dataX.csv',encoding='ISO-8859-1',low_memory=False)
```

In [3]:
```
data.head()
```

Out[3]:

	STATION CODE	LOCATIONS	STATE	Temp	D.O. (mg/l)	PH	CONDUCTIVITY (µmhos/cm)	B.O.D. (mg/l)	NITRATENAN N+ NITRITENANN (mg/l)	FECAL COLIFORM (MPN/100ml)	TOTAL COLIFORM (MPN/100ml)Mean	year
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	11	27	2014
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	4953	8391	2014



In [82]:
```
dt = pd.DataFrame({'Actual': y_test, 'Predicted': a})
```

In [83]:
```
#using gradient descent to optimize it further
x = (x - x.mean()) / x.std()
x = np.c_[np.ones(x.shape[0]), x]
x
```

Out[83]:
```
array([[ 1.        , -1.11068591,  0.90399236],
       [ 1.        , -1.08243305,  0.9390309 ],
       [ 1.        , -1.05418019,  0.93965086],
       [ 1.        , -1.02592733,  0.98243275],
       [ 1.        , -0.99767447,  0.99835409],
       [ 1.        , -0.9694216 ,  1.02655863],
       [ 1.        , -0.94116874,  1.12041542],
       [ 1.        , -0.91291588,  1.00854495],
       [ 1.        , -0.88466302,  1.06009024]])
```

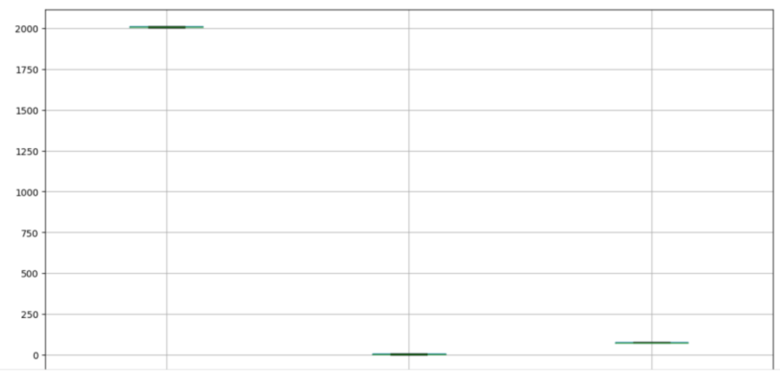
In [84]:
```
Y = data.iloc[:,1:3].values
```

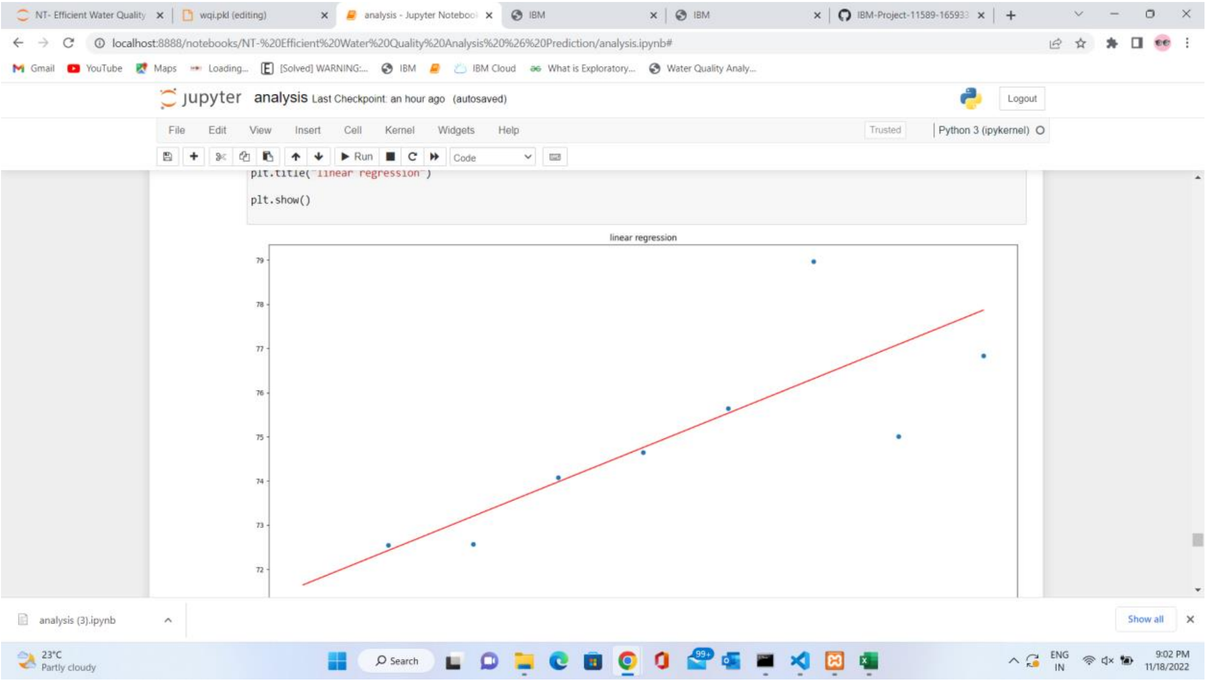
In [85]:
```
import pickle
pickle.dump(reg,open('wqi.pkl','wb'))
model = pickle.load(open('wqi.pkl','rb'))
```

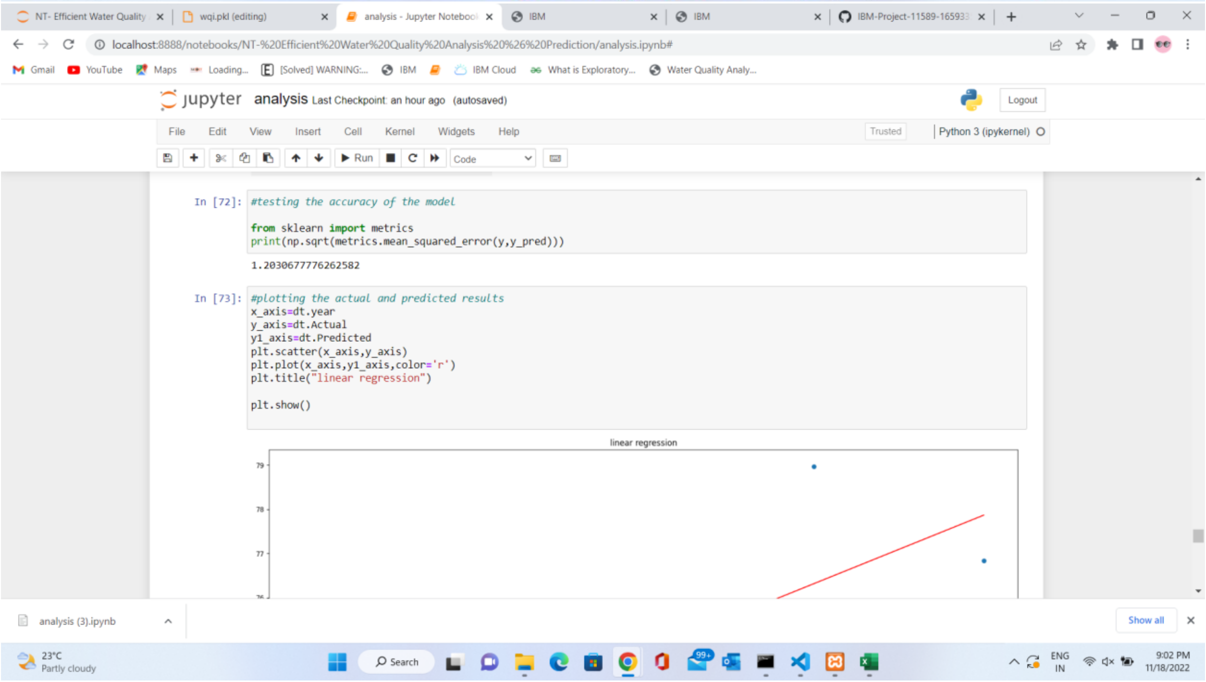
In [ ]:

```
In [75]: #Splitting the data into dependent and independent variables
         x = data.iloc[:,1:7].values

In [76]: x.shape
Out[76]: (9, 2)

In [77]: y = data.iloc[:,7:].values

In [78]: y.shape
Out[78]: (9, 0)

In [79]: a=reg.predict(x_test)
         a
Out[79]: array([73.85895419, 74.59338162])

In [80]: y_test
Out[80]: 3    74.085193
         4    74.648723
         Name: wqi, dtype: float64

In [81]: from sklearn.metrics import mean_squared_error
         print('mse:%.2f'%mean_squared_error(y_test,a))

         mse:0.03
```

```
In [74]: data.boxplot(figsize=(14,7))
Out[74]: <AxesSubplot:>
```




analysis Last Checkpoint: an hour ago (autosaved)
plt.title("linear regression")
plt.show()
linear regression
analysis (3).ipynb


analysis Last Checkpoint: an hour ago (autosaved)
In [72]: #testing the accuracy of the model
from sklearn import metrics
print(np.sqrt(metrics.mean_squared_error(y,y_pred)))
1.2030677776262582
In [73]: #plotting the actual and predicted results
x_axis=dt.year
y_axis=dt.Actual
y1_axis=dt.Predicted
plt.scatter(x_axis,y_axis)
plt.plot(x_axis,y1_axis,color='r')
plt.title("linear regression")
plt.show()
linear regression
analysis (3).ipynb

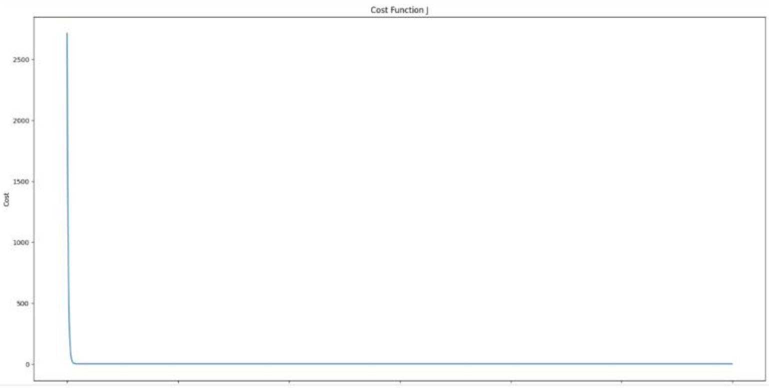
In [71]:

```python
#prediction of january(2013-2015) across india
import numpy as np
newB=[74.76, 2.13]

def rmse(y,y_pred):
    rmse= np.sqrt(sum(y-y_pred))
    return rmse


y_pred=x.dot(newB)

dt = pd.DataFrame({'Actual': y, 'Predicted': y_pred})
dt=pd.concat([data, dt], axis=1)
dt
```

Out[71]:

	year	index	wqi	Actual	Predicted
0	2006	0	71.308824	71.308824	71.648936
1	2007	1	72.549000	72.549000	72.426702
2	2008	2	72.570943	72.570943	73.204468
3	2009	3	74.085193	74.085193	73.982234
4	2010	4	74.648723	74.648723	74.760000
5	2011	5	75.647013	75.647013	75.537766
6	2012	6	78.969041	78.969041	76.315532
7	2013	7	75.009425	75.009425	77.093298
8	2014	8	76.833852	76.833852	77.871064

```python
plt.ylabel('cost')
plt.plot(past_costs)
plt.show()
```



```
In [69]: alpha = 0.1 #Step size
         iterations = 3000 #No. of iterations
         m = y.size #No. of data points
         np.random.seed(4) #Setting the seed
         theta = np.random.rand(2) #Picking some random values to start with

         def gradient_descent(x, y, theta, iterations, alpha):
             past_costs = []
             past_thetas = [theta]
             for i in range(iterations):
                 prediction = np.dot(x, theta)
                 error = prediction - y
                 cost = 1/(2*m) * np.dot(error.T, error)
                 past_costs.append(cost)
                 theta = theta - (alpha * (1/m) * np.dot(x.T, error))
                 past_thetas.append(theta)

             return past_thetas, past_costs

         past_thetas, past_costs = gradient_descent(x, y, theta, iterations, alpha)
         theta = past_thetas[-1]

         #Print the results...
         print("Gradient Descent: {:.2f}, {:.2f}".format(theta[0], theta[1]))

         Gradient Descent: 74.62, 2.00

In [70]: plt.title('Cost Function J')
         plt.xlabel('No. of iterations')
         plt.ylabel('Cost')
         plt.plot(past_costs)
```

```
In [65]: y_test

Out[65]: 3    74.085193
         4    74.648723
         Name: wqi, dtype: float64

In [66]: from sklearn.metrics import mean_squared_error
         print('mse:%.2f'%mean_squared_error(y_test,a))

         mse:0.03

In [67]: dt = pd.DataFrame({'Actual': y_test, 'Predicted': a})

In [68]: #using gradient descent to optimize it further
         x = (x - x.mean()) / x.std()
         x = np.c_[np.ones(x.shape[0]), x]
         x

Out[68]: array([[ 1.        , -1.46059349],
                [ 1.        , -1.09544512],
                [ 1.        , -0.73029674],
                [ 1.        , -0.36514837],
                [ 1.        ,  0.        ],
                [ 1.        ,  0.36514837],
                [ 1.        ,  0.73029674],
                [ 1.        ,  1.09544512],
                [ 1.        ,  1.46059349]])

In [69]: alpha = 0.1 #Step size
```

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

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In [63]:
```
from sklearn import neighbors,datasets
data=data.reset_index(level=0,inplace=False)
data
```

Out[63]:

	year	index	wqi
0	2006	0	71.308824
1	2007	1	72.549000
2	2008	2	72.570943
3	2009	3	74.085193
4	2010	4	74.648723
5	2011	5	75.647013
6	2012	6	78.969041
7	2013	7	75.009425
8	2014	8	76.833852

In [64]:
```
a=reg.predict(x_test)
a
```

Out[64]:
```
array([73.85895419, 74.59338162])
```

In [65]:
```
y_test
```

Out[65]:
```
3    74.085193
4    74.648723
Name: wqi, dtype: float64
```

analysis (3).ipynb Show all

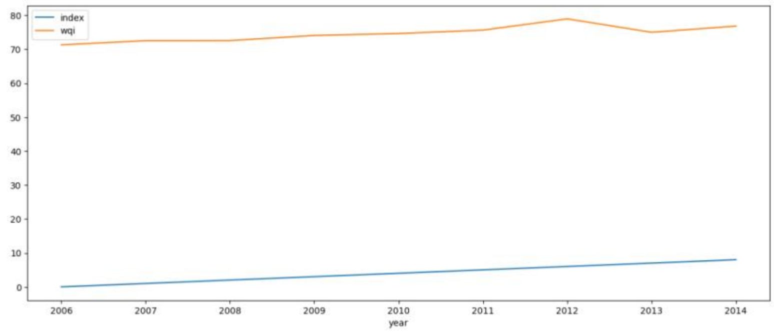
23°C Partly cloudy 9:02 PM 11/18/2022

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

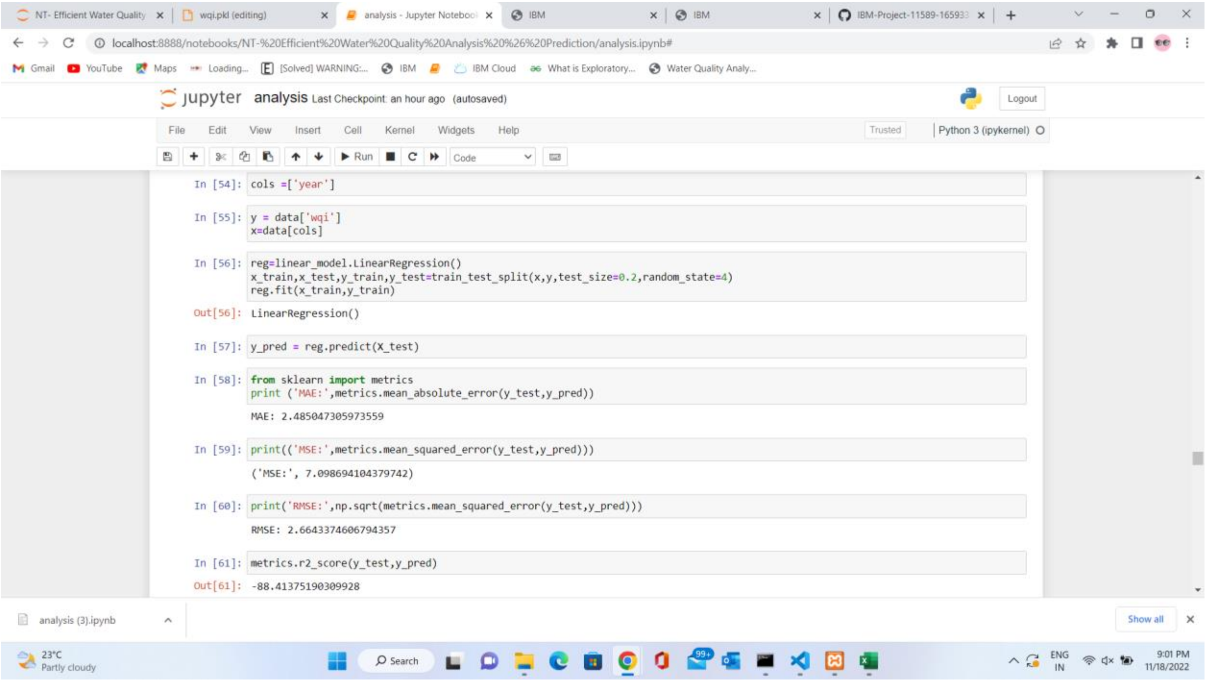
File Edit View Insert Cell Kernel Widgets Help Trusted Python 3 (ipykernel)

In [62]:
```
import matplotlib.pyplot as plt
data=data.set_index('year')
data.plot(figsize=(15,6))
plt.show()
```

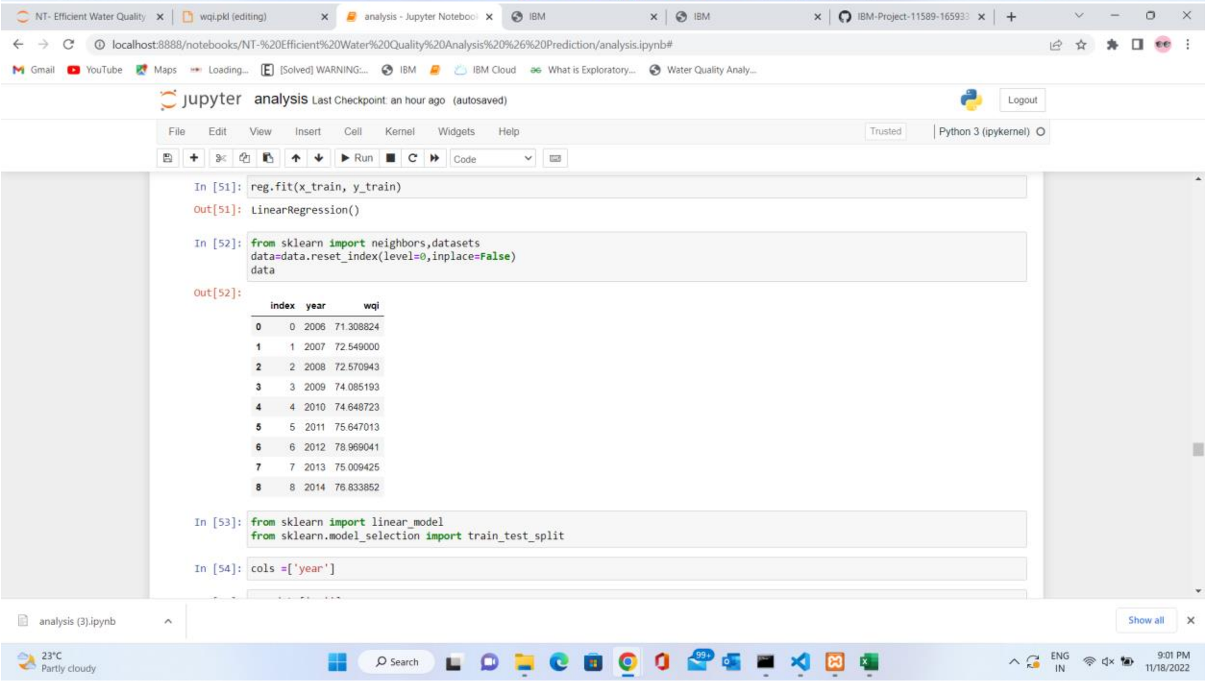


analysis (3).ipynb Show all

23°C Partly cloudy 9:02 PM 11/18/2022



```
In [54]: cols =['year']

In [55]: y = data['wqi']
         x=data[cols]

In [56]: reg=linear_model.LinearRegression()
         x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=4)
         reg.fit(x_train,y_train)

Out[56]: LinearRegression()

In [57]: y_pred = reg.predict(x_test)

In [58]: from sklearn import metrics
         print ('MAE:',metrics.mean_absolute_error(y_test,y_pred))

MAE: 2.485047305973559

In [59]: print(('MSE:',metrics.mean_squared_error(y_test,y_pred)))

('MSE:', 7.098694104379742)

In [60]: print('RMSE:',np.sqrt(metrics.mean_squared_error(y_test,y_pred)))

RMSE: 2.6643374606794357

In [61]: metrics.r2_score(y_test,y_pred)

Out[61]: -88.41375190309928
```



```
In [51]: reg.fit(x_train, y_train)

Out[51]: LinearRegression()

In [52]: from sklearn import neighbors,datasets
         data=data.reset_index(level=0,inplace=False)
         data

Out[52]:
```

	index	year	wqi
0	0	2006	71.308824
1	1	2007	72.549000
2	2	2008	72.570943
3	3	2009	74.085193
4	4	2010	74.648723
5	5	2011	75.647013
6	6	2012	78.969041
7	7	2013	75.009425
8	8	2014	76.833852

```
In [53]: from sklearn import linear_model
         from sklearn.model_selection import train_test_split

In [54]: cols =['year']
```

jupyter analysis Last Checkpoint: an hour ago (autosaved)

```
In [47]: y_train

Out[47]: 5    75.647013
         6    78.969041
         3    74.085193
         1    72.549000
         0    71.308824
         7    75.009425
         4    74.648723
         Name: wqi, dtype: float64
```

```
In [48]: X_test
```

Out[48]:

	year
8	2014
2	2008

```
In [49]: y_test

Out[49]: 8    76.833852
         2    72.570943
         Name: wqi, dtype: float64
```

```
In [50]: reg = linear_model.LinearRegression()
         x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 4)
```

```
In [51]: reg.fit(x_train, y_train)
```

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Splitting data into Train & Test

```
In [43]: from sklearn import neighbors, datasets
         data = data.reset_index(level = 0, inplace = False)
```

```
In [44]: from sklearn import linear_model
```

```
In [45]: 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 = 10)
```

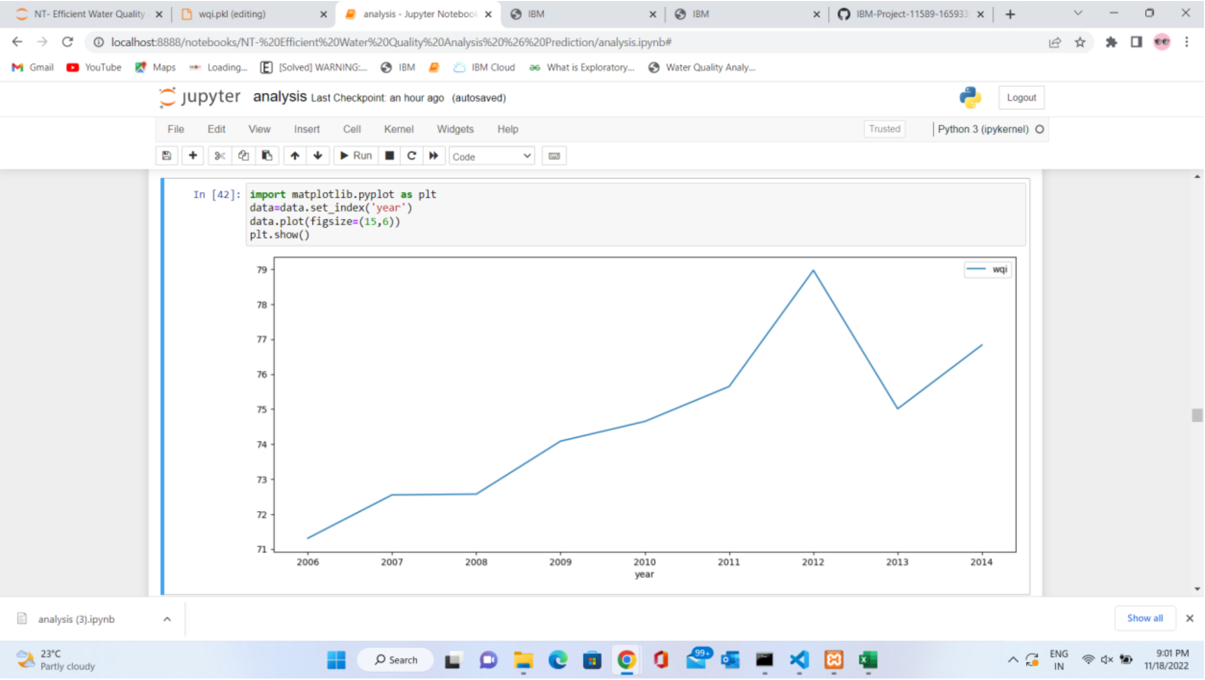
```
In [46]: X_train
```

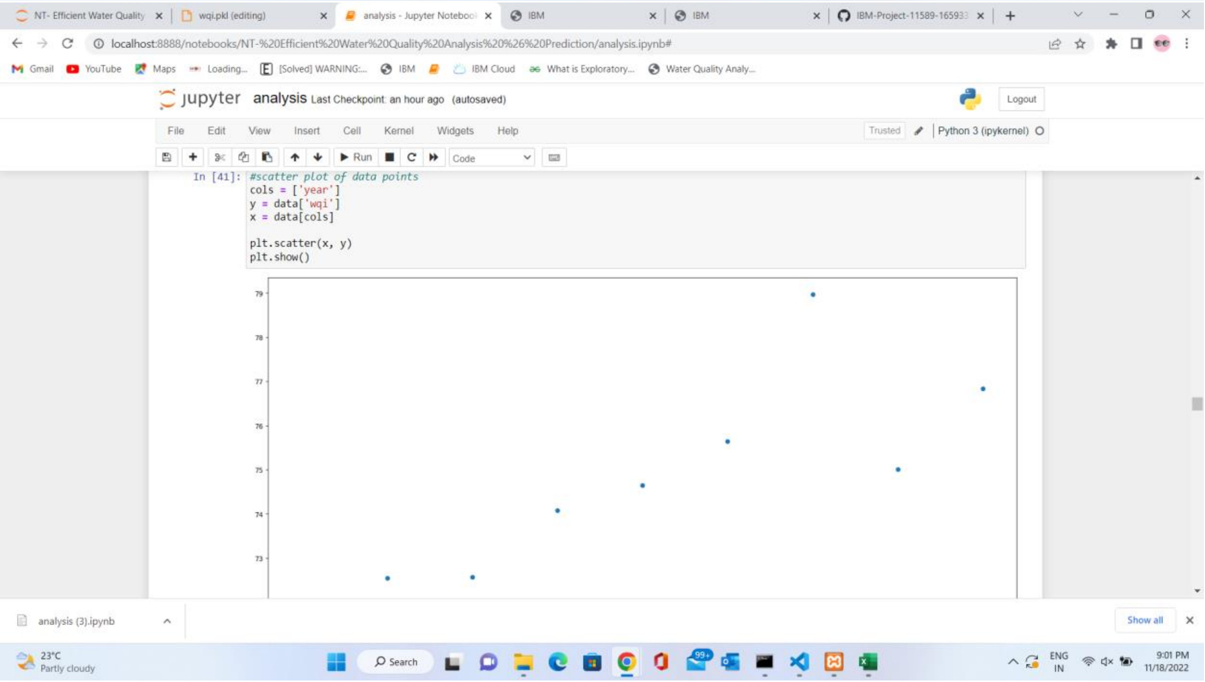
Out[46]:

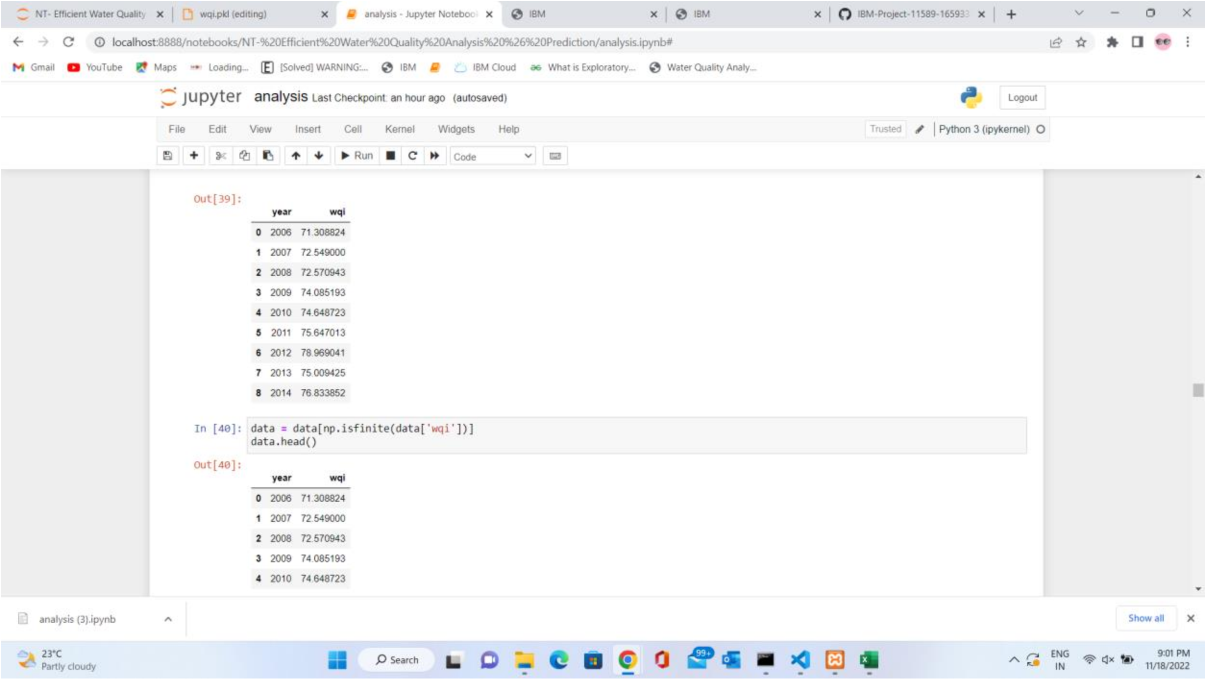
	year
5	2011
6	2012
3	2009
1	2007
0	2006
7	2013
4	2010


```
In [47]: y_train

Out[47]: 5    75.647013
```


analysis - Jupyter Notebook
localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#
jupyter analysis Last Checkpoint: an hour ago (autosaved)
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
In [42]:
import matplotlib.pyplot as plt
data=data.set_index('year')
data.plot(figsize=(15,6))
plt.show()
wqi
79
78
77
76
75
74
73
72
71
2006
2007
2008
2009
2010
2011
2012
2013
2014
year
analysis (3).ipynb
Show all
23°C
Partly cloudy
9:01 PM
11/18/2022


analysis - Jupyter Notebook
localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#
jupyter analysis Last Checkpoint: an hour ago (autosaved)
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
In [41]:
#scatter plot of data points
cols = ['year']
y = data['wqi']
x = data[cols]
plt.scatter(x, y)
plt.show()
analysis (3).ipynb
Show all
23°C
Partly cloudy
9:01 PM
11/18/2022



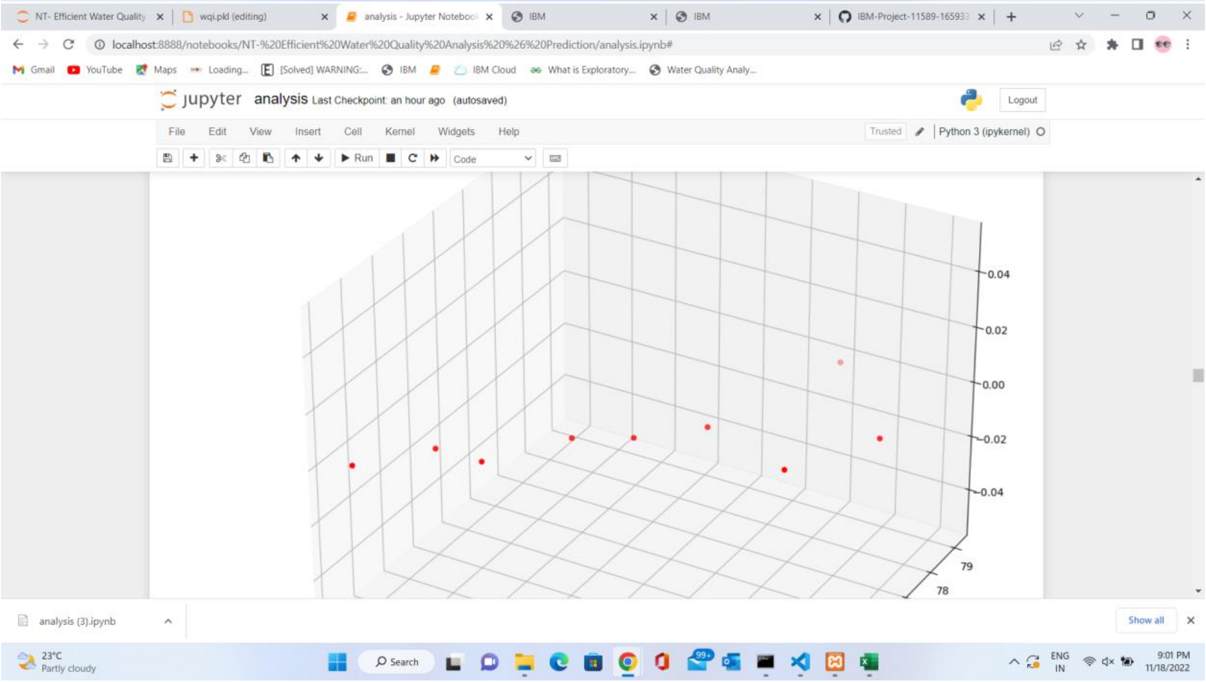
Out[39]:

	year	wqi
0	2006	71.308824
1	2007	72.549000
2	2008	72.570943
3	2009	74.085193
4	2010	74.648723
5	2011	75.647013
6	2012	78.969041
7	2013	75.009425
8	2014	76.833852

In [40]:
```
data = data[np.isfinite(data['wqi'])]
data.head()
```

Out[40]:

	year	wqi
0	2006	71.308824
1	2007	72.549000
2	2008	72.570943
3	2009	74.085193
4	2010	74.648723



Data Visualization

In [36]:
```
import matplotlib.pyplot as plt
%matplotlib inline

plt.rcParams['figure.figsize'] = (20.0, 10.0)
```

In [37]:
```
from mpl_toolkits.mplot3d import Axes3D
```

In [38]:
```
year = data['year'].values
AQI = data['wqi'].values
data['wqi'] = pd.to_numeric(data['wqi'], errors = 'coerce')
data['wqi'] = pd.to_numeric(data['wqi'], errors = 'coerce')
```

In [39]:
```
fig = plt.figure()
ax = Axes3D(fig)
ax.scatter(year, AQI, color = 'red')
plt.show()
data
```

```
c:\users\samit\appdata\local\programs\python\python37\lib\site-packages\ipykernel_launcher.py:2: MatplotlibDeprecationWarning:
Axes3D(fig) adding itself to the figure is deprecated since 3.4. Pass the keyword argument auto_add_to_figure=False and use fi
g.add_axes(ax) to suppress this warning. The default value of auto_add_to_figure will change to False in mpl3.5 and True values
will no longer work in 3.6.  This is consistent with other Axes classes.
```

```
2008    72.570943
2009    74.085193
2010    74.648723
Name: wqi, dtype: float64
```

In [34]:
```
data=average.reset_index(level=0,inplace=False)
data
```

Out[34]:

	year	wqi
0	2006	71.308824
1	2007	72.549000
2	2008	72.570943
3	2009	74.085193
4	2010	74.648723
5	2011	75.647013
6	2012	78.969041
7	2013	75.009425
8	2014	76.833852

In [35]:
```
year=data['year'].values
AQI=data['wqi'].values
data['wqi']=pd.to_numeric(data['wqi'],errors='coerce')
data['year']=pd.to_numeric(data['year'],errors='coerce')
```

jupyter analysis Last Checkpoint: an hour ago (autosaved)

In [30]:
```
data['wqi']=data.wph+data.wdo+data.wbdo+data.wec+data.wna+data.wco
```

In [31]:
```
data.head()
```

Out[31]:

	station	location	state	do	ph	co	bod	na	tc	year	...	nbdo	nec	nna	wph	wdo	wbdo	wec	wna	wco	wqi
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	5.7	7.2	189.0	2.0	0.2	NaN	2014	...	100	60	100	16.5	22.48	23.40	0.54	2.8	0.00	65.72
2	1475	ZUARI AT PANCHAWADI	GOA	6.3	6.9	179.0	1.7	0.1	5330.0	2014	...	100	60	100	13.2	28.10	23.40	0.54	2.8	11.24	79.28
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	5.8	6.9	64.0	3.8	0.5	8443.0	2014	...	80	100	100	13.2	22.48	18.72	0.90	2.8	11.24	69.34
4	3182	RIVER ZUARI AT MARCAIM JETTY	GOA	5.8	7.3	83.0	1.9	0.4	5500.0	2014	...	100	80	100	16.5	22.48	23.40	0.72	2.8	11.24	77.14
5	1400	MANDOVI AT NEGHBOURHOOD OF PANAJI, GOA	GOA	5.5	7.4	81.0	1.5	0.1	4049.0	2014	...	100	80	100	16.5	22.48	23.40	0.72	2.8	11.24	77.14

5 rows × 23 columns

In [32]:
```
#Calculating overall wqi for each year
average=data.groupby('year')['wqi'].mean()
```

In [33]:
```
average.head()
```

Out[33]:
```
year
2006    71.308824
2007    72.549000
2008    72.570943
2009    74.085193
2010    74.648723
Name: wqi, dtype: float64
```

jupyter analysis Last Checkpoint: an hour ago (autosaved)

In [24]:
```
#calc of B.D.O
data['nbdo']=data.bod.apply(lambda x:(100 if (3>=x>=0)
                                 else(80 if  (6>=x>=3)
                                     else(60 if (80>=x>=6)
                                         else(40 if (125>=x>=80)
                                             else 0)))))
```

In [25]:
```
#calculation of electrical conductivity
data['nec']=data.co.apply(lambda x:(100 if (75>=x>=0)
                                 else(80 if  (150>=x>=75)
                                     else(60 if (225>=x>=150)
                                         else(40 if (300>=x>=225)
                                             else 0)))))
```

In [26]:
```
#Calulation of nitrate
data['nna']=data.na.apply(lambda x:(100 if (20>=x>=0)
                                 else(80 if  (50>=x>=20)
                                     else(60 if (100>=x>=50)
                                         else(40 if (200>=x>=100)
                                             else 0)))))
```

In [27]:
```
data.head()
```

Out[27]:

	station	location	state	do	ph	co	bod	na	tc	year	npH	ndo	nco	nbdo	nec	nna
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	5.7	7.2	189.0	2.0	0.2	NaN	2014	100	80	0	100	60	100
2	1475	ZUARI AT PANCHAWADI	GOA	6.3	6.9	179.0	1.7	0.1	5330.0	2014	80	100	40	100	60	100
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	5.8	6.9	64.0	3.8	0.5	8443.0	2014	80	80	40	80	100	100

Calculating Water Quality Index(WQI)

In [21]:
```
#calulation of Ph
data['npH']=data.ph.apply(lambda x: (100 if (8.5>=x>=7)
                                 else(80 if  (8.6>=x>=8.5) or (6.9>=x>=6.8)
                                      else(60 if (8.8>=x>=8.6) or (6.8>=x>=6.7)
                                          else(40 if (9>=x>=8.8) or (6.7>=x>=6.5)
                                              else 0)))))
```

In [22]:
```
#calculation of dissolved oxygen
data['ndo']=data.do.apply(lambda x:(100 if (x>=6)
                                 else(80 if  (6>=x>=5.1)
                                      else(60 if (5>=x>=4.1)
                                          else(40 if (4>=x>=3)
                                              else 0)))))
```

In [23]:
```
#calculation of total coliform
data['nco']=data.tc.apply(lambda x:(100 if (5>=x>=0)
                                 else(80 if  (50>=x>=5)
                                      else(60 if (500>=x>=50)
                                          else(40 if (10000>=x>=500)
                                              else 0)))))
```

In [24]:
```
#calc of B.D.O
data['nbdo']=data.bod.apply(lambda x:(100 if (3>=x>=0)
                                 else(80 if  (6>=x>=3)
                                      else(60 if (80>=x>=6)
                                          else(40 if (125>=x>=80)
```

In [17]:
```
data.drop(["FECAL COLIFORM (MPN/100ml)"],axis=1,inplace=True)
```

In [18]:
```
data=data.rename(columns={'D.O. (mg/l)':'do'})
data=data.rename(columns={'CONDUCTIVITY (µmhos/cm)':'co'})
data=data.rename(columns={'B.O.D. (mg/l)':'bod'})
data=data.rename(columns={'NITRATENAN N+ NITRITENANN (mg/1)':'na'})
data=data.rename(columns={'TOTAL COLIFORM (MPN/100ml) Mean': 'tc'})
data=data.rename(columns={'STATION CODE': 'station'})
data=data.rename(columns={'LOCATIONS': 'location'})
data=data.rename(columns={'STATE': 'state'})
data=data.rename(columns={'PH':'ph'})
```

In [19]:
```
data = pd.concat([station,location,state,do,ph,co,bod,na,tc,year], axis=1)

data.columns = ['station','location','state','do','ph','co','bod','na','tc','year']
```

In [20]:
```
data.head()
```

Out[20]:

	station	location	state	do	ph	co	bod	na	tc	year
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	5.7	7.2	189.0	2.0	0.2	NaN	2014
2	1475	ZUARI AT PANCHAWADI	GOA	6.3	6.9	179.0	1.7	0.1	5330.0	2014
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	5.8	6.9	64.0	3.8	0.5	8443.0	2014
4	3182	RIVER ZUARI AT MARCAIM JETTY	GOA	5.8	7.3	83.0	1.9	0.4	5500.0	2014
5	1400	MANDOVI AT NEGHBOURHOOD OF PANAJI, GOA	GOA	5.5	7.4	81.0	1.5	0.1	4049.0	2014

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

```
In [16]: data['Temp'].fillna(data['Temp'].mean(), inplace=True)
         data['D.O. (mg/l)'].fillna(data['D.O. (mg/l)'].mean(), inplace=True)

         data['PH'].fillna(data['PH'].mean(),inplace=True)

         data['CONDUCTIVITY (µmhos/cm)'].fillna(data['CONDUCTIVITY (µmhos/cm)'].mean(), inplace=True)

         data['B.O.D. (mg/l)'].fillna(data['B.O.D. (mg/l)'].mean(),inplace=True)

         data['NITRATENAN N+ NITRITENANN (mg/l)'].fillna(data['NITRATENAN N+ NITRITENANN (mg/l)'].mean(), inplace=True)
         data['TOTAL COLIFORM (MPN/100ml)Mean'].fillna(data['TOTAL COLIFORM (MPN/100ml)Mean'].mean(), inplace=True)

In [17]: data.drop(["FECAL COLIFORM (MPN/100ml)"],axis=1,inplace=True)

In [18]: data=data.rename(columns={'D.O. (mg/l)':'do'})
         data=data.rename(columns={'CONDUCTIVITY (µmhos/cm)':'co'})
         data=data.rename(columns={'B.O.D. (mg/l)':'bod'})
         data=data.rename(columns={'NITRATENAN N+ NITRITENANN (mg/l)':'na'})
         data=data.rename(columns={'TOTAL COLIFORM (MPN/100ml) Mean': 'tc'})
         data=data.rename(columns={'STATION CODE': 'station'})
         data=data.rename(columns={'LOCATIONS': 'location'})
         data=data.rename(columns={'STATE': 'state'})
         data=data.rename(columns={'PH':'ph'})

In [19]: data = pd.concat([station,location,state,do,ph,co,bod,na,tc,year], axis=1)

         data.columns = ['station','location','state','do','ph','co','bod','na','tc','year']

In [20]: data.head()
```

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

```
In [14]: start = 1
         end = 1779
         station = data.iloc[start:end, 0]
         location = data.iloc[start:end ,1]
         state = data.iloc[start:end, 2]
         do = data.iloc[start:end, 4].astype(np.float64)

         value=0

         ph = data.iloc[ start:end, 5]
         co = data.iloc [start:end, 6].astype(np.float64)

         year = data.iloc[start:end, 11]
         tc = data.iloc[2:end, 10].astype(np.float64)


         bod = data.iloc[start:end, 7].astype(np.float64)
         na = data.iloc[start:end, 8].astype(np.float64)
         na.dtype

Out[14]: dtype('float64')

In [15]: data.head()

Out[15]:
```

	STATION CODE	LOCATIONS	STATE	Temp	D.O. (mg/l)	PH	CONDUCTIVITY (µmhos/cm)	B.O.D. (mg/l)	NITRATENAN N+ NITRITENANN (mg/l)	FECAL COLIFORM (MPN/100ml)	TOTAL COLIFORM (MPN/100ml)Mean	year
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203.0	NaN	0.1	11	27.0	2014

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help — Trusted — Python 3 (ipykernel)

In [12]:
```
data['Temp']=pd.to_numeric(data[ 'Temp'],errors='coerce')
data['D.O. (mg/l)']=pd.to_numeric(data['D.O. (mg/l)'],errors='coerce')
data['PH']=pd.to_numeric(data['PH'], errors='coerce')
data['B.O.D. (mg/l)']=pd.to_numeric(data['B.O.D. (mg/l)'],errors='coerce')
data['CONDUCTIVITY (µmhos/cm)']=pd.to_numeric(data['CONDUCTIVITY (µmhos/cm)'], errors='coerce')
data['NITRATENAN N+ NITRITENANN (mg/l)']=pd.to_numeric(data['NITRATENAN N+ NITRITENANN (mg/l)'],errors='coerce')
data['TOTAL COLIFORM (MPN/100ml)Mean']=pd.to_numeric(data['TOTAL COLIFORM (MPN/100ml)Mean'],errors='coerce')
data.dtypes
```

Out[12]:
```
STATION CODE                          object
LOCATIONS                             object
STATE                                 object
Temp                                 float64
D.O. (mg/l)                          float64
PH                                   float64
CONDUCTIVITY (µmhos/cm)              float64
B.O.D. (mg/l)                        float64
NITRATENAN N+ NITRITENANN (mg/l)     float64
FECAL COLIFORM (MPN/100ml)            object
TOTAL COLIFORM (MPN/100ml)Mean       float64
year                                   int64
dtype: object
```

In [13]:
```
data.isnull().sum()
```

Out[13]:
```
STATION CODE      0
LOCATIONS         0
STATE             0
Temp             92
D.O. (mg/l)      31
PH                8
```

analysis (3).ipynb — Show all

23°C Partly cloudy — 9:00 PM 11/18/2022

localhost:8888/notebooks/NT-%20Efficient%20Water%20Quality%20Analysis%20%26%20Prediction/analysis.ipynb#

jupyter analysis Last Checkpoint: an hour ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help — Trusted — Python 3 (ipykernel)

In [10]:
```
data.dtypes
```

Out[10]:
```
STATION CODE                         object
LOCATIONS                            object
STATE                                object
Temp                                 object
D.O. (mg/l)                          object
PH                                   object
CONDUCTIVITY (µmhos/cm)              object
B.O.D. (mg/l)                        object
NITRATENAN N+ NITRITENANN (mg/l)     object
FECAL COLIFORM (MPN/100ml)           object
TOTAL COLIFORM (MPN/100ml)Mean       object
year                                  int64
dtype: object
```

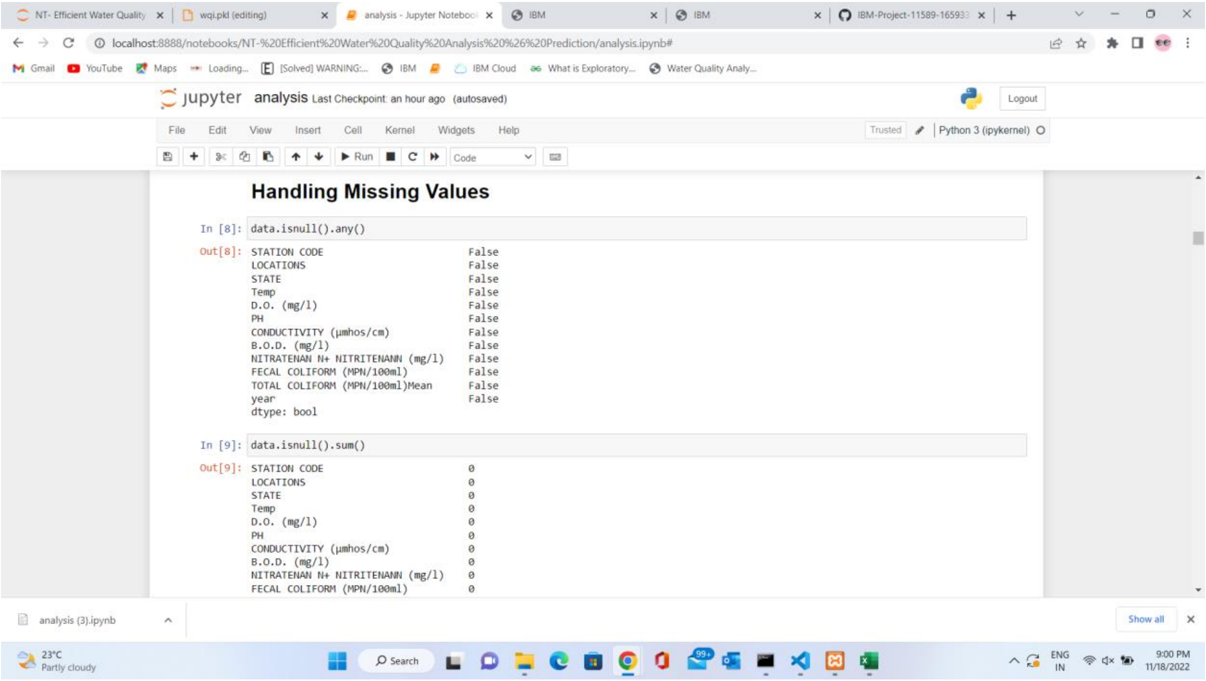
In [11]:
```
data.head()
```

Out[11]:

	STATION CODE	LOCATIONS	STATE	Temp	D.O. (mg/l)	PH	CONDUCTIVITY (µmhos/cm)	B.O.D. (mg/l)	NITRATENAN N+ NITRITENANN (mg/l)	FECAL COLIFORM (MPN/100ml)	TOTAL COLIFORM (MPN/100ml)Mean	year
0	1393	DAMANGANGA AT D/S OF MADHUBAN, DAMAN	DAMAN & DIU	30.6	6.7	7.5	203	NAN	0.1	11	27	2014
1	1399	ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...	GOA	29.8	5.7	7.2	189	2	0.2	4953	8391	2014
2	1475	ZUARI AT PANCHAWADI	GOA	29.5	6.3	6.9	179	1.7	0.1	3243	5330	2014
3	3181	RIVER ZUARI AT BORIM BRIDGE	GOA	29.7	5.8	6.9	64	3.8	0.5	5382	8443	2014

analysis (3).ipynb — Show all

23°C Partly cloudy — 9:00 PM 11/18/2022



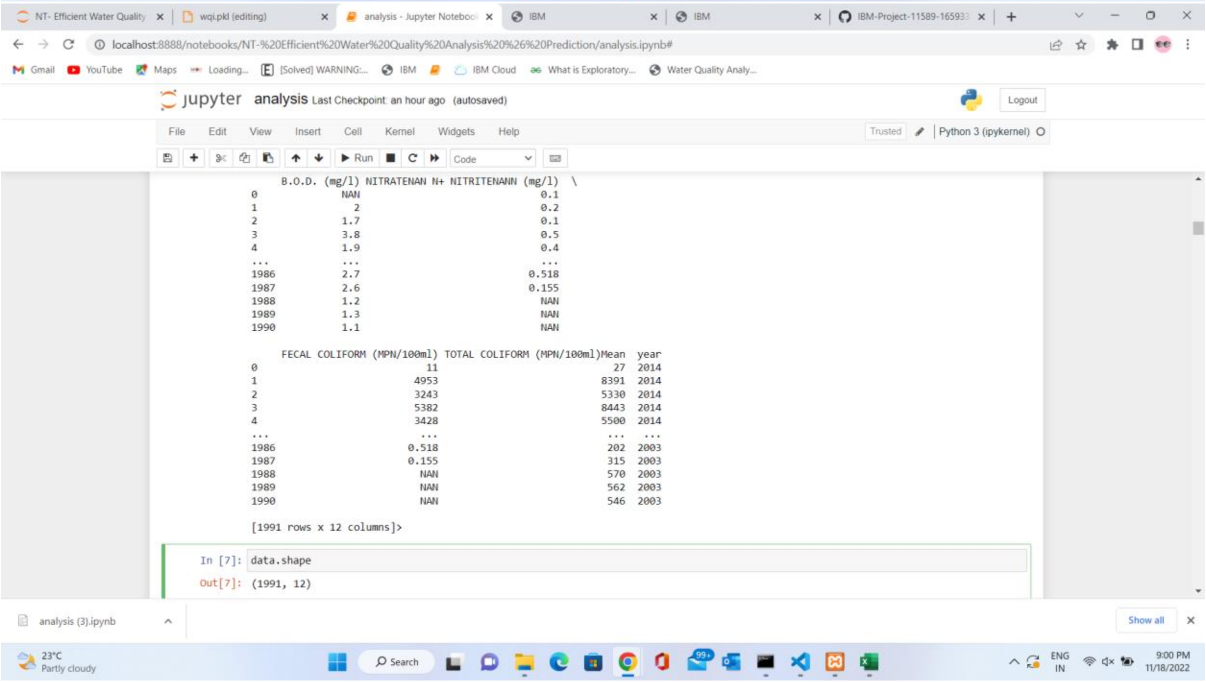
Handling Missing Values

```
In [8]: data.isnull().any()
```

```
Out[8]: STATION CODE                          False
        LOCATIONS                             False
        STATE                                 False
        Temp                                  False
        D.O. (mg/l)                           False
        PH                                    False
        CONDUCTIVITY (µmhos/cm)               False
        B.O.D. (mg/l)                         False
        NITRATENAN N+ NITRITENANN (mg/l)      False
        FECAL COLIFORM (MPN/100ml)            False
        TOTAL COLIFORM (MPN/100ml)Mean        False
        year                                  False
        dtype: bool
```

```
In [9]: data.isnull().sum()
```

```
Out[9]: STATION CODE                          0
        LOCATIONS                             0
        STATE                                 0
        Temp                                  0
        D.O. (mg/l)                           0
        PH                                    0
        CONDUCTIVITY (µmhos/cm)               0
        B.O.D. (mg/l)                         0
        NITRATENAN N+ NITRITENANN (mg/l)      0
        FECAL COLIFORM (MPN/100ml)            0
```



```
     B.O.D. (mg/l) NITRATENAN N+ NITRITENANN (mg/l)  \
0              NAN                              0.1
1                2                              0.2
2              1.7                              0.1
3              3.8                              0.5
4              1.9                              0.4
...            ...                              ...
1986           2.7                            0.518
1987           2.6                            0.155
1988           1.2                              NAN
1989           1.3                              NAN
1990           1.1                              NAN

     FECAL COLIFORM (MPN/100ml) TOTAL COLIFORM (MPN/100ml)Mean  year
0                            11                             27  2014
1                          4953                           8391  2014
2                          3243                           5330  2014
3                          5382                           8443  2014
4                          3428                           5500  2014
...                         ...                            ...   ...
1986                      0.518                            202  2003
1987                      0.155                            315  2003
1988                        NAN                            570  2003
1989                        NAN                            562  2003
1990                        NAN                            546  2003

[1991 rows x 12 columns]>
```

```
In [7]: data.shape
Out[7]: (1991, 12)
```

Data preprocessing

In [6]:
```
data.info
```

Out[6]:
```
<bound method DataFrame.info of      STATION CODE                                          LOCATIONS  \
0            1393              DAMANGANGA AT D/S OF MADHUBAN, DAMAN
1            1399  ZUARI AT D/S OF PT. WHERE KUMBARJRIA CANAL JOI...
2            1475                             ZUARI AT PANCHAWADI
3            3181                        RIVER ZUARI AT BORIM BRIDGE
4            3182                       RIVER ZUARI AT MARCAIM JETTY
...           ...                                                ...
1986         1330            TAMBIRAPARANI AT ARUMUGANERI, TAMILNADU
1987         1450  PALAR AT VANIYAMBADI WATER SUPPLY HEAD WORK, T...
1988         1403                     GUMTI AT U/S SOUTH TRIPURA,TRIPURA
1989         1404                    GUMTI AT D/S SOUTH TRIPURA, TRIPURA
1990         1726   CHANDRAPUR, AGARTALA D/S OF HAORA RIVER, TRIPURA

             STATE  Temp D.O. (mg/l)   PH CONDUCTIVITY (µmhos/cm)  \
0     DAMAN & DIU  30.6          6.7  7.5                      203
1             GOA  29.8          5.7  7.2                      189
2             GOA  29.5          6.3  6.9                      179
3             GOA  29.7          5.8  6.9                       64
4             GOA  29.5          5.8  7.3                       83
...           ...   ...          ...  ...                      ...
1986          NAN   NAN          7.9  738                      7.2
1987          NAN    29          7.5  585                      6.3
1988          NAN    28          7.6   98                      6.2
1989          NAN    28          7.7   91                      6.5
1990          NAN    29          7.6  110                      5.7

    B.O.D. (mg/l) NITRATENAN N+ NITRITENANN (mg/l)  \
```

In [4]:
```
data.describe()
```

Out[4]:

	year
count	1991.000000
mean	2010.038172
std	3.057333
min	2003.000000
25%	2008.000000
50%	2011.000000
75%	2013.000000
max	2014.000000

In [5]:
```
data.dtypes
```

Out[5]:
```
STATION CODE                         object
LOCATIONS                            object
STATE                                object
Temp                                 object
D.O. (mg/l)                          object
PH                                   object
CONDUCTIVITY (µmhos/cm)              object
B.O.D. (mg/l)                        object
NITRATENAN N+ NITRITENANN (mg/l)     object
FECAL COLIFORM (MPN/100ml)           object
TOTAL COLIFORM (MPN/100ml)Mean       object
year                                  int64
```

RMSE: 2.6643374606794357

In [61]:
```
metrics.r2_score(y_test,y_pred)
```

Out[61]: -88.41375190309928

In [62]:
```
import matplotlib.pyplot as plt
data=data.set_index('year')
data.plot(figsize=(15,6))
plt.show()
```

In [28]:
```
data.dtypes
```

Out[28]:
```
station      object
location     object
state        object
do          float64
ph          float64
co          float64
bod         float64
na          float64
tc          float64
year          int64
npH           int64
ndo           int64
nco           int64
nbdo          int64
nec           int64
nna           int64
dtype: object
```

In [29]:
```
# Calculate  water quality index WQI
data['wph']=data.npH * 0.165
data['wdo']=data.ndo * 0.281
data['wbdo']=data.nbdo * 0.234
data['wec']=data.nec* 0.009
data['wna']=data.nna * 0.028
data['wco']=data.nco * 0.281
```

In [30]:
```
data['wqi']=data.wph+data.wdo+data.wbdo+data.wec+data.wna+data.wco
```