AIR QUALITY ASSESMENT IN TAMILNADU

Project Objectives:

- To identify issues in air quality and develop long-term solutions.
- Non-statutory limits on the acceptable presence of contaminants in the atmosphere.
- Objectives are established by government agencies to protect: Human health.

Analysis approach:

- Objectives are established by government agencies to protect-Human health.
- Analysis methods like chromatography, infrared spectroscopy, spectrophotometry and atomic absorption spectroscopy.
- The higher the AQI value, the greater the level of air pollution and the greater the health concern.
- The basic analysis approach is to find out the percentage of harmful gases that causes severe damage to lives.
- The Analysis methods are:

❖ Ozone – ultraviolet spectroscopy. ...
❖ Oxides of nitrogen - chemiluminescence. ...
❖ Sulfur dioxide - pulsed fluorescent spectrophotometry. ...
❖ Carbon monoxide - infrared spectrometry. ...
❖ Fine particles as PM10. ...
❖ Fine particles as PM2.5. ...
❖ Ammonia - chemiluminescence. ...
❖ Visibility - nephelometer.

Visualization Techniques:

- The visualization techniques are as follows:

❖ Bar chart
❖ Pie chart
❖ Scatter plot
❖ Histogram
❖ Heat maps
❖ Distributed maps

Code Implementation:

TO IMPORT THE PYTHON LIBRARIES FOR ANALYSIS

```
In [23]: import numpy as np
         import pandas as pd
         import seaborn as sns
         import matplotlib.pyplot as plt
         import sklearn as sk
         import warnings
         warnings.filterwarnings('ignore')
```

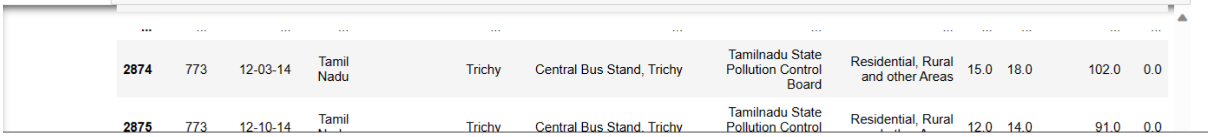
TO GET THE DATA FROM THE RENEWABLE RESOURCES

```
In [24]: air=pd.read_csv("cpcb_dly_aq_tamil_nadu-2014.csv")
```

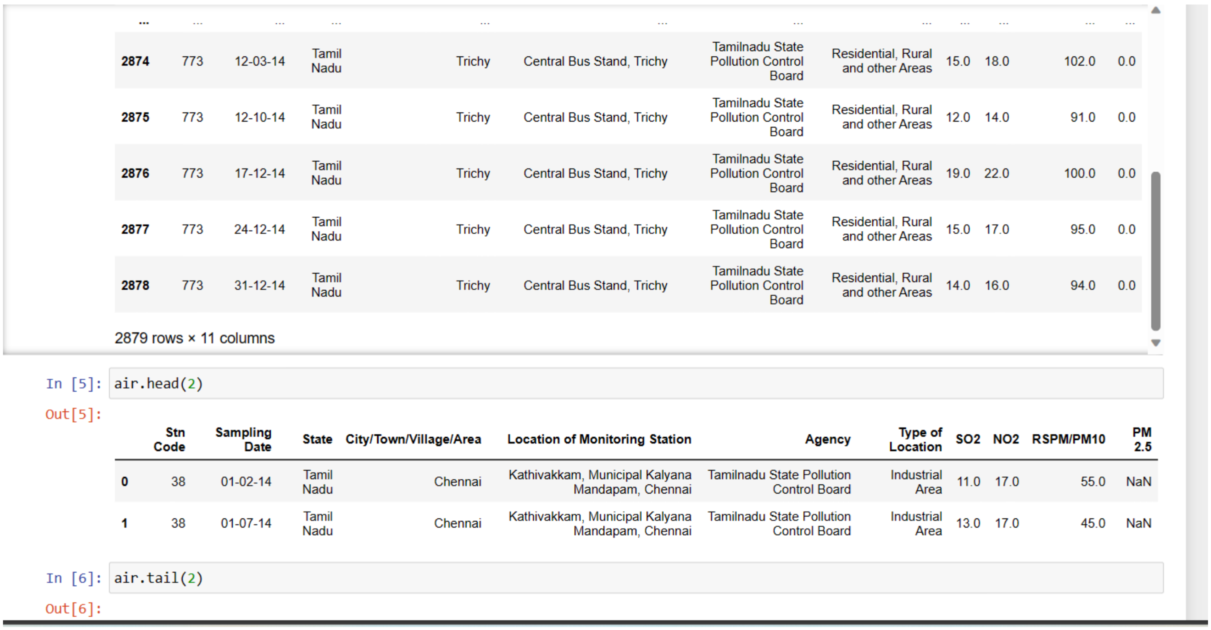
TO FIND THE SHAPE OF THE DATASET

```
In [25]: shape = air.shape
         print("Shape = {}".format(shape))

         Shape = (2879, 11)
```

```
In [4]: air.fillna(0)
```



...	...	...	...	...	...	...	...	...	...	...	...
2874	773	12-03-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	15.0	18.0	102.0	0.0
2875	773	12-10-14	Tamil	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control	Residential, Rural	12.0	14.0	91.0	0.0



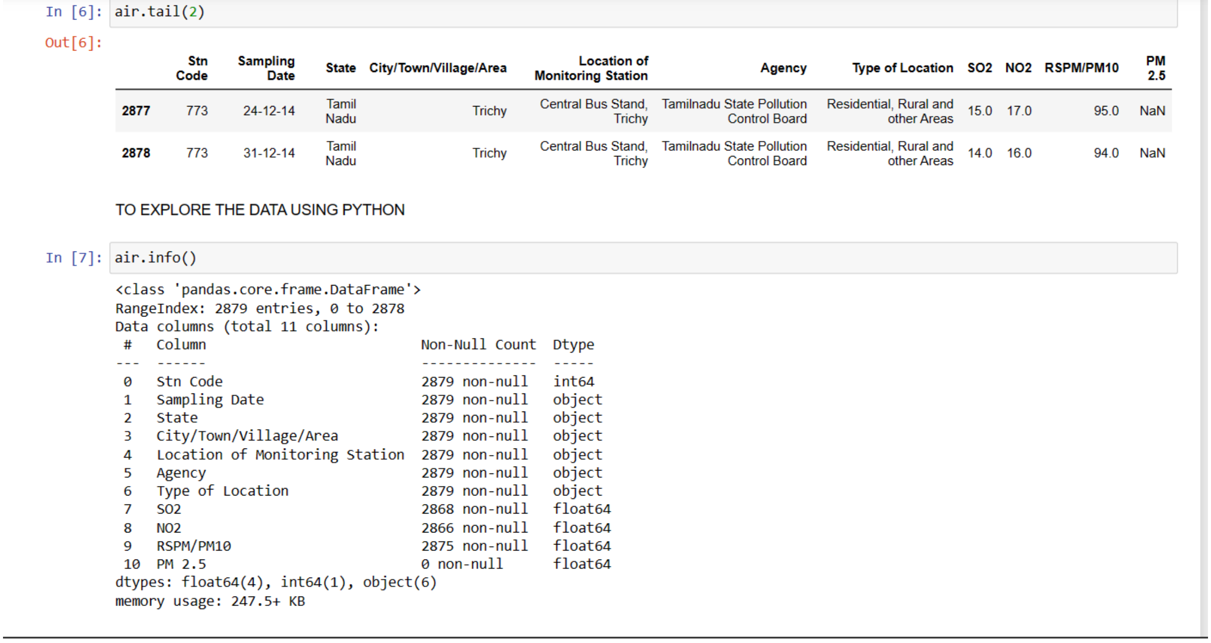
...	...	...	...	...	...	...	...	...	...	...	...
2874	773	12-03-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	15.0	18.0	102.0	0.0
2875	773	12-10-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	12.0	14.0	91.0	0.0
2876	773	17-12-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	19.0	22.0	100.0	0.0
2877	773	24-12-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	15.0	17.0	95.0	0.0
2878	773	31-12-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	14.0	16.0	94.0	0.0

2879 rows × 11 columns

```
In [5]: air.head(2)
Out[5]:
```

	Stn Code	Sampling Date	State	City/Town/Village/Area	Location of Monitoring Station	Agency	Type of Location	SO2	NO2	RSPM/PM10	PM 2.5
0	38	01-02-14	Tamil Nadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam, Chennai	Tamilnadu State Pollution Control Board	Industrial Area	11.0	17.0	55.0	NaN
1	38	01-07-14	Tamil Nadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam, Chennai	Tamilnadu State Pollution Control Board	Industrial Area	13.0	17.0	45.0	NaN

```
In [6]: air.tail(2)
Out[6]:
```



In [6]:

```
air.tail(2)
```

Out[6]:

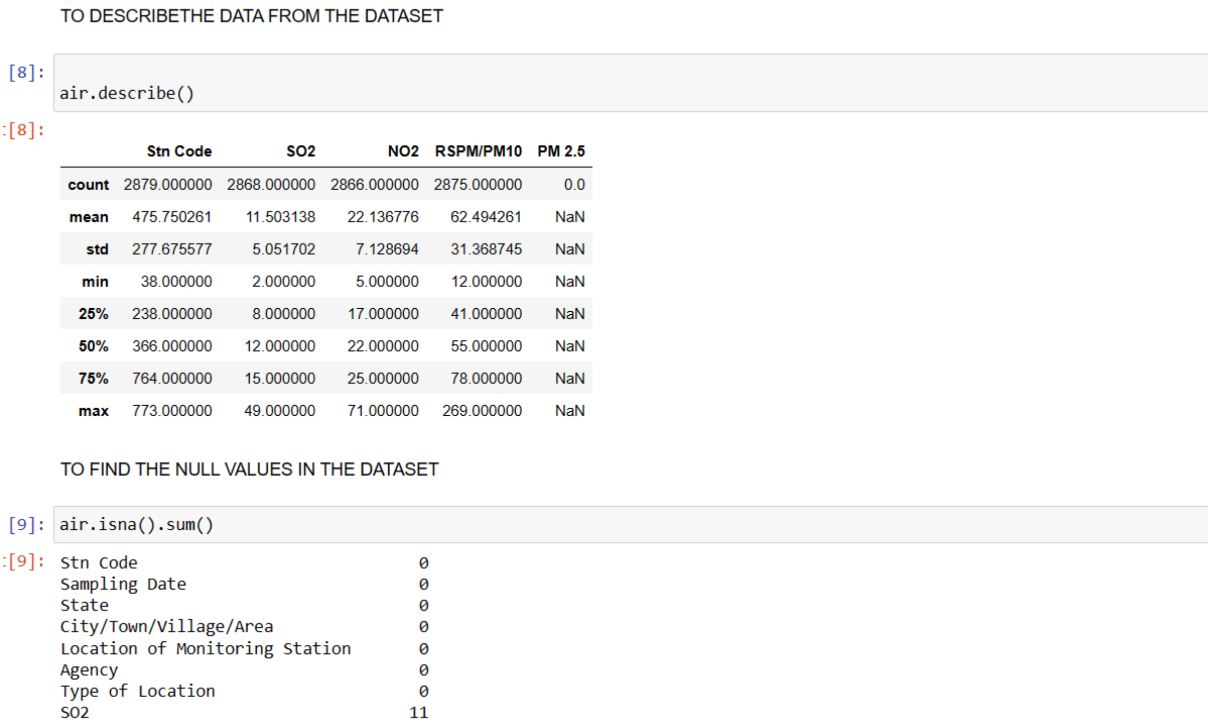
	Stn Code	Sampling Date	State	City/Town/Village/Area	Location of Monitoring Station	Agency	Type of Location	SO2	NO2	RSPM/PM10	PM 2.5
2877	773	24-12-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	15.0	17.0	95.0	NaN
2878	773	31-12-14	Tamil Nadu	Trichy	Central Bus Stand, Trichy	Tamilnadu State Pollution Control Board	Residential, Rural and other Areas	14.0	16.0	94.0	NaN

TO EXPLORE THE DATA USING PYTHON

In [7]:

```
air.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2879 entries, 0 to 2878
Data columns (total 11 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   Stn Code                        2879 non-null   int64  
 1   Sampling Date                   2879 non-null   object 
 2   State                           2879 non-null   object 
 3   City/Town/Village/Area          2879 non-null   object 
 4   Location of Monitoring Station  2879 non-null   object 
 5   Agency                          2879 non-null   object 
 6   Type of Location                2879 non-null   object 
 7   SO2                             2868 non-null   float64
 8   NO2                             2866 non-null   float64
 9   RSPM/PM10                       2875 non-null   float64
 10  PM 2.5                          0 non-null      float64
dtypes: float64(4), int64(1), object(6)
memory usage: 247.5+ KB
```



TO DESCRIBETHE DATA FROM THE DATASET

[8]:

```
air.describe()
```

:[8]:

	Stn Code	SO2	NO2	RSPM/PM10	PM 2.5
count	2879.000000	2868.000000	2866.000000	2875.000000	0.0
mean	475.750261	11.503138	22.136776	62.494261	NaN
std	277.675577	5.051702	7.128694	31.368745	NaN
min	38.000000	2.000000	5.000000	12.000000	NaN
25%	238.000000	8.000000	17.000000	41.000000	NaN
50%	366.000000	12.000000	22.000000	55.000000	NaN
75%	764.000000	15.000000	25.000000	78.000000	NaN
max	773.000000	49.000000	71.000000	269.000000	NaN

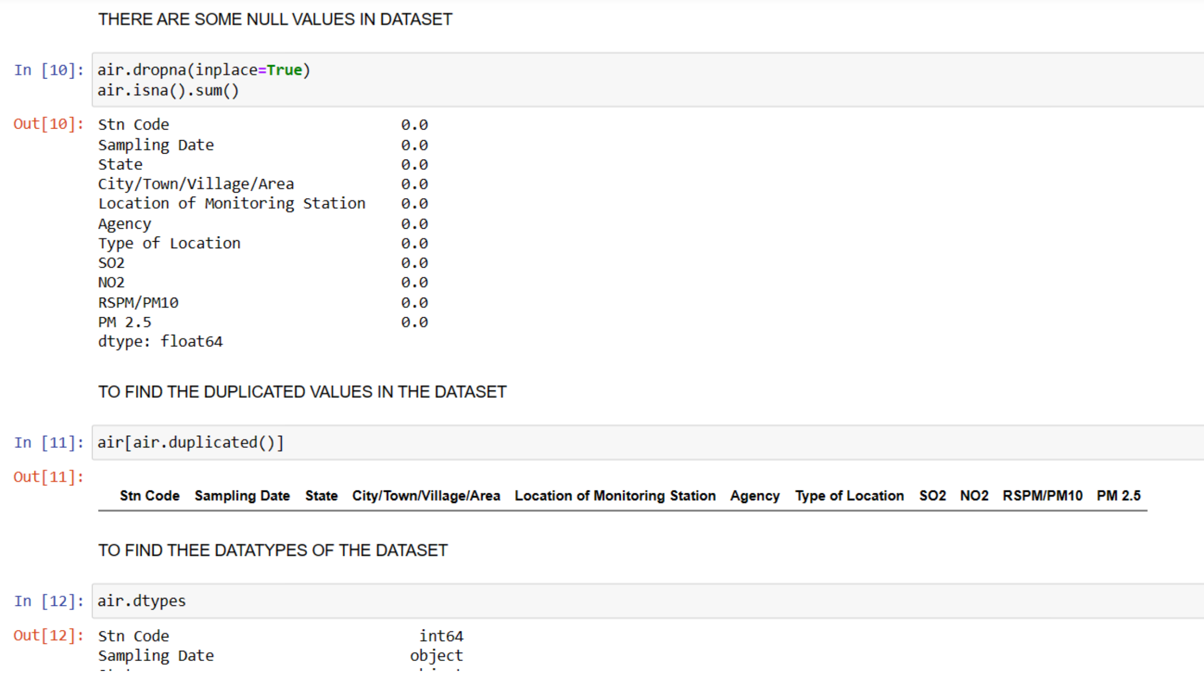
TO FIND THE NULL VALUES IN THE DATASET

[9]:

```
air.isna().sum()
```

:[9]:

```
Stn Code                           0
Sampling Date                      0
State                              0
City/Town/Village/Area             0
Location of Monitoring Station     0
Agency                             0
Type of Location                   0
SO2                               11
```



THERE ARE SOME NULL VALUES IN DATASET

```
In [10]: air.dropna(inplace=True)
         air.isna().sum()

Out[10]: Stn Code                          0.0
         Sampling Date                     0.0
         State                             0.0
         City/Town/Village/Area            0.0
         Location of Monitoring Station    0.0
         Agency                            0.0
         Type of Location                  0.0
         SO2                               0.0
         NO2                               0.0
         RSPM/PM10                         0.0
         PM 2.5                            0.0
         dtype: float64
```

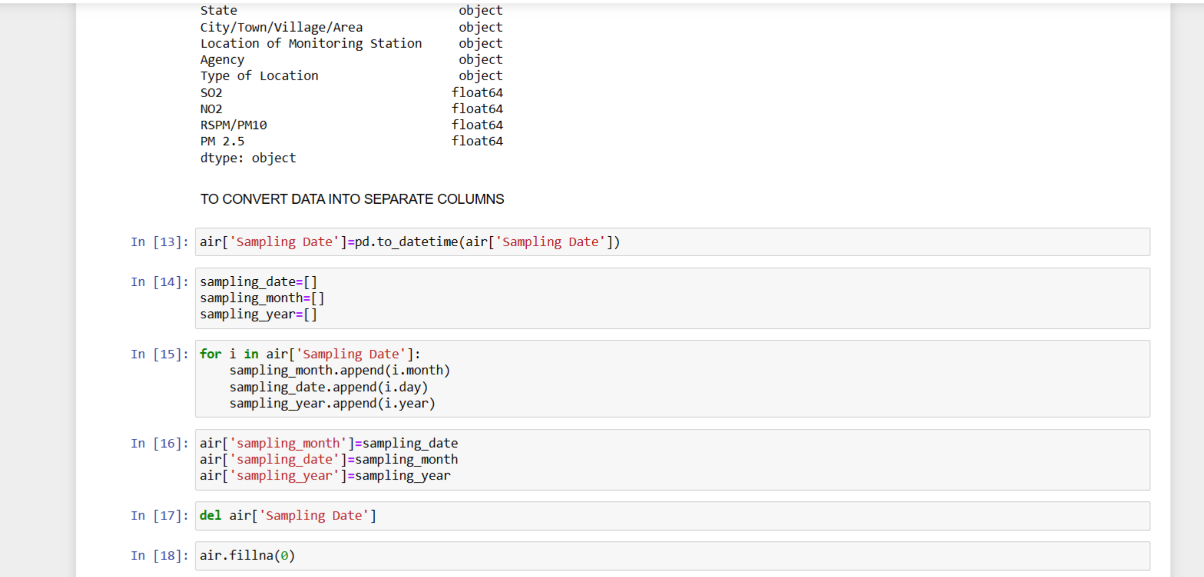
TO FIND THE DUPLICATED VALUES IN THE DATASET

```
In [11]: air[air.duplicated()]

Out[11]:
```

Stn Code	Sampling Date	State	City/Town/Village/Area	Location of Monitoring Station	Agency	Type of Location	SO2	NO2	RSPM/PM10	PM 2.5

TO FIND THEE DATATYPES OF THE DATASET

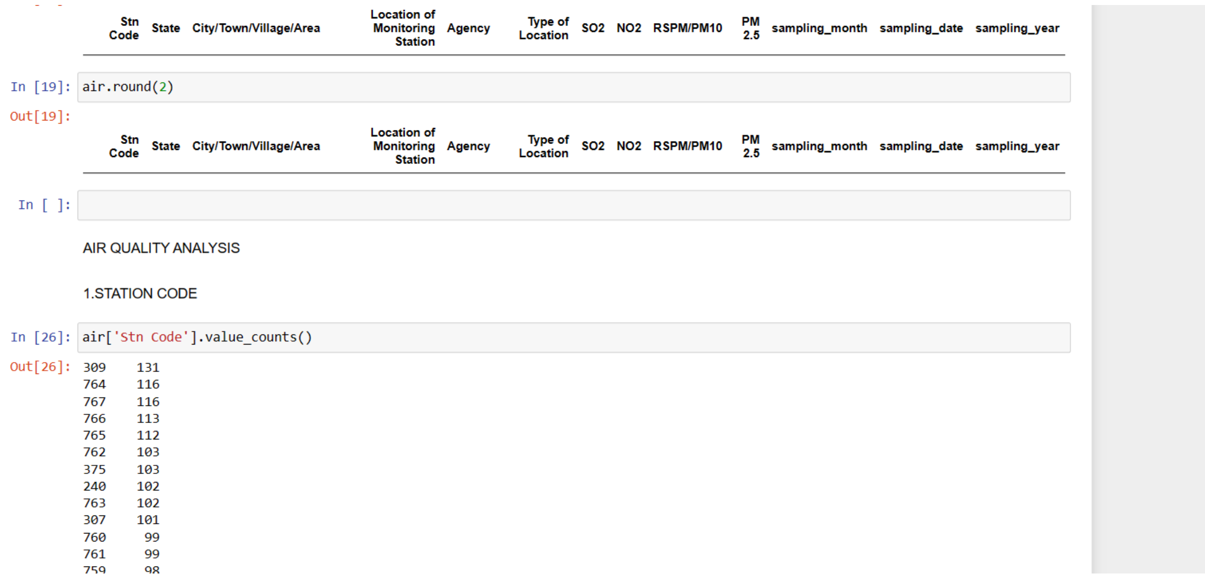
```
In [12]: air.dtypes

Out[12]: Stn Code                            int64
         Sampling Date                      object
```



```
         State                             object
         City/Town/Village/Area            object
         Location of Monitoring Station    object
         Agency                            object
         Type of Location                  object
         SO2                              float64
         NO2                              float64
         RSPM/PM10                        float64
         PM 2.5                           float64
         dtype: object
```

TO CONVERT DATA INTO SEPARATE COLUMNS

```
In [13]: air['Sampling Date']=pd.to_datetime(air['Sampling Date'])

In [14]: sampling_date=[]
         sampling_month=[]
         sampling_year=[]

In [15]: for i in air['Sampling Date']:
             sampling_month.append(i.month)
             sampling_date.append(i.day)
             sampling_year.append(i.year)

In [16]: air['sampling_month']=sampling_date
         air['sampling_date']=sampling_month
         air['sampling_year']=sampling_year

In [17]: del air['Sampling Date']

In [18]: air.fillna(0)
```



Stn Code	State	City/Town/Village/Area	Location of Monitoring Station	Agency	Type of Location	SO2	NO2	RSPM/PM10	PM 2.5	sampling_month	sampling_date	sampling_year

In [19]:
```
air.round(2)
```

Out[19]:

Stn Code	State	City/Town/Village/Area	Location of Monitoring Station	Agency	Type of Location	SO2	NO2	RSPM/PM10	PM 2.5	sampling_month	sampling_date	sampling_year

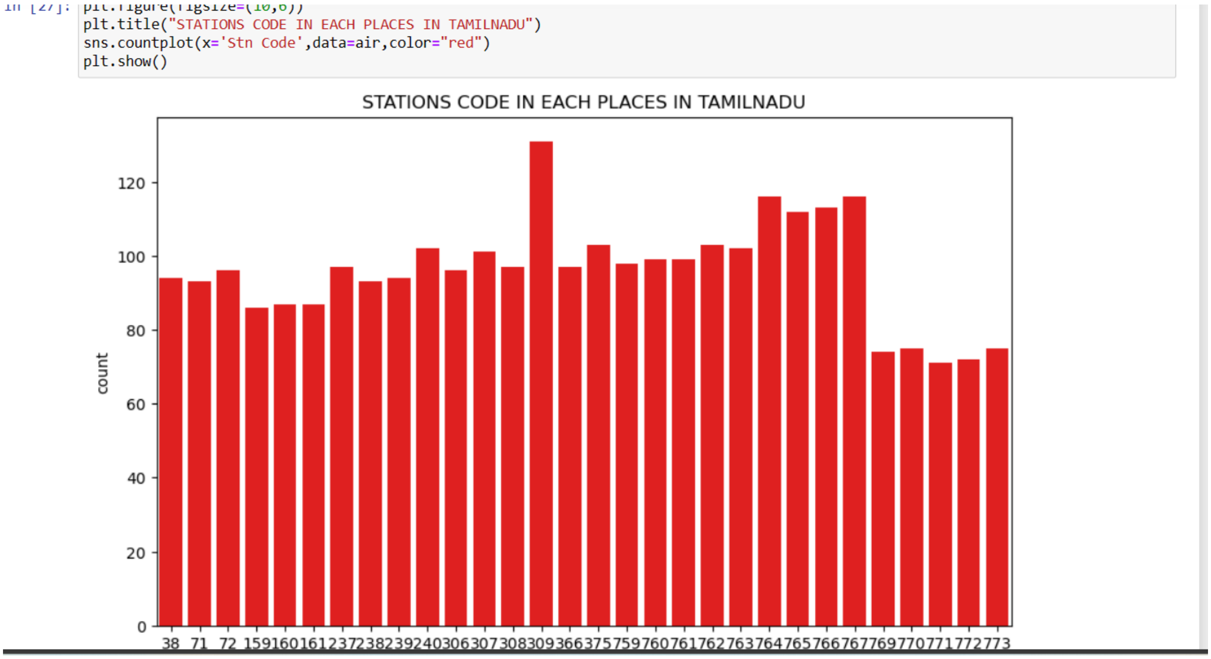
In [ ]:

AIR QUALITY ANALYSIS

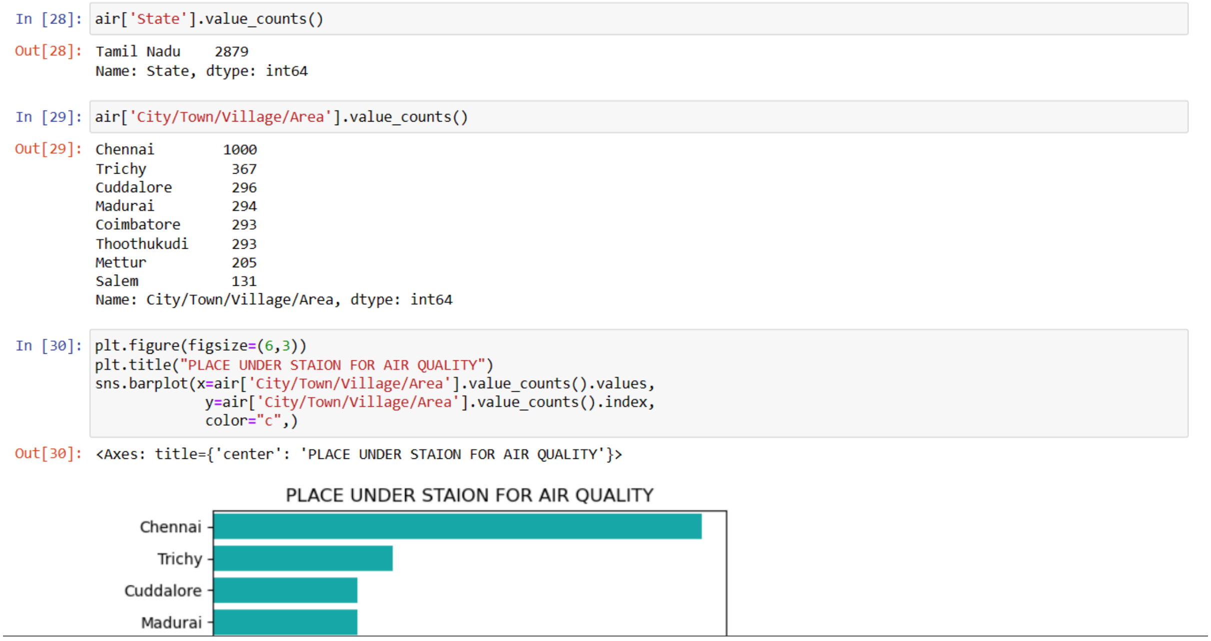
1.STATION CODE

In [26]:
```
air['Stn Code'].value_counts()
```

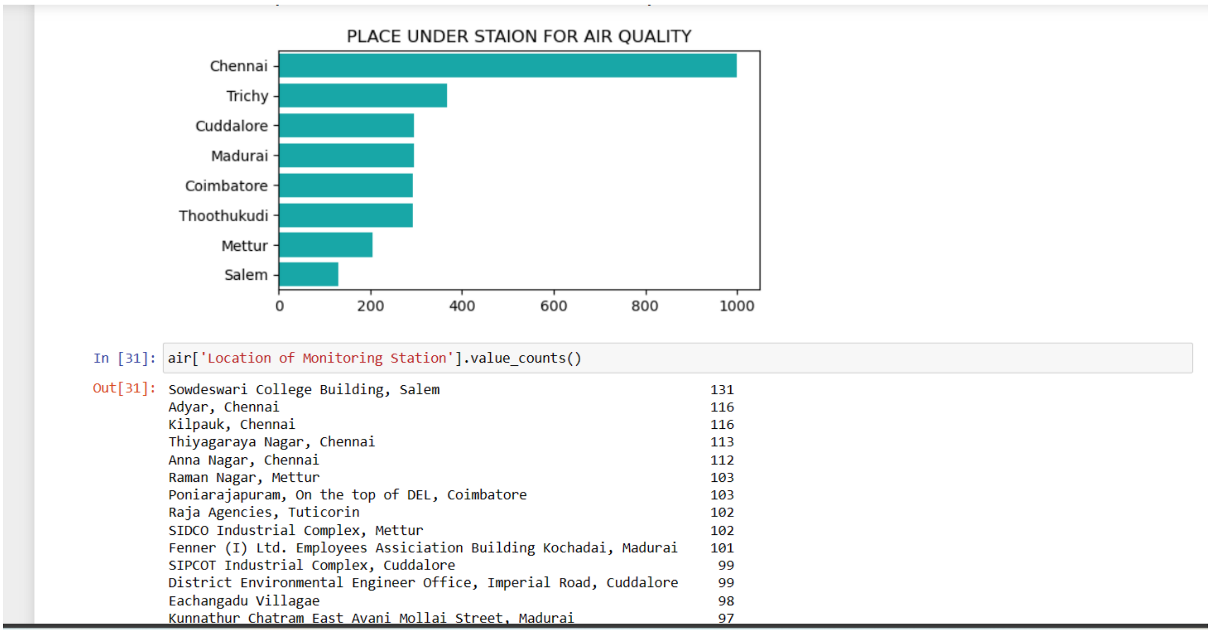
Out[26]:
```
309    131
764    116
767    116
766    113
765    112
762    103
375    103
240    102
763    102
307    101
760     99
761     99
759     98
```



In [27]:
```
plt.figure(figsize=(10,6))
plt.title("STATIONS CODE IN EACH PLACES IN TAMILNADU")
sns.countplot(x='Stn Code',data=air,color="red")
plt.show()
```



```
In [28]: air['State'].value_counts()

Out[28]: Tamil Nadu    2879
         Name: State, dtype: int64

In [29]: air['City/Town/Village/Area'].value_counts()

Out[29]: Chennai        1000
         Trichy          367
         Cuddalore       296
         Madurai         294
         Coimbatore      293
         Thoothukudi     293
         Mettur          205
         Salem           131
         Name: City/Town/Village/Area, dtype: int64

In [30]: plt.figure(figsize=(6,3))
         plt.title("PLACE UNDER STAION FOR AIR QUALITY")
         sns.barplot(x=air['City/Town/Village/Area'].value_counts().values,
                     y=air['City/Town/Village/Area'].value_counts().index,
                     color="c",)

Out[30]: <Axes: title={'center': 'PLACE UNDER STAION FOR AIR QUALITY'}>
```

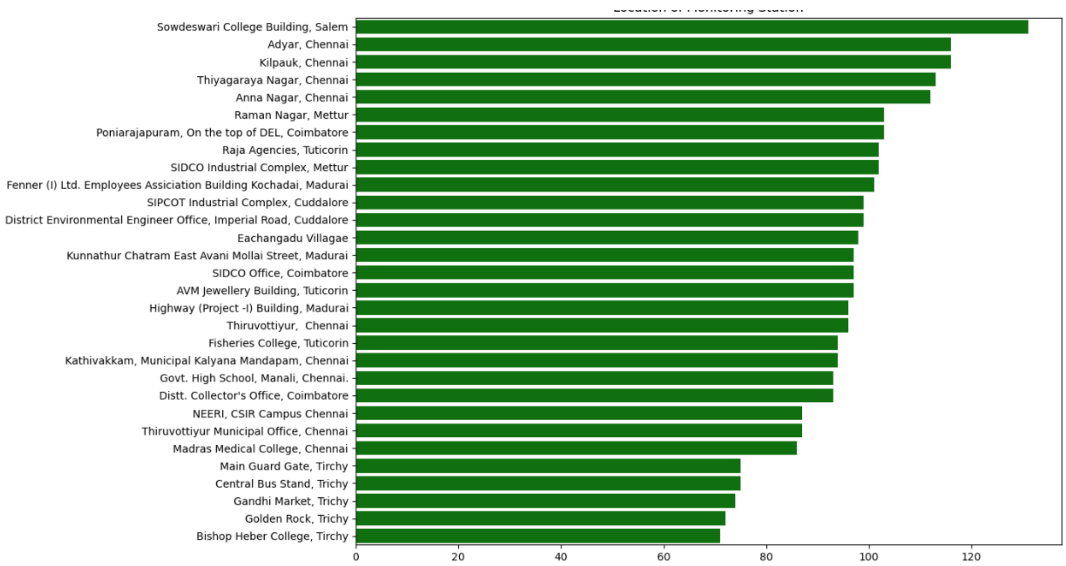


```
In [31]: air['Location of Monitoring Station'].value_counts()

Out[31]: Sowdeswari College Building, Salem                                    131
         Adyar, Chennai                                                        116
         Kilpauk, Chennai                                                      116
         Thiyagaraya Nagar, Chennai                                            113
         Anna Nagar, Chennai                                                   112
         Raman Nagar, Mettur                                                   103
         Poniarajapuram, On the top of DEL, Coimbatore                         103
         Raja Agencies, Tuticorin                                              102
         SIDCO Industrial Complex, Mettur                                      102
         Fenner (I) Ltd. Employees Assiciation Building Kochadai, Madurai      101
         SIPCOT Industrial Complex, Cuddalore                                   99
         District Environmental Engineer Office, Imperial Road, Cuddalore       99
         Eachangadu Villagae                                                    98
         Kunnathur Chatram East Avani Mollai Street, Madurai                    97
```

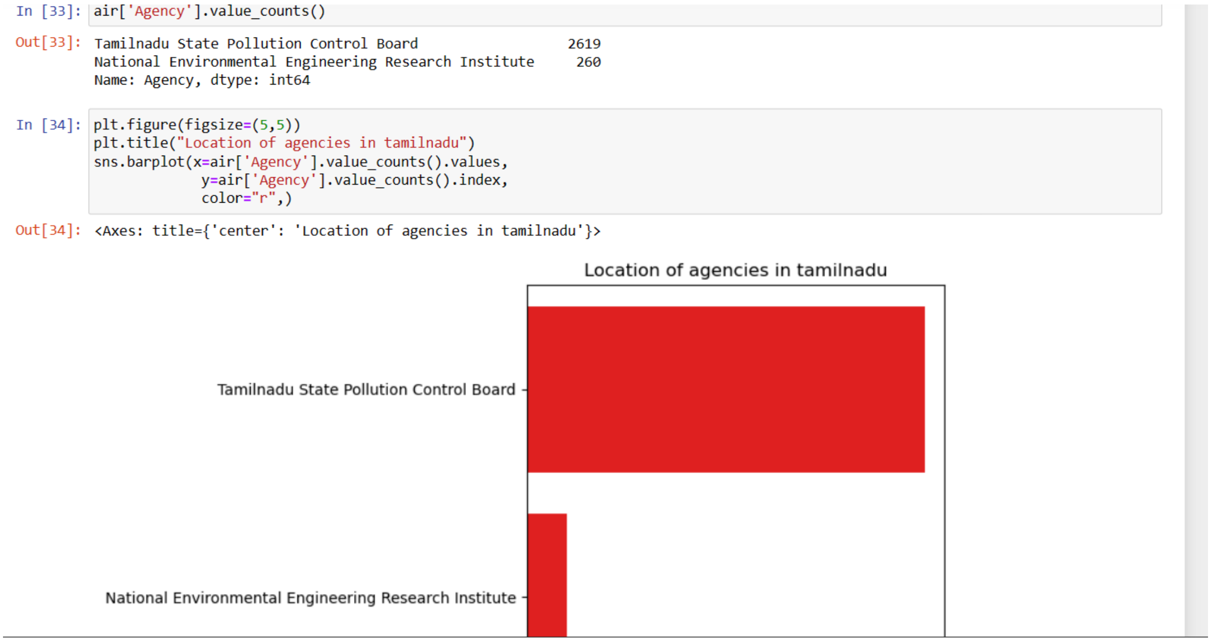
```
Raja Agencies, Tuticorin                                             102
SIDCO Industrial Complex, Mettur                                     102
Fenner (I) Ltd. Employees Assiciation Building Kochadai, Madurai     101
SIPCOT Industrial Complex, Cuddalore                                  99
District Environmental Engineer Office, Imperial Road, Cuddalore      99
Eachangadu Villagae                                                   98
Kunnathur Chatram East Avani Mollai Street, Madurai                   97
SIDCO Office, Coimbatore                                              97
AVM Jewellery Building, Tuticorin                                     97
Highway (Project -I) Building, Madurai                                96
Thiruvottiyur,  Chennai                                               96
Fisheries College, Tuticorin                                          94
Kathivakkam, Municipal Kalyana Mandapam, Chennai                      94
Govt. High School, Manali, Chennai.                                   93
Distt. Collector's Office, Coimbatore                                 93
NEERI, CSIR Campus Chennai                                            87
Thiruvottiyur Municipal Office, Chennai                               87
Madras Medical College, Chennai                                       86
Main Guard Gate, Tirchy                                               75
Central Bus Stand, Trichy                                             75
Gandhi Market, Trichy                                                 74
Golden Rock, Trichy                                                   72
Bishop Heber College, Tirchy                                          71
Name: Location of Monitoring Station, dtype: int64
```

```
n [32]: plt.figure(figsize=(12,9))
        plt.title("Location of Monitoring Station")
        sns.barplot(x=air['Location of Monitoring Station'].value_counts().values,
                    y=air['Location of Monitoring Station'].value_counts().index,
                    color="g",)
```

```
ut[32]: <Axes: title={'center': 'Location of Monitoring Station'}>
```

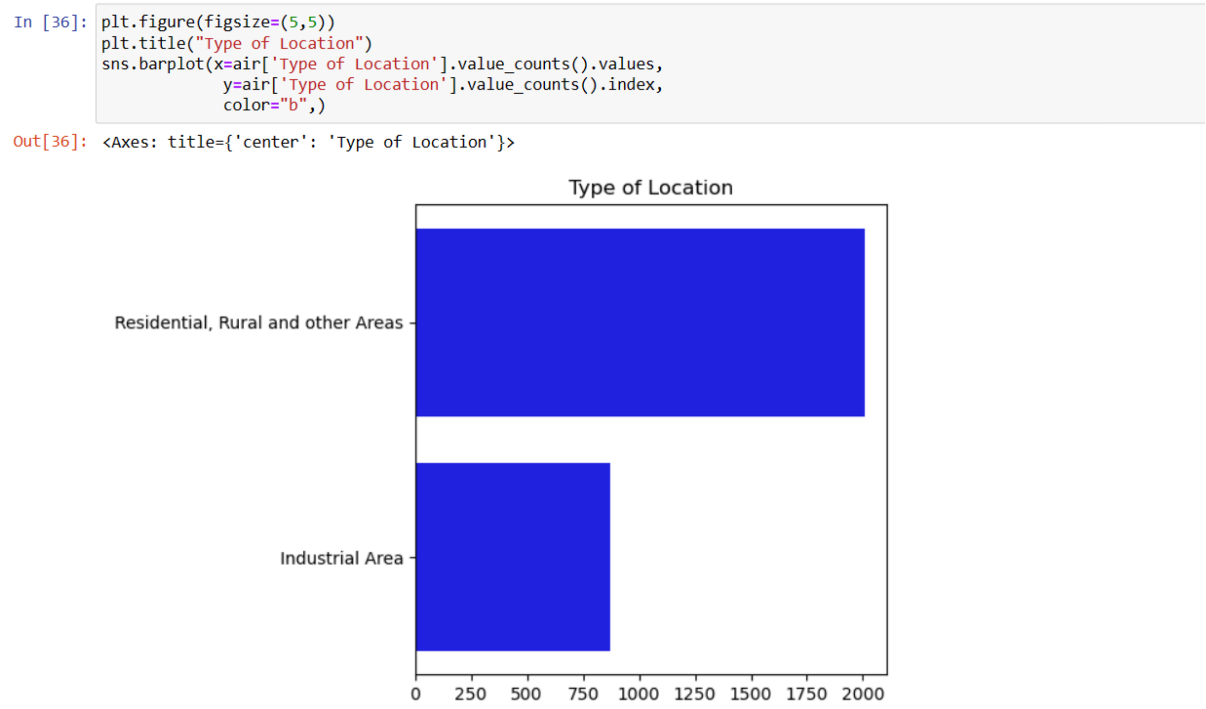


```
In [33]: air['Agency'].value_counts()
```



```
In [33]: air['Agency'].value_counts()

Out[33]: Tamilnadu State Pollution Control Board              2619
         National Environmental Engineering Research Institute     260
         Name: Agency, dtype: int64

In [34]: plt.figure(figsize=(5,5))
         plt.title("Location of agencies in tamilnadu")
         sns.barplot(x=air['Agency'].value_counts().values,
                     y=air['Agency'].value_counts().index,
                     color="r",)

Out[34]: <Axes: title={'center': 'Location of agencies in tamilnadu'}>
```

Location of agencies in tamilnadu
Tamilnadu State Pollution Control Board
National Environmental Engineering Research Institute



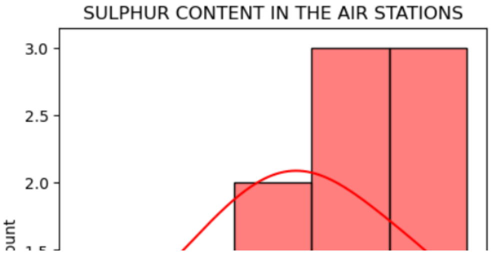
```
In [36]: plt.figure(figsize=(5,5))
         plt.title("Type of Location")
         sns.barplot(x=air['Type of Location'].value_counts().values,
                     y=air['Type of Location'].value_counts().index,
                     color="b",)

Out[36]: <Axes: title={'center': 'Type of Location'}>
```

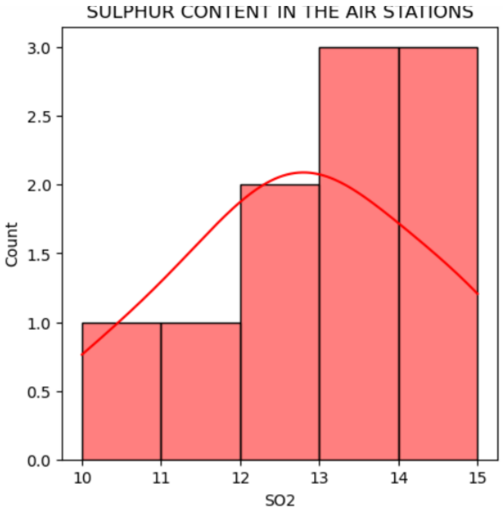
```
In [37]: air['SO2']=air['SO2'].head(10)
```

```
In [38]: air['SO2'].value_counts()
```

```
Out[38]: 13.0    3
         12.0    2
         15.0    2
         11.0    1
         14.0    1
         10.0    1
         Name: SO2, dtype: int64
```

```
In [39]: plt.figure(figsize=(5,5))
         plt.title("SULPHUR CONTENT IN THE AIR STATIONS")
         sns.histplot(x='SO2',data=air,kde=True,color='red')
         plt.show()
```





```
In [40]: air['NO2']=air['NO2'].head(10)
```

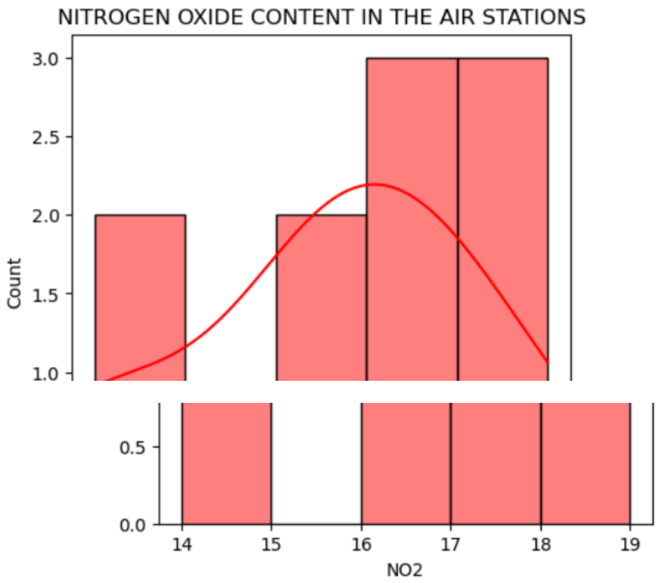
```
In [41]: air['NO2'].value_counts()
```

```
Out[41]: 17.0    3
         18.0    2
```

```
n [41]: air['NO2'].value_counts()
```

```
ut[41]: 17.0    3
        18.0    2
        16.0    2
        14.0    2
        19.0    1
        Name: NO2, dtype: int64
```

```
n [42]: plt.figure(figsize=(5,5))
        plt.title("NITROGEN OXIDE CONTENT IN THE AIR STATIONS")
        sns.histplot(x='NO2',data=air,kde=True,color='red')
        plt.show()
```

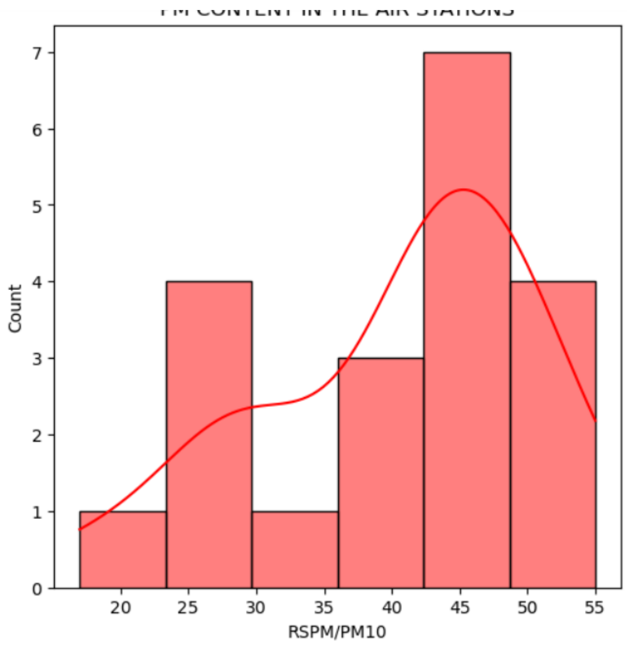


```
In [43]: air['RSPM/PM10'].value_counts()
```

```
Out[43]: 47.0     64
         41.0     62
         43.0     59
         51.0     58
         40.0     58
                  ..
         163.0     1
         138.0     1
         211.0     1
         202.0     1
         238.0     1
         Name: RSPM/PM10, Length: 169, dtype: int64
```

```
In [44]: air['RSPM/PM10']=air['RSPM/PM10'].head(20)
```

```
In [45]: plt.figure(figsize=(6,6))
         plt.title("PM CONTENT IN THE AIR STATIONS")
         sns.histplot(x='RSPM/PM10',data=air,kde=True,color='red')
         plt.show()
```



THUS AIR QUALITY PREDICTION AND ANALYSIS HAS BEEN DONE SUCCESSFULLY