PHASE 4 - AIR QUALITY ANALYSIS AND PREDICTION IN TAMIL NADU

The project aims to analyze and visualize air quality data from monitoring stations in Tamil Nadu. The objective is to gain insights into air pollution trends, identify areas with high pollution levels, and develop a predictive model to estimate RSPM/PM10 levels based on SO2 and NO2 levels. This project involves defining objectives, designing the analysis approach, selecting visualization techniques, and creating a predictive model using Python and relevant libraries.

DEVELOPMENT PART 1:

Step 1: Data Loading

Data loading is the process of bringing external data into a format suitable for analysis. In this case, we’ve imported data in CSV format by utilizing the Pandas library and subsequently printed it to confirm the successful loading of the data.

Step 2: Explore the data

Exploring the data using the head() and info() function is a process of initially examining a dataset to understand its structure, content, and quality.

head() - This function displays the first few rows of the dataset.

info() - It displays information about the data types of each column, the number of non-null entries, and the memory usage.

Step 3: Data cleaning

To address the issue of missing values in the provided dataset, we can resolve it by filling those missing values with zeros.

□Check whether the data set contain any missing values

□Replace the missing values with zeros

□Save the preprocessed data to a new file

□Check missing values again to verify they are handled

Step 4: Data Analysis

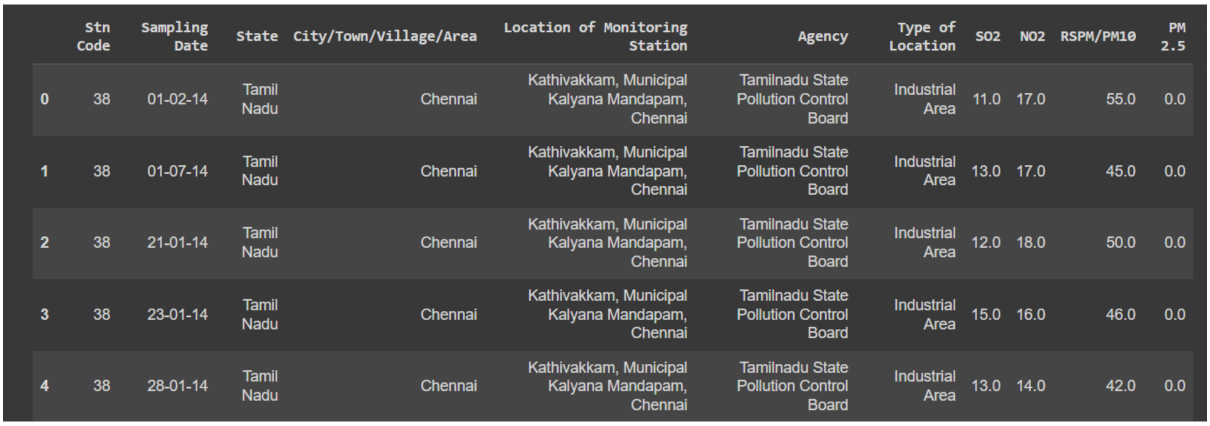
This analysis aims to visually assess patterns and variations in SO2 levels across different locations (City/Town/Village/Area). It helps identify areas with notably high or low SO2 pollution levels, providing insights into air quality variations across different areas.

Step 5: Scatter Plot

It creates the scatter plot with the specified data, axis labels, color, size, and title.The plot visually represents the relationship between SO2, NO2, and RSPM/PM10 levels, with color and marker size indicating RSPM/PM10 levels, making it easy to observer patterns and associations between these variables.

Code:

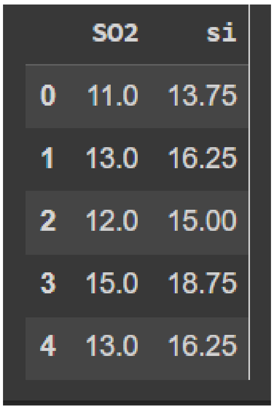
```
import numpy as np

import pandas as pd

import matplotlib.pyplot as plt

import seaborn as sns

%matplotlib inline

plt.rcParams['figure.figsize'] = (10,7)

import warnings

warnings.filterwarnings('ignore')

import os

data = pd.read_csv("cpcb_dly_aq_tamil_nadu-2014 (1).csv")

data.fillna(0, inplace = True)

data.head()
```



	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	0.0
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	0.0
2	38	21-01-14	Tamil Nadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam, Chennai	Tamilnadu State Pollution Control Board	Industrial Area	12.0	18.0	50.0	0.0
3	38	23-01-14	Tamil Nadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam, Chennai	Tamilnadu State Pollution Control Board	Industrial Area	15.0	16.0	46.0	0.0
4	38	28-01-14	Tamil Nadu	Chennai	Kathivakkam, Municipal Kalyana Mandapam, Chennai	Tamilnadu State Pollution Control Board	Industrial Area	13.0	14.0	42.0	0.0

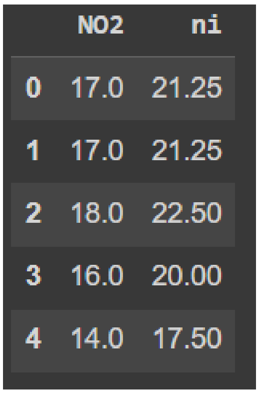
```
def calculate_si(SO2):

   si=0

   if (SO2<=40):

      si = SO2*(50/40)

   if (SO2>40 and SO2<=80):

      si = 50+(SO2-40)*(50/40)

   if (SO2>80 and SO2<=380):

      si = 100+(SO2-80)*(100/300)
```

```
    if (SO2>380 and SO2<=800):
        si = 200+(SO2-380)*(100/800)
    if (SO2>800 and SO2<=1600):
        si = 300+(SO2-800)*(100/800)
    if (SO2>1600):
        si = 400+(SO2-1600)*(100/800)
    return si
data['si']=data['SO2'].apply(calculate_si)
df=data[['SO2','si']]
df.head()
```



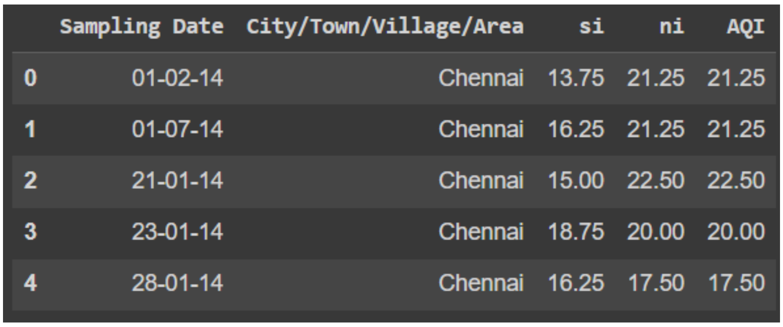
```
    SO2     si
0  11.0  13.75
1  13.0  16.25
2  12.0  15.00
3  15.0  18.75
4  13.0  16.25
```

```
def calculate_ni(NO2):
    ni=0
    if (NO2<=40):
        ni = NO2*50/40
    elif (NO2>40 and NO2<=80):
        ni = 50+(NO2-14)*(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+(NO2-800)*(100/120)
    else:
        ni = 400+(NO2-400)*(100/120)
    return ni
data['ni']=data['NO2'].apply(calculate_ni)
df=data[['NO2','ni']]
df.head()
```



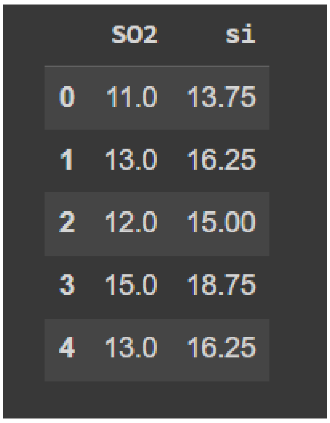
	NO2	ni
0	17.0	21.25
1	17.0	21.25
2	18.0	22.50
3	16.0	20.00
4	14.0	17.50

```
def calculate_aqi(si,ni):
    aqi=0
    if(si>ni):
        aqi=si
    if(ni>si):
        aqi=ni
    return aqi
data['AQI']=data.apply(lambda x:calculate_aqi(x['si'],x['ni']),axis=1)
df=data[['Sampling Date', 'City/Town/Village/Area', 'si', 'ni', 'AQI']]
df.head()
```



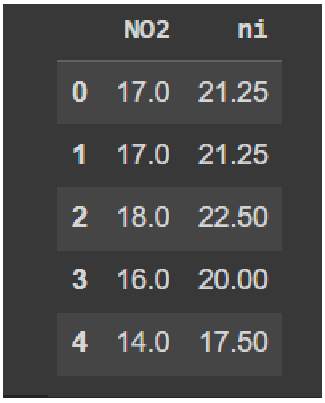
	Sampling Date	City/Town/Village/Area	si	ni	AQI
0	01-02-14	Chennai	13.75	21.25	21.25
1	01-07-14	Chennai	16.25	21.25	21.25
2	21-01-14	Chennai	15.00	22.50	22.50
3	23-01-14	Chennai	18.75	20.00	20.00
4	28-01-14	Chennai	16.25	17.50	17.50

```
def calculate_rspmi(rspm):
    rspmi=0
    if (rspm<=40):
        rspmi = rspm*50/40
    elif (rspm>40 and rspm<=80):
        rspmi = 50+(rspm-14)*(50/40)
    elif (rspm>80 and rspm<=180):
        rspmi = 100+(rspm-80)*(100/100)
    elif (rspm>180 and rspm<=280):
        rspmi = 200+(rspm-180)*(100/100)
    elif (rspm>280 and rspm<=400):
        rspmi = 300+(rspm-800)*(100/120)
    else:
        rspmi = 400+(rspm-400)*(100/120)
    return rspmi
data['rspmi']=data['RSPM/PM10'].apply(calculate_rspmi)
df=data[['RSPM/PM10','rspmi']]
df.head()
```



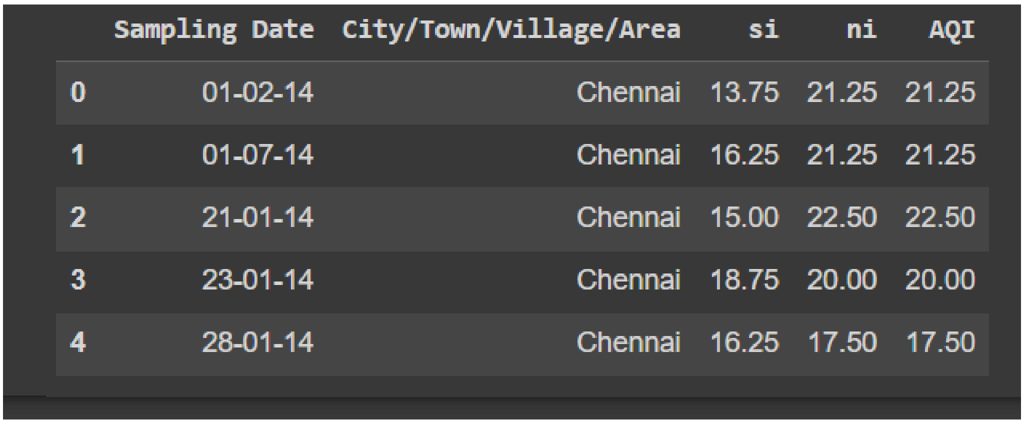
```
    SO2     si
0  11.0  13.75
1  13.0  16.25
2  12.0  15.00
3  15.0  18.75
4  13.0  16.25
```

```
def calculate_ni(NO2):
    ni=0
    if (NO2<=40):
        ni = NO2*50/40
    elif (NO2>40 and NO2<=80):
        ni = 50+(NO2-14)*(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+(NO2-800)*(100/120)
    else:
        ni = 400+(NO2-400)*(100/120)
    return ni
data['ni']=data['NO2'].apply(calculate_ni)
df=data[['NO2','ni']]
df.head()
```



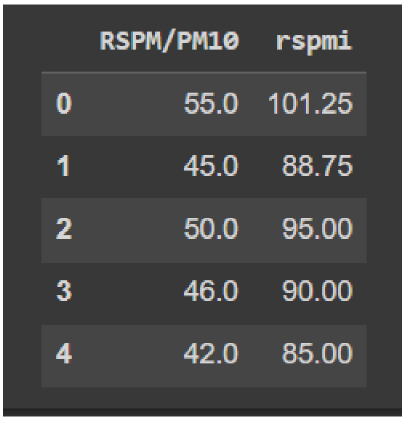
```
    NO2     ni
0  17.0  21.25
1  17.0  21.25
2  18.0  22.50
3  16.0  20.00
4  14.0  17.50
```

```
def calculate_aqi(si,ni):
    aqi=0
    if(si>ni):
        aqi=si
    if(ni>si):
        aqi=ni
    return aqi
data['AQI']=data.apply(lambda x:calculate_aqi(x['si'],x['ni']),axis=1)
df=data[['Sampling Date', 'City/Town/Village/Area', 'si', 'ni', 'AQI']]
df.head()
```



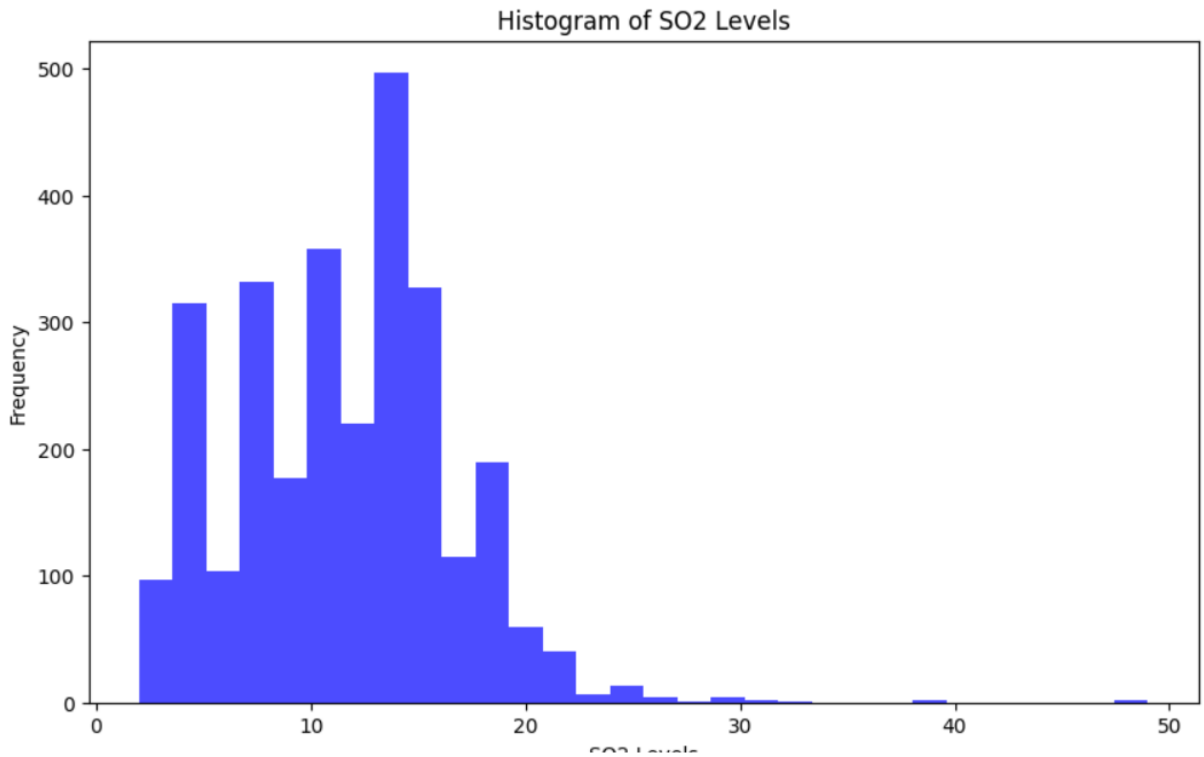
	Sampling Date	City/Town/Village/Area	si	ni	AQI
0	01-02-14	Chennai	13.75	21.25	21.25
1	01-07-14	Chennai	16.25	21.25	21.25
2	21-01-14	Chennai	15.00	22.50	22.50
3	23-01-14	Chennai	18.75	20.00	20.00
4	28-01-14	Chennai	16.25	17.50	17.50

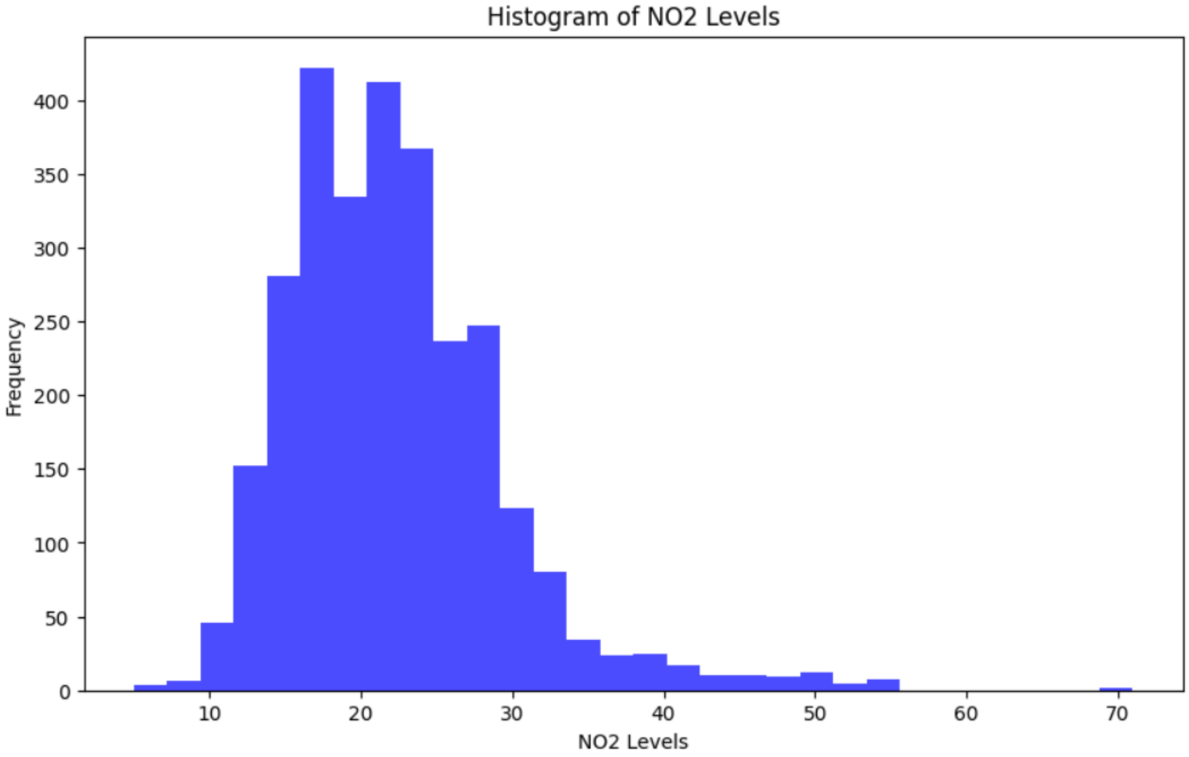
```
def calculate_rspmi(rspm):
   rspmi=0
   if (rspm<=40):
      rspmi = rspm*50/40
   elif (rspm>40 and rspm<=80):
      rspmi = 50+(rspm-14)*(50/40)
   elif (rspm>80 and rspm<=180):
      rspmi = 100+(rspm-80)*(100/100)
   elif (rspm>180 and rspm<=280):
      rspmi = 200+(rspm-180)*(100/100)
   elif (rspm>280 and rspm<=400):
      rspmi = 300+(rspm-800)*(100/120)
   else:
      rspmi = 400+(rspm-400)*(100/120)
   return rspmi
data['rspmi']=data['RSPM/PM10'].apply(calculate_rspmi)
df=data[['RSPM/PM10','rspmi']]
df.head()
```

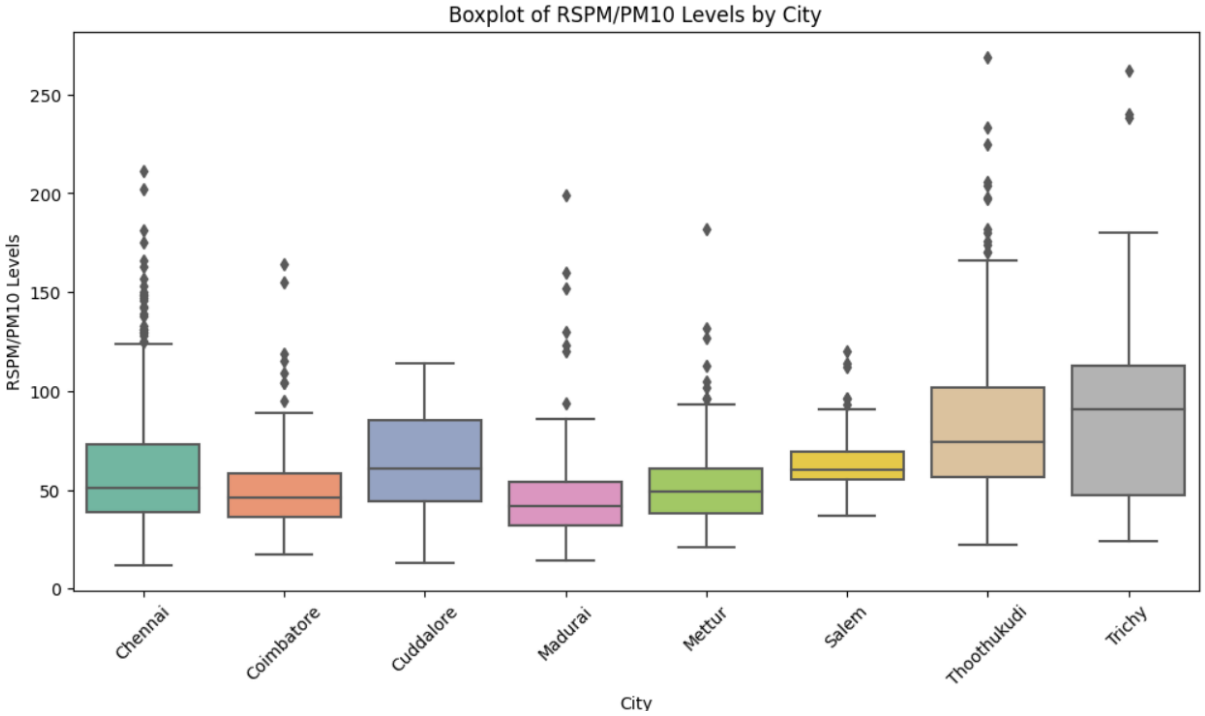


	RSPM/PM10	rspmi
0	55.0	101.25
1	45.0	88.75
2	50.0	95.00
3	46.0	90.00
4	42.0	85.00

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Load the dataset
file_path = r"/content/cpcb_dly_aq_tamil_nadu-2014 (1).csv"
data = pd.read_csv(file_path)

# Data cleaning and preprocessing (if needed)
# Example: data = data.dropna()  # Remove rows with missing values

# Create visualizations

# Example 1: Histogram of SO2 levels
plt.figure(figsize=(10, 6))
plt.hist(data['SO2'], bins=30, color='blue', alpha=0.7)
plt.title("Histogram of SO2 Levels")
plt.xlabel("SO2 Levels")
plt.ylabel("Frequency")
plt.show()

# Example 2: Time series plot of NO2 levels
plt.figure(figsize=(10, 6))
plt.hist(data['NO2'], bins=30, color='blue', alpha=0.7)

plt.title("Histogram of NO2 Levels")

plt.xlabel("NO2 Levels")

plt.ylabel("Frequency")

plt.show()


# Example 3: Boxplot of RSPM/PM10 levels by City

plt.figure(figsize=(12, 6))

sns.boxplot(data=data, x="City/Town/Village/Area", y="RSPM/PM10", palette="Set2")

plt.title("Boxplot of RSPM/PM10 Levels by City")

plt.xlabel("City")

plt.ylabel("RSPM/PM10 Levels")

plt.xticks(rotation=45)

plt.show()
```




Histogram of NO2 Levels
Frequency
0
50
100
150
200
250
300
350
400
10
20
30
40
50
60
70
NO2 Levels


Boxplot of RSPM/PM10 Levels by City
RSPM/PM10 Levels
0
50
100
150
200
250
Chennai
Coimbatore
Cuddalore
Madurai
Mettur
Salem
Thoothukudi
Trichy
City