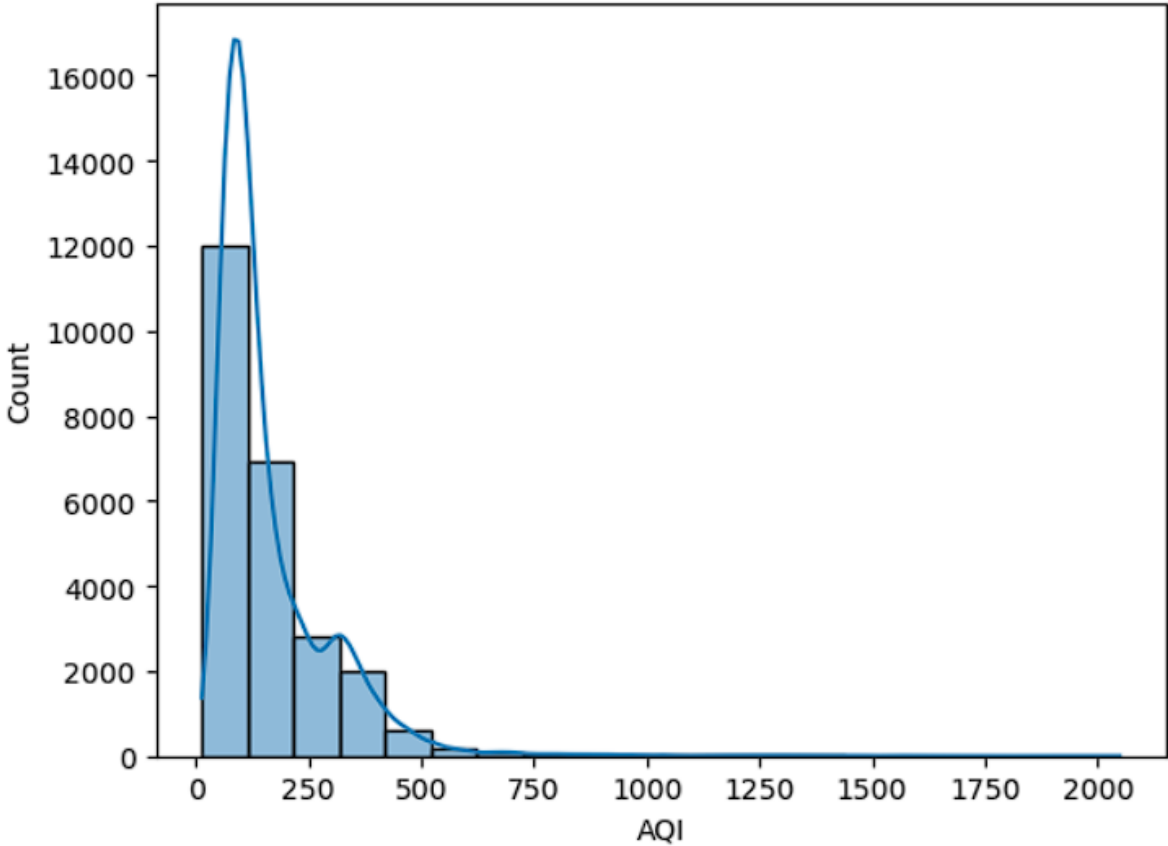


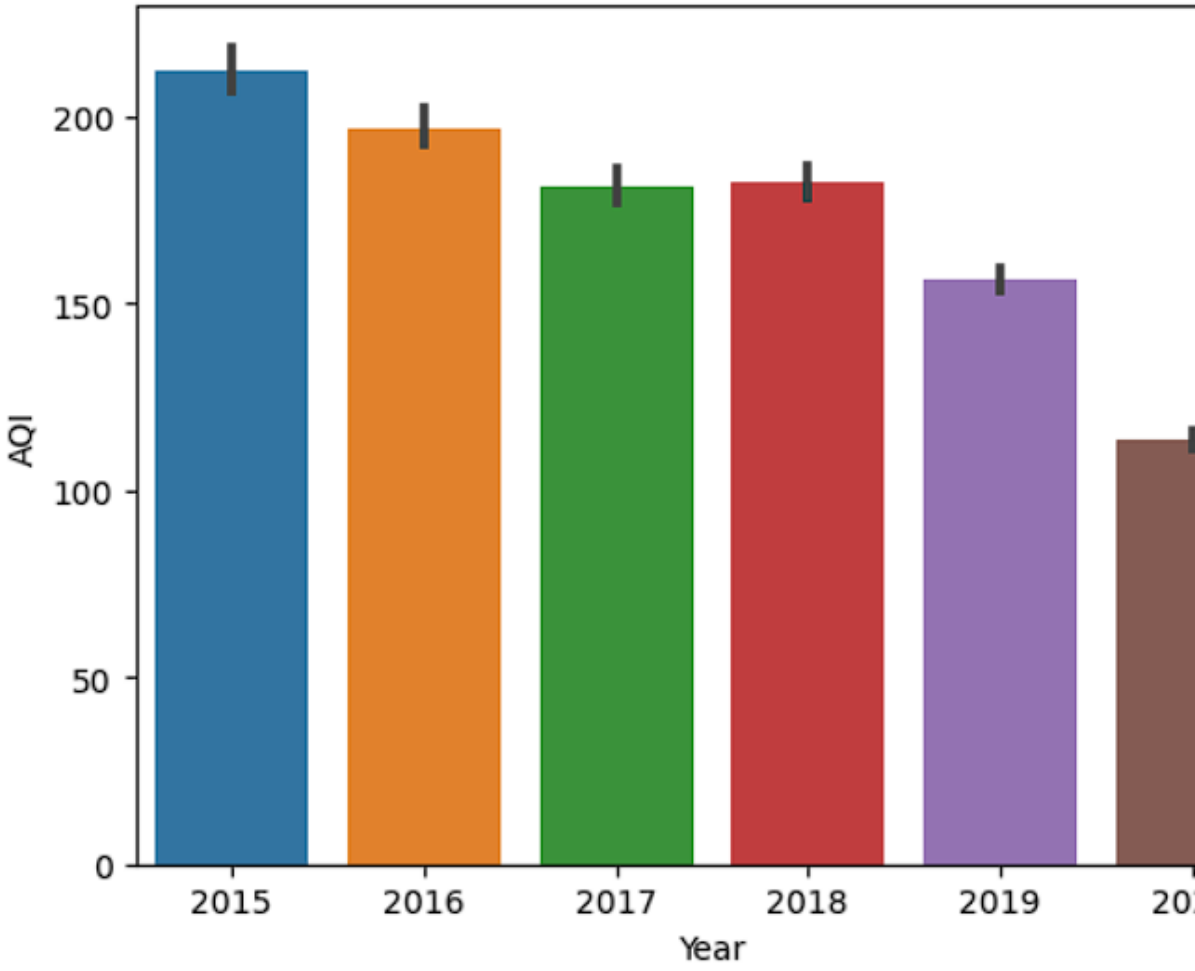
### **Data Collection and Preprocessing Phase**

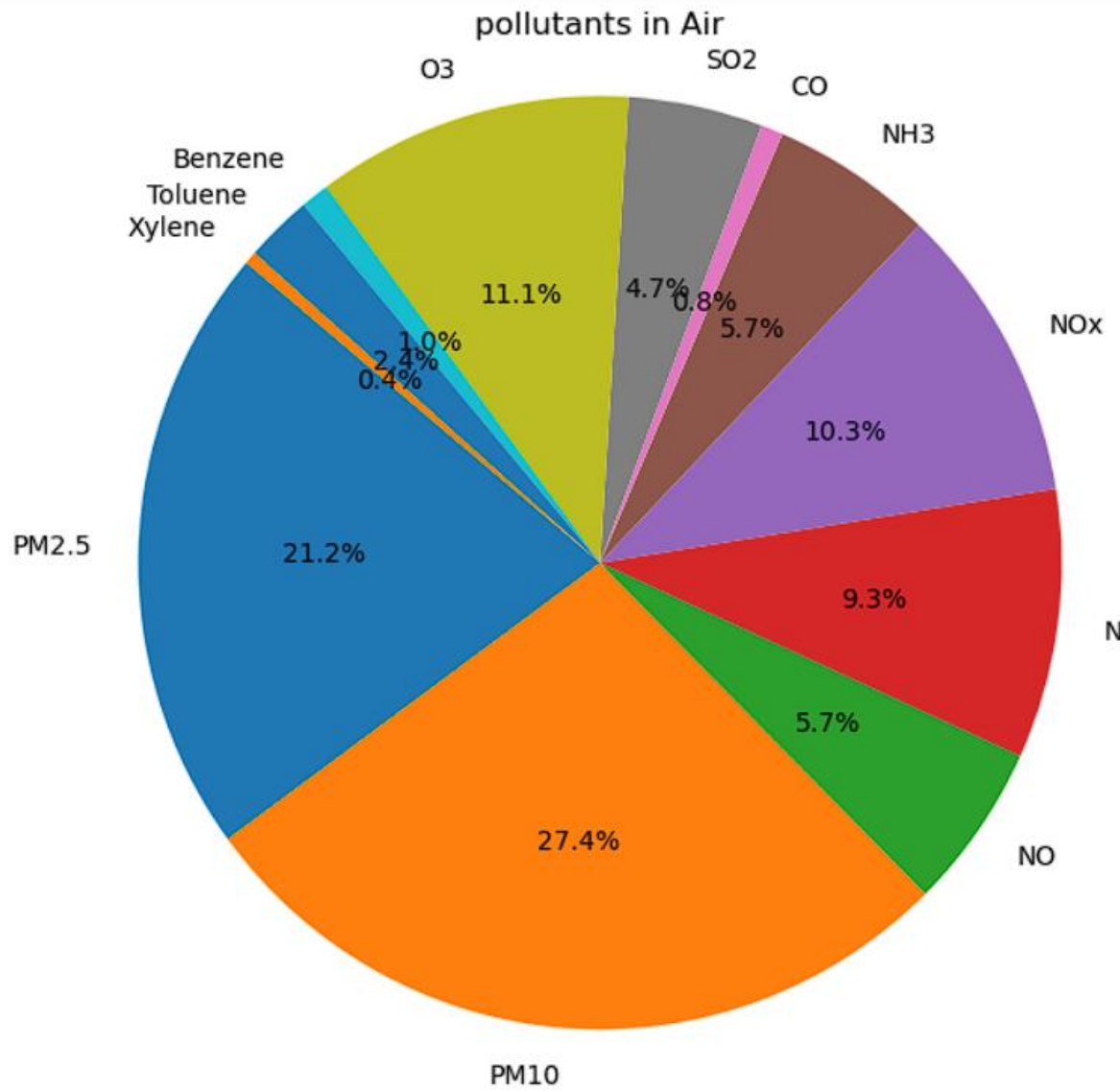
Date	07 JULY 2024
Team ID	739752
Project Title	Air Quality Index Analyzer using machine learning
Maximum Marks	6 Marks

### **Data Exploration and Preprocessing Report**

Identifies data sources, assesses quality issues like missing values and duplicates, and implements resolution plans to ensure accurate and reliable analysis

Section	Description																																																															
Data Overview	<div><pre>data_city.describe()</pre><table><thead><tr><th></th><th>PM2.5</th><th>PM10</th><th>NO</th><th>NO2</th><th>NOx</th><th>NH3</th></tr></thead><tbody><tr><td>count</td><td>24933.000000</td><td>18391.000000</td><td>25949.000000</td><td>25946.000000</td><td>25346.000000</td><td>19203.000000</td></tr><tr><td>mean</td><td>67.450578</td><td>118.127103</td><td>17.574730</td><td>28.560659</td><td>32.309123</td><td>23.483476</td></tr><tr><td>std</td><td>64.661449</td><td>90.605110</td><td>22.785846</td><td>24.474746</td><td>31.646011</td><td>25.684275</td></tr><tr><td>min</td><td>0.040000</td><td>0.010000</td><td>0.020000</td><td>0.010000</td><td>0.000000</td><td>0.010000</td></tr><tr><td>25%</td><td>28.820000</td><td>56.255000</td><td>5.630000</td><td>11.750000</td><td>12.820000</td><td>8.580000</td></tr><tr><td>50%</td><td>48.570000</td><td>95.680000</td><td>9.890000</td><td>21.690000</td><td>23.520000</td><td>15.850000</td></tr><tr><td>75%</td><td>80.590000</td><td>149.745000</td><td>19.950000</td><td>37.620000</td><td>40.127500</td><td>30.020000</td></tr><tr><td>max</td><td>949.990000</td><td>1000.000000</td><td>390.680000</td><td>362.210000</td><td>467.630000</td><td>352.890000</td></tr></tbody></table></div> <p>Basic statistics, dimensions, and structure of the data.</p>		PM2.5	PM10	NO	NO2	NOx	NH3	count	24933.000000	18391.000000	25949.000000	25946.000000	25346.000000	19203.000000	mean	67.450578	118.127103	17.574730	28.560659	32.309123	23.483476	std	64.661449	90.605110	22.785846	24.474746	31.646011	25.684275	min	0.040000	0.010000	0.020000	0.010000	0.000000	0.010000	25%	28.820000	56.255000	5.630000	11.750000	12.820000	8.580000	50%	48.570000	95.680000	9.890000	21.690000	23.520000	15.850000	75%	80.590000	149.745000	19.950000	37.620000	40.127500	30.020000	max	949.990000	1000.000000	390.680000	362.210000	467.630000	352.890000
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Univariate Analysis	<p>Exploration of individual variables (mean, median, mode, etc.).</p>  <p>A histogram showing the distribution of the Air Quality Index (AQI). The x-axis is labeled 'AQI' and ranges from 0 to 2000 with major ticks every 250 units. The y-axis is labeled 'Count' and ranges from 0 to 16000 with major ticks every 2000 units. The histogram bars are light blue with black outlines. A smooth blue curve is overlaid on the histogram, representing a normal distribution fit. The distribution is right-skewed, with a peak count of approximately 12000 at an AQI value of about 100. The curve peaks at approximately 16500 at the same AQI value. The data tapers off significantly as AQI increases beyond 500.</p>																																																															
Bivariate Analysis	<p>Relationships between two variables (correlation, scatter plots).</p>																																																															

	 <table border="1"><thead><tr><th>Year</th><th>AQI</th></tr></thead><tbody><tr><td>2015</td><td>215</td></tr><tr><td>2016</td><td>198</td></tr><tr><td>2017</td><td>185</td></tr><tr><td>2018</td><td>185</td></tr><tr><td>2019</td><td>158</td></tr><tr><td>2020</td><td>115</td></tr></tbody></table>	Year	AQI	2015	215	2016	198	2017	185	2018	185	2019	158	2020	115
Year	AQI														
2015	215														
2016	198														
2017	185														
2018	185														
2019	158														
2020	115														
Multivariate Analysis	Patterns and relationships involving multiple variables.														



Outliers and Anomalies

Identification and treatment of outliers.

```
26]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

def handle_outliers(df):
    # Plot boxplots before handling outliers
    plt.figure(figsize=(15, 10))
    df.boxplot(rot=90)
    plt.title('Boxplot Before Handling Outliers')
    plt.show()

    for column in df.columns:
        if pd.api.types.is_numeric_dtype(df[column]):
            Q1 = df[column].quantile(0.25)
            Q3 = df[column].quantile(0.75)
            IQR = Q3 - Q1
            lower_bound = Q1 - 1.5 * IQR
            upper_bound = Q3 + 1.5 * IQR

            # Cap the outliers
            df[column] = np.where(df[column] < lower_bound, lower_bound,
                                  np.where(df[column] > upper_bound, upper_bound, df[column]))

    # Plot boxplots after handling outliers
    plt.figure(figsize=(15, 10))
    df.boxplot(rot=90)
    plt.title('Boxplot After Handling Outliers')
    plt.show()

    return df
```

## Data Preprocessing Code Screenshots

## Loading Data

Code to load the dataset into the preferred

```
In [48]: x=data_city.drop('AQI',axis=1)
y=data_city['AQI']
```

```
In [49]: x
```

```
Out[49]:
```

	City	PM2.5	PM10	NO	NO2	NOx	NH3	CO	SO2	C
0	0	34.515	154.750	0.92	18.22	17.15	8.975	0.92	27.640	85.63
1	0	25.830	226.235	0.97	15.69	16.46	9.095	0.97	24.550	34.06
2	0	36.205	72.125	17.40	19.30	29.70	6.880	2.86	29.070	30.70
3	0	25.830	226.235	1.70	18.48	17.97	9.085	1.70	18.590	36.08
4	0	54.440	72.125	22.10	21.42	37.76	7.915	2.86	29.545	39.33
...	...	...	...	...	...	...	...	...	...	...
29526	25	15.020	50.940	7.68	25.06	19.54	12.470	0.47	8.550	23.30
29527	25	24.380	74.090	3.42	26.06	16.53	11.990	0.52	12.720	30.14
29528	25	22.910	65.730	3.45	29.53	18.33	10.710	0.48	8.420	30.96
29529	25	16.640	49.970	4.05	29.26	18.80	10.030	0.52	9.840	28.30
29530	25	15.000	66.000	0.40	26.85	14.05	5.200	0.59	2.100	17.05

29531 rows × 15 columns

Handling Missing Data	<p>Code for identifying and handling missing values.</p> <h2>Handling Null Values</h2> <pre>2]: data_city.isna().sum()</pre> <pre>2]: City          0       Date          0       PM2.5       4598       PM10       11140       NO          3582       NO2         3585       NOx         4185       NH3        10328       CO          2059       SO2         3854       O3          4022       Benzene     5623       Toluene     8041       Xylene     18109       AQI         4681       AQI_Bucket  4681       dtype: int64</pre>
Data Transformation	Code for transforming variables (scaling, normalization).
Feature Engineering	Code for creating new features or modifying existing ones.

```
In [48]: x=data_city.drop('AQI',axis=1)
y=data_city['AQI']
```

```
In [49]: x
```

```
Out[49]:
```

	City	PM2.5	PM10	NO	NO2	NOx	NH3	CO	SO2	O3	Benzene	Toluene	Xylene	Year	Month
0	0	34.515	154.750	0.92	18.22	17.15	8.975	0.92	27.640	85.635	0.00	0.02	0.00	2015.0	1.0
1	0	25.830	226.235	0.97	15.69	16.46	9.095	0.97	24.550	34.060	3.68	5.50	3.77	2015.0	1.0
2	0	36.205	72.125	17.40	19.30	29.70	6.880	2.86	29.070	30.700	6.80	16.40	2.25	2015.0	1.0
3	0	25.830	226.235	1.70	18.48	17.97	9.085	1.70	18.590	36.080	4.43	10.14	1.00	2015.0	1.0
4	0	54.440	72.125	22.10	21.42	37.76	7.915	2.86	29.545	39.310	7.01	18.89	2.78	2015.0	1.0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
29526	25	15.020	50.940	7.68	25.06	19.54	12.470	0.47	8.550	23.300	2.24	12.07	0.73	2020.0	6.0
29527	25	24.380	74.090	3.42	26.06	16.53	11.990	0.52	12.720	30.140	0.74	2.21	0.38	2020.0	6.0
29528	25	22.910	65.730	3.45	29.53	18.33	10.710	0.48	8.420	30.960	0.01	0.01	0.00	2020.0	6.0
29529	25	16.640	49.970	4.05	29.26	18.80	10.030	0.52	9.840	28.300	0.00	0.00	0.00	2020.0	6.0
29530	25	15.000	66.000	0.40	26.85	14.05	5.200	0.59	2.100	17.050	0.00	0.00	0.00	2020.0	7.0

29531 rows × 15 columns