Exploratory Data Analysis of Air Quality Index of Delhi

Air performs a vital role in supporting life on Earth. But with the passage of time the fresh and pure air is gradually getting contaminated due to increase in air pollution.

Problem of air pollution is increasingly getting more serious. Increasing levels of pollutants in air is causing extreme health disorder. It directly affects a population of millions who are suffering from shortness of breath, eye irritation to chronic respiratory disorders, pneumonia, acute asthma etc.

This study is based on hourly data collected for Delhi state (www.cpcb.nic.in)

We will be doing Exploratory Data Analysis for this data using pandas, numpy, matplotlib and seaborn libraries.

In [1]:

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

In [2]:

```
df=pd.read_csv("C:\\Users\\Ankita\\Desktop\\Datasets\\Delhi_AQI.csv")
print(df.head())
date=df.iloc[: ,1]
AQI_bucket=df.iloc[:,-1]
```

```
    City      Date   PM2.5    PM10     NO    NO2     NOx     NH3     CO   SO2  \
0  Delhi  1/1/2015  313.22  607.98  69.16  36.39  110.59   33.85  15.20  9.25
1  Delhi  1/2/2015  186.18  269.55  62.09  32.87   88.14   31.83   9.54  6.65
2  Delhi  1/3/2015   87.18  131.90  25.73  30.31   47.95   69.55  10.61  2.65
3  Delhi  1/4/2015  151.84  241.84  25.01  36.91   48.62  130.36  11.54  4.63
4  Delhi  1/5/2015  146.60  219.13  14.01  34.92   38.25  122.88   9.20  3.33

      O3  Benzene  Toluene  Xylene    AQI AQI_Bucket
0  41.68    14.36    24.86    9.84  472.0     Severe
1  29.97    10.55    20.09    4.29  454.0     Severe
2  19.71     3.91    10.23    1.99  143.0   Moderate
3  25.36     4.26     9.71    3.34  319.0  Very Poor
4  23.20     2.80     6.21    2.96  325.0  Very Poor
```

Descriptive Statistics

In [3]:

```
df.describe()
```

Out[3]:

	PM2.5	PM10	NO	NO2	NOx	NH3	CO	SO2	O3	Benzene	Toluene	Xylene	AQI
count	2007.000000	1932.000000	2007.000000	2007.000000	2009.000000	2000.000000	2009.000000	1899.000000	1925.00000	2009.000000	2009.000000	1228.000000	1999.000000
mean	117.196153	232.809229	38.985595	50.785182	58.567023	41.997150	1.976053	15.901253	51.32361	3.544480	17.185042	1.438339	259.487744
std	82.912945	121.873025	33.389456	22.696721	37.690350	17.301221	2.560253	7.966770	26.06234	2.431232	15.291597	2.377762	119.537333
min	10.240000	18.590000	3.570000	10.630000	0.000000	6.780000	0.000000	2.340000	6.94000	0.000000	0.000000	0.000000	29.000000
25%	57.095000	137.040000	15.895000	33.895000	31.150000	31.157500	0.910000	10.335000	33.71000	1.870000	6.650000	0.110000	161.500000
50%	94.620000	216.730000	27.200000	47.150000	52.750000	38.040000	1.240000	14.450000	44.44000	2.960000	12.750000	0.650000	257.000000
75%	153.030000	311.667500	50.790000	63.570000	75.360000	48.792500	1.870000	19.700000	60.84000	4.680000	23.200000	1.970000	345.500000
max	685.360000	796.880000	221.030000	162.500000	254.800000	166.700000	30.440000	71.560000	257.73000	20.640000	103.000000	23.300000	716.000000

Here we get PM10 pollutant with highest mean (232.8) which shows that for poor air quality of Delhi PM10 is the most responsible pollutant present in the air.

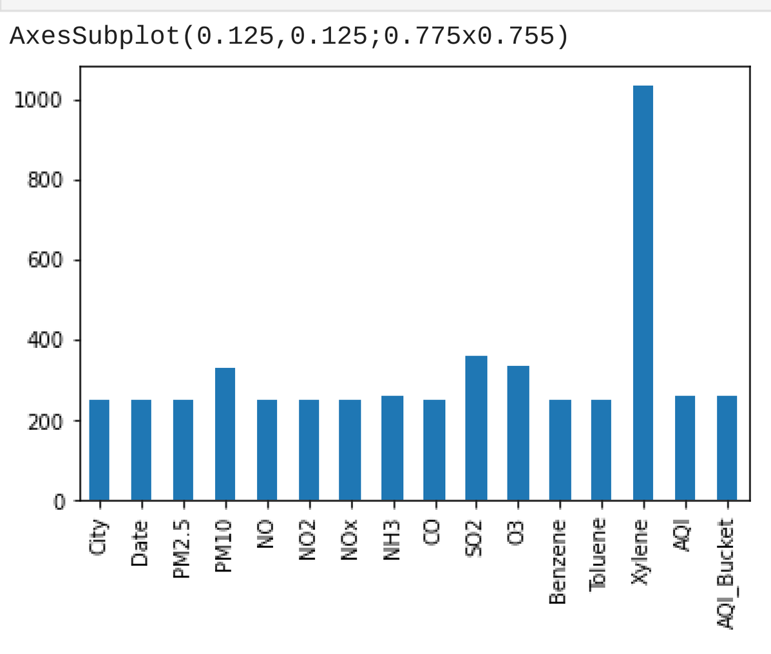
Data Cleaning

we have to clean the dataset to start the Exploratory Data Analysis.

In [4]:

```
print(df.isnull().sum().plot(kind='bar'))
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



In [5]:

```
print(df.shape)
```

```
(2260, 16)
```

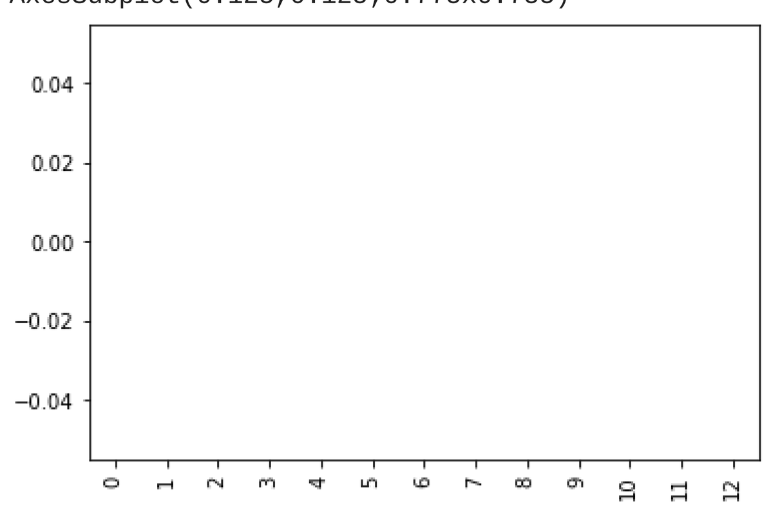
In [6]:

```
# Importing the SimpleImputer class
from sklearn.impute import SimpleImputer
```

In [7]:

```
imputer = SimpleImputer(missing_values=np.nan, strategy='median')
df1=df.iloc[: ,2:15]
df1= imputer.fit_transform(df1)
df1=pd.DataFrame(df1)
print(df1.isnull().sum().plot(kind='bar'))
```

```
AxesSubplot(0.125,0.125;0.775x0.755)
```



Our dataset is now clean with no null values.

In [8]:

```
df1.loc[:,"Date"]=date
df1.loc[:,"AQI_bucket"]=AQI_bucket
df1.columns=['PM2.5','PM10','NO','NO2','NOX','NH3','CO','SO2','O3','Benzene','Toluene','Xylene','AQI','Date','AQI_bucket']
print(df1.head())
```

```
    PM2.5    PM10     NO    NO2     NOX     NH3     CO   SO2     O3  Benzene  \
0  313.22  607.98  69.16  36.39  110.59   33.85  15.20  9.25  41.68    14.36
1  186.18  269.55  62.09  32.87   88.14   31.83   9.54  6.65  29.97    10.55
2   87.18  131.90  25.73  30.31   47.95   69.55  10.61  2.65  19.71     3.91
3  151.84  241.84  25.01  36.91   48.62  130.36  11.54  4.63  25.36     4.26
4  146.60  219.13  14.01  34.92   38.25  122.88   9.20  3.33  23.20     2.80

   Toluene  Xylene    AQI      Date AQI_bucket
0    24.86    9.84  472.0  1/1/2015     Severe
1    20.09    4.29  454.0  1/2/2015     Severe
2    10.23    1.99  143.0  1/3/2015   Moderate
3     9.71    3.34  319.0  1/4/2015  Very Poor
4     6.21    2.96  325.0  1/5/2015  Very Poor
```

EDA

How AQI Bucket list is distributed?

In [9]:

```
#AQI Bucket list we have
df1['AQI_bucket'].value_counts()
```

Out[9]:

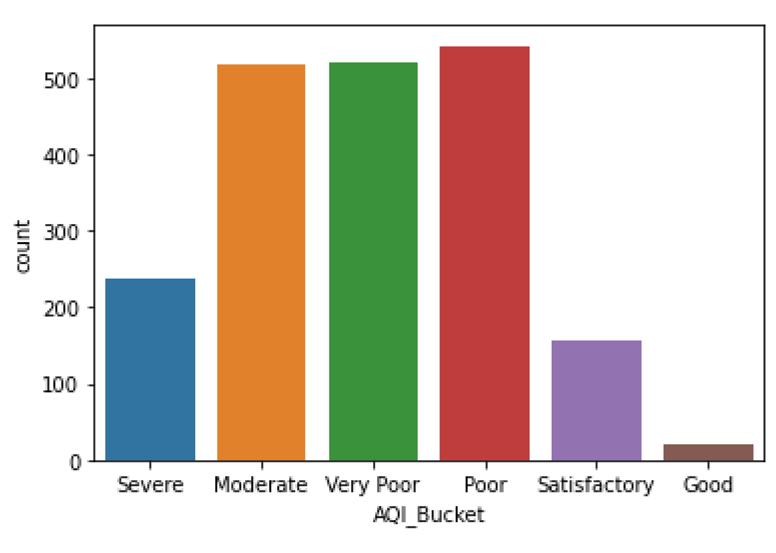
```
Poor            542
Very Poor       520
Moderate        519
Severe          239
Satisfactory    158
Good             21
Name: AQI_bucket, dtype: int64
```

In [10]:

```
sns.countplot(x=df.iloc[:,-1],data=df1)
```

Out[10]:

```
<AxesSubplot:xlabel='AQI_Bucket', ylabel='count'>
```



There are six AQI categories, namely Good, Satisfactory, moderately polluted, Poor, Very Poor, and Severe.

Most of the observations lie under Moderate, Poor, Very Poor region (which is serious matter of concern).

Very few observations are falls under Good air quality, which means most of the time air of Delhi is highly polluted.

How AQI is distributed?

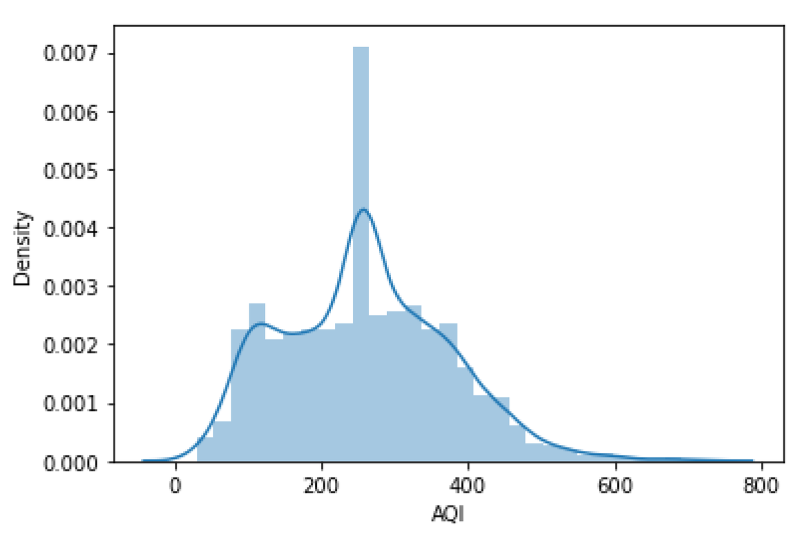
In [11]:

```
sns.distplot(df1['AQI'],kde=True,hist=True)
```

```
C:\Users\Ankita\anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future
version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histogram
s).
  warnings.warn(msg, FutureWarning)
```

Out[11]:

```
<AxesSubplot:xlabel='AQI', ylabel='Density'>
```

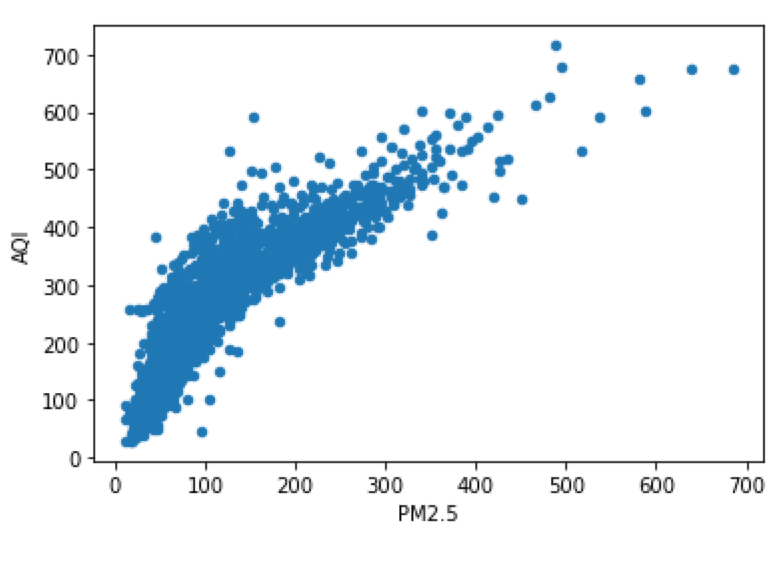


In [12]:

```
df1.plot(kind='scatter',x='PM2.5',y='AQI')
```

Out[12]:

```
<AxesSubplot:xlabel='PM2.5', ylabel='AQI'>
```



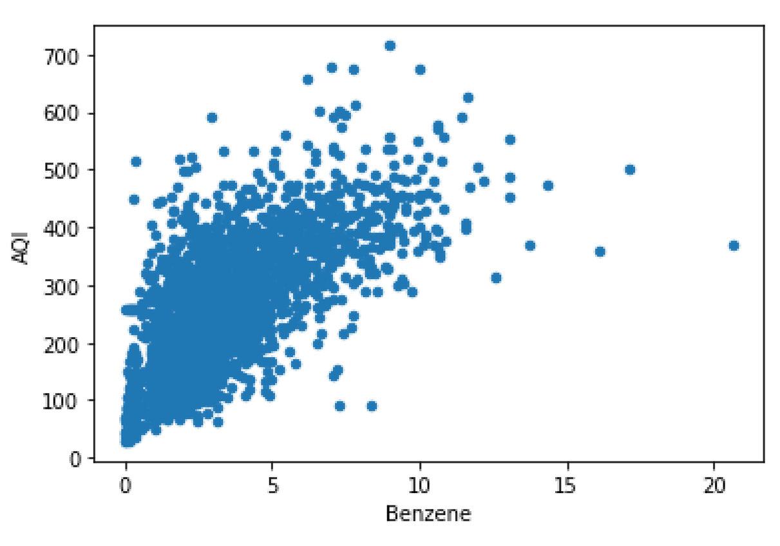
PM2.5 directly affecting the AQI value. Higher the concentration of PM2.5 in the atmosphere poorer the quality of air is. PM2.5 contributing highly for the poor air quality of Delhi.

In [13]:

```
df1.plot(kind='scatter',x='Benzene',y='AQI')
```

Out[13]:

```
<AxesSubplot:xlabel='Benzene', ylabel='AQI'>
```



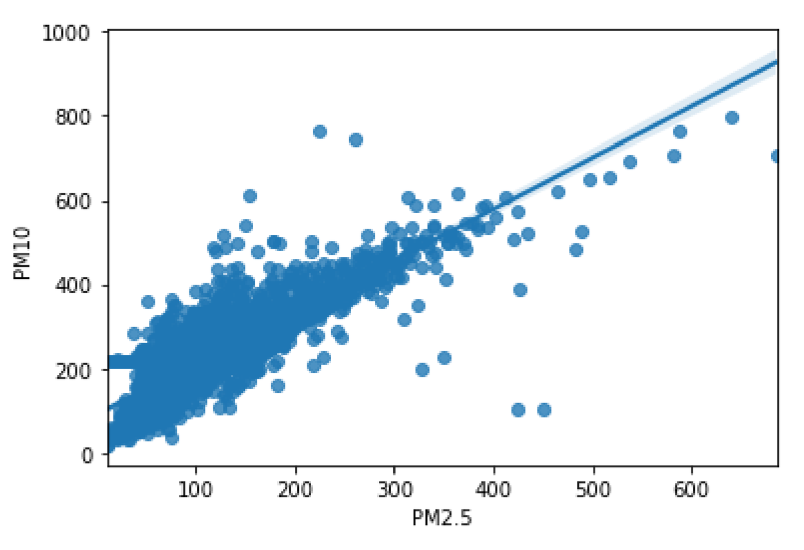
Even if the Benzene concentration is low in the environment,the AQI value is high. So,we can say that Benzene does not affect much in the AQI

In [14]:

```
sns.regplot(x='PM2.5',y='PM10',data=df1,scatter=True,fit_reg=True)
```

Out[14]:

```
<AxesSubplot:xlabel='PM2.5', ylabel='PM10'>
```



PM10 and PM2.5 are correlated, as concentration of PM2.5 increases the concentraion of PM10 also increases.

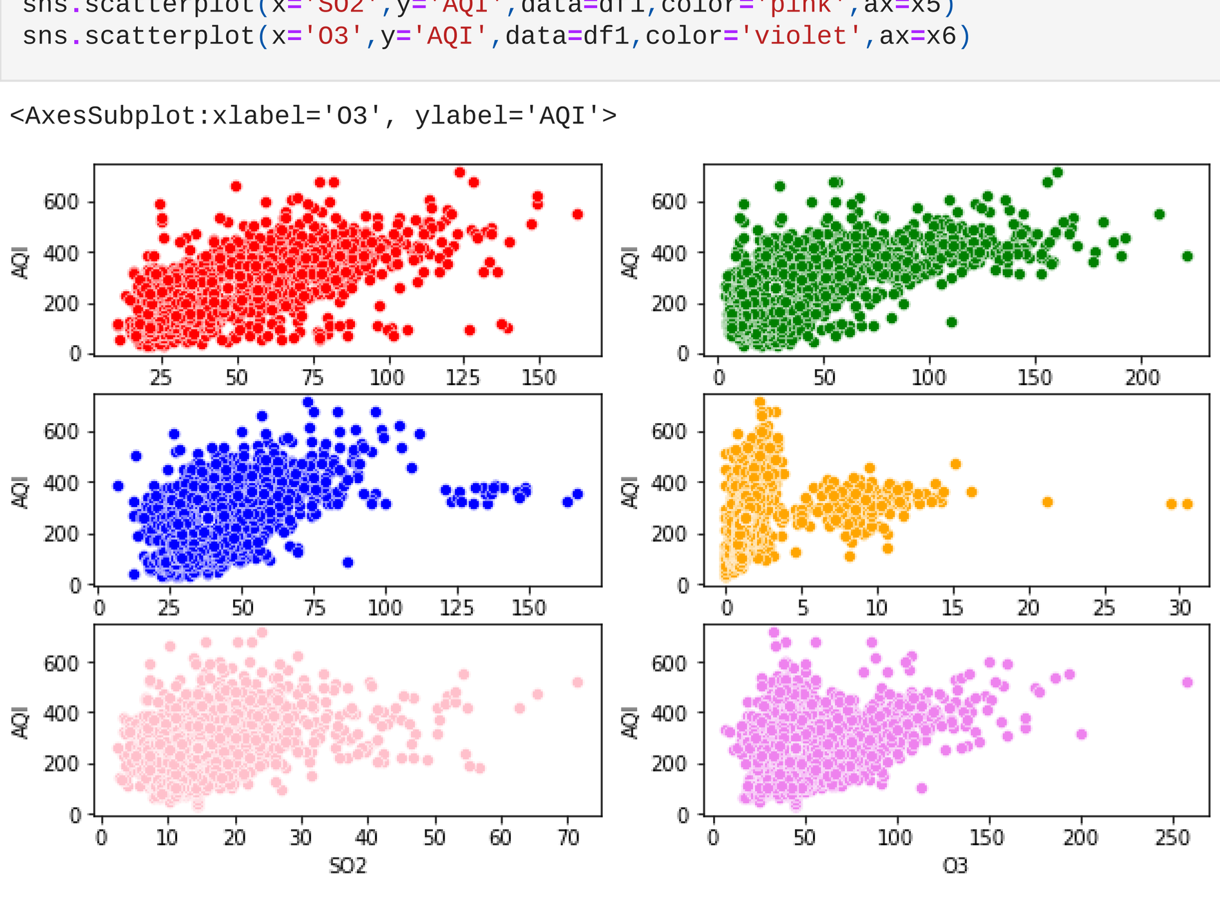
How each pollutant affects AQI ?

In [15]:

```
fig,((x1,x2),(x3,x4),(x5,x6))=plt.subplots(nrows=3,ncols=2,figsize=(10,6))
sns.scatterplot(x='NO2',y='AQI',data=df1,color='red',ax=x1)
sns.scatterplot(x='NO',y='AQI',data=df1,color='green',ax=x2)
sns.scatterplot(x='NH3',y='AQI',data=df1,color='blue',ax=x3)
sns.scatterplot(x='CO',y='AQI',data=df1,color='orange',ax=x4)
sns.scatterplot(x='SO2',y='AQI',data=df1,color='pink',ax=x5)
sns.scatterplot(x='O3',y='AQI',data=df1,color='violet',ax=x6)
```

Out[15]:

```
<AxesSubplot:xlabel='O3', ylabel='AQI'>
```



From the above plots we find that NO2, NO and NH3 are positively correlated with AQI, means as the concentration of these three pollutants increases in the enviroment, the air becomes more polluted.

CO, SO2 and O3 are not affecting the Air Quality much.

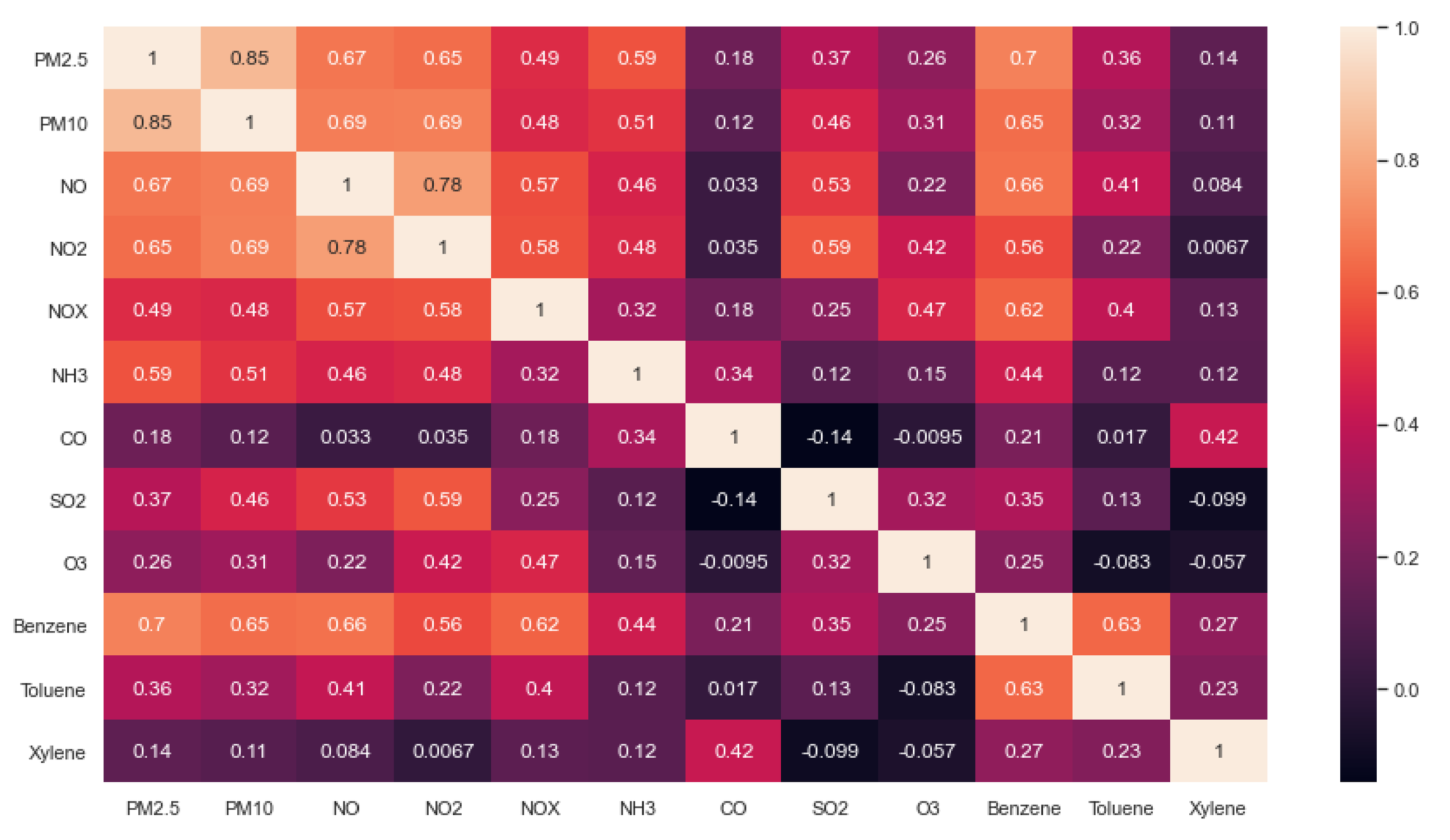
How Pollutants are correlated?

In [20]:

```
df3=df1.iloc[:,0:12]
sns.set(rc = {'figure.figsize':(15,8)})
sns.heatmap(data=df3.corr(), annot=True)
```

Out[20]:

```
<AxesSubplot:>
```



From the above heatmap we find that PM2.5 and PM10 are highly correlated with correlation coefficient 0.85

CO, O3, Toulene and xylene are found to be poorely related(or we can say uncorrelated) with other pollutants.