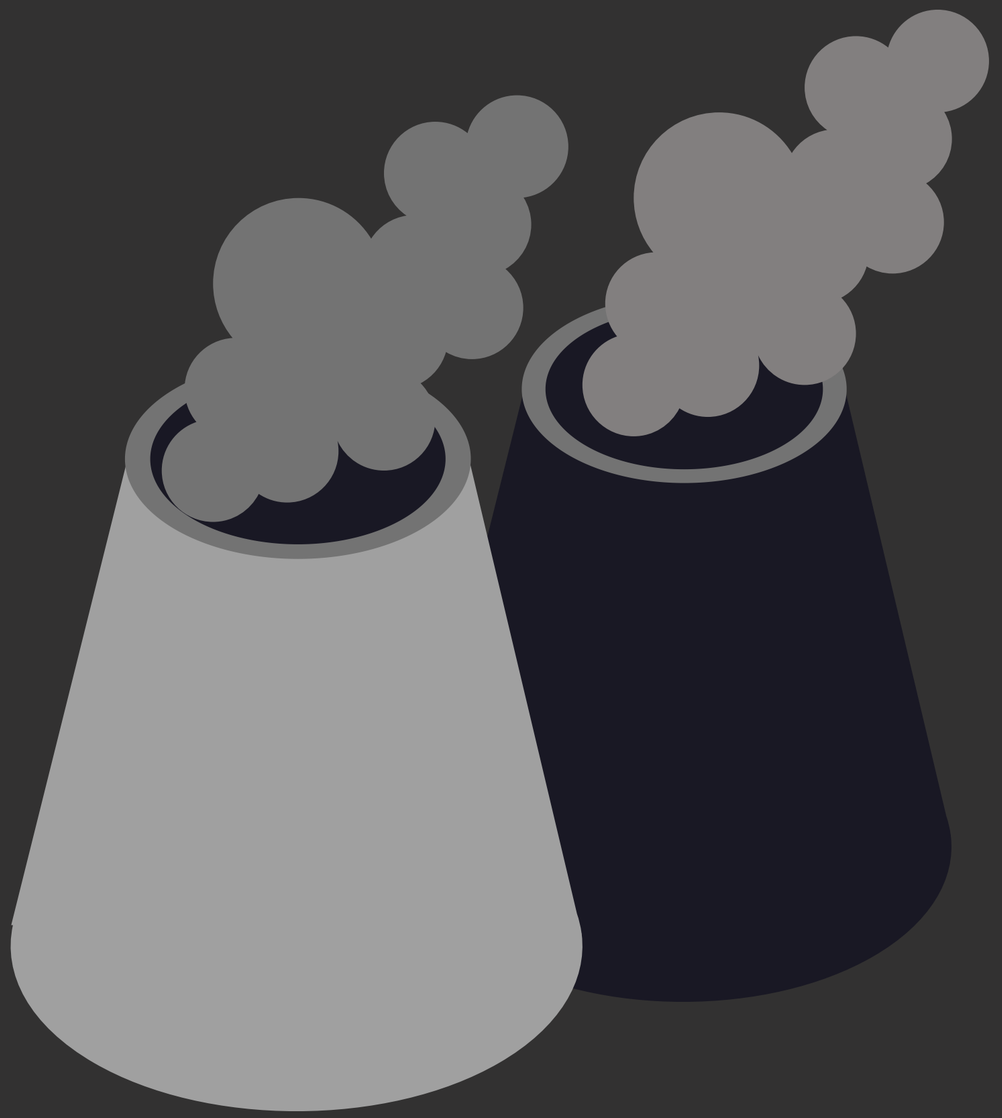

# AIR QUALITY INDEX ANALYSIS

# MEET THE GROUP !

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# Problem Statement

- Air quality has been a matter of concern, particularly in urban areas. Air pollution means the undesirable presence of impurities or the abnormal rise in the proportion of some constituents of the atmosphere. In addition, monitoring air pollution levels has become very important to detect pollution peaks, better control air pollution and eventually improve air quality.

- This project aims to inform people about the quality of air they breathe in simple terms as well as its possible health impacts.

- This would certainly make people more aware and enhance their involvement in improving air quality.

# Dataset Introduction

The dataset used in our project has been taken from https://www.kaggle.com/

- No. of rows : 5,97,002
- No. of columns : 20

- **The main headings in dataset are as follows :**

**1 ) City :** It represents the cities whose air quality data is measured. Number of cities covered under this dataset are 23.

**2 ) Year :** The data set covers AQI data for 5 years from 2015 to 2019.

**3 ) Quarter:** The dataset is divided into 4 quarters.

**4 ) Month :** The dataset contains the data for all 12 months.

**5 ) Date :** The following dataset contains AQI data from 01-01-2015 to 31-12-2019.

**6 ) Day :** The dataset contains data for all 7 days of the week.

**7 ) Hour :** The following dataset contain hourly data in the 24 hour format.

**8 ) Elements/Chemical Compounds :** PM2.5, PM10, NO, NO2, NOx, NH3, CO, SO2, O3, Benzene, Toluene are the elements covered in dataset.

**9 ) AQI :** It represents Air Quality Index for each city.

**10 ) AQI Bucket :** It represents the category of AQI each city falls under.

| Element | Description |
|---|---|
| PM2.5 | PM2.5 refers to the atmospheric particulate matter that has a diameter of less than 2.5 micrometres, which is about 3% of the diameter of human hair. particulate matter (PM2.5) is an air pollutant that is a concern for people's health when levels in air are high. PM2.5 are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated. |
| PM10 | PM10 describes inhalable particles, with diameters that are generally 10 micrometers and smaller.<br>Depending on their chemical composition, the effects of PM10 settling may include: making lakes and streams acidic. changing the nutrient balance in coastal waters and large river basins, depleting the nutrients in soil. |
| NO | Nitric oxide is colourless and is oxidised in the atmosphere to form nitrogen dioxide. Nitrogen dioxide has an odour, and is an acidic and highly corrosive gas that can affect our health and environment. |
| NO2 | Nitrogen Dioxide (NO2) is one of a group of highly reactive gases known as oxides of nitrogen or nitrogen oxides. NO2 and other interact with water, oxygen and other chemicals in the atmosphere to form acid rain. Acid rain harms sensitive ecosystems such as lakes and forests. |
| NOx | Nitrogen oxide (NOx) is a chemical compound of oxygen and nitrogen that is formed by reacting with each other during combustion at high temperatures, mainly combustion of fuel such as oil, diesel, gas and organic matter.<br>High levels of NOx can have a negative effect on vegetation, including leaf damage and reduced growth. It can make vegetation more susceptible to disease and frost damage. |
| NH3 | NH3 is Nitrogen trihydride which is known as ammonia. Ammonia is a colourless gas, which is directly or indirectly used in many pharmaceutical products. Ammonia is one of the main sources of nitrogen pollution, alongside nitrogen oxides. Ammonia pollution also effects species composition through soil acidification, direct toxic damage to leaves. |
| CO | Carbon monoxide, (CO), a highly toxic, colourless, odourless, flammable gas produced industrially for use in the manufacture of numerous organic and inorganic chemical products; it is also present in the exhaust gases of internal-combustion engines and furnaces. When carbon monoxide is emitted into the atmosphere it effects the amount of greenhouse gases, which are linked to climate change and global warming. This means that land and sea temperature increases changing to ecosystems, increasing storm activity and causing other extreme weather events. |
| SO2 | Sulfur dioxide (SO2) is a colourless gas with a sharp, irritating odour. It is produced by burning fossil fuels and by the smelting of mineral ores that contain sulfur. Sulfur dioxide affects the respiratory system, particularly lung function, and can irritate the eyes. Sulfur dioxide irritates the respiratory tract and increases the risk of tract infections. It causes coughing, mucus secretion and aggravates conditions such as asthma and chronic bronchitis. |
| O3 | Ozone, O3, is a form of oxygen; a blue gas with a pungent odor noticeable when gas is formed by an electrical discharge. Ozone affects sensitive vegetation and ecosystems, including forests, parks, wildlife refuges and wilderness areas. |
| Benzene | Benzene is a colourless liquid with a characteristic odour and is primarily used in the production of polystyrene. benzene can react with other chemicals to create smog. This could break down naturally but it might also attach to rain and snow and be carried to the ground to contaminate water and soil. |
| Toluene | Toluene occurs as a colorless, fractive liquid, that is slightly soluble in water. Toluene has a sweet, pungent odor, with an odor threshold of 2.9 parts per million (ppm). The Central Nervous System is the primary target organ for toluene toxicity in both humans and animals for acute and chronic exposures. Cardiac arrhythmia has also been reported in humans acutely exposed to toluene. |

# Assumptions and Constraints

- Data for the year 2020 has been removed because the information provided was incomplete.
- The blank spaces have been replaced with 0.0 using fillna(0.0)
- For the AQI Bucket analysis the blank values have been deleted using dropna().

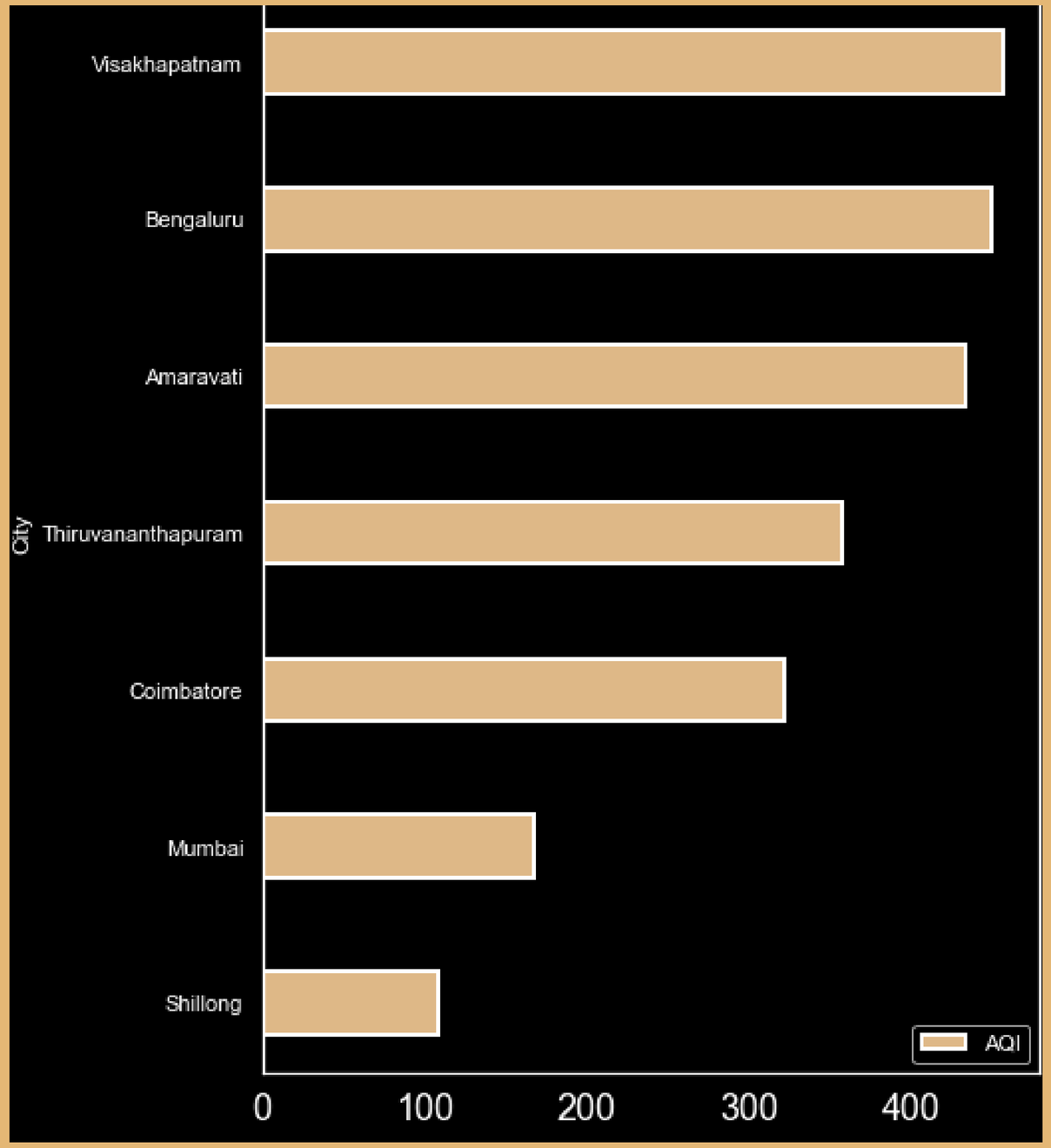
# Technical Approach

- **Data Cleaning in Excel :** Data for the year 2020 had to be deleted, as it was available only up till the first quarter.
- **Data Transformation Using Pandas :** Blank cells have been replaced with 0.0 using fillna(). dropna() has been used for analysis of AQI Bucket.
- **Visualization:** Modules like seaborn, matplotlib and plotly were used to get different kinds of graphs and enhance visualizations.

# Let’s define and visualize the significance of each colour that is used in the Air Quality Index

- Following chart shows the operational scheme of AQI system based of maximum operator (i.e. maximum sub-index being the overall index). To present status of the air quality and its effects on human health, the following description categories.

| AQI | Remark | Colour Code | Possible Health Effects |
|---|---|---|---|
| 0-50 | Good | | Minimal impact |
| 51-100 | Satisfactory | | Minor breathing discomfort to sensitive people |
| 101-200 | Moderate | | Breathing discomfort to the people with lungs, asthma and heart diseases |
| 201-300 | Poor | | Breathing discomfort to most people on prolonged exposure |
| 301-400 | Very Poor | | Respiratory illness on prolonged exposure |
| 401-500 | Severe | | Affects healthy people and seriously impacts those with existing diseases |

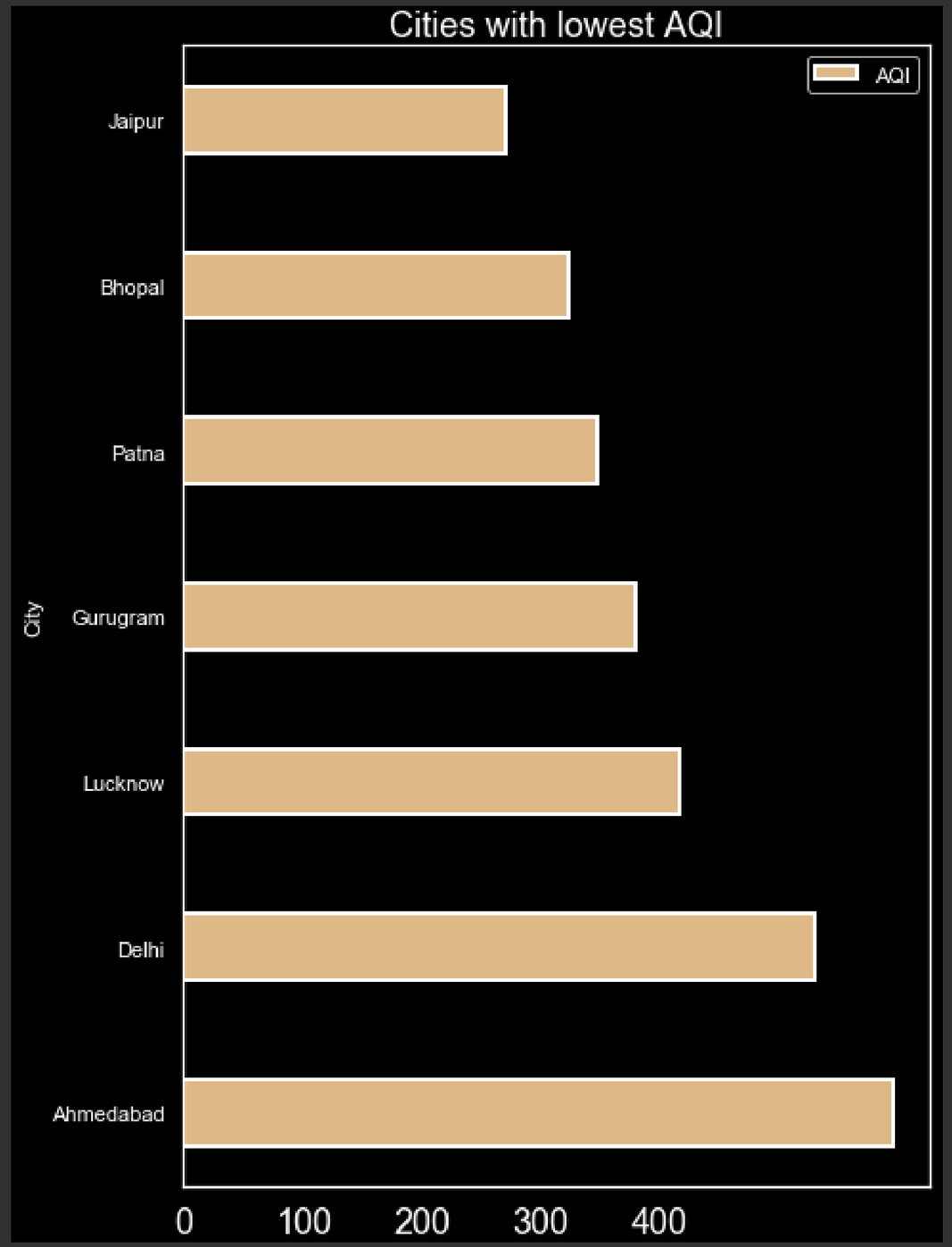


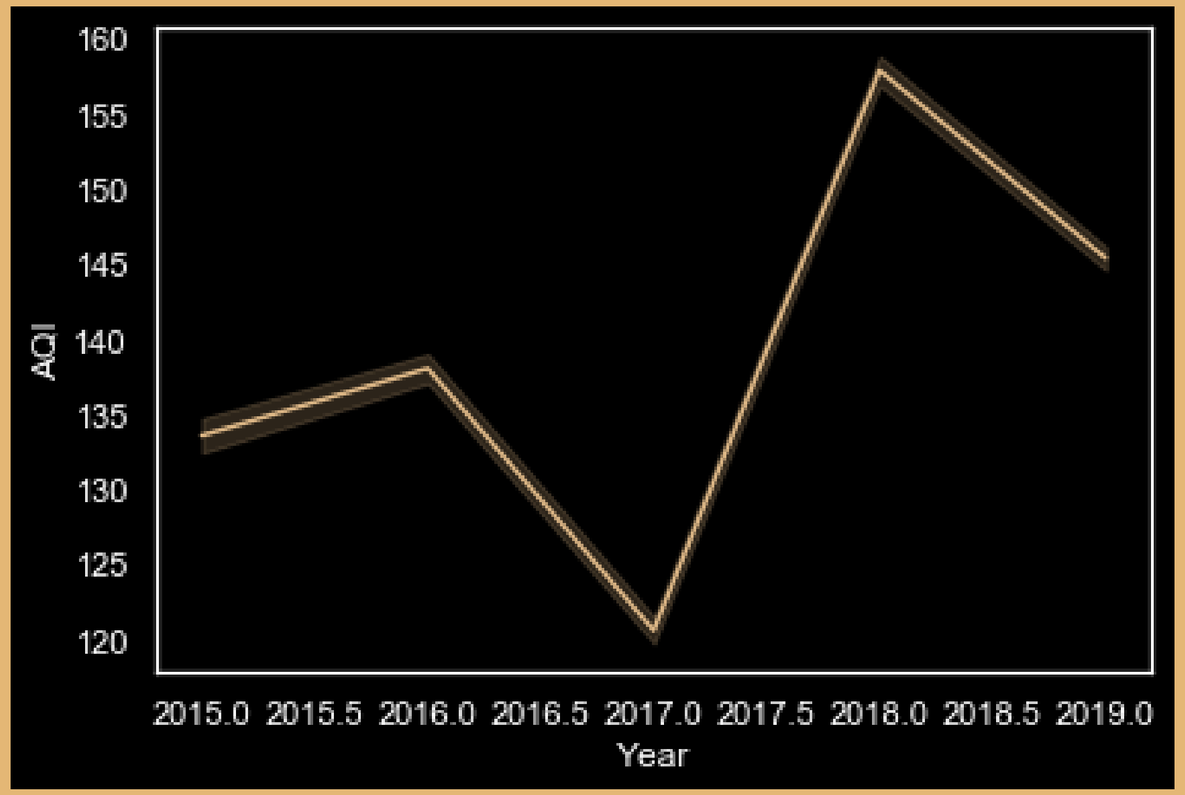

# Cities With Highest AQI

- Vishakhapatnam has the highest level of AQI.
- Thiruvananthapuram, Coimbatore, Mumbai, Shilong are the least affected cities.

# Cities With Lowest AQI

- Jaipur has the lowest level of AQI.
- Bhopal, Patna, Gurugram and Lucknow are the least affected cities.



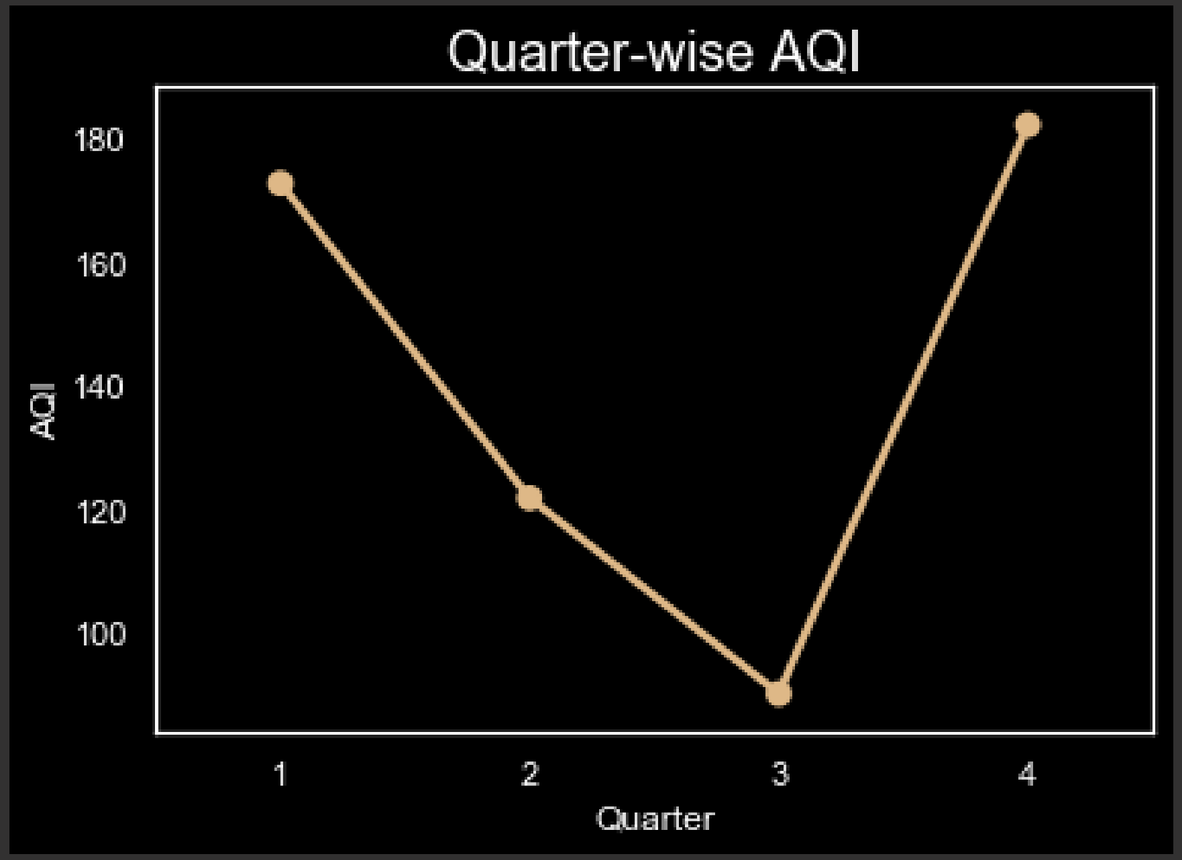


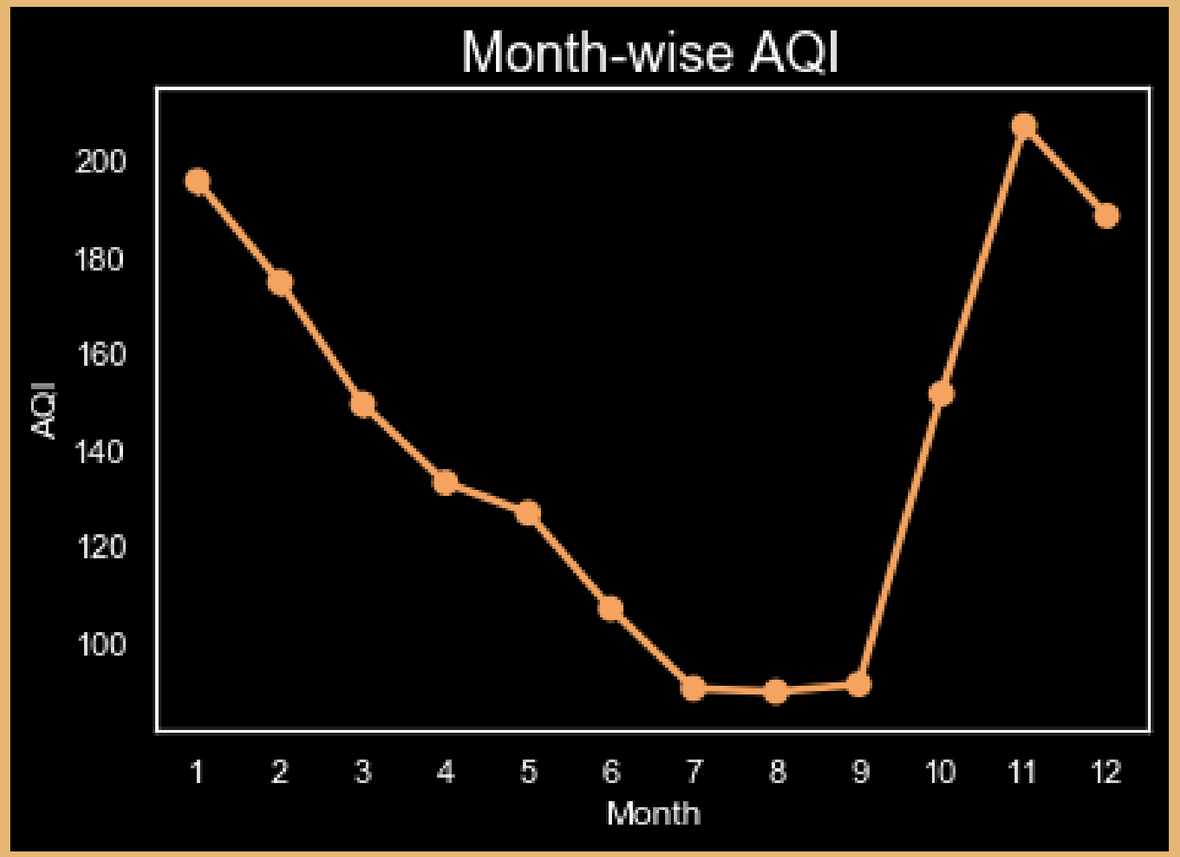

# Year-wise AQI Analysis

- India's average air quality has deteriorated throughout the years.
- AQI has increased exponentially from 2015 to 2016 and there is a sudden decrease from 2016 to 2017.
- There is an increase in AQI from the second quarter of 2017 to 2018 which decreased gradually till 2019.
- India has moderate air quality throughout the year.

# Quarter-wise AQI Analysis

- AQI increases in 1st quarter and decreases from 170 to 100 during 2nd and 3rd quarters.
- After 3rd quarter there is linear growth in AQI level till 4th quarter.
- So, air quality is better in the summers as compared to the winters.
- Air quality is good in summers, moderate in monsoon and poor in winters.



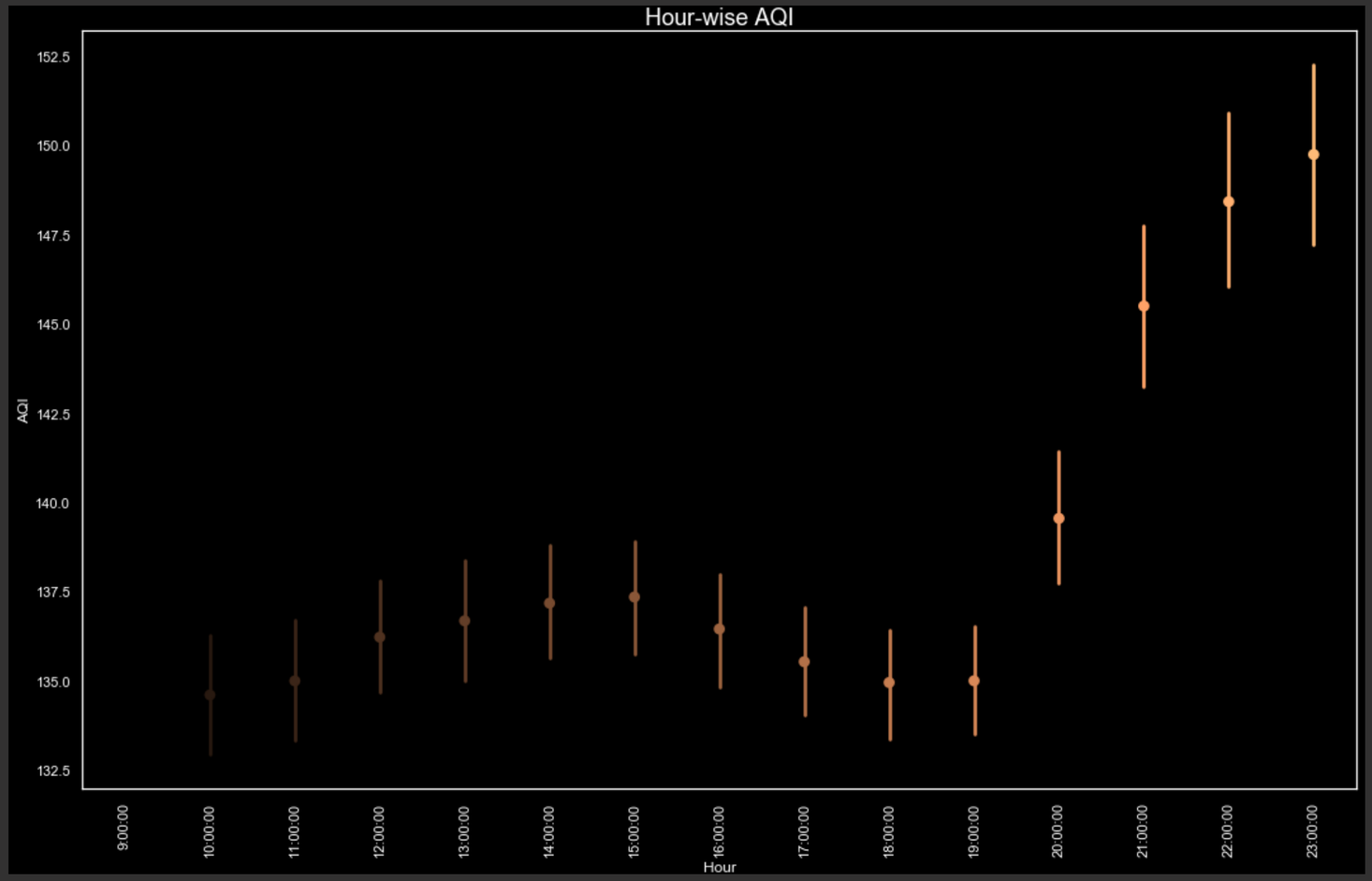


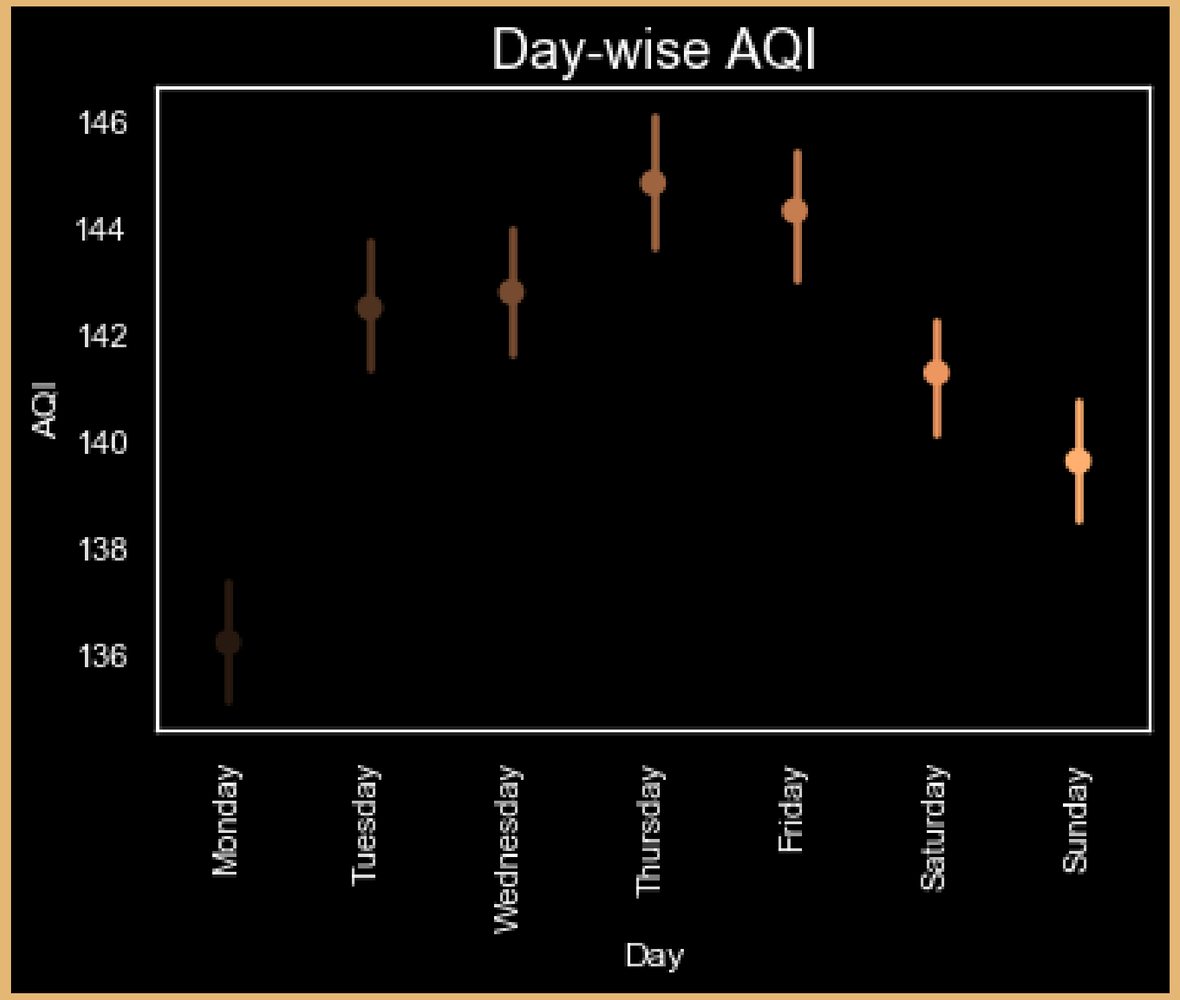

# Month-wise AQI Analysis

- For monthly analysis, the AQI started off with a decrease in the starting 4-5 months.
- Then there was a sudden spike in the AQI levels at the end of the year i.e between August and December.

# Hour-wise AQI Analysis

- AQI is least during the daytime.
- Air quality is good from 10am to 1pm. However AQI increases between 2pm-5 pm.
- There is exponential growth of AQI between 6pm-11pm. Thus the air quality is poor/severe during night time.






# Day-wise AQI Analysis

- There is gradual increase in AQI from Monday to mid-week and gradual decrease from Thursday to Sunday.
- The lowest AQI is usually recorded on Monday, whereas the highest AQI is recorded on Thursday.
- As a result, the air quality is good on weekends and deteriorates moderately during weekdays.

# Quarter-wise Analysis of Elements

| Quarter | PM2.5 | PM10 | NO | NO2 | NOx | NH3 | CO | SO2 | O3 | Benzene | Toluene | AQI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 53.000000 | 41.000000 | 6.930000 | 19.990000 | 18.560000 | 6.490000 | 0.810000 | 6.700000 | 23.060000 | 0.320000 | 0.900000 | 131.000000 |
| 2 | 33.250000 | 0.000000 | 4.920000 | 15.130000 | 14.480000 | 2.620000 | 0.600000 | 5.300000 | 21.400000 | 0.100000 | 0.180000 | 99.000000 |
| 3 | 21.250000 | 11.760000 | 6.300000 | 12.990000 | 13.580000 | 3.460000 | 0.580000 | 5.320000 | 14.300000 | 0.130000 | 0.250000 | 72.000000 |
| 4 | 56.860000 | 54.500000 | 7.650000 | 22.570000 | 21.100000 | 7.590000 | 0.830000 | 7.610000 | 20.360000 | 0.610000 | 1.090000 | 132.000000 |

# Monthly Analysis of Elements

| Month | PM2.5 | PM10 | NO | NO2 | NOx | NH3 | CO | SO2 | O3 | Benzene | Toluene | AQI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 64.790000 | 0.000000 | 7.180000 | 22.560000 | 19.650000 | 6.490000 | 0.880000 | 7.260000 | 20.895000 | 0.330000 | 0.780000 | 152.000000 |
| 2 | 53.210000 | 47.250000 | 6.940000 | 19.780000 | 18.620000 | 6.450000 | 0.810000 | 6.490000 | 22.740000 | 0.240000 | 0.660000 | 131.000000 |
| 3 | 45.250000 | 47.900000 | 6.710000 | 18.380000 | 17.670000 | 6.530000 | 0.750000 | 6.420000 | 25.130000 | 0.350000 | 1.300000 | 117.000000 |
| 4 | 38.000000 | 0.000000 | 5.100000 | 16.640000 | 15.470000 | 3.300000 | 0.660000 | 5.520000 | 22.400000 | 0.060000 | 0.480000 | 105.500000 |
| 5 | 36.200000 | 6.440000 | 4.970000 | 15.710000 | 14.560000 | 2.950000 | 0.620000 | 5.650000 | 24.410000 | 0.160000 | 0.310000 | 106.000000 |
| 6 | 26.000000 | 0.000000 | 4.680000 | 13.210000 | 13.480000 | 1.450000 | 0.520000 | 4.850000 | 17.880000 | 0.090000 | 0.000000 | 83.000000 |
| 7 | 21.500000 | 10.000000 | 6.360000 | 12.740000 | 14.080000 | 4.260000 | 0.540000 | 5.210000 | 15.000000 | 0.130000 | 0.200000 | 71.000000 |
| 8 | 20.250000 | 7.540000 | 6.330000 | 12.440000 | 13.550000 | 3.235000 | 0.600000 | 5.500000 | 12.925000 | 0.140000 | 0.180000 | 70.000000 |
| 9 | 22.100000 | 15.750000 | 6.210000 | 14.040000 | 13.120000 | 2.695000 | 0.610000 | 5.220000 | 15.050000 | 0.140000 | 0.470000 | 74.000000 |
| 10 | 42.250000 | 27.250000 | 6.990000 | 19.670000 | 18.200000 | 6.840000 | 0.720000 | 6.480000 | 18.120000 | 0.290000 | 0.730000 | 107.000000 |
| 11 | 63.145000 | 64.250000 | 7.965000 | 23.885000 | 22.900000 | 7.160000 | 0.860000 | 8.390000 | 22.480000 | 0.870000 | 1.600000 | 151.000000 |
| 12 | 66.250000 | 74.090000 | 7.870000 | 24.490000 | 22.200000 | 9.250000 | 0.910000 | 8.100000 | 20.940000 | 0.730000 | 1.000000 | 147.000000 |

# Day-wise Analysis of Elements

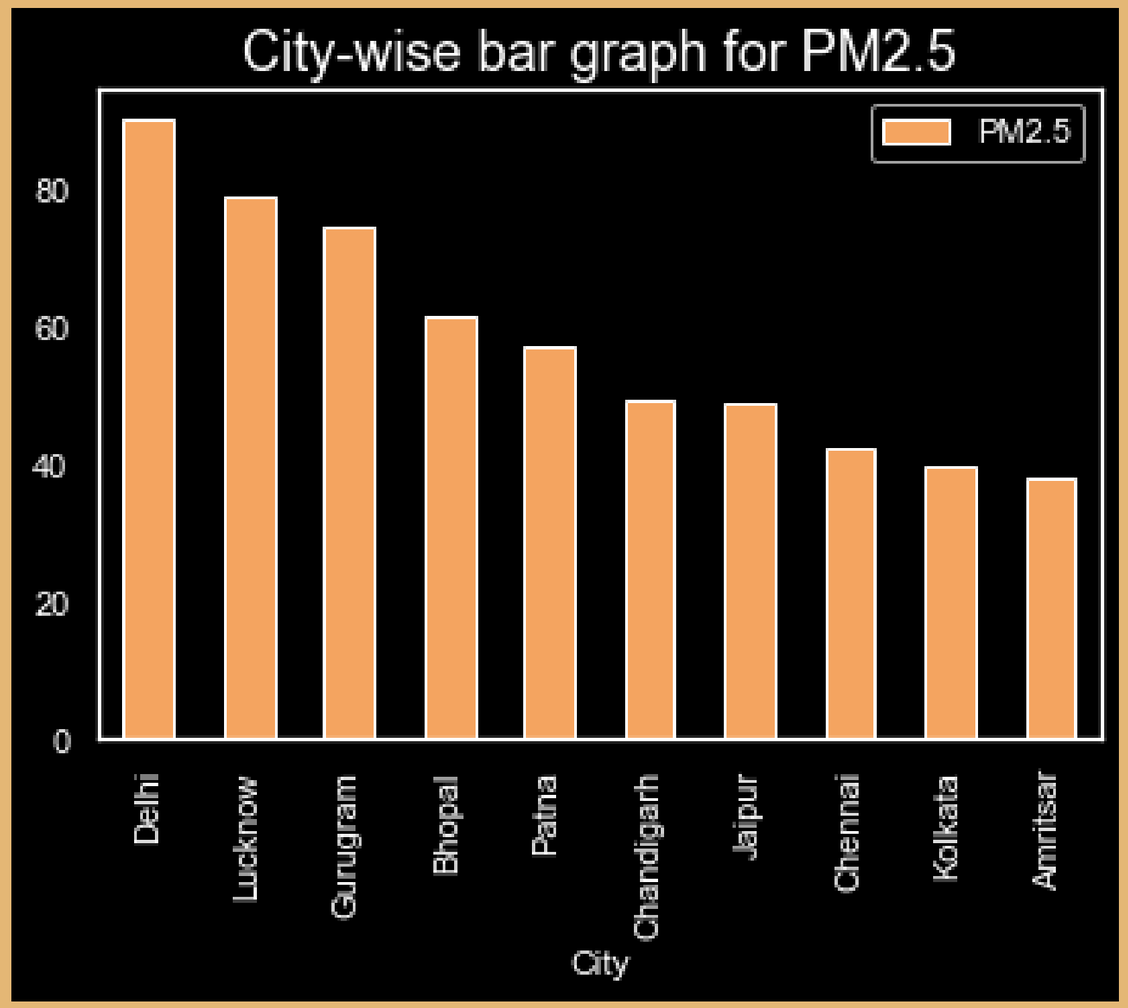
| Day | PM2.5 | PM10 | NO | NO2 | NOx | NH3 | CO | SO2 | O3 | Benzene | Toluene | AQI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Friday | 37.115000 | 24.865000 | 6.620000 | 17.160000 | 16.960000 | 5.630000 | 0.710000 | 6.220000 | 18.740000 | 0.250000 | 0.620000 | 102.000000 |
| Monday | 36.180000 | 20.500000 | 6.320000 | 16.670000 | 16.370000 | 5.050000 | 0.700000 | 6.130000 | 18.990000 | 0.230000 | 0.530000 | 99.000000 |
| Saturday | 37.310000 | 25.000000 | 6.460000 | 16.930000 | 16.730000 | 5.670000 | 0.700000 | 6.180000 | 18.900000 | 0.240000 | 0.580000 | 102.000000 |
| Sunday | 35.020000 | 19.500000 | 5.930000 | 15.640000 | 15.400000 | 4.880000 | 0.660000 | 5.920000 | 18.880000 | 0.180000 | 0.430000 | 102.000000 |
| Thursday | 37.000000 | 24.100000 | 6.640000 | 17.430000 | 17.230000 | 5.690000 | 0.720000 | 6.220000 | 18.810000 | 0.250000 | 0.650000 | 103.000000 |
| Tuesday | 37.790000 | 25.350000 | 6.660000 | 17.340000 | 17.210000 | 5.650000 | 0.730000 | 6.220000 | 18.980000 | 0.240000 | 0.610000 | 104.000000 |
| Wednesday | 37.470000 | 25.270000 | 6.560000 | 17.300000 | 17.140000 | 5.670000 | 0.720000 | 6.180000 | 18.830000 | 0.240000 | 0.620000 | 104.000000 |

# Hour-wise Analysis of Elements

| Hour | PM2.5 | PM10 | NO | NO2 | NOx | NH3 | CO | SO2 | O3 | Benzene | Toluene | AQI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00:00:00 | 41.500000 | 24.350000 | 7.220000 | 18.790000 | 18.950000 | 5.440000 | 0.750000 | 6.170000 | 13.750000 | 0.300000 | 0.670000 | 102.000000 |
| 01:00:00 | 39.040000 | 22.305000 | 6.490000 | 17.120000 | 16.990000 | 5.430000 | 0.670000 | 6.030000 | 14.045000 | 0.240000 | 0.520000 | 102.000000 |
| 02:00:00 | 36.520000 | 19.705000 | 5.900000 | 15.715000 | 15.615000 | 5.250000 | 0.620000 | 5.910000 | 14.410000 | 0.200000 | 0.440000 | 101.000000 |
| 03:00:00 | 34.980000 | 17.870000 | 5.610000 | 14.800000 | 14.725000 | 5.140000 | 0.590000 | 5.800000 | 14.690000 | 0.170000 | 0.400000 | 101.000000 |
| 04:00:00 | 33.670000 | 16.190000 | 5.625000 | 14.460000 | 14.400000 | 5.340000 | 0.580000 | 5.765000 | 14.420000 | 0.160000 | 0.370000 | 101.000000 |
| 05:00:00 | 32.980000 | 16.165000 | 6.020000 | 14.650000 | 14.880000 | 5.005000 | 0.590000 | 5.750000 | 13.010000 | 0.150000 | 0.350000 | 100.000000 |
| 06:00:00 | 33.490000 | 16.020000 | 6.890000 | 15.690000 | 16.375000 | 4.900000 | 0.620000 | 5.720000 | 12.120000 | 0.150000 | 0.340000 | 99.000000 |
| 07:00:00 | 35.535000 | 17.500000 | 7.820000 | 16.730000 | 18.060000 | 4.900000 | 0.690000 | 5.910000 | 11.385000 | 0.170000 | 0.400000 | 98.000000 |
| 08:00:00 | 38.500000 | 20.135000 | 8.240000 | 17.150000 | 18.570000 | 5.000000 | 0.740000 | 6.055000 | 12.740000 | 0.200000 | 0.460000 | 98.000000 |
| 09:00:00 | 40.130000 | 23.000000 | 7.510000 | 16.770000 | 17.700000 | 5.120000 | 0.750000 | 6.260000 | 17.100000 | 0.220000 | 0.520000 | 98.000000 |
| 10:00:00 | 39.440000 | 24.750000 | 6.680000 | 16.660000 | 16.880000 | 5.320000 | 0.720000 | 6.380000 | 23.150000 | 0.250000 | 0.600000 | 99.000000 |
| 11:00:00 | 38.340000 | 25.990000 | 5.930000 | 16.250000 | 15.890000 | 5.670000 | 0.720000 | 6.430000 | 28.970000 | 0.270000 | 0.680000 | 101.000000 |
| 12:00:00 | 36.445000 | 25.815000 | 5.730000 | 15.635000 | 15.130000 | 5.700000 | 0.670000 | 6.610000 | 33.520000 | 0.250000 | 0.650000 | 102.000000 |
| 13:00:00 | 34.750000 | 25.760000 | 6.430000 | 15.475000 | 16.700000 | 5.620000 | 0.630000 | 6.400000 | 37.040000 | 0.230000 | 0.590000 | 104.000000 |
| 14:00:00 | 33.895000 | 24.990000 | 5.080000 | 15.180000 | 13.830000 | 5.700000 | 0.620000 | 6.150000 | 38.550000 | 0.220000 | 0.580000 | 104.000000 |
| 15:00:00 | 33.000000 | 25.000000 | 5.040000 | 15.030000 | 13.470000 | 5.660000 | 0.610000 | 5.930000 | 38.930000 | 0.210000 | 0.560000 | 105.000000 |
| 16:00:00 | 32.340000 | 25.445000 | 5.130000 | 15.300000 | 13.780000 | 5.655000 | 0.610000 | 5.960000 | 38.145000 | 0.200000 | 0.560000 | 105.000000 |
| 17:00:00 | 32.740000 | 26.500000 | 5.320000 | 16.090000 | 14.700000 | 5.640000 | 0.650000 | 5.960000 | 35.750000 | 0.210000 | 0.620000 | 105.000000 |
| 18:00:00 | 34.200000 | 29.750000 | 5.900000 | 18.350000 | 16.950000 | 5.720000 | 0.740000 | 6.160000 | 28.850000 | 0.230000 | 0.690000 | 105.000000 |
| 19:00:00 | 37.200000 | 32.950000 | 6.870000 | 21.370000 | 19.730000 | 5.780000 | 0.890000 | 6.430000 | 21.100000 | 0.290000 | 0.870000 | 105.000000 |
| 20:00:00 | 41.500000 | 33.750000 | 7.890000 | 22.770000 | 21.580000 | 5.720000 | 1.000000 | 6.620000 | 16.600000 | 0.350000 | 1.000000 | 104.000000 |
| 21:00:00 | 44.050000 | 32.195000 | 8.280000 | 22.650000 | 21.810000 | 5.690000 | 1.020000 | 6.570000 | 14.685000 | 0.400000 | 1.030000 | 104.000000 |
| 22:00:00 | 44.250000 | 29.710000 | 8.280000 | 21.485000 | 21.305000 | 5.625000 | 0.960000 | 6.480000 | 14.050000 | 0.385000 | 0.970000 | 104.000000 |
| 23:00:00 | 43.480000 | 27.250000 | 7.950000 | 20.240000 | 20.320000 | 5.600000 | 0.880000 | 6.400000 | 13.670000 | 0.350000 | 0.830000 | 103.000000 |

# AQI_Bucket Analysis of Elements

| AQI_Bucket | PM2.5 | PM10 | NO | NO2 | NOx | NH3 | CO | SO2 | O3 | Benzene | Toluene | AQI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Good | 13.850000 | 25.570000 | 3.460000 | 10.570000 | 8.570000 | 5.670000 | 0.350000 | 4.560000 | 16.310000 | 0.100000 | 0.340000 | 42.000000 |
| Moderate | 52.390000 | 92.000000 | 7.600000 | 22.060000 | 20.000000 | 11.550000 | 0.840000 | 8.160000 | 28.920000 | 0.670000 | 1.480000 | 132.000000 |
| Poor | 82.810000 | 102.570000 | 9.330000 | 27.610000 | 25.490000 | 11.270000 | 1.090000 | 10.250000 | 30.910000 | 1.180000 | 2.920000 | 242.000000 |
| Satisfactory | 28.020000 | 45.320000 | 6.510000 | 16.540000 | 15.640000 | 9.120000 | 0.680000 | 5.860000 | 21.180000 | 0.280000 | 0.640000 | 77.000000 |
| Severe | 154.085000 | 0.000000 | 22.130000 | 51.825000 | 46.230000 | 0.000000 | 2.740000 | 19.340000 | 21.400000 | 3.780000 | 16.265000 | 471.000000 |
| Very Poor | 144.000000 | 0.000000 | 13.380000 | 35.640000 | 32.100000 | 0.000000 | 1.400000 | 11.920000 | 27.340000 | 1.740000 | 4.240000 | 339.000000 |

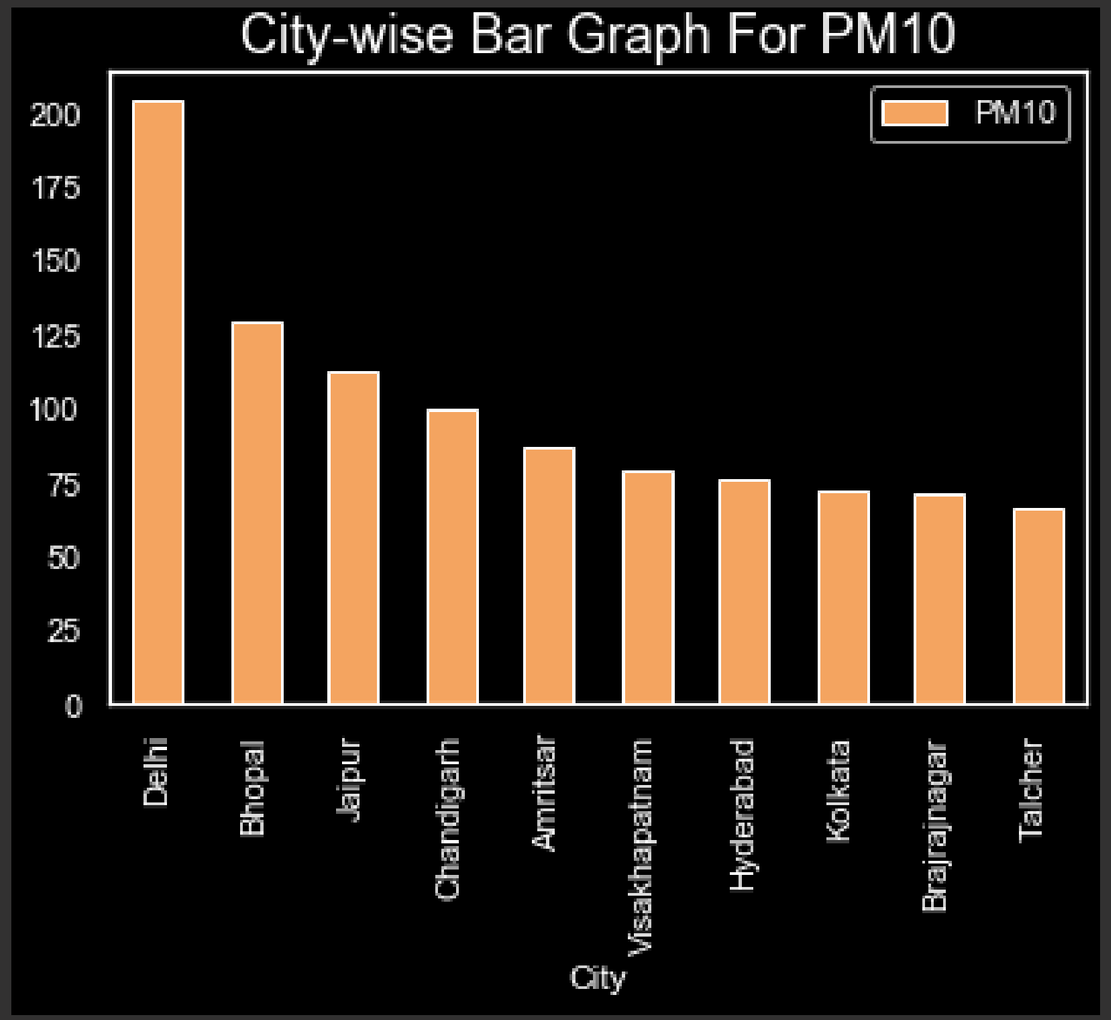


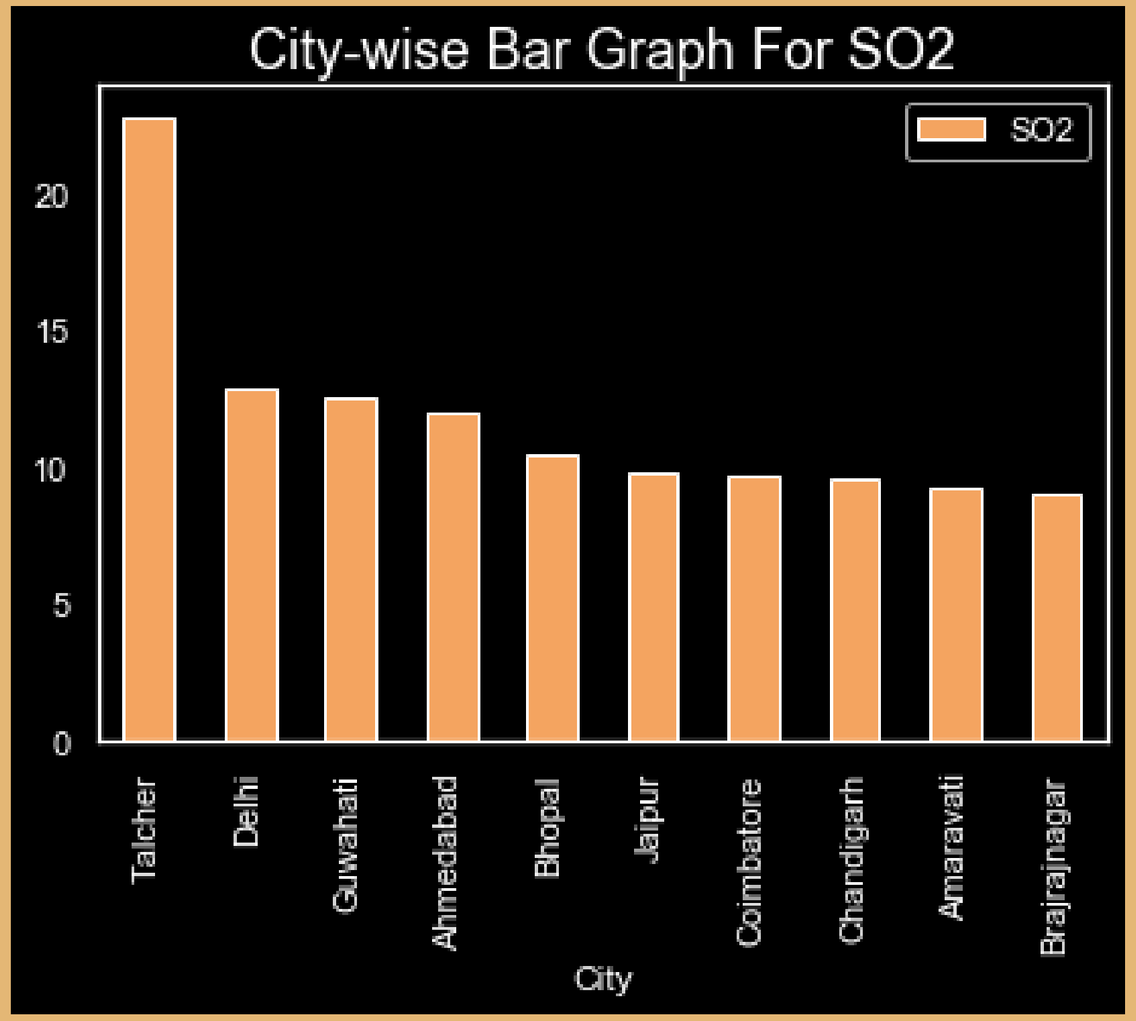

# City-wise Analysis for PM2.5

- PM2.5 is of specific concern because it contains a high proportion of various toxic metals and acids, and aerodynamically it can penetrate deeper into the respiratory tract.
- PM2.5 levels in Indian cities are about 4-5 times higher than in the US cities.
- 56% of PM 2.5 is contributed by the 3 states namely New Delhi, Lucknow, Gurugram.

# City-wise Analysis for PM10

- WHO (2005) suggests that there is no threshold for particulate concentration below which there is no harmful effect.
- High PM10 background concentration in India cannot be disregarded which is reflected in relatively high level of INAQS (Indian National Air Quality Standards).
- Delhi produces the highest amount of PM10 whereas Talcher produces the lowest amount of PM10.



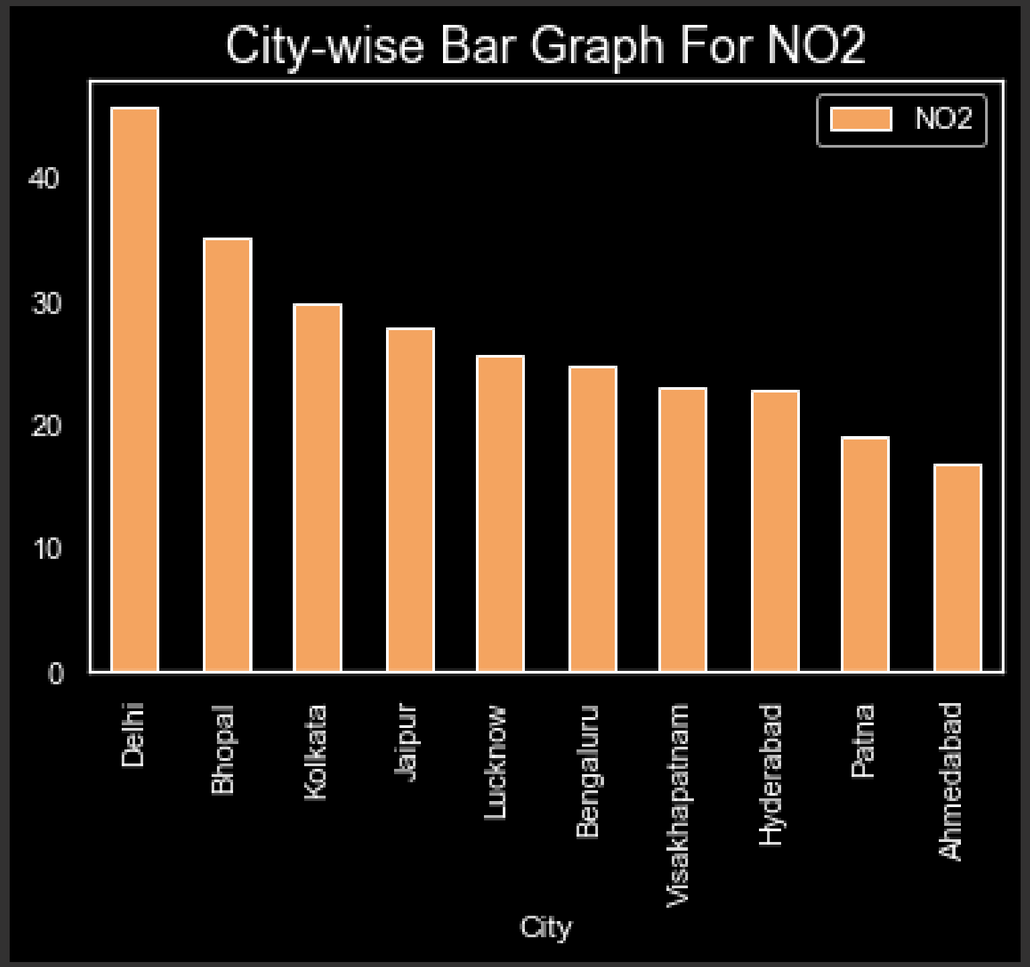


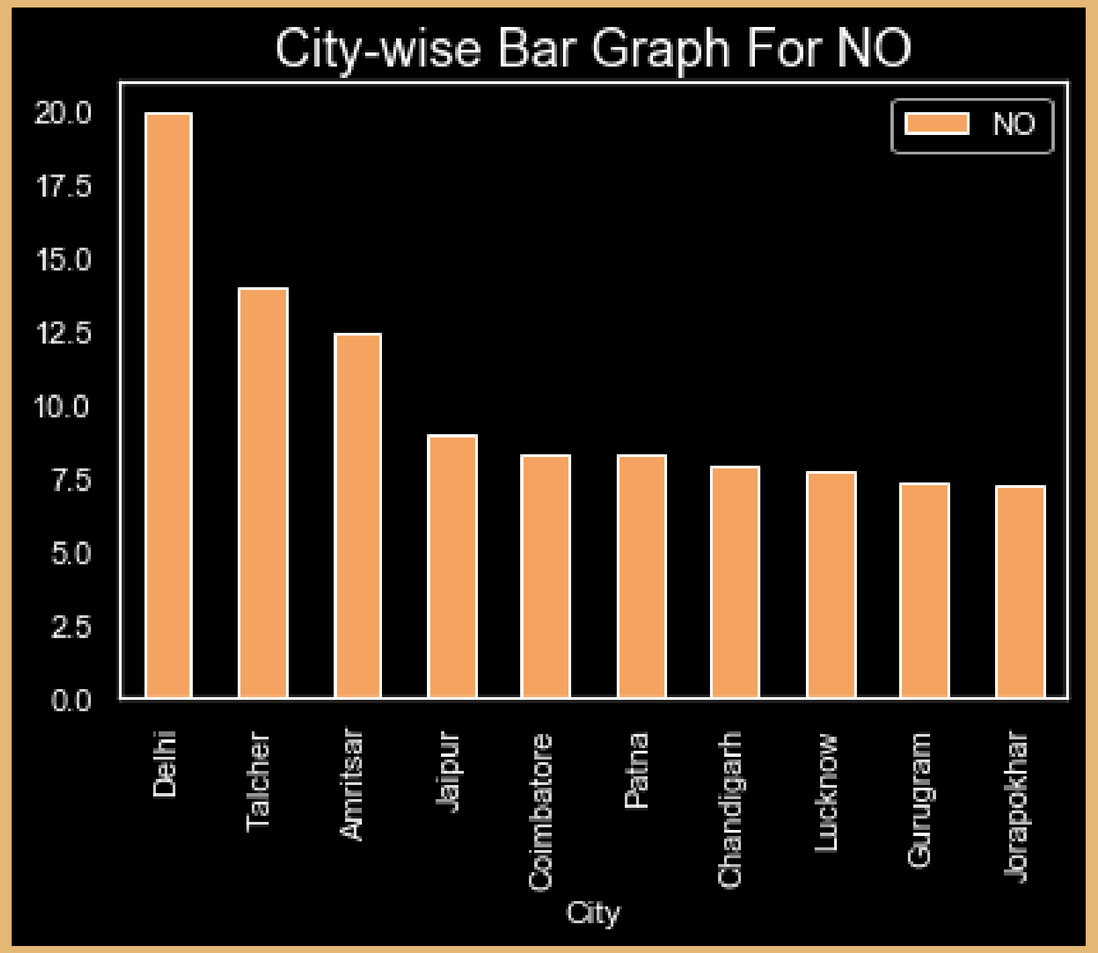

# City-wise Analysis for SO2

- SO2 is soluble in aqueous media and affects mucous membranes of the nose and upper respiratory tract.
- Reduction in mean lung function values among groups of healthy individual have been observed for 10-minute exposures at 4000 ppb.
- Talcher is the highest contributor of SO2 whereas Bajrangpur does the lowest contribution.

# City-wise Analysis for NO2

- The major source of NO2 is combustion processes. An appreciable quantity of NO2 is present in rural and urban environments.
- Further, NO2 is showing alarmingly high increasing trend in Indian cities due to increase in number of vehicles.
- Delhi produces the most amount of NO2 whereas Ahemdabad produces the least.






# City-wise Analysis for NO

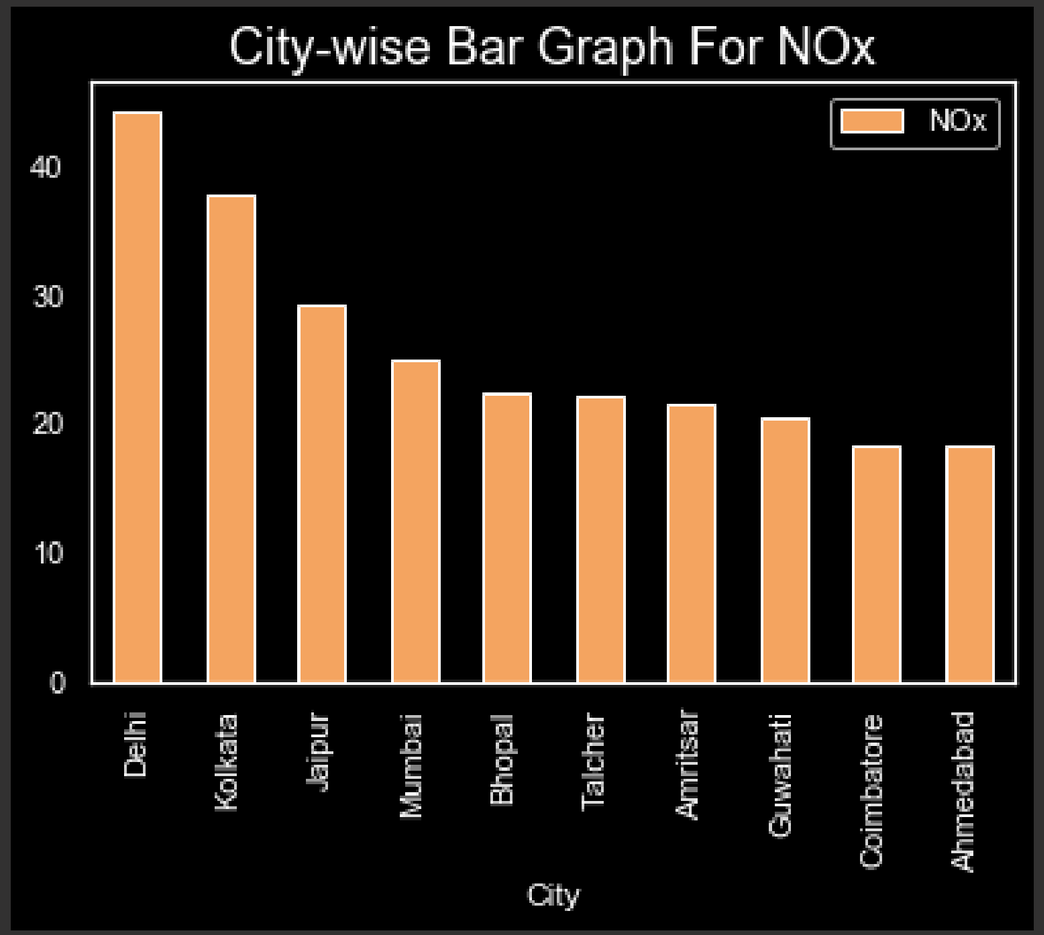
- Nitric oxide (NO), also called nitrogen monoxide, colourless toxic gas that is formed by the oxidation of nitrogen.
- Nitric oxide performs important chemicalsignaling functions in humans and other animals and has various applications in medicine.
- Delhi has the highest level of NO while jorapokhar has the least level of NO

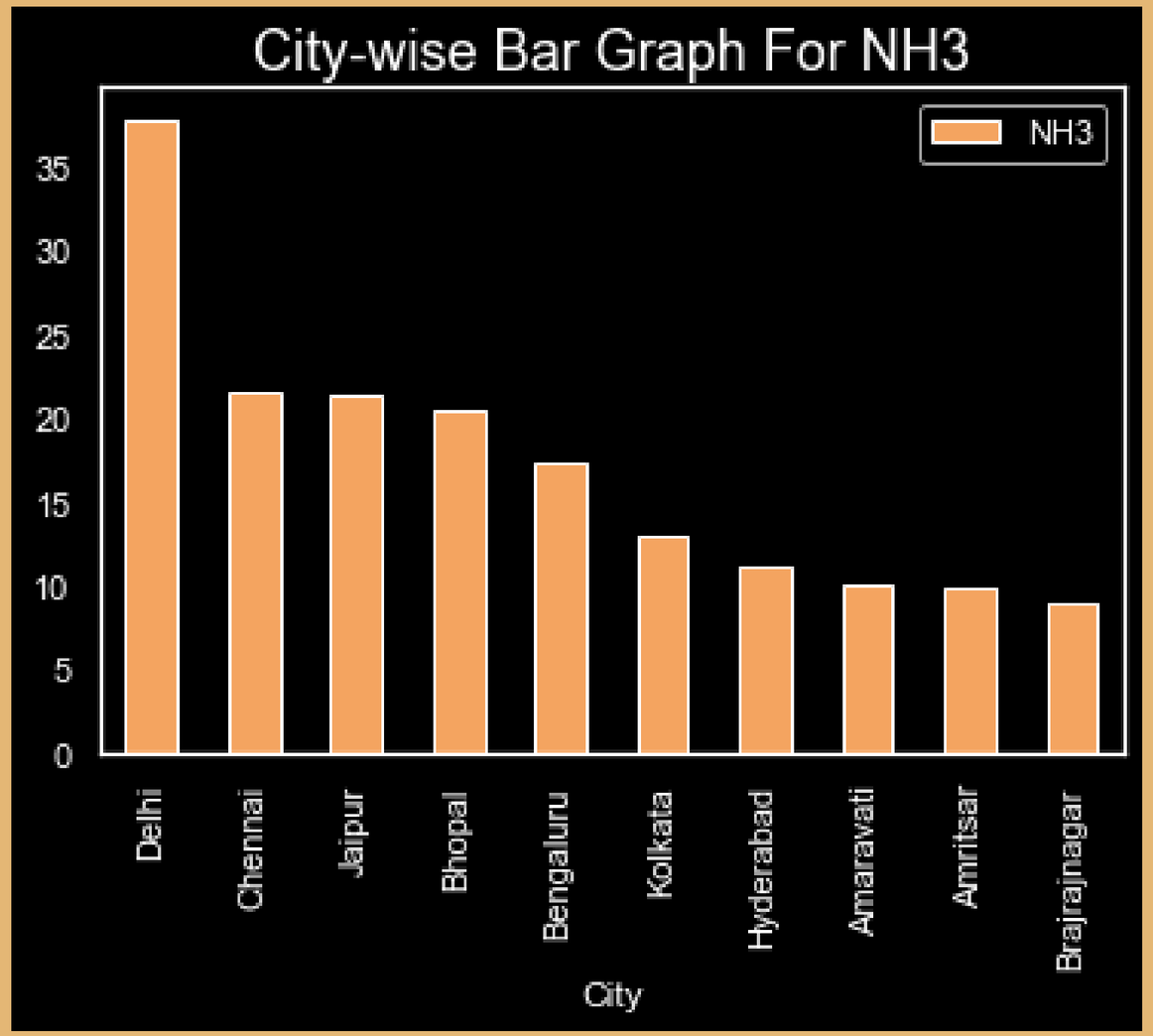
# City-wise Analysis for NOx

- Nitrogen oxides (NOx) is a collective term used to refer to nitrogen monoxide (nitric oxide or NO).

- Nitrogen oxides (NOx ) react to form smog and acid rain.The impacts of NOx on human health include damage to the lung tissue, breathing and respiratory problems.

- Delhi has the highest production of NOx and Ahmedabad produces the least amount of NOx.





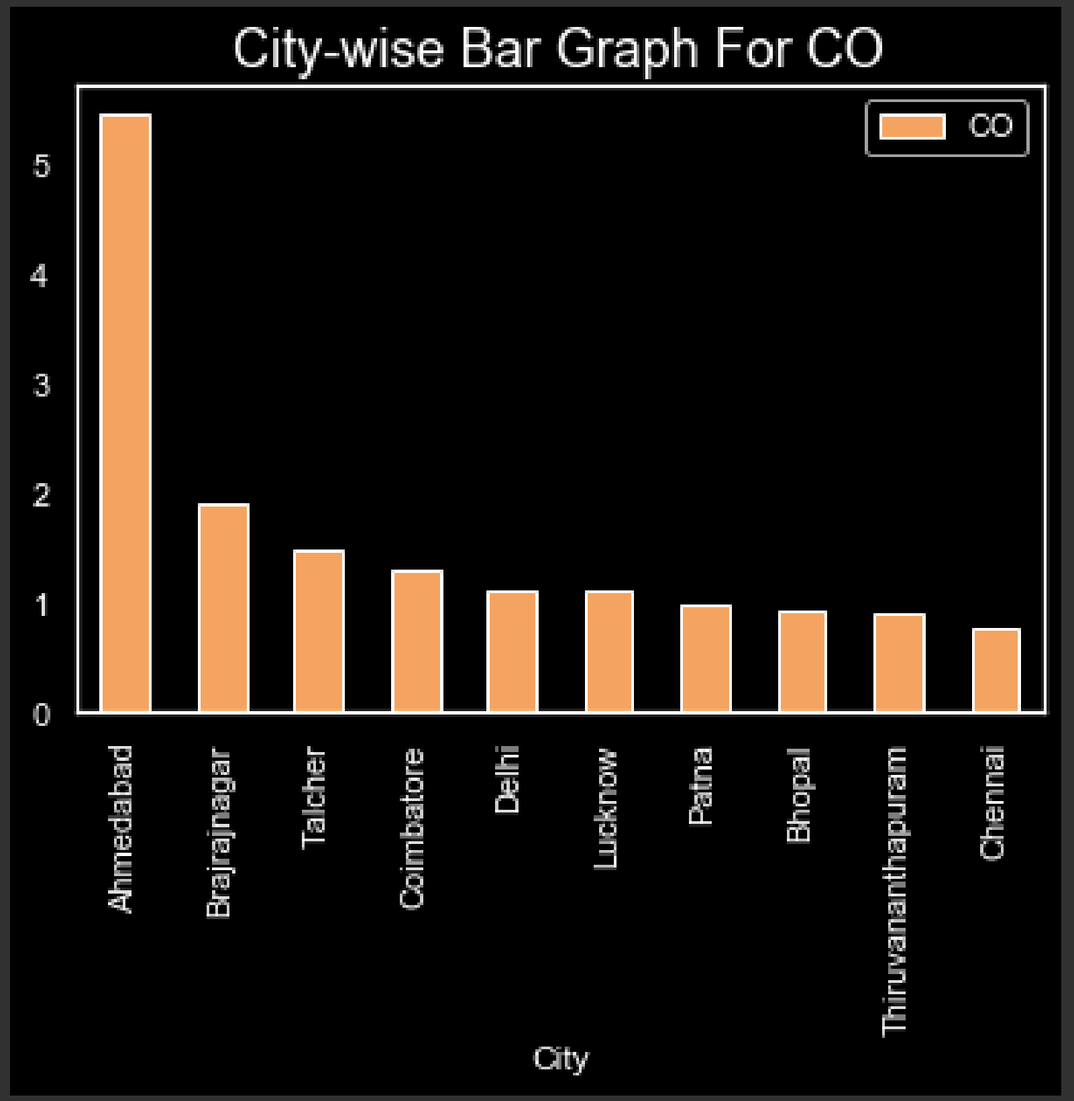

# City-wise Analysis for NH3

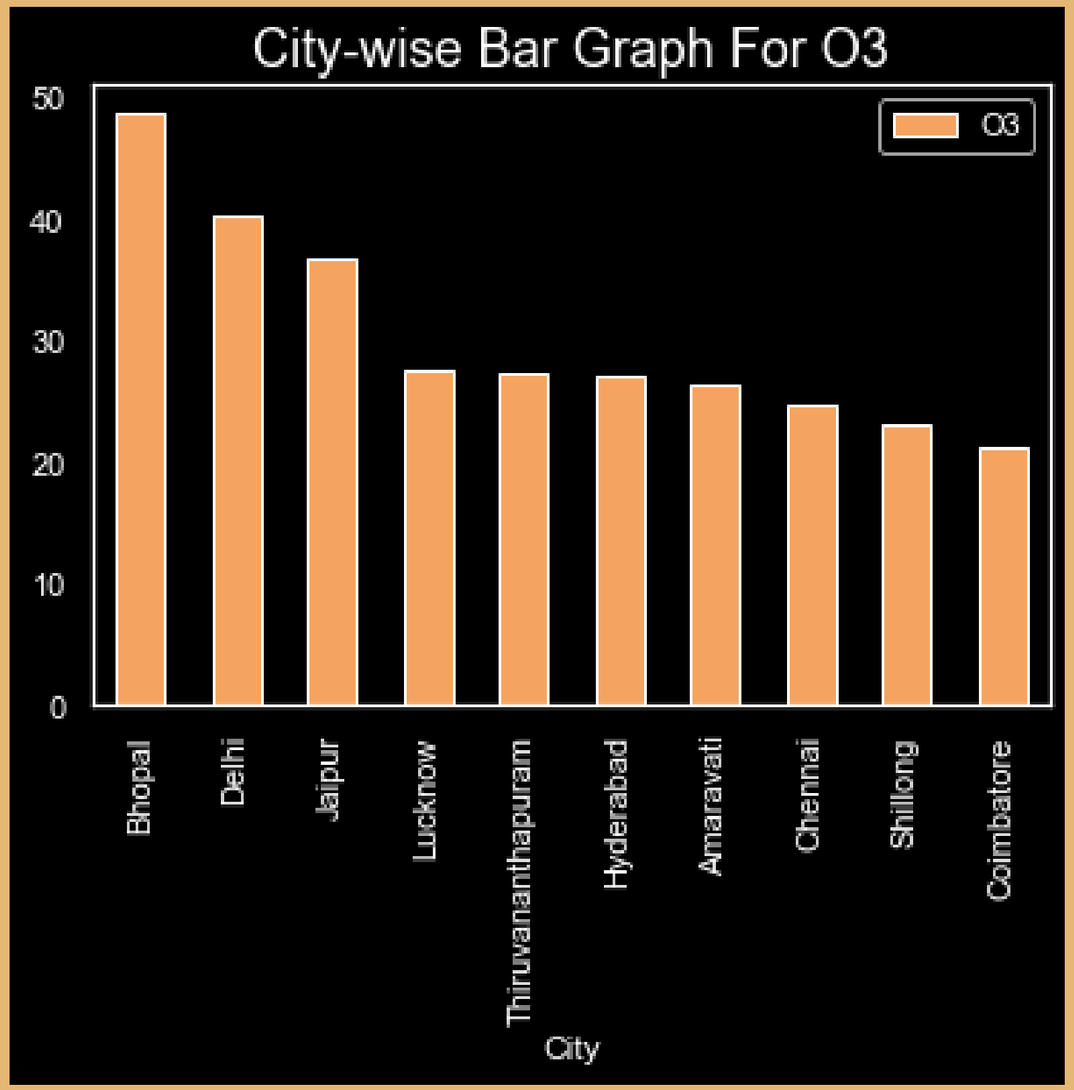
- Inhalation of high levels of NH3 causes irritation to the nose, throat and respiratory tract.
- Increased inhalation may result in cough and an increased respiratory rate as well as respiratory distress.
- Delhi is the highest contributor of NH3 and Bajrangpur is the lowest contributor.

# City-wise Analysis For CO

- Carbon monoxide (CO) is an important criteria pollutant which is ubiquitous in urban environment and it's production mostly occurs due to incomplete combustion.

- Ahemdabad has the highest production of CO followed by other cities like Bajrangpur, Talcher, Coimbatore and Chennai produces the least amount of CO.



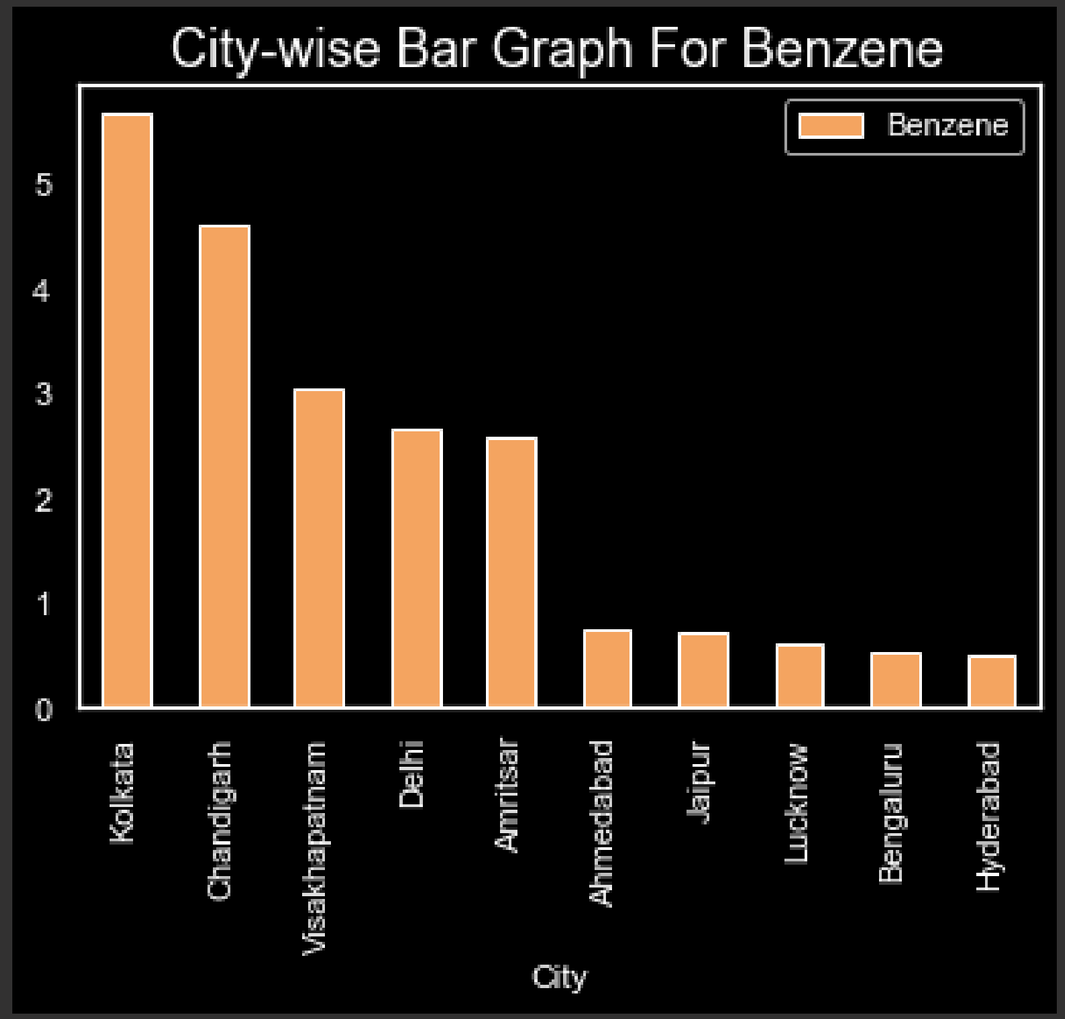


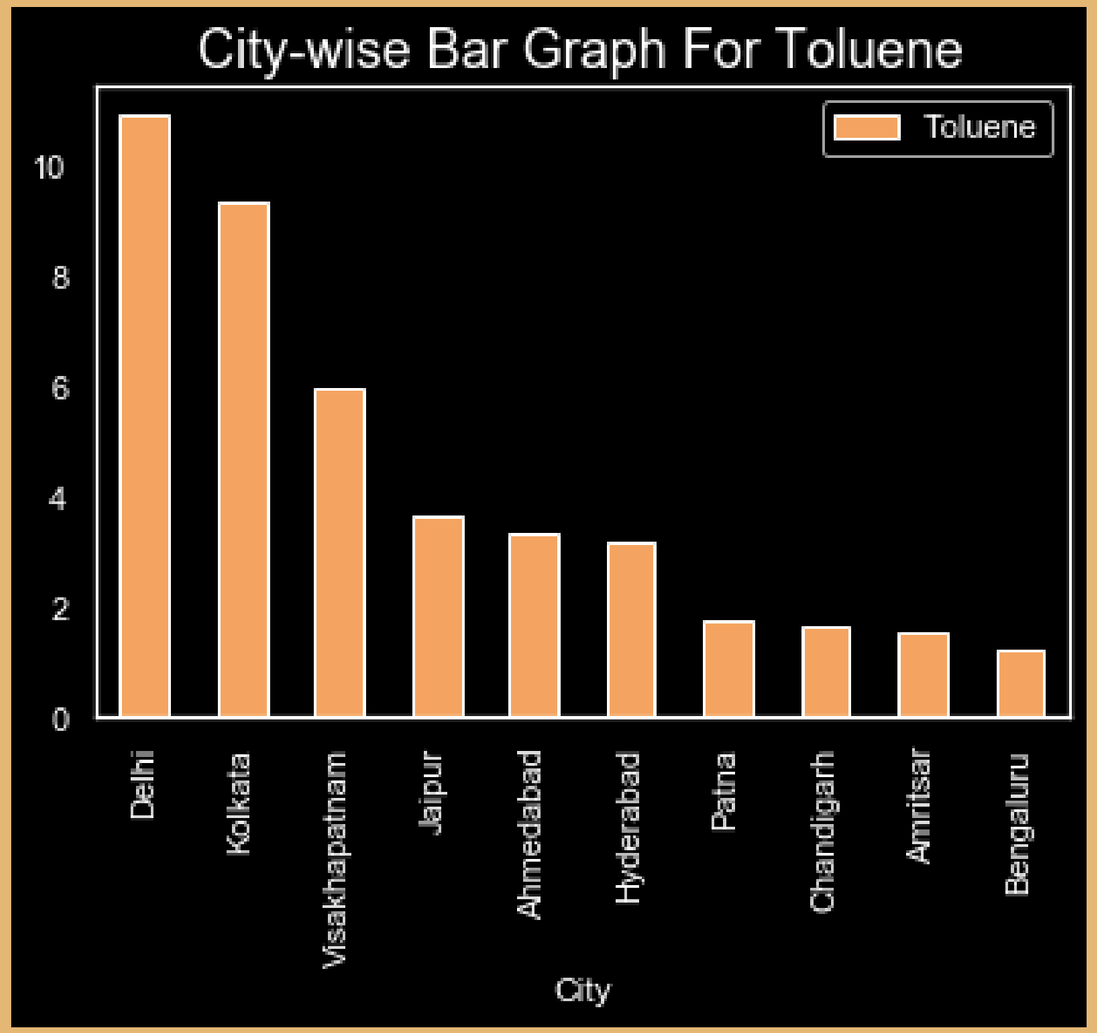

# City-wise Analysis for O3

- Ozone, a secondary pollutant formed in the atmosphere, has serious health impacts.
- Ozone is a strong oxidant, and it can react with a wide range of cellular components and biological materials.
- Bhopal has the highest level of ozone followed by other cities like Delhi, Jaipur...etc while Coimbatore has the lowest level of ozone.

# City-wise Analysis for Benzene

- Benzene is a natural constituent of crude oil and is one of the elementary petrochemicals.
- Benzene is a colorless and highly flammable liquid with a sweet smell.
- Kolkata produces the highest level of benzene while Hyderabad produces the least.



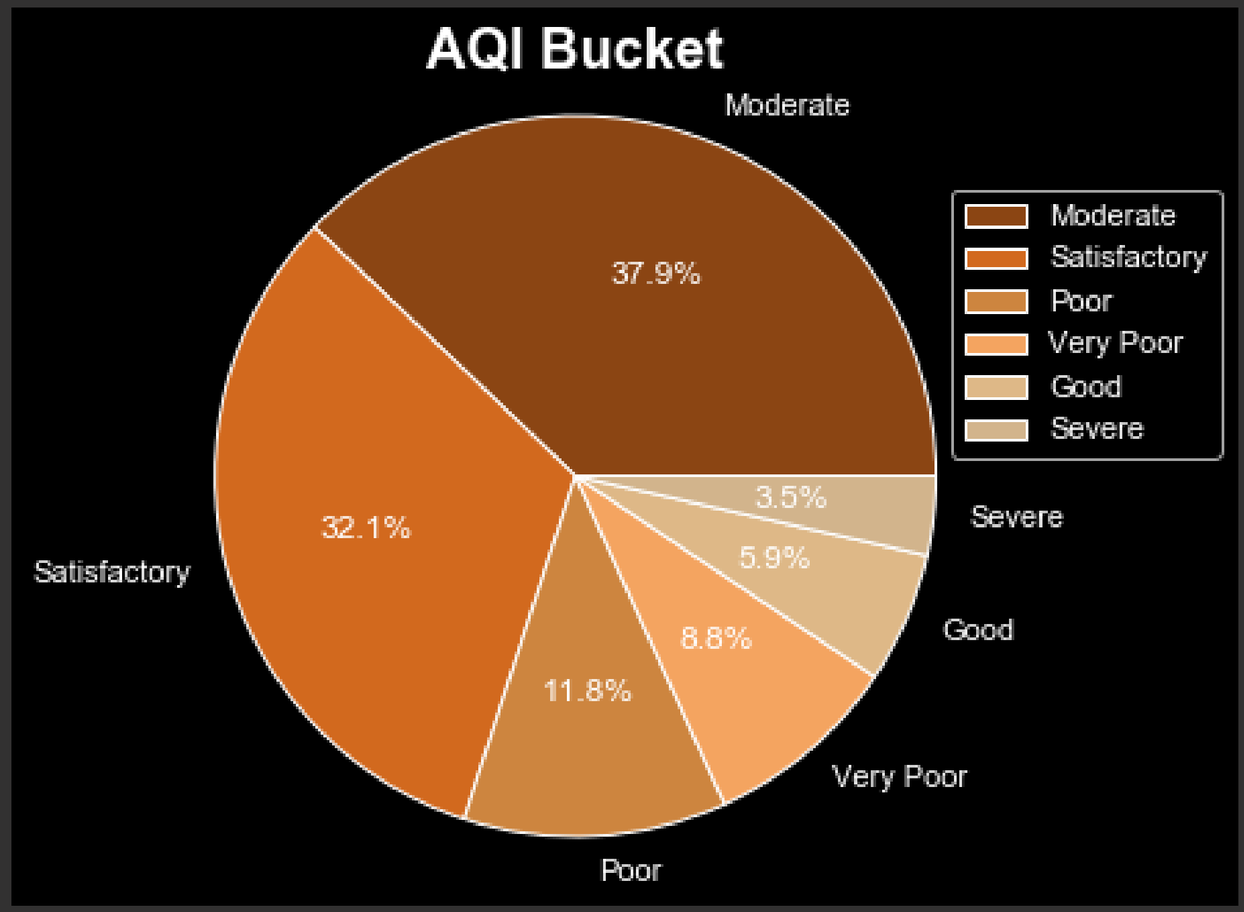



# City-wise Analysis for Toluene

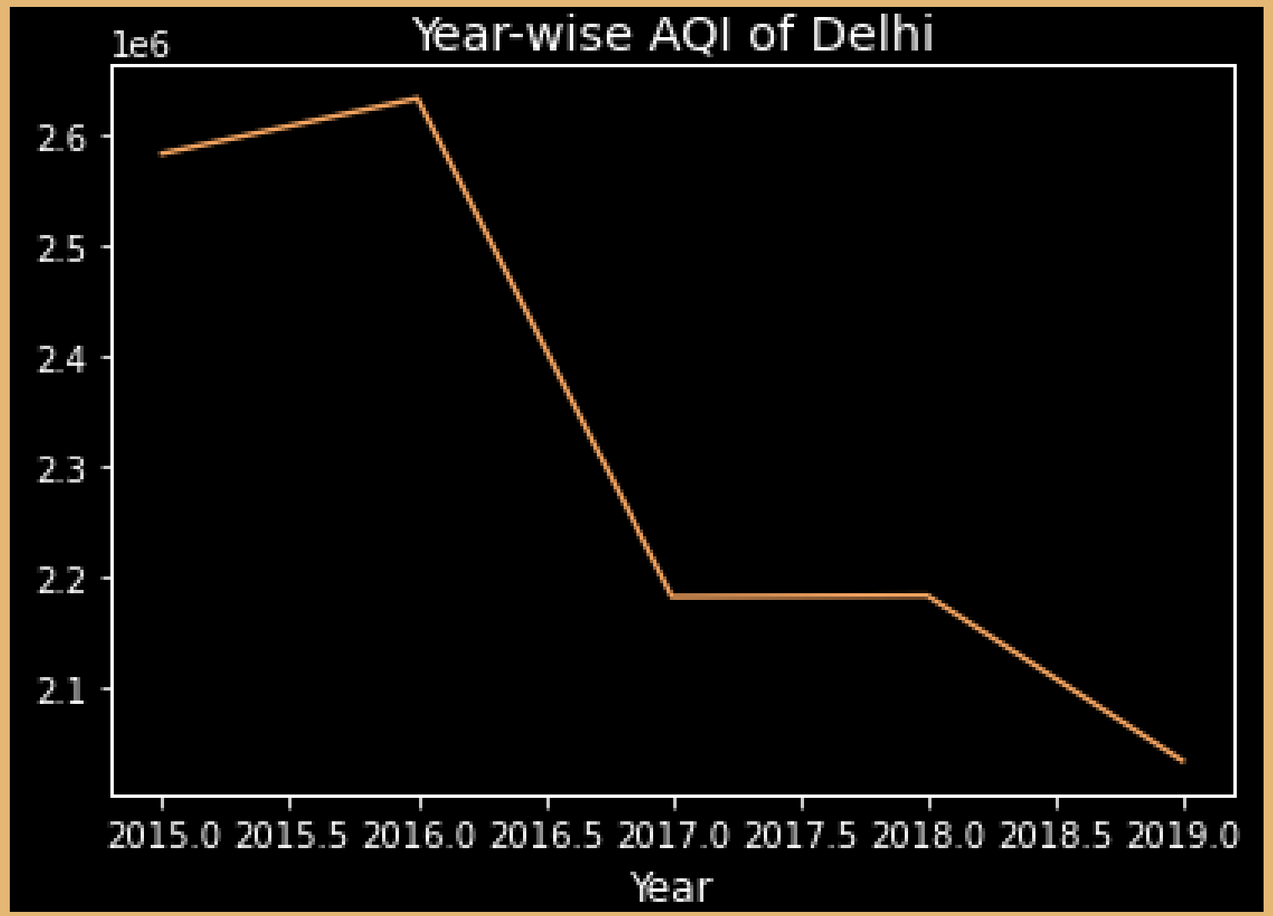
- Toluene is believed to be the most prevalent hydrocarbon in the troposphere.
- It is widespread in the environment owing to its use in a wide variety of commercial and household products.
- Delhi produces more amount of Toluene than any other cities while Bengaluru produces the least amount of Toluene.

# AQI Bucket Analysis

- Most of the cities are in Moderate AQI bucket.
- 32.1% cities are in satisfactory AQI bucket.
- Very few i.e 5.9% cities are in Good AQI bucket whereas 3.5% cities in Severe AQI bucket.

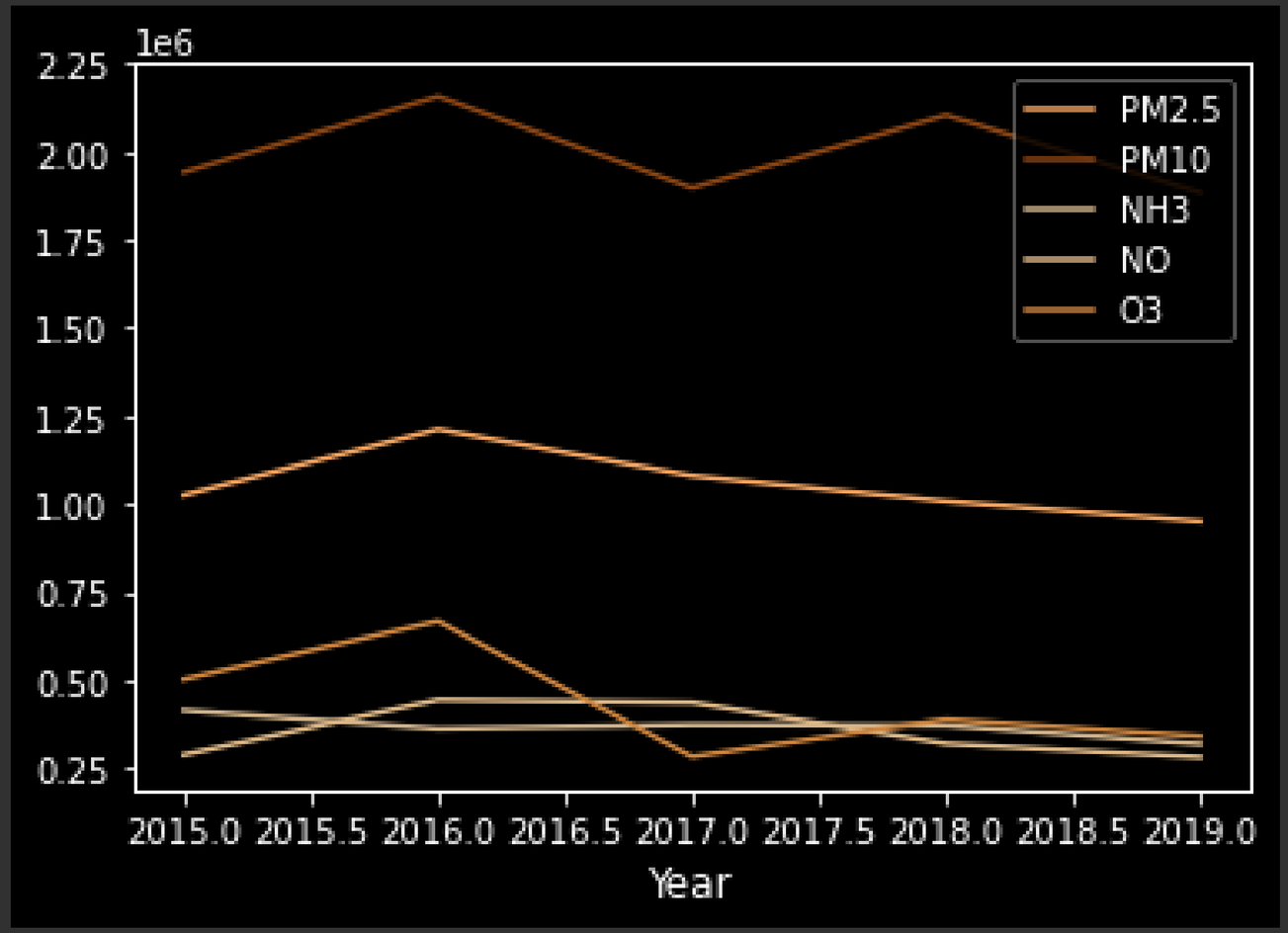


# Year-wise AQI for Delhi



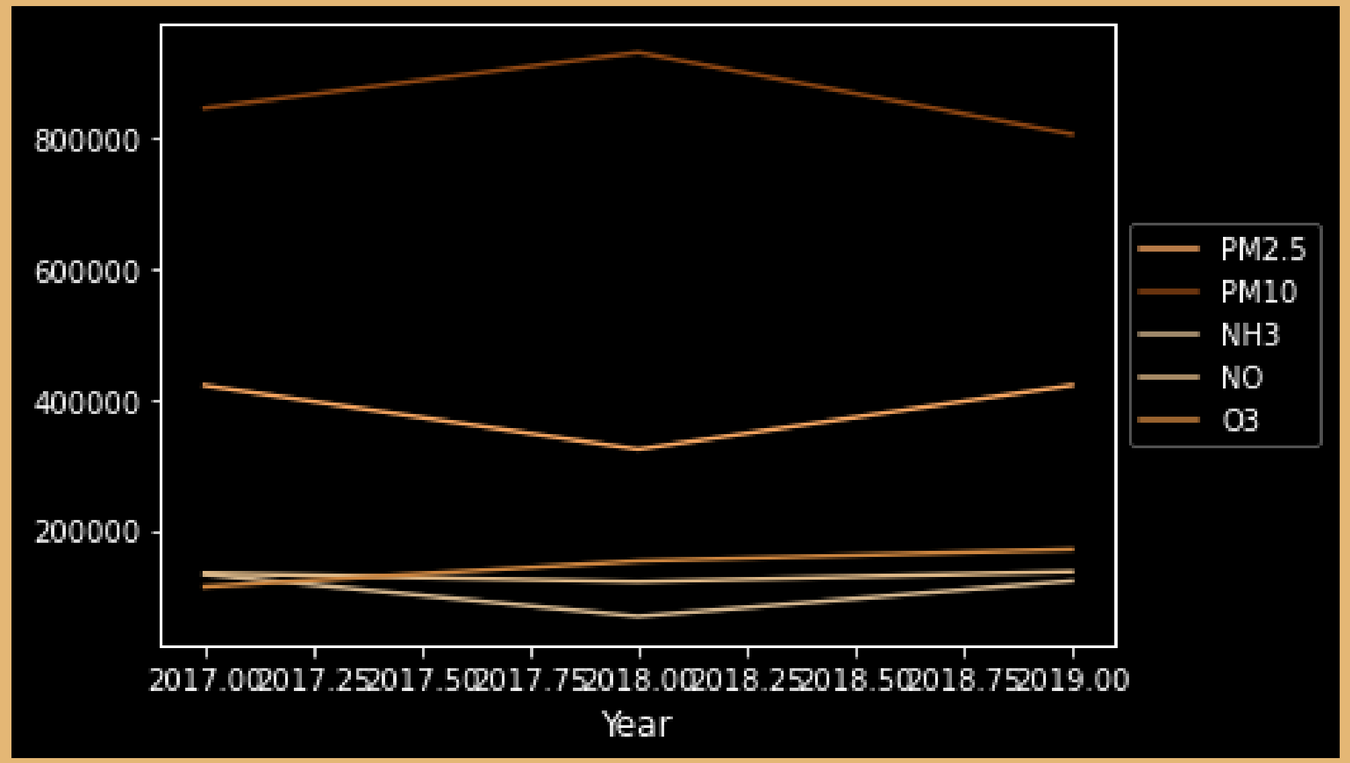

- There is linear decrease in AQI for Delhi from the year 2015 to 2019.
- AQI increased in second half of 2015 but dropped in the year 2016.
- AQI was stable in the year 2017 and decreased again in 2018 and 2019.

# Delhi



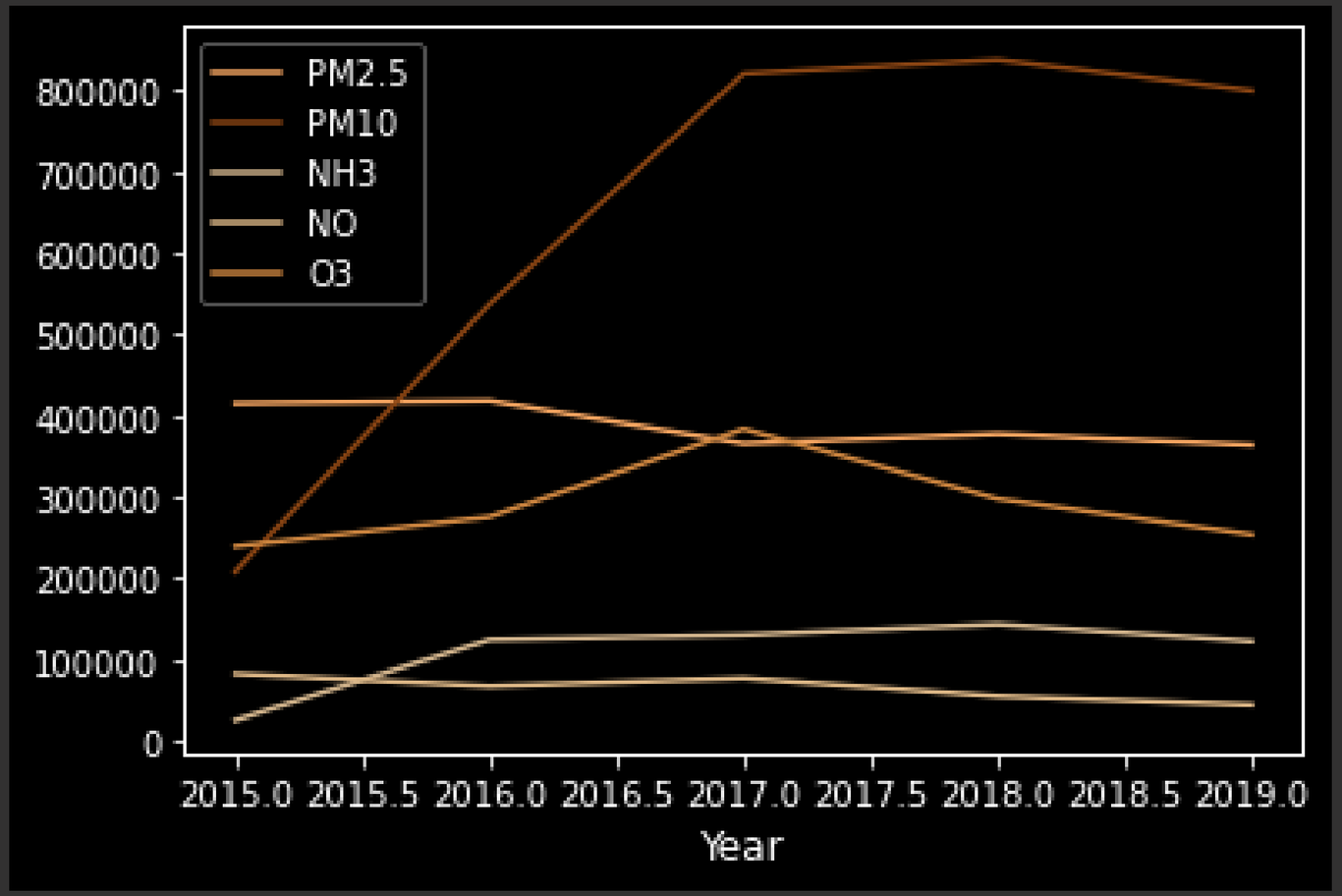

- Minimum AQI recorded for the city of Delhi is 53.
- Maximum AQI recorded for the city of Delhi is 762.
- Delhi occurred 474 times in 'Good' AQI bucket and 23,479 times in 'Poor' AQI Bucket.
- Main elements that contribute to AQI of Delhi are PM2.5, PM10, NH3, NO and O3.

# Amritsar



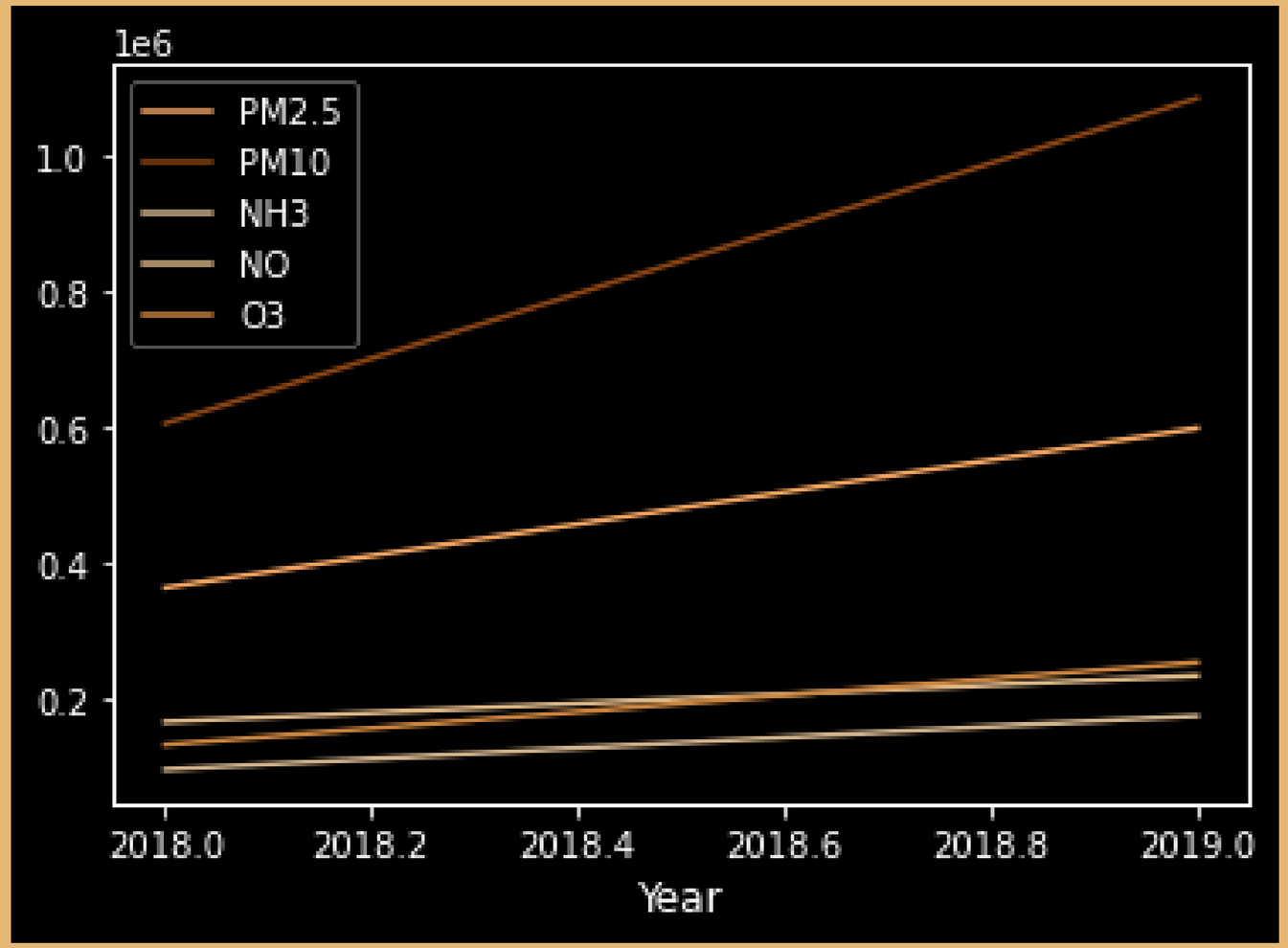

- Minimum AQI recorded for the city of Amritsar is 32.
- Maximum AQI recorded for the city of Amritsar is 1052.
- Amritsar occurred 1794 times in the 'Good' AQI Bucket  and 2673 times in the 'Poor' AQI Bucket.
- Main elements are PM2.5, PM10, NH3, NO and O3.

# Hyderabad



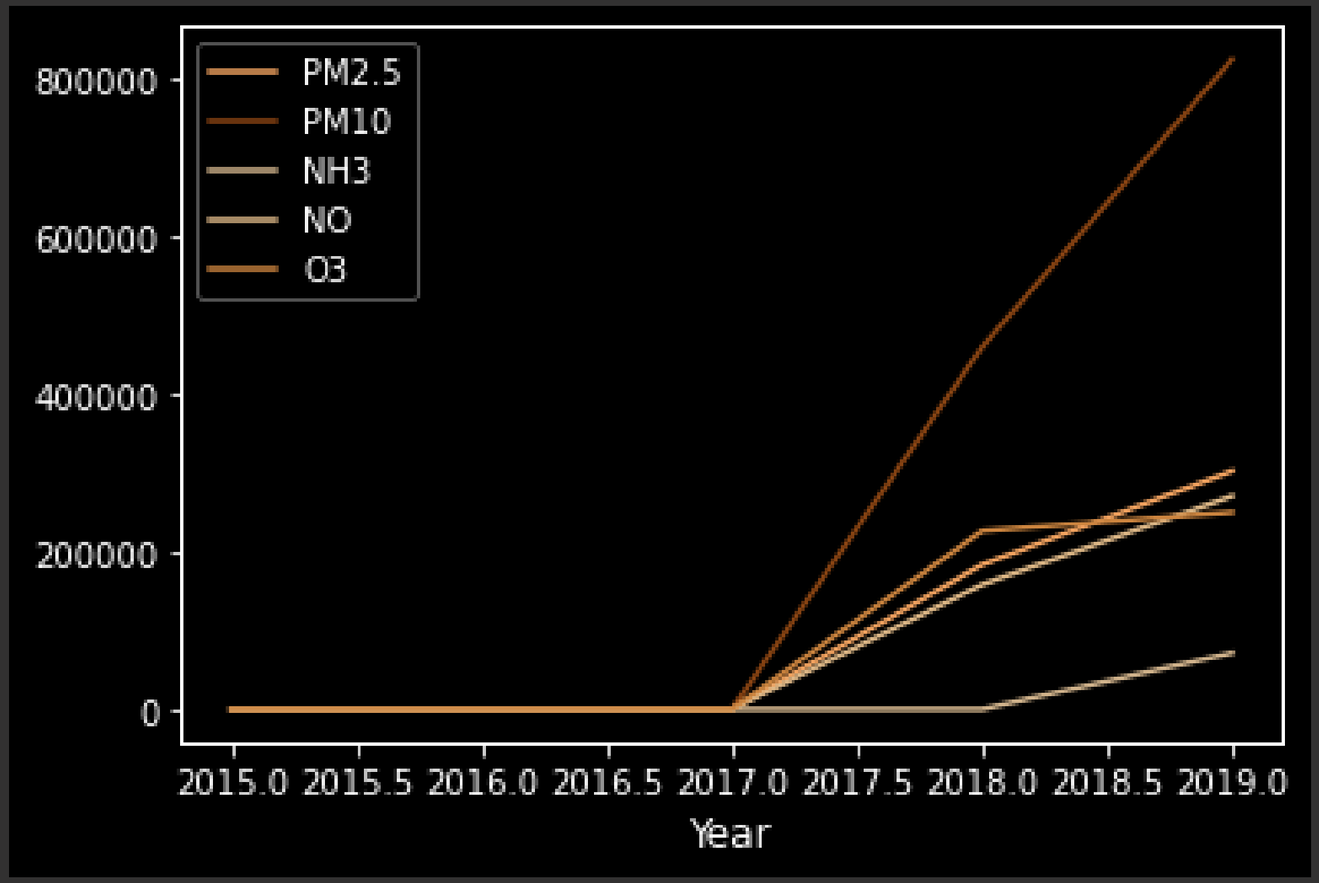

- Minimum AQI recorded for the city of Hyderabad is 20.
- Maximum AQI recorded for the city of  Hyderabad is 877.
- Hyderabad occurred 4591 times in 'Good' AQI bucket and 1862 times in 'Poor' AQI Bucket.
- Main elements that contribute to AQI of Hyderabad are PM2.5, PM10, NH3, NO and O3.

# Kolkata




- Minimum AQI recorded for the city of Kolkata is 23.
- Maximum AQI recorded for the city of Kolkata is 500.
- Kolkata occurred 1886 times in 'Good' AQI bucket and 3659 times in 'Poor' AQI Bucket.
- Main elements that contribute to AQI of Kolkata are PM2.5, PM10, NH3, NO and O3.

# Mumbai




- Maximum AQI recorded for the city of Mumbai is 317.
- Mumbai occurred 257 times in 'Good' AQI bucket and 689 times in 'Poor' AQI Bucket.
- Main elements that contribute to AQI of Mumbai are PM2.5, PM10, NH3, NO and O3.

# Conclusion

- India has moderate air quality throughout the year.
- The air quality is good on weekends and deteriorates moderately during weekdays.
- Most of the cities are in Moderate AQI bucket.
- Air quality is good in summers, moderate in monsoon and poor in winters.
- Main elements that contribute to AQI are PM2.5, PM10, NH3, NO and O3.

- Delhi, Kolkata and Hyderabad are the most affected cities.
- Delhi which is known to have dangerously high levels of AQI almost all year round, experienced a linear decrease in AQI from the year 2015 to 2019.
- 37.9% cities are in 'Moderate' AQI bucket, 32.1% cities are in 'Satisfactory' AQI bucket. Very few i.e 3.5% cities are in 'Severe' AQI bucket followed by 5.9% of cities in 'Good' AQI bucket whereas 8.8% cities and 11.8% cities are in 'Poor' and 'Very Poor' AQI buckets respectively.

# Thankyou!