**Air Quality Index (AQI) Report**

Data Source: West Bengal Pollution Control Board
Station: Bhasa,2nd Campus of Asutosh College
(October 2024)

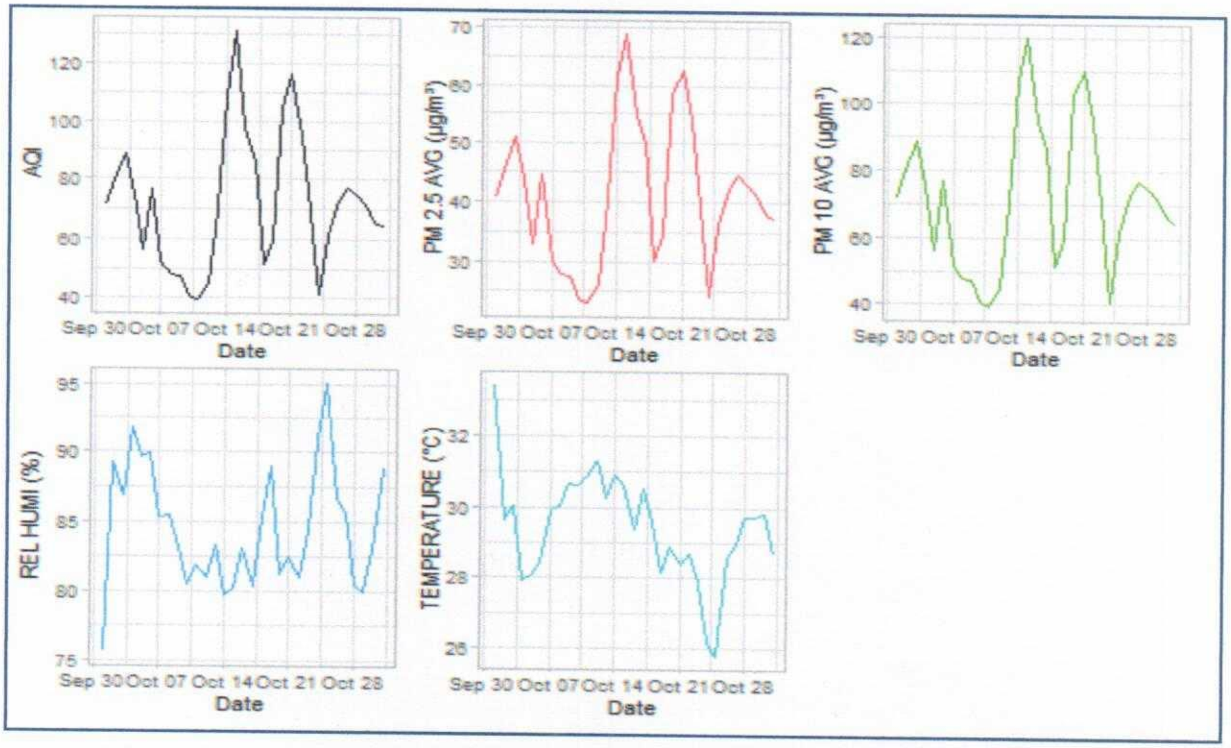
**Introduction**

The October Air Quality Index (AQI) refers to the measure of air pollution levels during October, a month often marked by significant changes in air quality in many parts of the world. This period typically coincides with seasonal transitions and events that influence pollution levels, such as the onset of cooler weather, agricultural stubble burning, and festivities like Diwali in India, which involve fireworks. The AQI assesses key pollutants such as particulate matter ($PM_{2.5}$, $PM_{10}$), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and ozone (O3), assigning a score that categorizes air quality from "Good" to "Hazardous." Monitoring October AQI is critical for public health, especially for individuals with respiratory or cardiovascular conditions.

| AQI | $PM_{2.5}$ AVG (μg/m³) | $PM_{10}$ AVG (μg/m³) | REL HUMI (%) | TEMPERATURE (°C) |
|---|---|---|---|---|
| 39.25 | 22.97 | 39.23 | 75.60 | 25.82 |
| 54.27 | 31.58 | 54.22 | 80.95 | 28.52 |
| 71.23 | 40.76 | 71.24 | 83.43 | 29.65 |
| 83.06 | 48.09 | 83.09 | 87.87 | 30.41 |
| 131.42 | 68.81 | 120.04 | 95.11 | 33.42 |
| 72.19 | 41.26 | 71.43 | 84.58 | 29.41 |
| 23.11 | 12.16 | 21.54 | 4.42 | 1.50 |

The table provides a detailed summary of air quality and meteorological parameters observed over a specific period. The **Air Quality Index (AQI)** values range from 23.11 to 131.42, reflecting varying pollution levels. The **$PM_{2.5}$ average concentrations** (measured in μg/m³) fluctuate between 12.16 and 68.81, while the **$PM_{10}$ averages** span from 21.54 to 120.04 μg/m³, indicating particulate matter levels that contribute to air pollution. Relative humidity percentages are observed between 4.42% and 95.11%, showcasing diverse moisture conditions in the atmosphere. The recorded **temperatures** range from 1.50°C to 33.42°C, illustrating a significant variation in thermal conditions. Together, these parameters highlight the interplay between pollution, atmospheric humidity, and temperature, offering insights into environmental conditions and their potential impact on air quality.

This data underscores the dynamic nature of air quality and its sensitivity to meteorological factors. Higher AQI levels correspond with increased concentrations of $PM_{2.5}$ and $PM_{10}$, as well as elevated humidity and temperature, suggesting a correlation between these variables. For instance, the highest AQI of 131.42 is accompanied by peak particulate matter levels and high humidity of 95.11%, along with a temperature of 33.42°C, indicating that warmer and more humid conditions may exacerbate air pollution. Conversely, the lowest AQI of 23.11 aligns with the minimum values of particulate matter and relative humidity, coupled with a significantly cooler temperature. This relationship highlights the importance of continuous monitoring and analysis to understand the seasonal and temporal variations in air quality and to devise strategies for mitigating pollution under varying climatic conditions.




The provided graphs illustrate the temporal dynamics of air quality and meteorological parameters (AQI, PM $_{2.5}$, $PM_{10}$, relative humidity, and temperature) over a one-month period. Each parameter shows distinctive patterns that collectively provide insights into the interplay between pollution levels and atmospheric conditions.

1. **Air Quality Index (AQI)**:
   The AQI graph exhibits periodic fluctuations, with sharp peaks and valleys. The peaks indicate days with poor air quality, while the troughs suggest relatively better conditions. This variability is likely influenced by factors such as emissions, meteorological conditions, and localized activities like stubble burning or urban activities. The cyclical nature may also hint at recurring weather patterns affecting pollutant dispersion.
2. **PM $_{2.5}$ and PM $_{10}$ Concentrations**:
   The PM $_{2.5}$ and $PM_{10}$ graphs show similar trends, with both displaying synchronous peaks that align with AQI spikes. $PM_{10}$ levels consistently exceed PM $_{2.5}$ levels, which is expected as $PM_{10}$ includes larger particles. Notably, the highest particulate matter concentrations coincide with high AQI values, underscoring the significant contribution of these pollutants to air quality deterioration. The periodicity in the graphs may also

reflect daily or weekly pollution cycles influenced by traffic, industry, or weather conditions.

3. **Relative Humidity**:
   Relative humidity exhibits significant variability, with values ranging from about 75% to 95%. Higher humidity levels often coincide with increased AQI and particulate matter concentrations, suggesting a possible interaction. Elevated humidity may lead to hygroscopic growth of particulate matter, increasing their size and concentration, which can exacerbate air quality issues. The peaks in humidity might align with certain weather events like fog or light rain, which can trap pollutants closer to the ground.
4. **Temperature**:
   The temperature graph shows a general upward trend with occasional dips. Higher temperatures are typically associated with increased pollutant dispersion due to atmospheric mixing, but in this case, they appear to coincide with AQI and particulate matter peaks. This could be due to other overriding factors like stagnant weather conditions or increased emissions during warmer days. The temperature dips might align with nighttime cooling or weather changes, which could reduce atmospheric mixing and temporarily increase pollution concentrations.

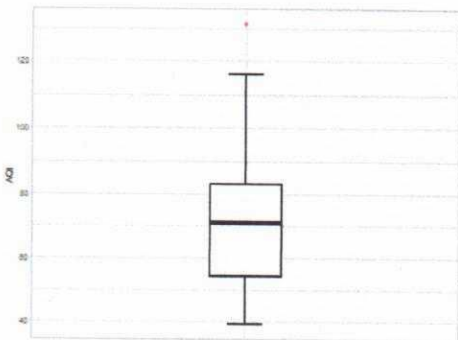
**Combined Analysis:**

- The simultaneous peaks in AQI, $PM_{2.5}$, and $PM_{10}$, along with high humidity levels, indicate periods of significant air quality deterioration.
- The correlation between relative humidity and particulate matter levels suggests that moisture plays a role in particle accumulation and suspension in the air.
- Temperature variations show a complex relationship with air quality, indicating that other meteorological or anthropogenic factors may contribute to pollutant concentrations.

This analysis highlights the intricate interplay between air pollutants and meteorological parameters, emphasizing the need for integrated monitoring and modeling to predict and manage air quality effectively.

The box plot represents the distribution of the Air Quality Index (AQI) values over a specified time period. Here's a detailed description:

1. **Central Tendency**:
   - The horizontal line within the box represents the **median AQI**, which appears to be around 70. This indicates that half of the observed AQI values are below 70, and half are above.
2. **Interquartile Range (IQR)**:



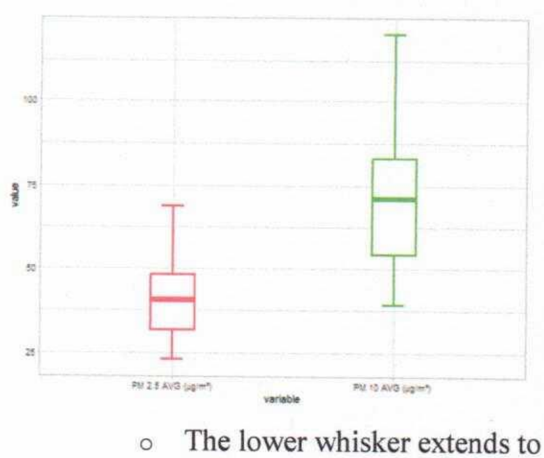
- The box itself spans from the **first quartile (Q1)** (approximately 60) to the **third quartile (Q3)** (approximately 85), representing the middle 50% of the data. This range shows the typical variation in AQI values, excluding extreme values.

3. **Whiskers**:
   - The whiskers extend from the box to the minimum and maximum non-outlier AQI values. The lower whisker reaches approximately 40, while the upper whisker extends close to 110. These represent the range of most AQI observations, excluding any outliers.
4. **Outlier**:
   - A single red dot above the upper whisker indicates an **outlier**, with an AQI value exceeding 120. This suggests an unusually high level of air pollution on a specific day compared to the rest of the data.

**Interpretation:**

The box plot shows that most AQI values are concentrated between 60 and 85, indicating moderate air quality. The presence of a high outlier (above 120) suggests that there was at least one day with significantly worse air quality, potentially due to specific events like increased emissions, weather changes, or localized pollution sources. The relatively symmetric whiskers suggest that the AQI distribution is not heavily skewed, though the outlier skews the perception of the maximum values slightly.

This box plot displays the distribution of $PM_{2.5}$ and $PM_{10}$ average concentrations (measured in µg/m³) over a specific period. Here is a detailed interpretation:



**$PM_{2.5}$ Average Concentrations (Red Boxplot):**

1. **Central Tendency**:
   - The **median** (horizontal line inside the box) is slightly below 40 µg/m³, indicating that half of the $PM_{2.5}$ values are below this level.
2. **Interquartile Range (IQR)**:
   - The box spans from approximately 30 µg/m³ (first quartile, Q1) to 45 µg/m³ (third quartile, Q3), representing the middle 50% of $PM_{2.5}$ observations.
3. **Whiskers**:
   - The lower whisker extends to about 25 µg/m³, and the upper whisker reaches close to 50 µg/m³. These represent the range of most $PM_{2.5}$ values, excluding any outliers.
4. **Outliers**:

- No apparent outliers are visible for PM $_{2.5}$ in this plot.

**PM10 Average Concentrations (Green Boxplot):**

1. **Central Tendency**:
   - The **median** is approximately 70 µg/m³, indicating that half of the $PM_{10}$ values are below this level.
2. **Interquartile Range (IQR)**:
   - The box spans from about 55 µg/m³ (Q1) to 90 µg/m³ (Q3), showing a broader range of $PM_{10}$ values compared to PM $_{2.5}$.
3. **Whiskers**:
   - The lower whisker extends to around 40 µg/m³, while the upper whisker reaches approximately 110 µg/m³. This indicates a wider range of variability in $PM_{10}$ levels.
4. **Outliers**:
   - There are no visible outliers for $PM_{10}$ concentrations in this plot.

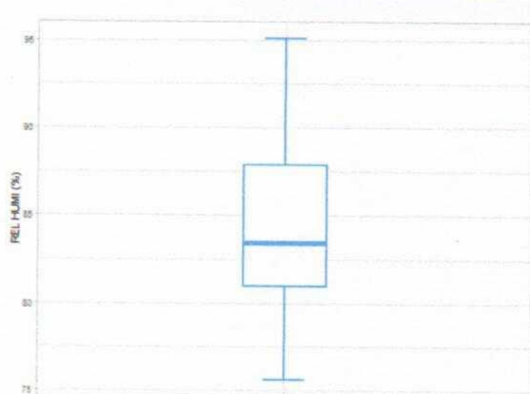
**Comparative Analysis:**

- **PM $_{2.5}$ vs. $PM_{10}$**: The $PM_{10}$ concentrations exhibit a broader range and higher values compared to PM $_{2.5}$, which is expected as $PM_{10}$ encompasses larger particulate matter.
- **Distributions**: The PM $_{2.5}$ distribution is more compact, while $PM_{10}$ shows greater variability, with a wider IQR and longer whiskers.
- **Pollution Levels**: Both parameters indicate varying levels of particulate pollution, with $PM_{10}$ consistently higher, suggesting it may have a greater impact on overall air quality.

This comparison underscores the importance of monitoring both PM $_{2.5}$ and $PM_{10}$ as they influence air quality differently due to their distinct size and behavior in the atmosphere.

This box plot illustrates the distribution of relative humidity (REL HUMI) percentages. Here's how to interpret it:

1. **Median (Horizontal Line inside the Box):**




- The thick horizontal line inside the box represents the median (the middle value of the data). From the plot, it looks like the median relative humidity is around 85%.

2. **Interquartile Range (IQR):**
   - The box spans from the 25th percentile (lower boundary of the box) to the 75th percentile (upper boundary of the box). This range represents the middle 50% of the data. The IQR appears to range from about 80% to 90%.
3. **Whiskers:**

- The whiskers extend from the edges of the box to the smallest and largest data points within 1.5 times the IQR. In this case, the whiskers extend roughly from 75% to 95%, indicating the range of most of the data.

4. **Outliers (Not Visible Here):**
   - If there were any data points outside the whiskers, they would be plotted as individual dots. This plot doesn't show any obvious outliers.

**Summary:**

The relative humidity values mostly fall between 75% and 95%, with the central 50% of values between 80% and 90%. The median relative humidity is approximately 85%. This indicates that the data is moderately spread around its median, with no extreme values visible.

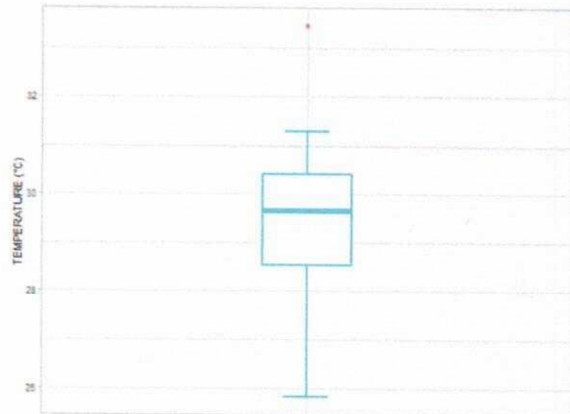
This box plot illustrates the distribution of relative humidity (REL HUMI) percentages. Here's how to interpret it:

1. **Median (Horizontal Line inside the Box):**
   - The thick horizontal line inside the box represents the median (the middle value of the data). From the plot, it looks like the median relative humidity is around 85%.
2. **Interquartile Range (IQR):**
   - The box spans from the 25th percentile (lower boundary of the box) to the 75th percentile (upper boundary of the box). This range represents the middle 50% of the data. The IQR appears to range from about 80% to 90%.
3. **Whiskers:**
   - The whiskers extend from the edges of the box to the smallest and largest data points within 1.5 times the IQR. In this case, the whiskers extend roughly from 75% to 95%, indicating the range of most of the data.
4. **Outliers (Not Visible Here):**
   - If there were any data points outside the whiskers, they would be plotted as individual dots. This plot doesn't show any obvious outliers.

**Summary:**

The relative humidity values mostly fall between 75% and 95%, with the central 50% of values between 80% and 90%. The median relative humidity is approximately 85%. This indicates that the data is moderately spread around its median, with no extreme values visible.

The image depicts a boxplot representing temperature data in degrees Celsius (°C). Here's the interpretation:




1. **Median**: The horizontal line within the box represents the median temperature. This is the central value of the dataset.
2. **Interquartile Range (IQR)**:
   - The box itself spans the interquartile range (IQR), which is the range between the first quartile (Q1, the lower edge of the box) and the third quartile (Q3, the upper edge of the box).
   - The IQR indicates the middle 50% of the data.
3. **Whiskers**:
   - The vertical lines extending from the box are the "whiskers," which typically represent the range of data within 1.5 times the IQR from the quartiles.
   - The lower whisker shows the minimum value within this range, while the upper whisker shows the maximum value.
4. **Outlier**:
   - The red dot above the upper whisker indicates an outlier, a data point that lies beyond 1.5 times the IQR above Q3.
5. **Range**:
   - The entire span from the lower whisker to the upper whisker represents the range of the majority of the data (excluding outliers).

**Key Observations:**

- The median temperature appears to be around 30°C.
- The IQR indicates that most of the temperatures lie roughly between 28°C and 31°C.
- The outlier above 32°C suggests an unusually high temperature compared to the rest of the dataset.

The provided data reveals significant variations in air quality, particulate matter concentrations, relative humidity, and temperature. AQI values range from 23.11 to 131.42, indicating air quality conditions from "Good" to "Unhealthy for Sensitive Groups," with higher AQI levels corresponding to elevated concentrations of $PM_{2.5}$ (up to 68.81 µg/m³) and $PM_{10}$ (up to 120.04 µg/m³). These patterns highlight the strong influence of particulate matter on air quality. Temperature and relative humidity also exhibit wide variations, ranging from 1.50°C to 33.42°C and 4.42% to 95.11%, respectively, suggesting diverse environmental conditions, possibly across different seasons or times of the day. The lowest recorded values, particularly for temperature and humidity, stand out as extreme outliers, potentially representing unique events or anomalies. Overall, the data underscores the dynamic interplay between air quality and meteorological factors, with notable peaks in pollution linked to adverse AQI levels.

Report produced by Air Quality Monitoring System Committee

| Name of the members | Signatures |
|---|---|
| Dr. Debasmrity Mukherjee (Nodal Officer) Dept. of Geography | Debasmrity Mukherjee 25/10/24 |
| Dr. Bidisha Maitra Sen (Dept. of IFF) | Bidisha Maitra Sen |
| Dr. Sudip Dasgupta (Dept. of Geography) | Sudip DasGupta |
| Sri Debabrata Chanda (Dept. of Geography) | Debabrata Chanda |
| Dr. Shramana Roy Barman (Dept. of Environmental Science) | |
| Dr. Sayanti Kar (Dept. of Environmental Science) | Sayanti Kar 25/10/24 |

Dr. Manas Kabi
Principal
Asutosh College

PRINCIPAL
ASUTOSH COLLEGE
92, S. P. MUKHERJEE ROAD
KOLKATA-700 026