Air Quality Index (AQI) Report

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

Introduction

The **Air Quality Monitoring Index (AQI)** plays a crucial role in assessing air quality during December, a month often marked by deteriorating air conditions due to seasonal factors. In many regions, colder weather leads to temperature inversions, which trap pollutants close to the ground, preventing their dispersion and causing a significant rise in particulate matter ($PM_{2.5}$ and PM_{10}) and other pollutants. Additionally, emissions from residential heating, industrial activity, and increased vehicular usage during winter contribute to heightened pollution levels. In some areas, agricultural practices like crop residue burning and festive activities such as fireworks further exacerbate the issue. December often sees AQI levels in the "Unhealthy" or "Hazardous" range, posing severe health risks, particularly to sensitive groups like children, the elderly, and those with respiratory or cardiovascular conditions. Monitoring AQI during this month is vital for raising awareness, providing timely health advisories, and encouraging actions to minimize exposure and reduce pollution sources.

Description of the Data

Table 1 Description of the data

STATISTIC	AQI	$PM_{2.5}$ AVG ($\mu G/M^3$)	PM_{10} AVG ($\mu G/M^3$)	REL HUMI (%)	TEMPERATURE (°C)
Min.	72.91	41.21	72.92	63.79	18.8
1st Qu.	115.48	62.3	110.46	70.92	20.62
Median	128.75	67.58	120.41	73.24	21.82
3rd Qu.	139.6	71.84	127.71	75.46	22.55
Max.	182.96	84.87	149.11	87.99	25.91
Mean	128.18	66.53	118.14	73.4	21.61
St. d.	22.58	8.64	15.3	4.98	1.63

Source: PCB (Station: Bhasa ,2nd Campus of Asutosh College)

. Air Quality Index (AQI):

- **Range**: The AQI varies from a minimum of 72.91 (Moderate) to a maximum of 182.96 (Unhealthy), with an average value of 128.18 (falling into the "Unhealthy for Sensitive Groups" category).
- **Median**: The median AQI is 128.75, meaning half of the observations were below this value.
- **Standard Deviation (22.58)**: This indicates moderate variability in AQI values during the observation period.

2. PM $_{2.5}$ Average (µg/m³):

- **Range**: PM $_{2.5}$ levels range from 41.21 µg/m³ to 84.87 µg/m³, with an average of 66.53 µg/m³. These values exceed most international air quality standards (e.g., the WHO guideline of 15 µg/m³ annual mean), highlighting significant pollution levels.
- **Median**: A median of 67.58 µg/m³ indicates that half the observed values were above this threshold.
- **Standard Deviation (8.64)**: This relatively low variability suggests that PM $_{2.5}$ levels remained consistently high during the period.

3. PM_{10} Average (µg/m³):

- **Range**: PM_{10} concentrations vary between 72.92 µg/m³ and 149.11 µg/m³, with an average of 118.14 µg/m³. These levels also exceed acceptable limits (e.g., WHO guideline of 45 µg/m³ daily mean), indicating poor air quality.
- **Median**: The median PM_{10} value is 120.41 µg/m³, showing a central tendency near the mean.
- **Standard Deviation (15.3)**: Moderate variability suggests fluctuating PM_{10} levels over time.

4. Relative Humidity (REL HUMI, %):

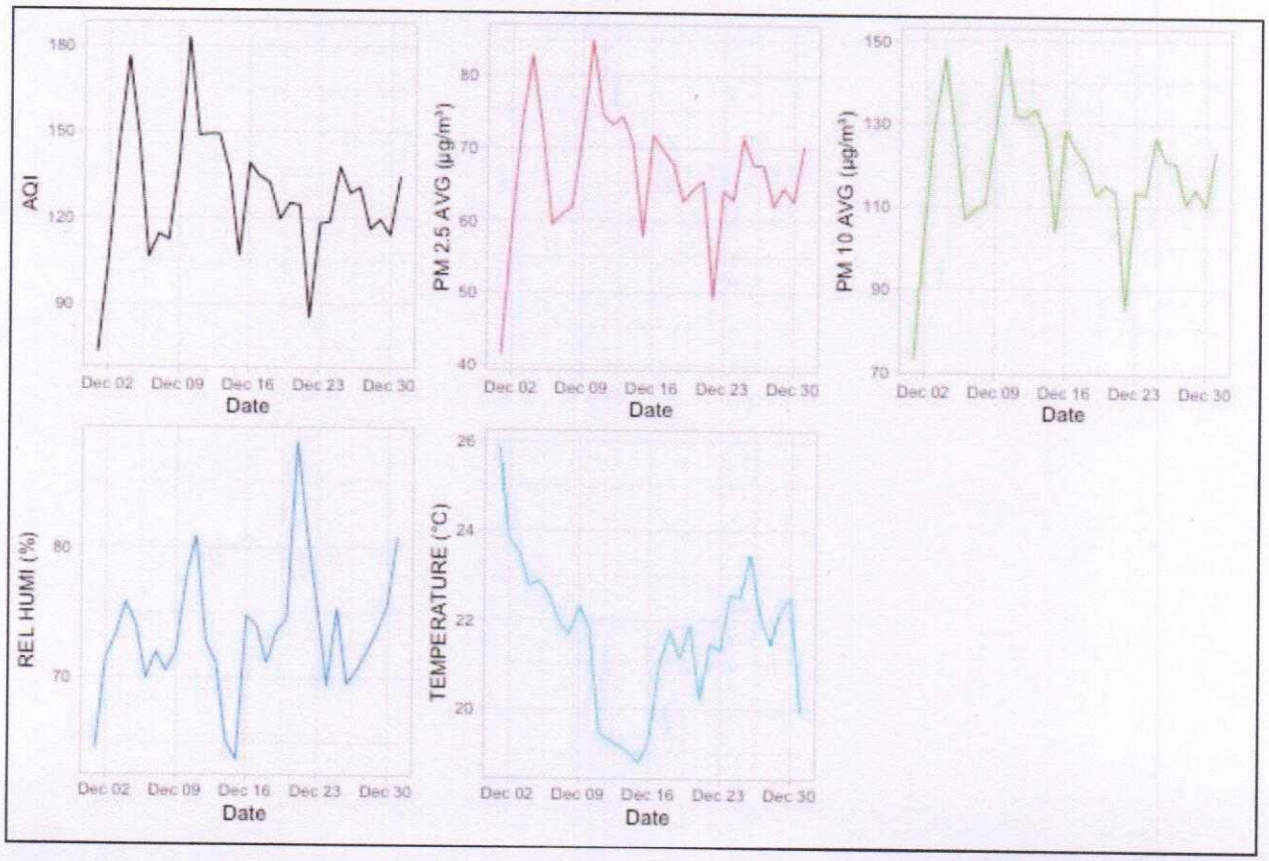
- **Range**: Humidity levels range from 63.79% to 87.99%, with an average of 73.4%. Higher humidity levels could contribute to the persistence of particulate matter in the atmosphere.
- **Median**: The median value of 73.24% aligns closely with the mean, indicating fairly consistent humidity throughout the period.
- **Standard Deviation (4.98)**: Low variability suggests relative stability in humidity levels.

5. Temperature (°C):

- **Range**: Temperatures vary from 18.8°C to 25.91°C, with an average of 21.61°C. This reflects typical cool to mild conditions, which are conducive to temperature inversions and the accumulation of air pollutants.
- **Median**: The median temperature is 21.82°C, close to the mean, showing limited variation.
- **Standard Deviation (1.63)**: The low variability indicates that temperature remained relatively stable during the observation period.

Key Takeaways:

- The data indicates poor air quality with elevated levels of $PM_{2.5}$ and PM_{10}, which consistently exceed global standards.
- Moderate variability in AQI suggests that air pollution levels were fairly steady, with occasional spikes to more hazardous levels.
- High humidity and mild temperatures likely contributed to the persistence of particulate matter in the atmosphere, while stable conditions overall reflect a typical December environment conducive to pollution accumulation.



- Health risks, particularly for sensitive groups, would remain significant throughout the period, necessitating regular monitoring and mitigation measures.

1. Air Quality Index (AQI):

- The AQI exhibits notable variability throughout December. It peaks around **December 2 and 9**, with values nearing 180, falling into the **"Unhealthy"** category.
- There is a gradual downward trend after mid-December, but the AQI still remains above 90 for most of the month, which corresponds to at least **"Moderate"** air quality, often closer to the **"Unhealthy for Sensitive Groups"** range.
- This pattern indicates that air quality is persistently poor, with only brief periods of slight improvement toward the later weeks of the month.

2. $PM_{2.5}$ Average:

- $PM_{2.5}$ levels closely track the AQI, as particulate matter is a major contributor to poor air quality. The concentrations range from **40 µg/m³ to over 80 µg/m³**, with peaks early in the month, especially around **December 2–10**.
- Levels remain consistently above **60 µg/m³** for most of the month, which is significantly higher than global health guidelines (e.g., WHO recommends a daily mean of **15 µg/m³** for $PM_{2.5}$).
- The high $PM_{2.5}$ levels reflect emissions from activities such as heating, vehicle use, and industrial processes, exacerbated by weather conditions that trap pollutants.

3. PM_{10} Average:

- PM_{10} levels are consistently high, ranging from **70 µg/m³ to approximately 150 µg/m³**. The highest values are observed in early December, particularly around **December 2 and 9**, similar to AQI and $PM_{2.5}$ trends.
- Although there are slight dips mid-month, PM10 concentrations never fall below 70 µg/m³, which is well above recommended thresholds for health safety (e.g., WHO guideline of **45 µg/m³ daily mean**).
- These elevated PM_{10} levels likely stem from road dust, construction activities, and industrial emissions, compounded by weather conditions.

4. Relative Humidity (REL HUMI):

- Relative humidity shows considerable fluctuations, ranging from **63% to nearly 88%**. Spikes in humidity occur around **December 16 and 30**, coinciding with a slight increase in AQI.
- High humidity is known to enhance the persistence of particulate matter, as water vapor can bind with pollutants to form larger particles, worsening air quality.
- The consistently high average humidity (~73%) suggests that atmospheric conditions during December are conducive to trapping pollutants, reducing their dispersion.

5. Temperature (°C):

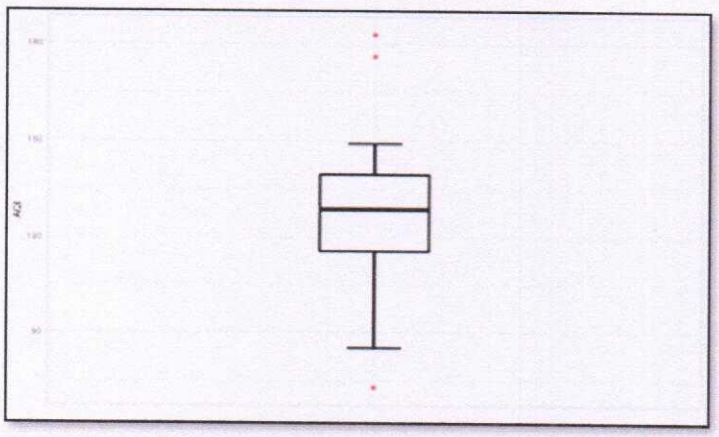
- Temperatures show a gradual decline from around **25°C at the start of December to approximately 20°C toward mid-December**, stabilizing in the latter half of the month.
- Cooler temperatures are linked to **temperature inversions**, a phenomenon where a layer of warm air traps cooler air (and pollutants) close to the ground. This contributes significantly to the observed high AQI and pollutant levels.
- Stable, mild temperatures toward the end of December indicate that the air quality might remain stagnant without external disturbances like strong winds.

Overall Insights:

- The data highlights **early December** as the most polluted period, with peaks in AQI, $PM_{2.5}$, and PM_{10} levels.
- **Humidity and temperature** play a significant role in worsening pollution, as high humidity and cooler temperatures create conditions for pollutant accumulation and prolonged persistence in the atmosphere.
- **Health Risks**: The consistently poor air quality throughout December poses severe health risks, particularly to vulnerable populations such as children, the elderly, and individuals with respiratory or cardiovascular conditions. Prolonged exposure to elevated $PM_{2.5}$ and PM_{10} levels is particularly concerning due to their ability to penetrate deep into the lungs and bloodstream.
- **Call to Action**: The data underscores the need for pollution control measures, such as reducing emissions from heating, transportation, and industrial sources,

along with raising public awareness about protective actions like minimizing outdoor activities during peak pollution periods.

The box plot shown represents the distribution of AQI (Air Quality Index) values. Here's the interpretation:



1. **Median**: The bold line within the box represents the median AQI value, indicating the central tendency of the data.
2. **Interquartile Range (IQR)**: The height of the box shows the range between the first quartile (25th percentile) and the third quartile (75th percentile). This indicates where the middle 50% of AQI values lie.
3. **Whiskers**: The lines (whiskers) extending from the box show the range of AQI values that are within 1.5 times the IQR. These represent the spread of most data points.
4. **Outliers**: The red dots outside the whiskers represent outliers—data points that are significantly higher or lower than the rest of the distribution.

Key Observations:

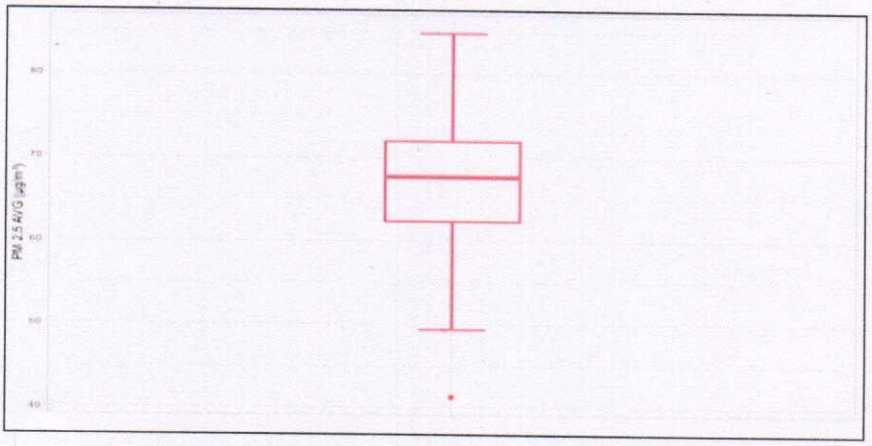
- The majority of AQI values are concentrated between approximately 120 and 150.
- There are two high outliers (above 180) and one low outlier (below 90).
- The distribution seems relatively symmetric, with no extreme skewness evident.

The provided image is a box plot representing the distribution of $PM_{2.5}$ average concentrations (measured in $\mu g/m^3$). Here's an interpretation of the plot:

1. **Central Tendency (Median):**
   - The thick horizontal line inside the box represents the median $PM_{2.5}$ concentration, which appears to be around 67 $\mu g/m^3$.
2. **Interquartile Range (IQR):**
   - The box itself spans from the lower quartile (Q1, 25th percentile) to the upper quartile (Q3, 75th percentile), indicating the middle 50% of the data.

- The lower bound (Q1) is approximately 63 µg/m³, and the upper bound (Q3) is around 72 µg/m³.

3. **Whiskers (Min & Max, without outliers):**
   - The whiskers extend to the minimum and maximum values within 1.5 times the IQR from Q1 and Q3.
   - The lower whisker extends to approximately 50 µg/m³, and the upper whisker reaches around 85 µg/m³.
4. **Outliers:**
   - There is a red dot below the lower whisker, indicating an outlier around 42 µg/m³. This suggests that some values are significantly lower than the general trend of the data.

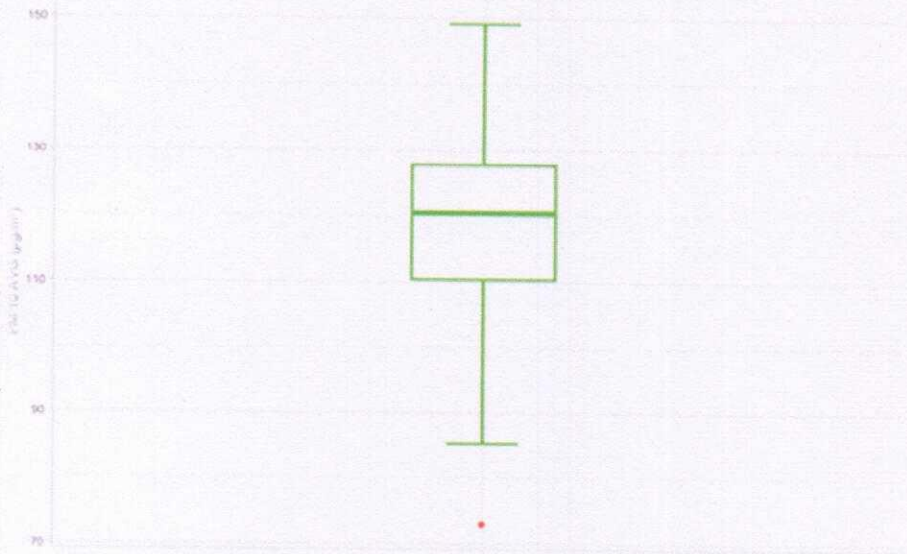


Summary Interpretation:

- The data distribution shows that PM $_{2.5}$ levels mostly range between 63 and 72 µg/m³.
- There is a potential outlier below the lower range, which might indicate an unusual drop in PM $_{2.5}$ levels at some point.
- The overall spread suggests variability, but the concentration levels remain relatively high, indicating potential air quality concerns.

The provided image is a box plot representing the distribution of PM $_{10}$ average concentrations (measured in µg/m³). Here's an interpretation of the plot:

1. **Central Tendency (Median):**
   - The thick horizontal line inside the box represents the median PM $_{10}$ concentration, which is approximately 120 µg/m³.
2. **Interquartile Range (IQR):**
   - The box spans from the lower quartile (Q1, 25th percentile) to the upper quartile (Q3, 75th percentile), indicating the middle 50% of the data.



- The lower quartile (Q1) is around 110 µg/m³, and the upper quartile (Q3) is approximately 130 µg/m³.

3. **Whiskers (Min & Max, without outliers):**
   - The whiskers extend to the minimum and maximum values within 1.5 times the IQR from Q1 and Q3.
   - The lower whisker extends to around 90 µg/m³, while the upper whisker reaches about 150 µg/m³.
4. **Outliers:**
   - There is a red dot below the lower whisker, indicating an outlier around 75 µg/m³. This suggests that some values fall significantly below the main distribution.

Summary Interpretation:

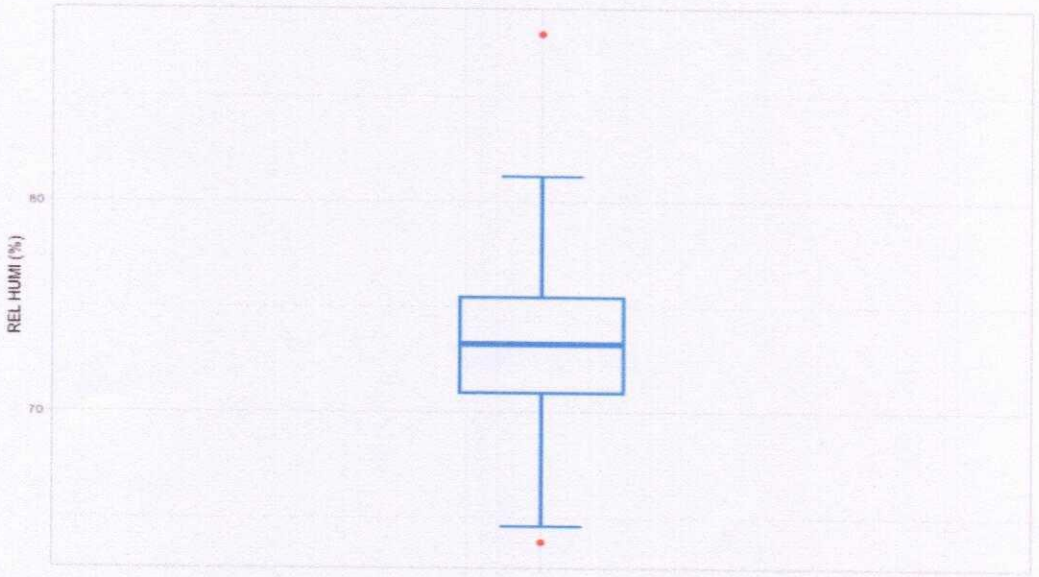
- The data distribution shows that PM_{10} levels mostly range between 110 and 130 µg/m³.
- There is an outlier below the lower range, indicating an unusual low PM_{10} concentration at a certain time or location.
- The overall spread suggests moderate variability, with concentrations generally remaining at elevated levels, which could have potential health implications.

This is a boxplot showing the distribution of relative humidity (REL HUMI %) data. Here's how to interpret it:

1. **Box (Interquartile Range, IQR)**:
   - The blue box represents the interquartile range (IQR), which is the middle 50% of the data.
   - The lower edge of the box is the first quartile (Q1), and the upper edge is the third quartile (Q3).
2. **Median**:

- The horizontal line within the box indicates the median (the 50th percentile) of the data.

3. **Whiskers**:
   - The vertical lines extending from the box (whiskers) indicate the range of data within 1.5 times the IQR below Q1 and above Q3.
4. **Outliers**:
   - The red dots above and below the whiskers represent outliers, which are data points outside the range of 1.5 times the IQR from Q1 and Q3. These are unusual or extreme values.
5. **Range**:
   - The minimum and maximum values of the data (excluding outliers) are represented by the ends of the whiskers.



In this case:

- The relative humidity data is centered between 70% and 80%.
- There are outliers on both ends of the distribution, above 80% and below 70%.

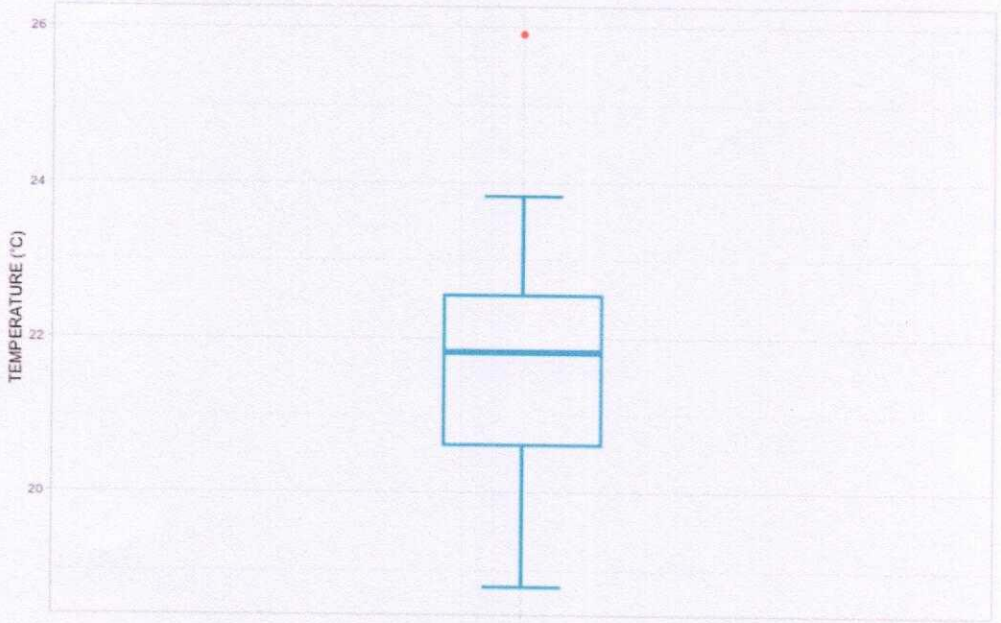
This is a boxplot showing the distribution of temperature (°C) data. Here's how to interpret it:

1. **Box (Interquartile Range, IQR)**:
   - The cyan box represents the interquartile range (IQR), covering the middle 50% of the data.
   - The lower edge of the box corresponds to the first quartile (Q1), and the upper edge corresponds to the third quartile (Q3).

2. **Median**:
    - The horizontal line within the box shows the median temperature (the 50th percentile).
3. **Whiskers**:
    - The vertical lines extending from the box indicate the data range within 1.5 times the IQR below Q1 and above Q3.
4. **Outliers**:
    - The red dot above the whisker represents an outlier, which is a data point outside the range of 1.5 times the IQR from Q1 and Q3. This value is unusually high compared to the rest of the data.
5. **Range**:
    - The minimum and maximum values (excluding the outlier) are represented by the ends of the whiskers.

In this case:

- The temperature data is centered between 21°C and 23°C, with the median close to 22°C.
- There is one outlier above 25°C, indicating an unusually high temperature in the dataset.



The boxplot of temperature data reveals that the majority of the values are distributed between approximately 21°C and 23°C, with a median temperature around 22°C. This

indicates that the central tendency of the dataset lies within this range. The interquartile range (IQR) is relatively narrow, suggesting low variability within the middle 50% of the data. However, the presence of an outlier above 25°C highlights an unusually high temperature that deviates significantly from the rest of the distribution. This outlier may warrant further investigation to determine its cause, such as a recording error or an extreme environmental condition. Overall, the data appears consistent, except for the notable single outlier.

Note:

Report produced by Air Quality Monitoring System Committee

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