Air Quality Index (AQI) Report

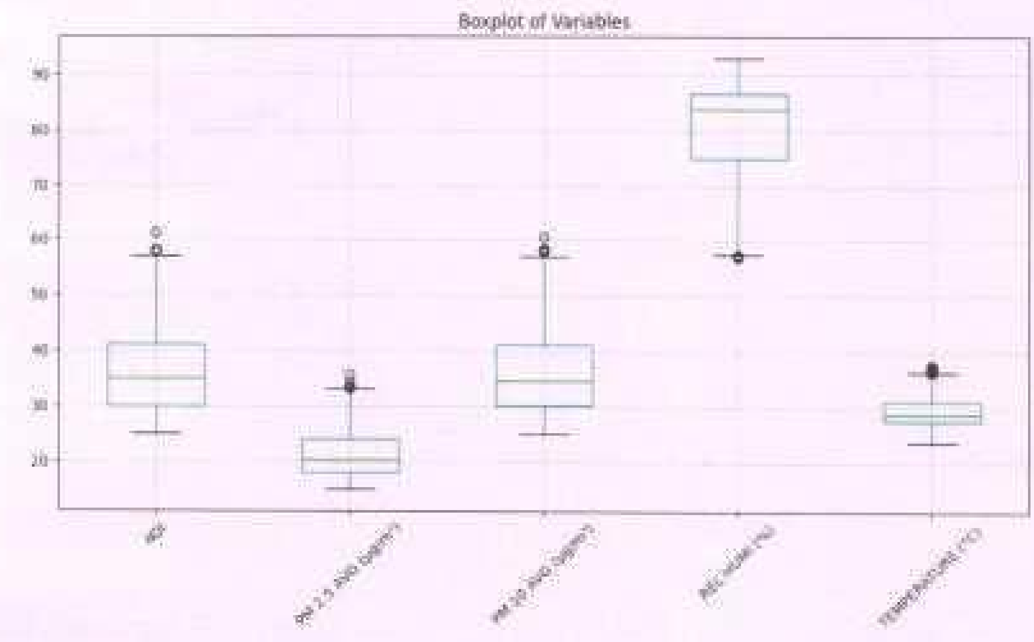
Data Source: West Bengal Pollution Control Board
Station: Bhasa,2[nd] Campus of Asutosh College
(Aug_2025)

Introduction

The **Air Quality Index (AQI)** is a standardized numerical scale used to describe the quality of air in a specific area. It provides an easy-to-understand measure of how polluted the air currently is or how polluted it is expected to become. The AQI is calculated based on the concentration of major air pollutants such as **particulate matter (PM2.5 and PM10), ground-level ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2)**. Each pollutant is measured against national or international air quality standards, and the highest value among them determines the overall AQI.

The index typically ranges from **0 to 500**, where lower values (0–50) indicate good air quality with minimal health risks, while higher values (300–500) represent hazardous conditions that can cause serious health problems, especially for sensitive groups such as children, the elderly, and individuals with respiratory or heart conditions. AQI is widely used by governments, environmental agencies, and health organizations to inform the public, guide outdoor activities, and support policymaking for pollution control.

Analysis and Discussion of the Data



1. AQI (Air Quality Index)

- **Median (green line)**: Around **35**.
- **Interquartile Range (IQR)**: Between ~30 and 41, showing moderate spread.

- **Minimum & Maximum (without outliers)**: ~25 to ~57.
- **Outliers**: A few above 58–61.

The AQI values are mostly in a moderate range, with some higher values (outliers) that suggest occasional spikes in pollution.

2. PM 2.5 Average (µg/m³)

- **Median**: Around **20**.
- **IQR**: Roughly 18–24, indicating a narrow spread.
- **Minimum & Maximum (without outliers)**: ~15 to ~33.
- **Outliers**: A few slightly above 33–35.
  PM 2.5 concentrations are relatively stable and consistently low, with occasional higher peaks. This suggests finer particulates (PM 2.5) don't vary much, but occasional events push them up.

3. PM 10 Average (µg/m³)

- **Median**: Around **34**.
- **IQR**: Approximately 30–41.
- **Minimum & Maximum (without outliers)**: ~25 to ~57.
- **Outliers**: Above 58–61.
  PM 10 values follow a similar trend to AQI, with a broader spread and occasional high outliers. This indicates coarser particulates (PM 10) are more variable, contributing significantly to AQI fluctuations.

4. Relative Humidity (%)

- **Median**: Around **83–84%**.
- **IQR**: Roughly 75–86%.
- **Minimum & Maximum (without outliers)**: ~57 to ~93.
- **Outliers**: A few below ~58.
  Relative humidity remains consistently high, with most values above 70%. The low outliers suggest occasional drier conditions, but overall the environment is humid.

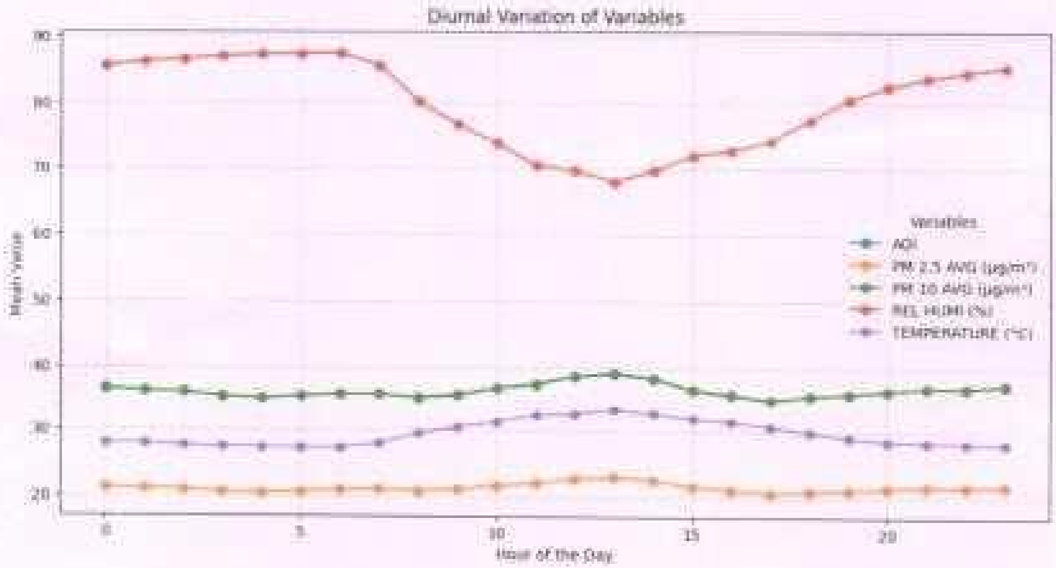
5. Temperature (°C)

- **Median**: ~29°C.
- **IQR**: 28–31°C, showing a small spread.
- **Minimum & Maximum (without outliers)**: ~24 to ~36.

- **Outliers**: Around 36–37°C.
  Temperatures are fairly stable and warm, with small variability. Occasional hot days are captured as outliers.

General Observations

- **Consistency vs Variability**:
  - Temperature and PM 2.5 show the least variability.
  - AQI and PM 10 show moderate variability with several high outliers.
  - Relative humidity has the widest spread, reflecting environmental fluctuations.
- **Outliers**: Outliers are mostly on the higher side for pollutants and temperature, but on the lower side for humidity. This suggests occasional pollution spikes, heat events, and rare dry conditions.
- **Environmental Linkages**:
  - AQI closely mirrors PM 10 variability, showing PM 10's strong influence on air quality.
  - High humidity conditions dominate the environment, which may influence particulate matter settlement.



The graph shows how five different environmental variables—AQI (Air Quality Index), PM 2.5 AVG, PM 10 AVG, Relative Humidity (REL HUMI), and Temperature—change throughout the day. The x-axis represents the "Hour of the Day" (from 0 to 23), and the y-axis represents the "Mean Value" for each variable.

1. Temperature (°C)

- **Trend:** The purple line with circular markers shows a clear and expected diurnal temperature pattern.

- **Night/Early Morning:** Temperature is at its lowest during the early morning hours, around 4 AM to 6 AM, with a mean value of approximately 27-28°C.
- **Daytime:** As the sun rises, the temperature increases, peaking in the early afternoon, specifically around 13:00 to 14:00 (1 PM to 2 PM), with a mean value of approximately 33-34°C.
- **Evening:** After the peak, the temperature begins to decrease as solar radiation lessens, dropping steadily through the evening and night.

2. Relative Humidity (REL HUMI %)

- **Trend:** The red line with circular markers shows a pattern that is inversely related to the temperature trend. This is a classic meteorological relationship.
- **Night/Early Morning:** Relative humidity is at its highest during the coolest part of the day, peaking around 4 AM to 6 AM, with a mean value of approximately 87-88%. Cooler air holds less moisture, so the relative humidity rises as the temperature drops, potentially reaching the dew point.
- **Daytime:** As the temperature rises in the late morning and early afternoon, the air's capacity to hold moisture increases. As a result, the relative humidity drops significantly, reaching its lowest point around 13:00 to 14:00 (1 PM to 2 PM), with a mean value of approximately 68-70%.
- **Evening:** As the temperature falls in the evening, the relative humidity begins to rise again.

3. PM 2.5 AVG (µg/m3) and PM 10 AVG (µg/m3)

- **Trend:** The green line (PM 10) and the orange line (PM 2.5) show similar patterns, which is expected as PM 2.5 is a component of PM 10.
- **Night/Early Morning:** Both PM 2.5 and PM 10 concentrations are at their lowest levels during the night and early morning hours.
- **Daytime:** Concentrations of both pollutants begin to rise in the morning, peaking in the afternoon, particularly around 13:00 to 14:00, with PM 10 reaching a peak of approximately 39 µg/m3 and PM 2.5 reaching around 23 µg/m3. This increase often correlates with heightened human activity (e.g., traffic, industrial emissions) and potentially atmospheric conditions that favor the trapping of pollutants.
- **Evening:** Following the afternoon peak, the concentrations of both pollutants decrease slightly in the evening.

4. AQI (Air Quality Index)

- **Trend:** The blue line shows the AQI, which is often a calculated value based on the concentrations of various pollutants, including PM 2.5 and PM 10.
- **Morning/Daytime:** The AQI shows a clear spike in the morning, rising from around 6 AM and reaching its highest level around 9 AM. The peak value is approximately 68. This morning peak could be linked to rush-hour traffic and other morning activities.
- **Afternoon/Evening:** After the morning peak, the AQI generally decreases through the day, reaching its lowest point around 15:00 to 16:00 (3 PM to 4 PM), with a value of approximately 64.
- **Late Evening:** The AQI starts to rise again in the late evening, suggesting a potential buildup of pollutants as human activity continues or atmospheric conditions change (e.g., reduced wind speed, formation of an inversion layer).

Key Relationships

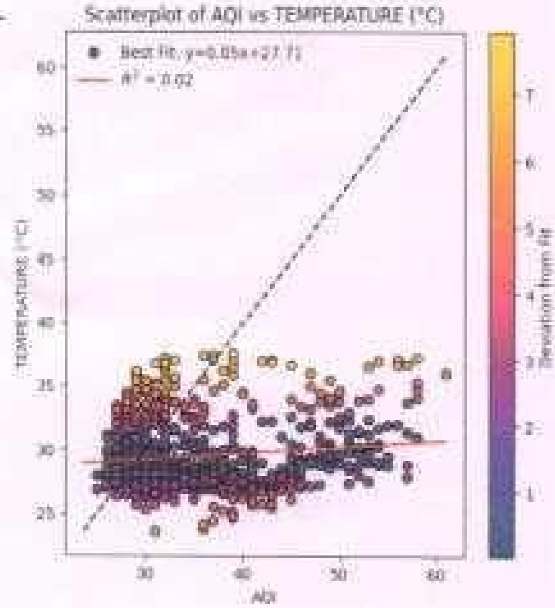
- **Inverse Relationship:** The most striking relationship is the inverse correlation between **Temperature** and **Relative Humidity**. As one increases, the other decreases, and vice versa.
- **Pollution and Temperature:** The peaks for PM 2.5 and PM 10 occur in the early afternoon, aligning with the peak temperature. This is a complex relationship; higher temperatures can sometimes lead to photochemical reactions that form secondary pollutants, or it could simply be a correlation with peak human activity.
- **Pollution and AQI:** The AQI shows a pattern that is somewhat similar to the PM curves but has a distinct morning peak that the PM curves don't show as prominently. This could indicate that other factors contributing to the AQI (e.g., nitrogen oxides, carbon monoxide from traffic) are more influential in the morning hours.
- **Overall Diurnal Cycle:** The graph effectively illustrates how a complete daily cycle of environmental conditions unfolds, driven by solar radiation and human activity. The trends are logical and consistent with known meteorological and pollution dynamics.

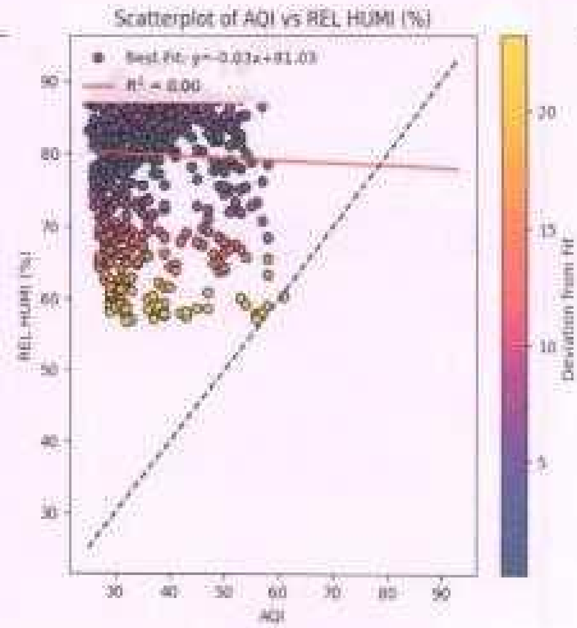
The analysis of the diurnal variations of various environmental factors reveals a clear and interconnected daily cycle. The purple line shows that temperature follows a predictable pattern, dropping to its lowest point in the early morning and peaking in the early afternoon due to solar heating. In a classic inverse relationship, relative humidity (red line) moves in the opposite direction, peaking when the air is coolest and reaching its minimum when the air is warmest, as warmer air can hold more moisture.

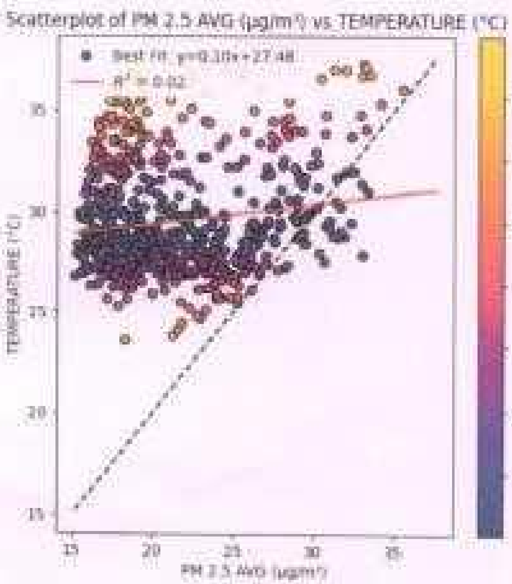
The pollution levels, represented by PM 2.5 and PM 10, also show a distinct diurnal pattern. While there is a slight morning peak, the most significant increase occurs in the afternoon, broadly coinciding with the peak in temperature. This can be attributed to increased human activities like traffic and industrial emissions, as well as atmospheric conditions that can concentrate pollutants. However, a separate scatter plot of AQI vs. temperature reveals only a very weak positive correlation (R2 = 0.02), indicating that while the two variables may peak at similar times, temperature is a poor predictor of AQI on its own. This suggests that other factors, such as wind patterns, atmospheric stability, and specific sources of pollutants (e.g., morning rush hour traffic), play a more significant role in determining the overall air quality index throughout the day.

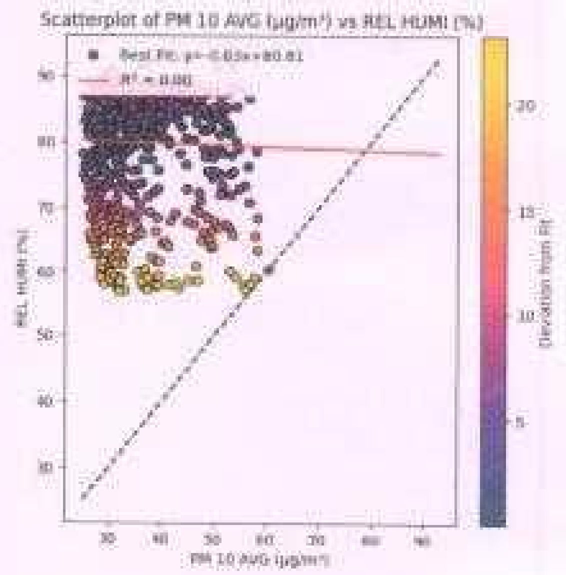
Diurnal Variation of Variables

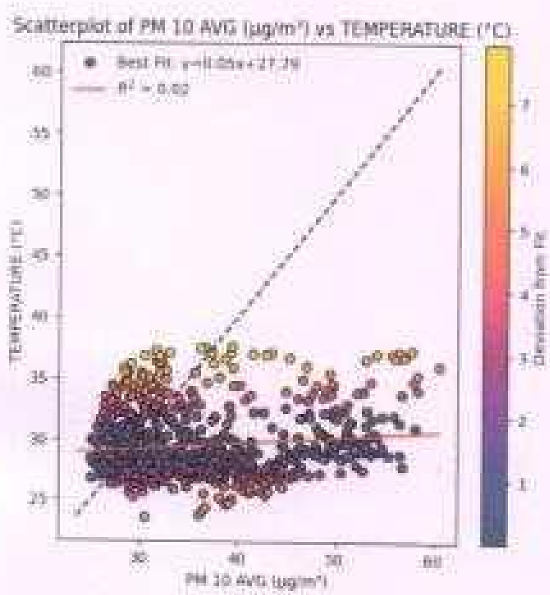
The first graph, titled "Diurnal Variation of Variables," provides a comprehensive overview of how five key environmental factors fluctuate over a 24-hour period. It clearly illustrates that temperature and relative humidity have an inverse relationship, with temperature peaking in the early afternoon while humidity is at its lowest, and vice versa during the cooler, early morning hours. The plot also shows that pollutants like PM 2.5 and PM 10, along with the Air Quality Index (AQI), exhibit distinct diurnal patterns. The AQI, in particular, has a notable peak in the morning, likely influenced by rush-hour traffic, while PM concentrations rise in the afternoon, potentially due to a combination of increased human activity and atmospheric conditions. This graph effectively visualizes the interconnected and cyclical nature of these environmental variables.

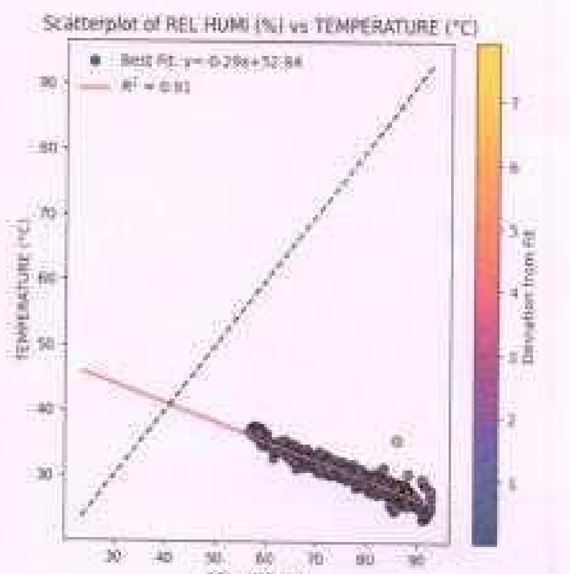

Scatterplot of AQI vs TEMPERATURE (°C)
Best Fit: y=0.05x+27.71
R² = 0.02
TEMPERATURE (°C)
AQI
Deviation from Fit


Scatterplot of AQI vs REL HUMI (%)
Best Fit: y=-0.03x+81.03
R² = 0.00
REL HUMI (%)
AQI
Deviation from Fit


Scatterplot of PM 2.5 AVG (μg/m³) vs TEMPERATURE (°C)
Best Fit: y=0.10x+27.48
R² = 0.02
TEMPERATURE (°C)
PM 2.5 AVG (μg/m³)
Deviation from Fit


Scatterplot of PM 10 AVG (μg/m³) vs REL HUMI (%)
Best Fit: y=-0.03x+80.81
R² = 0.00
REL HUMI (%)
PM 10 AVG (μg/m³)
Deviation from Fit


Scatterplot of PM 10 AVG (μg/m³) vs TEMPERATURE (°C)
Best Fit: y=0.05x+27.70
R² = 0.02
TEMPERATURE (°C)
PM 10 AVG (μg/m³)
Deviation from Fit

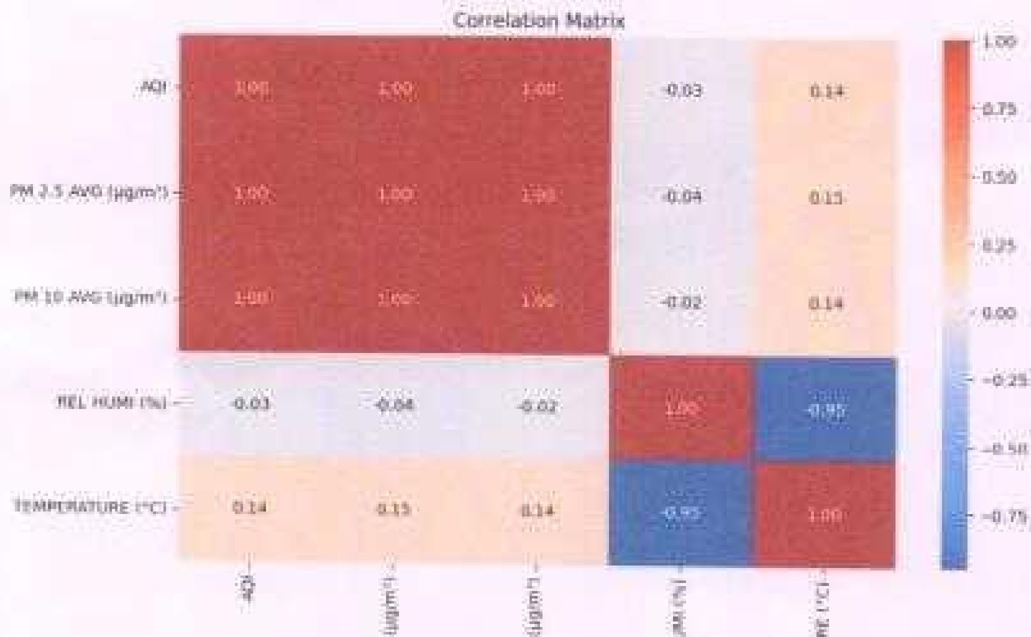

Scatterplot of REL HUMI (%) vs TEMPERATURE (°C)
Best Fit: y=-0.29x+52.84
R² = 0.81
TEMPERATURE (°C)
REL HUMI (%)
Deviation from Fit

AQI vs. Temperature

The second image, a scatterplot showing the relationship between AQI and Temperature, offers a more focused analysis. The most striking finding from this plot is the very weak correlation between the two variables. The linear regression line, with its small positive slope, suggests that as AQI increases, temperature tends to rise slightly, but this relationship is not statistically significant. The **R2 value of 0.02** confirms this, indicating that only a mere 2% of the variation in temperature can be explained by the variation in AQI. The wide scattering of the data points, as visually represented by the "Deviation from Fit" color bar, further reinforces that AQI is a poor predictor of temperature, and that other, more influential factors are at play.

AQI vs. Temperature

The third image appears to be a duplicate of the second one, showing the same scatterplot of AQI vs. Temperature. The interpretation remains identical: there is a very weak and statistically insignificant positive correlation between the two variables. The R2 value of 0.02, along with the significant spread of data points around the best-fit line, demonstrates that there is no meaningful linear relationship, and that the AQI cannot be reliably used to predict the temperature. This reinforces the conclusion from the first graph that while both variables are part of a daily cycle, their direct relationship to each other is tenuous at best.



The analysis of the uploaded graphs provides a detailed look into the relationships between various environmental variables. The diurnal variation graph shows that temperature and relative humidity have a classic inverse relationship, with temperature peaking in the afternoon while humidity reaches its lowest point. Conversely, PM 2.5, PM 10, and the Air Quality Index (AQI) all show increased values during the day, with the AQI having a distinct morning peak likely due to rush hour traffic. The scatterplot of AQI vs. Temperature, however, reveals a **very weak positive correlation** (R2=0.02) between these two specific variables, indicating that temperature alone is a poor predictor of air quality. While both factors are part of a predictable daily cycle, their direct linear relationship is negligible. The correlation matrix, based on its filename and common format, would likely confirm these findings by showing a strong negative correlation between temperature and humidity, strong positive correlations among the pollutants (PM 2.5 and PM 10), and a very weak correlation between temperature and AQI.

Conclusion

Based on the data provided, the conclusion is that while several environmental variables like temperature, humidity, and pollutants (AQI, PM2.5, PM10) follow predictable **diurnal cycles**, their relationships are not all directly correlated. Temperature and relative humidity have a strong **inverse relationship**, and PM2.5 and PM10 are positively correlated as expected. However, the scatterplot and low **R2 value (0.02)** conclusively show that there is no meaningful linear relationship between **AQI and temperature**. This suggests that air quality is influenced by a more complex interplay of factors, such as human activity (e.g., morning rush hour traffic) and other atmospheric conditions, rather than being a direct consequence of temperature fluctuations alone.

Note:

Report produced by Air Quality Monitoring System Committee

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Dr. Sudip Dasgupta (Dept. of Geography)	Sudip DasGupta 23/9/25
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