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CIVE202

Project #1: Written Summary

Introduction:

This project was conducted for the UNMC Water, Climate, and Health Working Group to review public air quality data collected from PurpleAir sensors located throughout Nebraska. The main goal of the project was to observe and analyze trends in air pollution data and determine whether observed pollutant concentrations align with (EPA) and (NAAQS). Being able to understand regional air quality is important in terms of assessing potential public health risks and identifying environmental patterns that may influence pollutant levels.

The scope of work included organizing and cleaning raw sensor data, computing summary statistics for the main pollutants (VOC, PM2.5, and PM10). The SOW also included identifying locations and dates associated with maximum pollution events, and evaluating whether external environmental factors such as humidity and temperature can alter air quality trends. Additionally, the project examined whether pollutant concentrations reached levels associated with (AQI) standards health risk categories. The project's final deliverables included cleaned datasets, an annotated Python analysis code, python summary tables, and a written interpretation of findings.

Methods:

The CSV files used in this project were provided by the client, the data is collected from PurpleAir sensors from the dates Feb. 2024 to Mar. 2025. The procedures used in this project in order to organize data include, column formatting, format missing values, and verifying consistency across sensor records. Cleaned datasets were stored to preserve reproducibility.

This project analysis was done using Python data analysis libraries such as pandas. The CSV data was grouped by the “groupby” function and by sensor location and environmental categories to calculate summary statistics, including mean, median, and maximum pollutant concentrations for VOC, PM2.5, and PM10. Custom categorization functions were written to classify humidity and temperature into ranges requested by the client. These categories allowed comparisons of pollutant behavior under different atmospheric conditions.

Maximum pollution events were identified by filtering records where pollutant values exceeded defined thresholds and locating the associated dates and sensor locations. Additional grouping operations summarized high-risk periods and identified the sensors most frequently associated with elevated readings. AQI thresholds from EPA standards were applied to PM2.5 and PM10 measurements to classify potential health risk conditions.

All analysis steps were documented in an annotated Jupyter notebook to ensure that another analyst could reproduce the workflow and obtain identical results.

Results & Discussion:

The analysis identified interesting variation in pollutant concentrations across Nebraska sensor locations. Some locations consistently exemplified higher mean and median values for PM2.5, PM10, and VOC concentrations, this can support the idea that external environmental/human factors may play a role. Maximum pollution events were associated with specific dates and regions, indicating random spikes rather than uniform statewide exposure. The highest spikes being VOC on 6/24/24 and PM2.5 + PM10 on 2/18/25, this suggests that there might have been a specific event happening on February 18 to cause these spikes. These potential spikes could be caused by wildfires, vehicles, industrial emissions, and agricultural burning. Agricultural burning is a common practice in Nebraska, due to its economy being mainly supported by agriculture. The spikes of pm2.5 and pm10 happened in Richardson County Nebraska, which is notably an area dependent on agriculture, with 78% of its land is dedicated to agriculture itself. The main causes of pollutants such as PM10 and PM2.5 are combustion, wood/agricultural burning, and dust, so these findings can imply these spikes in these specific pollutants are due to agricultural burning.

Humidity and temperature categorization revealed patterns suggesting that atmospheric conditions may influence pollutant behavior. Higher humidity and warmer temperature ranges were occasionally associated with elevated particulate levels. According to Airly.org, humidity can cause air to feel uncomfortable for sensitive respiratory groups, because the air can feel damp. This definition supports the idea that there are many external factors that play into pollutant behavior.

Comparing our data with EPA AQI, the results showed that some readings reached levels considered unhealthy for sensitive groups. While most measurements remained within acceptable ranges, the presence of high-risk periods emphasized the importance of continued monitoring and having the public be notified of these spikes. Overall, the results support the client's goal and request by identifying pollutant risk areas and the causes behind them.

References:

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