Weather Impact on Air Quality

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Introduction

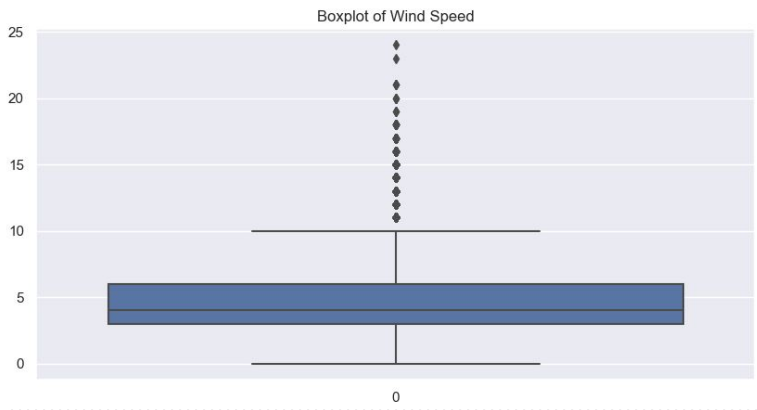
Air quality is a critical aspect of our environment, impacting both human health and climate change. This study investigates the relationship between wind speed and the concentration of nitrogen dioxide (NO_2) in the Netherlands. The research was conducted using data from air quality station NL49014 to measure NO_2 concentrations and weather station with code 240, located 7km away, to record wind speed. The hypothesis is that wind speed affects the concentration of NO_2 in the air, and this study aims to provide insights into this relationship.

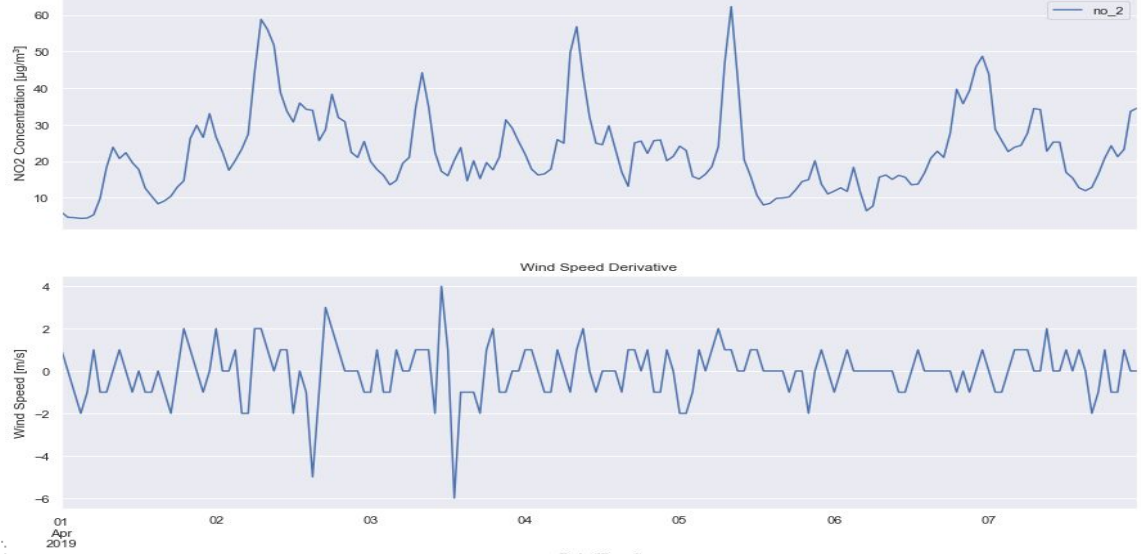
Methods

To investigate the relationship between wind speed and NO2 concentration, air quality and weather data was collected. The weather data was pre-processed and cleaned to extract key specifications like (min, max, mean, median)and identify anomalies. The rate of change of air quality and wind speed was then calculated to determine its effect on NO2 concentration. The Null and Alternative hypothesis were formulated and tested by discretizing the weather data and plotting the Kernel Density and Q-Q plots. Finally, the normality of the weather data was analyzed to validate our hypothesis.

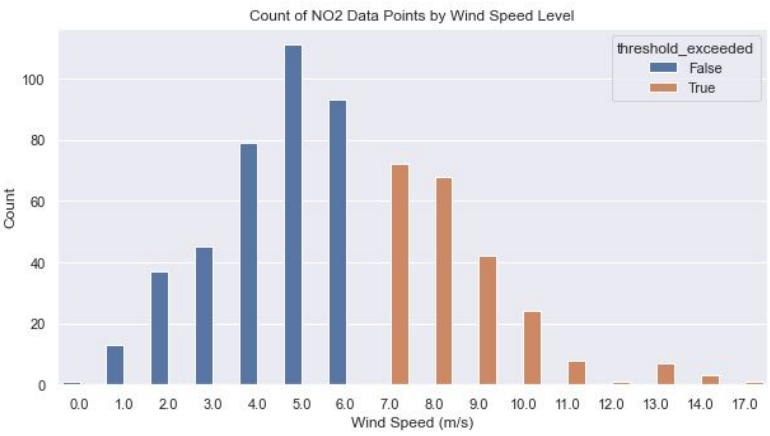
Results

Boxplot used to showcase well distributed wind speed data.

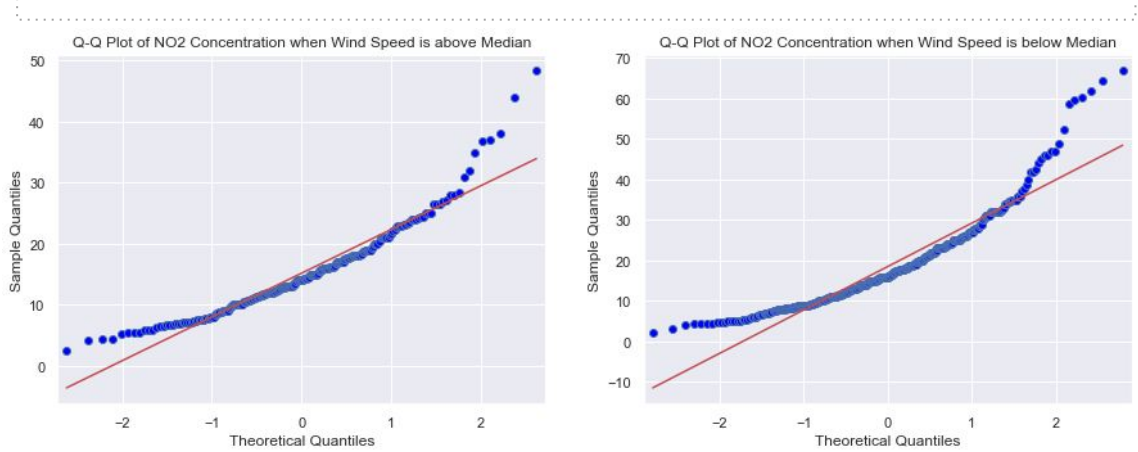




NO_2 Data points count by wind speed, split in a meaningful way after determining a concrete threshold through a kernel density plot.



NO_2 rate of change and wind speed over 7 days have weak correlation, while actual wind speed showed clear correlation. Q-Q plot confirmed abnormality, so the null hypothesis was rejected alternative accepted.



Discussion

Insights into the impact of wind speed on air quality were obtained through the methods applied. The investigation found that the actual levels of wind speed affect air quality more than its rate of change. The t-test resulted in a p-value below 0.05, indicating rejection of the null hypothesis and acceptance of the alternative hypothesis at a 95% confidence level. The concentration of NO_2 decreases with increasing wind speed. The Q-Q plots confirmed abnormality. Limitations include having one measurement location and not conducting diagnostics on regression analysis. Future studies should expand the dataset and explore additional locations to increase the robustness of the conclusions.

Conclusion

The investigation provided insights into the impact of wind speed on air quality, indicating that actual levels of wind speed affect NO_2 concentration more than the rate of change. The t-test results confirmed that higher wind speed leads to lower NO_2 concentration. Limitations include using only one measurement location and not performing diagnostics on regression analysis. Future studies should expand the dataset to improve the robustness of the conclusions. Overall, this study highlights the importance of wind speed in air quality management and provides a basis for further research.