Indoor Air Quality Analysis in Oakridge Oregon

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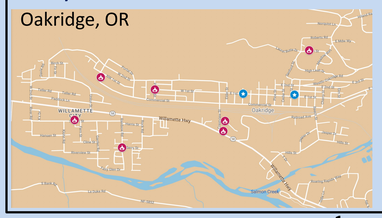
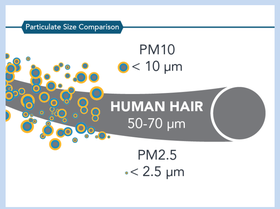
Introduction

Climate change and intense fire seasons in Oregon have worsened air quality, posing health risks to residents. Low-cost PM2.5 sensors monitor indoor air quality in Oakridge, Oregon. Many homes received interventions to improve indoor air quality. This study evaluates these interventions' effectiveness and examines the relationship between outdoor and indoor air quality before and after the interventions. We used statistical methods to analyze the data and present preliminary results of this air quality analysis.





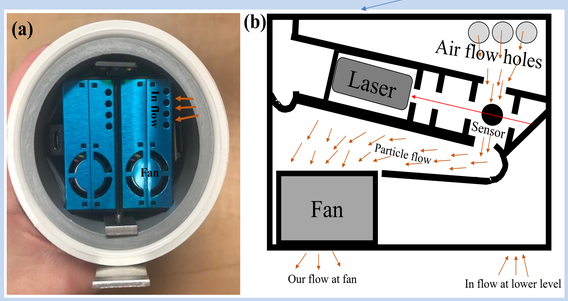
Research Question

How can we determine the efficacy of interventions in improving indoor air quality in homes?

Interventions and Air Quality

- I downloaded data from the Purple air API
- 60-minute averages of PM2.5 CF1 AVG, PM2.5a, PM2.5b, temperature, air pressure and humidity.
- The data I downloaded was collected starting in Jan 2023 and is updated through April 2024
- Factors affecting Indoor Air quality:
  1. Cooking
  2. Smoking
  3. Wildfire Season
- Interventions intended to improve air quality:
  1. Weatherization
  2. Woodstove
  3. Electric Heating

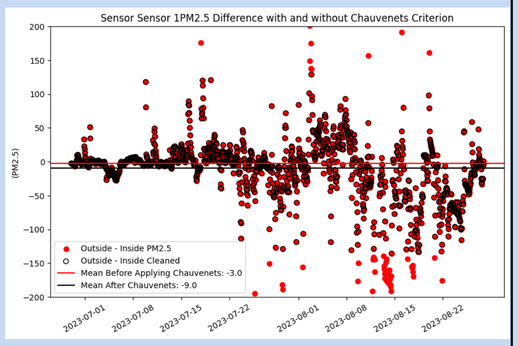
Purple air Sensor Design



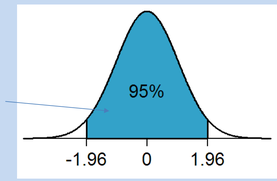
Data Cleaning

- To clean up the data I implemented Chauvenets Criterion
  1. First take a t-test of the point
  2. Determine p value $n * p < 0.5$
  3. If $n * p < 0.5$ data point was removed

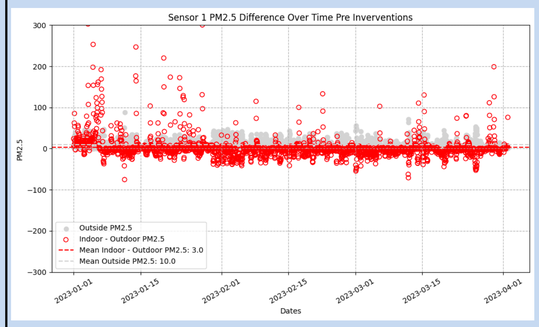
Creates a probability threshold containing 95% of datapoints

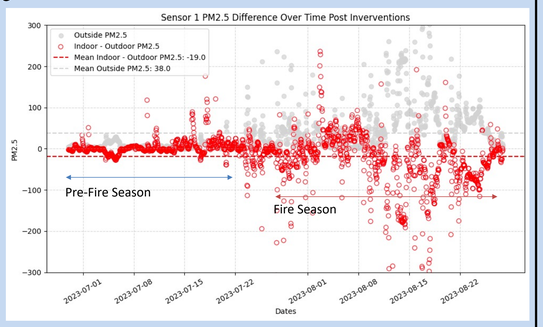


Cumulative Distribution of accepted data



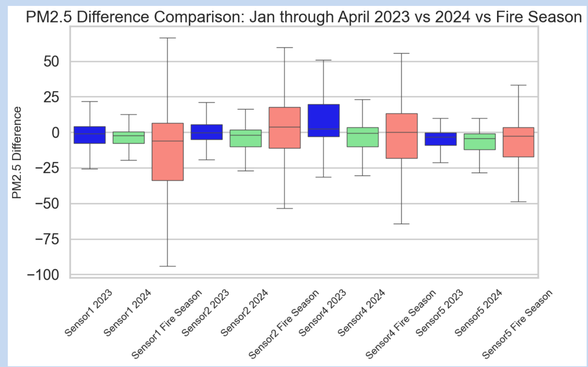
Analysis





- The two main methods used to this point to analyze the data include a basic t-test, and a difference in difference method.
- Both methods attempted to measure how the average indoor air quality changed before and after the interventions were conducted. The first step in analyzing the data was to take the difference $Indoor - Outdoor$ to see how the interventions affected the indoor air quality in relation to the outdoor PM2.5.
- t – test was used to determine the change in the mean
- difference $t\ -stat = \frac{\mu_{post} - \mu_{pre}}{\sqrt{\frac{\sigma^2 pre}{n_{pre}} + \frac{\sigma^2 post}{n_{post}}}},$
- the t-values calculated when the test was applied to the before and after intervention periods was significant (p<.05)
- Higher outdoor PM2.5 time periods after the interventions record a higher difference between indoor and outdoor, which suggests the interventions may be effective at maintaining lower indoor PM2.5 levels during these periods.

Analysis Continued



- The other test I used was a simplified difference in differences. $DID = (\mu_{post} - \mu_{pre})_{Indoor} - (\mu_{post} - \mu_{pre})_{Outdoor}$
- Like a t-test it is intended to determine the change in the mean of a treatment group relative to a control.
- In this case the control was the outdoor sensor, and the indoor sensor was the treatment group.
- This test supports the t-test result in showing that PM2.5 inside increased less relative to the outdoor air quality in higher outdoor air quality time periods such as fire season

Summary and Outlook

In conclusion, more thought is needed to determine the best methods to account for environmental and human factors affecting the indoor data. However, this analysis does suggest that there may be a statistically significant impact of interventions on the air quality.

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Acknowledgments

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