

Extension Plan for Smoke Impact Analysis in Vancouver, WA

This extension plan aims to explore the effects of smoke, particularly on health and economic issues in Vancouver, WA, caused by wildfires. By using existing data from Part-1 of the course project (Common Analysis), this extension seeks to help policymakers and community leaders understand how vulnerable and resilient the community is to smoke exposure.

1. Motivation/Problem Statement

The recent increase in wildfire incidents has raised significant concerns regarding the health and economic impacts on communities, particularly in urban areas like Vancouver, WA¹.

Wildfires generate a complex mixture of harmful pollutants, primarily fine particulate matter (PM_{2.5}), carbon monoxide, and volatile organic compounds, which can severely impact air quality². When these particles are inhaled, they penetrate deep into the lungs, leading to respiratory issues such as irritation of the airways, exacerbation of asthma, chronic bronchitis, and other lung diseases³. Individuals with pre-existing conditions, children, and older adults are particularly vulnerable to these effects. Moreover, the smoke can trigger inflammatory responses in the respiratory system, making it even more difficult for affected individuals to breathe and increasing the likelihood of hospitalizations due to respiratory failure or other complications associated with poor air quality^{4,5}.

Wildfires contribute to unemployment, poverty, and premature deaths through multiple interconnected mechanisms. The destruction of homes and infrastructure leads to job losses in affected areas, particularly in sectors such as construction, tourism, and local businesses that struggle to recover from the economic fallout⁶. Additionally, prolonged smoke exposure results in adverse health outcomes, such as respiratory illnesses, which can increase healthcare costs and lead to greater absenteeism in the workforce⁷. This health impact further exacerbates poverty as affected individuals may face reduced earning capacity and increased financial burdens due to medical expenses. Finally, the combined stress of economic instability and health complications can lead to premature deaths⁸ among vulnerable populations, including the elderly and those with pre-existing conditions.

This analysis aims to understand how smoke from wildfires affects respiratory health outcomes, hospitalization rates, and the economic stability of local industries. By focusing on this issue, we

¹<https://www.forbes.com/sites/jamiehailstone/2024/08/14/wildfires-costing-the-us-89-billion-in-lost-output-study-finds/>

²<https://www.epa.gov/wildfire-smoke-course/health-effects-attributed-wildfire-smoke>

³<https://www.lung.org/blog/how-wildfires-affect-health>

⁴<https://www.yalemedicine.org/news/how-bad-is-wildfire-smoke-for-your-health>

⁵<https://www.cdc.gov/wildfires/risk-factors/index.html>

⁶<https://www.resources.org/common-resources/how-do-wildfires-affect-local-economies/>

⁷<https://doi.org/10.1038/s41612-023-00432-0>

⁸<https://www.theguardian.com/us-news/article/2024/jun/07/california-premature-deaths-wildfire-smoke-study#:~:text=More%20than%2050%2C000%20people%20have,lungs%20and%20enter%20the%20bloodstream.>

seek to provide valuable insights that can facilitate community preparedness, enhance public health responses, and inform city officials about necessary interventions. The goal is to learn about the relationship between increased smoke exposure and its potential consequences on community health and economic activity.

2. Impact Focus

The analysis will concentrate mainly on the following areas:

- **Health Care:** Investigating the correlation between smoke impact and mortality rates due to respiratory diseases, such as asthma and other chronic respiratory diseases.
- **Socio-Economics:** Assessing the effects of smoke on socio-economic factors, specifically focusing on how wildfire smoke exposure contributes to increased poverty levels, unemployment rates, and premature deaths in the community.

3. Data to Be Used

The analysis will utilize several datasets:

- **Respiratory Disease Mortality (IHME):** This dataset provides information on mortality rates due to various respiratory diseases in Clark County, which includes Vancouver.
 - **Description:** Contains data related to various respiratory conditions, categorized by cause and sex for years: 1980 to 2014. The dataset can be accessed from here: <https://ghdx.healthdata.org/record/ihme-data/united-states-chronic-respiratory-disease-mortality-rates-county-1980-2014> and can be further filtered to obtain Clark County, WA.
 - **Columns:** "measure_id", "measure_name", "location_id", "location_name", "FIPS", "cause_id", "cause_name", "sex_id", "sex", "age_id", "age_name", "year_id", "metric", "mx", "lower", "upper"
 - **Access:** The dataset is available in a CSV format. The terms and conditions for using the data from the Institute for Health Metrics and Evaluation (IHME) are governed by the IHME FREE-OF-CHARGE [NON-COMMERCIAL USER AGREEMENT](#). Users are permitted to use, share, modify, or build upon the data for non-commercial purposes. For inquiries related to commercial use, it is advised to refer to the [IHME Terms and Conditions](#). For detailed information, it is recommended to consult the [IHME website](#) directly.
- **Unemployment rate (FRED):** Data from the Federal Reserve Bank of St. Louis Economic Data (FRED) that covers unemployment rates and economic activity in Clark County.
 - **Description:** This dataset includes time series data on unemployment rates (years: 1990 - 2024), which can be correlated with smoke events and economic downturns. The dataset can be accessed from here: <https://fred.stlouisfed.org/series/WACLAR1URN>
 - **Columns:** "DATE", "WACLAR1URN"

- **Access:** The dataset is available in a CSV format and can be used freely. The data is available for public access without any subscription or payment required. When using the data, proper citation of the source is encouraged. It is important to credit FRED as the source of the data. Users are mainly encouraged to use the data for non-commercial purposes. FRED data is typically released under a Creative Commons license which allows for use, sharing, modification, and adaptation as long as appropriate credit is given. For detailed terms, refer to the [FRED website](#).
- **Poverty rate (FRED):** Data from the Federal Reserve Bank of St. Louis Economic Data (FRED) that covers poverty rates (age 0-17) and economic activity in Clark County.
 - **Description:** This dataset includes time series data on poverty rates (years: 1989-2022), which can be correlated with smoke events and economic downturns. The dataset can be accessed from here: <https://fred.stlouisfed.org/series/PPU18WA53011A156NCEN>
 - **Columns:** "DATE", "PPU18WA53011A156NCEN"
 - **Access:** The dataset is available in a CSV format and can be used freely. The data is available for public access without any subscription or payment required. When using the data, proper citation of the source is encouraged. It is important to credit FRED as the source of the data. Users are mainly encouraged to use the data for non-commercial purposes. FRED data is typically released under a Creative Commons license which allows for use, sharing, modification, and adaptation as long as appropriate credit is given. For detailed terms, refer to the [FRED website](#).
- **Premature Death Rate (FRED):** Data from the Federal Reserve Bank of St. Louis Economic Data (FRED) that covers premature death rates in Clark County.
 - **Description:** This dataset includes time series data on premature death rates, which can be correlated with smoke events and economic downturns. The dataset can be accessed from here: <https://fred.stlouisfed.org/series/CDC20N2UAA053011>
 - **Columns:** "DATE", "CDC20N2U053011"
 - **Access:** The dataset is available in a CSV format and can be used freely. The data is available for public access without any subscription or payment required. When using the data, proper citation of the source is encouraged. It is important to credit FRED as the source of the data. Users are mainly encouraged to use the data for non-commercial purposes. FRED data is typically released under a Creative Commons license which allows for use, sharing, modification, and adaptation as long as appropriate credit is given. For detailed terms, refer to the [FRED website](#).
- **Additional Data Sources:**
 - Datasets acquired and developed in Part 1 of the course project (USGS Wildland Fire Combined Dataset with average distance and smoke estimate, Air Quality Index data). For more details, refer to: <https://github.com/parvatijay2901/data-512-project-part1.git>

4. Unknowns and Dependencies

Several unforeseen factors may affect the outcomes of this analysis:

- Access to specific datasets related to smoke events may be limited (we do not have the complete data from 1965 - 2024, and, neither have specific data for Vancouver, WA), making it challenging to draw direct correlations between smoke exposure and health outcomes. The data collected in this step mostly reflects Clark County. Vancouver, WA is a part of this county.
- Economic trends influenced by other variables (e.g., COVID-19 impacts) may confound results, making it difficult to isolate the effect of smoke on hospitalization and loss of revenue.
- Changes in healthcare practices and reporting standards over the years may affect data consistency.

5. Timeline to Completion

1. Data Collection and Preparation
 - a. I have already collected the dataset and tried to acquire the same here:
<https://github.com/parvatijay2901/data-512-project-part2/tree/main/data>
 - b. I will further have to clean and process (merge) the datasets for further analysis.
 - c. **Deadline: November 08, 2024**
2. Model Development and Analysis:
 - a. Modify the existing smoke impact model to include correlations with health and economic data.
 - b. Conduct analysis using time series models to identify trends and impacts.
 - c. **Deadline: November 15, 2024**
3. Visualization and Interpretation:
 - a. Create visualizations to communicate findings effectively.
 - b. **Deadline: November 20, 2024**
4. Documentation and Reporting:
 - a. Prepare a detailed report summarizing methodology, findings, and implications for local policy.
 - i. Prepare a PechaKucha presentation for Course Project Part 3.
 - **Deadline: November 25, 2024**
 - ii. Final Review and Submission.
 - **Deadline: December 02, 2024**