

Extension Plan

Jenny Wong

Problem Statement

The proposed analysis is designed to address the problems impacting our community by the effects of wildfire smoke on urban life. In the previous part of this analysis on wildfires, I developed a predictive time series model for smoke estimation. However, it is not sufficient to merely understand the presence of smoke. This extension plan aims to delve deeper, examining the specific economic impacts of the smoke on Cedar City, Utah. The goals of this analysis are to enhance the understanding of smoke's impact on economic development, refine the initial model to expand its scope, and provide data-driven insights for city stakeholders for informed decision-making.

The analysis is interesting and useful from both scientific and practical perspectives. From a scientific standpoint, the research offers a chance to explore the potential relationships between environmental hazards and their consequences on urban ecosystems. Practically, the analysis is invaluable for city stakeholders, including council members, city managers, and residents. Understanding the specific impacts of smoke on aspects such as public health and economic activities enables the formulation of targeted policies and interventions. This not only helps in reacting to the current challenges but also in proactively designing strategies to mitigate the adverse effects of smoke. Consequently, this analysis is a key tool in enhancing the quality of life in urban areas and facilitating the creation of informed policies.

In this analysis, I aim to uncover several vital insights. I want to comprehensively understand the extent to which smoke affects the social and economic aspects of city life. Alongside this, I hope to discover and evaluate practical measures that can be implemented to protect and enhance the community's well-being, particularly in response to smoke.

Impact focus

The impact focus that I want to focus on is economics. Specifically, I am going to revolve around the crime rate of the city. A study that examined the effect of air pollution exposure on crime in the US over eight years found a robust positive relationship between air pollution and violent crimes, specifically assaults. This study concluded that a 10% increase in PM2.5 exposure was associated with a 0.14% increase in violent crimes, indicative of

aggressive behavior. A similar increase in ozone exposure led to a 0.3% rise in violent crime and a 0.35% increase in assaults (Burkhardt, J.).¹

Wildfire smoke, a complex mixture of gasses and particulate matter, significantly contains pollutants such as PM2.5 and ozone. These pollutants, capable of deep lung and bloodstream penetration, are linked not only to significant health risks but also to an increase in violent behaviors. This connection suggests that the physical and psychological stress induced by exposure to wildfire smoke can exacerbate aggressive tendencies, leading to a notable increase in crimes in areas affected by wildfire smoke (Power, M. C.).² Such findings emphasize the need for comprehensive community response plans that address both health and socio-economic concerns.

Data to be used

In addition to the wildfire data from USGS and air quality data from EPA, the crime data from NIBRS managed by the FBI is used for this extended analysis:

- [NIBRS Crime Data](#)

This crime data is collected by the National Incident-Based Reporting System, a system managed by the FBI Uniform Crime Reporting (UCR) Program, which provides incident-level crime reports across the US (*NIBRS*).³ This comprehensive dataset covered 87 cities in Utah, which includes our city, Cedar City. This database includes crime data from 1993 to 2022 for Utah. For this analysis, I am going to look at the data for Cedar City only. This dataset does not provide specific information regarding the license or terms of use.

Unknowns and dependencies

NIBRS Data Limitation

The wildfire data that I can obtain from USGS is from 1963, while the NIBRS only has data available since 1993. There are 30 years of missing data that I could not make up, and it may impact the prediction accuracy for the model.

Stakeholder Engagement

It is important to align with the stakeholders' needs, ensuring that the analysis meets the expectations of the city council and residents. Misalignment can impact the applicability of the analysis and future policymaking.

¹ <https://doi.org/10.1016/j.jeem.2019.102267>

² <https://doi.org/10.1136/bmj.h1111>

³ <https://www.fbi.gov/how-we-can-help-you/more-fbi-services-and-information/ucr/nibrs>

Timeline to completion

Nov 19 - Data Collection

- Download all crime data from NIBRS for Utah;
- Extract all incidents that happened in Cedar City, and aggregate data to obtain a data table with the number of incidents per year from 1993 to 2022.

Nov 21 - Model Building

- Perform exploratory data analysis and examine the relationship among air quality, wildfire smoke, and crime data;
- Select the variables and refine the initial predictive model.

Nov 23 - Model Analysis

- Design metrics and perform model evaluation.

Nov 25 - Visualization

- Visualize the predictive model and extract insights from the prediction;
- Visualize the crime data with a time series graph, and compare the trend with air quality and smoke estimates.

Nov 30 - Presentation Slide

- Submit the presentation slide for the PechaKucha presentation.

Dec 8 - Documentation

- For this analysis to be reproducible, documentation of all processes needs to be included in a README file;
- The documentation should include:
 - Description of the goal of the analysis;
 - A list of licenses of source data and the link to source data;
 - Link to all relevant data/API documentation;
 - Name and description of the values of all fields for any intermediary and final output data files that the code produces;
 - A list of any known issues or special considerations with the data that would be useful for future reproducibility by other researchers;
 - A LICENSE file.

Dec 12 - Final Report

- Submit the final report and the link to the final repository.

References

- Burkhardt, J., Bayham, J., Wilson, A., Carter, E., Berman, J. D., O'Dell, K., Ford, B., Fischer, E. V., & Pierce, J. R. (2019). The effect of pollution on crime: Evidence from data on Particulate Matter and ozone. *Journal of Environmental Economics and Management*, 98, 102267. <https://doi.org/10.1016/j.jeem.2019.102267>
- NIBRS* — *FBI*. National Incident-Based Reporting System (NIBRS) . (n.d.). <https://www.fbi.gov/how-we-can-help-you/more-fbi-services-and-information/ucr/nibrs>
- Power, M. C., Kioumourtzoglou, M.-A., Hart, J. E., Okereke, O. I., Laden, F., & Weisskopf, M. G. (2015). The relation between past exposure to fine particulate air pollution and prevalent anxiety: Observational cohort study. *BMJ*. <https://doi.org/10.1136/bmj.h1111>