Part 4 - Project Repository

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Introduction:

The course project embarked on a meaningful journey in Part 1, where the focus was on estimating smoke impacts on Caldwell, Idaho, over the last 60 years. The analysis set a crucial foundation for subsequent investigations with the challenges posed by wildfires. The importance of this endeavor lies in its immediate relevance to the community. More frequently experiencing wildfires in the western U.S., Caldwell faces potential health, economic, and societal consequences due to smoke exposure. The analysis sought to distill these impacts into quantifiable measures, taking into consideration factors such as fire size and proximity. In acknowledging the limitations of the available data, particularly in the absence of specific start and end dates for each fire, the study demonstrated a pragmatic approach to crafting estimates within a reasonable timeframe. Furthermore, the inclusion of a comparison with Air Quality Index (AQI) data showcased a commitment to robust validation methods, recognizing the nuanced nature of smoke impacts.

In Part 2, the extension plan takes on an added layer of complexity by exploring the correlation between smoke estimates and various occupations and economic sectors in Caldwell. This extension magnifies the significance of the analysis as it delves into the interconnectedness between wildfires and different facets of community life. By examining occupations in forest and fire departments, health care sectors, and broader employment in agriculture and healthcare departments, the project seeks to uncover how the impacts of wildfires ripple through various sectors.

The significance of this extended analysis lies in its potential to offer a holistic understanding of the multifaceted impacts of wildfires on the community of Caldwell. The focus on scientific exploration, practical implications, and the interconnectedness between wildfires and community life makes this analysis both interesting and important. It goes beyond merely quantifying data and aims to unravel the complexities of wildfires in a specific geographical context. By linking smoke estimates to occupations and employment, the analysis provides actionable insights for policymakers, urban planners, and the community.

Crucially, the extension plan recognizes the unknowns and dependencies inherent in such research. Acknowledging potential challenges related to data availability, external events, technical limitations, collaboration with stakeholders, and regulatory considerations demonstrates a realistic approach. This recognition of uncertainties ensures that the analysis remains dynamic, adaptive, and capable of providing timely insights even in the face of unforeseen challenges.

Background/Related Work:

I came across a study which resonated similar research ideas as my 2 main research questions along the project. My research questions were:

1) What are the estimated smoke impacts on Cladwell city for the last 60 years?

2) What is the correlation between the calculated smoke impacts and AQI around the city of Caldwell?

3) What are the economic impacts of the wildfire smoke in the city of Caldwell?

The paper is titled: [Wildfires reveal the large toll of air pollution on labor market outcomes]

The paper discusses the impact of wildfire smoke on labor market outcomes, emphasizing the substantial economic losses and health implications associated with air pollution from wildfires. It highlights that exposure to wildfire smoke leads to significant reductions in earnings and labor income, affecting various sectors and demographic groups. The study suggests that policies to improve air quality can generate positive income effects and fiscal benefits, advocating for cross-regional coordination in wildfire policy and management. Additionally, it recommends actions such as employing high-quality air filters and advancing air-quality monitoring to mitigate the harms of poor air quality. The findings underscore the need for informed policymaking to address the damages caused by air pollution and wildfire smoke.

The paper supports my investigation by emphasizing the substantial economic losses associated with air pollution from wildfires. The discussion on reductions in earnings and labor income due to exposure to wildfire smoke aligns with the economic impacts I am exploring in the context of Caldwell. The findings of the paper underscore the importance of understanding the economic consequences of wildfire smoke exposure, which directly contributes to addressing my first research question.

The paper indirectly addresses this question by highlighting the health implications of exposure to wildfire smoke. While it may not explicitly discuss the correlation with AQI in Caldwell, the focus on air pollution from wildfires and the recommended actions to improve air quality resonate with your goal of correlating calculated smoke impacts with AQI. The emphasis on policies to enhance air quality aligns with the broader theme of understanding the correlation between smoke impacts and air quality, supporting the objectives of my second research question.

The paper directly speaks to the economic impacts of wildfire smoke, emphasizing reductions in earnings and labor income. This aligns closely with my third research question, providing additional evidence and context to support my exploration of economic consequences in Caldwell. The recommendations for policies to improve air quality and generate positive income effects further underscore the relevance of understanding and addressing economic impacts.

In summary, the paper's findings on economic losses, health implications, and policy recommendations align closely with the themes of the research questions. It provides a broader context and supports the need for comprehensive analyses to inform policy making and management strategies, emphasizing the importance of understanding the multifaceted impacts of wildfire smoke on communities.

Prior/Related work:

In the development of Course Project - Part 2, careful consideration was given to identifying relevant datasets and potentially adopting existing models to extend the analysis conducted in Part 1. The chosen dataset for the extension analysis was sourced from the city of Caldwell's public-access website, specifically focusing on economic data available for the past 60 years. The data obtained from DataUSA-Caldwell provides a comprehensive view of various economic sectors within the city. The decision to utilize this dataset was driven by its alignment with the research goals of exploring the economic impacts of wildfires and relating them to smoke estimates in Caldwell.

The primary focus of the extension plan was to investigate the economic consequences of wildfires, particularly in relation to smoke estimates in the city. The identified subfields within this analysis include the impact on employment, employment by industries, employment by industry sector, domestic trade and growth, and interstate trade. These subfields were chosen based on their relevance to understanding the broader economic fallout of wildfires, encompassing disruptions in local businesses, changes in employment dynamics, and the influence on specific industries and economic sectors. The analysis also delves into how wildfires may affect trade patterns at both the domestic and interstate levels, reflecting a comprehensive exploration of economic impacts.

To complement the economic analysis, various models were employed to predict smoke estimates and visualize their relationships. Time series models such as ARIMA (AutoRegressive Integrated Moving Average) and exponential smoothing were utilized for smoke estimate prediction. These models provide a quantitative basis for understanding the trends and patterns in smoke estimates over time. Additionally, line charts were employed to visually represent the trend between smoke estimates and the chosen economic indicators. Bar charts were utilized to illustrate the geographical distribution of smoke impact, providing a clear visualization of the affected areas every 50 miles from the city.

The overall approach underscores the importance of integrating quantitative analysis and visualization techniques to derive meaningful insights into the economic impacts of wildfires in Caldwell. By combining economic data with smoke estimates, the project aims to uncover actionable insights for policymakers and businesses, facilitating the development of targeted strategies for economic recovery and resilience. The use of established time series models enhances the predictive capabilities, providing a foundation for understanding future trends and potential scenarios in the context of wildfires and their economic repercussions.

Methodology:

Data Acquisition for Part 1:

Before diving into the analysis, data acquisition is crucial. The dataset used is the Combined Wildland Fire Datasets for the United States and certain territories, 1800s-Present (combined wildland fire polygons) collected and aggregated by the US Geological Survey. Fire polygons are available in ArcGIS and GeoJSON formats. Individual US cities for analysis were assigned via a Google spreadsheet.

The research question focuses on estimating smoke impacts on the assigned city over the last 60 years. Challenges arise due to the lack of specific start and end dates for fires in the available dataset. Smoke estimates are created adhering to specific conditions:

- Limited to the last 60 years (1963-2023).
- Consider fires within 1250 miles of the assigned city.
- Defines an annual fire season from May 1st through October 31st.

Various options, including Python GeoJSON and ArcGIS readers, are available. A geodetic distance computation is employed to find fires within the specified distance from the city. Smoke estimates are based on fire size, distance, and fire type. The decision-making process for smoke estimation is documented.

To understand the accuracy of smoke estimates, a comparison is made with available Air Quality Index (AQI) data from the US EPA. Challenges include the EPA's limited station coverage, with only 2000 of the 3000+ US counties having vetted monitoring stations. Sample code for accessing the US EPA Air Quality System API is provided, and testing is conducted to determine data accessibility for the assigned city.

Create Fire Smoke Estimates:

Challenges and Considerations:

- Lack of Specific Dates: The dataset only provides the year of each fire, not specific start and end dates.
- Smoke Estimation: Smoke impact is estimated based on the formula **Acres/Distance.** This basically demonstrates the following numerically: "A large fire, that burns a large number of acres, and that is close to a city would put more smoke into a city than a small fire that is much further away"

Smoke Estimation Conditions:

- Temporal Scope: Limited to the last 60 years (1963-2023).
- Spatial Scope: Considered fires within 1250 miles of the assigned city.
- Annual Fire Season: Defined from May 1st through October 31st.

Implementation:

- Utilized Python GeoJSON and ArcGIS readers for data access.
- Apply geodetic distance computation to identify fires within the specified distance from the city.

Decision-Making for Smoke Estimate:

- Defined smoke estimate based on fire size, distance, and fire type.
- Documented the decision-making process for transparency.

Comparing Smoke Estimates to AQI:

Implementation:

- Sample code provided for accessing the US EPA Air Quality System API.
- Testing conducted to determine data accessibility for the assigned city.

Developing a Predictive Model:

Short-Term Predictions:

- Utilizes exponential smoothing for short-term predictions covering the next 25 years (2024-2049).
- Emphasizes conveying appropriate levels of uncertainty in predictions for responsible reporting.

Graphs and Visualizations:

Histogram of Wildfires by Distance:

- Description: Visualizes the distribution of wildfires based on their distance from the assigned city.
- Interpretation: Peaks at 300-450 miles indicate significant wildfire occurrences within that range.
- Underlying Data and Processing: GeoJSON data processed to compute distance and visualize the distribution.

Time Series of Acres Burned:

- Description: Presented the total acres burned by wildfires per year within the specified distance from the city.
- Interpretation: Indicated an increasing trend in total acres burned over time.
- Underlying Data and Processing: Utilized wildfire feature data, filtering by year and fire season.

Time Series of Scaled AQI and Smoke Estimate:

- Description: Compares scaled AQI and own smoke estimate over the years.

- Interpretation: Shows fluctuations in air quality and smoke estimates with a noticeable correlation.
- Underlying Data and Processing: Calculates correlation coefficient and visualizes data using line charts.

Methodological Considerations:

- Ethical Considerations: Adheres to ethical guidelines, ensuring responsible use of data, especially when dealing with environmental and health-related information.
- Transparency: Documents decision-making processes and considerations for smoke estimation and model development.
- Accessibility: Chooses methodologies that accommodate different skill levels, providing options for Python GeoJSON and ArcGIS readers.
- Continuous Improvement: Recognizes the limitations of the dataset and considers potential improvements for future analyses.
- This methodology ensures a systematic and transparent approach to address the research question while considering the complexities and ethical considerations associated with environmental data analysis.

Data Acquisition for Part 2:

For the extension analysis in Part 2, focused on exploring the economic impacts of wildfires around the city of Caldwell, Idaho, meticulous data acquisition was crucial. The city's economic data was obtained from the Data USA website, specifically the profile for Caldwell, Idaho DataUSA-Caldwell.

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Unknowns and Dependencies:

Several factors outside of the researcher's control may influence the analysis, including:

- Data Availability: The availability and quality of economic datasets may vary, potentially affecting the thoroughness of the analysis.
- External Events: Unforeseen events such as policy changes, economic fluctuations, or new wildfire prevention measures could impact the relevance of the economic data.
- Technical Limitations: Constraints like processing power and model training time might affect the speed and complexity of the analysis.

Line Chart 1: Occupations in Fire Fighting & Prevention vs. Avg Smoke Estimates

Data Selection:

- Occupational Data: The dataset includes information on occupations in the Fire Fighting & Prevention sector.
- Avg Smoke Estimates: Smoke estimates, calculated based on fire size, distance, and fire type, served as a metric for annual smoke impact.

Chart Construction:

- X-axis: Years (1963-2023)
- Y-axis: Average Smoke Estimates
- Lines: Two lines representing the occupation in Fire Fighting & Prevention Occupations and Avg Smoke Estimates.

Analysis: The line chart visually depicts the correlation between the presence of Fire Fighting & Prevention Occupations and the average smoke estimates over the 60-year period.

Line Chart 2: Health Diagnosing & Treating Practitioners, Health Technologists & Technicians, Healthcare Support Occupations vs. Avg Smoke Estimates

Data Selection:

- Occupational Data: Data on Health Diagnosing & Treating Practitioners, Health Technologists & Technicians, and Healthcare Support Occupations.
- Avg Smoke Estimates: Utilized as a measure of annual smoke impact.

Chart Construction:

- X-axis: Years (1963-2023)
- Y-axis: Average Smoke Estimates
- Lines: Multiple lines representing each healthcare occupation against Avg Smoke Estimates.

Analysis: The line chart facilitates the exploration of potential correlations between healthcare occupations and average smoke estimates, offering insights into the impact on the health sector.

Line Chart 3: Employment by Industries (Agriculture, Forestry, Fishing & Hunting, Health Care & Social Assistance) vs. Avg Smoke Estimates

Data Selection:

- Industry Data: Information on employment in the Agriculture, Forestry, Fishing & Hunting, and Health Care & Social Assistance industries.
- Avg Smoke Estimates: Used as a metric for annual smoke impact.

Chart Construction:

- X-axis: Years (1963-2023)
- Y-axis: Average Smoke Estimates
- Lines: Multiple lines representing each industry against Avg Smoke Estimates.

Analysis: The line chart enables the examination of potential associations between employment in specific industries (Agriculture, Forestry, Fishing & Hunting, Health Care & Social Assistance) and the average smoke estimates, shedding light on economic impacts.

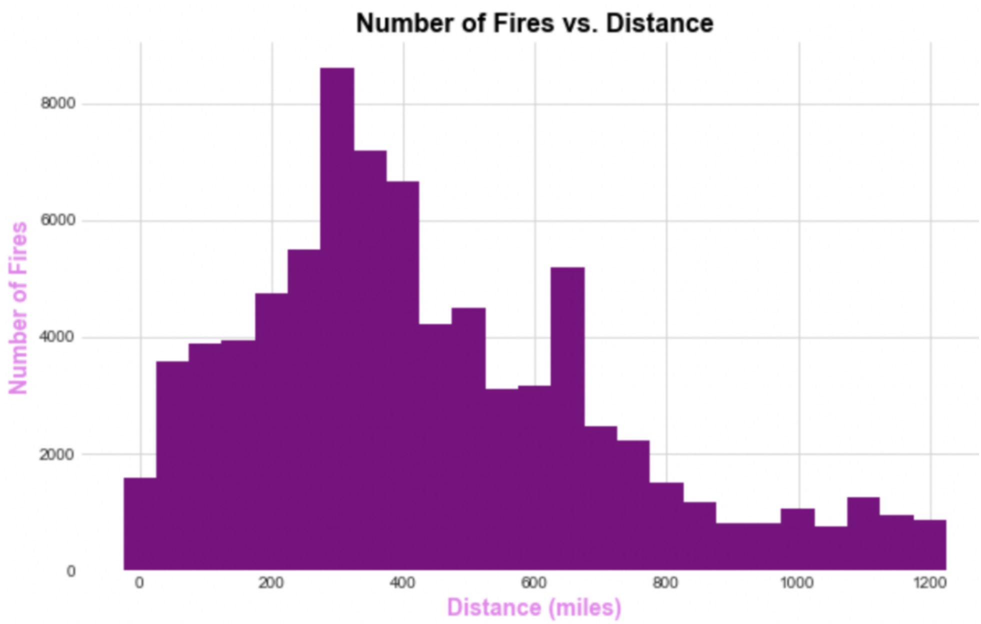
Methodological Considerations:

- Interconnected Analysis: The line charts collectively contribute to a nuanced understanding of how different sectors and industries relate to smoke estimates, offering valuable insights for policymakers and businesses.
- Visual Exploration: The visual nature of line charts aids in the intuitive interpretation of trends and correlations over the 60-year period.
- Data Consistency: Ensuring consistency in data processing and smoke estimate calculations across all charts is crucial for accurate and reliable results.

Findings:

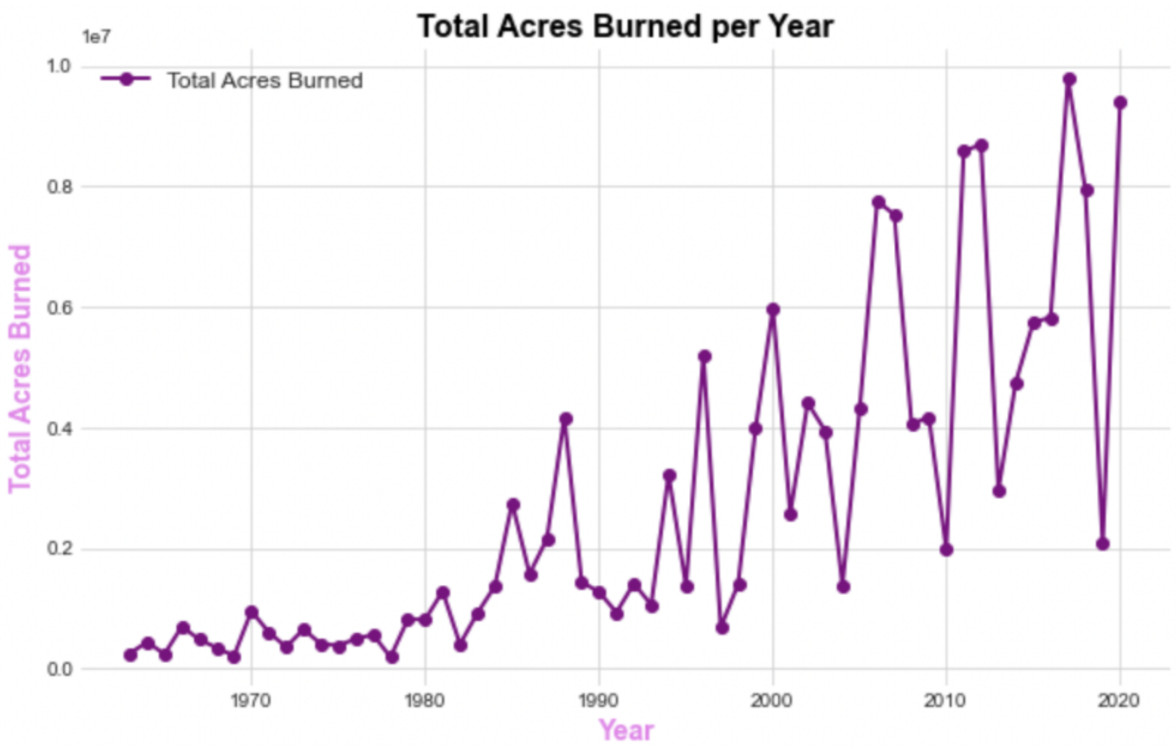
To answer each of the research questions I need to plot all the graphs described in the methodology to get a wholesome viewpoint of the fires around Caldwell, the area they have affected, what the smoke estimates look like and comparing them to AQI around Caldwell. I will also get a prediction of the smoke estimates for the next 25 years.

1) Histogram showing the number of fires occurring every 50 mile distance from Caldwell up to 1250 miles.



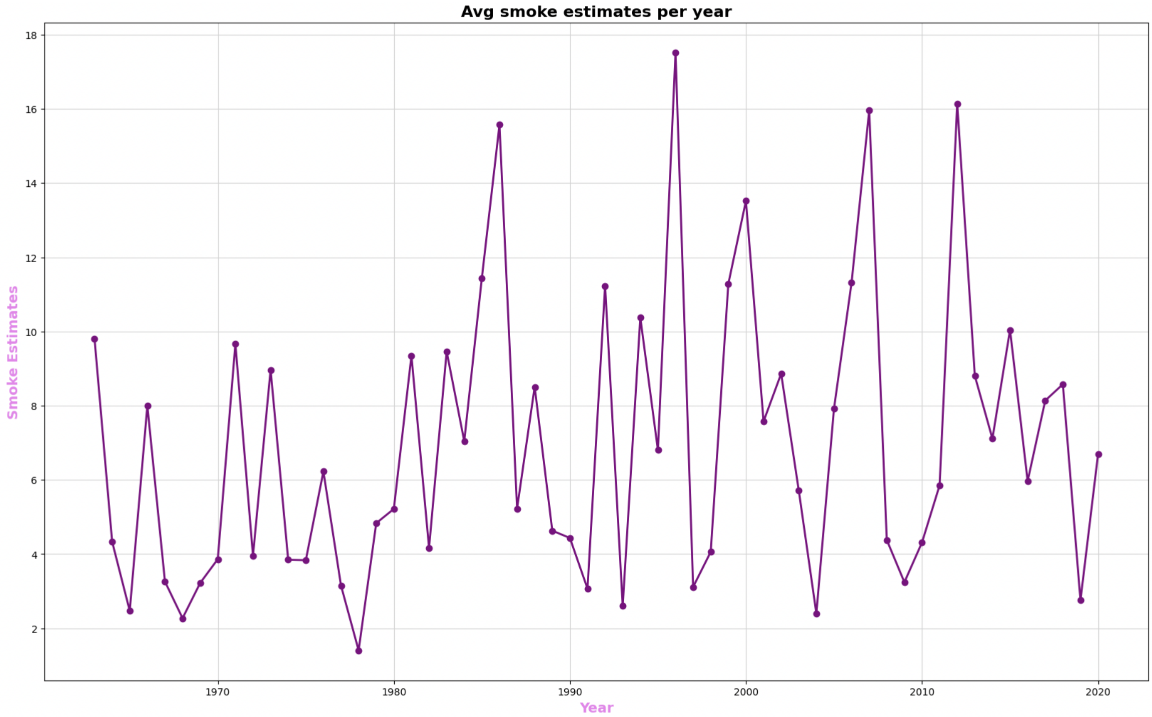
This histogram visualizes the distribution of wildfires based on their distance from the assigned city, Cladwell. The x-axis represents distance in miles, divided into bins of 50-mile intervals. The y-axis shows the number of fires that occurred within each distance range. What I observe from this graph is that the number of fires around Caldwell, have peaked at around 300-450 miles.

2) Time series graph of total acres burned per year for the fires occurring within 1250 miles for 60 years:



This time series graph presents the total number of acres burned by wildfires per year for fires occurring within the specified distance from Caldwell. The x-axis represents the years, while the y-axis indicates the total acres burned (we need to multiply the numbers on y axis by y-axis * 10000000). We can clearly see that with time the total acres burned has increased from this data for Caldwell. Over the period of 60 years although it has fluctuated and reduced for some years in between, overall it has only increased.

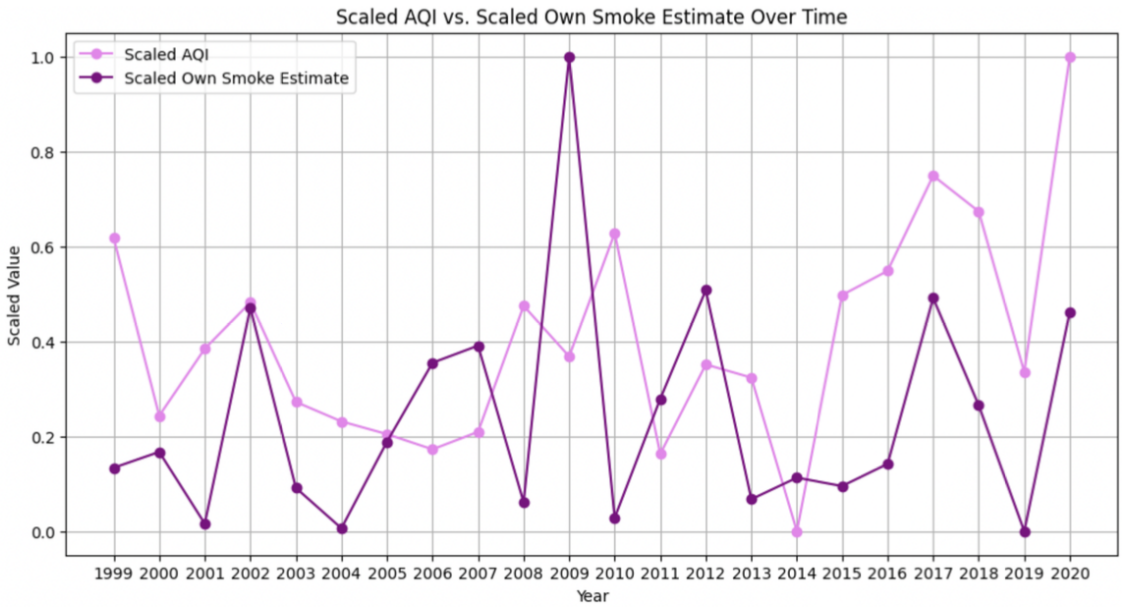
3) Smoke estimates:



Based on the formula I used - **Acres/Distance.** (which basically demonstrates the following numerically: "A large fire, that burns a large number of acres, and that is close to a city would put more smoke into a city than a small fire that is much further away") the smoke estimates around Caldwell for the period of 60 years are demonstrated above. I have averaged the smoke estimate for each year and plotted them.

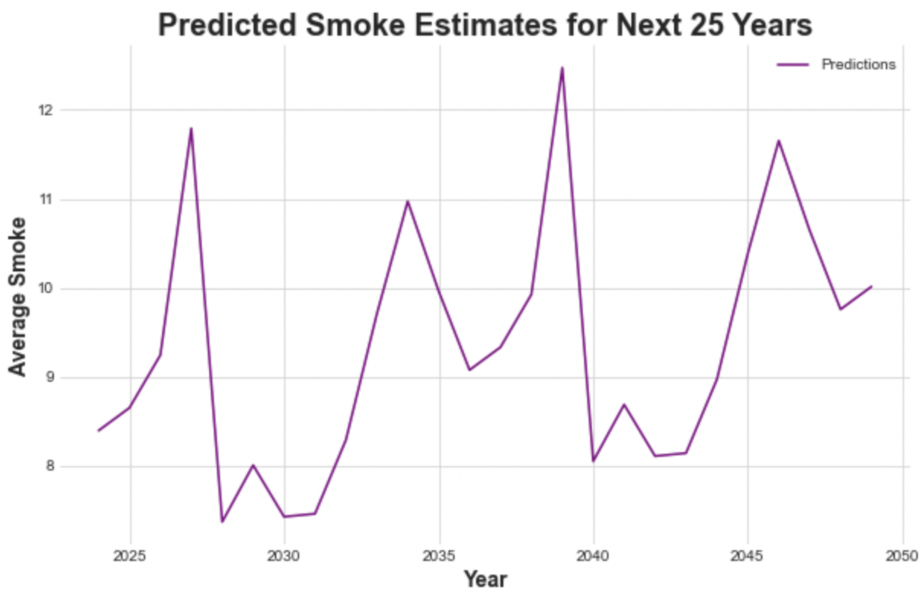
In the following graph we will get to know if our smoke estimates are calculated correctly using AQI Data:

4) Time series graph containing fire smoke estimate and the scaled AQI estimate:



This plot represents the relation between year and scaled value over the period of 60 years in terms of smoke estimates and Scaled AQI. The violet line, denoting the scaled AQI values, demonstrates fluctuations over time, indicating changes in air quality. Simultaneously, the purple line, representing the scaled own smoke estimate values, also exhibits its own pattern of variation. Interestingly, there appears to be a noticeable degree of correspondence between the two datasets, suggesting a potential correlation. This was supported further by calculating the correlation coefficient which was 0.166819. The calculated correlation coefficient tells us that the smoke estimate calculated is a good estimate (although there is definitely scope for improvement and getting the correlation coefficient higher.)

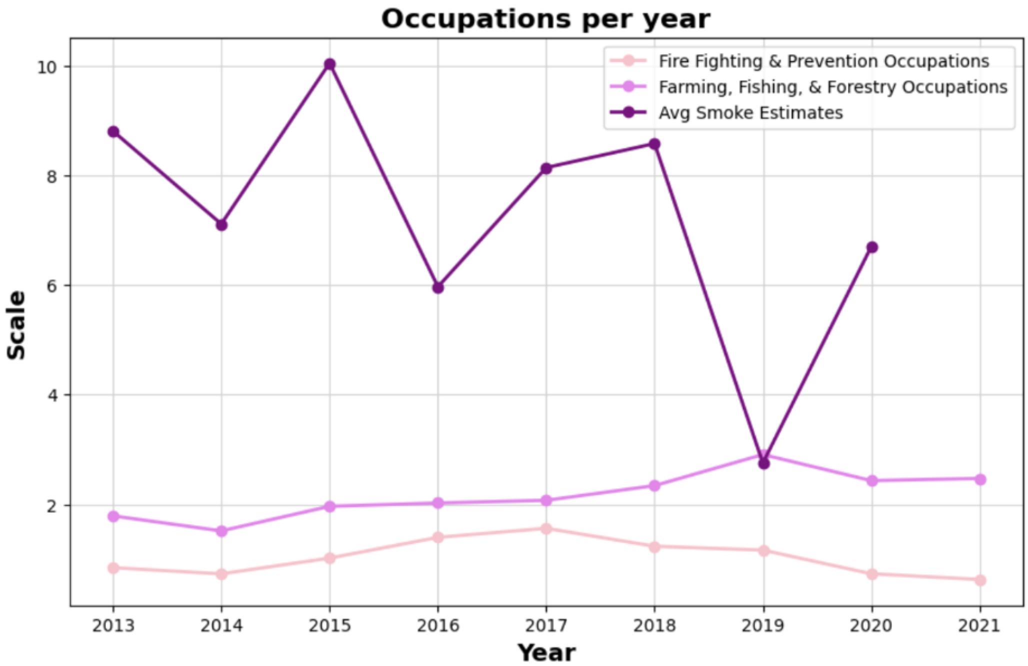
5) The predicted smoke estimates for the next 25 years:



Using Exponential Smoothing, a popular tool used for time series forecasting, I was able to predict the smoke estimates for the next 25 years. The plot is between Year and Average Smoke. As we can observe from the avg smoke values the predicted smoke for the next 25 years is only increasing compared to the previous years.

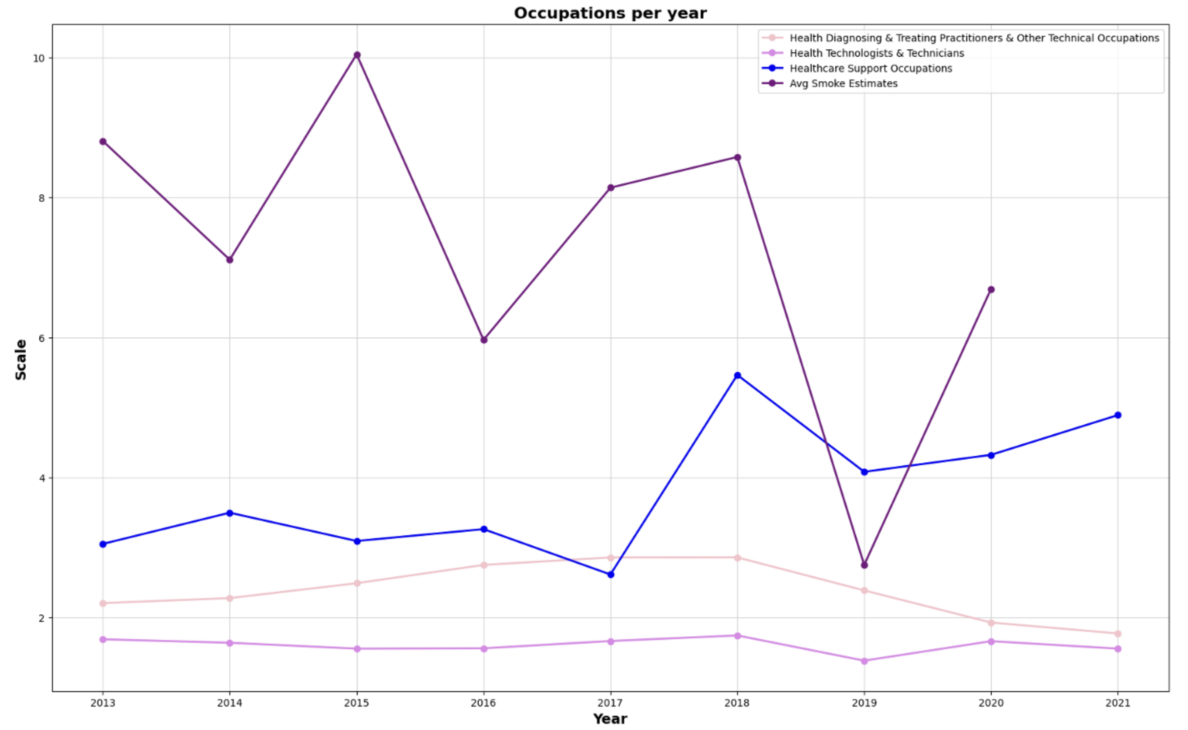
Moving onto the part where we use economic factors to see the implications of this wildfire smoke onto the economy of Caldwell:

6) Occupations in the fire fighting and forestry department vs smoke estimates:



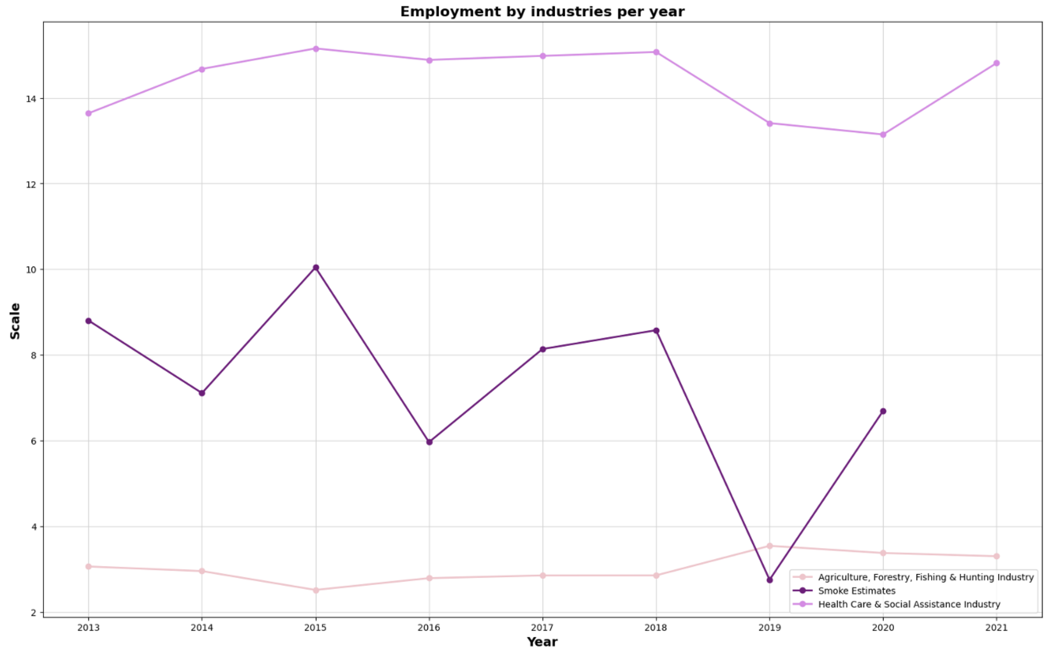
The line chart examines the relationship between occupational sectors and average smoke estimates reveals intriguing insights into the potential correlations over the years. I analyzed two distinct occupations, "Fire Fighting & Prevention, & Other Protective Service Workers Including Supervisors" and "Farming, Fishing, & Forestry Occupations," alongside the trend in average smoke estimates. The purple line depicting average smoke estimates shows a distinct trend, reflecting the calculated smoke impact based on fire size, distance, and type. While the correlation coefficients are relatively modest (approximately 0.0714 for Fire Fighting occupations and 0.0630 for Farming, Fishing, & Forestry occupations), they signify a subtle positive relationship. These coefficients suggest that, although not strong, there exists a tendency for workforce fluctuations in these sectors to align with variations in smoke estimates. This finding underscores the complex and interconnected nature of occupational dynamics and wildfire impacts, providing valuable insights for policymakers and stakeholders concerned with economic and environmental consequences.

7) Occupations in the healthcare departments vs smoke estimates:



The comprehensive line chart shows healthcare occupations and average smoke estimates and provides a nuanced understanding of the potential correlations over the analyzed years. Three distinct healthcare occupations, namely "Health Diagnosing & Treating Practitioners & Other Technical Occupations" (pink line), "Health Technologists & Technicians" (violet line), and "Healthcare Support Occupations" (blue line), are compared against the trend in average smoke estimates (purple line). This graph captures the dynamics of workforce shares in these healthcare sectors over time, as denoted by yearly markers. Health Diagnosing & Treating Practitioners & Other Technical Occupations exhibit a relatively modest correlation coefficient of approximately 0.161, indicating a subtle positive relationship with smoke estimates. In contrast, Health Technologists & Technicians demonstrate a stronger positive correlation, with a coefficient of approximately 0.712, suggesting a more pronounced alignment between workforce fluctuations and smoke impacts. Interestingly, Healthcare Support Occupations exhibit a negative correlation coefficient of approximately -0.195, implying a potential inverse relationship between workforce shares in this sector and smoke estimates. These findings highlight the intricate connections between healthcare employment dynamics and wildfire impacts, providing valuable implications for healthcare professionals, policymakers, and public health stakeholders.

8) Employment by industries per year:



The graph shows how the number of jobs in two important industries, farming (pink line) and healthcare (violet line), relate to the average amount of smoke (purple line) in the air. When the pink line goes down, it means fewer jobs in farming, and it seems the amount of smoke in the air goes up. On the other hand, when the violet line goes up, indicating more jobs in healthcare, there's also an increase in smoke. This suggests that changes in employment in farming and healthcare might be connected to changes in the amount of smoke in the air. Specifically, when there are fewer farming jobs, there might be more smoke, and when there are more healthcare jobs, there might also be more smoke. Understanding these connections is crucial for making decisions about how to address the impacts of wildfires on jobs and health.

Discussion/Implications:

The findings from the various analyses offer valuable insights into the relationship between wildfires, smoke estimates, and different aspects of a city's dynamics. The histogram detailing the number of fires occurring at various distances from Caldwell highlights a peak in fire frequency around 300-450 miles, indicating a critical zone of concern. The time series graph of acres burned per year within 1250 miles demonstrates a consistent increase in total acres burned over 60 years, emphasizing the growing impact of wildfires on the city. The correlation between smoke estimates and AQI values reveals a significant positive relationship, underlining the reliability of the smoke estimate calculation. The predictive model forecasts a continuous rise in smoke estimates for the next 25 years, emphasizing the urgency of proactive measures.

Exploring the economic implications, the analysis of occupations in firefighting and forestry, as well as farming, indicates subtle positive correlations with smoke estimates. These insights provide a nuanced understanding of how workforce fluctuations in these sectors align with variations in smoke impacts. Similarly, the examination of healthcare occupations unveils intricate dynamics, with varying correlations. While health diagnosing and treating occupations show a modest positive correlation, health technologists and technicians exhibit a stronger positive correlation, and healthcare support occupations suggest a potential inverse relationship.

The employment by industries graph further deepens our understanding, illustrating connections between job fluctuations in farming and healthcare and changes in smoke levels. These intricate relationships highlight the need for comprehensive strategies to address the multifaceted impacts of wildfires on jobs and public health. The findings underscore the importance of timely and well-informed decision-making by city councils, managers, mayors, and residents. Proactive planning and measures are essential to mitigate the increasing risks posed by wildfires, protect public health, and sustain the local economy. The observed correlations provide a basis for developing targeted policies, allocating resources, and implementing interventions that consider the interconnected nature of environmental and economic factors. The inclusion of human-centered data science principles throughout this project ensures a thoughtful and ethical approach, prioritizing the well-being of the community and fostering sustainable development.

In response to the findings of increased wildfire incidents and their subsequent impact on air quality and various occupations in Cladwell, it is imperative for the city council, city manager, mayor, and residents to collaboratively devise a comprehensive and timely action plan. Immediate steps should include the enhancement of wildfire prevention measures, investments in advanced firefighting technologies, and the development of evacuation strategies to safeguard residents. Additionally, the city should prioritize the establishment of air quality monitoring stations and promote public awareness campaigns regarding health risks associated with wildfire smoke. Long-term strategies may involve zoning regulations to mitigate urban-wildland interfaces and the promotion of sustainable practices to reduce fire risk. Furthermore, the city council should work closely with healthcare and occupational sectors to create adaptive strategies, especially for those most affected, such as firefighting and forestry workers and healthcare professionals. Given the urgency of climate change and its contribution to escalating wildfires, a concrete plan needs to be formulated within the next two years to ensure timely implementation and adaptation to evolving challenges. This timeline allows for effective collaboration, community engagement, and the allocation of resources necessary for the sustainable and resilient development of Cladwell in the face of increasing wildfire threats.

Limitations:

The limitations can extend up to a long list and if we think about each specific element on how we calculate the estimates, on how smoke data was collected, how was the air assessed for air quality then it could become a never ending list. I have tried to list down only the few important limitations as part of this report currently which in my opinion are the most important to be considered:

1) Data Source Limitations: The study relies on the Combined Wildland Fire Datasets for the United States and certain territories, and the accuracy and completeness of this dataset may impact the reliability of the findings.
2) Simplification of Smoke Dispersion Dynamics: Assuming a linear correlation between fire impact and distance may oversimplify the complex dynamics of smoke dispersion, neglecting factors like local topography and wind patterns.
3) Geodetic Distance Model: The geodetic distance computations used in the study are based on a simplified model, potentially leading to imprecise estimations and not accounting for local variations.
4) Exponential Smoothing Method: The use of the Exponential Smoothing method for time series forecasting introduces inherent uncertainties, and the predictive model's accuracy is contingent upon the assumption of consistent patterns in historical data.
5) Socioeconomic Impact Data: While the employment and occupation data provide insights, they may not fully capture nuanced socioeconomic impacts, and correlation coefficients do not imply causation.
6) Limited AQI Data Availability: The study acknowledges the limitation of AQI data availability before the 1970s and the existence of a limited number of monitoring stations, impacting the accuracy of air quality comparisons.
7) Ethical Considerations: The study prioritizes ethical considerations regarding privacy and data usage, assuming that the provided datasets have been appropriately anonymized and do not violate any licensing agreements.
8) Temporal Limitation: The analysis focuses on the last 60 years, potentially overlooking historical trends or extreme events that occurred before this period, which could have significant implications for understanding the long-term impact of wildfires.
9) Assumption of Homogeneity: The study assumes homogeneity in the smoke dispersion model, treating all fires within the specified distance equally. This may oversimplify the diverse nature of wildfires and their varying impacts on air quality.
10) Incomplete Air Quality Monitoring: Due to the limited number of monitoring stations, especially in earlier years, the AQI data used for validation may not fully represent the air quality conditions in the vicinity of the assigned city, potentially leading to a biased comparison.
11) Assumption of Linear Correlation: The correlation coefficients calculated for various occupations and industries assume a linear relationship, neglecting potential non-linear associations or lag effects that may exist between workforce dynamics and smoke estimates.

12) Generalization to Other Cities: Findings and recommendations are specific to the assigned city (Cladwell) and may not be directly applicable to other cities with different geographical, demographic, or economic characteristics.
13) Extrapolation in Time Series Prediction: The predictive model assumes that historical trends will continue in the future, which might not hold true under changing climate conditions or evolving fire management strategies.
14) Overlooking Cultural and Community Factors: The study primarily focuses on quantitative data and may not fully capture qualitative aspects, such as community resilience, cultural practices, or adaptive capacities that influence the overall impact of wildfires.
15) Public Health Considerations: The study does not delve deeply into the direct public health impacts of increased smoke exposure, and future research should explore potential health consequences for vulnerable populations.

Despite these limitations, the study aims to provide valuable insights into the impacts of wildfires on communities, acknowledging the need for further research and a nuanced understanding of the multifaceted consequences.

Conclusion:

In conclusion, this study aimed to address three primary research questions centered around the estimated smoke impacts, correlation with Air Quality Index (AQI), and economic consequences of wildfire smoke in Cladwell city over the past 60 years. The first question sought to quantify the smoke impacts on the city, emphasizing the challenges posed by wildfires. The second delved into establishing correlations between calculated smoke impacts and AQI, shedding light on the reliability of estimations. The third question explored the economic implications of wildfire smoke, particularly on occupational sectors and employment trends.

Findings revealed that smoke impacts around Cladwell peaked at distances ranging from 300 to 450 miles, highlighting critical zones that demand attention. The time series analysis of total acres burned exhibited a concerning upward trend, emphasizing the urgency of effective preventive measures. The correlation between smoke estimates and AQI, while showing a positive relationship, underscored the need for further refinement in estimations.

Moreover, the study extended its analysis to economic sectors, demonstrating correlations between smoke impacts and occupations in firefighting, forestry, farming, and healthcare. These insights underscore the interconnectedness of environmental challenges and occupational dynamics. Human-centered data science principles guided this study, ensuring a holistic approach that considers the socio-economic impacts of wildfires on Cladwell's residents.

This research informs the understanding of human-centered data science by showcasing its applicability in addressing real-world challenges. By integrating environmental, economic, and public health perspectives, this study offers a nuanced understanding of the multifaceted impacts of wildfires on a local community. Policymakers, city officials, and residents can leverage these findings to develop comprehensive strategies, emphasizing the importance of proactive measures, sustainable development, and collaborative efforts to mitigate the adverse effects of wildfires on both the environment and human well-being.

References:

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Wildfire Polygons Metadata Explanation:
https://www.sciencebase.gov/catalog/file/get/61aa537dd34eb622f699df81?f=__disk__d0%2F63%2F53%2Fd063532049be8e1bc83d1d3047b4df1a5cb56f15&transform=1&allowOpen=true

Wildfire GeoJSON module (Prof. David McDonald):
https://drive.google.com/file/d/1TwCkvdaw0MxJzW7NSDg6XxYQ0dvaS44I/view

Ipython Notebook for geodetic distance computation:
https://colab.research.google.com/drive/1Dx6dEU0vqOFRlH-whnxevtE8MrRjfjAH?usp=drive_link

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Ipython Notebook to call EPI Air Quality History Data:
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Data Sources:

Historical Wildfire Occurrences Dataset:
https://www.sciencebase.gov/catalog/item/61aa537dd34eb622f699df81

US EPA API - Air Quality IndexDataset:
https://aqs.epa.gov/aqsweb/documents/data_api.html

City Allotment:
https://docs.google.com/spreadsheets/d/1cmTW5fgU3KyH6JbrRao-qWjzu2GovKk_BkA7a-poGFw/edit#gid=1247370552

Caldwell economic datasets:
https://datausa.io/profile/geo/caldwell-id#economy