Part 2 - An Extension Plan

Motivation/Problem Statement

As a part of the extension plan, I wish to integrate economic indicators into wildfire impact assessment and represents a crucial evolution in our understanding of how natural disasters affect urban communities. While traditional wildfire impact analyses have focused primarily on physical characteristics such as fire shape, area, circleness, etc, this approach potentially overlooks some profound socioeconomic impacts that extend far beyond the immediate burn zone. By looking into comprehensive economic data for the Denver-Aurora-Lakewood metropolitan area – including housing market dynamics, employment statistics, population growth, and consumer price indices – I wish to develop a more nuanced and holistic understanding of wildfire impacts on urban populations.

Through the available datasets I would like to explore the unique opportunity to quantify how smoke exposure from wildfires influences various aspects of urban economic health. This economic approach to smoke impact assessment can potentially serve multiple stakeholders: it helps city planners and policymakers develop more effective wildfire preparedness strategies, assists real estate developers in understanding market risks, enables public health officials to better quantify the full scope of wildfire impacts, and provides valuable insights for insurance companies and investors evaluating climate-related risks in urban areas.

I wish to answer the following questions -

1. To what extent do wildfire smoke events influence employment patterns and wage growth in affected urban areas?
2. How do wildfire smoke impacts correlate with population movement and economic disparities across different areas of the metropolitan region?

This analysis can help bridge a gap in environmental justice research by examining how wildfire smoke impacts may disproportionately affect different economic segments of the population, as reflected in varying housing market responses and employment patterns across different areas. By developing a better model that incorporates these economic indicators alongside traditional physical measurements, we can create a more accurate assessment of wildfire smoke impacts, ultimately leading to better-informed policy decisions and more effective mitigation strategies for affected communities.

Additional Data

The dataset covers a range of economic indicators for the Denver-Aurora-Lakewood, CO metropolitan area (CBSA/MSA) over various time periods. This comprehensive dataset, covering housing, labor, development, wages, prices, and population, will enable a robust analysis of how wildfire smoke events have influenced the economic health and resilience of the Denver-Aurora-Lakewood metropolitan area. By examining these indicators before, during, and

after major wildfire occurrences, I can hopefully develop a more nuanced understanding of the far-reaching socioeconomic impacts beyond the immediate physical effects.

I plan to use the following datasets, each of which contains a single column with the metric indicated in the title.

Housing Inventory: Active Listing Count (ACTLISCOU19740)

This measures the number of active home listings in the metro area, providing insight into housing market dynamics. The monthly data spans from July 2016 to October 2024, allowing analysis of housing inventory trends before, during, and after wildfire events.

Unemployment Rate (DENV708URN)

The monthly unemployment rate data for the metro area dates back to January 1990, enabling long-term analysis of labor market conditions. Changes in unemployment patterns could reflect the economic disruption caused by wildfire smoke exposure.

Housing Inventory: Median Listing Price per Square Foot (MEDLISPRIPERSQUFEE19740)

This metric tracks the median price per square foot for home listings, shedding light on real estate market valuations. The monthly data is available from July 2016 to October 2024.

New Private Housing Structures Authorized by Building Permits (DENV708BPPRIV)

This measures the number of new home construction permits issued, indicative of development activity and investor confidence. The monthly permit data is available, though the start date is not specified in the information provided.

Average Hourly Earnings of All Employees: Total Private (SMU08197400500000003)

This dataset captures changes in wage levels for private sector workers, potentially reflecting labor market impacts of wildfires. The monthly earnings data ranges from January 2007 to September 2024.

Market Hotness: Hotness Rank (HORAMSA19740)

This metric provides a monthly "hotness" ranking for the Denver consumer goods market, combining various demand and supply indicators. The data spans from August 2017 to September 2024.

Resident Population (DNVPOP)

Annual population data for the Denver metro area is available from 2000 to 2022. Changes in population growth trends could indicate migration patterns influenced by wildfire events.

Consumer Price Index (CPI) for All Urban Consumers: All Items (CUUSA433SA0)

This annual CPI data for the Denver area covers 1984 to 2023, reflecting changes in local cost of living. Fluctuations in the CPI may be linked to the economic impacts of wildfire smoke.

The links and citations to all these data sources are cited in the References section of this document.

Per Capita Personal Income (DENV708PCPI)

Annual per capita personal income data for the Denver metro area is available from 1969 to 2022. This metric can provide insights into the overall economic well-being of residents.

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Unknowns and Dependencies

I could think of several critical unknowns and dependencies that could impact the ability to effectively analyze wildfire smoke impacts using economic indicators:

1. Data Temporal Misalignment: The datasets have varying time ranges and frequencies (monthly vs. annual), making direct correlation analysis challenging. These temporal mismatches may require advanced statistical methods for normalization and could impact the reliability of the results. I still believe it makes sense to include whatever data we currently have to gain insights, rather than disregarding it entirely. As noted in the timeline, I have yet to critically analyze all these sources. While I'm familiar with the content of each dataset, I still need to perform feature engineering and conduct domain-specific research to determine which fields should be included.

2. Geographic Scope Limitations: Centennial's incorporation in 2001 presents a significant data limitation, as noted. According to the City of Centennial's official website and historical records, the city's relatively recent establishment means pre-2001 data cannot be disaggregated from the surrounding areas. The city-specific economic indicators for Centennial are embedded within the broader Denver-Aurora-Lakewood metropolitan statistical area (MSA) data.This geographic aggregation may mask localized effects specific to Centennial. After conducting extensive research, I concluded that this approach would be the most effective. There is no available data for Centennial prior to 2001, and even the data from that time onward is sparse and challenging to find in good quality.

3. Confounding Variables: Economic indicators may be influenced by numerous factors beyond wildfire smoke impacts. The 2008 financial crisis, COVID-19 pandemic, and recent inflation trends

could overshadow smoke-related effects. Regional economic policies and development initiatives may create noise in the data. Natural market cycles in real estate and employment could mask smoke-related impacts.

4. Causality Establishment Challenges: It would be rather difficult to isolate the specific impact of wildfire smoke from other environmental factors. Economic changes may lag behind smoke events by varying periods. The cumulative effects of multiple smoke events could be hard to disaggregate. Furthermore, long-term versus short-term impacts may have different signatures in the data

Being aware of these limitations, uncertainties, and dependencies, I will approach model development with caution, focusing on creating a model with substantial potential by addressing the following aspects:

- Developing appropriate statistical methods for handling temporal and spatial misalignments
- Creating robust controls for confounding variables
- Establishing clear causal relationships between smoke events and economic indicators
- Validating findings against other impact assessment approaches
- Acknowledging and documenting limitations in the final analysis

Timeline

Week 1 (Nov 6 - Nov 12): Initial Research and Data Preparation

- **Nov 6- Nov 8:** I'll research economic indicators linked to environmental impacts and review studies on assessing wildfire smoke effects.
- **Nov 9-12:** I'll clean and organize datasets, address missing values, standardize time frequencies, and do some feature engineering.

Week 2 (Nov 13 - Nov 19): Analysis Development

- **Nov 13-Nov 15:** I'll handle differing time ranges, adjust for seasonality, and create combined features, ensuring each transformation is documented.
- **Nov 16-Nov 19:** I will begin model development with initial correlation analysis, and confounding variable controls.

Week 3 (Nov 20 - Nov 26): Results Analysis & Presentation Preparation

- **Nov 20- Nov 22:** I'll complete correlation analysis, validate findings, refine visualizations, and document assumptions.
- **Nov 23- Nov 26:** I will spend time creating slides, preparing speaking notes, and refining visuals for clear communication.

Week 4 (Nov 27 - Dec 4): Final Documentation & Report

Nov 27: I'll deliver the presentation and incorporate feedback.
Nov 28-Dec 3: I'll finalize the methodology section, document all analysis steps, and detail results, insights, and limitations.
Dec 4: I'll review the documentation, organize code and files, and submit all deliverables.

References

1. Realtor.com, Housing Inventory: Active Listing Count in Denver-Aurora-Lakewood, CO (CBSA) [ACTLISCOU19740], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ACTLISCOU19740, November 6, 2024.
2. U.S. Bureau of Labor Statistics, Unemployment Rate in Denver-Aurora-Lakewood, CO (MSA) [DENV708URN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DENV708URN, November 6, 2024.
3. Realtor.com, Housing Inventory: Median Listing Price per Square Feet in Denver-Aurora-Lakewood, CO (CBSA) [MEDLISPRIPERSQUFEE19740], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MEDLISPRIPERSQUFEE19740, November 6, 2024.
4. U.S. Census Bureau, New Private Housing Structures Authorized by Building Permits for Denver-Aurora-Lakewood, CO (MSA) [DENV708BPPRIV], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DENV708BPPRIV, November 6, 2024.
5. U.S. Bureau of Labor Statistics and Federal Reserve Bank of St. Louis, Average Hourly Earnings of All Employees: Total Private in Denver-Aurora-Lakewood, CO (MSA) [SMU08197400500000003], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SMU08197400500000003, November 6, 2024.
6. Realtor.com, Market Hotness: Hotness Rank in Denver-Aurora-Lakewood, CO (CBSA) [HORAMSA19740], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/HORAMSA19740, November 6, 2024.
7. U.S. Census Bureau, Resident Population in Denver-Aurora-Lakewood, CO (MSA) [DNVPOP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DNVPOP, November 6, 2024.
8. U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: All items in Denver-Aurora-Lakewood, CO (CBSA) [CUUSA433SA0], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CUUSA433SA0, November 6, 2024.
9. U.S. Bureau of Economic Analysis, Per Capita Personal Income in Denver-Aurora-Lakewood, CO (MSA) [DENV708PCPI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DENV708PCPI, November 6, 2024.