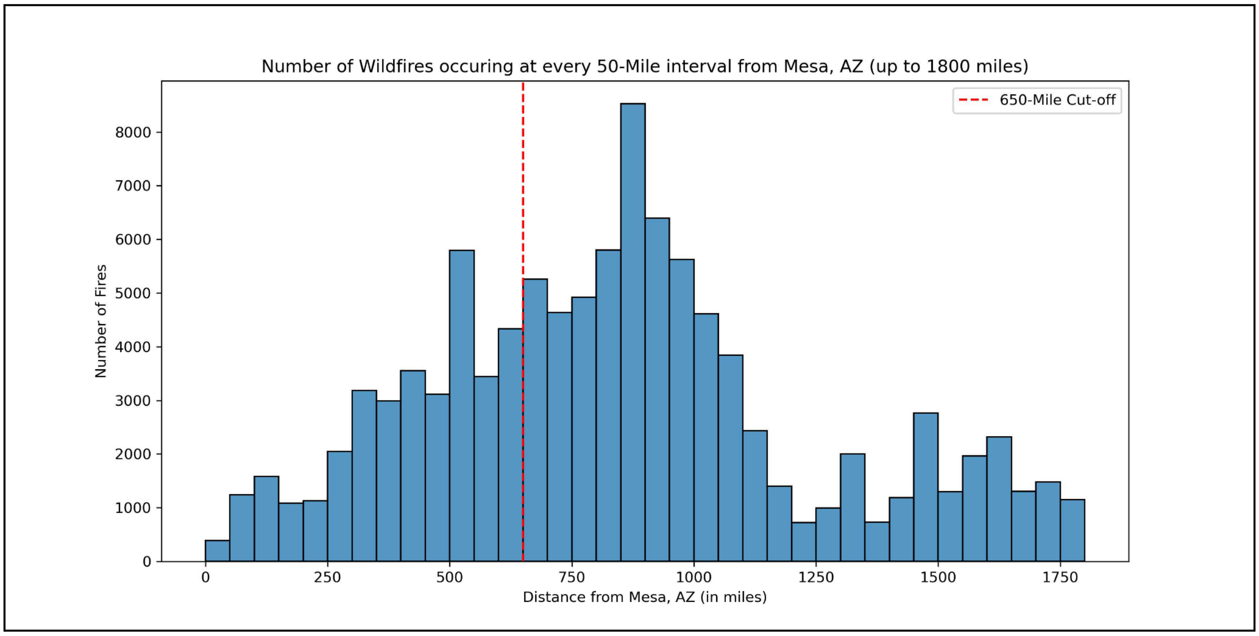
Reflection

Part 1: Reflect on the visualizations

Visualization 1: Histogram of Wildfires by Distance from Mesa, AZ (Up to 1800 Miles)

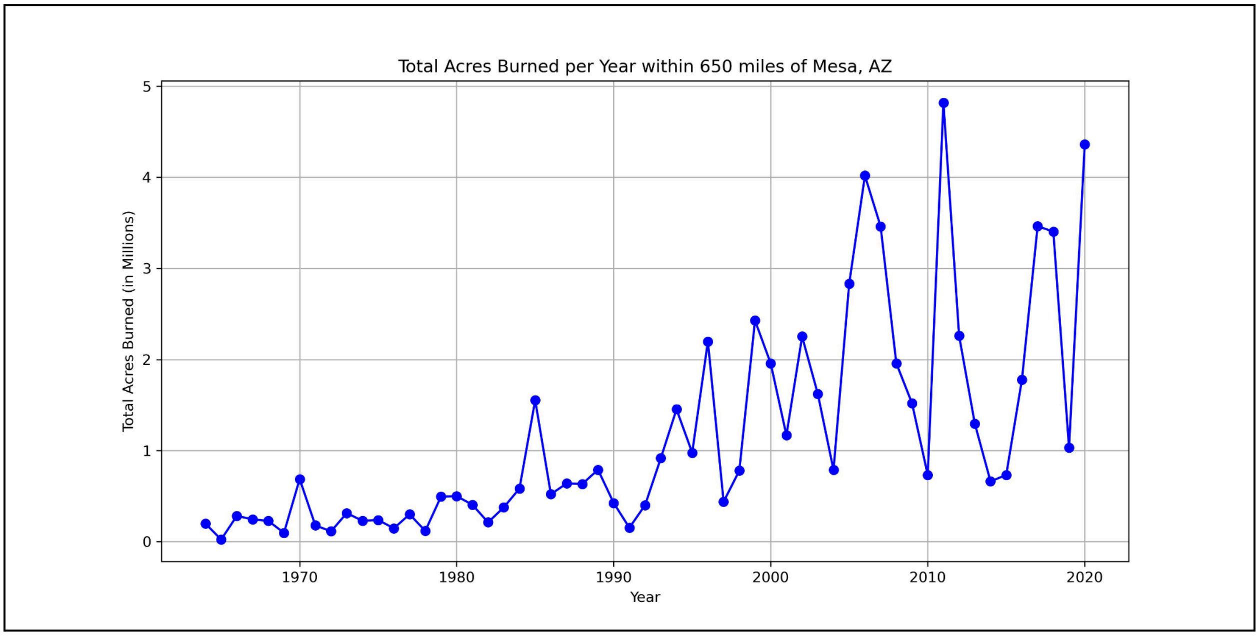


The histogram above displays the distribution of wildfires at 50-mile intervals, extending up to 1800 miles from Mesa, AZ. The x-axis shows the distance from Mesa in miles, while the y-axis represents the number of wildfires within each interval of 50. The data was processed by aggregating wildfire counts based on their distance from Mesa and grouping them into 50-mile intervals to create this visualization.

A prominent feature of the visualization is the peak of approximately 8,500 fires occurring around 850-900 miles from Mesa, indicating a particularly wildfire-prone region at that distance. Additionally, there is a secondary peak around 500-550 miles, suggesting another area with increased wildfire activity. The red dashed line at 650 miles also acts like a significant boundary, and it seems that many wildfires are not close enough to Mesa to have a major negative impact on the city. The distribution is multi-modal, with several distinct peaks between 500 and 1000 miles, which might reflect varying geographical or climatic conditions influencing wildfire occurrences.

Lastly, we also see very few wildfires within about 300 miles of Mesa and beyond 1200 miles. This pattern suggests that certain regions are more susceptible to wildfires than others across this range.

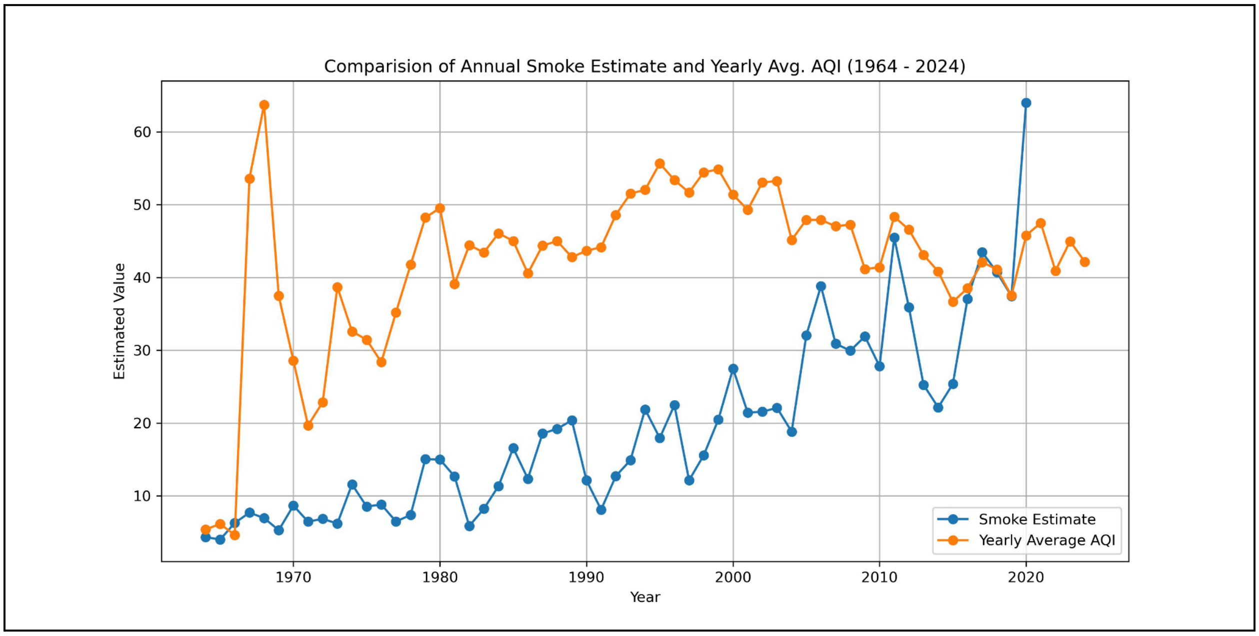
Visualization 2: Time Series of Total Acres Burned Per Year Within 650 Miles of Mesa, AZ



The time-series graph above tracks the total acres burned by wildfires each year within a 650-mile radius of Mesa, AZ, from around 196 to 2020. The x-axis represents the years, while the y-axis shows the total burned area in millions of acres. The underlying data was processed by aggregating the total acres burned (scaling it since acres are in millions) by wildfires each year within a 650-mile radius of Mesa, AZ, and plotting these values over time from 1964 to 2020. From 1965 to about 1990, the burned acreage remains relatively low and stable, generally below 1 million acres per year (barring 1985). However, after 1990, there is a noticeable shift, with a sharp increase in the intensity and variability of wildfire activity. What is particularly striking to me are the peaks in recent decades, with notable spikes in 2006 and 2011, where the total area burned reached nearly 5 million acres.

I think this graph highlights a significant change in wildfire patterns over time, with more frequent and severe fire seasons occurring after 1990. The increasing volatility and larger areas burned in recent years probably suggest potential shifts in climate conditions or fire management practices, potentially even changes in the population density leading to less active prevention methods. The fluctuations between extreme peaks and lower troughs post-2000 further emphasize this trend, indicating that wildfires have become more unpredictable and destructive in recent decades. I believe that this visualization effectively captures the growing severity of wildfires near Mesa, raising important questions about environmental changes and future fire management strategies.

Visualization 3: Time Series of Wildfire Smoke Estimates and AQI for Mesa, AZ (1964 - 2024)



The dual-line time-series graph above compares the annual smoke estimate (blue line) and the yearly average AQI (orange line) from 1964 to 2024. The x-axis represents the years, while the y-axis shows the estimated values for both metrics. The smoke estimate is derived from a weighted formula that incorporates fire proximity, size (using area burned), and type, while the AQI is a direct measure of air quality based on different pollutants. To create the graph, I plotted both datasets based on the year.

In the chart above, we observe that in certain periods, such as between the late 1960s and early 2000s, both lines exhibit more or less similar upward trends, suggesting a correlation between higher smoke estimates from wildfire activity and increased AQI values. However, after 2010, the two metrics diverge significantly, with the smoke estimate rising sharply around 2020 while the AQI remains relatively stable. This divergence could indicate that while fire characteristics suggest a high potential for smoke impact, other environmental factors like wind patterns or atmospheric conditions may have mitigated the actual air quality effects.

The underlying data for the smoke estimate is processed using a weighted formula that accounts for fire proximity (weighted at 0.7), size (0.8), and type (0.4), which helps quantify the potential smoke impact each year. The AQI data is measured directly from air quality monitoring stations. The sharp increase in the smoke estimate after 2000 may reflect larger or closer wildfires near Mesa, AZ, but the relatively stable AQI during this period suggests that environmental factors might have moderated the actual air quality impact despite higher fire activity. Additionally, some variation in the early years could also be attributed to the lack of adequate wildfire monitoring data.

Part 2: Reflect on the Learnings and Collaborative Activities

In working on this assignment, I gained valuable insights into the complex relationships between wildfires, and air quality around Mesa, Arizona. Specifically, I understood how the impact of wildfire, in this case in terms of the smoke estimate is dependent on so many factors like proximity, fire type, fire size (based on area burned), etc and how critical it is to understand what to give weightage to. Additionally, I also learned that although AQI seems like one concrete measure, it is also affected by so many components like gaseous and particulate pollutants. One of the most significant things I learned was how wildfire activity can actually influence air quality metrics, such as the AQI, and how this relationship can vary depending on factors like fire proximity, size, and type. The visualizations helped me observe that while there is often a correlation between increased wildfire activity and worsening air quality, other environmental factors—such as wind patterns, atmospheric conditions, or potentially even industry factors—can moderate this impact. For example, based on visualization 3, the smoke estimate in recent years shows a sharp increase, but the AQI remains relatively stable, suggesting that external factors may have mitigated the expected rise in air pollution or that there is a potential lack of data especially in terms of the smoke estimate to make the correct judgment. This realization deepened my understanding of how multifaceted wildfire impacts can be and highlighted the importance of considering multiple variables when analyzing environmental data. Overall, based on all the analysis and visualizations I also got an insight into how unpredictable wildfires are, and that climate change is real and making it significantly harder to prevent wildfires, while also potentially strongly increasing its impact.

For me, collaboration played a crucial role in shaping my approach to this problem. Initially, I was taken aback by the sheer amount of components in this project and was almost uncertain of where to begin. However, during discussions with my cohort, we exchanged ideas on how to go about the assignment and create mini-milestones to make the project more achievable. I think that was super helpful as it made me believe that I could do this project. I also appreciated having the option of being able to talk to my peers about the processes and visualizations. One key takeaway from these collaborative sessions was learning how to think about smoke estimates and also about how to acquire the data more efficiently. Additionally, discussing different approaches to handling data gaps or inconsistencies helped me refine my methods for aggregating wildfire data over time. Overall, collaboration not only helped me overcome technical challenges but also broadened my perspective on interpreting complex environmental data.

Specific Attributions

1. Navya Eedula: I used Navya's help to understand how to efficiently get the wildfire data. I adapted parts of her code and the professor's code to actually gather wildfire data.

2. Manasa Shivappa: I was actively discussing how to calculate the smoke estimates with Manasa. We spoke about a variety of ways it could be done and how each of the factors could play a role in the estimate. I specifically took Manasa's advice to divide my yearly_aqi data by 184 (the duration of the fire season) in order to get a better estimate. This helped boost my correlation score by quite a bit!

3. Sushma Vankayala: I discussed with Sushma how to predict the smoke estimates for the next 25 years. I used parts of her code to help me visualize the results of my Arima model