**Project Part 1: Common Analysis**

Figure 1: Number of fires vs every 50-mile-distance in Gillette, Wyoming

A graph of a number of tires

Description automatically generated

The figure above represents a histogram that displays the number of fires occurring at every 50-mile-distance from Gillette, Wyoming up to a maximum specified distance of 1250 miles. The x-axis represents the distance in miles from Gillette, Wyoming. Each bin on the x-axis represents a range of distances, with labels at the bin edges (e.g., 0-50, 50-100, 100-150 miles, and so on). The y-axis represents the number of fires that occurred within each distance range. It shows the count of fires falling within each bin.

The underlying data used for this visualization is a dataset of fire occurrences. The data is filtered to include only fires that fall within a specified maximum distance from the city (in this case, 1250 miles). The data is then grouped into 50-mile range bins based on the distance from Gillette.

The figure above can be ‘read’ from left-to-right or vice versa. From the histogram, it is evident that the most significant concentration of fires, numbering approximately 14,000 incidents, occurred in regions situated around 850 to 900 miles away from Gillette, Wyoming. In contrast, areas within a 100-mile radius of the city have experienced fewer than 2,000 fires in the last 60 years. After 1,000 miles, the number of fires declines again. This indicates a possibility that certain fire-prone regions of the country are located about 800-1000 miles from Gillette which contributes to the spike we see on the histogram.

Figure 2: Total Acres Burned per Year within 1250 miles of Gillette, Wyoming

A graph with purple lines and numbers

Description automatically generated

The figure above presents a time series plot that visualizes the total acres burned each year within 1250 miles from Gillette, Wyoming. The x-axis represents the years from 1963 to 2020, displaying each year at five-year intervals, which provides a clear view of the long-term trends. The y-axis shows the total acres burned, illustrating the scale of wildfires' impact on the area.

The underlying data has been processed by filtering the dataset to include only fire incidents within the specified distance from the city. Then, the data is grouped by year and the total acres burned in each year are calculated. This processed data is used to create the time series plot.

The plot is best read left-to-right. It reveals a pattern of wildfire activity that is not continuous but rather characterized by fluctuations from year to year. While the total acres burned display a general upward trend over the analyzed years, the data exhibits distinct periods of increase and decrease in wildfire impact. During some years, such as 2011 and 2017, there are noticeable spikes in the total acres burned, signifying periods of elevated wildfire activity. Conversely, there are years, like 2010 and 2019, when the total acres burned decrease, indicating a reduction in wildfire impact.

This variability strongly suggests that Gillette, Wyoming, is not consistently prone to being near large fires. Instead, the region experiences intermittent periods of heightened wildfire risk, with some years witnessing more significant wildfire events while others enjoy relative respite.

Figure 3: Fire Smoke Estimate and AQI Over Time

A graph with blue and orange lines

Description automatically generated

The figure above displays a time series graph representing the Fire Smoke Estimate and Air Quality Index (AQI) for Gillette from 1963 to 2023. The x-axis represents the years from 1963 to 2020, displaying each year at five-year intervals, which provides a clear view of the long-term trends. The y-axis represents the value of the two variables being measured. The scale of the y-axis corresponds to the values of the Fire Smoke Estimate which is from 0-100 and AQI which is from 0 – 500.

The underlying data comprises records from 1963-2023, with associated values for Fire Smoke Estimate and AQI Estimate. Fire Smoke Estimate is calculated based on distance and the area burned. AQI Estimate represents air quality data, and its values reflect air pollution levels, which are usually measured using a standardized index. The AQI data for Gillette was quite sparse despite the presence of monitoring stations. Consistent data is only available after 2000.

The plot is best read left-to-right. Rather than a continuous trend, the graph displays fluctuations in Fire Smoke Estimate from year to year. In contrast, the Air Quality Index (AQI) for the city appears relatively stable over the years, with a slight but noticeable decline beginning around 2012. A correlation if 0.29 is present between both variables which seems reasonable considering many factors that affect smoke impact such as wind direction over a course of several days, the intensity of the fire, and its duration are not available to us.

Reflection Statement

Working on this assignment was a valuable experience that resulted in a deeper understanding of air quality monitoring and factors affecting air quality. Moreover, through collaboration on the assignment underscored the significance of engaging in discussions when addressing complex data-related questions.

Throughout this assignment, I gained insights into how air quality data is monitored and calculated. The process involved working with historical data to estimate the impact of smoke on air quality in a city. This experience emphasized the importance of air quality monitoring for assessing public health and environmental impacts.

The assignment also encouraged a critical examination of the various factors that influence air quality. It highlighted the significance of considering variables like distance from fires, areas burned, and the number of fires in estimating the impact of smoke on air quality. This recognition of complexity and multiple contributing factors underlined the intricacies involved in air quality assessments.

Collaboration played a crucial role in this assignment by enabling discussions and the sharing of diverse ideas on how to derive smoke estimates. These exchanges provided opportunities to explore different perspectives and approaches, ultimately leading to more robust and well-informed analyses.

Additionally, the collaboration allowed for comparative analyses. By examining how fire impacts differed for other cities, I gained a broader perspective on the geographical and environmental factors influencing air quality. This insight expanded my understanding of the unique challenges that different locations face concerning air quality and fire impacts.

While collaboration offered numerous advantages, it also presented challenges. Differing viewpoints and approaches sometimes added complexity to decision-making and analysis. However, these challenges were valuable as they encouraged critical thinking and the consideration of alternative methods.

This assignment underscored the importance of continuous learning in fields related to environmental assessments and air quality. Staying updated and adaptable is essential to accurately address complex questions, such as the impact of smoke on air quality over time. As datasets and research methodologies evolve, a commitment to ongoing learning is paramount.

In conclusion, the collaborative experience of addressing the research question and analyzing the estimated smoke impacts on a city over the past 60 years deepened my understanding of air quality monitoring, the complexities of factors influencing air quality, and the advantages of collaboration in tackling intricate environmental challenges. It reinforced the importance of adaptability, open-mindedness, and the power of diverse perspectives in research and problem-solving.