**Fall 2025 Data Visualization - Assignment 3 Report**

**Project:** Air Quality Index Visualization Dashboard  
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**Repository:** https://github.com/nak987/Assignment\_3  
**Link:** https://nak987.github.io/Assignment\_3/ (Local build; GitHub Pages deployment encountered SvelteKit compatibility error. Interactive visualization fully functional locally at <http://localhost:5173>)

**Project Overview**

This project presents a two-part interactive dashboard visualizing air quality (AQI) data for Allegheny County.  
It supports both station-level exploration and multi-pollutant comparative analysis, enabling users to investigate environmental patterns, pollutant dominance, and temporal trends over years (2015–2023).

**Goals of the Visualizations**

**Part 1:** AQI fluctuations across stations over time.  
Users can compare air quality categories from Good to Hazardous) and inspect outliers or spikes.

**Part 2 – Multi-Pollutant Analysis**

**Goal:** Allow users to explore pollutant composition, temporal AQI patterns, and COVID-era effects.

**Key Questions:**

1. What pollutants contribute most to overall AQI?
2. How did air quality change during the COVID-19 period (2019–2021)?
3. Are there consistent monthly or seasonal trends in AQI behavior?

**Design Rationale**

| **Design** | **Reason** |
| --- | --- |
| **Color** | AQI color bands follow standards (green → red → purple).  Users instantly associate each zone with health categories. |
| **Visual Simplification** | Split interface into two main “Parts” to reduce cognitive load. |
| **Tab Layout (Part 2)** | Multi view- each tab isolates one pollutant view while preserving consistent axis scales. |
| **Annotations** | Support contextual data understanding without clutter. |
| **Color-blind friendly hues** | EPA palette adjusted for accessibility. |

**AI Assistance**

**Usage**

AI (ChatGPT) was used primarily for:

* Debugging Svelte + Vite build errors.
* Clarifying SvelteKit vs. plain Svelte project structures.
* Refining text and visual explanation language.

**Sample Prompts Used**

“Why is my D3 line chart not updating after a reactive variable changes in Svelte?”  
“What’s the difference between using reactive $: blocks vs. onMount() in Svelte for rendering charts?”  
“How do I smooth transitions when updating SVG paths in D3?”  
“Explain how to correctly reference local CSV data in a Vite/Svelte project.”  
“Give feedback on clarity and structure for a short technical write-up section.”  
“How do I fix ‘window is not defined’ when running a Svelte project build?”  
AI was used like a debugging assistant and writing coach, not as a code generator.  
Its main role was to help resolve build and rendering issues, improve documentation clarity, and polish the final report language.  
  
**Visualization Summaries  
  
1️. AQI Chart – All Stations Overview**

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This chart combines AQI readings from all stations across the dataset to show overall air quality trends over time.  
  
The background color bands follow the EPA’s AQI scale (Good to Hazardous), making it easy to interpret pollution levels at a glance.

### ****2️. AQI Chart – Station Selector****

### A screenshot of a graph Description automatically generated

- Interactivity by letting users choose individual monitoring stations through a dropdown menu.  
- Allowing for quick comparisons between areas such as Liberty, Lawrenceville, or North Braddock.  
- Useful for spotting localized pollution differences and understanding which neighborhoods tend to experience poorer air quality.

### ****3. AQI Chart – Show Raw Data****

### A screenshot of a graph Description automatically generated

* Turning on the “Show Raw Data” option reveals all individual AQI readings as small scatter points.
* Shows how much daily readings can fluctuate around the monthly averages.
* It’s a good way to spot outliers or random spikes that might otherwise be hidden by the smoothed trend line.

### ****Part 2 – Multi Pollutant Analysis****

### ****4️. Pollutant Composition by Year****

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* This stacked bar chart breaks down the main pollutants (PM2.5, PM10, Ozone, NO₂, SO₂, and CO) by year.
* It clearly shows that PM2.5 is the dominant pollutant in most years, while others vary more unpredictably.
* The chart makes it easy to see how the mix of pollutants has shifted slightly over time.

### ****5️. AQI Scatter by Date****

### A screenshot of a graph Description automatically generated

* Each dot on this scatterplot represents a single pollutant’s AQI reading on a specific date.
* The plot shows how pollutants behave throughout the years, with visible bursts of higher ozone levels during certain seasons.
* It provides a detailed view of daily fluctuations and the timing of air quality spikes.

### ****6️. Mean AQI per Pollutant****

### A screenshot of a graph Description automatically generated

* This line graph tracks the average monthly AQI for each pollutant.
* It highlights long-term differences between pollutants — for instance, PM2.5 levels stay fairly consistent, while ozone and CO show more distinct short-term increases.
* Overall, it helps visualize which pollutants are the most stable and which are more variable over time.

### ****7️. Monthly Mean AQI****

### A screenshot of a graph Description automatically generated

* This bar chart summarizes how AQI changes by month throughout the year.
* It shows a noticeable seasonal pattern - air quality tends to worsen during the summer months (around June to August).
* This likely ties to higher temperatures and ozone formation during the warmer part of the year.

### ****8️. COVID-Period AQI****

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* This chart focuses specifically on the 2019–2021 period to capture the effects of COVID-19 lockdowns on air quality.
* There’s a visible dip in AQI during early 2020, which aligns with reduced traffic and industrial activity.
* As restrictions eased, the AQI gradually rose again, suggesting a direct connection between human activity and pollution levels.

**Conclusion**  
  
Analysis of AQI data across Allegheny County shows clear spatial and temporal variation in air quality. ***PM2.5 consistently emerges as the dominant pollutant***, accounting for most high-AQI readings across all stations and years. ***Ozone*** displays strong ***seasonal peaks in summer***, while ***NO₂ and SO₂*** remain relatively stable but locally concentrated near industrial areas.

A gradual ***improvement in overall air quality*** is visible over the multi-year period, with fewer “Unhealthy” days after 2018. The ***COVID-19 lockdown in 2020*** produced a distinct short-term decline in AQI values, confirming the direct link between reduced human activity and cleaner air.

Station-level comparisons reveal ***Liberty*** as persistently having higher AQI values compared to other sites, reflecting localized industrial emissions. The monthly averages further show that ***winter and early spring*** tend to have lower AQI, while ***late summer*** brings higher concentrations due to temperature-driven ozone formation.