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UC San Diego

Gun Violence in the US : Exploratory Data Analysis

ECE 143 Group-16

Agenda

1. Motivation
2. Dataset Overview & Extraction
3. Fatality Analysis
4. Police Response Analysis
5. Interactive Data Visualization
6. Conclusion

Motivation

Gun violence is on the rise - at an **alarming rate**.

- In the US:
  - **~2x** spike in mass-shooting incidents & mass-shooting deaths in the last 5 years.
  - Over the last decade ~ **3x** spike

Directions to explore:

- How fatal are these incidents?
- Which states/cities suffer the most?
- How well has the police responded to them?
- How can we leverage publicly available data to analyze this issue?

based on data from gunviolencearchive.org

Dataset Overview

Data Collection

- Mass-shooting incident reports from the **gun violence archives**
- Search database for specific type of incidents
- Take CSVs and convert to Pandas dataframes

Sorting and Merging

- Sorted data by
  - Year/Month/Day
  - State
  - City/County
- Merge CSVs together and store

Cleaning

- Took out Null data points with no location
- Filtered Incidents by keywords
- Examined Outlier possibilities

Incident ID	Incident Date	State	City Or County	Address	Victims Killed	Victims Injured	Suspects Killed	Suspects Injured	Suspects Arrested	Operations	Year
2790854	December 31, 2023	California	Hawthorne	14125 Crenshaw Blvd	1	5	0	0	0		2023
2793000	December 31, 2023	Louisiana	New Roads		1	3	0	0	1		2023
2791696	December 31, 2023	South Carolina	Little River	3389 Hwy 9 E	2	2	0	0	0		2023

based on data from gunviolencearchive.org

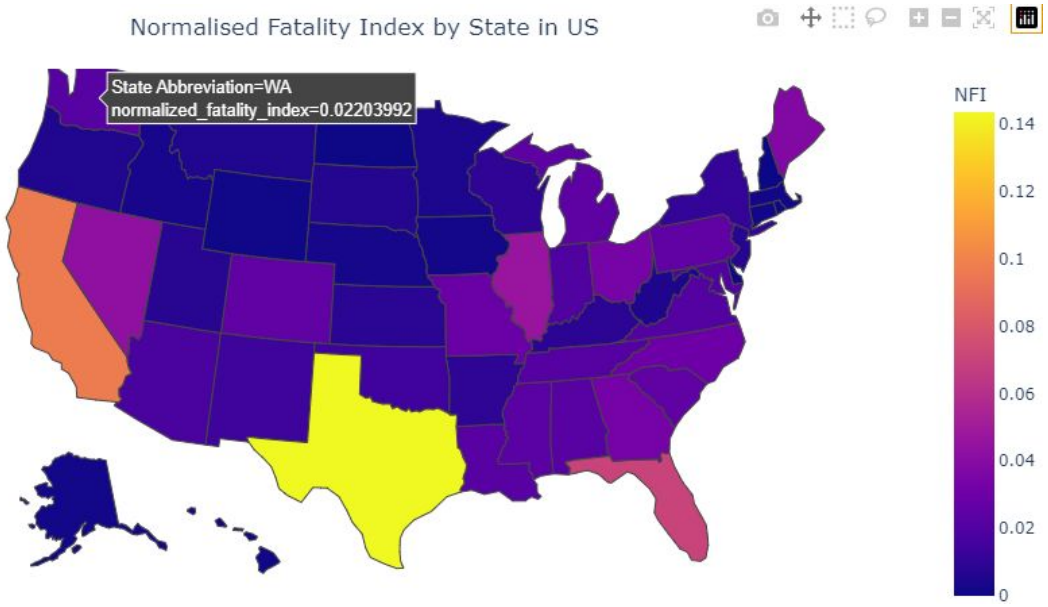
Fatality Analysis

Normalised Fatality Index (NFI)

$$\text{FatalityIndex}_{State} = (\#\text{ of Total Deaths})_{State}^{2} / (\#\text{ of Total Incidents})_{State}$$

$$\text{NFI}_{State} = \text{FatalityIndex}_{State} / \Sigma(\text{FatalityIndex}_{i})$$

- More weightage to absolute number of deaths in a state.
- Neutralises outliers with very few incidents to accurately judge fatality.
- Interactive USA heatmap reflects geographical NFI trends - Texas, California & Florida being the most fatal.



based on data from gunviolencearchive.org

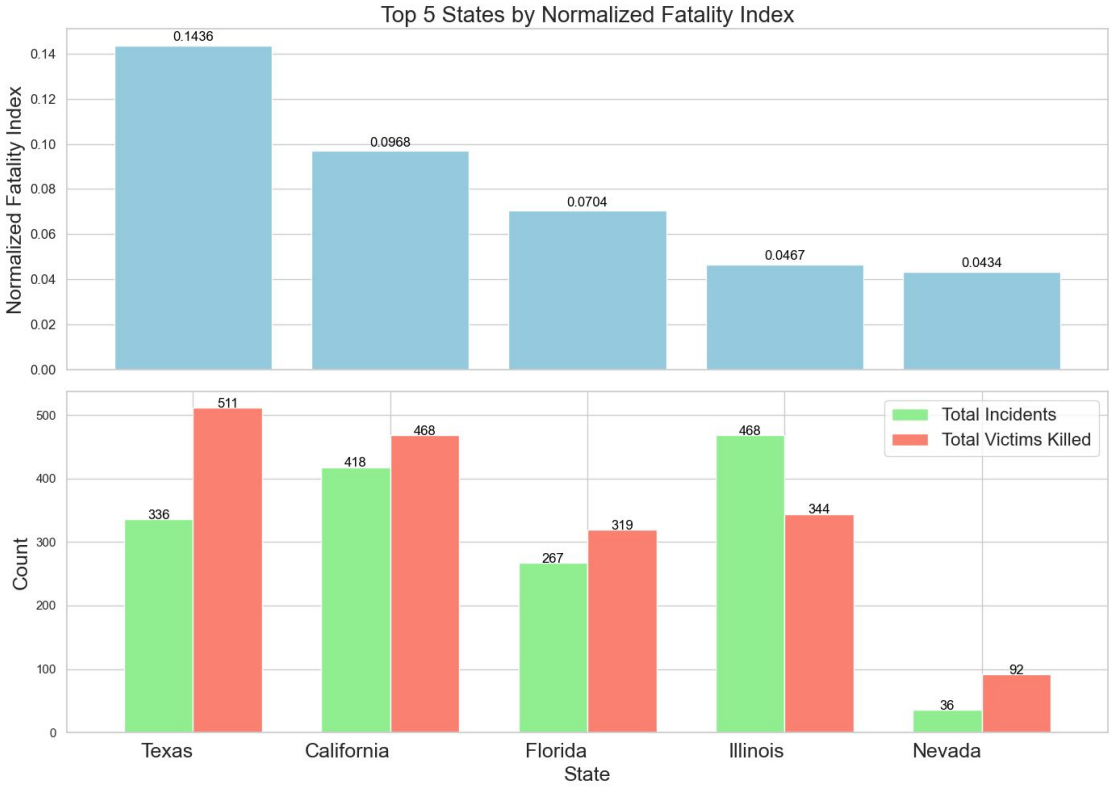
Top 5 States in US by NFI [2014-2023]

- Top 5 states together contribute to **40%** of the national fatality.

➔ Do states with higher number of incidents always have a higher fatality? **NO**

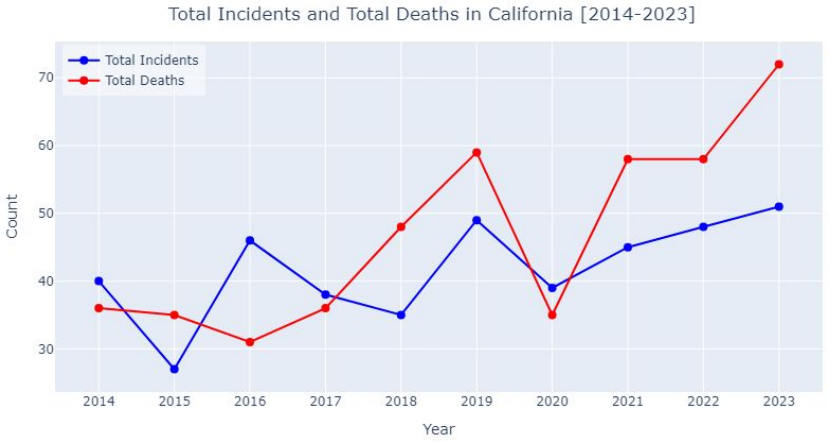
- **Nevada -** Historically fewer incidents, yet extremely fatal - 2.5 victims killed per incident.

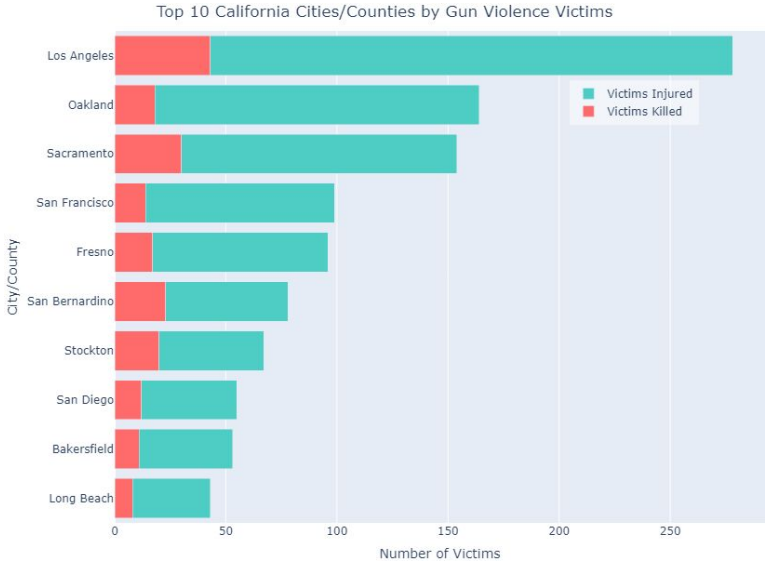
➔ Who is better prepared - states with historically higher or lower incidents? **Let's analyze the police response.**



based on data from gunviolencearchive.org

A deeper dive into California





based on data from gunviolencearchive.org

Police Response Analysis

Police Action Index (PAI)

$$PAI_{incident} = \sum[(Suspects\ Status_i) \times (Weight_i)] + \sum[(Victims\ Status_i) \times (Weight_i)]$$

$$Normalized\ PAI_{incident} = PAI_{incident} / \sum PAI_{incidents}$$

- ***2019 Fresno shooting, California***: 4 deaths, 6 injuries, all 7 suspects captured by police

  $PAI_{incident} = 5.9$

- ***2022 Uvalde School Shooting***, Texas: 21 deaths, 17 injuries, 1 suspect killed by law enforcement

  $PAI_{incident} = -4.45$

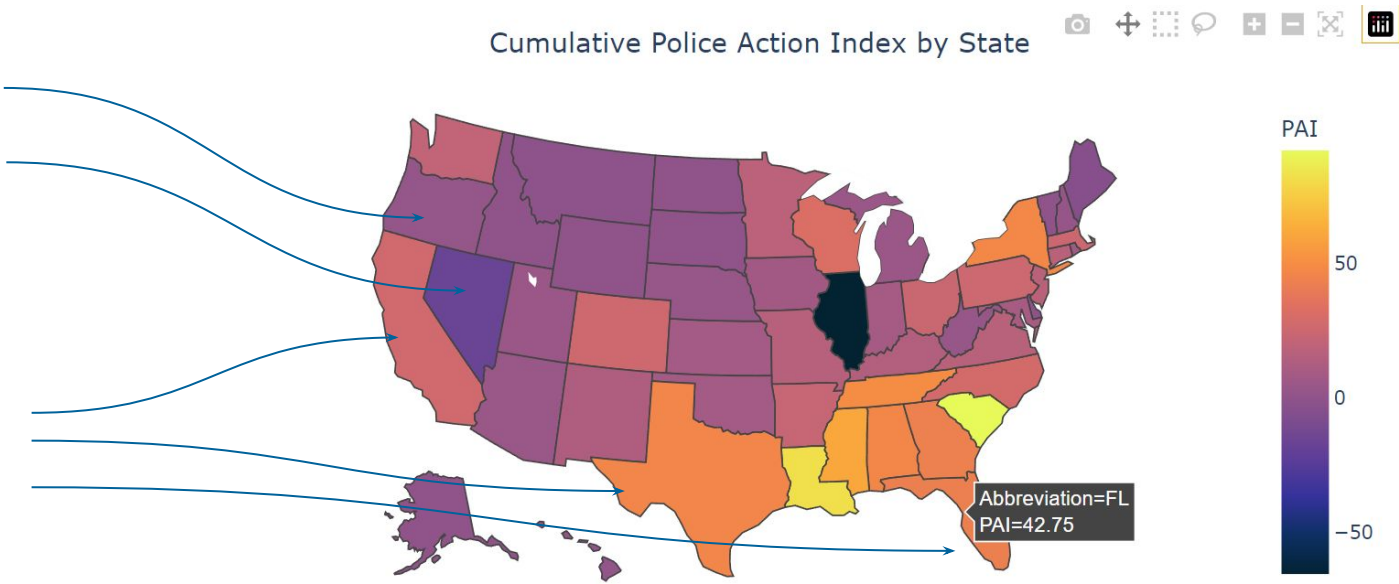
Status	Weight
Suspect Captured	1.0
Suspect Surrender	0.8
Suspect Killed	0.6
Suspect Suicide	0.3
Suspect at Large	0.0
Victim Killed	-0.2
Victim Injured	-0.05

based on data from gunviolencearchive.org

PAI Trends

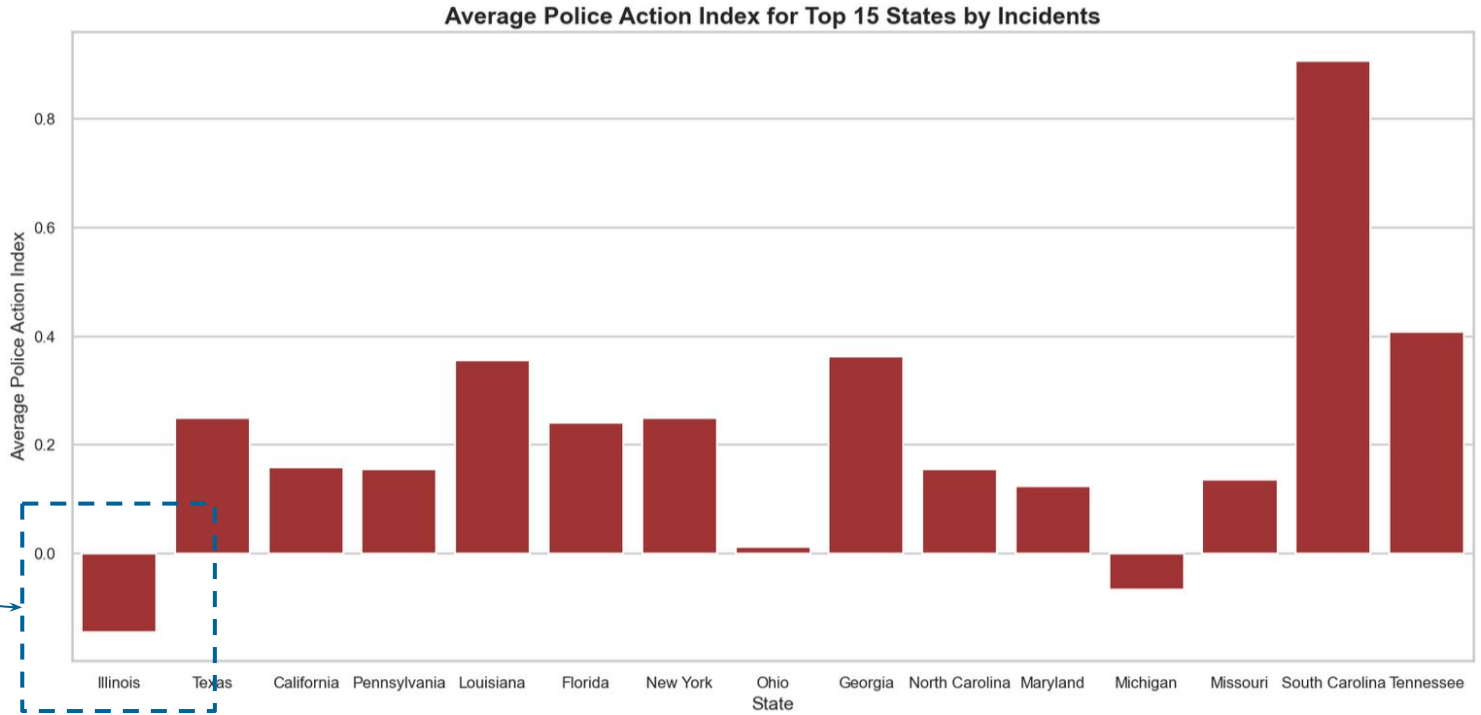
Relatively lower PAI for states with lesser incidents

Generally higher PAI observed for states with higher incidents



Have these trends been followed in the last decade?

PAI Trends



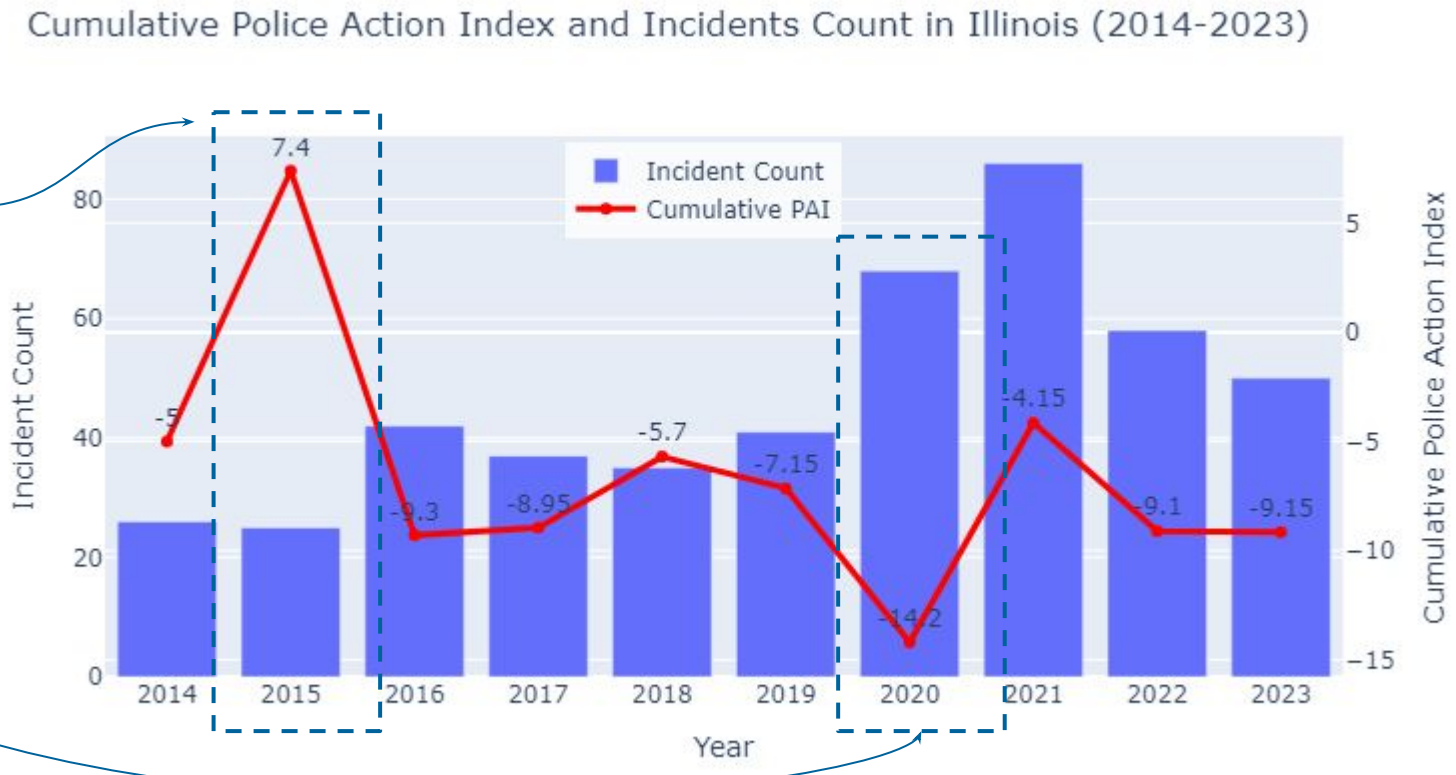
Exception

based on data from gunviolencearchive.org

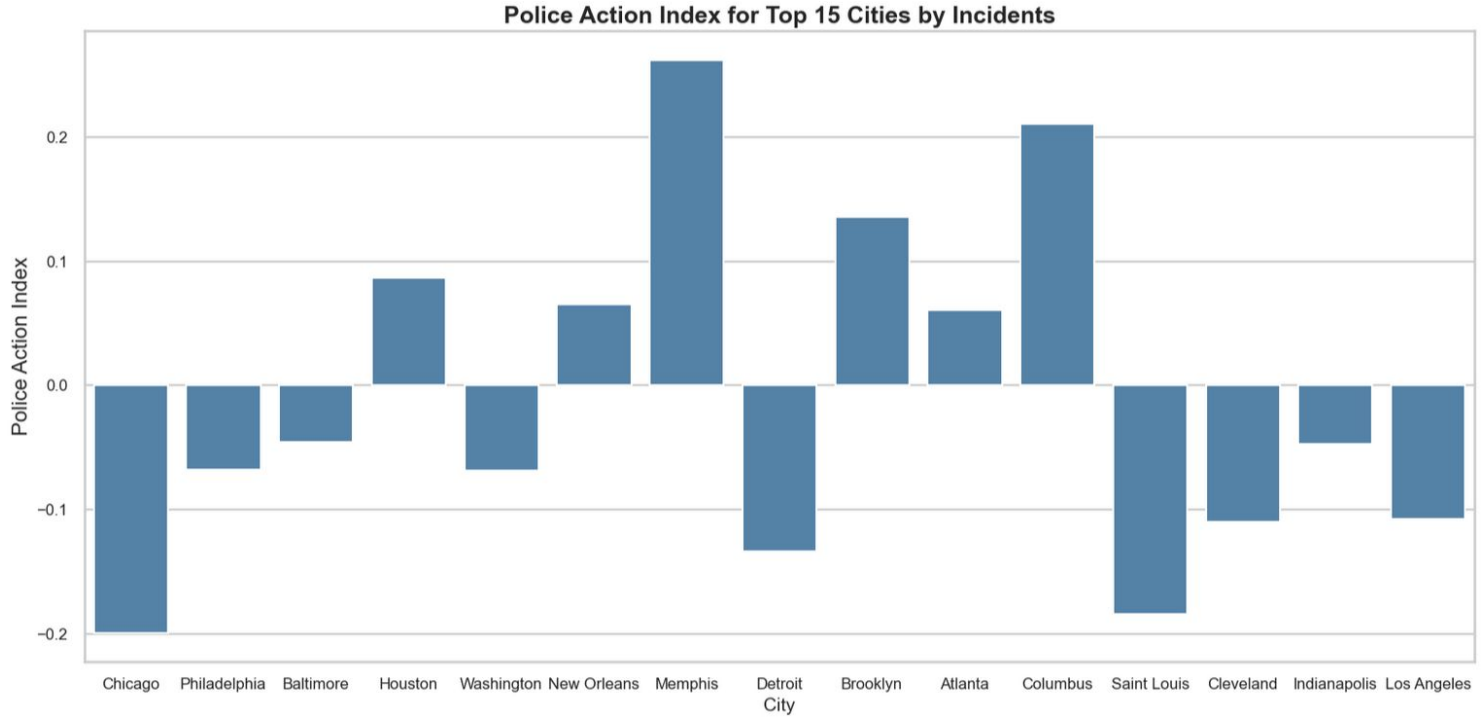
Analyzing PAI for Illinois

Better PAI; same # of incidents

Worse PAI; spike in incidents

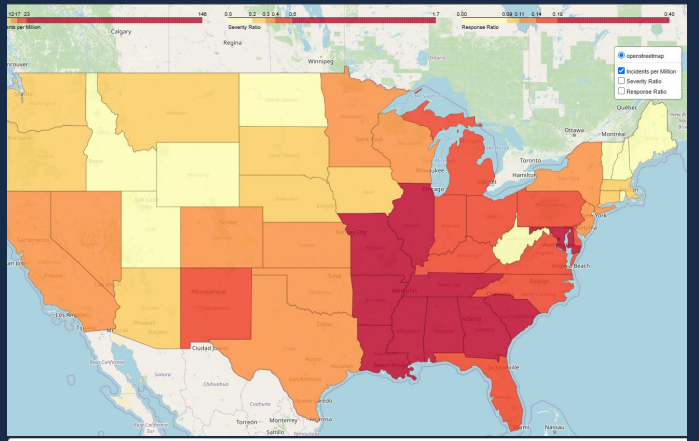


PAI Trends



based on data from gunviolencearchive.org

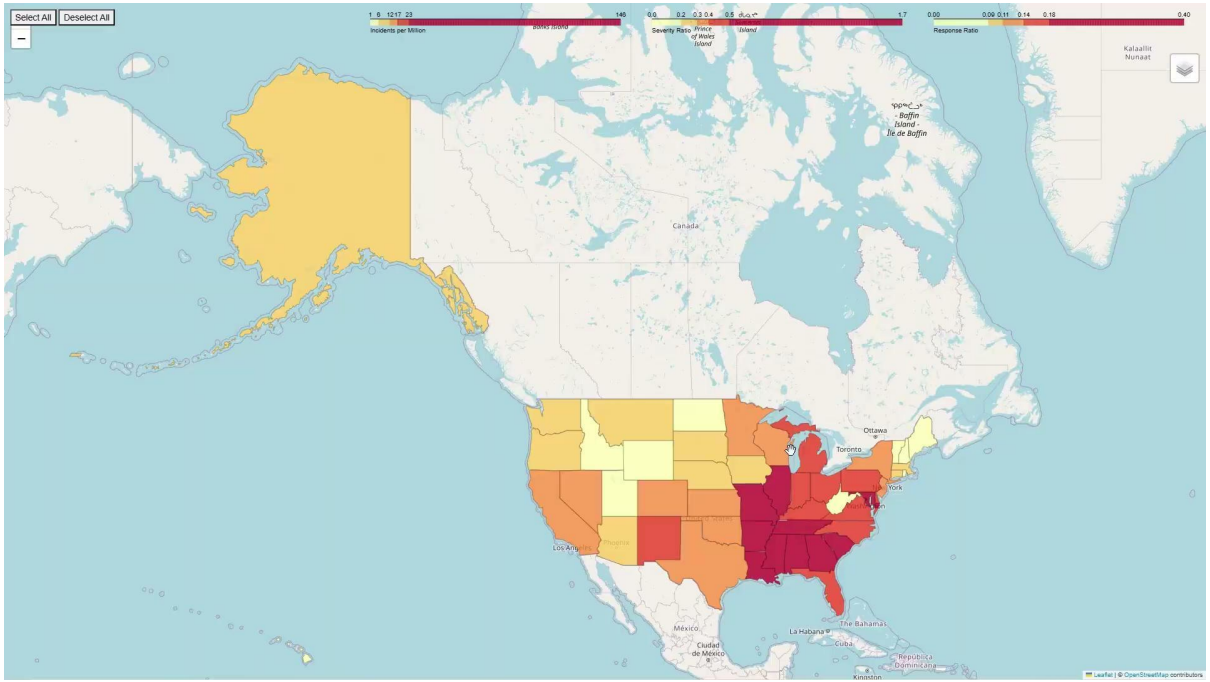
Interactive Data Visualization



Geospatial Data Map

Interactive Gun Violence Visualization Using Folium and GeoJSON

- Incorporate state population data to calculate:
  - Incidents per Million
  - Severity ratio
  - Response ratio
- Helps in identifying concentrated regions of gun violence in the US.
- Factors - Varying gun laws, socioeconomic factors (high poverty, unemployment, literacy rates)



Incidents per million = (Total # of incidents)*10^6/ (State population)
Severity Ratio = (# of victims killed) / (# of victims injured)
Response Ratio = (# of suspects arrested) / (# of victims injured)

[*to be replaced by NFI]

[*to be replaced by PAI]

Interactive Dashboard - Temporal Trends

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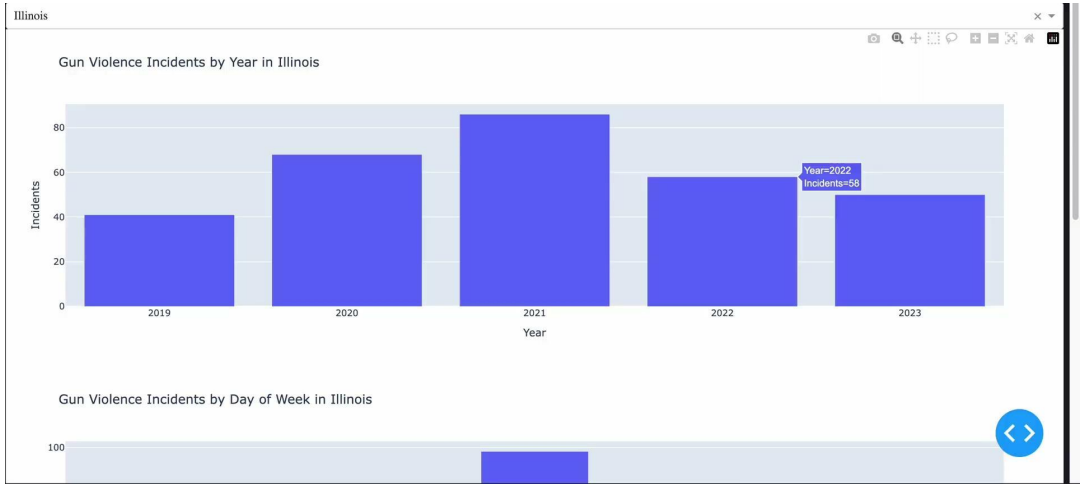
Features:

- Dropdown menu for each state.
- Dynamic plots for temporal trends of total incidents by Year/Month/Day

Potential Use Cases:

- Spikes in summer months, dip in extreme weather.
- Special occasions/holidays during the year.



*Features to be added:

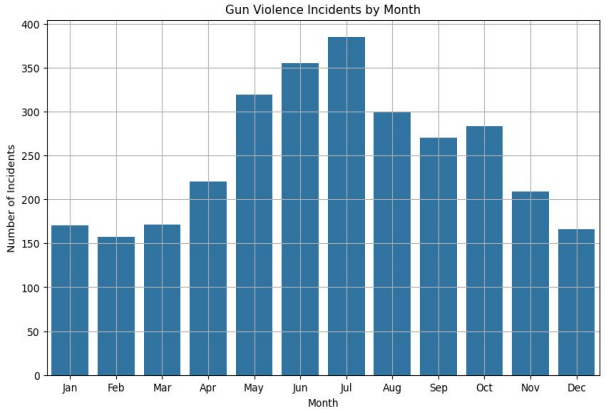
- Extend analysis to victim/suspect statistics.
- Line graphs for time-series analysis

based on data from gunviolencearchive.org

Potential Use Cases

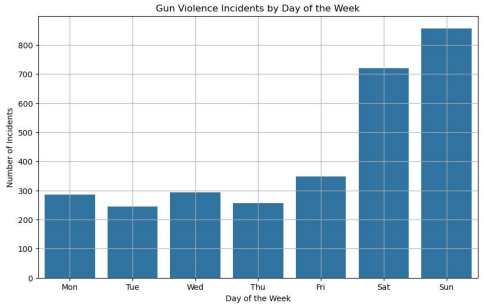
Monthly Patterns

- Spikes in summer months, dips in extreme weather.
- Peak holiday seasons, breaks.
- Special events, occasions



Daily Patterns

- Social Routine and Weekend Behavior
- Work Stress and Release Mechanisms
- Circadian Rhythms and Risky Behavior



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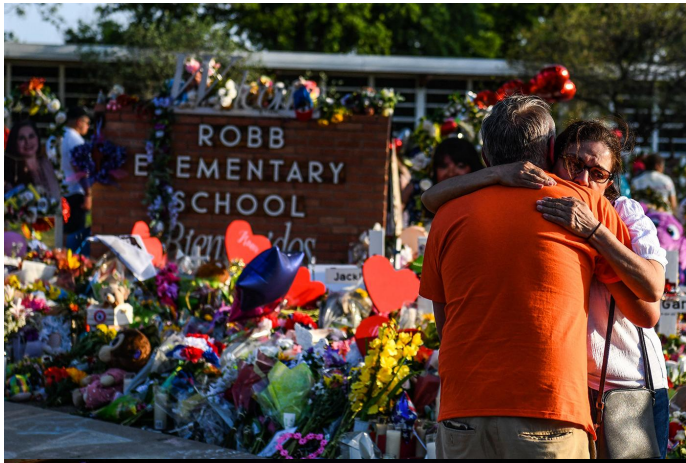
Conclusion

- Gun violence in the US - The numbers are alarming, and the data never lies! Something needs to change!
- Huge surge in gun violence incidents post COVID-19 pandemic, as well as in the last 5 years.
- Bolstering police response and resilience against such incidents.
- Urgent need for effective policy interventions.
- Leveraging this analysis to address both immediate and long-term concerns in curbing gun violence.



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Questions?

Please direct them to our amazing team who put it all together:

Dhylan - The Data Scientist
Hariram - The Justice Vigilante
Peiyuan - The Geospatial Pro
Zihan - The Dashboard Maestro
Aryan - The Fatal Presenter