

A photograph of the Boston skyline, featuring the Prudential Tower and other skyscrapers against a cloudy sky.

# **Gun Violence**

## **Team I**

### **Deliverable 4 Report**

# **BOSTON**

#### **Team Members:**

- Shaunak Joshi  
(U13870687)
- Marcel Aubry  
(U02577695)
- Hemant Singh  
(U17284611)
- Angela Castronuovo  
(U68837053)

#### **Contacts:**

- Bruce Boisman - Client Policy Director  
[bruce.broisman@boston.gov](mailto:bruce.broisman@boston.gov)
- Yagev Levi - Technical Engineer @ BU Spark - [yagev@bu.edu](mailto:yagev@bu.edu)
- Jacqueline Lin - Project Manager @ BU Spark - [linjiaqi@bu.edu](mailto:linjiaqi@bu.edu)

# Introduction

Gun violence has become a growing concern in the United States, particularly in urban areas. In Boston's District 4, there has been an increase in gun possession among young people, which has prompted Councilor Worrell to seek a better understanding of the issue. The councilman is particularly interested in determining what variables may be associated with increases or decreases in gun violence, such as police presence, poverty, and population movements, and how existing programs can help curb gun violence.

To accomplish this goal, the project team has analyzed several datasets, including the Districts for City Council Shapefile, Police Districts, and Police Records of Violence/Firearm Activity. The team also explored non-emergency issues reported through 311, discipline records from schools, and gun license and recovery data. The analysis will seek to establish what violence looks like in District 4, compare it to the rest of the city, and identify patterns in terms of location and type of violence.

One of the key questions the team seeks to answer is what the drivers of violence are in District 4 compared to other areas of Boston. We investigate the rate of gun violence in District 4 and patterns of violence in terms of location and type. By understanding these factors, we hope to inform policies that can improve public safety and help reduce gun violence in District 4 and beyond.

In addition to the base project, we propose an extension project that utilizes additional datasets and sources to tell a compelling story. Some potential datasets the team may explore include truancy/attendance rates, school performance data, and environmental/community factors such as green space and community programming.

As part of the analysis, we are also exploring police presence in District 4 and the city as a whole. Using data on police schedules, the team has mapping out where officers are stationed within the district and comparing this to other areas in the city. The team hopes to determine whether police presence has any

correlation with gun violence rates and if there are any patterns in terms of where violence tends to occur. Additionally, we investigate existing programs meant to help curb gun violence in the community, such as community centers and after-school programs, to determine their effectiveness in terms of the broader perspective for the community.

One of the team's primary goals was to understand the drivers of violence in District 4 as compared to other areas in the city. By analyzing data on poverty rates, population movements, and other variables, we uncover deeper correlations with gun violence rates. The team also aims to identify any patterns in terms of location or type of violence, which may inform future policy decisions.

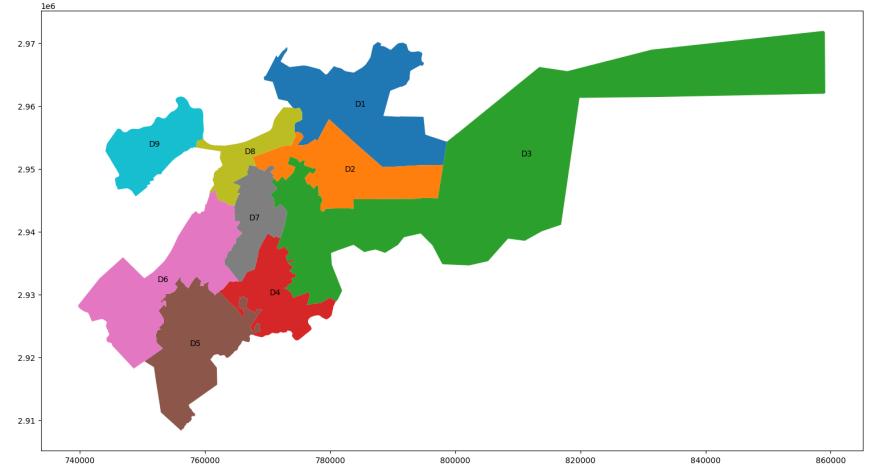
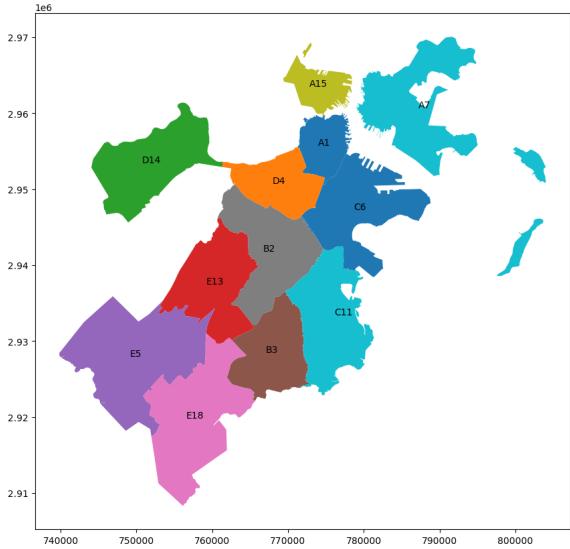
Ultimately, through this project we hope that our analysis will provide insights into how to effectively curb gun violence in District 4 and beyond. By understanding the root causes of violence and the effectiveness of existing programs, the team hopes to inform policy decisions that can have a positive impact on the community. The team's extension project, which will involve exploring additional data sets related to environmental factors, schools, and interactions, will provide further insights into potential solutions to this complex issue.

## Quick Glance DashBoard

- Facts at a glance:
  1. Total number of shooting incidents - 1798
  2. Total number of shots fired - 7555 shots
  3. Total number of deaths from shooting - 300 deaths
  4. Total number of collateral deaths - 90 deaths
  5. Most dangerous locality - B2, B3, C11 PD
- Districts in Boston  
We can see D4 is made up of B3 and C11 police districts.

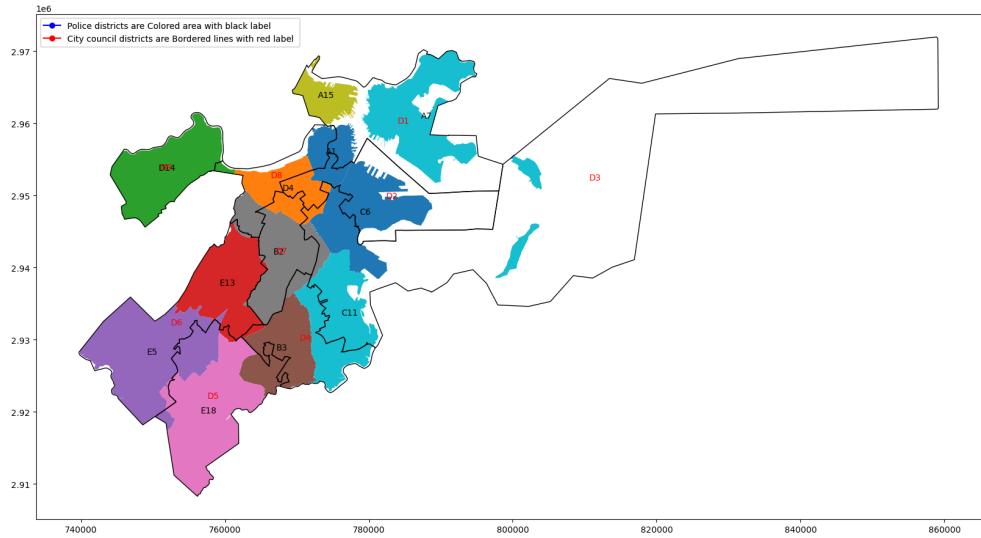
**Map of Police Districts in Boston**  
**Boston**

**Map of Congressional Districts in**



Here we can see the police districts overlaid with the congressional districts.

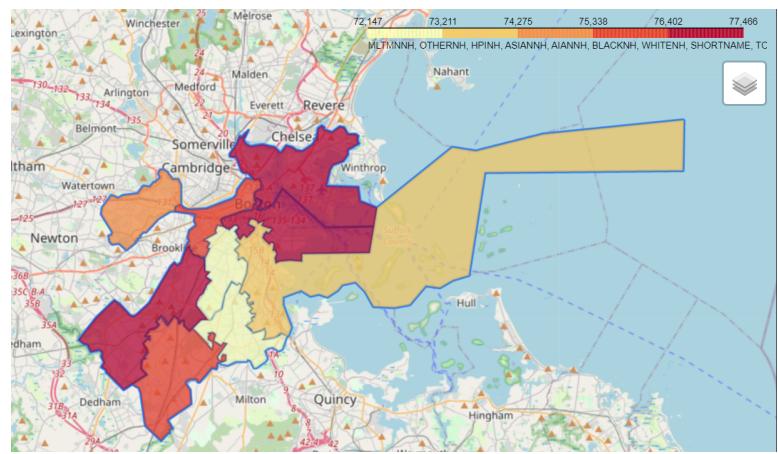
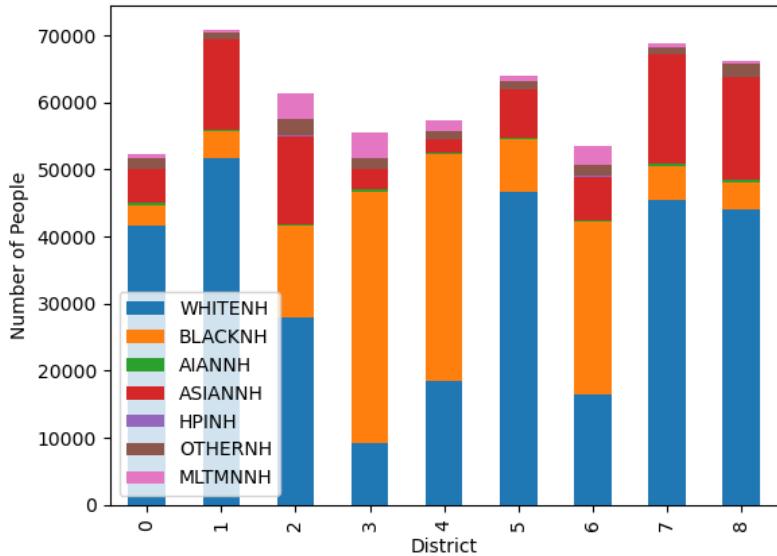
#### **Overlay of Police Districts on to Congressional Districts:**



- Race Distribution throughout Congressional Districts:**

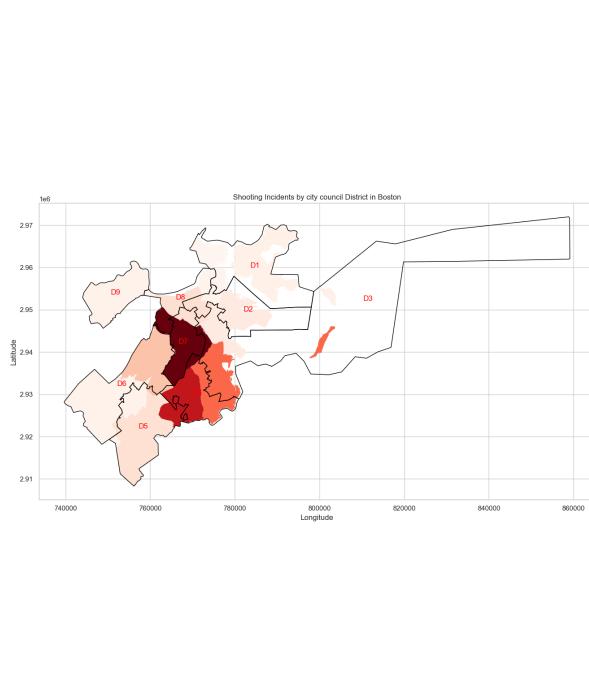
From the Bar graph on the left, we can visualize the demographics of Boston's congressional districts by population. The map on the right visualizes which district has the highest concentration of each race.

Race Distribution in Districts



### Shootings in Boston Congressional Districts:

The following map displays the concentration of shootings based on congressional districts. We can see that district D4 has the 2nd highest concentration of shootings when compared to the other districts.



# **Base Analysis**

**Q1: What are the drivers of violence in District 4? How does this compare to the rest of the city?**

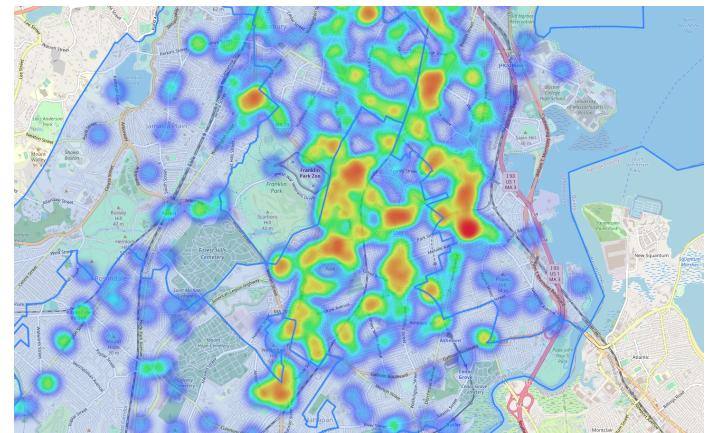
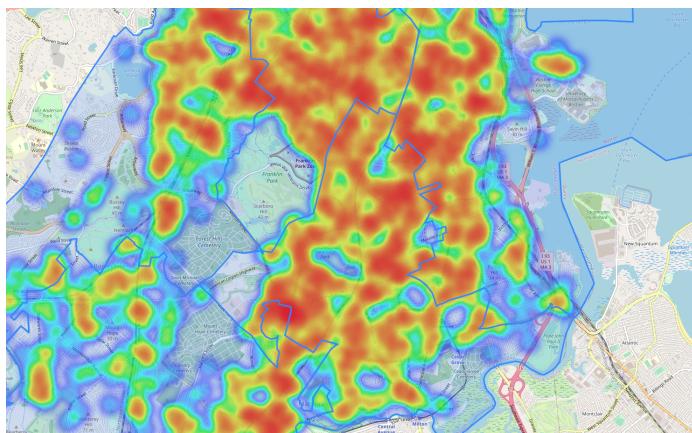
**How we answered the question:**

To answer this question, we had looked at the data we had available in our main datasets as well as potential extension datasets to try and see if there was any correlation between certain factors and the violence in District 4. Dropout rates can be regarded as a driver of violence for a multitude of reasons including the fact that these young teenagers now have a lot more time on their hands, may be involved in gang related activities, or are inclined to commit crime as a means for financial gain. Additionally, weapons on high school premises were observed as there is a clear correlation between weapon presence and violence. Next, we are inclined to think that crime is a driver of other crime and therefore we looked into theft, drug, and firearm related offenses in Boston to see how they correlate to overall violence.

**How we analyzed the data:**

For the dropout rate and weapon on school premise datasets, we mapped out the city of Boston and obtained the address of every high school in the city through the GeoPy library. Then, depending on the amount of dropouts/weapons on school premise offenses, we linearly scaled the data using matplotlib. Finally, we plotted it out onto the mapped city with each district delimiter. For the crime offenses dataset, we used a heat map and GeoPy, as each offense is nicely recorded along with its latitude and longitude.

## What does the resulting output look like:

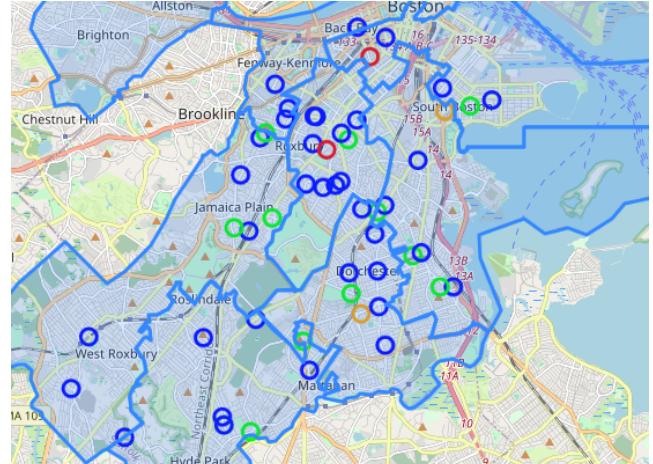
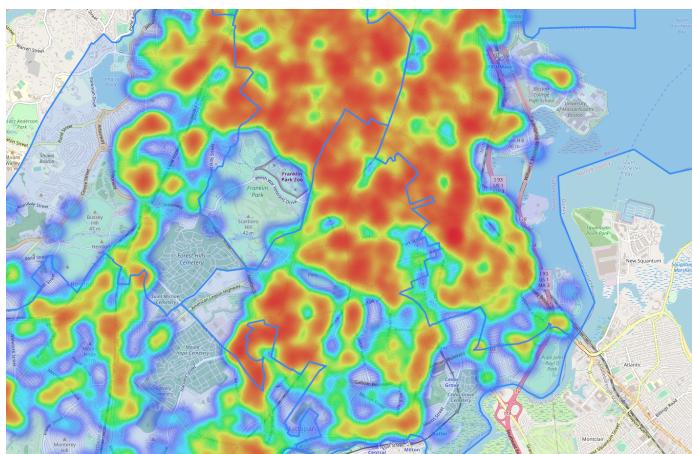


### Drug Offenses (2022)

This heat map illustrates drug related offenses such as possession, use, and trafficking.

### Firearm Offenses (2022)

This heat map illustrates firearm offenses such as possession, trafficking, and robbery.

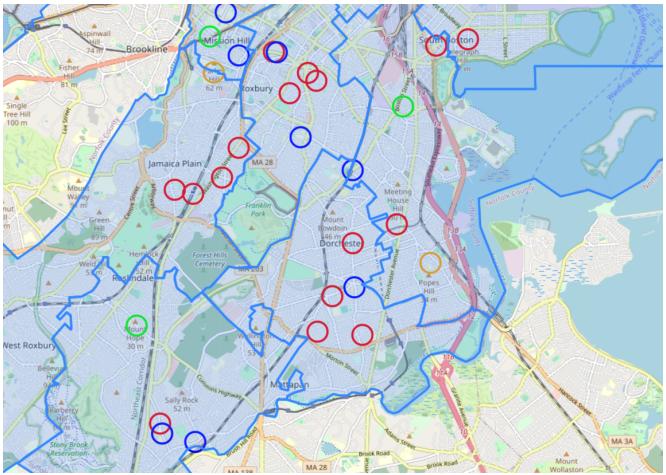


### Theft Offenses (2022)

This heat map illustrates theft related offenses such as larceny, auto theft, and robbery.

### Weapons on School Premise (2022)

This graph illustrates the schools that had the presence of weapons and their occurrence density.



### **Dropout Rate High School (2022)**

This graph illustrates the schools that had dropouts and their occurrence density.

## **How does this help us answer the question :**

At first glance, we can conclude that indeed crime leads to more crime. This can clearly be seen with drug and theft offenses being strongly correlated to the location of firearm offenses (including carrying, and violent use). There is heavy presence of these offenses in District 4 along with north of it leading into Roxbury and the South End. Nonetheless, District 4 is heavily hit by these offenses. Another point to be made is that these are only the recorded offenses. There is a high likelihood that due to having fewer police stations in District 4, many offenses are not accounted for, and therefore the data does not show the whole story of many offenses committed in District 4. Further, the presence of weapons on school premises has been reported often in and around District 4, with Dorchester having a very high if not the highest number of occurrences. Similarly, the dropout rate of high school students follows the same pattern. We can conclude that these offenses and reports are a part of the leading drivers of violence in District 4. However, there are still more questions to be answered on what the deeper and root cause of violence is.

Datasets used -

Discipline records from schools for school discipline

Dropout Rate - <https://profiles.doe.mass.edu/statereport/dropout.aspx>

Weapon on School Premise - <https://profiles.doe.mass.edu/statereport/dropout.aspx>

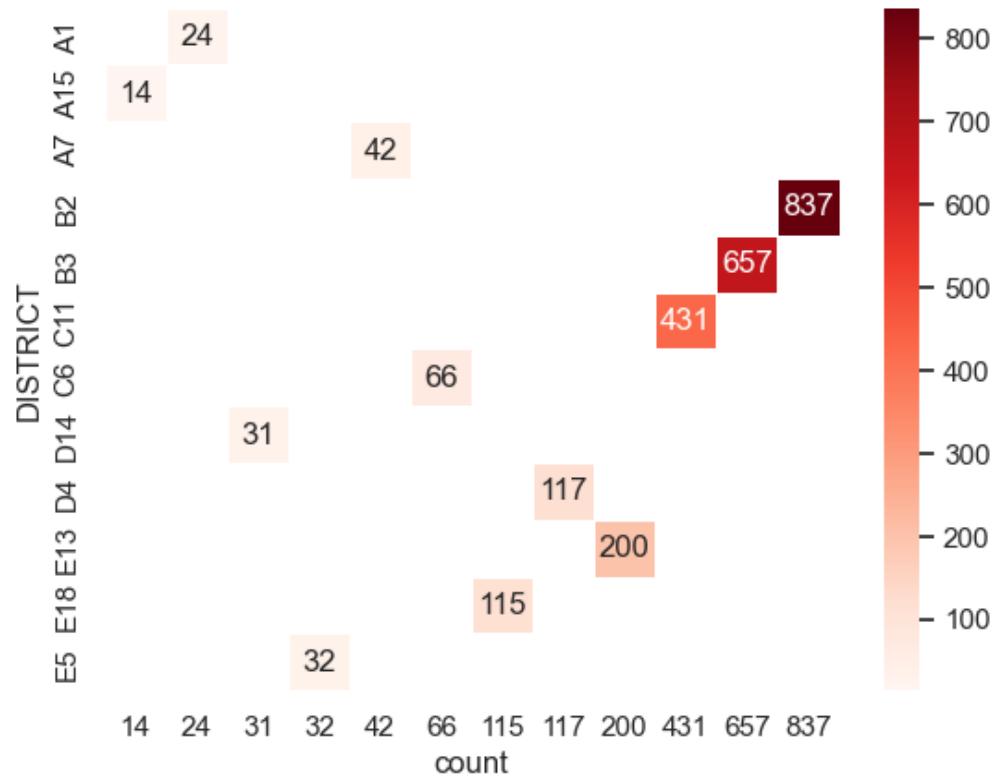
Crime Incident Reports - Analyze Boston

<https://data.boston.gov/dataset/crime-incident-reports-august-2015-to-date-source-new-system>

## Q2: What is the rate of gun violence in District 4? How does this compare to the rest of the city?

As we can see the congressional district D4 is made up of police districts C11 and B3 (referred to from now on as D4) where we can see based on Figure 1.1 based on the data from 2015-2023 for shooting incidents in D4 there were a total of 1088 incidents which took place. As for referring to Figure 1.2 D4 we can see there has been a pattern rise and fall however the median remains the same. We can also see that in terms of race affected the most and the least, Black males were the most affected by the shooting incidents and in terms of females, Black females were the most affected. Asians were the least affected / non affected demographic. White males were mildly affected and White females were mostly unaffected.

Fig. 1.1 Shooting incidents in different police districts in the year 2015 - 2023



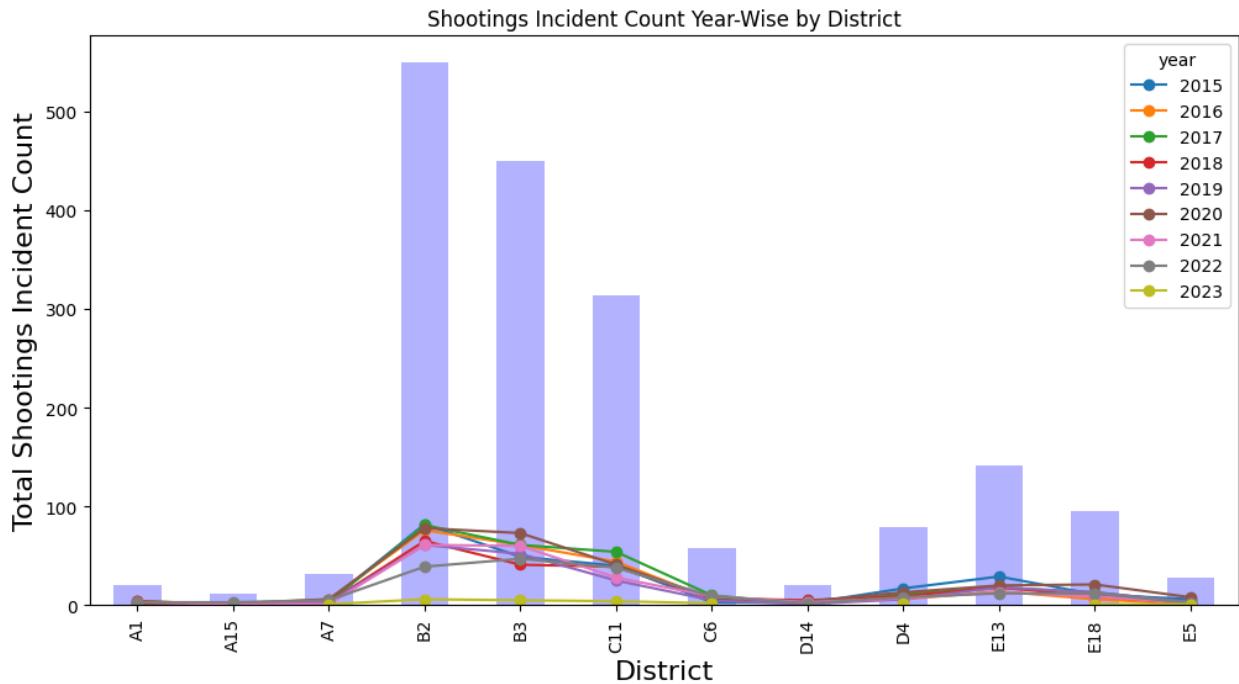


Fig. 1.2 Total shooting per district along with shootings in a particular year.

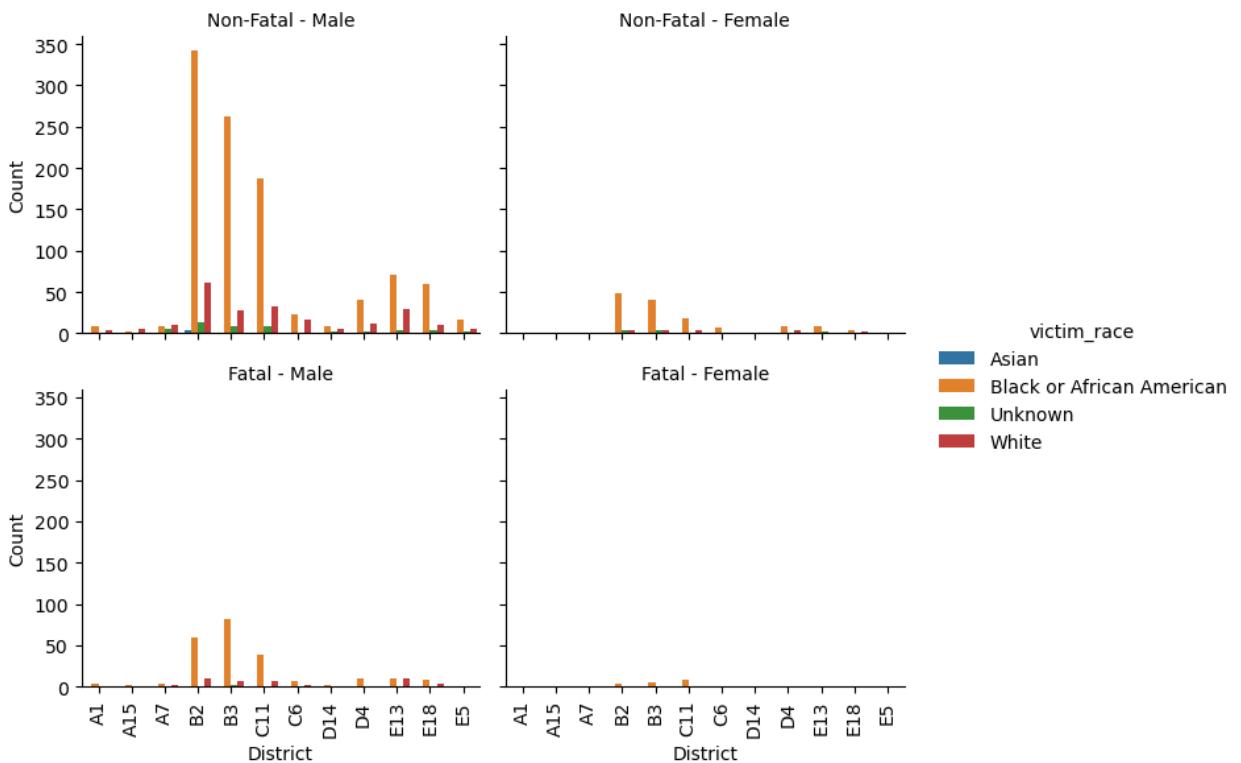
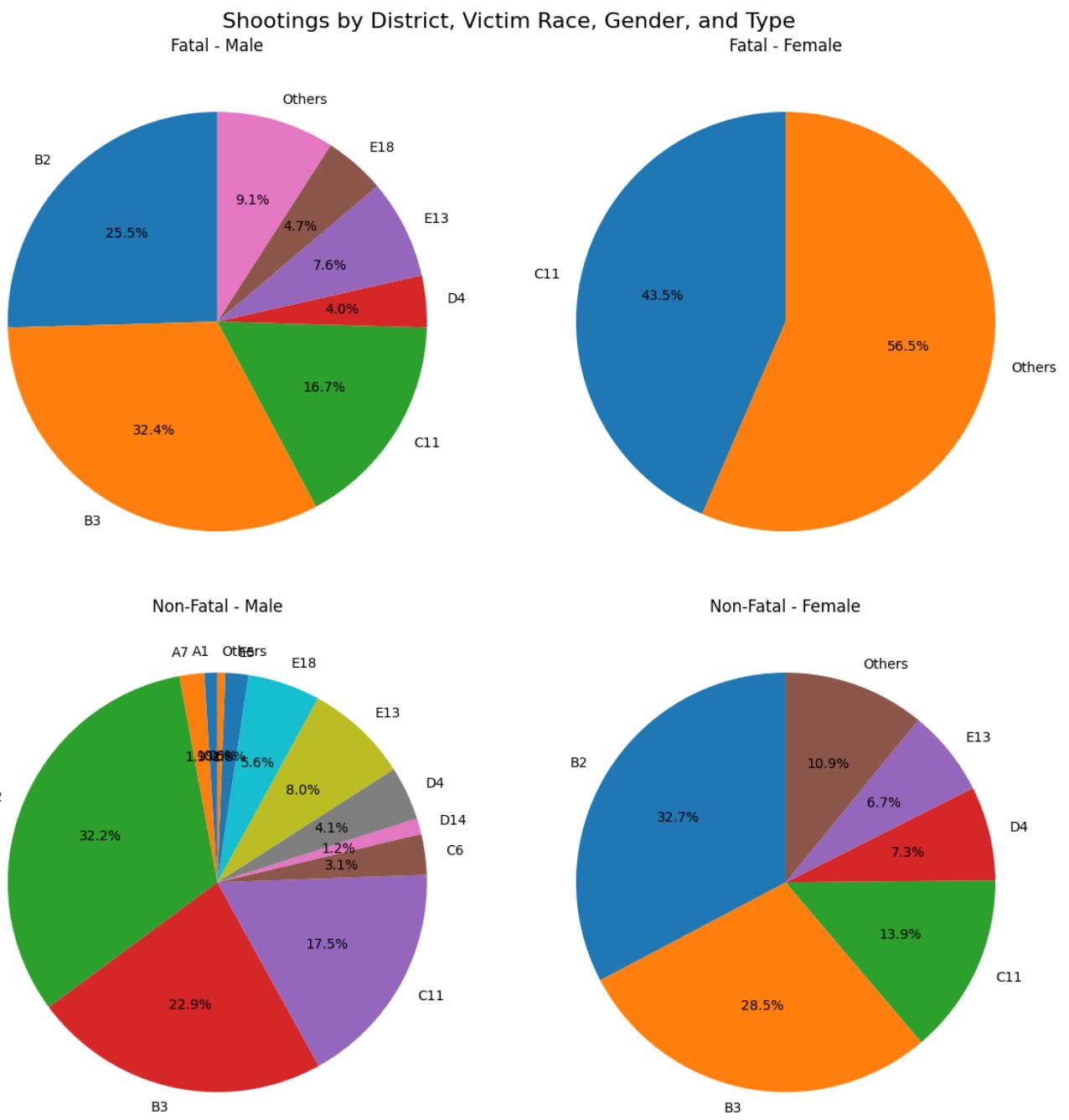


Fig. 1.3 Bar chart of victims in shooting incidents in police districts



**Fig. 1.4 Shootings by district, victims race, gender and fatality type**

### **Q3: Are there patterns of violence in terms of location in District 4? How does this compare to the rest of the city?**

Early Analysis:

- Less police stations spread near D4 and compared to main Boston. (more easy of violent people to do crime)
- Only one hospital in D4 and compared to main Boston. (bad health and human services strategy to put one hospital )
- Only one university in D4 , but very densely situated universities in the main city. (High school students don't see universities as an aspiration and resort to other methods to earn money. Some of them might choose a criminal path.)
- Parks and greenery is very less in D4 as compared to the rest of the city. (Less greenery might lead to bad mental health situations)

#### **How we answered the question:**

To answer the question regarding violence in District 4, we analyzed several datasets, including those from the Police Department and public transportation (MBTA). Additionally, we considered supplemental data such as police districts, police stations in districts, community centers, and parks.

Our analysis revealed several socio-economic factors that may contribute to the violence in District 4:

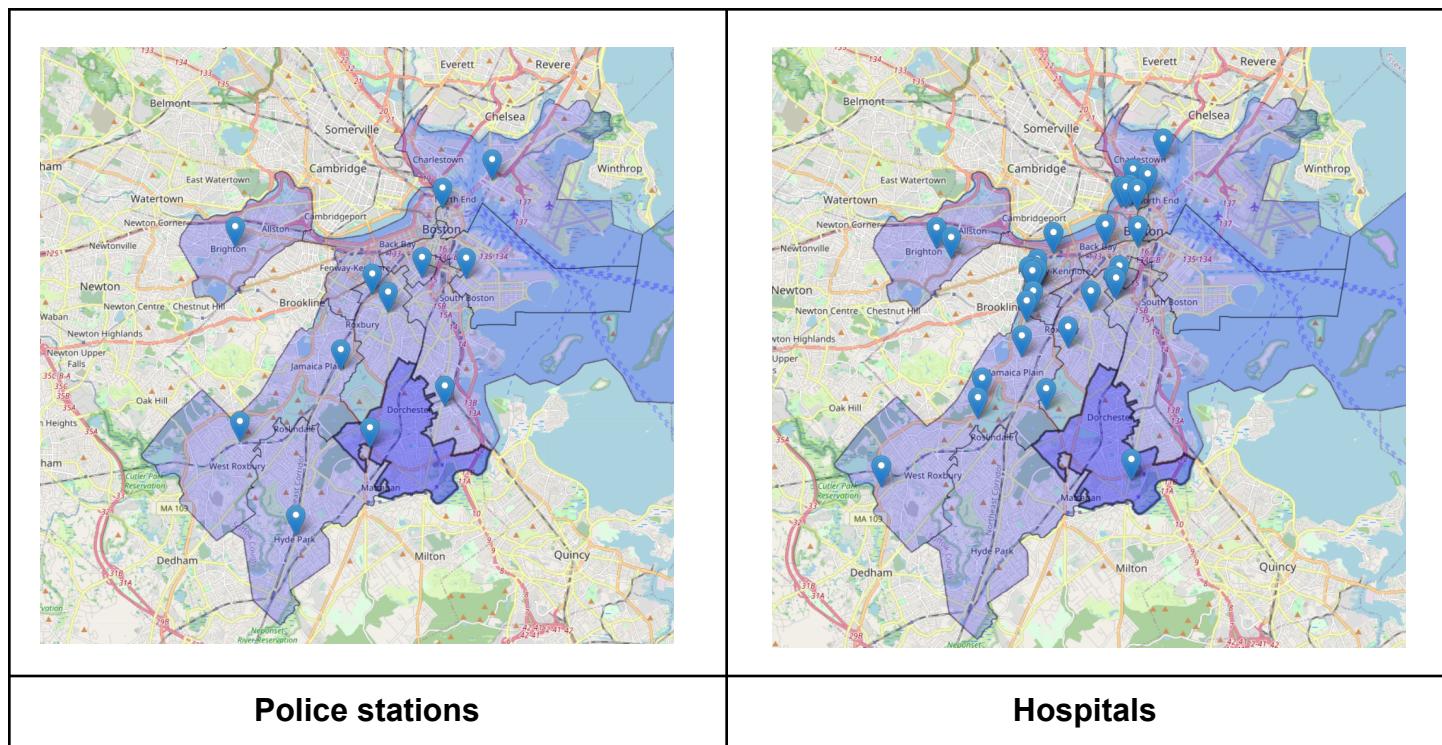
- A limited number of police stations in District 4 compared to main Boston, which may facilitate criminal activity.
- Only one hospital in District 4, pointing to a potential lack of adequate health and human services.
- A single university in District 4, which might discourage high school students from aspiring to higher education and drive them towards alternative, potentially criminal, paths for income.
- A scarcity of parks and green spaces in District 4 compared to the rest of the city, which could negatively impact mental health.
- Upon examining the Field Interrogation and Observation dataset, we identified a significant pattern of gun-related violence in District 4, particularly in Dorchester,

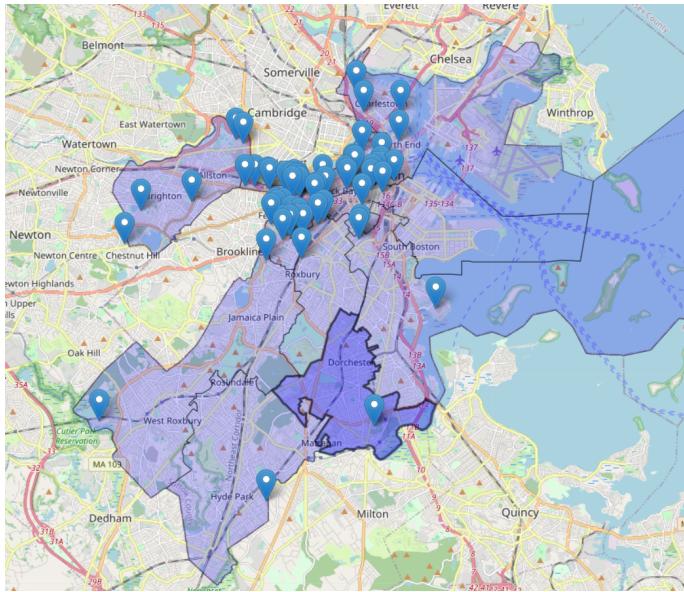
Mattapan, and parts of Jamaica Plain and Roslindale. The majority of these incidents occur during afternoon, evening, and nighttime hours, emphasizing the need for targeted interventions during these times.

An analysis of shooting locations in relation to public transportation revealed that most shootings happen in areas further away from MBTA stops, which is consistent with the geographical distribution of District 4. In contrast, areas such as east and south Boston experience shootings mainly near MBTA stop locations.

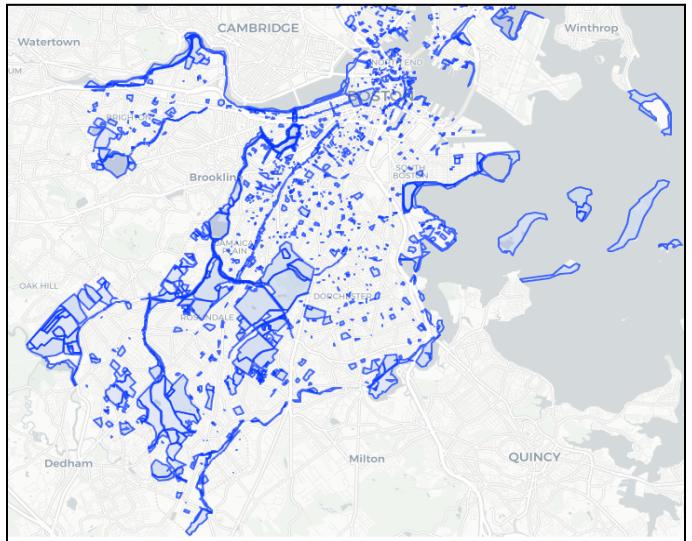
We also found that the primary age group for suspects involved in gun-related incidents in District 4 is between 19 and 34 years old. However, Dorchester displayed a higher number of suspects under 18, indicating a concerning trend of youth involvement in gun-related violence.

Lastly, we observed that the homicide clearance rate in District 4 has been generally decreasing from 2015 to 2020, with a brief increase in 2018 before hitting the lowest rate of 0.35 in 2020. This trend could signify a need for more effective law enforcement strategies and community engagement to address the ongoing violence in District 4.

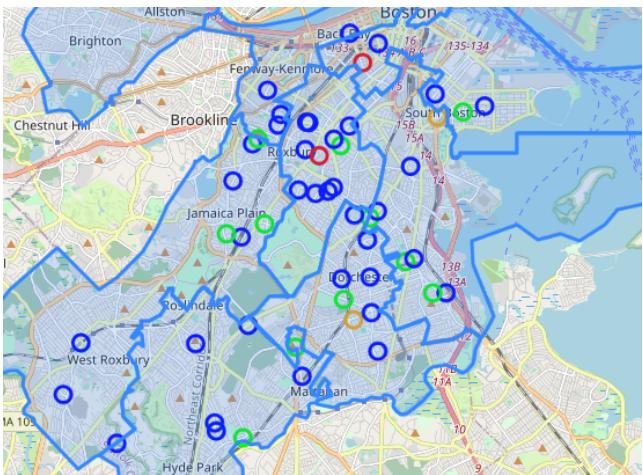




**Colleges and universities**



**Parks**



### **Weapons in high school**

This graph illustrates the schools that had the presence of weapons and their occurrence density.

## **How we analyzed the data:**

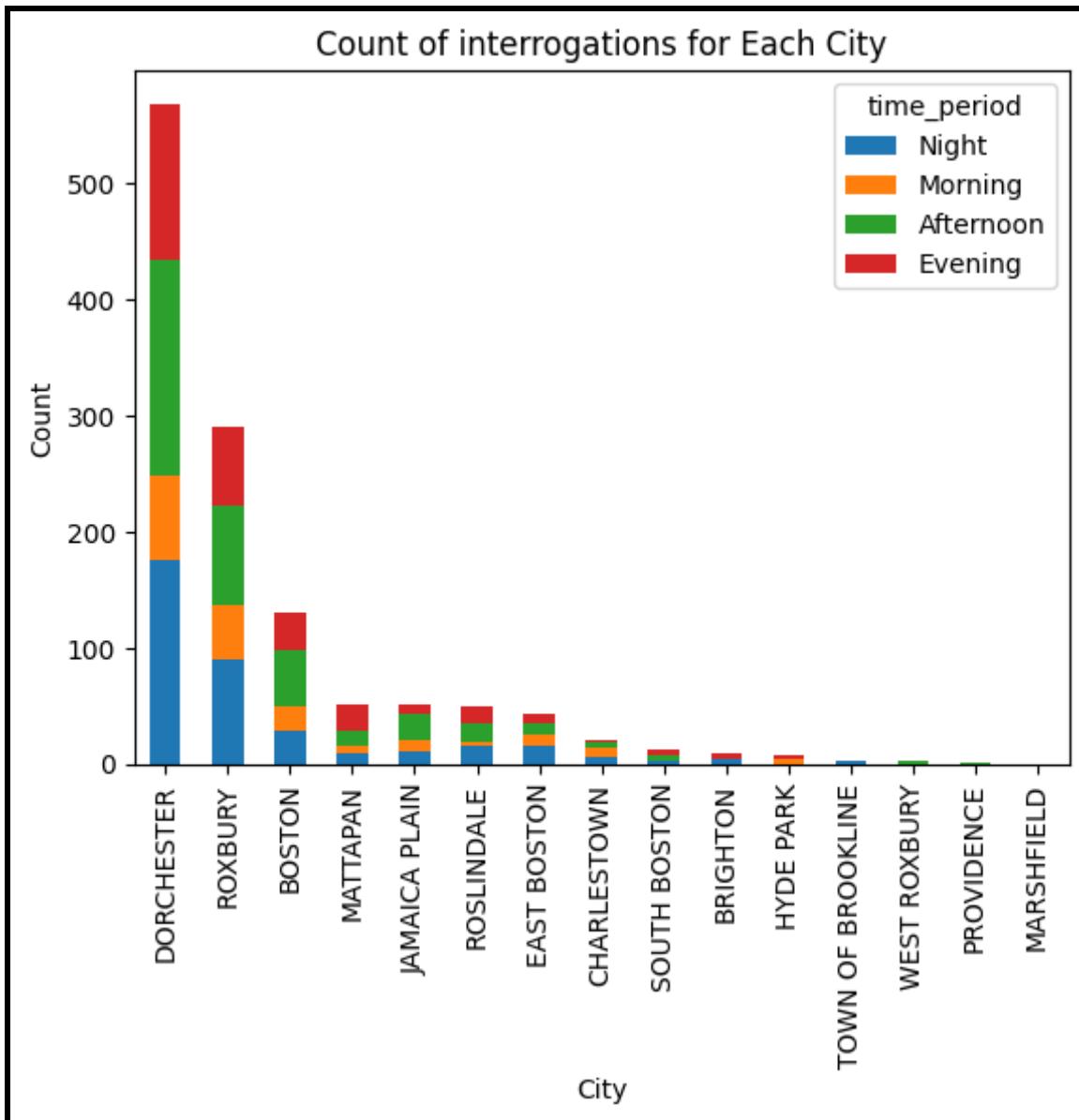
To analyze the data and understand the factors contributing to violence in District 4, we followed a systematic approach, utilizing various datasets and supplemental data sources. Our methodology is outlined below:

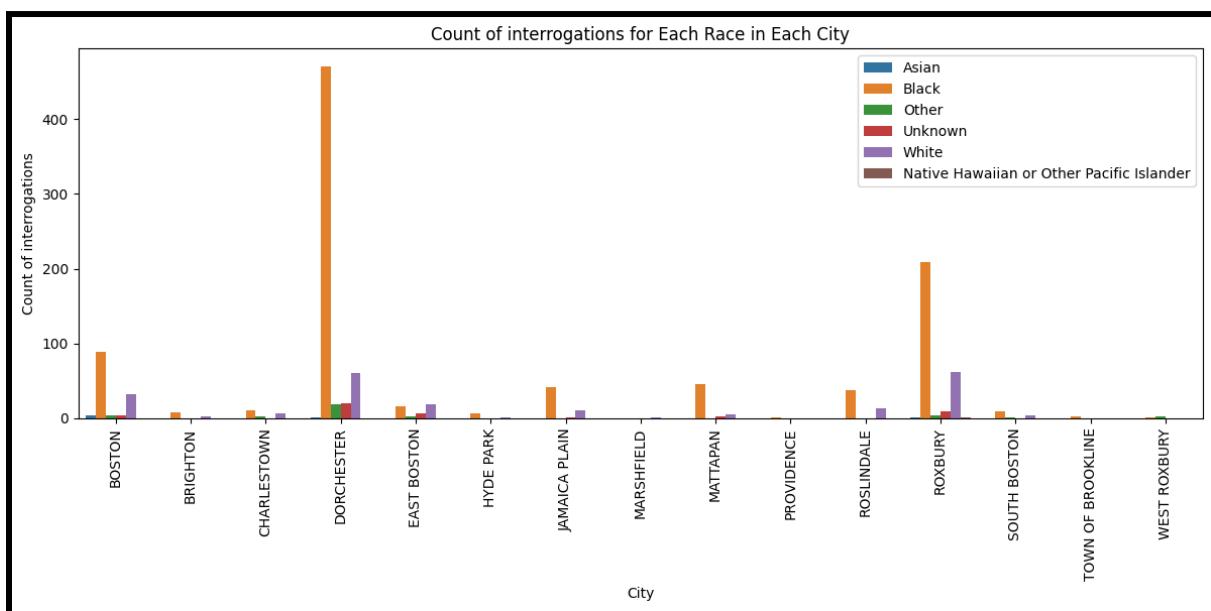
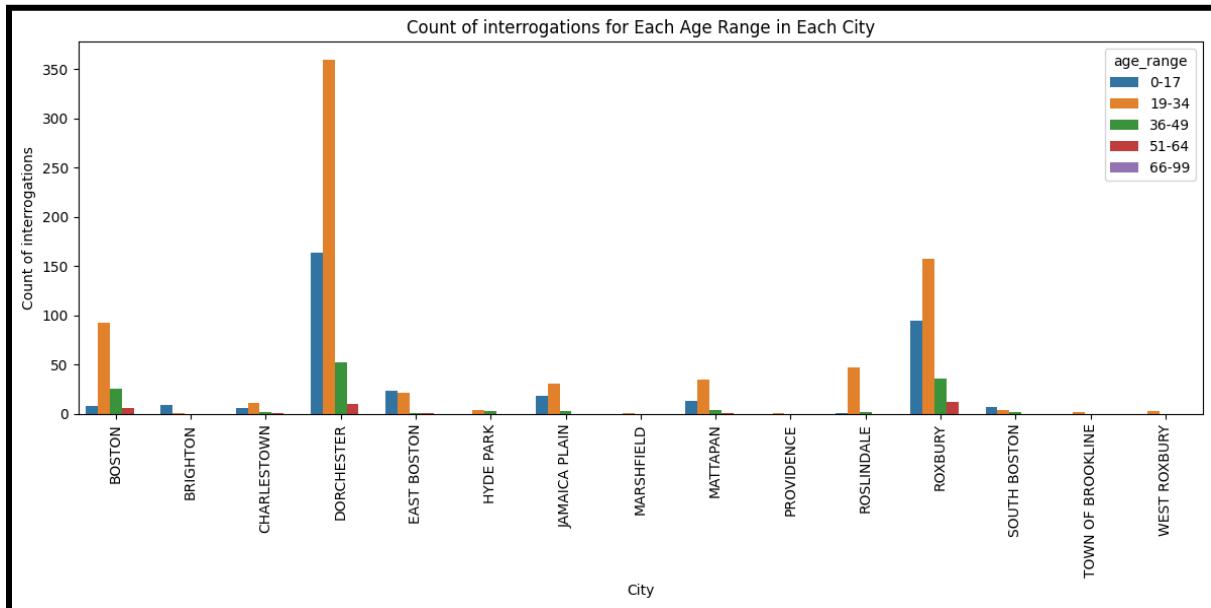
- **Data Collection:** We first gathered relevant datasets, including Police Department datasets (Field Interrogation and Observation data, Shootings, Shots Fired, and Crime Incident Reports) and public transportation data (MBTA). We also collected supplemental data such as information on police districts, police stations, community centers, parks, hospitals, and universities.
- **Early Analysis:** We conducted an initial examination of the socio-economic factors that could be related to violence in District 4. This involved comparing the availability of resources like police stations, hospitals, universities, and green spaces in District 4 to the rest of Boston.
- **In-depth Examination:** We delved deeper into the Field Interrogation and Observation dataset to identify patterns of gun-related violence in District 4. We focused on factors such as the timing of incidents and the age of suspects involved.
- **Geospatial Analysis:** We analyzed shooting locations in relation to public transportation, specifically MBTA stop locations, to identify any correlations or patterns that might help explain the violence in District 4.
- **Trend Analysis:** We investigated trends in the homicide clearance rate from 2015 to 2020 to understand how effective law enforcement has been in addressing violence in District 4.

Throughout our analysis, we used various data processing and visualization techniques to better understand the relationships between different factors and violence in District 4. We identified key insights, such as the prevalence of gun-related violence, the timing of incidents, the age of suspects, and the relationship between violence and public transportation.

By synthesizing the information gathered from these datasets and analyses, we were able to draw conclusions about the potential drivers of violence in District 4 and suggest targeted interventions and strategies to address these issues.

Our analysis of gun-related interrogations has revealed that the primary age group for suspects in City Council District 4, as well as throughout the city, falls between 19 and 34 years old. However, we must pay particular attention to the Dorchester neighborhood within District 4. This area exhibits a significantly higher number of suspects under the age of 18, indicating a concerning trend of youth involvement in gun-related incidents.





## How does this help us answer the question :

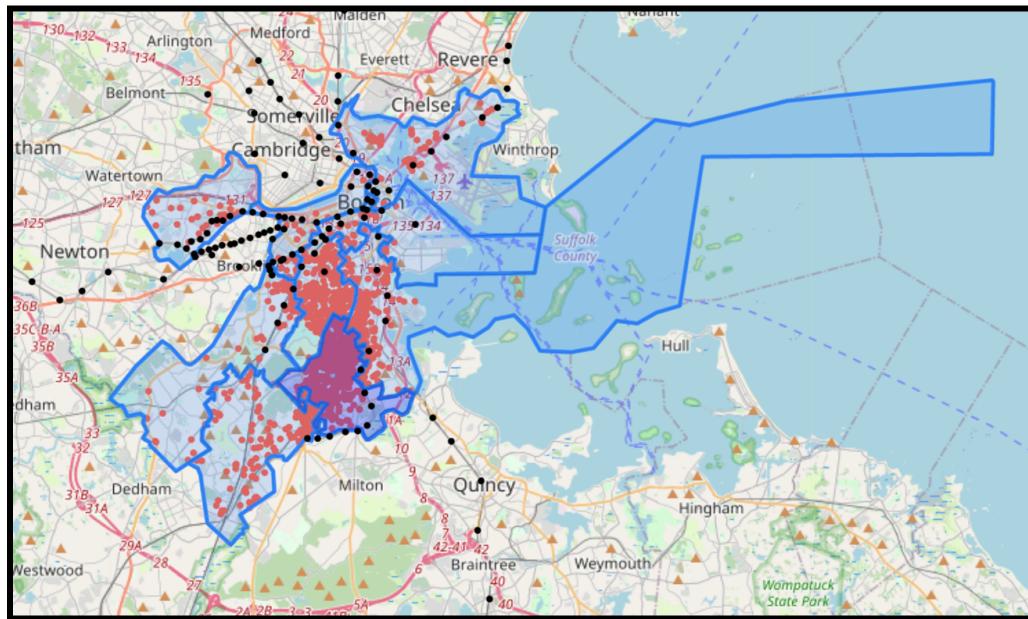
After conducting a thorough analysis of the Field Interrogation and Observation dataset, it has come to our attention that a notable pattern of gun related violence exists within District 4. This district, which encompasses Dorchester, Mattapan, and parts of Jamaica Plain and Roslindale, experiences a significantly higher rate of firearm-related incidents compared to the rest of the city.

Furthermore, our analysis reveals that the majority of gun-related incidents occur during afternoon, evening and nighttime hours. This crucial insight highlights the need for targeted interventions and increased vigilance during these specific periods.

This data helps us answer the question by providing insights into the factors contributing to the violence in District 4 and identifying areas for targeted interventions. The key findings from the analysis are:

1. The prevalence of gun-related violence in District 4 compared to the rest of the city indicates that firearm-related incidents should be a primary focus when addressing violence in the district.
2. The timing of gun-related incidents (afternoon, evening, and nighttime hours) suggests that targeted interventions and increased vigilance during these periods could potentially reduce the number of violent incidents.
3. The relationship between shooting locations and their proximity to public transportation reveals an area-specific pattern in District 4, which could help law enforcement and city planners develop strategies to improve safety in these locations.
4. The age group of suspects in gun-related incidents, particularly the higher number of suspects under 18 in the Dorchester neighborhood, emphasizes the need for prevention and intervention programs targeted at young people in District 4.
5. The decreasing homicide clearance rate from 2015 to 2020 suggests a need for improved law enforcement strategies and community engagement to better address ongoing violence in District 4.
6. The inverse relationship between the number of guns recovered and the homicide clearance rate highlights a potential area for further investigation. Understanding this relationship could help identify strategies to improve the effectiveness of law enforcement in reducing violence.

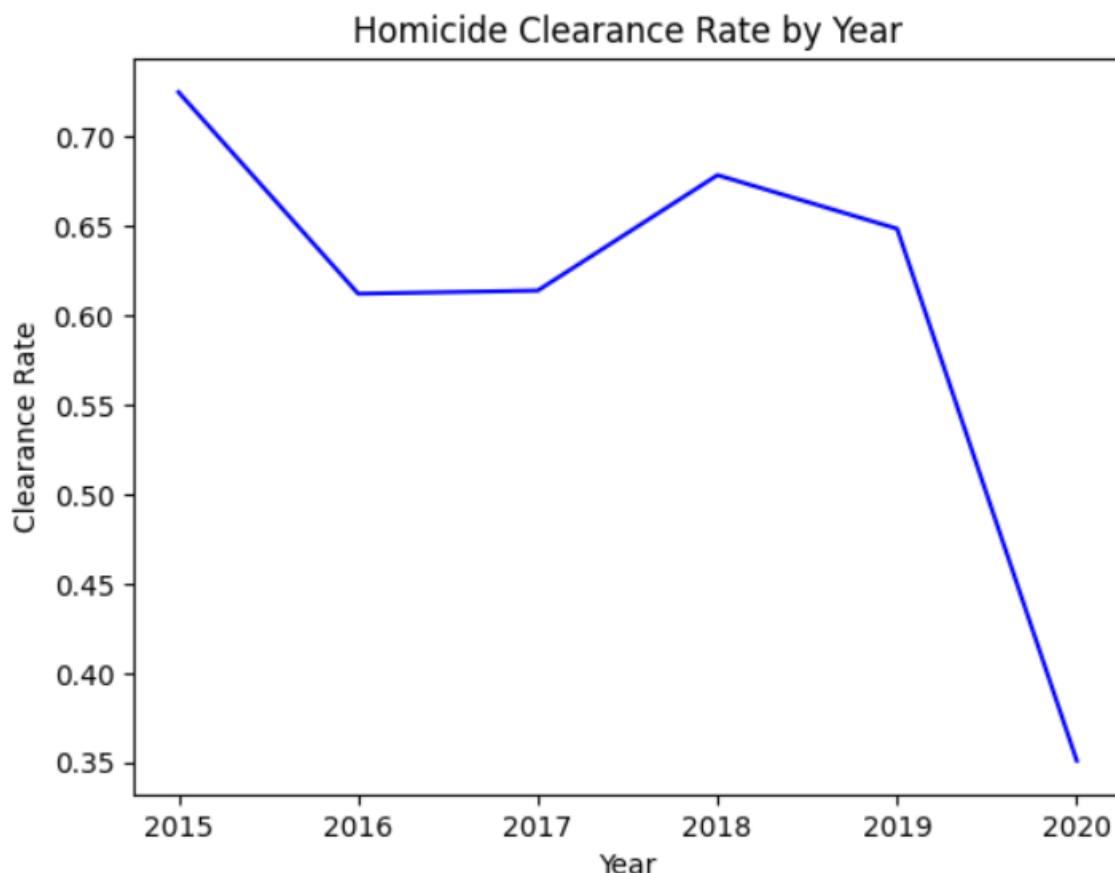
By analyzing the data from various sources, we can better understand the patterns, trends, and factors associated with violence in District 4. This understanding enables the development of targeted interventions and strategies to address the root causes of violence and create safer communities.



Upon further examination of shooting locations and their proximity to public transportation, specifically MBTA stop locations in Boston, we've identified a distinct pattern. The majority of shootings appear to occur in areas farther away from MBTA stops. Significantly, these areas encompass almost the entirety of Boston City Council District 4. For other neighborhoods, for example east and south Boston, the shooting pattern is specifically near MBTA stop locations.

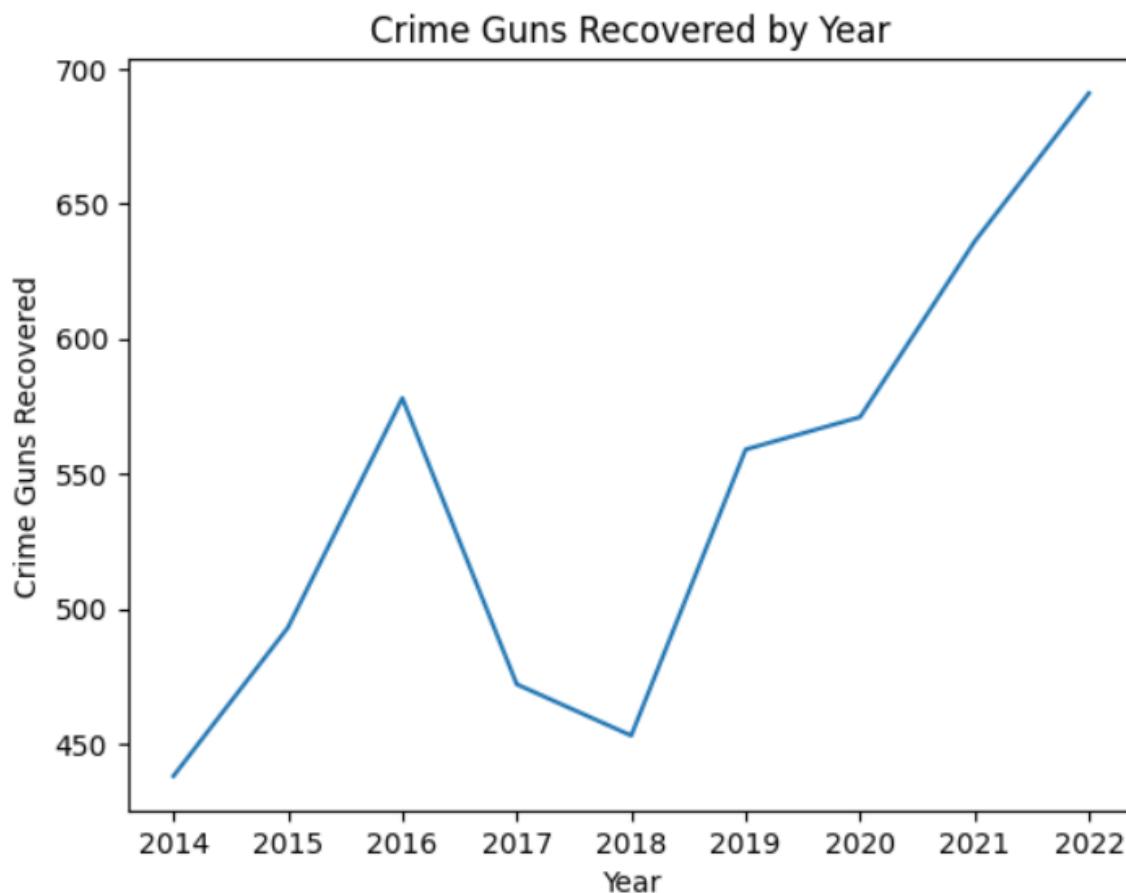
## Homicide Clearance Rate by Year

From 2015 to 2020, the rate of homicides cleared in District 4 has been generally decreasing with an uptick in 2018 of 0.68 before reaching the lowest rate of 0.35 in 2020.



## Crime Guns Recovered by Year

From the chart, we can see that the number of guns recovered in District 4 is generally increasing from 2014 to 2022 with a dip in 2018 of 450 guns and the highest number of recovered guns in 2022 with just under 700 guns. It is interesting to note that the trends in the number of guns recovered and the homicide clearance rate in district 4 have an inverse relationship. When the homicide clearance rate is high, the number of guns recovered is low and vice-versa.



#### Datasets used

→ Police Department Datasets

- FIO data - <https://data.boston.gov/dataset/boston-police-department-fio>
- Shootings - <https://data.boston.gov/dataset/shootings>
- Shots fired - <https://data.boston.gov/dataset/shots-fired>
- Crime incident reports -  
<https://data.boston.gov/dataset/crime-incident-reports-august-2015-to-date-source-new-system>

→ Public Transportation (MBTA) Dataset

→ Supplemental Data used

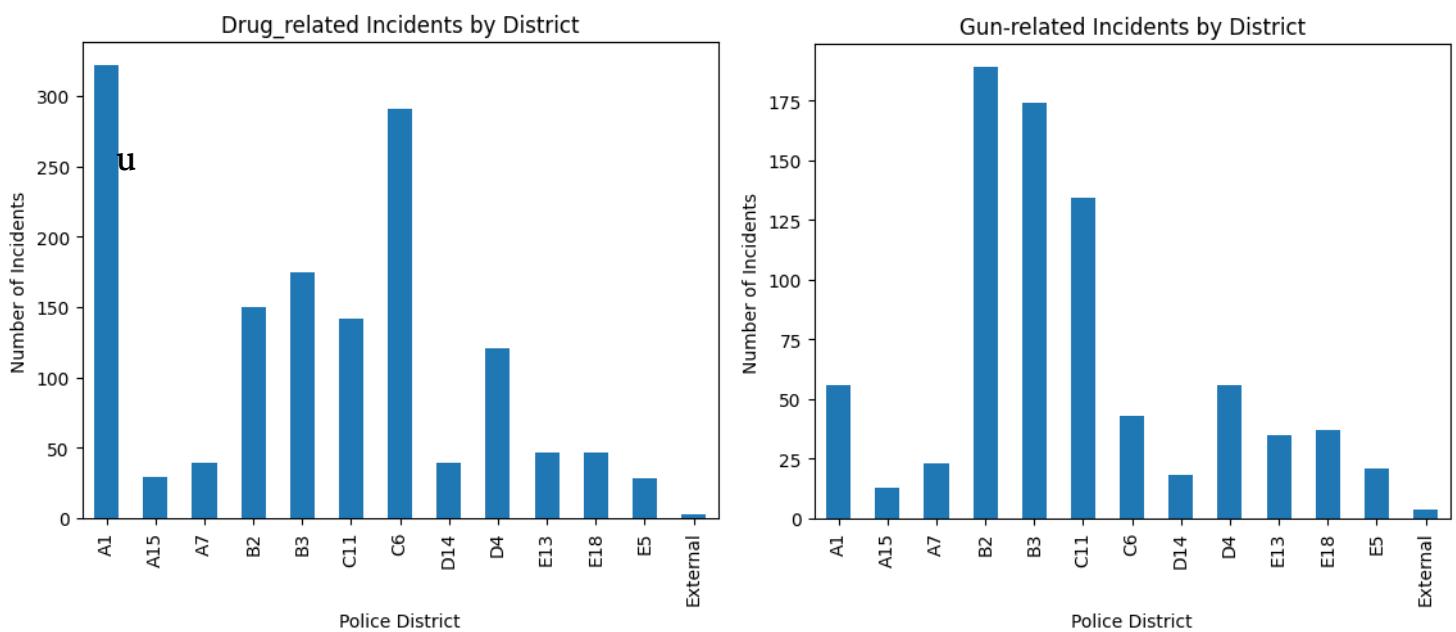
1. Police districts
2. Police stations in districts
3. Community centers and parks

## **Q4: Are there patterns in terms of type of violence in District 4? How does this compare to the rest of the city?**

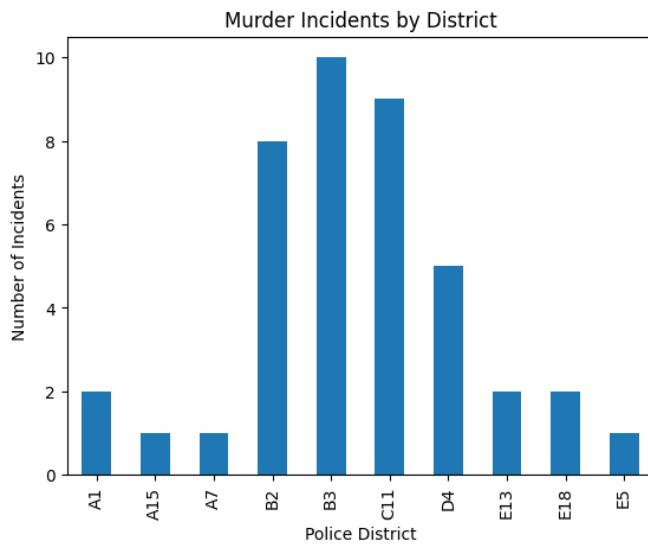
Some patterns that we can see arise in terms of type of violence include high concentrations of gun-related and murder incidents when compared to the other districts. District 4's concentrations of drug related incidents did not appear to be significantly more or less concentrated than the other districts. The variation of types of violence in district 4 appeared to be higher than that of the other districts. There did not seem to be any violence patterns among districts when comparing incidents of weapons in schools.

From the following bar graphs we can see several patterns when comparing police districts B3 and C11 (which happen to be in congressional district 4) to the other police districts. We can see that drug related incidents in B3 and C11 have the 3rd and 5th most drug related incidents respectively.

We can also see that police districts B3 and C11 have the 2nd and 3rd most gun-related incidents respectively, when compared to the other police districts.

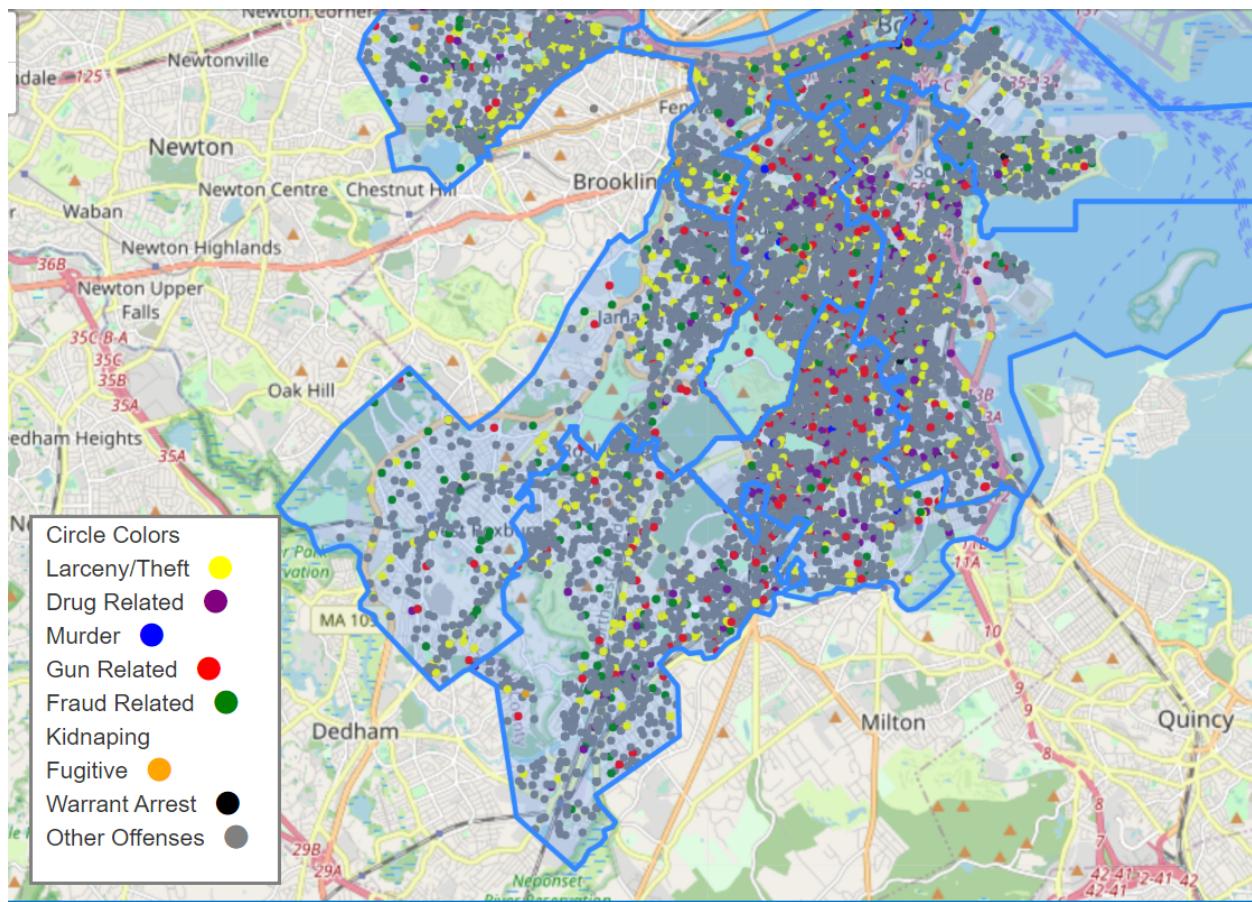


From the graph, we can see that murder incidents in districts B3 and C11 have the highest and second highest number of incidents than the other districts. This means that congressional district 4 has the highest number of murder incidents.



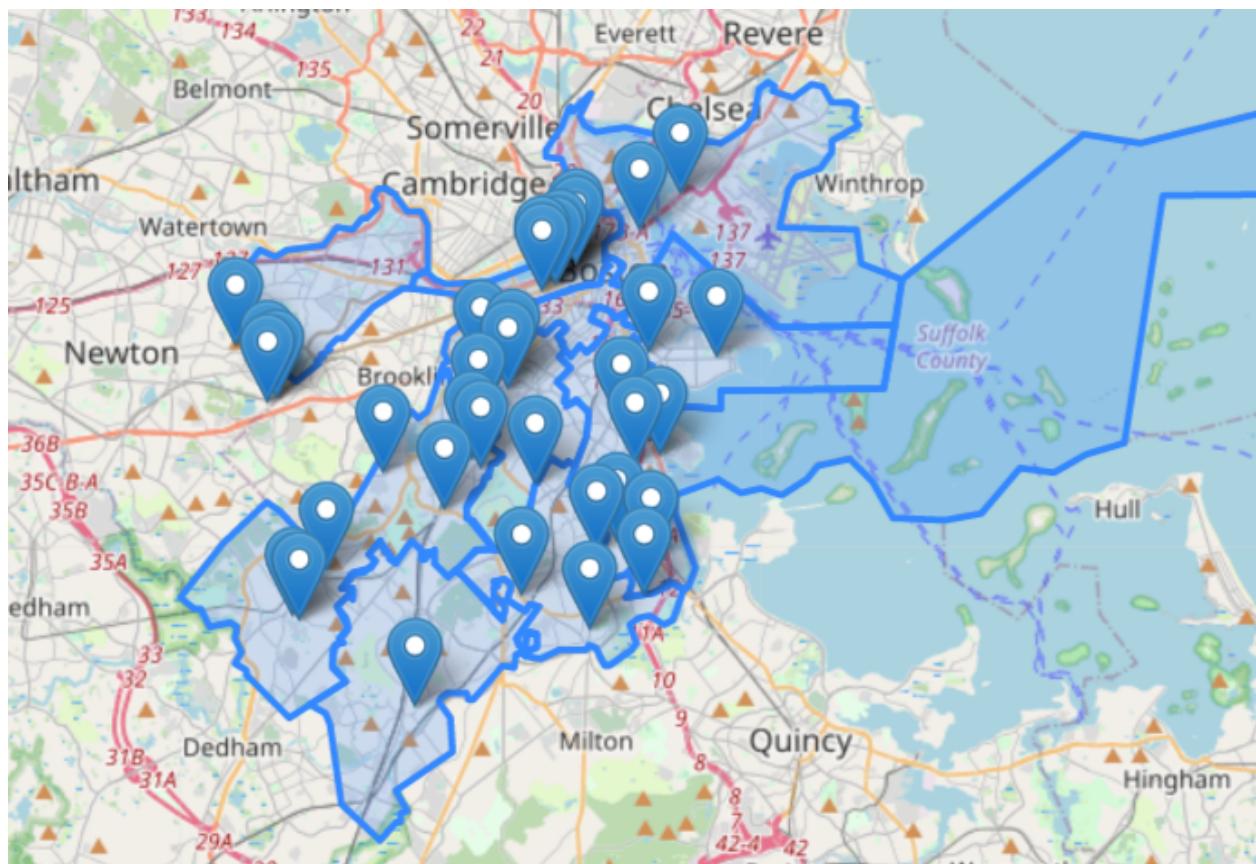
## Map of Different Types of Violence in Boston:

The following map shows a high concentration of violent acts in the downtown Boston area as well as the district 4 area. It is interesting to note that even though the district 4 area is not the most concentrated for violent acts, there is more variation in types of violent acts in district 4 than there is in the downtown area.



## Map of Incidents of Weapons found in Schools throughout Boston:

The following map shows points where there was at least one incident where a student brought a weapon on the school campus. We can see that there does not appear to be a high concentration of these incidents in district 4. Because of this, we can conclude that incidents of students bringing weapons to campus do not contribute to the patterns of violence in district 4.



# Extension Proposal

Explore connections between gun violence and Community Engagement Centers and Resource Accessibility.

**Rationale:** Understand social determinants of gun violence and pinpoint community-based solutions.

## **Leading Questions:**

- What is the relationship between community engagement and gun violence in District 4?
- How does resource accessibility (education, employment, and recreational facilities) impact gun violence in District 4?

## **Additional Questions:**

- Are there specific community programs or resources that demonstrate a substantial impact on reducing gun violence?
- Do areas featuring a higher prevalence of green spaces or public amenities experience lower rates of gun violence?
- Which socio-economic factors contribute to the observed patterns of gun violence?
- Can recreational resources like entertainment and food establishments serve as a distraction for the population and potentially decrease the incidence of gun violence?

## **Data:**

- Community centers/programs
- Parks, recreation, and green spaces
- School performance/dropouts
- Income restricted housing

## **Visualizations:**

- Heatmaps
- Scatter plots
- Bar charts

## Implementation of Machine Learning Models

We would like to implement machine learning models to our project, however, datasets that we are currently using are not large enough to produce anything relevant, more precisely within the city of Boston. We hope to find a large enough dataset to retrieve relevant features and build a model off it before the final report is due.

## *Extension Questions*

**Q5: Can recreational resources like entertainment and food establishments serve as a distraction for the population and potentially decrease the incidence of gun violence?**

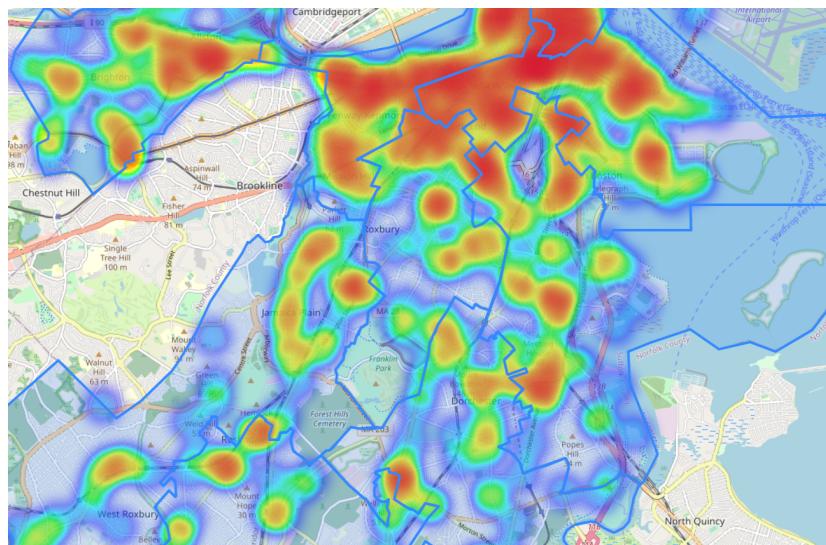


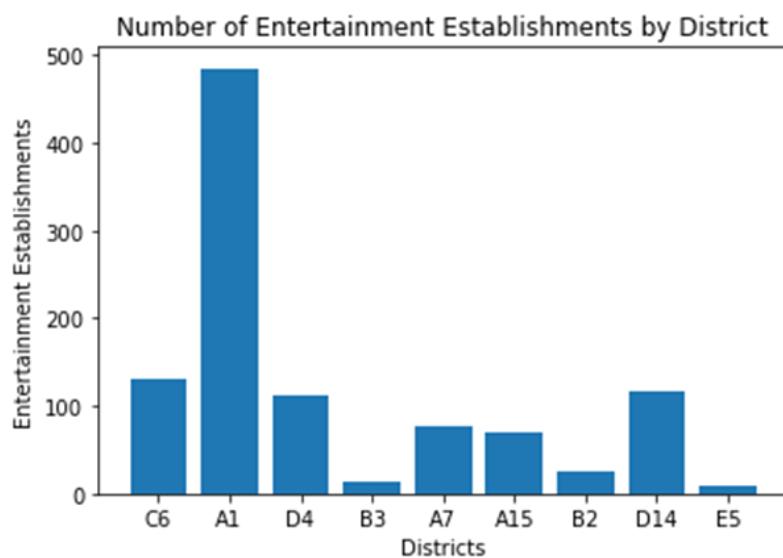
Fig. Food Establishments in Boston that have an active license.

Above we have shown the food establishments that have an active license on a heat map of the city of Boston. These data points come from this [dataset](#) from Analyze Boston. Note that the dataset contains ~3,000 establishments but only ~2,000 had valid longitude and latitude coordinates making them usable for this visualization.

We can see a clear lack of dining establishments in South Boston and particularly in district D4 as compared to the rest of Boston. This disparity may suggest that district D4 is economically disadvantaged or has a lower population density, leading to less job opportunities for residents. This can be a driver for gun violence as crime is committed for financial gain.

Further, another interesting point is that this lack of dining establishments could be reducing the amount of foot traffic and social activities in the area which act as a deterrent to gun violence. Locations with less foot traffic can also be considered as less safe, which attracts criminal activity and contributes to higher rates of gun violence.

When looking at the number of entertainment establishments by district, we can see that district 4 is among the districts with the least number of entertainment establishments. There is most likely a correlation between this and the number of dining establishments due to socio-economic factors. This reinforces the previously mentioned effects of having fewer establishments in the district. Once again, the decrease in foot traffic and social activities could be linked to more gun violence in the area. Another effect of having less entertainment establishments could lessen the sense of community, which could be a factor for violence.



## **Q6: Which socio-economic factors contribute to the observed patterns of Violence?**

Based on our analysis of the available data, we can identify several socio-economic factors that contribute to the observed patterns of violence in District 4:

**Limited police presence:** District 4 has fewer police stations compared to other parts of Boston, which may lead to decreased law enforcement presence and response times. This could make it easier for criminals to engage in violent activities.

**Inadequate healthcare and community center access:** District 4 has only one hospital and very few community centers, which may contribute to insufficient healthcare and human services support for the community. Access to these institutions can play a role in reducing violence by providing mental health services, substance abuse treatment, and other resources to at-risk individuals.

**Lack of higher education opportunities:** District 4 has only one university, which might discourage high school students from aspiring to higher education. A lack of educational opportunities may push some individuals towards alternative, potentially criminal, paths for income.

**Limited green spaces:** District 4 has fewer parks and green spaces compared to the rest of the city. Green spaces can have positive effects on mental health and well-being, and a lack of these spaces may contribute to increased stress and aggression in the community.

**High dropout rates and presence of weapons in schools:** Our analysis found a significant presence of weapons in schools and high dropout rates in and around District 4. Dropout rates can be a driver of violence, as disengaged youth may turn to crime or join gangs as alternative sources of income or social support.

**Concentration of drug, theft, and firearm offenses:** The data showed a strong correlation between the location of drug, theft, and firearm offenses in District 4. The concentration of these crimes may contribute to an environment where violence is more likely to occur.

**Youth involvement in gun-related violence:** Our analysis revealed that the Dorchester neighborhood within District 4 has a higher number of suspects under the age of 18 involved in gun-related incidents. This suggests that targeting prevention and intervention programs at young people in District 4 may be crucial for addressing the root causes of violence.

These socio-economic factors likely interact with each other and contribute to the observed patterns of violence in District 4. Addressing these factors through targeted interventions, improved access to resources, and community engagement may help reduce violence and create safer communities in District 4.

## **How we answered the question:**

In order to identify the socio-economic factors contributing to the observed patterns of violence in District 4, we analyzed multiple datasets from various sources, including Police Department datasets, public transportation data, and supplemental data on police districts, police stations, community centers, parks, hospitals, and universities. By examining these datasets, we aimed to uncover any correlations or patterns that could help explain the violence in District 4.

## **How we analyzed the data:**

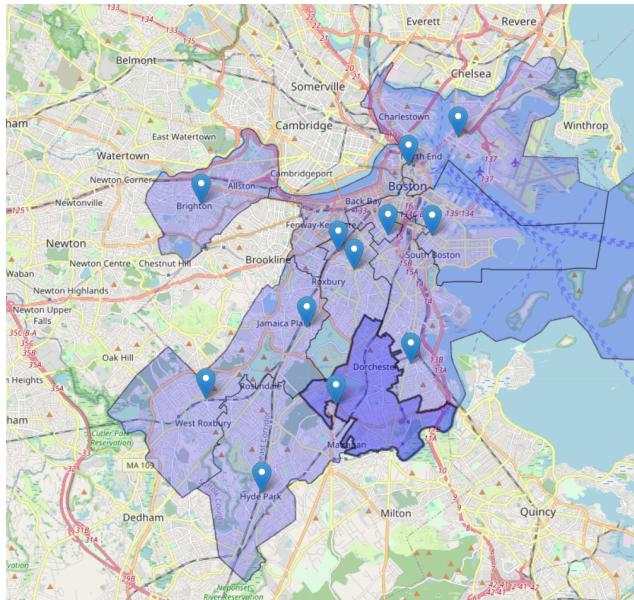
We followed a systematic approach to analyze the data:

- **Data Collection:** We gathered relevant datasets, including Police Department datasets (Field Interrogation and Observation data, Shootings, Shots Fired, and Crime Incident Reports) and public transportation data (MBTA). We also collected

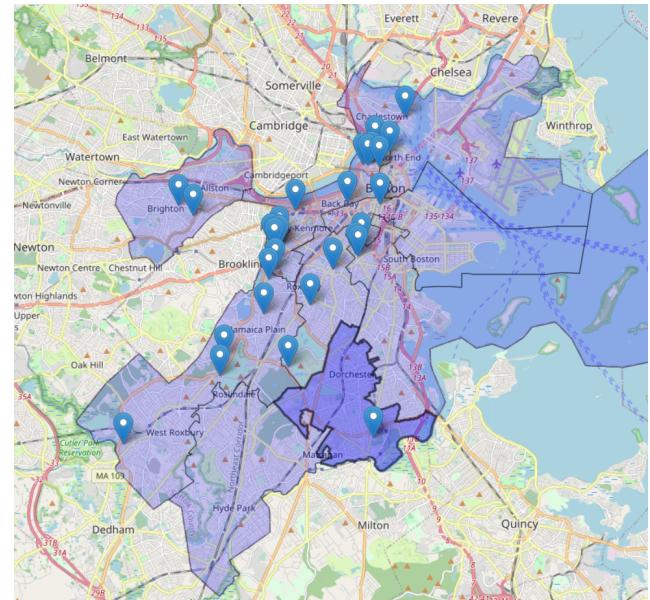
supplemental data on police districts, police stations, community centers, parks, hospitals, and universities.

- **Early Analysis:** We conducted an initial examination of the socio-economic factors that could be related to violence in District 4. This involved comparing the availability of resources like police stations, hospitals, universities, and green spaces in District 4 to the rest of Boston.
- **In-depth Examination:** We delved deeper into the Field Interrogation and Observation dataset to identify patterns of gun-related violence in District 4. We focused on factors such as the timing of incidents and the age of suspects involved.
- **Geospatial Analysis:** We analyzed shooting locations in relation to public transportation, specifically MBTA stop locations, to identify any correlations or patterns that might help explain the violence in District 4.
- **Trend Analysis:** We investigated trends in the homicide clearance rate from 2015 to 2020 to understand how effective law enforcement has been in addressing violence in District 4.

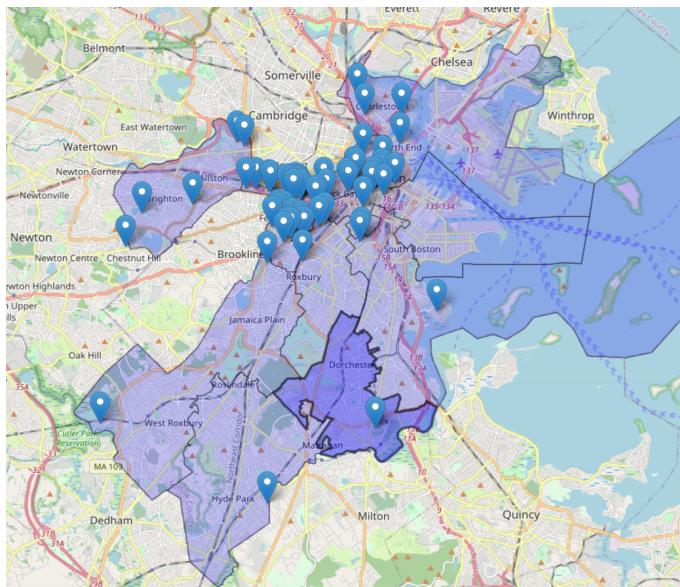
Throughout the analysis, we used various data processing and visualization techniques to better understand the relationships between different factors and violence in District 4.



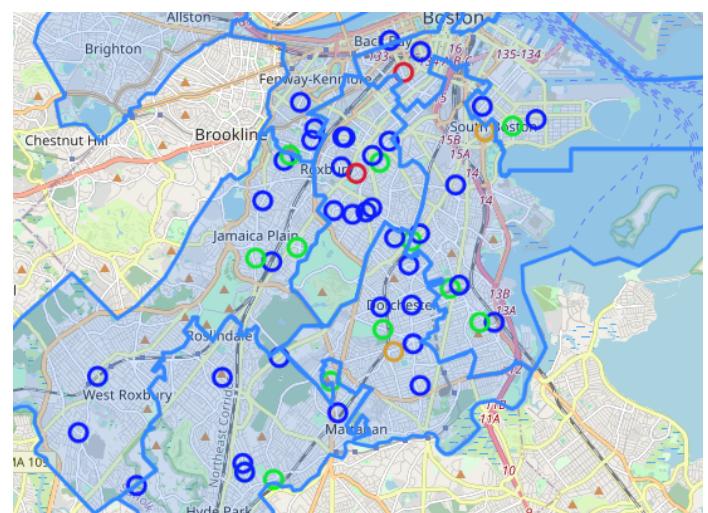
**Police stations**



**Hospitals**

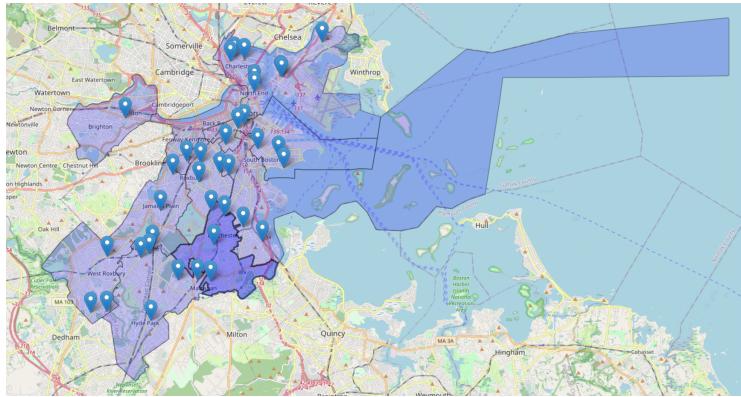


**Colleges and universities**

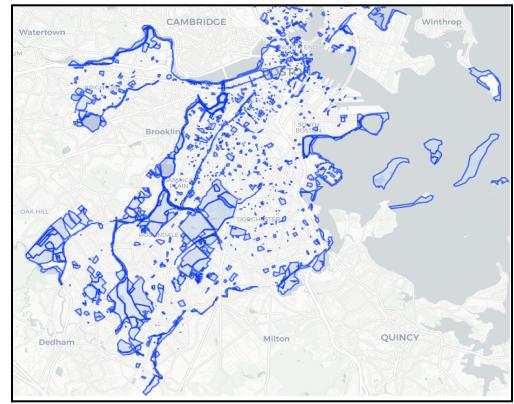


**Weapons in high school**

This graph illustrates the schools that had the presence of weapons and their occurrence density



**Community Centers**



**Parks**

## How does this help us answer the question:

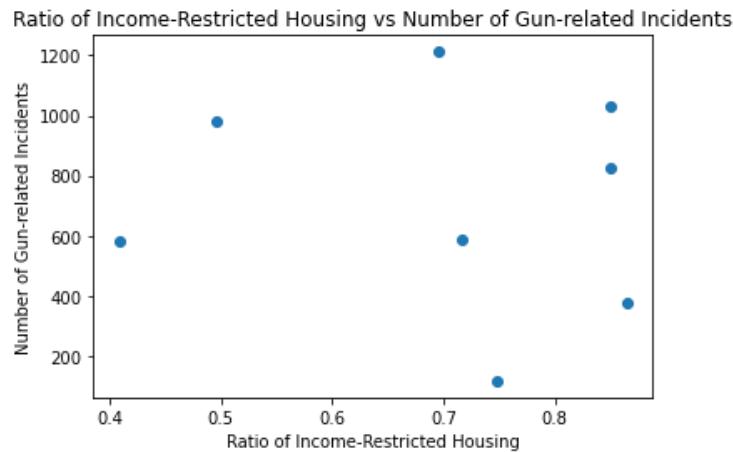
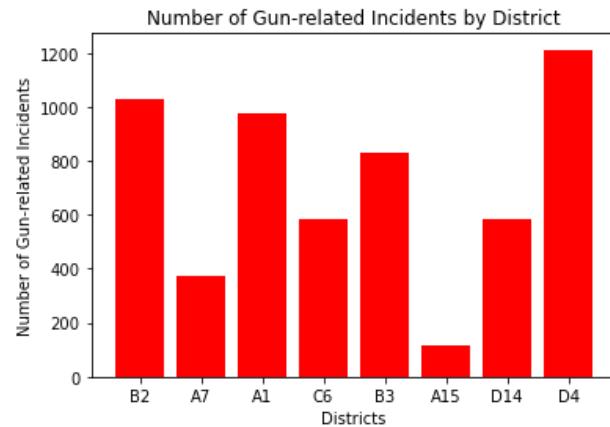
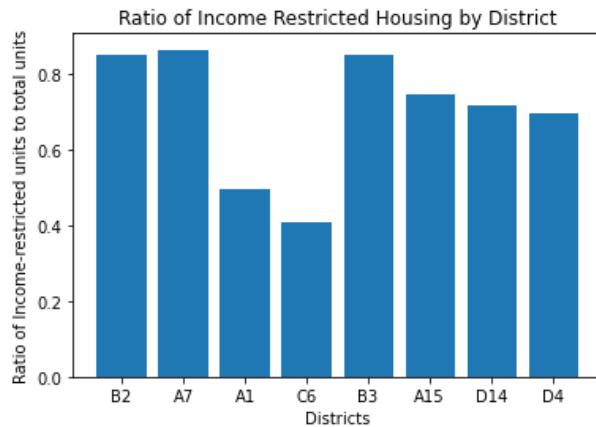
Our analysis of the data allowed us to identify key socio-economic factors that contribute to the observed patterns of violence in District 4. The factors we identified include:

- **Limited number of police stations** in District 4 compared to the main Boston area, which may facilitate criminal activity.
- **Only one hospital in District 4**, pointing to a potential lack of adequate health and human services.
- **A single university in District 4**, which might discourage high school students from aspiring to higher education and drive them towards alternative, potentially criminal, paths for income.
- **A scarcity of parks and green spaces in District 4** compared to the rest of the city, which could negatively impact mental health.

These factors, along with the insights gained from analyzing the timing of incidents, the age of suspects, and the relationship between violence and public transportation, help us understand the underlying socio-economic factors that

contribute to the observed patterns of violence in District 4. This understanding enables the development of targeted interventions and strategies to address the root causes of violence and create safer communities.

## **Q7: Does accessibility to a resource, such as income-restricted housing, impact Gun-Violence?**

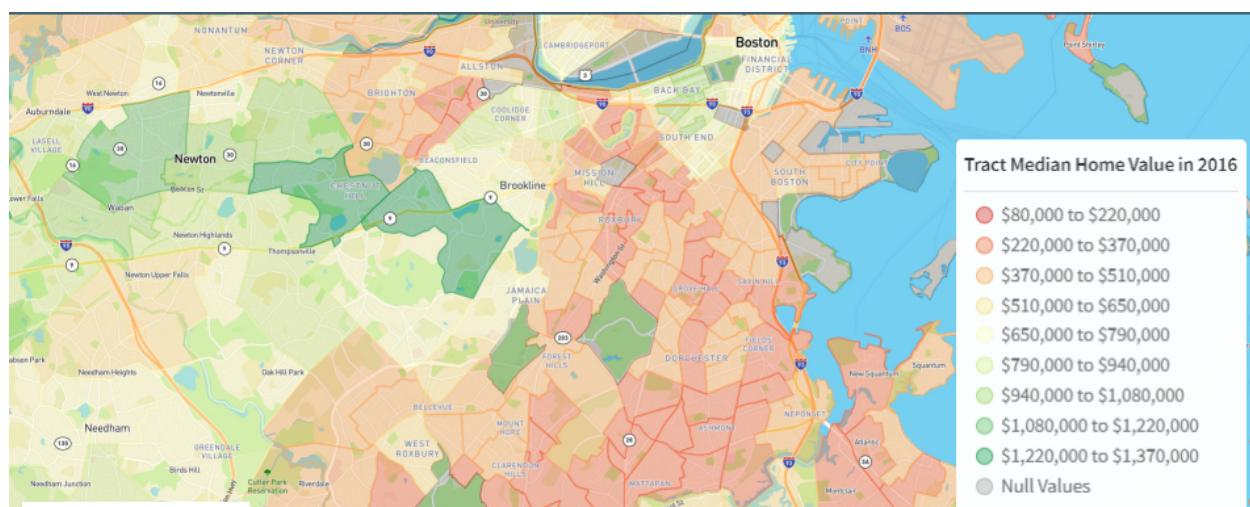


After collecting data from Analyze Boston on Income restricted housing, we were able to determine the percentage of income restricted housing in each district out of all housing units. Our thought was that there could be a relation between the number of gun related incidents and the amount of income-restricted housing available in each district. After plotting a scatter plot of the ratio of income-restricted housing vs the number of gun-related incidents, we can determine that there isn't a significant relationship between the two.

Dataset used: [Income-Restricted Housing Inventory - Datasets - Analyze Boston](#)

## **Q8: How does the demographics and socioeconomic status of neighborhoods in district 4 and the city of Boston correlate with the prevalence of gun violence? Do the seasonal variations have any effect on gun violence?**

Based on the census, socioeconomic and housing data, we can see a relationship between demographics, socioeconomic status, and the prevalence of gun violence in District 4 and the city of Boston.

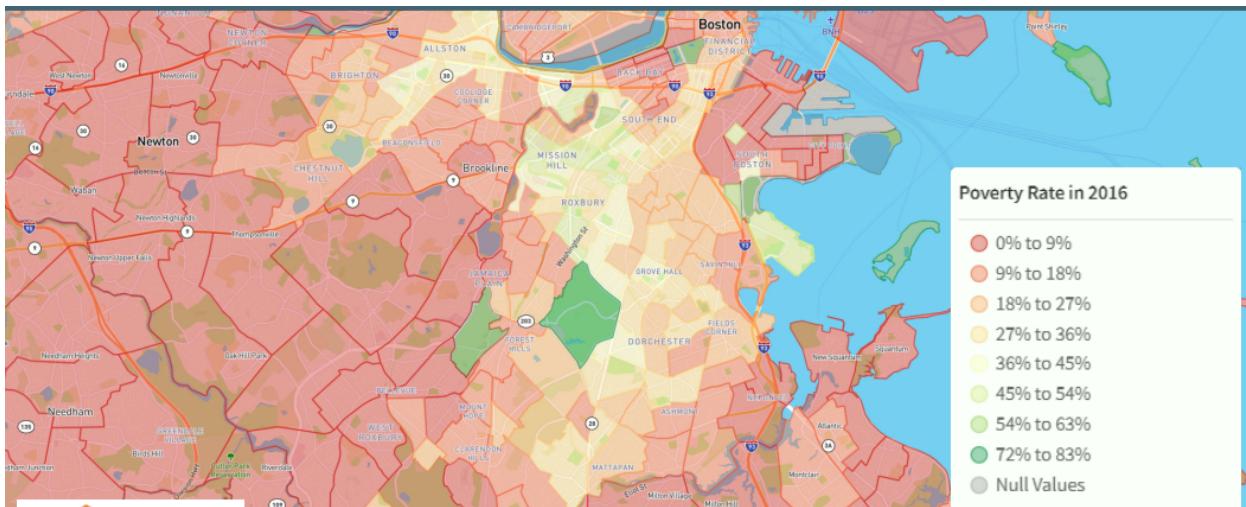


Median Home Value in 2016

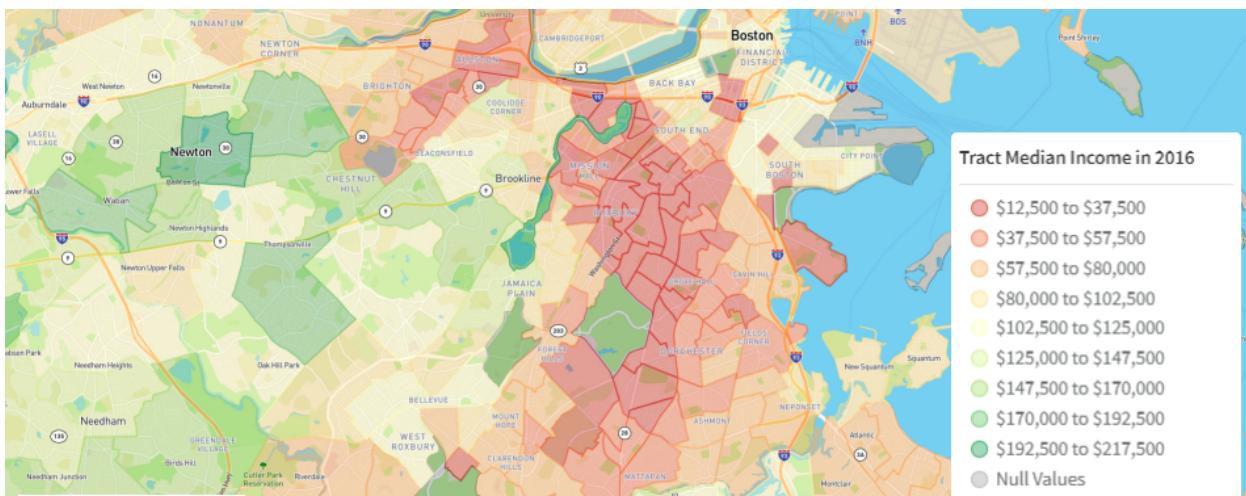
Historically, neighborhoods in District 4, such as South End, Roxbury, and Dorchester, have had lower median home values compared to other areas in Boston. This can be attributed to a variety of factors, including a history of redlining, discriminatory housing policies, and disinvestment in these communities. Lower home values may serve as a proxy for lower socioeconomic status, further contributing to the observed disparities in gun violence.

Race-based land ownership patterns also play a role in this relationship. Minority populations, particularly African Americans and Latinos, have historically faced systemic barriers to property ownership, such as discriminatory lending practices, restrictive covenants, and racial steering. These practices have resulted in

concentrated areas of poverty and a lack of generational wealth among minority communities in District 4 and beyond.



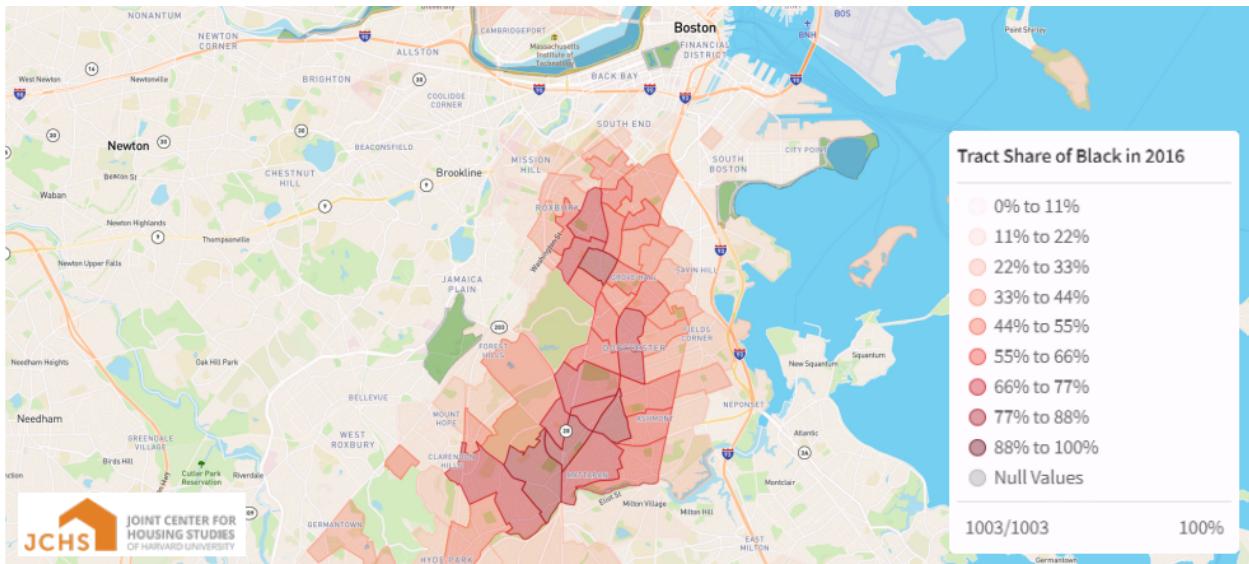
Poverty Rate in 2016



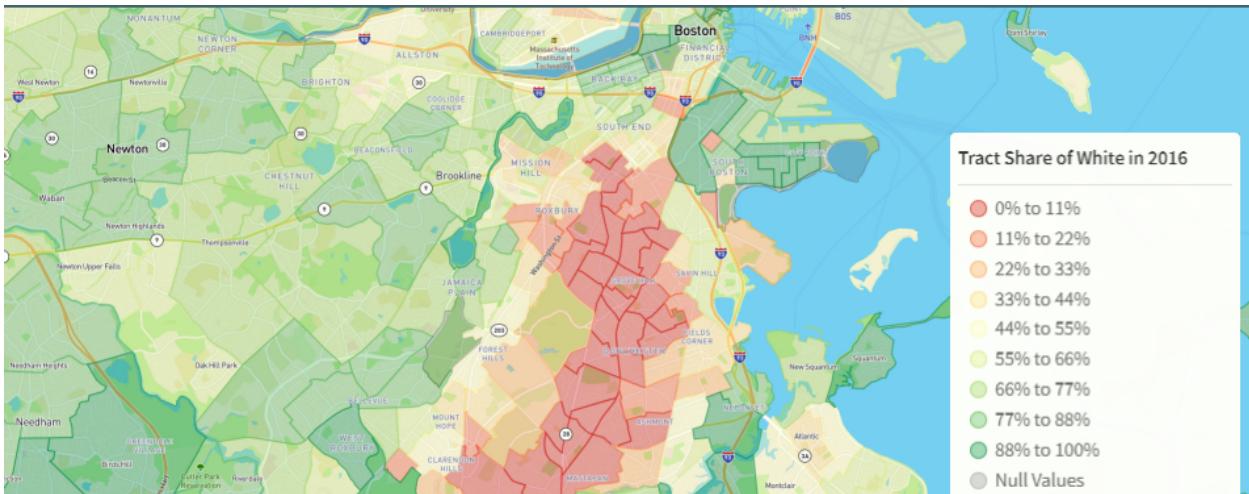
Median Income in 2016

Neighborhoods in District 4, such as South End, Roxbury, and Dorchester, tend to have lower median incomes compared to other areas in the city. Lower median income levels can be indicative of limited economic opportunities, reduced access to quality education and healthcare, and fewer resources for community development. These circumstances may contribute to higher levels of stress, social disorganization, and crime in economically disadvantaged neighborhoods. The disparities in median income, combined with other factors like lower home values and race-based land

ownership patterns, further perpetuate the cycle of poverty and inequality that has been historically linked to higher rates of gun violence in these communities

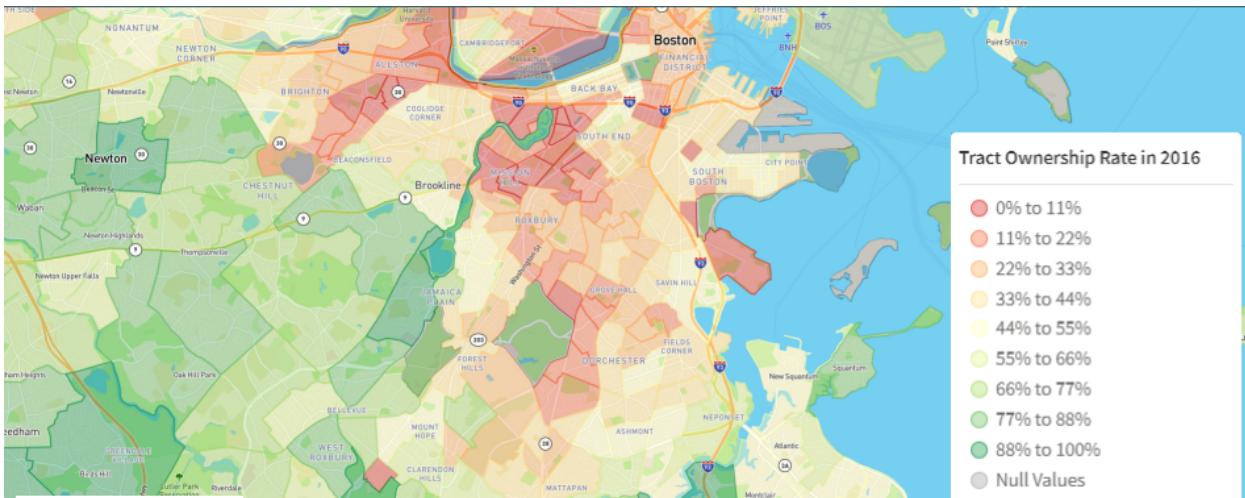


Demographic distribution for Blacks in 2016



Demographic distribution for Whites in 2016

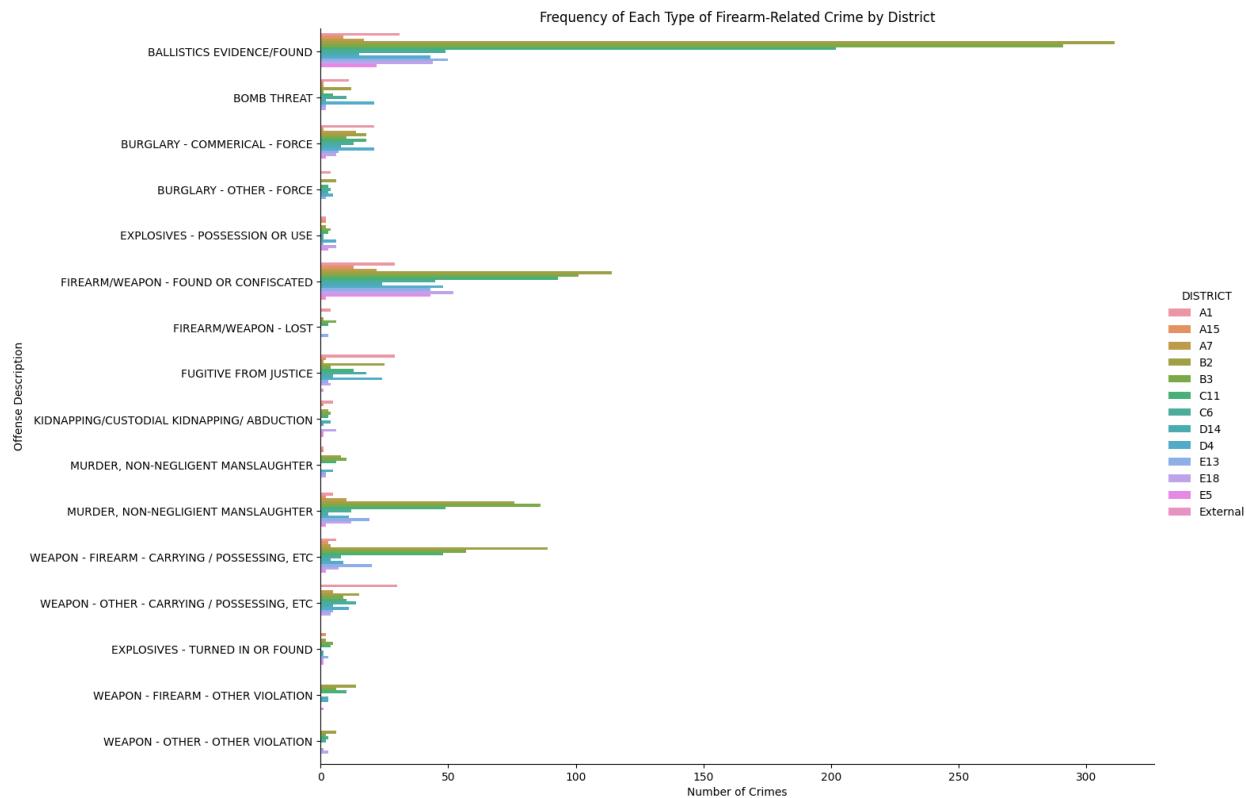
Neighborhoods in District 4, which includes areas like South End, Roxbury, and Dorchester, have been known to experience higher rates of gun violence when compared to other parts of the city. These neighborhoods have a higher percentage of minority populations, particularly African Americans and Latinos. Socioeconomic factors, such as higher poverty rates, lower median incomes, and lower educational attainment, are also more prevalent in these areas.



Land Ownership rate in 2016

The data confirms that there are indeed fewer economic opportunities in District 4, which may contribute to the increased prevalence of gun violence. The lack of economic opportunities can lead to unemployment, financial strain, and limited access to resources, ultimately exacerbating social tensions and increasing the likelihood of crime and violence.

Furthermore, the concentration of illicit activities, such as drug trafficking and gang-related conflicts, in economically disadvantaged neighborhoods can also contribute to higher rates of gun violence. Individuals in these areas may be more likely to resort to crime as a means of survival or as a way to assert power and control within the community.

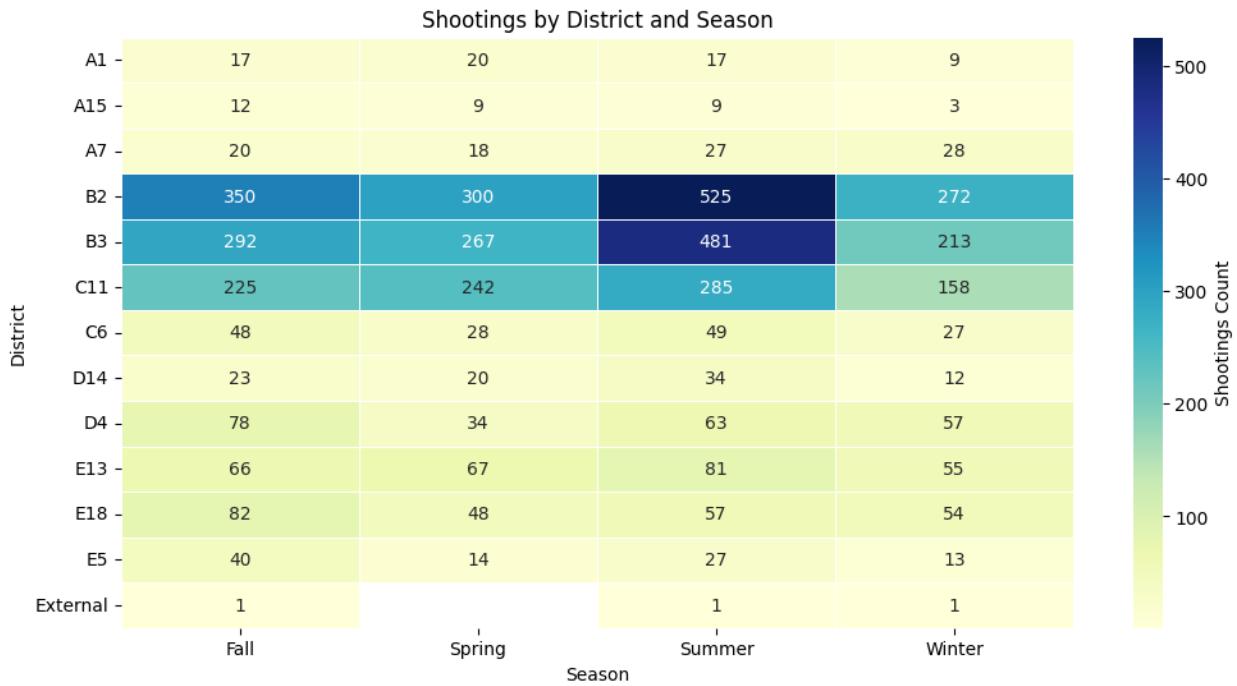


### Count of various types of illegal weapons in each district

When examining the frequency of other crime categories such as bomb threats, fugitives from justice, and explosives-related incidents, it is important to note that these events tend to be less common than firearm-related crimes in the city of Boston. However, the distribution of these incidents across different districts may vary based on specific circumstances and factors unique to each area.

While these types of crime are relatively rare, they can still pose a significant threat to public safety. In the event of a bomb threat, fugitive from justice, or explosives-related incident, the response capacity and preparedness of law enforcement agencies play a crucial role in mitigating potential harm and ensuring community safety.

Given the infrequent nature of these incidents, it is difficult to establish a strong correlation between their occurrence and the demographic or socioeconomic characteristics of Boston's districts.



Plot of season wise shootings in each district

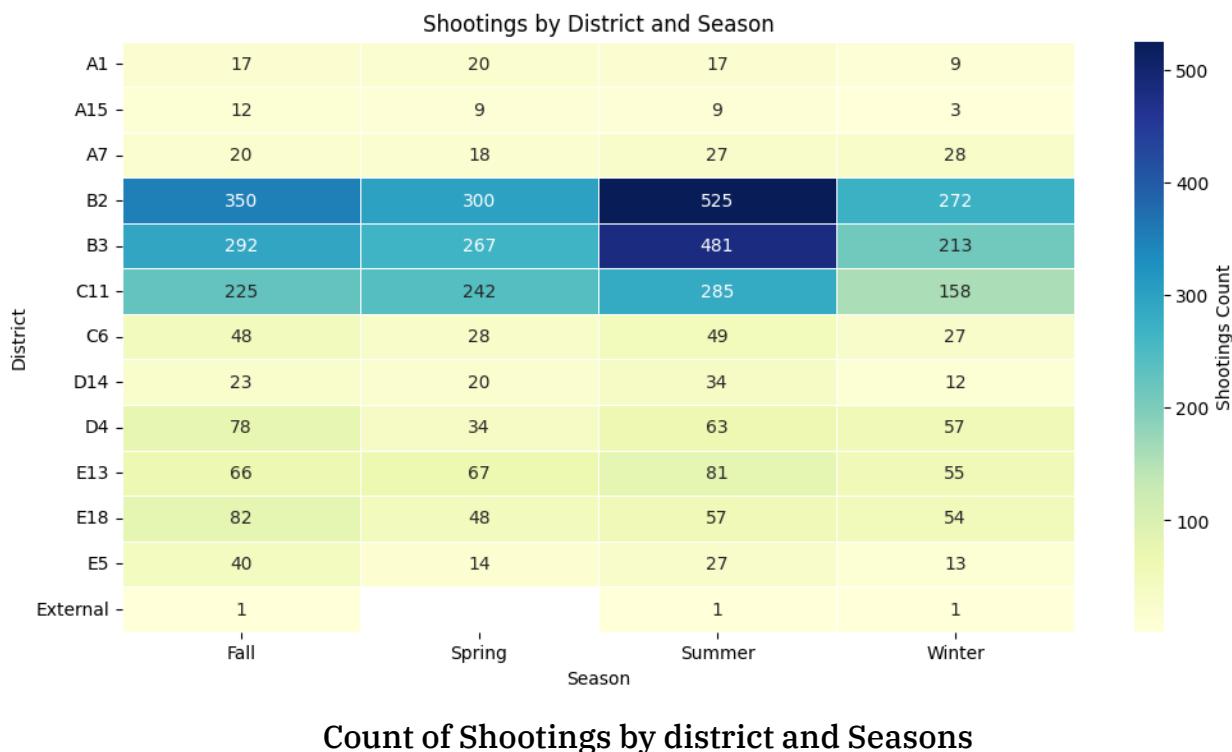
As for seasonal variations, gun violence rates in Boston, as well as in other cities, tend to be higher during the warmer months of the year, particularly from late spring to early fall. This could be attributed to various factors, such as increased outdoor activities, escalated gang-related conflicts, or the psychological impact of warmer weather on aggression levels. However, seasonal variations should be considered as one of many factors influencing gun violence trends and not as a standalone cause.

In summary, a complex interplay of demographic, socioeconomic, and historical factors contributes to the prevalence of gun violence in District 4 and the city of Boston. Lower median incomes, home values, and economic opportunities, as well as race-based land ownership patterns, the relationship between demographics, socioeconomic factors, and crime rates, including gun violence, varies across different districts in the city of Boston. District 4, which includes neighborhoods like South End, Roxbury, and Dorchester, has experienced higher rates of gun violence, which can be attributed to factors attributed above. Other types of crime, such as bomb threats, fugitives from justice, and explosives-related incidents, are relatively rare in Boston and may not have a strong correlation with demographic or socioeconomic factors due to their infrequent nature. Seasonal variations in gun violence also serve as an additional layer of complexity.

## Q9: What are the correlations between high counts of shootings, firearm-related crimes, and frisks in districts B2, B3, and C11 as compared to the rest of the city?

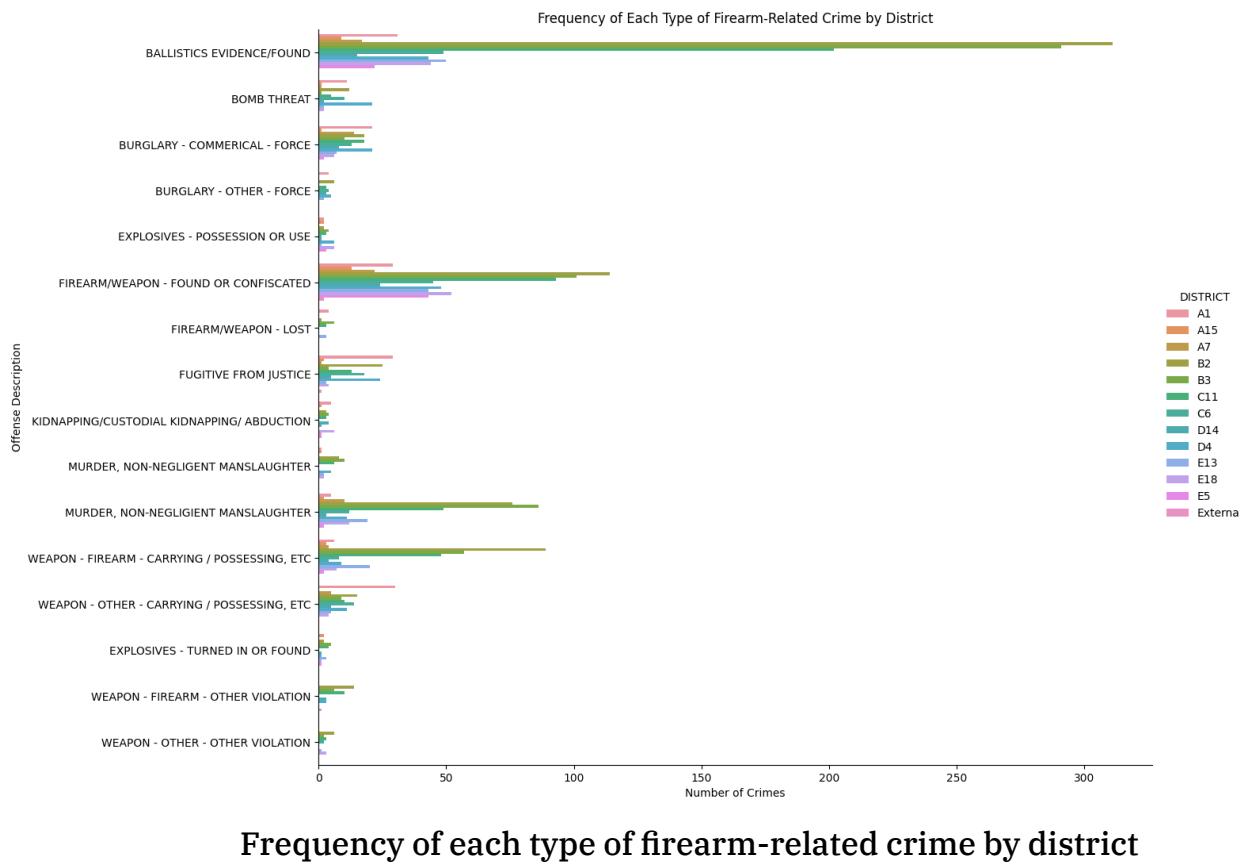
The correlation between high counts of shootings, firearm-related crimes, and frisks in districts B2, B3, and C11 compared to the rest of the city provides valuable insight into the underlying factors contributing to gun violence in these specific areas. In order to thoroughly assess the situation, it is crucial to consider the available data from various perspectives.

Firstly, examining the plots of the count of shootings in each district by season highlights the severity of the gun violence issue in districts B2, B3, and C11. A possible explanation for the high count of shootings in these districts could be attributed to socioeconomic disparities, which can lead to higher crime rates and social unrest.



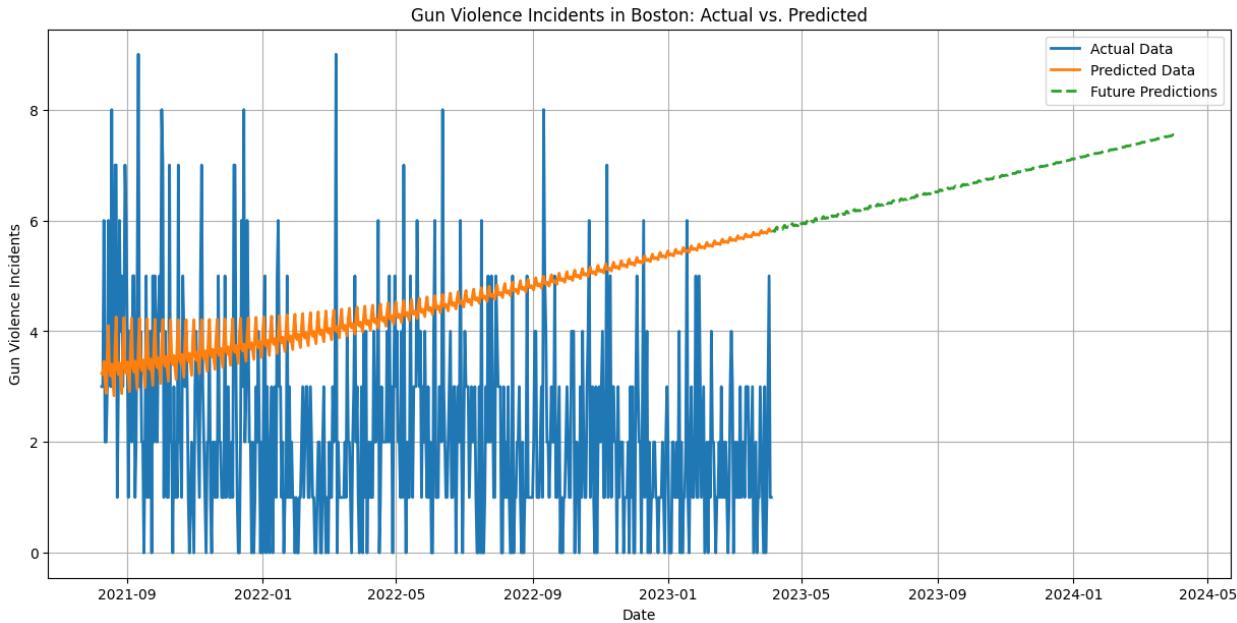
The plot of the frequency of each type of firearm-related crime by district reveals a high count of 'ballistic evidence found' and 'firearm found or confiscated' in

districts B2, B3, and C11. This pattern suggests that the presence of firearms and firearm-related activities is significantly more pronounced in these districts compared to the rest of Boston. Further investigation into the underlying reasons for this distribution, such as analyzing the sources of illegal firearms and the presence of gangs or organized crime, may offer valuable insight.



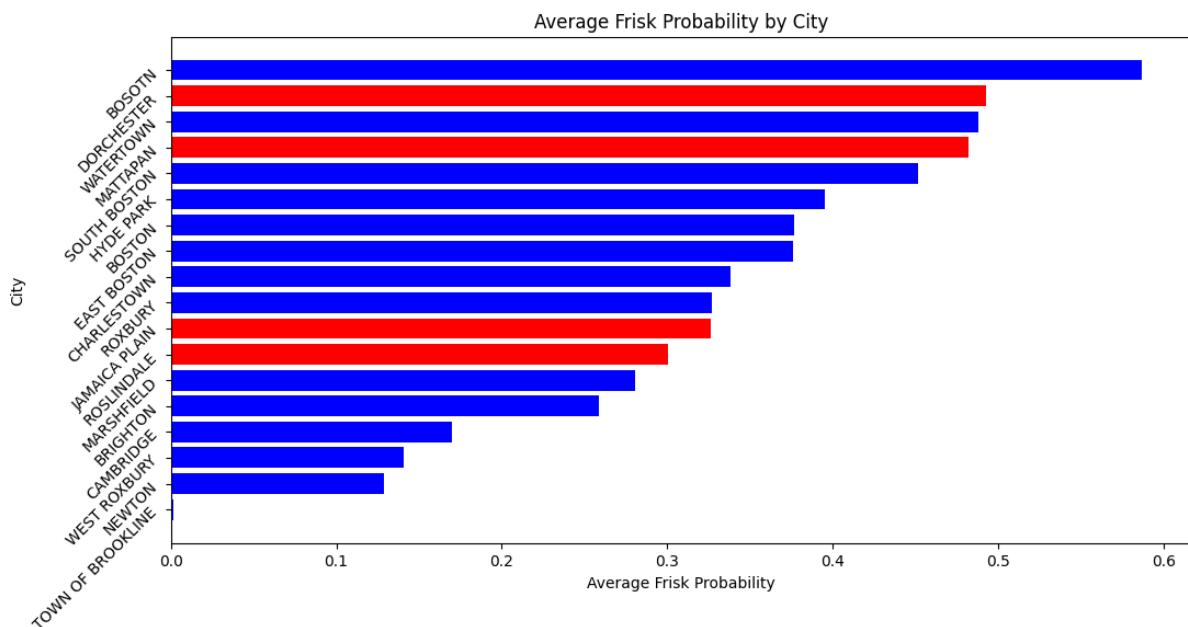
Frequency of each type of firearm-related crime by district

Additionally, the future prediction of gun violence incidents in Boston based on historical data demonstrates a concerning trend of a significant increase in gun violence across the city. This highlights the urgent need for more comprehensive and effective strategies to address the issue, particularly in the high-risk areas of B2, B3, and C11.

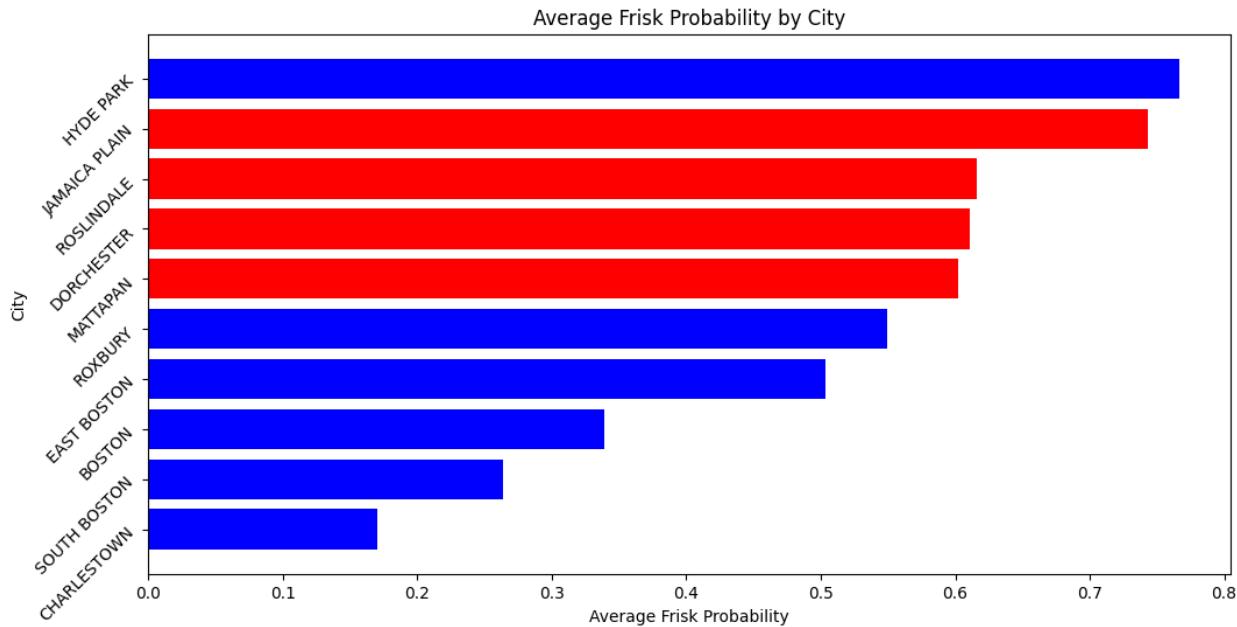


Future prediction of gun violence incidents in Boston

The plot of the likelihood of a person getting frisked in each district, when selecting firearm incidents, also shows a high count in districts B2, B3, and C11. This could be an indication of increased police presence and proactive measures being taken by law enforcement to curb gun violence in these areas. However, it is also possible that the high rate of firearm-related crimes in these districts has led to a higher frisk rate due to increased suspicion and caution by law enforcement officers.

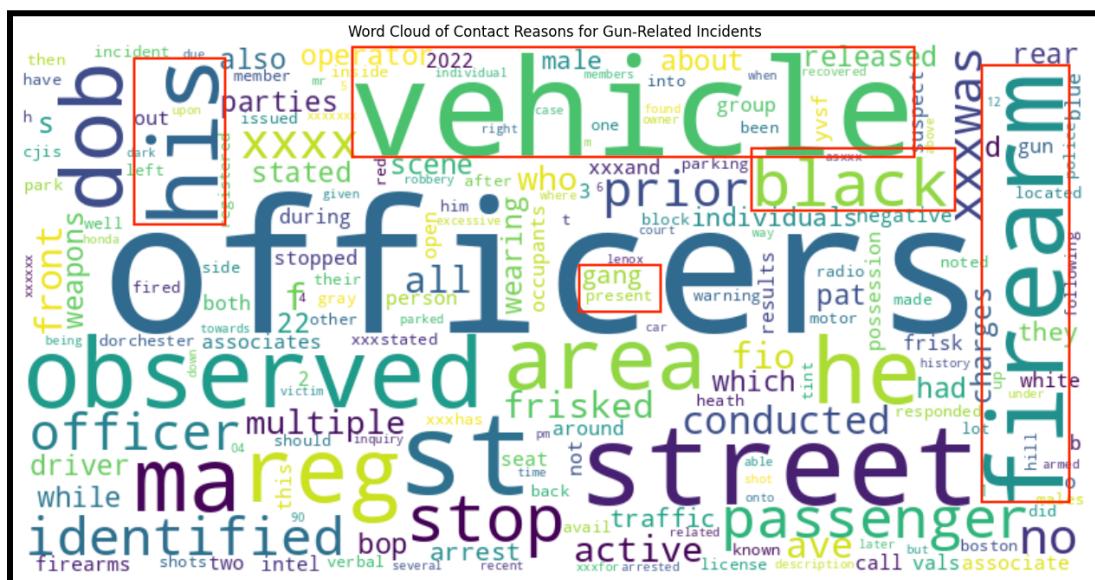


Likelihood of a person getting frisked in each district - All crimes included



Likelihood of a person getting frisked in each district - Firearm crimes only

The word cloud of contact reasons during field interrogation further illustrates the prevalence of firearm-related incidents in these districts. Words such as "firearm," "vehicle," "his," and "black" , “gang present”, stand out as significant, indicating that many interactions between law enforcement and individuals in these areas revolve around suspicions of firearm possession or use potentially by gang members of certain communities.



Word cloud of contact reasons during field interrogation

In conclusion, the correlation between high counts of shootings, firearm-related crimes, and frisks in districts B2, B3, and C11 compared to the rest of the city highlights the pressing need for targeted interventions in these areas. Factors such as socioeconomic disparities, gang activity, and access to illegal firearms may be contributing to the elevated levels of gun violence in these districts. A multi-faceted approach, involving community-based initiatives, improved policing strategies, and investment in social and economic development, is necessary to address the root causes of gun violence and create safer communities in Boston.

## How we analyzed the data:

Data sets used:

1. <https://data.boston.gov/dataset/shots-fired>
2. <https://data.boston.gov/dataset/shootings>
3. <https://data.boston.gov/dataset/crime-incident-reports-august-2015-to-date-source-new-system>
4. <https://data.boston.gov/dataset/boston-police-department-fio>

Count of shootings by season and district plot was analyzed using datasets 1 and 2.

Frequency of each type of firearm-related crime by district was analyzed using datasets

Future prediction of gun violence incidents in Boston was analyzed using dataset

1. We implemented the machine learning model which performs time series analysis on gun violence incidents in Boston by taking a datetime field, resampling the data to daily counts, and then fitting a SARIMA model. The model is evaluated using mean absolute error, and future predictions are made using the fitted model. Finally, the actual and predicted data, as well as future predictions, are plotted using matplotlib.

The likelihood of a person getting frisked in each district was analyzed using dataset 4. We implemented the machine learning model which analyzes the relationship between various factors such as day\_of\_week, month, year, circumstance, basis, sex, race, age, and city, and the likelihood of being frisked by police officers in

Boston. It preprocesses the data using a column transformer, fits a random forest classifier model with pipeline and evaluates the model's performance. It also generates a horizontal bar chart to show the average frisk probability by city, highlighting certain cities in red.

The word cloud of contact reasons during field interrogation was analyzed using dataset 4. We implemented the machine learning model which analyzes the contact reasons for gun-related incidents in Boston by filtering the data to only gun-related incidents and concatenating all the contact\_reason text from these incidents. It then tokenizes the text, counts the word occurrences, removes common stopwords, and creates a word cloud using the filtered word counts. Finally, the word cloud is plotted using matplotlib.

# Conclusion

We have done extensive research on the gun violence issues in Boston's Congressional District 4 at the request of Councilor Worrell. We have explored several key metrics such as the drivers, location patterns, type and rate of gun violence in district 4. Additionally, we have answered questions such as what the relationship between community engagement and gun violence in district 4 is and how resource accessibility impacts gun violence in district 4.

The prevalence of gun violence in Boston is a complex issue influenced by a variety of factors such as demographics, socioeconomic status, and historical patterns of discrimination and inequality. Some key takeaways are that Neighborhoods with lower median incomes, home values, and fewer economic opportunities tend to experience higher rates of gun violence and police districts B2, B3, and C11 are particularly affected by gun violence, with higher rates of firearm-related crimes, frisks, and shootings compared to other areas in Boston.

The data underscores the need for targeted interventions to address the root causes of gun violence, including community-based initiatives, improved policing strategies, and investment in social and economic development. It is important to implement a multi-faceted approach when dealing with these issues in order to create safer communities and reduce gun violence in Boston.

# TeamWork Task Division

- **Shaunak:** Defined the strategy to approach the extension datasets, looked at socio-economic factors affecting the spate of gun violence, refined and edited the report, while exploring better ways to present the data. Also looked at other factors such as seasonal influence on gun violence. Scanned datasets and took a deep dive into the economics of gun violence.
- **Marcel:** Refined visualizations, explored worthwhile project extension topics and datasets and explored the entertainment and dining datasets to answer the question of whether recreational resources influence gun violence. Completed README.md file.
- **Angela:** Collected datasets for entertainment, dining and income-restricted housing in the congressional districts of Boston. Conducted a deeper analysis of income-restricted housing.
- **Hemant:** Created Machine learning models to explore and predict factors related to gun violence. Answered multiple base analysis questions and extension questions. Explored several datasets to provide detailed evidence for extension questions. Visualized multiple datasets to give future trends in shootings, frisk probabilities in each district, seasonal shooting evidence in each district and several other visualizations.