Gun Violence

2023 Summer Spark! Special Initiatives

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Introduction

Gun violence is a significant issue affecting many urban areas in the United States, including District 4 in Boston. It is a complex problem that demands a multi-faceted approach to understanding the underlying causes and developing effective solutions. Councilor Worrell, a Boston City Councilman for District 4, is dedicated to addressing this challenge and improving the safety and well-being of his constituents, and has expressed concern about the increasing number of firearms possessed by young people in the district and the impact of gun violence on the community. This project aims to contextualize gun violence in District 4 by identifying key variables associated with its occurrence. The ultimate goal is to provide valuable insights that can inform data-driven policies and strategies for reducing gun violence in the district and throughout Boston. By understanding the drivers of violence, policymakers and community leaders can work together to create a safer environment for all residents.

The project is conducted in several phases, beginning with a comprehensive analysis of gun violence in District 4 and the city of Boston. This includes a comparative analysis of the volume and geographic distribution of gun violence in District 4 and the broader city. We go on to assess factors such as police presence, identify patterns in terms of types of violence and location, analyze discipline records from high schools, and other socio-economic variables to determine their correlation with gun violence rates. To accomplish this goal, the project team has analyzed a handful of diverse datasets. By examining data from police districts overlapped with the city council districts shapefile and police records of violence/firearm activity, the team was able to map out police stations and police activity in D4 and the overall city. The team also examines patterns in terms of location, including various types of locations and major streets. Furthermore, the team examines non-emergency issues reported through 311 to examine patterns in terms of types of violence. Finally, we examine discipline records from schools to gather insights on young people in the district.

The potential impact of this project is substantial, as it seeks to improve the safety and well-being of residents in District 4 and throughout the city of Boston. By contextualizing variables related to gun violence and evaluating the effectiveness of existing programs, the project can inform the development of targeted policies and strategies that address the issue more effectively. In the long term, this could lead to a significant reduction in gun violence, fostering safer communities and enhancing the overall quality of life for Boston residents.

1. Gun Violence in District 4

1A. Rate of Gun Violence

Figure 1.1 - Shooting Events From Each Congressional District 2015-2021 (p. 4, T2)

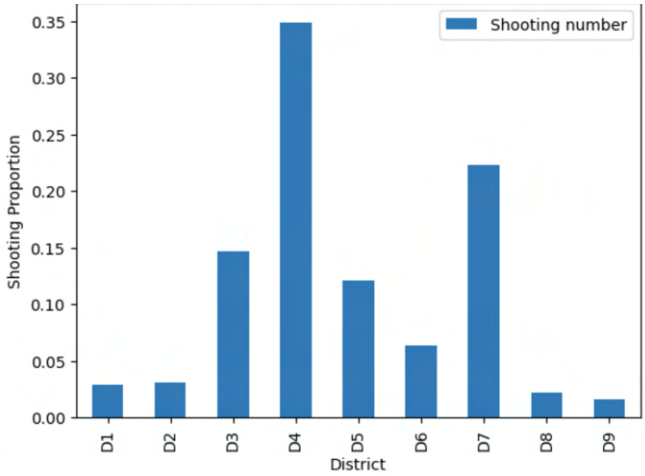


Figure 1.1 shows the number of shooting incidents between 2015 and 2021 across the congressional districts. As shown, around 35% of shooting incidents take place in District 4, and around 23% take place in D7, which is near District 4. To sum up, 58% of shooting incidents took place in these two districts between 2015 and 2021, which is a significantly high proportion of the total shootings in Boston.

Figure 1.2 - District Wide Intensity of Gun Violence Incidents Count 2015-2023
(p. 7, T3, Deliverable1.ipynb)

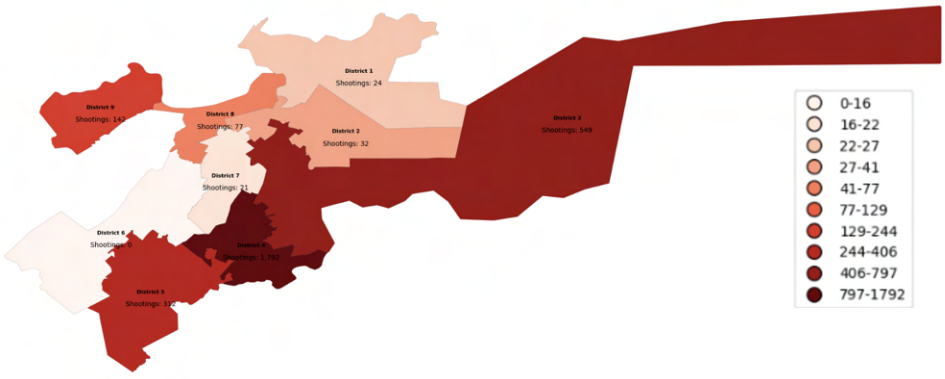


Figure 1.2 shows the district-wide gun violence intensity with the help of color gradients. Districts are marked with a color according to the count of gun violence incidents in that district. This figure highlights the stark difference in the intensity of gun violence incidents in District 4

as compared to the rest of Boston, with 1792 incidents in District 4. This is three times the amount of District 3, the second most affected district, with 549 incidents.

Figure 1.3: Ballistic Evidence Counts By Police District 2015-2023 (p. 21, T4, deliverable3/code/gv2.ipynb)

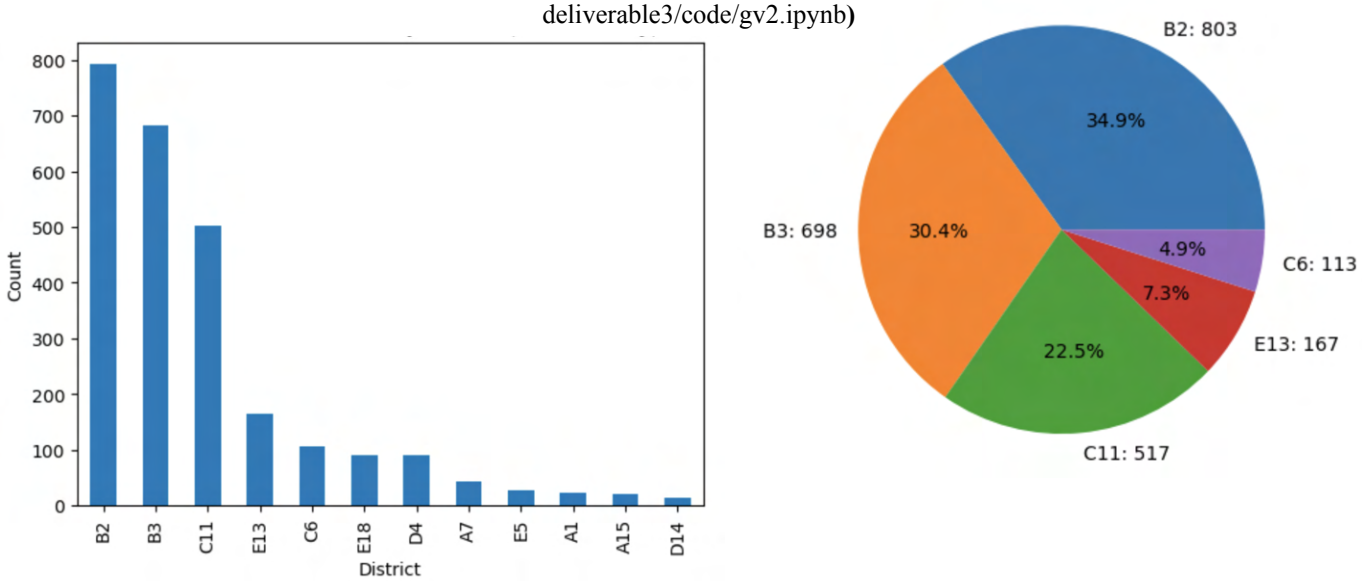


Figure 1.3 shows the distribution of ballistic evidence found by each police district between 2015 and 2023, with the counts on the left and percentages on the right. On the left, we can see that the police districts with the most ballistic evidence found were Police Districts B2, B3, and C11, the three districts that make up Congressional District 4. These three police districts make up over 75% of the total ballistic evidence found in all of Boston, as seen in the pie chart.

Figure 1.4: Buyers of Firearms in Each Congressional District 2022 (p. 3, T2, deliverable1/pattern_modified.ipynb)

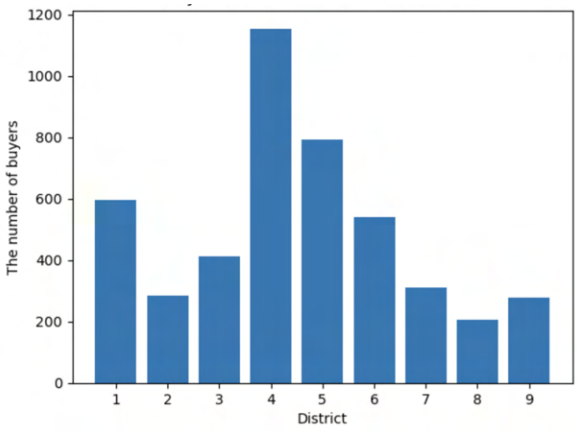


Figure 1.4 is a histogram of buyers' number of firearms in different congressional districts. Our analysis of firearm transactions indicates that District 4 experiences a higher volume of transactions compared to other districts. The prevalence of firearm transactions in the area could be a factor contributing to the increased gun violence observed in District 4. If this were entirely true however, we would expect to see a similar pattern in District 7. The absence of this pattern suggests there may be something unique about the gun ownership motivations and habits for residents of District 4. Some possibilities that are beyond the scope of this report include: gun ownership for protection (studies indicate that the mere presence of firearms increases proclivity to use them – more guns do not make communities safer), gun ownership as a cultural totem (a tool to demonstrate one's bonafides among street/gang culture), guns as targets for petty theft, and more.

1B. Gun Violence Time trends

Figure 1.5: Ratio of Gun Violence in D4 vs Other Districts 2015 - 2023

(p. 4, T3, Deliverable1.ipynb)

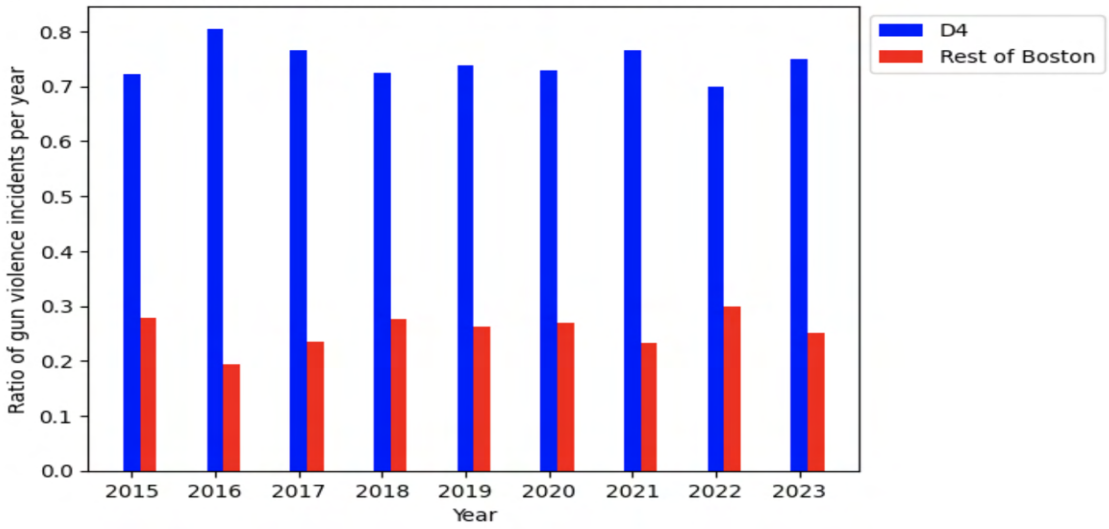


Figure 1.5 shows the ratio of gun violence incidents each year for District 4 compared to the rest of Boston. Colored in blue are the police districts that form District 4. As seen in the figure above, District 4 has the highest ratio of gun violence each year from 2015 to 2023. The disparity in the ratio of gun violence between District 4 and the rest of Boston ranges from slightly more than twice to slightly more than 4 times. The highest ratio of gun violence occurred in 2016, with 80% of gun violence in that year occurring in District 4. In 2023 alone, 70% of gun violence thus far occurred in District 4.

Figure 1.6: Shooting Incidents in D4 vs. Other Districts By Year, Month, Day, and Hour

(p. 5, T5)

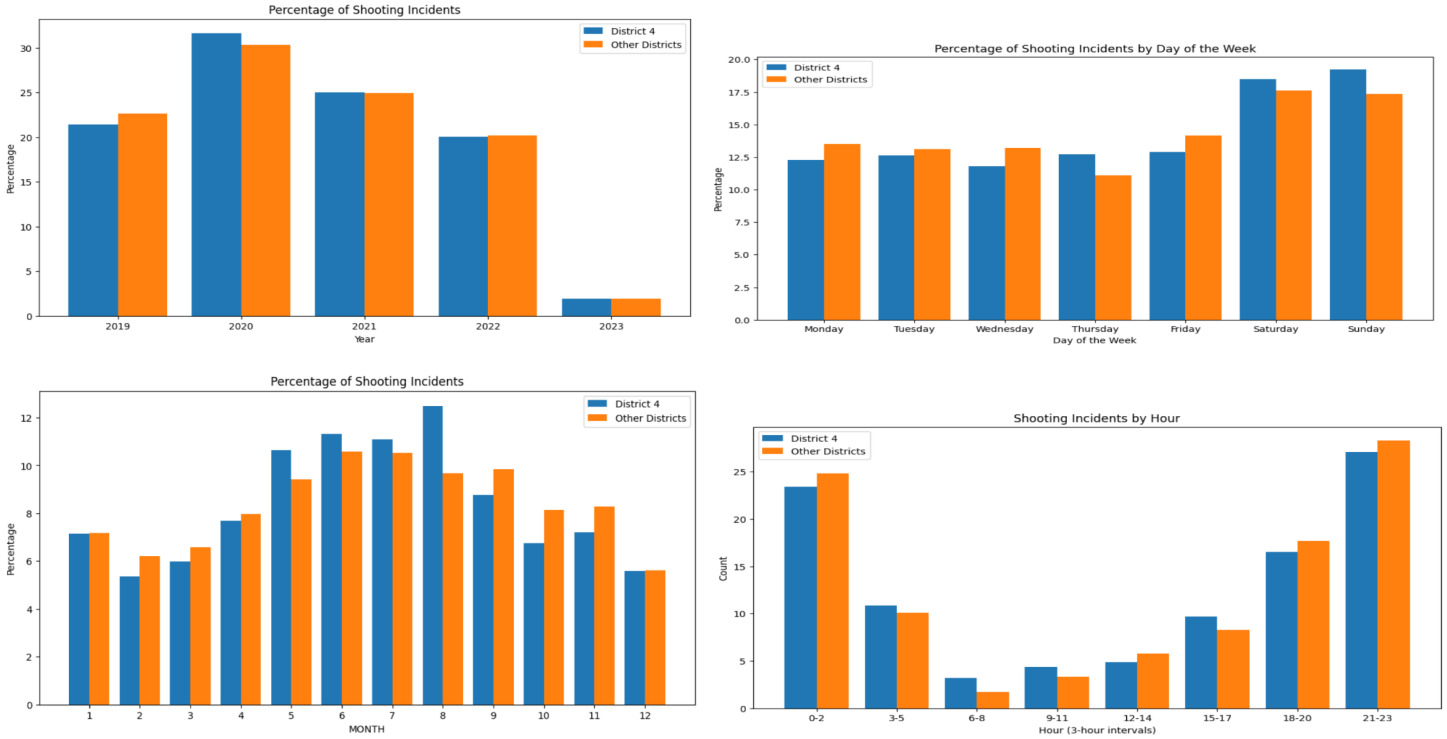
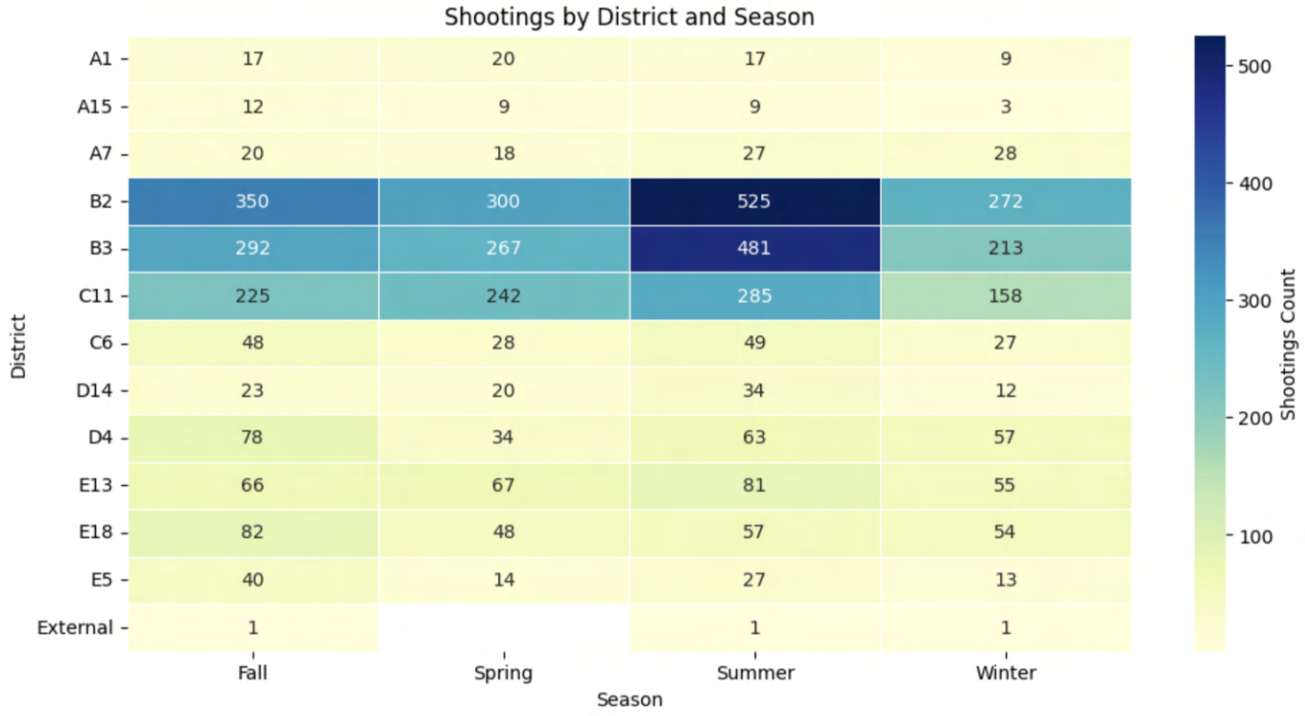


Figure 1.6 shows the percentage of shootings by year, month, day of the week, and by hour using data from the Boston Police Department. The percentages of shooting incidents in District 4 are shown in blue while the other districts are shown in orange. We can see from the top right chart of the distribution of shootings over years that the year 2020 saw a spike in shooting incidents across all Districts, with District 4 increasing more than other districts. From the bottom right chart, we can see that shootings generally are more likely to occur during the warmer months of summer than the colder months, with District 4 having higher percentages in the summer than other districts. Additionally, we can see from the top right chart shooting incidents were significantly more likely to occur on weekends than on weekdays, with District 4's percentages being higher on the weekends than the other districts. Regarding the time of day shown on the bottom right, shootings in Boston are significantly more likely to occur during the

nighttime hours than during the day. This chart also highlights how District 4 has a higher percentage of shootings occurring during the daytime hours than other districts.

Figure 1.7: Shootings By District and Season 2015-2022

(p. 39, T1, Extension Analysis part 2.ipynb)



As a brief note for this figure, the language used for police districts and governmental ones is similar. District in this context refers to police districts within a governmental district. All of the districts in figure 1.7 are within district 4 in the city.

Figure 1.7 shows a heatmap of shooting incidents by Police District and season. As seen, the table shows a higher amount of shootings year-round in police districts B2, B3, and C11, the police districts making up District 4. Each season, hundreds of shootings occur in District 4, a significantly higher amount than other districts. The season with the least number of shootings across all districts is in the winter. The most shootings occur during the summer season, with 1,291 shootings in D4 between 2015-2022, as compared to 365 shootings across all other districts. This means that between 2015 and 2022, District 4 saw around four times the amount of

shootings as compared to all other districts. As an interesting aside, recent research in prison populations has found air conditioning contributes to a decrease in violent behavior.

1C. Gun Violence Demographic trends

Figure 1.8: Percentage of Shooting Incidents in District 4 By Victim Race 2015-2023

(p. 6, T3, Deliverable1.ipynb)

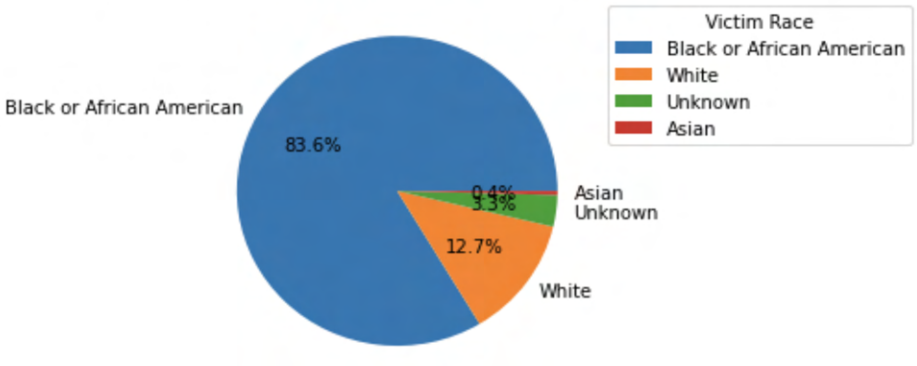


Figure 1.8 shows the percentage of shootings by victim race between 2015 and 2023. According to the figure, most shooting incidents in District 4 involve Black victims (1172 out of 1798 incidents, or 65% of the incidents). White victims come in second, with a much smaller number of incidents (178 out of 1798, or approximately 10%), followed by Unknown (46 out of 1798 or 2.5%) and Asian victims (6 out of 1798 or 0.3%). This suggests that Black residents in District 4 are disproportionately affected by shooting incidents. Further analysis and investigation are needed to understand the underlying reasons for this disparity and to develop effective strategies for reducing gun violence in the area.

Figure 1.9: Total Number of Shooting Victims in District 4 By Gender 2015-2023

(p. 16, T4, deliverable4/code/gun_violence_PatW.ipynb)

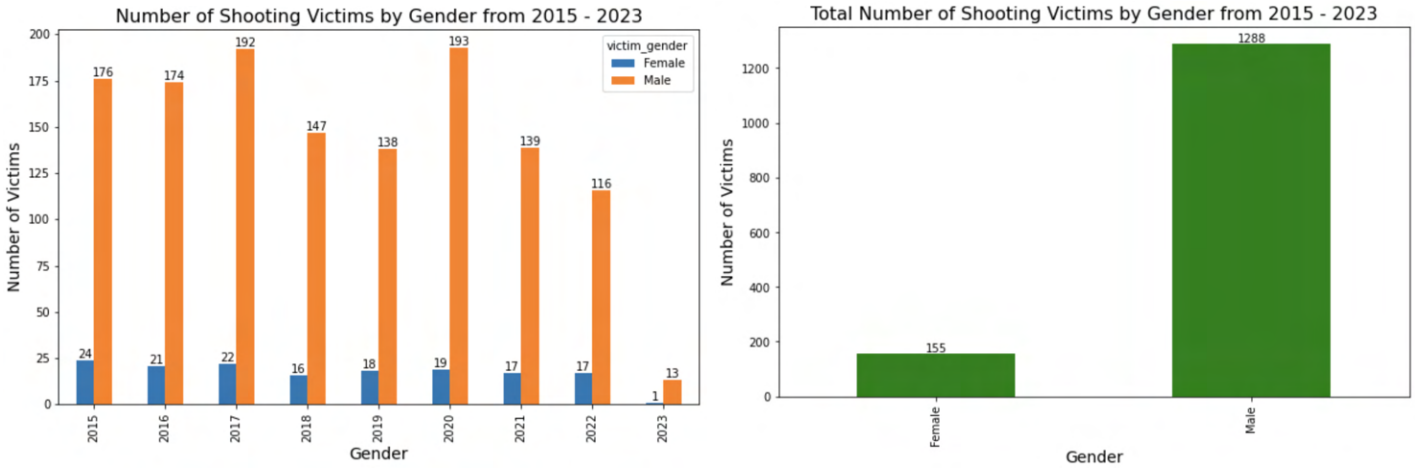


Figure 1.9 highlights the difference in the amount of shooting victims by gender. The left shows the number of shooting victims for both genders broken down by each year, while the right shows the total number of shooting victims across all the years. The number of male victims is consistently significantly higher than female victims across all years. Between 2015 and 2023, there were 155 female shooting victims and 1288 male shooting victims in D4. This means that the number of male victims was more than eight times that of the number of female victims within D4. In just the past five years, the year 2020 saw the most victims, with 193 male victims and 19 female victims.

2. Policing

2A. Police Districts and Stations

Figure 2.1: Overlap of Police Districts & Congressional Districts (p.3, T4)

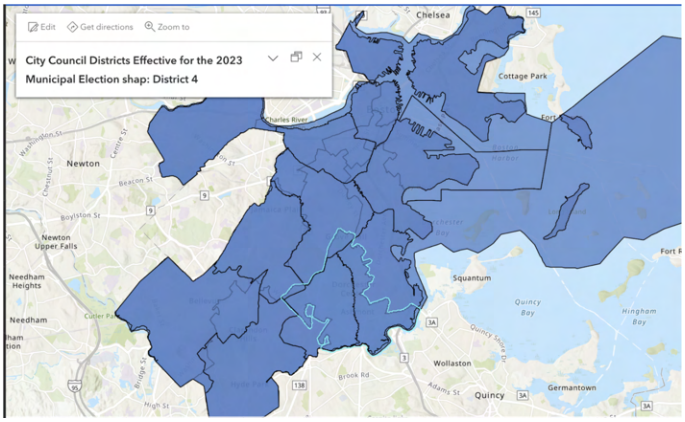


Figure 2.1 displays a map of police districts overlapped with a map of congressional districts in Boston. The light blue border represents congressional district 4, and is made up of police districts B2, B3, and C11.

Figure 2.2: Police Stations (p. 13, T1) /
(p. 6, T2, deliverable4/pattern_4.ipynb)

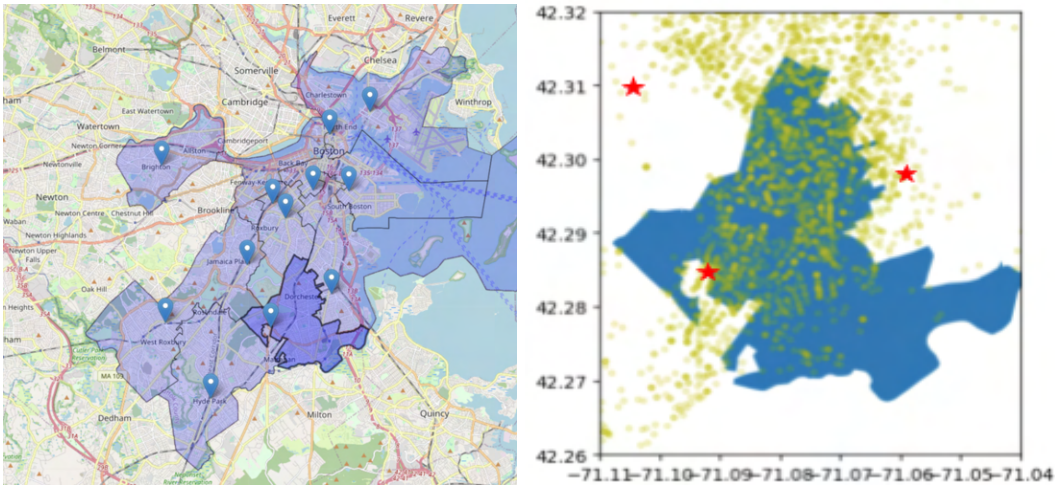


Figure 2.2 displays the dispersion of police stations. Police stations in the overall Boston area are shown on the left, and a closer zoomed-in map of District 4 police districts with shooting incidents is shown on the right. On the left, the blue markers represent a police station. As seen, district 4 has a low concentration of police stations within the district, which may be correlated with the amount of shootings in the area. On the right, the three red stars represent the police stations in District 4, while the yellow dots represent shootings in the area. Hundreds of shootings occur across District 4 and the area has a lower concentration of police stations compared to other districts.

2B. Police Activity and Field Contacts

Figure 2.3: Field Contacts By Month in 2022 and Total Contacts by Month 2016-2022”
(p.12, T4, deliverable2/code/Field_Contacts_ data.ipynb)

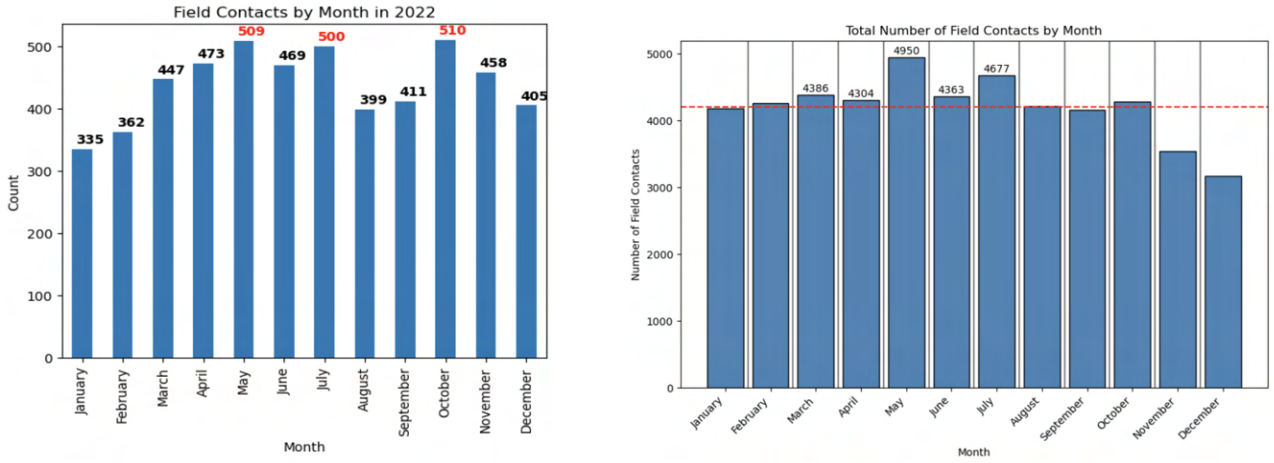


Figure 2.3 displays the number of field contacts per month. The left side field contacts per month for the year 2022, while the right side shows the total counts of field contacts per month for all years between 2016 and 2022. On the left side, it can be seen that in 2022, the most police activity occurred in the months of May, July, and October, with 509 field contacts in May, 500 in July, and 510 in October. From the right side we can see that between the years of 2016 - 2022, the most police activity occurred in the spring and summer months, between March-July, with a peak total number of field contacts in May with 4950 field contacts and July with 4677 field contacts.

3. Patterns of violence in terms of location

3A. Types of Locations

Figure 3.1: "Police stations, hospitals, colleges & universities" (p. 13-14, T1)

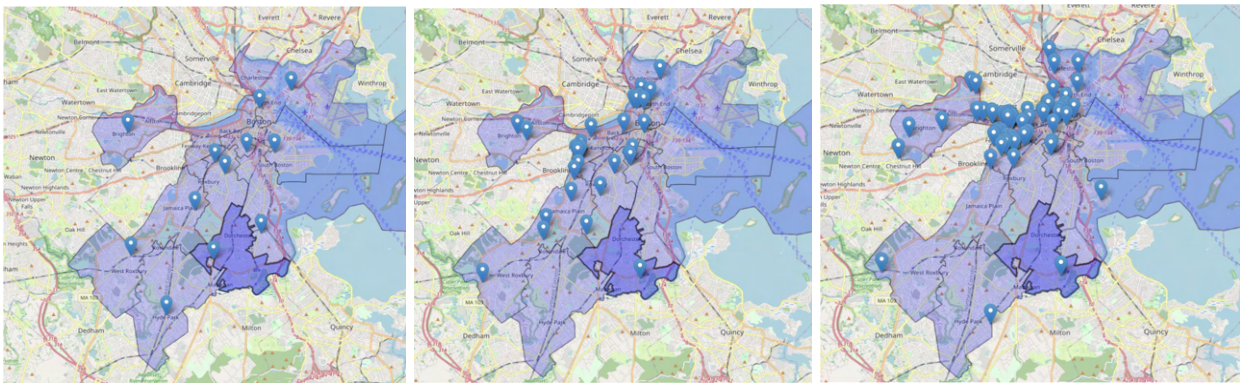


Figure 3.1 displays the densities of police stations, hospitals, and universities in Boston. As seen from the maps, there is a low concentration of police stations, hospitals, and universities in District 4.

Figure 3.2: "Gun violence incidents over parks" (p. 14, T3, Parks-Analysis.ipynb)

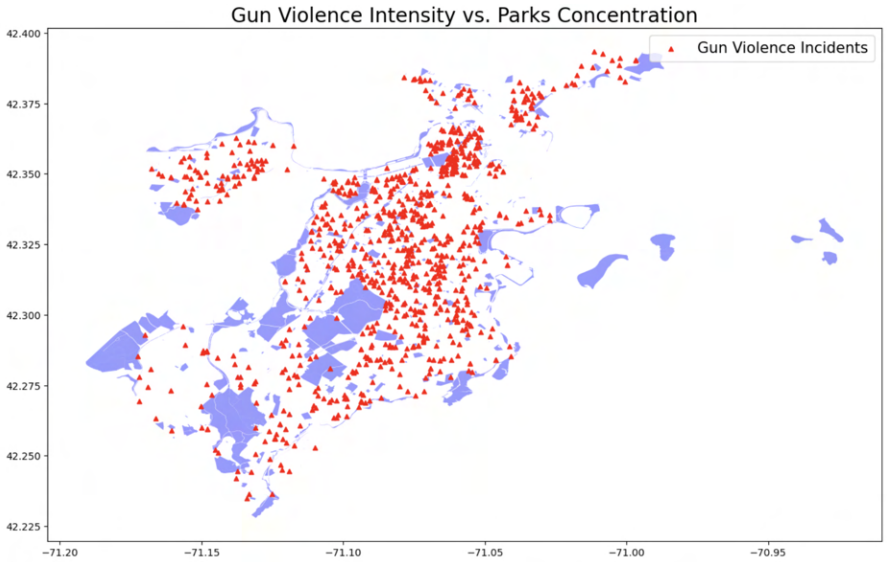
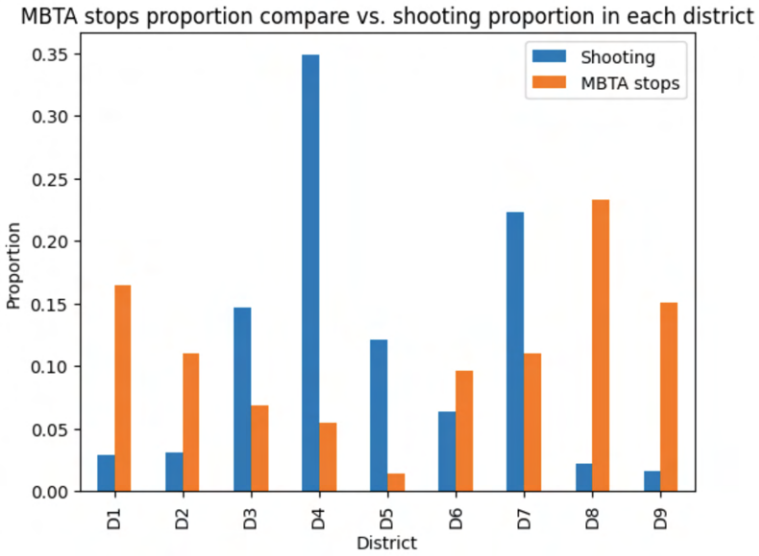


Figure 3.2 shows the concentration of parks and gun violence incidents in Boston. From the figure, it can be seen that most gun violence incidents do not happen in parks. District 4 has a lower concentration of parks which may be correlated with higher rates of gun violence. As an aside, parks tend to have a lower temperature (and heat up slower) than more urban spaces, which may be relevant when thinking about figure 1.7, related to seasonal violence.

Figure 3.3: "MBTA stops proportion compare vs shooting proportion 2015-2023" (p. 12, T2, deliverable4/pattern4.ipynb)



According to Figure 3.3, the district with smaller numbers of shooting incidents tend to have more MBTA stops while D4, which is the district with the largest number of shooting events, has relatively fewer MBTA stops. As a result, there may be an inverse correlation between shooting incidents and MBTA stops. Existing research supports the hypothesis that

more public transportation presence in a neighborhood may lower community violence due to increased mobility, educational/economic opportunity, increased health care access, and perception of institutional investment.

Figure 3.4: "Streetlights within 10 meters of shooting incidents 2019-2023" (p. 18, T5, deliverable4/Streetlight Analysis.ipynb)

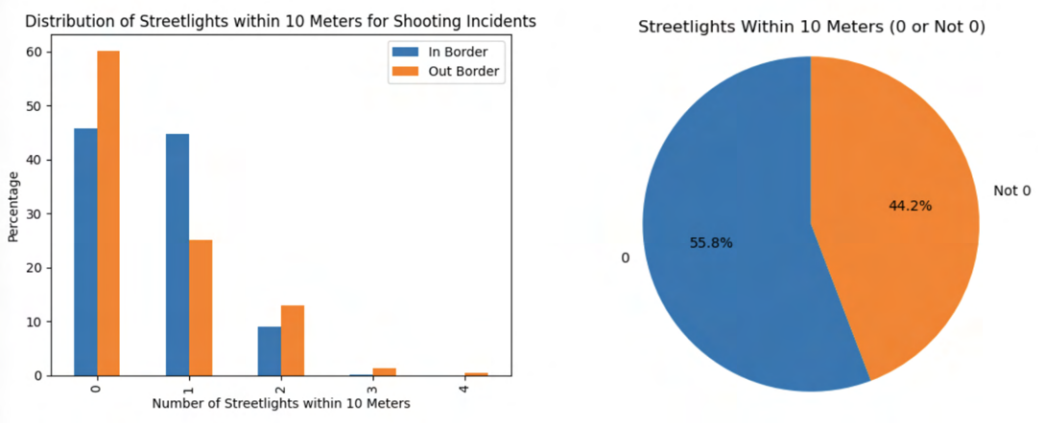
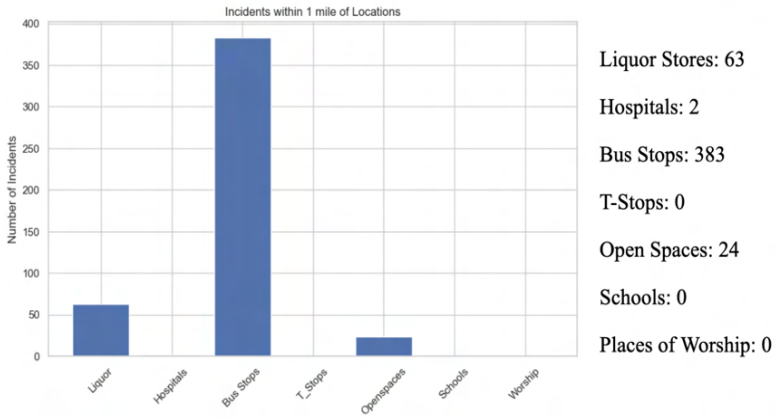


Figure 3.4 shows the number of streetlights within 10 meters of shooting crime incidents in D4 as compared to the rest of the districts. The blue color represents shooting incidents inside the border of District 4, while the orange color represents shooting incidents outside of the border of District 4. In general, we can see most shootings happen where there is zero or only one streetlight in proximity, and 55% of shootings occur where there are zero streetlights nearby.

Figure 3.5: "Incidents within 1 mile of locations 2015-2023" (p. 13, T5, deliverable4/Further Analysis.ipynb)



The plot shows the total number of incidents within a 1-mile radius of different types of locations such as liquor stores, hospitals, bus stops, T stops (train stops), open spaces, schools, and places of worship. It can be seen that between 2015-2023 the bus stops have the highest number of incidents happening within 1 mile of their radius, with 383 incidents, with liquor

stores following with 63 incidents. It should be noted however, that there are far more bus stops than hospitals/ liquor stores/ etc, in District 4. This does not mean bus stops attract violence, but that buses move through areas of violence. Similarly, there are fewer places of worship, and as such, fewer opportunities for violent behavior to intersect with their geographic space.

3B. Analysis of Major streets

Figure 3.6: Chart of Streets with Most Shootings in D4 (p. 5, T2, deliverable4/pattern_4.ipynb)

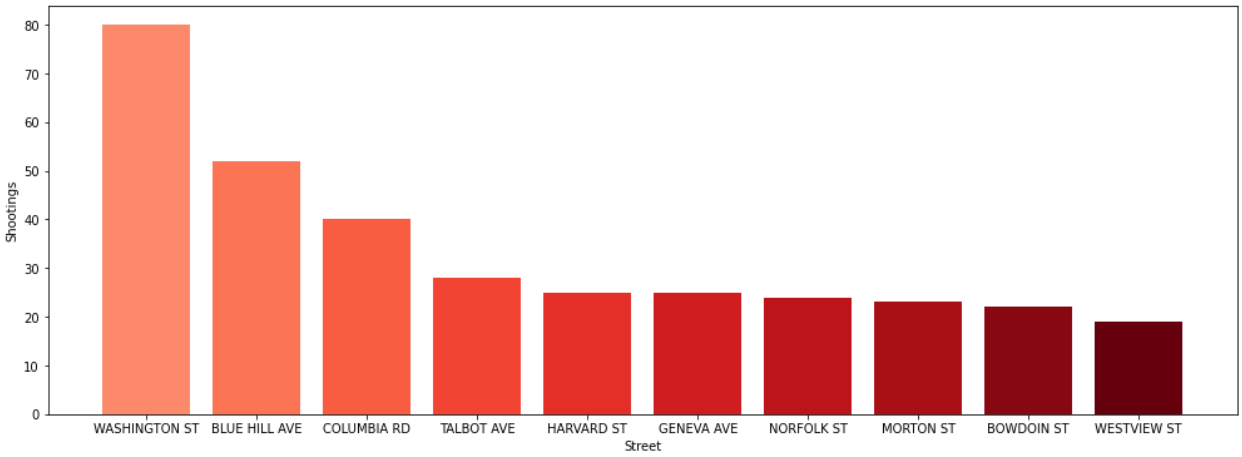


Figure 3.6 shows the streets in District 4 where the most number of shootings occur. The street with the most shootings is Washington St, with around 80 shootings, followed by Blue Hill Ave with around 54 shootings, and Columbia Rd with roughly 40 shootings. Many of these streets have a section located within Dorchester.

Figure 3.7: Map of Streets with Most Shootings in D4 2015-2023 (p. 5, T2, deliverable4/pattern_4.ipynb**)**

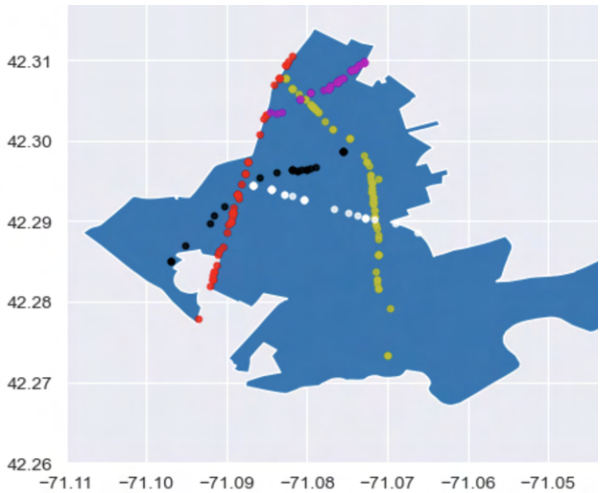


Figure 3.7 displays a map of District 4 with colored dots representing shootings on major streets. The yellow dots represent shootings that occurred on Washington Street, red dots represent shootings on Blue Hill Ave, magenta dots represent shootings on Columbia Rd, white dots represent shootings on Talbot Ave, and black dots represent shootings on Harvard St.

Figure 3.8: Close Up Maps of streets- washington, blue hill, westview,(p. 19-20, T4)

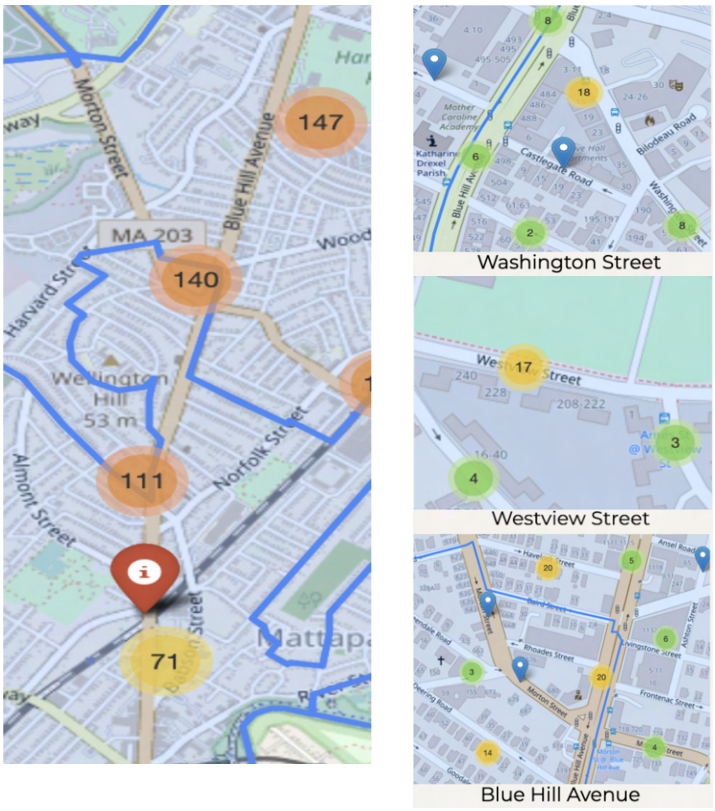


Figure 3.8 shows a close up of Blue Hill Ave, Washington Street, and Westview Street, with the dots showing the number of shootings occurring in a certain area.

4. Patterns in terms of types of violence

Figure 4.1: "gun-related incidents vs. murder incidents by district 2015-2023" (p. 22-23, T1, Deliverable1/Team_1_deliverable_1.ipynb)

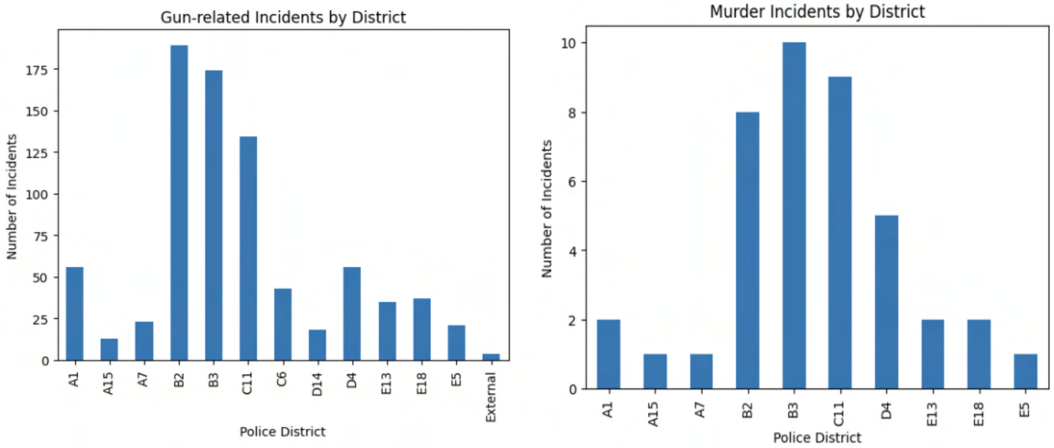


Figure 4.1 shows the counts of gun-related incidents compared to the counts of murder-related incidents by District. We can see that police districts B2, B3 and C11 (districts that make up congressional district 4) have the highest gun-related incidents and murder incidents when compared to the other police districts. Although this could be already assumed, the data backs up the notion that areas with higher firearm related incidents also have a higher chance of murder incidents.

Figure 4.2: "Counts of gun violence offenses by district 2015-2023" (p. 7, T5, deliverable1/GunViolence-Q3.ipynb)

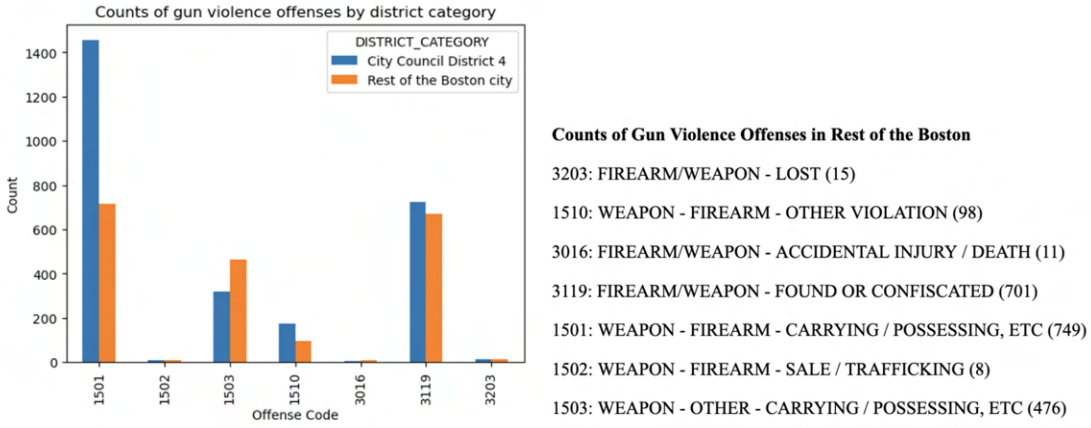


Figure 4.2 shows the counts of gun violence offenses in District 4 as compared with the rest of Boston. District 4 has around double the amount of carrying/possession of firearm offenses as the rest of Boston, and has a high proportion of offenses out of all districts. The top offense codes are carrying or possession of firearm, and firearm found or confiscated.

Figure 4.3: "Top 15 Offense codes in D4" & "Top 15" in boston 2015-2023 (p. 10-12, T5, deliverable1/GunViolence-Q3.ipynb)

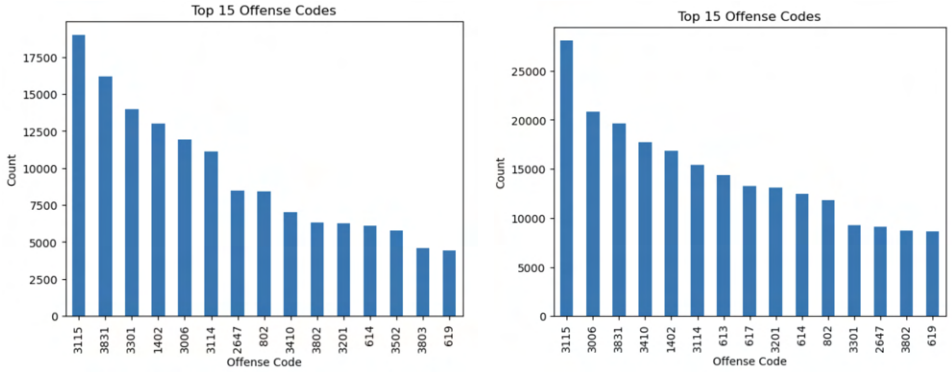


Figure 4.3 shows the top 15 offense codes in D4 as compared to the rest of the city. D4 has more violent offense codes recorded than other districts.

3115: INVESTIGATE PERSON (18,978)
3831: M/V - LEAVING SCENE - PROPERTY DAMAGE (16,182)
3301: VERBAL DISPUTE (13,972)
1402: VANDALISM (12,984)
3006: SICK/INJURED/MEDICAL - PERSON (11,939)
3114: INVESTIGATE PROPERTY (11,123)
2647: THREATS TO DO BODILY HARM (8,491)
802: ASSAULT SIMPLE - BATTERY (8,397)
3410: TOWED MOTOR VEHICLE (7,025)
3802: M/V ACCIDENT - PROPERTY DAMAGE (6,326)
3201: PROPERTY - LOST (6,257)
614: LARCENY THEFT FROM MV - NON-ACCESSORY (6,123)
3502: MISSING PERSON - LOCATED (5,760)
3803: M/V ACCIDENT - PERSONAL INJURY (4,605)
619: LARCENY ALL OTHERS (4,422)

3115	28076	INVESTIGATE PERSON
3006	20853	SICK/INJURED/MEDICAL - PERSON
3831	19673	M/V - LEAVING SCENE - PROPERTY DAMAGE
3410	17732	TOWED MOTOR VEHICLE
1402	16829	VANDALISM
3114	15430	INVESTIGATE PROPERTY
613	14406	LARCENY SHOPLIFTING
617	13252	LARCENY THEFT FROM BUILDING
3201	13122	PROPERTY - LOST
614	12460	LARCENY THEFT FROM MV - NON-ACCESSORY
802	11814	ASSAULT SIMPLE - BATTERY
3301	9246	VERBAL DISPUTE
2647	9088	THREATS TO DO BODILY HARM
3802	8741	M/V ACCIDENT - PROPERTY DAMAGE
619	8656	LARCENY ALL OTHERS

5. Discipline records from schools (dropouts, attendance, absences)

Figure 5.1: "Percentage of students disciplined per district" 2012-2022 (p. 10, T4)

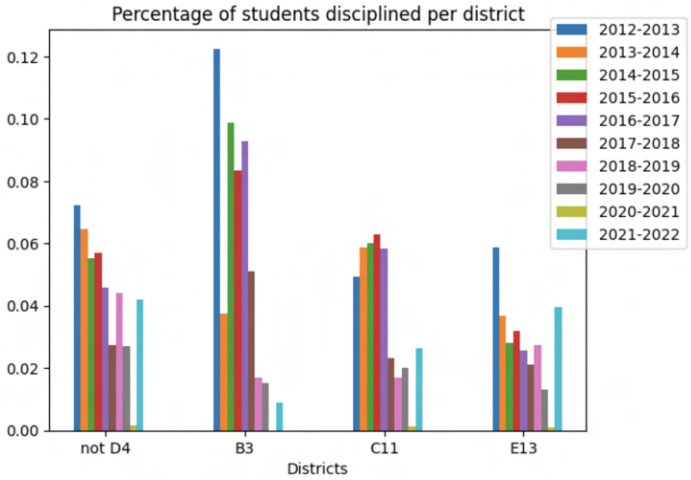


Figure 5.1 displays the percentages of students disciplined per district, between the years of 2012 and 2022. As seen, B2, B3, and C11 had a large proportion of students disciplined as compared to other districts. Student discipline is defined as forms of corrective action or punishment, such as detention, suspension, expulsion, or similar measures.

Figure 5.2: "Average attendance rate" vs " number of absences" 2018-2022 (p. 18, T5, deliverable4/extension analysis.ipynb)

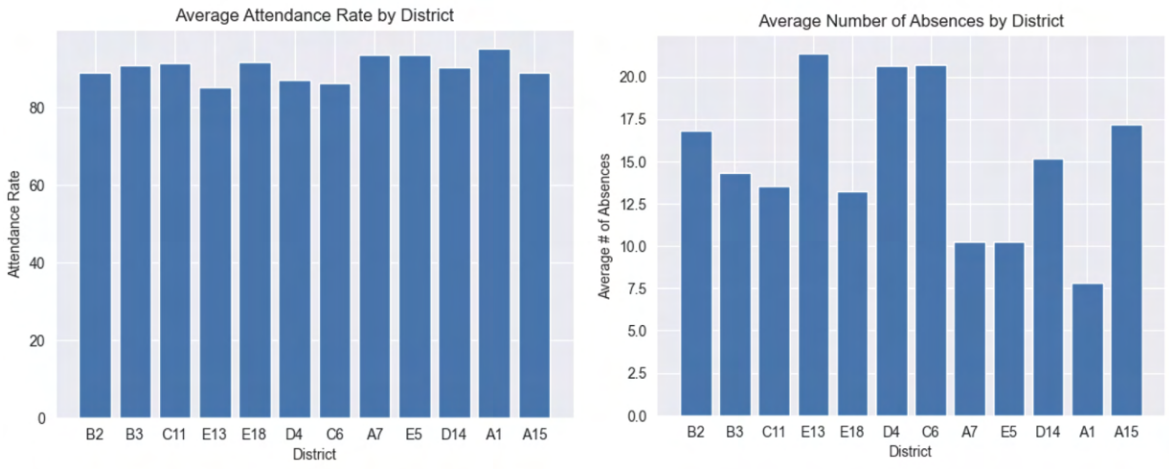


Figure 5.2 displays the average attendance rates and average number of absences by district between the years of 2018 and 2022. As seen, D4 has a lower attendance rate and higher number of absences than other districts.

Figure 5.3: "Yearly dropout rate" in D4 vs. outside D4 2015-2022 (p. 15, T5, delivrable4/school_analysis.ipynb)

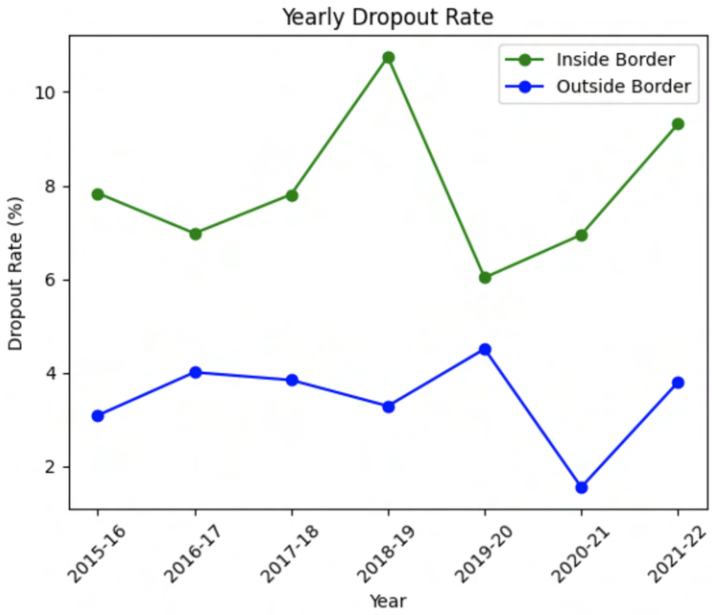


Figure 5.3 shows the yearly dropout rate between 2015-2022 for inside and outside the border of D4. As seen D4, has a much higher yearly dropout rate as compared to other districts.

Conclusion

Overall, congressional district 4 has a significantly higher rate of gun violence than other districts in Boston, with 1792 gun violence incidents between 2015 and 2023. The ballistic evidence and buyers of firearms are also significantly higher in District 4 than compared to other districts. In the past few years, shooting incidents were at the highest in 2020. Shootings also occur the most between 9pm and 2am, as well as on weekends and during the summertime. The number of field contacts or police activity increases in the summer times as well. Congressional district 4 has three nearby police stations, however two of these are outside district 4 and the third one is on the border of district 4 and 5. The large majority of district 4 does not have a police station. District 4 also has much fewer hospitals, universities, parks, and MBTA stops than other districts. We also observed several interesting patterns regarding location and type of violence. When examining the types of locations for shooting incidents, 24 incidents occurred within 1 mile of an open space, 63 within 1 mile of a liquor store, and 383 within 1 mile of a bus stop. The high volume of incidents occurring near bus stops could be due to a high concentration of bus stops within close proximity of each other. An interesting observation made was that 55% of shooting incidents had zero streetlights within 10 meters of the incident. This implies that shootings and streetlights may be correlated. The streets with the most numbers of shootings in D4 are Washington St, Blue Hill Ave, and Columbia Rd. When looking at types of violence, both gun-related incidents and murder-related incidents occur most in the police districts B2, B3, and C11, the three police districts making up congressional district D4. D4 has significantly more offenses for carrying or possession of a firearm than other districts, and the types of offenses overall were more violent than other districts. From our analysis of school discipline records, we observed that district 4 has a higher percentage of students disciplined, as forms of correction action or punishment such as detention, suspension, expulsion, etc. District 4 also has lower attendance rates, higher numbers in absences, and a consistently higher yearly dropout rate.

Limitations:

- We only have access to incidents that are recorded in the dataset. Not all gun violence incidents are documented in police records.

- Observing these relationships does not mean that these factors directly cause more gun violence, only that there may be a correlation.
- Violence is an extremely complex sociological problem with many contributing variables; While many findings from this report can inform mitigating policy, there are surely variables that cannot be captured that are missing from this report.
- It's difficult to measure or gauge the historical legacy of structural racism at play here. Much of the field of urban sociology highlights a throughline from discriminatory social dynamics to current crises in majority black communities. District 4 is likely no exception here.

Recommendations for further analysis:

1. Examine specific offenses of students across school districts within D4 (physical attack, physical fight, robbery, theft, vandalism, weapon on school premises)
2. Analyze enrollment by grade to see at which grades students drop out.
3. Explore qualitatively, the catalyzing impact of distinct 4 schools on violence (who are current educational policies helping, who are they hurting, and how?).
4. Compare traffic data with analysis of major streets of shootings
5. Explore data from hospitalizations related to gun violence

Takeaways:

With the caveat that it's quite difficult to boil down complex sociological phenomena into bite sized pieces with actionable solutions, there are some areas where gun violence may be abated. This is the low hanging fruit so to speak.

1. **Heat mitigation and parks** – There's a deeply interesting relationship between heat (weather), and violence. That's observable in District 4, and across the globe. Research on various populations has found that efforts at climate control significantly impact population violence. Prison populations for example[1], are less violent when they have air conditioning. Policy wise, this means local governments can investigate ways to keep

[1] Mukherjee, A., & Sanders, N. J. (2021). *The causal effect of heat on violence: Social implications of unmitigated heat among the incarcerated* (No. w28987). National Bureau of Economic Research.

citizens cooler during evermore brutal summer heat (thanks to climate change). Subsidized air conditioning, electricity, ice machines, ice cream, hats, summer clothing, and public pools are all quick fixes here. Additionally, the presence of green spaces significantly cools surrounding areas. Urban heat islands trap heat and leave sidewalks, stoops, porches, and apartments significantly hotter which correlates with more violence. Public green spaces have been shown[2] to have a tremendous, resilient cooling effect on surrounding urban areas. City investment in public parks for district 4, or, alternatively, more trees and bushes, will bring down the temperature which often leads to less violence.

2. **Guns and perception of safety** – Existing research shows that the presence of guns in a community begets more guns which leads to the increased use of guns. This is rarely due to the perceived desire to use guns offensively. Instead individuals seek to own guns as a form of protection from other gun owners[3]. District 4 currently has few police departments as well. As a caveat here, community relationships to police are extremely complex. Where the police are able to demonstrate dedication to public service, and protecting all members of the community, communities often report being comfortable with increased police presence in a neighborhood. If police units fail to demonstrate that dedication, their presence can inflame tensions. Dr. Michael Sierra-Arevalo's forthcoming book on the culture inside policing units describes how this culture and training can make or break this successful interaction with the community. Though admittedly difficult to implement, a campaign around properly training and trusting public safety officers, continued gun buybacks, and increased presence of public safety officers in the district could be effective at reducing the need for defensive gun ownership, and thus violence.
3. **Schooling and young men** – Currently black men face more behavioral scrutiny by academic institutions than any other group. They're also the most likely victims of gun violence. The solution for academic misbehavior is often detention, expulsion, or suspension. While these approaches are often the easiest and most traditional, research[4][5]

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[2] Lehmann, S. (2014). Low carbon districts: Mitigating the urban heat island with green roof infrastructure. *City, Culture and Society*, *5*(1), 1-8.
[3] Sierra-Arévalo, M. (2016). Legal cynicism and protective gun ownership among active offenders in Chicago. *Cogent Social Sciences*, *2*(1), 1227293.
[4] Atkins, M.S., McKay, M.M., Frazier, S.L. *et al.* Suspensions and Detentions in an Urban, Low-Income School: Punishment or Reward?. *J Abnorm Child Psychol* 30, 361–371 (2002). https://doi.org/10.1023/A:1015765924135
[5] Kohn, A. (2006). *Beyond discipline: From compliance to community*. ASCD.

shows that they do not work for correcting behavior or reducing violence. School systems are a public pillar of support for nearly all young people, and exclusion from that support often further instigates adverse behavior. This report is not equipped with the findings to offer detailed takeaways about public education policy, however possible next steps include a qualitative investigation of behavioral motivators and triggers within district 4 schools, as well as exploring alternative solutions to expelling students from support systems.