An Analysis of Springfield, Massachusetts Policing Data and Massachusetts Traffic Stop Data
A BU Spark! Project in collaboration with CfJJ
Neal Kewalramani, Kristen Lamb, Daniel Skahill, Aubrey Odom
December 2021

I. Introduction

The Commonwealth of Massachusetts has faced scrutiny over its policing tactics in several areas in recent years. Activism to hold police accountable for improper actions and tactics relies on an evidence-based approach that examines past actions and trends, thus calling for the critical analysis of relevant data to push forward more progressive policing policies.

This report takes a close look at policing in Springfield, MA, a department notorious for their violent and racialized policing tactics and traffic stops conducted across the commonwealth between 2016 and 2020. Here, several data analyses on Springfield detention admissions, student arrests, field investigations and observations, and other datasets pertinent to these topics will be discussed to better understand police treatment of youth, racial groups, and how specific officers and cities contribute to overpolicing. By providing a detailed analysis and report of our findings, the report aims to shine a light on police bias in Springfield to inform local activists working to make changes in police policy and ultimately practice.

The report has two sections: one section that analyzes Springfield-specific datasets of police practice, and another that analyzes Massachusetts Department of Transportation (MassDOT)-provided datasets of traffic stops state-wide conducted between 2016 and 2020. Both sections expose instances where policing targeted people of black or hispanic race/ethnicity, people with disabilities, and youth under the age of 18.

II. Springfield

In the Springfield section of our report, we wish to answer the following questions:

1. Is Springfield policing racially biased?
2. Is Springfield policing focused on certain neighborhoods?
3. How are youth (youth under 18, young adults 18-20, adults 21+) in Springfield treated differently by police?

To do this, we rely on a number of data sources provided by Citizens for Juvenile Justice (CfJJ). These are explained, along with their associated questions, in Table 1 below.

Table 1: Data sources used to answer questions about Springfield policing tactics

Dataset Name	Description of Dataset	Associated Questions
Springfield Field Interrogations & Observations - 2019	A compilation of records detailing interactions between the Springfield Police Department (SPD) and private individuals in 2019. Unredacted descriptive information is available on some aspects of the interaction (e.g., zip code, date caution used) and the individuals involved in the encounter (e.g., ethnicity, race, speech identifier).	2
Springfield Police DOT Citations and Roster Data - 2020	A list of traffic citations issued by Springfield police officers, joined with roster information including officers' names, date of hire, and employee ID number.	1
CPCS Springfield Police Roster	A roster of Springfield officers with their date of hire and active status with identification numbers.	1
School Arrest Data -2019-2020 (Springfield)	A list of 32 arrest instances with relevant information on students' date of birth, gender, race/ethnicity, school, English second language (ESL) status, and special education status/level of need from 2019-2020.	3
Springfield and surrounding areas Department of Youth Services (DYS) detention data	Tables on detention admissions from Springfield Court from 2017-2020, divided by year, race, gender, and most serious offense, for both the total number of detention admissions and the number of unique youth admitted only.	3
Census/Demographic Data (Assorted)	Additional contextual information on school demographics (such as percentages of students with high needs or with disabilities) were obtained from profiles.doe.mass.edu. General population data was obtained from the U.S. Census American Community Survey Data.	1, 2, 3

IIa. Is Springfield policing racially biased?

Using the traffic citation data's race labels[1], the three largest racial/ethnic groups given citations in Springfield in 2020 were white 52% (8794), hispanic 23% (3839), and black 21% (3619) (Figure 2). According to census data, the Springfield racial makeup is about 63.3% white, 20.9% black, 2.7% asian. Looking at census ethnicity, about 45% of white people are hispanic. Realigning these percentages[2] to the police labels, the racial makeup in Springfield is approximately 28% hispanic, 20.9% black, and 34% white.

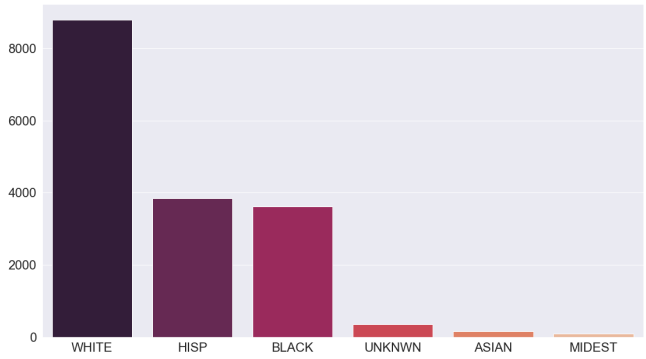


Figure 1: Citation dataset broken down by race. Because the racial categories of the citation data and census data are labeled differently, the bar graph cannot be normalized properly. Census data does not give numbers for white hispanic or black hispanic.

The percentage of white people who were searched and given a citation in 2020 was .26% (23) versus black people with .58% (21). Although these are low percentages, the alarming fact is there are the same number of black people who were searched as there were white people — black people are more than twice as likely than white people to be searched by the police during any given stop.

Additionally, when traffic citations were broken down according to offense, it was noted that the hispanic and black populations were being charged with higher offenses (arrests, criminal, and civil citations) more often than the white population— namely that hispanic people are about twice as likely to be arrested than white people. White people also received more warnings: 57% of white people received a warning compared to 52% and 48% of black and hispanic people who received a warning.

Running one-sided hypothesis t-tests comparing the white population versus the black and hispanic populations showed:

- A significant statistical difference (alpha=0.01, p-values=[0.005, 0.000001]) between the proportion of white people who are cited with a warning than black or hispanic people. We can conclude that white people are about 20% more likely to just get a warning.

---

[1] *In the MassDOT dataset, "hispanic" is considered a race whereas in census data, "hispanic" is not included in race and classified as ethnicity. This is the first recommendation that we have for policing data collection: align demographic data collection according to the most recent census models. Without proper race and demographic labels, analyzing policing data against the true population is significantly harder to accomplish.*

[2] *The adjusted racial makeup of the population is a rough estimate that should be observed with some skepticism as the question of race versus ethnicity creates room for many different errors. In addition, citation data is self reported by the police officers themselves, they are likely to have made many mistakes while identifying race.*

- A significant statistical difference (alpha=0.01, p-values=[0.0093, 0.0029, 5.94e-07]) between the proportion of white and hispanic people charged with higher offenses (criminal, civil, and arrests). We can conclude that hispanic people are about 20% more likely to be charged with a higher offense than white people.
- A significant statistical difference (alpha=0.01, p-value=0.0027) between the proportion of white and black people cited with a civil infraction. We can conclude that black people are about 15% more likely to be cited with a civil infraction than white people.

Examining citation types received among the different race groups within Springfield, it was discovered that out of all stops, 45% of stops within the white subpopulation were for speeding-related offenses, while this was true for only 35% of stops for both the hispanic and black subpopulations respectively. The 10% difference between the stops within the racial groups potentially indicates that the black and hispanic populations are being stopped for more minor or trivial offenses than white people which may suggest some degree of racial profiling.

Plotting the top offenses across each racial group, speeding, stopping, and traffic light violations were the most common across each racial group.

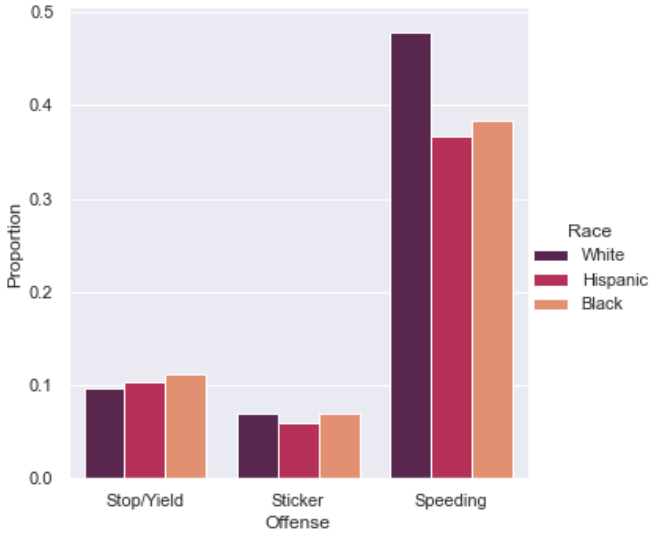


Figure 2: Top 3 offense types by race

However, when observing other offenses, it was clear that unlawful “operation of a motor vehicle” and “license not in possession” were much more common across the hispanic and black populations. An officer wouldn’t know that a person does not have their driver’s license in their possession or that they were unlawfully operating a motor vehicle unless they pulled that person over, which is why we wanted to isolate these two offenses. The black population had roughly 10% of their stops coming from these two violations, the hispanic population saw almost 13%, and the white population only had about 8%. The data suggests that police officers are profiling people of color as they are pulling them over for some unknown reason, and citing them for not having a valid driver’s license or operation of a motor vehicle.

After speaking with our client, we were able to gain more insight as to what type of traffic citation may indicate racial profiling. He directed us to a report titled "Too Blue" which reveals that any stop describing an infraction for license not in possession, operation of a motor vehicle, unregistered vehicle, unlicensed vehicle, no registration, suspended license, or uninsured vehicle has the potential to uncover racial bias. When we looked at these offenses and broke them down by race, we saw the same trend: 13.7% of the white population's offenses came from these categories while almost 17% of the black population's offenses and 19% of the hispanic population's offenses came from these offenses — a statistically significant result for both black and hispanic populations compared to the white population.

Using the most common offense types by race, we noted that the top 5 offense types for the white population accounted for 65% of the total citations, while they only accounted for only 55% and 59% of the hispanic population stops and black population stops, respectively. Again, this supports our initial finding that hispanic and black populations are being cited more often for more obscure offenses, indicating racial profiling.

To further investigate where these policing biases are coming from, we merged the MassDOT citation data with Springfield Police Department roster data. Unfortunately, only 11,000/16,000 citations remained after the merge because no valid police ID existed for about 4,500 citations. This leads to a recommendation: *formalize a process for identifying officers (have one unique publicly accessible officer ID)*.

However, we were still able to analyze the 11,000 remaining rows to find that out of 495 officers, the 75 police officers who stop blacks more often than whites, account for 27% of all police citations for black people. In other words, 15% of the police officers stopped 27% of the black people in the data.

Having seen clear trends within the citation dataset, we sought to develop a model that could help to explain some of these racial discrepancies. Our goal was to produce a model that could explain — with reasonable accuracy — racial disparities in police traffic enforcement within Springfield.

Summary of Model:

Table 2: Interpretation of confusion matrix for SVM model

True Arrests predicted: 70%	*When Arrest was true, 16% predicted civil*	*When Arrest was true, 1.6% predicted Criminal*	*When Arrest was true, 13% predicted Warning*
When Civil was true, .52% predicted Arrest	***True Civil Citations predicted: 69%***	*When Civil was true, 1.3% predicted Criminal*	*When Civil was true, 30% predicted Warning*
When Criminal was true, 0% predicted Arrest	*When Criminal was true, 14% predicted Civil*	***True Criminal Citations predicted: 64%***	*When Criminal was true, 22% predicted Warning*
When Warning was true, .23% predicted Arrest	*When Warning was true, 14% predicted Civil*	*When Warning was true, 1.3% predicted Criminal*	***True Warnings predicted: 85%***

- *Prediction:* The model aims to predict whether an individual would receive a warning, civil citation, criminal offense, or be arrested. These are referred to as "stop outcomes."

- *Feature selection:* The 4 features that predict the stop outcome are race, gender, age, and police officer ID. Features contributing to accurate prediction were chosen to be the most practical features and retained for model simplicity. The other features that were available for use were: Event Date, Citation Time, Violation Type, Offense, Offense Description, Searched, and Crashed. The features used in the model were selected by their direct relation to the identity of the cited individual or citing officer.
- *Models:* Using K-Nearest Neighbors classification (k=3), we were able to predict stop outcomes with an accuracy of 70% and a mean squared error of 1.03. Using a Support Vector Machine, that accuracy increased to 75% and a mean squared error of .88.
- *Feature Importance:* Year of birth and police ID have the most significant effect on the overall accuracy. This means that there is a strong correlation between the age of the individual being cited and the citation type that they will receive. The data indicates that younger individuals are more likely to be given an escalated citation (not just a warning) than older individuals. Race and gender still increase the accuracy of the model, but not nearly to a degree that age does.
- *Results:* We were able to create a model that could predict the outcome of a citation with high accuracy (75%; after 10-Fold cross validation). Given that this model was based solely on 4 predictors, it reveals strong implications. The same procedure listed above was also performed on the merged roster dataset that included all municipalities in Massachusetts. Using a K-Nearest Neighbors model (k=20), the best accuracy we were able to achieve was about 64% with a mean squared error of 1.15.
- *Conclusion:* The model predicting the citation outcome for Springfield was determined to be significant and reasonably effective on the basis of a few criterium:
    1. The model from all municipalities within Massachusetts struggled to predict any citation other than "warning" while the Springfield model achieved solid predictive accuracy across the board. (A future project would run the model across all municipalities and rank the accuracies accordingly)
    2. The Springfield model achieved an accuracy far better than that of the whole state model. Two baselines that the Springfield model can be compared to are randomly predicting citation outcomes and always predicting a "warning." If one were to randomly guess the outcome of a citation, the accuracy would be roughly 25%, but if one were to always predict a warning, the accuracy would be about 54%. The actual model therefore has predictive power 21% more accurate than a constant prediction method and three times greater than a random prediction. A 21% increase in accuracy strongly implies trends (functional relationship) within the data. Models are evaluated based on their performance against a baseline rather than ability to achieve 100% accuracy--this would not be a desired outcome as it would indicate strong overfitting of the model.
    3. The purpose of the models developed are to illustrate clearly biased trends within the Springfield police department. Achieving 75% accuracy clearly indicates that there are strong correlations between the citing officer and the race, gender, and age of the offender.
    4. Given the strong 10% difference in predictive power between the whole state versus Springfield models, the Springfield model has achieved a level of credibility that is both surprising and cause for concern. Springfield policing is showing strong trends with

regards to who is doing the stopping, what race is being stopped, how old they are, and what their gender is.

- *Recommendation:* The model developed is based only on 2020 data. Post-acquisition of 2021 data, we recommend that this model be tested to predict the outcomes of the new data and to record the accuracy. If predictions are still similar, we can speculate that any new policy that has been implemented in Springfield has not been effective. If the prediction is weaker, the model should be trained using a part of the new data and tested on the remainder. If the model is then weaker, there may be reason to believe that Springfield policing trends are changing for the better.

IIb. Is Springfield policing focused on certain neighborhoods?

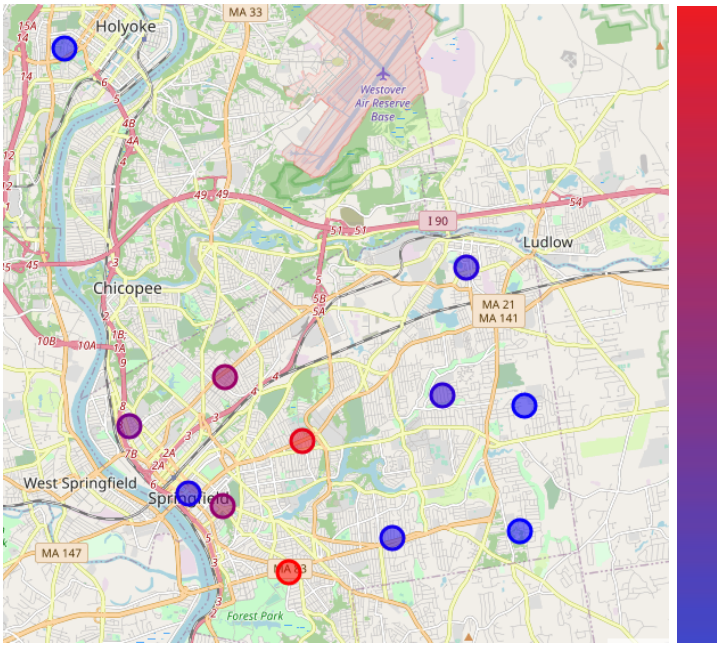
We next sought to conduct an analysis of the geographic distribution of policing in Springfield using a field investigations and observations dataset from 2019. Each observation listed an individual involved in a field investigation, with several observations listing multiple individuals from a single investigation. Unfortunately, many observations did not list the zip code where the investigation took place, rendering a majority of the data unusable for our analysis. Of the 1393 lines of data, only 614 (44.1%) had a zip code; furthermore, only 164 (11.8%) had a nine-digit zip code, which allowed us to map investigations to specific locations. The absence of zip codes could likely be ascribed to officers failing to record sufficient data for each field investigation, which hinders our work in ensuring police accountability. Most of our analysis was conducted with available five-digit zip codes due to the lack of nine-digit zip codes.

To begin our analysis, we first sought to determine whether there was an association between the number of field investigations and a given zip code — that is, do more or less investigations take place in any given Springfield zip code? We carried out a chi-square test of independence with the following hypotheses to understand this relationship:

H_0: Zip codes and the number of observed field investigations are independent.
H_A: Zip codes and the number of observed field investigations are not independent.

Based on the number of field investigations on each zip code, we could calculate the expected number of field investigations based on population. Our chi-square test yielded a p-value less than 10^{-30} , indicating that there is a dependent relationship between the number of field investigations and the area defined by the zip code in which they took place. To be more specific, this test indicates that certain zip codes see higher amounts of field investigations compared to other zip codes even when we normalize to population. To further reveal this relationship, we visualized the data by plotting field investigations by zip code on a map of Springfield (Figures 3, 4). Due to a lack of detailed location data, all investigations were plotted as one point with the total number expressed by the color of the point. A blue circle indicates a lower proportion of field investigations, and a red circle indicates a higher proportion of field investigations. The first map is based on the raw number of field investigations, and the second map is the number of field investigations normalized to the population of the zip code.

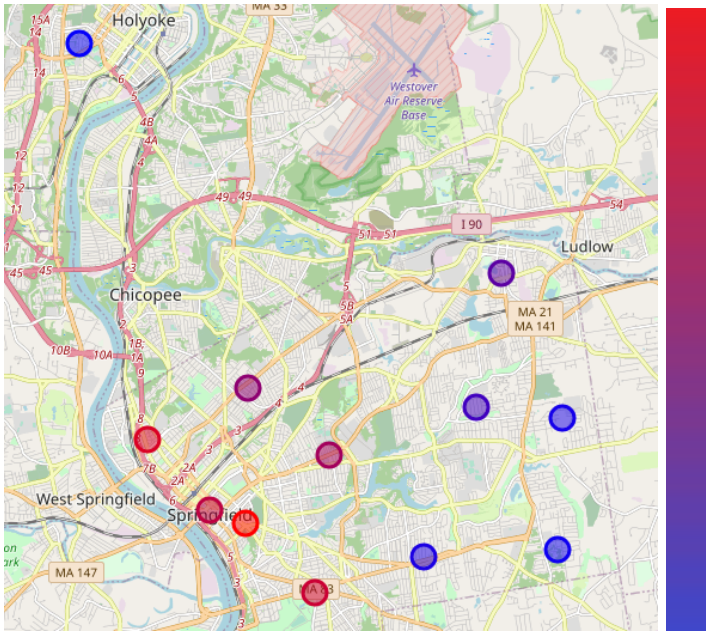
High Proportion of Field Investigations



Low Proportion of Field Investigations

Figure 3: Map of Springfield plotting the raw number of field investigations in 2019 by zip code. All investigations were plotted as one point with the total number expressed by the color of the point. A blue circle indicates a lower number of field investigations, and a red circle indicates a higher number of field investigations.

High Proportion of Field Investigations



Low Proportion of Field Investigations

Figure 4: Map of Springfield plotting the number of field investigations in 2019 normalized by the population residing in each zip code. All investigations were plotted as one point with the total number

expressed by the color of the point. A blue circle indicates a lower proportion of field investigations, and a red circle indicates a higher proportion of field investigations.

We see a noticeable shift in the number of field investigations when we normalize by population, indicating that there are certain zip codes that are seeing more field investigations than what we would expect.

However, due to limited data, we are not able to draw many conclusions as to whether the over-policed zip codes are experiencing racial bias. For each zip code, a *z*-test of proportions was done to compare the proportion of people involved in a field investigation by race and the demographics of the zip code. The only significant conclusion found was that there is significant evidence for zip code 01128 (p value $< 10^{-7}$) that shows white people are less likely to be involved in a field investigation, while black people are more likely to be involved in a field investigation (p value $< 10^{-22}$) when comparing to the demographics of the zip code. No other zip code was found to be statistically significant due to the limited amount of data.

Based on Figures 3 and 4, it seems that the zip codes closer to downtown Springfield have higher incidences of field investigations even when we control for population, indicating that these zip codes are over-policed. However, we are unable to make any conclusions on the over-policed neighborhoods with respect to race since there is not enough data.

Based on the proportion of races stopped in the field investigations, black people are twice as likely to be stopped compared to their white counterparts - even when we normalize for Springfield demographics.

IIc. How are youth (under 18, 18-20, 21+) in Springfield treated differently by police?
We were tasked with answering the question of how youth in Springfield are treated differently by police. We have access to two informational datasets regarding youth treatment by the Springfield police department. One consists of tables of Department of Youth Services (DYS) detention data from Springfield and surrounding areas, and the other contains 32 records of youth arrests from schools in Springfield from 2019-2020.

Results: School Arrests Data

We first examine the youth school arrests dataset, which contains information on students' date of birth, gender, race/ethnicity, school, English second language (ESL) status, and special education status/level of need. We were unable to determine age at time of arrest, so we estimated students' ages at the start of the COVID-19 pandemic (when MA schools were shut down on 3/16/20) given their dates of birth. We gathered contextual information on school demographics from profiles.doe.mass.edu. Our findings were as follows:

- Repeat arrests: Two students were arrested twice, so 30 students total were arrested in Springfield from 2019-2020.
    - One student was an 18-year-old male ESL hispanic student attending Springfield Public Day High School with a high-needs mental disability of intellectual nature. He is of hispanic ethnicity.

    - The other student was a 13-year old male student attending Springfield Public Day Middle School with a high-needs mental disability of emotional nature. He is of mixed white and black ethnicity.
- Age: We found that 80% (24/30) of students were under the age of 18. Of all students, 1 student was 12 years old, 13.3% (4/30) were 13 years old, 1 student was 14 years old, 13.3% (4/30) were 15 years old, 40% (12/30) were 16 years old, and 6.7% were 17 years old (2/30). 20% (6/30) of students were 18 years old.

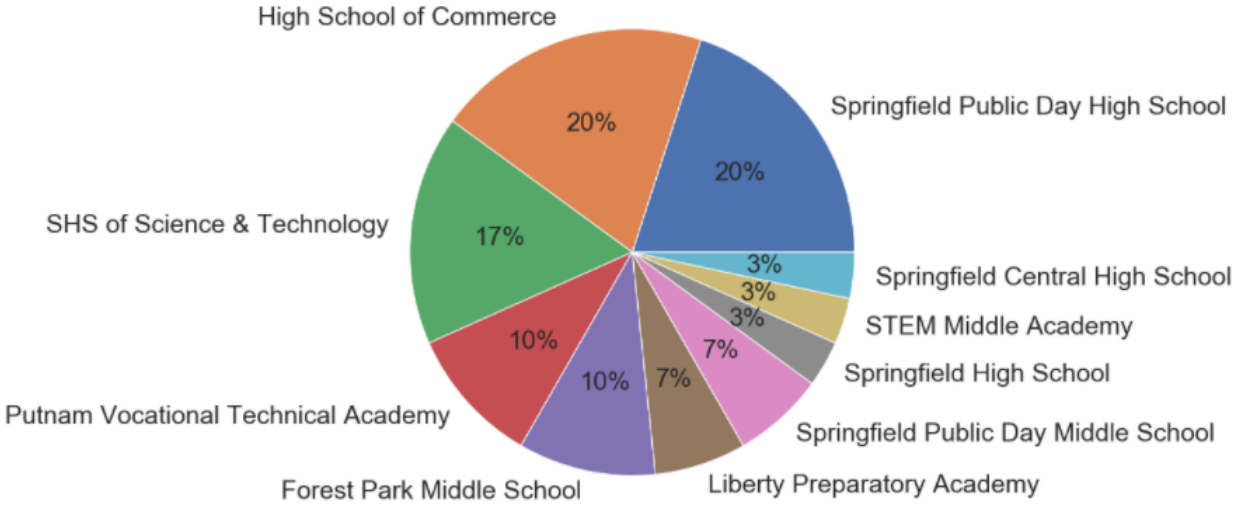


Figure 5: Percentage of Student Arrests at each Springfield School

- Middle schools: We found that about 20% of student arrests were middle school students at Forest Park Middle School (3/30), Springfield Public Day Middle School (2/30), and STEM Middle Academy (1/30).
    - Forest Park Middle School serves a population of mainly high needs (91.9%) and economically disadvantaged (87.5%) students. Its demographic is also mostly Hispanic (66%) and Black (20.1%).
    - Springfield Public Day Middle School serves students with disabilities that are high needs (100%) and economically disadvantaged (100%). Its demographic is also mostly Hispanic (64.3%) and Black (23.2%).
    - STEM Middle School serves a population of mainly high needs (81.1%) and economically disadvantaged (78%) students. Its demographic is also mostly Hispanic (62.4%) and Black (22.6%).
- High schools: The high schools with the most arrests were Springfield Public Day High School (20%, 6/30), High School of Commerce (20%, 6/30), and SHS of Science & technology (16.7%, 5/30).
    - Springfield Public Day High School serves students with disabilities that are high needs (100%) and economically disadvantaged (100%). Its demographic is also mostly Hispanic (68.6%) and Black (19.8%).
    - High School of Commerce serves a population of mainly high needs (88.3%) and economically disadvantaged (87.5%) students. Its demographic is also mostly hispanic (71.1%) and black (6.9%).

    - SHS of Science & technology serves a population of mainly high needs (87.9%) and economically disadvantaged (83.3%) students. Its demographic is also mostly Hispanic (70.8%) and Black (19%).
- Gender: **We identified 63.3% (19/30) of arrested students as male, and 36.7% (11/30) as female.**
- ESL: Students learning English as a second language made up 6.25% (2/30) of arrested students. These students are enrolled in a Sheltered English Immersion program within their school.
- Race/Ethnicity: **56.7% (17/30) were white and hispanic**, 16.7% (5/30) were black, 10% (3/30) were white, 10% (3/30) were black and hispanic, one student was white/black and hispanic, and one student was white/black and not hispanic. Additional information on the school district racial makeup is discussed in the *Police Treatment Findings: Youth of Color* subsection.

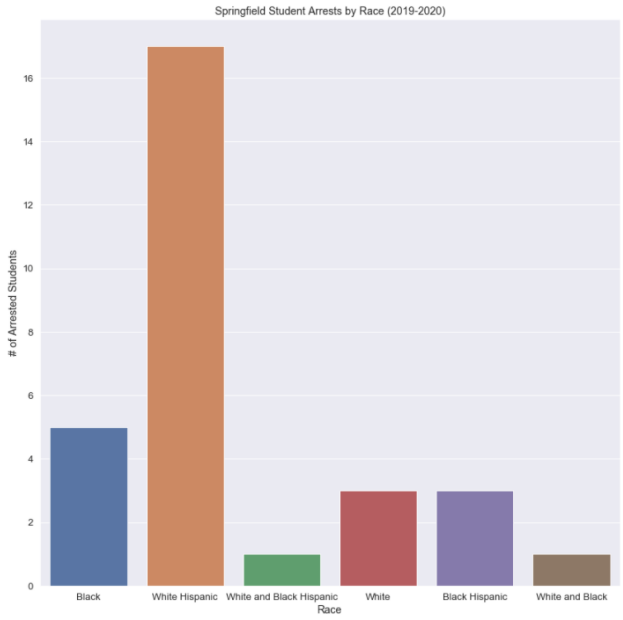


Figure 6: Springfield Student Arrests by Race

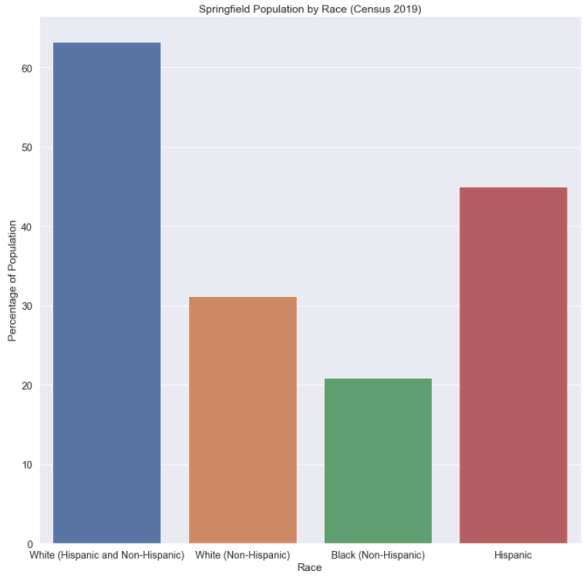


Figure 7: Springfield Population by Race (Census 2019)

- Special needs: **Half of arrested students (15/30) received some level of special education services.** Of these, 40% (6/15) received special education services outside of the classroom less than ⅕ of the time, one student received special education services outside of the classroom more than ⅕ of the time, and 53% (8/15) attended a separate public day school specifically for students with high needs.
    - Level of need and primary disability of the 15 arrested students requiring special education services:

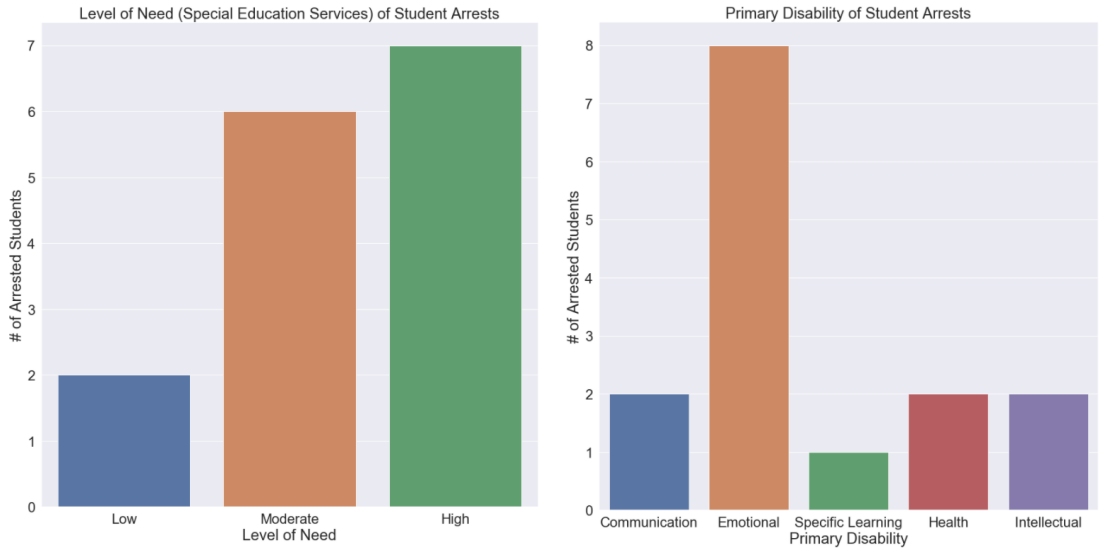


Figure 8: Level of Need and Primary Disability

Results: Detention Data

We also parsed tables on detention admissions from Springfield Court from 2017-2020, divided by year, race, gender, and most serious offense, for both the total number of detention admissions and the number of unique youth admitted only.

We found the following in our analysis:

- **The overall number of unique youth admitted to detentions decreased by 55% from 2017 (121 admitted) to 2020 (54 admitted).** It decreased by 60% when all non-unique youth are taken into account (176 in 2017 to 71 in 2020).
- Across years 2017-2020, unique women account for between 24% and 39% of detention admissions, while men remain the majority of admissions at between 63% and 76%.
- **Youth of color are the overwhelming majority of detentions admissions, making up between 81% and 96% of admissions. The percentage increased by 14% across the years of 2017-2020.**
    - The actual number of admissions counts only decreased by 47.5% for YOC (from 99 to 52), while it decreased 90.9% for white youth (from 22 to 2).
    - Only 67%-77% of YOC admissions are unique youth from 2017-2020. White admissions were 73% unique in 2017, 91% unique in 2018, and 100% unique in 2019. Two of three admissions were unique in 2020.

- As the number of detentions in the Springfield system have decreased, the average lengths of detention stays have gone up (indicating that detentions are not as common now for less serious offenses). White youth served 23.1 days on average in 2017, increasing to 40.3 days in 2020. YOC served 27.5 days on average in 2017, increasing to 34.7 in 2020. The pooled yearly averages are very similar to the YOC averages.

Police Treatment Findings: Youth of Color

After reviewing the statistics in the context of the Springfield, MA census estimates, we gain a better understanding about how the Springfield police have targeted youth based on their race/ethnicity.

The U.S. Census Bureau estimates the Springfield population as composed* of:

- 63.3% white (including white, non-hispanic and white hispanic)
- 31.2% white (non-hispanic)
- 20.9% black (including black, non-hispanic and black hispanic)
- 4.5% two or more races (including non-hispanic and hispanic)
- 45% latino/hispanic (including all races)

* (only listing those races present in the student arrest data)

Based on the data:

- 66.6% (20/30) white student arrests (including white, non-hispanic and white hispanic)
- 10% (3/30) white student arresta (non-hispanic)
- 26.6% (8/30) black student arrests (including black, non-hispanic and black hispanic)
- 6.6% (2/30) student arrests of two races (white/black)
- 70% (21/30) hispanic student arrests (white, black, white/black hispanic)

The juxtaposition of the census data and student arrest allows us to draw concern to percentages that show a large discrepancy. By looking at the percentages that differ by more than a 10% margin, the data suggests that the Springfield police are disproportionately targeting hispanic students as 70% of arrests were of hispanic students when only 45% of the population of Springfield is hispanic. Conversely, we can see that the Springfield police arrested only 10% white (non-hispanic) students when the city has a 31.2% white (non-hispanic) population.

Additionally, the high schools and middle schools with the most student arrests have hispanic student populations well above the city-wide populations. The Springfield police must ensure that they are not racially profiling hispanic students and not showing any racial bias/leniency toward white (non-hispanic) students.

From the DYS detention data, we find that in general, youth of color are being admitted at a far higher level than white youth, most notably in 2020. They are also being admitted as repeat offenders up to 20% more than white youth, which is concerning. While we lack the necessary fine detail to make comparisons like we did with the school data, it is clear that discrepancies in treatment exist. It is possible that youth of color (YOC) are being admitted more often for smaller crimes than are White youth, given that average

detention stays seem to be lower for YOC. All races must be given the same consideration for which offenses will send a youth to detention.

Police Treatment Findings: Age

A not-insignificant number (about 20%) of school arrests were composed of middle school age arrests. Furthermore, about 60% of arrests were under the age of 18. This is concerning as research shows that early police interactions can have lasting effects. In 2020, a Tulane University and University of Washington study tracking Seattle Public Schools students found that "Black respondents who experience contact with the police by eighth grade have 11 times greater odds of being arrested when they are 20 years old than their white counterparts" (McGlynn-Wright et al, 2020). While not the majority of arrested youth were not black, this indicates nonetheless that there may be unintended consequences or correllaries that grow from arrests as a youth.

Police Treatment Findings: ESL Speakers

English second language speakers only made up about 6.25%, or 2 of 30 of the total arrested students in the dataset. One of the students was arrested twice and also had a high-needs disability. Due to the low proportion and confounding factors, we conclude that this is not a likely significant contributor to bias in student arrests.

Police Treatment Findings: Youth with Disabilities

Based on the student arrest data, we have found that half of all Springfield student arrests (15/30) were made on students with disabilities receiving special education services. The two students that had repeated arrests both had high-needs disabilities. One of the high schools with the most arrests (6/30) was Springfield Public Day High School, which specifically serves high-needs students with disabilities. It is fairly apparent that an unusually high number of Springfield student arrests are of students with disabilities.

Our observations here echo the high nationwide trends of arrests of students with disabilities. An ACLU report on public 2015-2016 data released by the Department of Education found that students with disabilities, nationally, are three times more likely to be arrested than non-disabled students. These rates increase if that student is also a person of color or if there is a police presence on the campus.

Due to the high rate of arrests of youth with disabilities, it is important to understand the consequences of arresting these students. A Hechinger Report article brings to light several negative effects and important concerns with regard to this:

- “Students with emotional disabilities are three times more likely to be arrested before leaving high school than the general population.” We can see that, out of all disabled student arrests in Springfield, emotional disability was the primary disability with the most arrests (53%, 8/15) compared to the other primary disabilities (intellectual, communication, and health).
- “For youth with disabilities who end up in jail, education can be minimal, and at times non-existent…”

- "In Mississippi and across the country, the path to prison often starts very early for kids who struggle to manage behavioral or emotional disabilities in low-performing schools that lack mental health care, highly qualified special education teachers, and appropriately trained staff."
- "Nationwide, at least 73 percent of youth with emotional disabilities who drop out of school are arrested within five years, according to a federal study."

The consequences of arresting disabled students results in disrupting the education of disabled individuals, which is typically where these students are receiving their mental health counseling and behavioral treatment. Further, when these students are sent to juvenile detention, the education and services that they are able to receive are decreased to non-existent. All students attending Springfield Public Day Schools are designated as economically disadvantaged, so these students may not have access to high quality services in the first place. As a result, these students have a high likelihood of going to prison and early in their youth, as has been suggested by previous studies.

The high arrest rate of students with disabilities in Springfield is troubling. Upon first glance, the Springfield Police Department appears to be targeting this demographic intently, but due to our limited information on the environment of the Public Day Schools and circumstances leading to individual arrests, we cannot make any clear judgements as to why this is occurring. There may be a higher police presence at the Public Day Schools, which would lead to more arrests because officers are called in to restrain students or remove them from the classroom. Nevertheless, action must be taken to diminish these high arrest rates. School administrators need to consider the consequences on these student lives when students with disabilities are arrested at a young age, and consider other routes to remove distractions from the classroom or ensure safety on school grounds that would lead to less police presence and reliance on police. It would be important for the police to both educate themselves on indicators of emotional disability in young students and on resources and services that can be called upon to help students rather than making an arrest and bringing the student into the prison system.

III. MassDOT Citations

We now pivot to a broader analysis of traffic stops across the state of Massachusetts between 2016 and 2020 merged with rosters from 75 police departments, including the expansive Boston Police Department and the Massachusetts State Police. Datasets from 2016 to 2020 were initially cleaned for readability of all feature columns, before merging was conducted on employee ID and badge numbers present in the data and the MassDOT ID listed in the given citation datasets. Due to the lack of a clear connection between which department identifier was used by MassDOT for each department, merging first was attempted for whichever identifier had more unique values in the CPCS mega-roster, before defaulting to the leftover identifier. If a MassDOT ID was unable to be identified for a given officer in a department, the observation was kept, but sans identifying information.

Upon cleaning and merging the dataset, we were interested in answering three questions:

1. Are Massachusetts traffic stops racially biased?
2. Are there citation or stop trends for youth (under 16-17, 18-20) in Massachusetts?
3. Are there any outlier trends in the stops for certain towns, tickets, arrests, or officers?

IIIa. Are Massachusetts traffic stops racially biased?

In a brief analysis similar to the one performed on Springfield, we used the citation data to run one sided hypothesis t-tests comparing the difference in proportion of white people who received a certain level citation and the proportion of other races who received the same type of citation. After normalizing the significance level with a Bonferroni correction, it was found again that the black and hispanic populations are being stopped and arrested or cited for criminal and civil reasons at a statistically significant level compared to the white population (alpha=.01, p-value≈0).

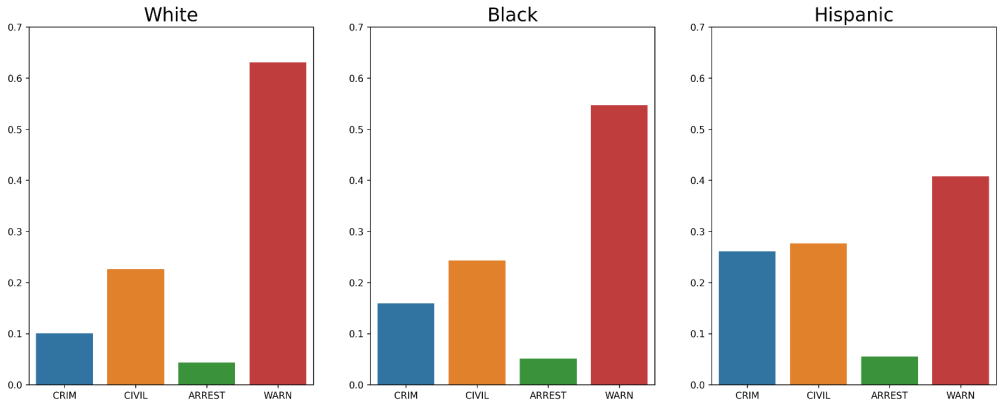


Figure 9: Citation types by race

IIIb. Are there citation or stop trends for youth (under 16-17, 18-20) in Massachusetts?

State-wide MassDOT Data Results

Based on the statewide data (2018–2020), there were 13,947 entries of youth (ages 16–17) citations and 1,638,527 entries of adults (ages 18+), of which 113, 218 were of young adults (ages 18–20). The top youth citations were: speeding rate of speed exceeding posted limit (16.5%), stop/yield (8.2%), and speeding in violation of special regulation (7%). The top young adult citations were: speeding rate of speed exceeding posted limit (21.4%), speeding in violation of special regulation (8.4%), and stop/yield (5.3%). The top adult citations are: speeding in violation of special regulation (16.6%), stop/yield (6.9%), and speeding in violation of special regulation.

MassDOT Data Conclusions

The three age groups analyzed, statewide, do not show any particular trends that distinguish their police treatment as they all share the same top three citations with similar proportions. We can note that the young adult entries show a 5% higher proportion of receiving a speed exceeding posted limit citation.

Springfield MassDOT Data Results

Looking specifically at citations made in Springfield, MA, there were 149 entries of youth (ages 16–17) citations and 36,620 entries of adults (ages 18+), of which 2,415 were of young adults (ages 18–20). The top youth citations were: speeding in violation of special regulation (9.3%), unlicensed operation of motor vehicle (9.3%), and speeding rate of speed exceeding posted limit (7.3%). The top young adult citations were: speeding rate of speed exceeding posted limit (13.4%), Unlicensed operation of motor vehicle (7.2%), and Speeding in violation of special regulation (6.8%). The top adult citations are: Speeding rate of speed exceeding posted limit (11.4%), Inspector/Sticker (8.6%), and Stop/yield (5.9%).

With focus on the Springfield citations, we can see that both the youth and young adult categories experience higher proportions of Special regulation speeding citations and Unlicensed operation of motor vehicle citations, whereas the adult category had higher proportions of Inspection/Sticker and Stop/yield citations. Overall, we are unable to conclude if there are defining trends in how the Springfield police are issuing citations to the youth and young adult population.

IIIc. Are the police handing out citations in a racially motivated manner?

For each year, we conducted a chi-square test for each officer to determine if the officer is likely to give out certain citations based on race. We used the following hypotheses:

H_0: For each officer, the citation handed out and the race of the person receiving the citation are independent.

H_A: For each officer, the citation handed out and the race of the person receiving the citation are not independent.

To determine significance, a Bonferroni correction was used to account for multiple hypothesis testing. The following table reports our findings.

Table 3: Findings of chi-square testing between citations handed out and race of person receiving the citation for each officer. Significance means that for the officer in question, the citations handed out by that officer and the race of the person receiving the citation are not independent. No Significance means that for the officer in question, the citations handed out by the officer and the race of the person receiving the citation are independent. Inconclusive means that there wasn't enough data to make a conclusion about the police officer in question. The number in each column indicates the number of officers.

Year	Significant	Not Significant	Inconclusive
2016	120	973	4479
2017	104	932	4486
2018	210	763	4717
2019	329	927	4864
2020	258	977	5119

The preliminary findings from this section indicate that there are officers whose actions suggest the type of citations handed out is racially motivated; however, more analysis is needed. For the officers in question, a further investigation is needed to find which citations are more likely to be given out to which race. In addition, since there is five years worth of data, a pattern of racial profiling can be established by looking at one officer over the course of five years. Due to time constraints, this analysis has not been done yet and can be considered a future direction for this project.

IV. Overall Project Conclusions

IVa. Conclusions and Recommendations

In this report, we sought to answer questions of whether age, geographic, and ethnic bias exists in the Springfield police department in addition to Massachusetts traffic stops. In our analyses of Springfield data, we concluded that inherent biases do exist within the police department and must be addressed and acted against. This is especially true for matters of race (hispanic and black), disability, and gender (males). We have compiled several recommendations to remedy the current problems in Springfield:

1. Formalize a system for the identification of officers, that is, maintain one unique publicly accessible officer ID. Too often, it seems that there is confusion resulting from employee IDs and badge number changes that preclude proper identification of officers. CPCS has begun to create such a system that involves a unique 11 digit code for officers across the state of Massachusetts.
2. Standardize recording procedures of data, especially zip codes in field investigations. High detail ensures geographic accuracy and ease of future analysis. Postal zip codes provide the highest level of accuracy, if possible.
3. Conduct racial bias awareness training for police officers and their superiors.
4. Consider creating a supervisor program for people with disabilities in Springfield public day schools to assist administrators in better handling situations that do not require deputy intervention.
5. Consider alternative methods for the removal of distractions from the school classroom and to ensure safety on school grounds that would lead to less police presence and reliance on police.
6. Provide police education on indicators of emotional disability in young students and on resources and services that can be called upon to help students rather than making an arrest and bringing the student into the prison system.

Turning to the greater whole of Massachusetts, we performed a less detailed analysis on the traffic stop data from MassDOT, but we overall determined that black and hispanic populations are being stopped and arrested or cited for criminal and civil reasons at a statistically significant level compared to the white population. Furthermore, citations handed out by hundreds of officers identified from the roster data were significantly associated with the race of the person receiving a citation. These findings are both cause for concern. We recommend that racial bias training be given to officers across the state of Massachusetts to ensure a more fair due process for traffic pullovers.

IVb. Limitations

While we were completing this project, we faced several challenges and limitations that were not able to be resolved. The biggest limitation was undoubtedly time. We had essentially two months to carry out this project, and the client offered us more subprojects that we had time to look into involving complex data visualizations or analyses of additional datasets. We did the best with the time we had to dedicate to this project, and met the requirement of about 10 hours of work per week per team member while extensively working on two subprojects.

Another major issue was lack of data, due to redaction or lack of information. In the Springfield field investigations data, we lacked zip code information for a large portion of observations, which inhibited a fully accurate geographic analysis. For the MassDOT traffic stop analysis, we lacked enough identifying roster information for officers to confidently link them to the MassDOT ID numbers. In general, we

lacked features to merge multiple datasets on asides from some officer IDs. We were unable to scrape data from a government salaries website, which would have allowed us to identify what SPD officers were being paid more and whether they also exhibited worrying trends in their interactions with citizens. Finally, we also lacked capability to match all citations in the MassDOT datasets with their corresponding police officers, as identifiers were only unique to departments, and it is unclear what number is used (it could be a department employee ID, a badge number, or some other internal identifier).

IVc. Next Steps

The following next steps could be taken in the future to improve the work completed on this analysis.

- Retest the model created in section IIa on 2021 data to predict the outcomes of the new citation data and to record model accuracy. If predictions are still similar, we can speculate that any new policy that has been implemented in Springfield has not been effective. If the prediction is weaker, the model should be trained using a part of the new data and tested on the remainder. If the model is then weaker, there may be reason to believe that Springfield policing trends are changing for the better.
    - Retest separately on juvenile-only data as well, and create a similar model for other locales.
- Conduct further analysis on the merged MassDOT data to identify whether specific towns, tickets, arrests, or officers stand out. Also work to determine which citations are more likely to be given out to which race, similar to what was done with the Springfield model. This will be easier to do when the dataset is more completely merged.
- Continue to improve joining of MassDOT identifiers with department officer identifiers. Reach out to departments to obtain these numbers if necessary.

V. Appendix: Code Used in Analyses

MassDOT_data_merging.Rmd

An R script that merges MassDOT datasets from 2016–2020 with police rosters aggregated by CPCS. Merged data is stored in this folder. This code was used for analyses in part III of the report.

MASSDOT Youth and Adult Citation Analysis.ipynb

This Python Jupyter Notebook merges MassDOT datasets from 2018-2020 and analyzes the top citations given to individuals in the following age groups: 16-17 years, 18-20 years, and 21+ years. This file is used to look both at Springfield citations and over Massachusetts citations.

SchoolArrests_ARO.Rmd

This R script looks at school arrests in the Springfield area and calculates elementary statistics to understand demographics of those arrested.

Student Arrests.ipynb

This Python Jupyter Notebook creates all of the pie and bar charts associated with the student arrest analysis based on the statistics from the Springfield data and the US Census data.

Is Springfield Policing Racially Biased.ipynb

Python Jupyter Notebook that contains all analysis for citation data in Springfield.

Quick Mass Citation Analysis.ipynb
Python Jupyter Notebook that contains similar analysis to Springfield, but done on the whole state of MA. Not as in depth as Springfield.

Springfield_Neighborhoods.ipynb
Python Jupyter Notebook that looks at the field investigations in Springfields zip codes. This notebook analyzes the field investigations to see if certain zip codes see more field investigations than other zip codes.

MassDot_Citations.ipynb
Python Jupyter Notebook that looks at the MassDOT citation data for 2018-2020. The analysis consists of looking at if the citations handed out by each officer is racially motivated.