INF2178 Midterm Submission
Application of Exploratory Data Analysis on Criminal Arrest and Stripe Search in Greater Toronto Area

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Table of Contents

Introduction

The report “Breaking The Golden Rule: A Review of the Police Strip Searches in Ontario" revealed that police officers in Ontario have performed around 22,000 strip searches annually, most of which were carried out by the Toronto Police Service (Write on Behalf of Barrison Law, 2021). The Office of the Independent Police Review Director (OIPRD) review revealed that men were more often subjected to strip searches than women. While the dataset provided by the Toronto Police Service is not completely reliable, it is estimated that around 20 - 25% of strip searches are conducted on women (McNeilly, 2019). Minority groups, particularly African Americans, were commonly overrepresented as offenders in the criminal justice system. As reported by the Uniform Crime Reports (UCR) in 2003, while only representing 12.7 percent of the total population, African Americans were arrested with 37 percent of violent crimes and 29 percent of property crimes. The situation meant that African Americans were more likely to be arrested for violent crimes, whereas whites were more likely to be arrested for burglaries and property crimes.

Even though most crimes are committed by males, black women are disproportionately involved in the criminal justice system. The rate of black women under control of the criminal justice system is increasing faster than any other group, including black men and white men (ASA, 2007). The issue is whether the applicant's race or gender influenced the officer's failure to calm the situation. The power dynamic between a police officer and a member of the public inherently involves the exercise of power, given the authority granted to police officers by law. However, when this power dynamic was combined with racial and gender elements, it can be inappropriately amplified.

Discrimination based on race often stems from unconscious attitudes and beliefs, such as the belief that Black individuals should stay in their place and that those who resist should be punished severely. Based on these factors, the officer's actions appear consistent with racism, where a White person in authority expects obedience and punishes a person of color who does not comply (Tanovich, 2011). Intriguingly, recent arrest data from 1980 to 2010 shows a slight increase in the age of individuals arrested for crimes listed in the Uniform Crime Report (UCR) index in 2000 and 2010 compared to 1980. Additionally, there are differences in age patterns between specific offenses, and some offenses display more significant changes in age patterns over time than others. For instance, offenses such as robbery and aggravated assault exhibit little change in age patterns between 1980 and 2010, while offenses such as murder, rape, burglary, and auto theft show more noticeable variations (Ulmer & Steffensmeier, 2014).

Therefore, based on the research, we hypothesize that there is no difference between the male and female in the Occurrence Category, different age groups at arrest act the same and no difference in the total number of strip searches conducted based on perceived race. To facilitate our research, we will use the dataset from the Toronto Public Service, which

includes information on arrests, strip searches, booking indicators, category of occurrence, actions at arrest, sex, age and race of the person arrested for this project.

Literative Review

In the literature on social justice and crime, S*trip Searching* is defined as the "removal or rearrangement of some or all of someone's clothing" to allow police officers to inspect (McNeilly, 2019) visually. The righteousness of to which extent strip searching should be used in police inspection is subject to debate. In 2019, Toronto Police Service ("The Service") started to construct a Race and Identity-based Data Collection Strategy that is aimed at promoting the transparency of crime-related data and "repairing the trust of the community (Toronto Police Service, 2019)." Though the official source has reassured the public that the data collection is bias-free and inclusive, it is inevitable and hard to avoid inconsistencies associated with the data collection methods. The source of data is primarily reported and recorded by police officers. The report "Breaking the Golden Rule: A Review of the Police Strip Searches in Ontario" has revealed that race-related data are collected based on police officers' perceptions instead of self-reported by the individual associated with the strip search (McNeilly, 2019). Though the Service seeks improvement, it remains unclear whether the data collection would lead to bias or not – as there is yet no other systematic data collection solution.

Among existing studies, social scientists have argued that there is a disproportionate amount of police enforcement with armed or unarmed control being deployed to Black people (The Canadian Press, 2022). Some scholars have questioned whether the official crime counting systems, commonly the data source for research, are intrusively biased (ASA, 2007). To counter systemic discrimination, the Service has rolled out a series of actions to address the potential of institutional discrimination. The goals of the new approaches aimed to include the decision-making process of “using force or searching a person in situations that are more unique, complex, and fluid (Toronto Police Service, 2022).” The Service adopted a cycle-based approach to replace the relatively linear process.

In this study, we aim to formulate our research inquiries through an extensive review of the relevant literature and subsequently employ statistical hypothesis testing to assess the validity and dependability of the Arrest and Strip Search dataset collected by the Toronto Police Services, with a particular emphasis on the fairness of the outcomes.

Research Objectives and Questions

Our study will examine how sex, racial groups, and age differences interact with the chances of getting strip searched or arrested with references to existing literature. We included descriptive statistics and a T-test to conduct the initial research and one-way ANOVA tests to testify to the impact of the independent variables on the dependent variable. We propose to research the following questions based on our preliminary research about the dataset (Arrest

and Strip Searches (RBDC-AS-TBL-001)) and the literature review on stripe and arrest policy deployment disparity.

RQ1: How does the attribute of sex interact with the results of who are arrested or striped (based on different occurrence categories)?
RQ2: How varied are the actions taken at arrests by different age groups? Do different age groups act differently?
RQ3: How does the perceived race and sex of arrested individuals affect the total number of strip searches conducted? Specifically, is there a significant difference in the total number of strip searches conducted based on perceived race, sex, or the interaction between the two?

We believe these questions will further facilitate our research regarding occurrence and justice of the arrest and strip search cases in the greater Toronto area.

Dataset Description

In the proposed project, the dataset used in the analysis is named "Arrest and Strip Searches (RBDC-AS-TBL-001)", which contains information related to all arrests and strip searches in the Great Toronto Area (Toronto Police Service, 2022). The data is gathered and published by the Toronto Police Service Public Safety Data Portal, an open-source website run by the Toronto Police Service platform, to improve public understanding of policing-related data and enhance information transparency (Toronto Police Service, 2022). The dataset collection is a vital part of the Toronto Police Service's commitment to enhance the transparency of the "*Race and Identity-based Collection Strategy*," highlighting some essential perspectives of each arrest case for researchers to navigate the dataset.

The table is composed of 24 attributes that capture the information of individuals who were arrested and strip search related information regarding each arrest case. In total, there are 65, 276 individual arrest records stored in the dataset with a time range spanning from 2020 to 2021. Notable demographic attributes include the perceived race, sex, and age group of each individual case. It is worth noticing that the perceived race refers to the police officer's perception of a person's race instead of a person's self identified race. The age groups of individuals being strip searched or arrested are divided into nine different groups to capture the characteristic of combative actions after getting arrested or strip searched.

Specifically, in this research, we will mainly use sex, perceived_race, occurrence_category, Action_at_arrest, and Age_group to explore our research questions.

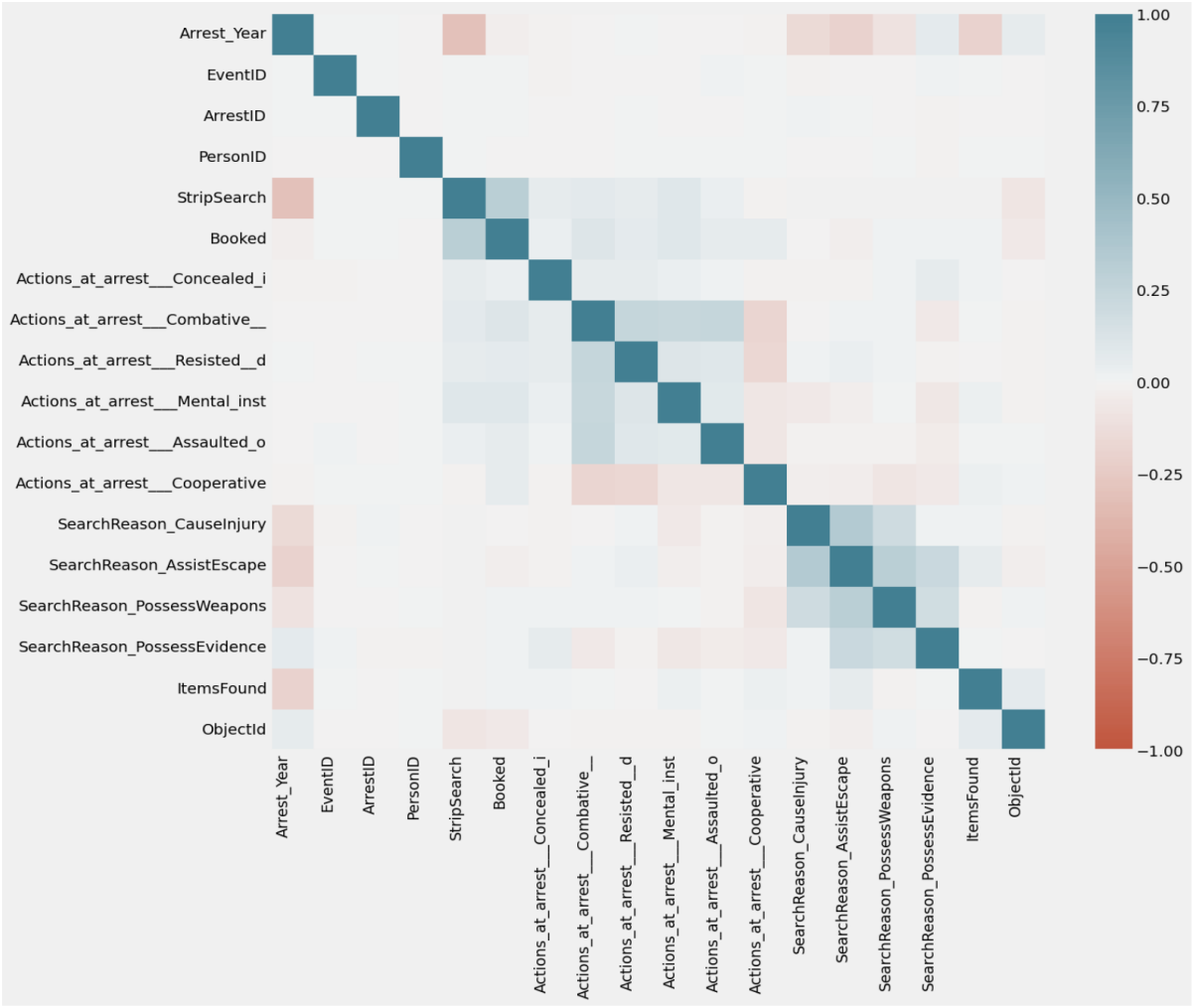
Descriptive Statistics & Motivation Graphs

Preliminary Data Exploration

Figure 1 is a comprehensive interaction figure of all variables. After reading in the .csv file into Python as a data frame, the shape of the dataset indicated that there are many missing

values in different columns. The legend of the color bar demonstrated the correlation coefficient of each pair of variables. Using this graph, we can draw initial research motivations from the graph.

Figure 1 Interaction Graph: All Variables



We started by locating missing values by incorporating a missing value matrix to explore the dataset further. Based on Figure 1, we can see that *ArrestID* and *Occurrence_Category* contain several missing cells, while the variables for the *SearchReason* and *ItemsFound* are missing majorities of data points. Thus, we used another verifying table (Figure 2) to create a more intuitive visualization of the bar chart to display the missing values. By observing the blue bar chart, we could confirm that *SearchReason* and *ItemsFound* contained the most missing values. To further explore, we created an additional graph that only contains the count of each search reason, as shown in Figure 3, to solidify the count for each category.

Figure 2 Visualization of Missing Values in the dataset

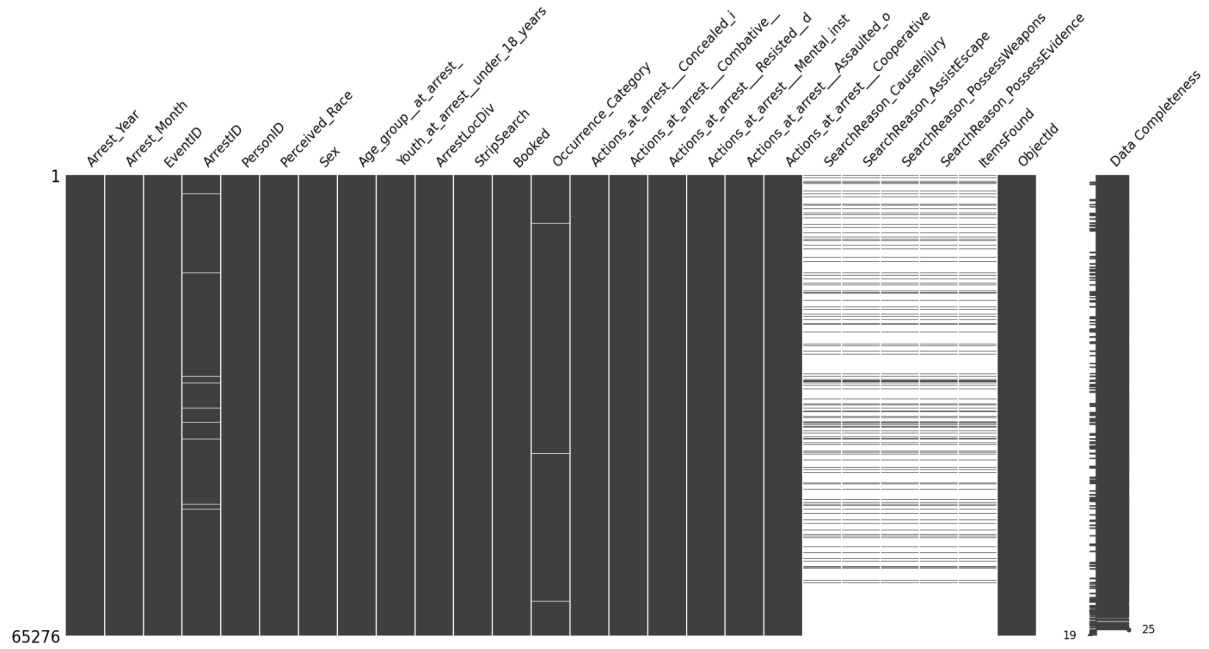


Figure 3 Visualization of Missing Values for ArrestID and SearchReasons

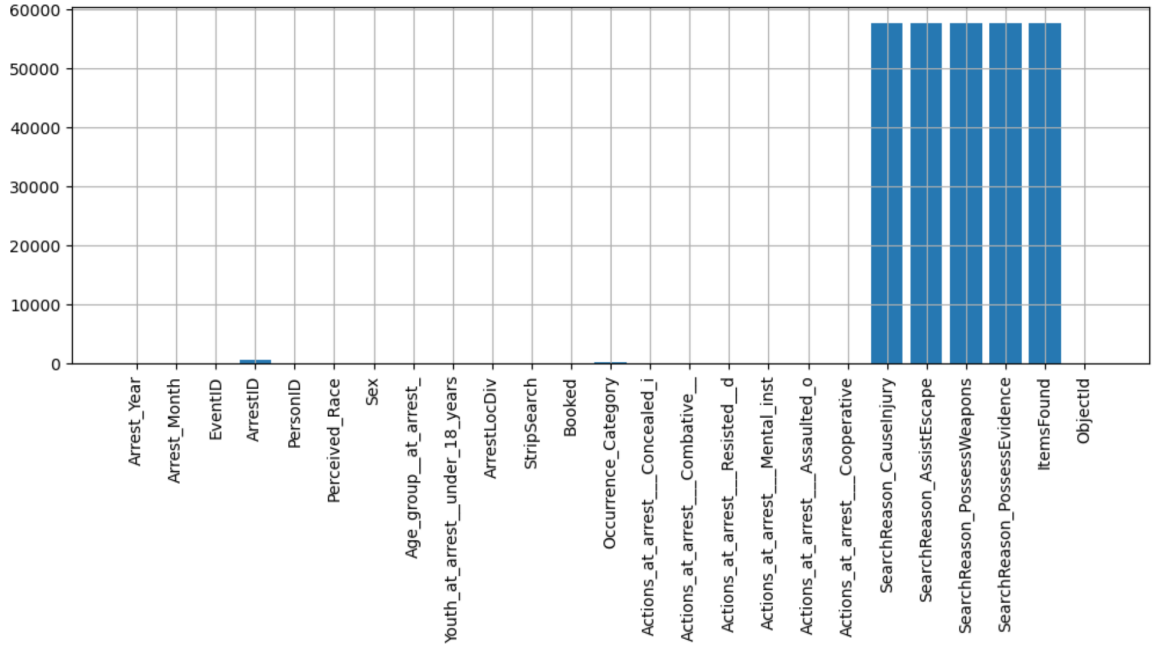
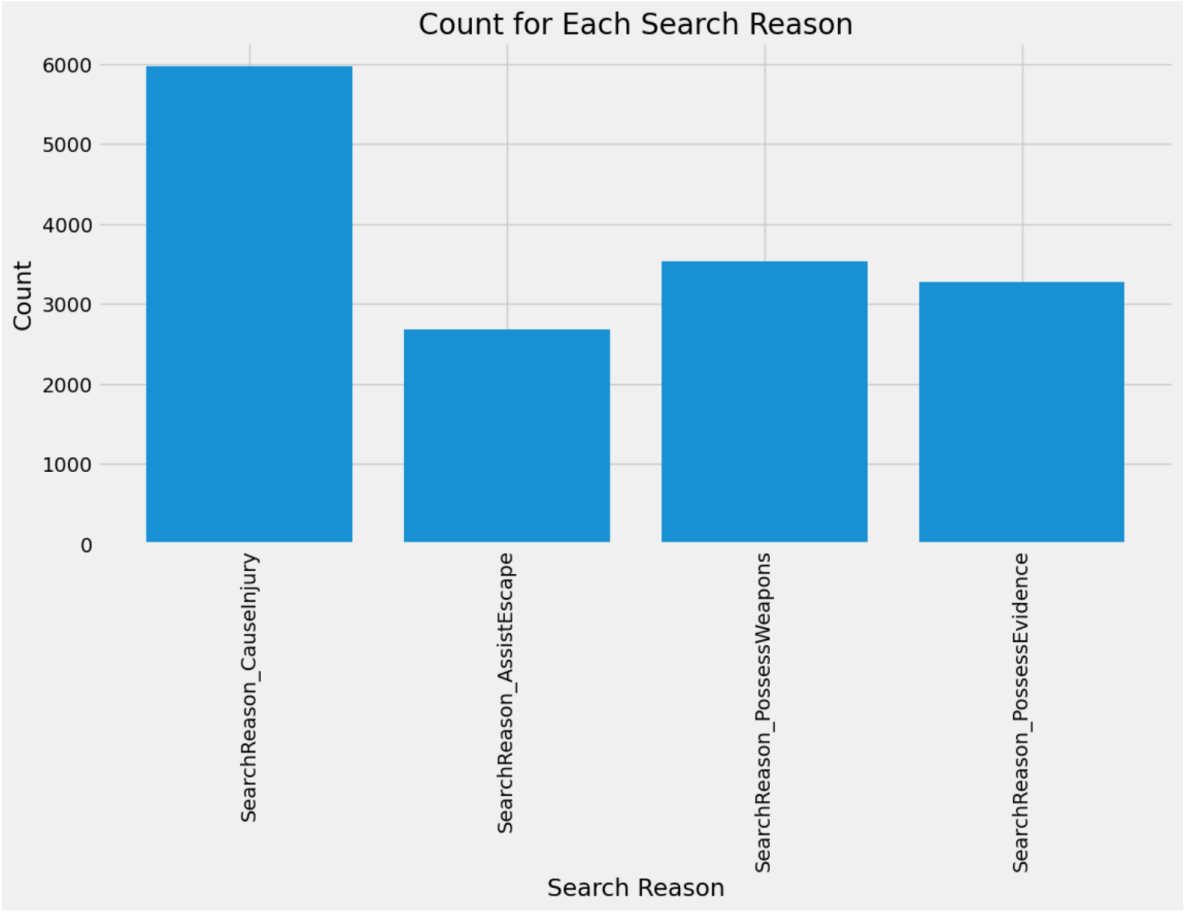


Figure 4 Count for Each Search Reason



Next, we explored the count of the Occurrence Category with several visualizations to use as a motivation graph for our research questions. Figure 4 and Figure 5 are bar charts that we created for the variable of *Occurrence_Category*, capturing the counts of each criminal incurrence. From Figure 4, we can see which categories have the highest to the lowest counts. Figure 5 is a breakdown of occurrence counts by sex. The cyan-colored bars represented the counts of males for each occurrence category, whereas the purple-colored bars represented the counts of females for each category in the sample population.

Figure 5 Occurrence Category Counts

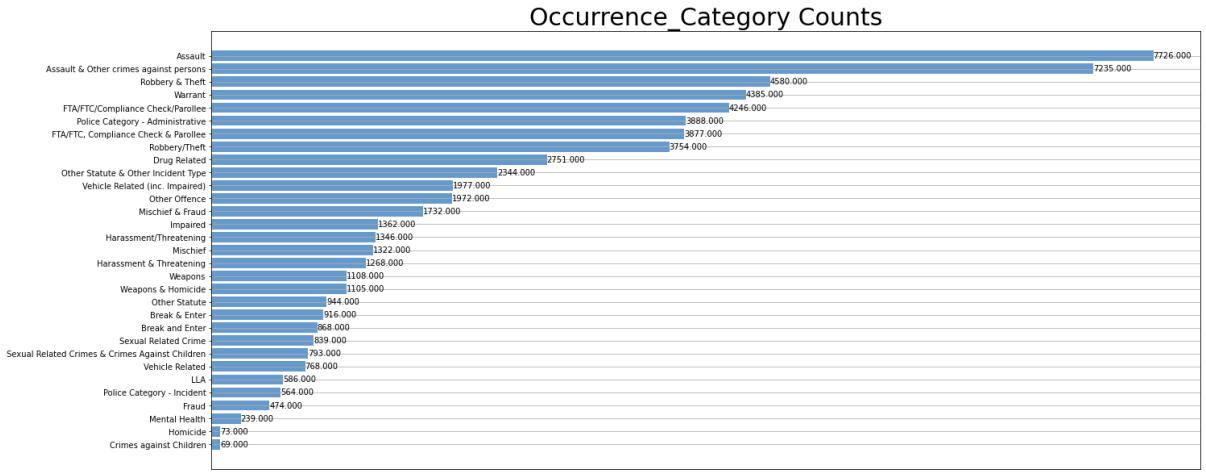
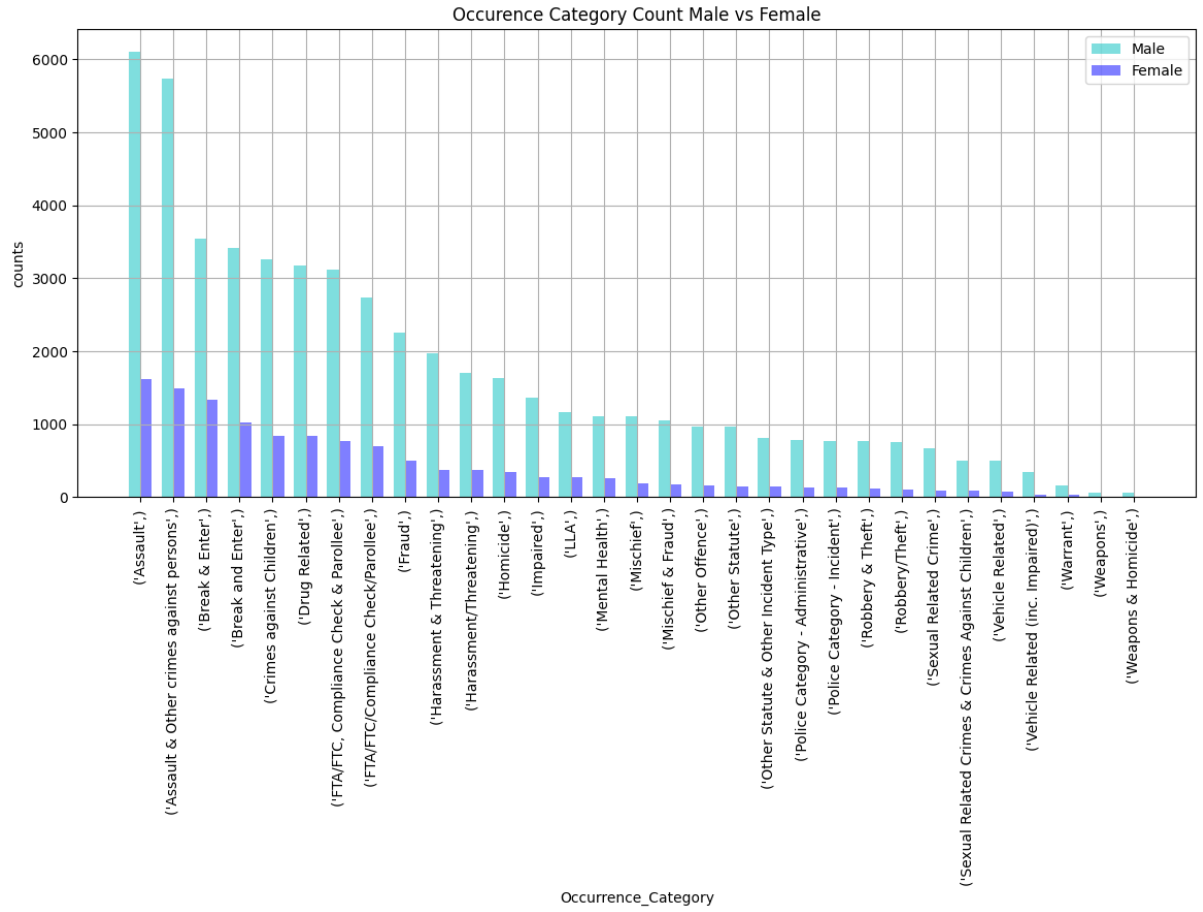
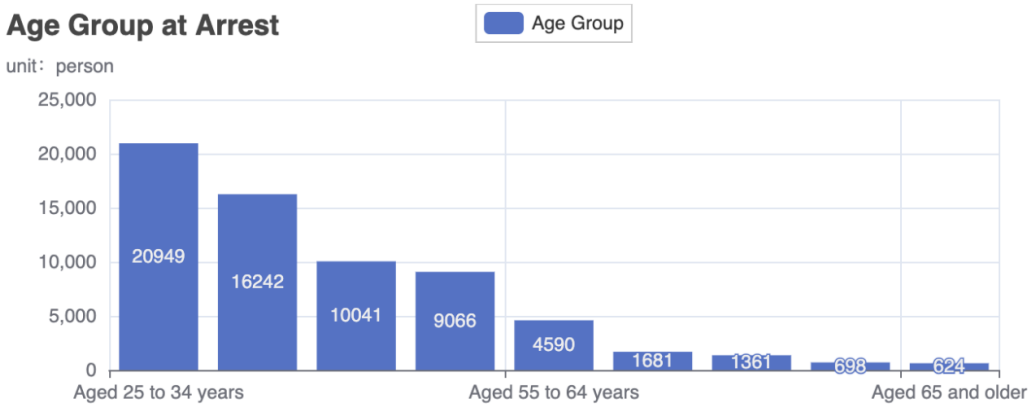


Figure 6 Occurrence Category Count by Sex



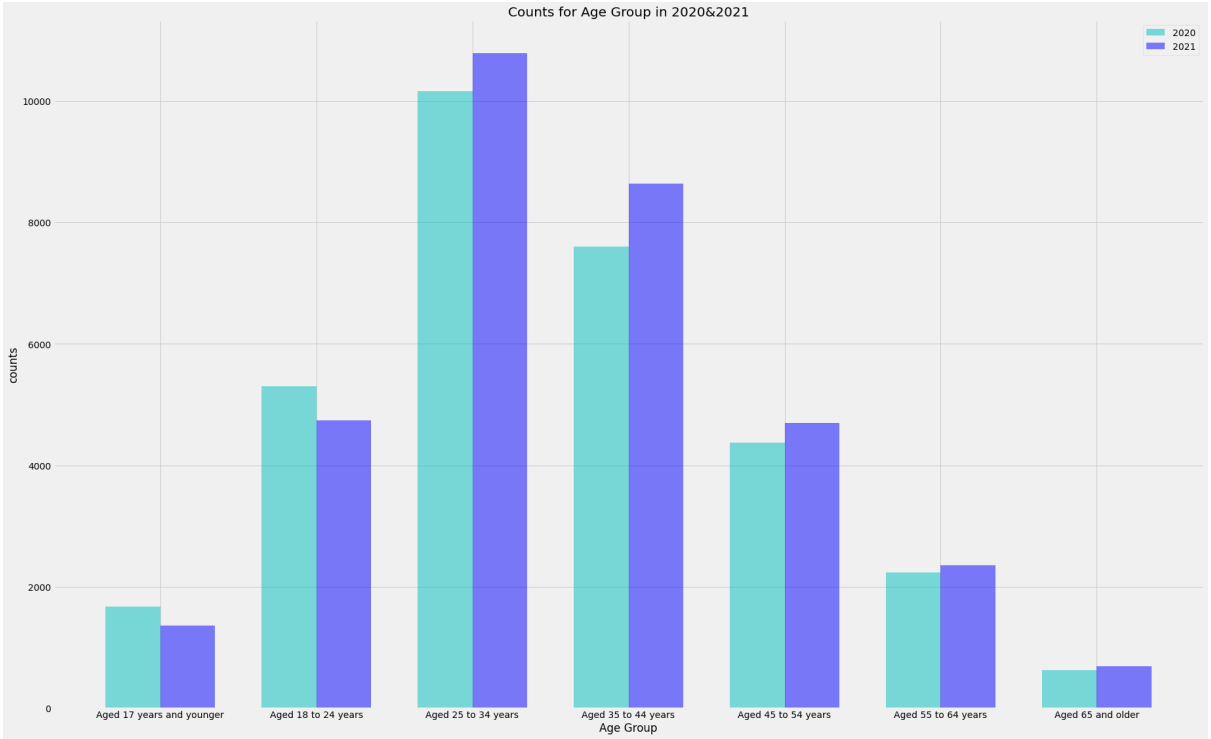
The next variable we are interested in studying is the Age_group_at_arrest, which breaks the total observation based on different age levels. The following motivation graph (Figure 6) is a bar chart of the count of arrested or searched individuals by age group. Figure 6 shows that the age group of 25 to 34 years has the highest count, whereas the oldest age group (65 and older) has the lowest count.

Figure 7 Age Groups at Arrest



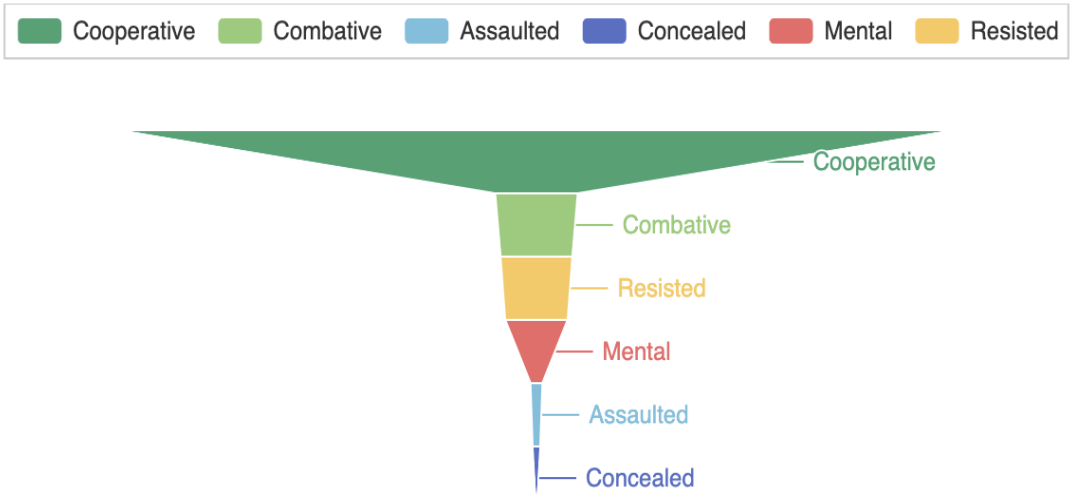
Given the outbreak of the pandemic in 2020 and the following economic slowdown in 2021, we would like to learn whether the overall economic situation triggered more criminal incidents. Thus, we created Figure 8 and tried to use this graph to distinguish the pattern. However, no significant difference can be derived from the graph, so we would not include the element of the year as a crucial variable in the analysis.

Figure 8 Counts for Different Age Groups in 2020 and 2021



Last, we are interested in the proportional distribution of which combative actions happen most frequently. Therefore, we created a data frame to integrate all the variables of the actions at arrest and produced the following funnel graph to visualize the counts of each action happening in both 2020 and 2021. From Figure 9, we can see that a majority of the sample population chose to cooperate with investigation and search, whereas only a small proportion would be triggered with combative actions.

Figure 9 Funnel Graph of Action at Arrest



Descriptive Statistics for Research Question 1

By observing Figure 5 and Figure 6, the visualizations only display the counts of each occurrence and the sex breakdown of each occurrence. We cannot identify any relationships or tendencies that could explain our research question about whether an individual's gender interacts with the results of who is arrested or striped. Thus, we choose to conduct a T-test to compare the means of the male and female groups to gain initial insights.

T-test 1

Table 1 T-test results based on attributes of Sex and Occurrence Category in Arrest & Strip Searches dataset

	Sample Size	Occurrence Category Mean
Male	52650	1694.129032
Female	12617	405.9354839

Table 2 T-test results of comparison of Occurrency Category frequency between male and female in Arrest & Strip Searches dataset

Test	Statistic	P-value	Conclusion
T-test on Sex	4.486161	0.0000033	reject H0 as p-value is smaller than 0.005

H0 (Null Hypothesis): The population means of two independent groups, male and female, who are arrested or striped (based on different occurrence categories), are equal.
HA (Alternative Hypothesis): The population means of two independent groups, male and female, who are arrested or striped (based on different occurrence categories), are not equal.

The first research question is to investigate how the attribute of sex interacts with the results of those who are arrested or striped. The sample population size for the male group is 52,650, and the size for the female group is 12,617. The results of the T-test indicate that the mean value of the arrested Male population (M=1694.13) is higher than the mean value of the arrested Female (405.94). With alpha established at 0.05, there is a statistically significant difference as the p-value (0.33e-5) is smaller than 0.05 with a 95% confidence interval. Therefore, we can reject the null hypothesis that there is a difference in the male and female populations with regard to the occurrence of arresting and strip searching.

One thing worth noticing is that the sample population of the male group is much larger than the female group sample population. Therefore, we want to conduct an additional one-way ANOVA test to confirm the result.

One-way ANOVA

Table 3 One-way anova results between Sex and Occurrence Category in the Arrest & Strip Searches dataset

Test	F-Value	P-value	Conclusion
ANOVA test on Sex	20.125642	0.0000033	reject H0 as p-value is smaller than 0.005

H0 (Null Hypothesis): The population means of two independent groups, male and female, who are arrested or striped (based on different occurrence categories), are equal.
HA (Alternative Hypothesis): The population means of two independent groups, male and female, who are arrested or striped (based on different occurrence categories), are not equal.

As shown in Table 3, the F-statistic is 20.125, which indicates that the population means between the male and female group (based on Occurence_category) variability differs from the within-group variability, suggesting that there is a significant difference between the two groups. The p-value (0.33e-5) is smaller than 0.05.Therefore we can reject the null hypothesis. We conclude that there is a significant difference between the means of male and female groups in the occurrence category.

Descriptive Statistics for Research Question 2

Because Figures 8 and 10 show only the distribution of count for the 9 Age Group at Arrest and the funnel distribution graph for the 6 Actions at Arrest of the data frame, so we want to

run Welch's t-test with categorical attributes in the dataset. Before running the tests, we checked that the following assumptions were fulfilled: (1) a nominal two-level explanatory variable; (2) a quantitative outcome variable; (3) a normality assumption; and (4) independence of the errors. As we ran Welch's t-test, equal variance among the residuals was not assumed. Therefore, we conducted the Welch T-test to analyze whether the specific means of the number of Actions at Arrest (outcome variables) differ between the Age Group of 25 to 34 years and 35 to 44 years (explanatory variable). The Hypothesis being tested below:

H0 (Null Hypothesis): The population means of two independent groups, people aged 25 to 34 years and 35 to 44 years, who acted differently (based on six different actions at arrest), are equal.
HA (Alternative Hypothesis): The population means of two independent groups, people aged 25 to 34 years and 35 to 44 years, who acted differently (based on six different actions at arrest), are not equal.

T-test 2

Table 4 T-test results based on Actions at Arrest and Aged 25 to 34 years and 35 to 44 years at Arrest in Arrest & Strip Searches dataset

	Sample Size	**Mean**	**SD**	**CI**	**DF**
Aged_Group_at_Arrest (25-34)	12092	2015.33	3508.677111	(0.00 , 898.00)	10
Aged_Group_at_Arrest (35-44)	9398	1566.33	2784.134671		

Table 5 T-test results of comparison of Action at Arrest frequency between Aged 25 to 34 years and 35 to 44 years at Arrest in Arrest & Strip Searches dataset

Test	**Statistic**	**P-value**	**Conclusion**
T-test on Aged_Group_at_Arrest (25-34 & 35 -44)	0.245545773	0.810999815	Fail to reject H0 as p-value is larger than 0.05

The results of Tables 4 & 5 indicate that the mean arrested people aged 25 to 34 with all actions at arrest size less than ten (10) (M=2015.3, 3508.68) is higher than those aged 35 to 44 years (M=1566.33, 2784.13). With alpha established at 0.05, there is no significant difference as the p-value (0.811) is more extensive than 0.05, 95% CI [0.00, 898.00]. Therefore, we fail to reject the null hypothesis that there is no difference in the means between arrested people aged 25 to 34 years (10) and 35 to 44 years acted differently (based on the six different actions ar arrest, 10).

One-way ANOVA

To analyze whether there is a significant difference in the mean of the number of Actions at Arrest among all Age Groups at Arrest, we run One-way ANOVA to test the assumption based: (1) A nominal explanatory variable (Aged_Group_at _Arrest); (2) A quantitative outcome variable (Actions at Arrest); (3) Normality assumption; (4) Independence of errors. The hypothesis being tested below:

Table 6 One-way anova results between Actions at Arrest and Aged Group at Arrest in Arrest & Strip Searches dataset

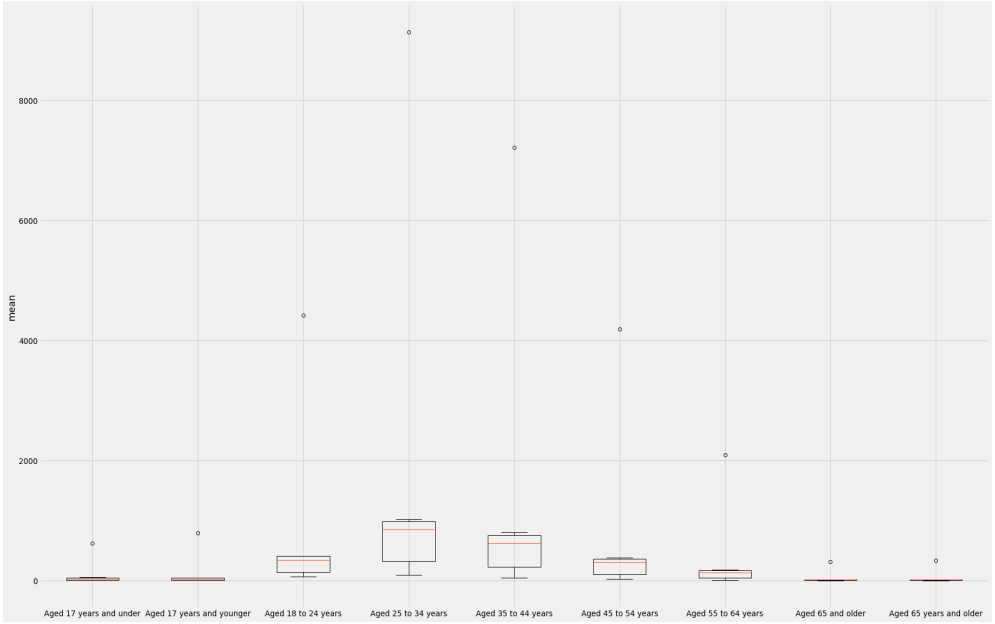
Test	F-Value	P-value	Conclusion
ANOVA test on Aged_Group_at_Arrest	1.043035135	0.419061575	Fail to reject H0 as p-value is larger than 0.05

H0 (Null Hypothesis): The population means of dependent variable(Actions_at_arrest), for different age groups (based on Aged_Group_at_Arrest), are equal.
HA (Alternative Hypothesis): The population means of dependent variable(Actions_at_arrest), for different age groups (based on Aged_Group_ at_Arrest), are not equal.

As you can see from Table 6, the F-statistic obtained from the One-way ANOVA test is 1.043, which indicates that the population means between dependent(Actions_at_arrest) for different age groups (based on Aged_Group_at_Arrest) variability are similar to the within-group variability, suggesting that there might be no significant difference between the groups. The p-value (0.42) is more significant than 0.05; therefore, we fail to reject the null hypothesis. We conclude that insufficient evidence suggests a significant difference between the means of dependent(Actions_at_arrest) for different age groups.

Post-hoc Test (Tukey's Test)

Figure 10 Box-and Whisker plot for Action at Arrest among Age Group at Arrest



From the box and whisker box from Figure 10, we can see overlap in the interquartile ranges group 1 (Aged 17 years and younger) to group 2(Aged 18 to 24 years) to group 3 (Aged 25 to 34 years) to very last group. However, we can apply the Tukey test to determine if the difference between population means of the dependent variable(Actions_at_arrest) for different age groups (based on Aged_Group_at_Arrest) is significant. We set a significance level of 0.05 to reject the null hypothesis.

Figure 11 Tukey's HSD Pairwise Group Comparisons of the frequency of Action at Arrest among Age Group at Arrest-1

Age Group at Arrest	Comparison	Statistic	P-value	Lower CI	Upper CI
Aged 17 years and under	(0 - 1)	-26.333	1.000	-3252.893	3200.227
	(0 - 2)	-822.167	0.995	-4048.727	2404.393
	(0 - 3)	-1892.833	0.610	-5119.393	1333.727
	(0 - 4)	-1443.833	0.869	-4670.393	1782.727
	(0 - 5)	-751.000	0.997	-3977.560	2475.560
	(0 - 6)	-304.500	1.000	-3531.060	2922.060
	(0 - 7)	63.167	1.000	-3163.393	3289.727
	(0 - 8)	56.500	1.000	-3167.060	3283.060
Aged 17 years and younger	(1 - 0)	26.333	1.000	-3200.227	3252.893
	(1 - 2)	-795.833	0.996	-4022.393	2430.727
	(1 - 3)	-1866.500	0.628	-5093.060	1360.060
	(1 - 4)	-1417.500	0.880	-4644.06	1809.06
	(1 - 5)	-724.667	0.998	-3951.227	2501.893
	(1 - 6)	-278.167	1.000	-3504.727	2948.393
	(1 - 7)	89.500	1.000	-3137.06	3316.060
	(1 - 8)	82.833	1.000	-3143.727	3309.393
Aged 18 to 24 years	(2 - 0)	822.167	0.995	-2404.393	4048.727
	(2 - 1)	795.833	0.996	-2430.727	4022.393
	(2 - 3)	-1070.667	0.974	-4297.227	2155.893
	(2 - 4)	-621.667	0.999	-3848.227	2604.893
	(2 - 5)	71.167	1.000	-3155.393	3297.727
	(2 - 6)	517.667	1.000	-2708.893	3744.227
	(2 - 7)	885.333	0.992	-2341.227	4111.893
	(2 - 8)	878.667	0.993	-2347.893	4105.227
Aged 25 to 34 years	(3 - 0)	1893.833	0.610	-1333.727	5119.393
	(3 - 1)	1866.500	0.628	-1360.060	5093.060
	(3 - 2)	1070.667	0.974	-2155.893	4297.227
	(3 - 4)	449.000	1.000	-2777.560	3675.560
	(3 - 5)	1141.833	0.962	-2084.727	4368.393
	(3 - 6)	1588.333	0.798	-1638.227	4814.893
	(3 - 7)	1956.000	0.568	-1270.56	5182.56
	(3 - 8)	1949.333	0.573	-1277.227	5175.893
Aged 35 to 44 years	(4 - 0)	1443.833	0.869	-1782.727	4670.393
	(4 - 1)	1417.500	0.880	-1809.06	4644.06
	(4 - 2)	621.667	0.999	-2604.893	3448.227
	(4 - 3)	-449.000	1.000	-3675.56	2777.56
	(4 - 5)	692.833	0.999	-2533.727	3919.393
	(4 - 6)	1139.333	0.963	-2087.227	4365.893
	(4 - 7)	1507.000	0.840	-1719.560	4733.56
	(4 - 8)	1500.333	0.843	-1726.227	4726.893

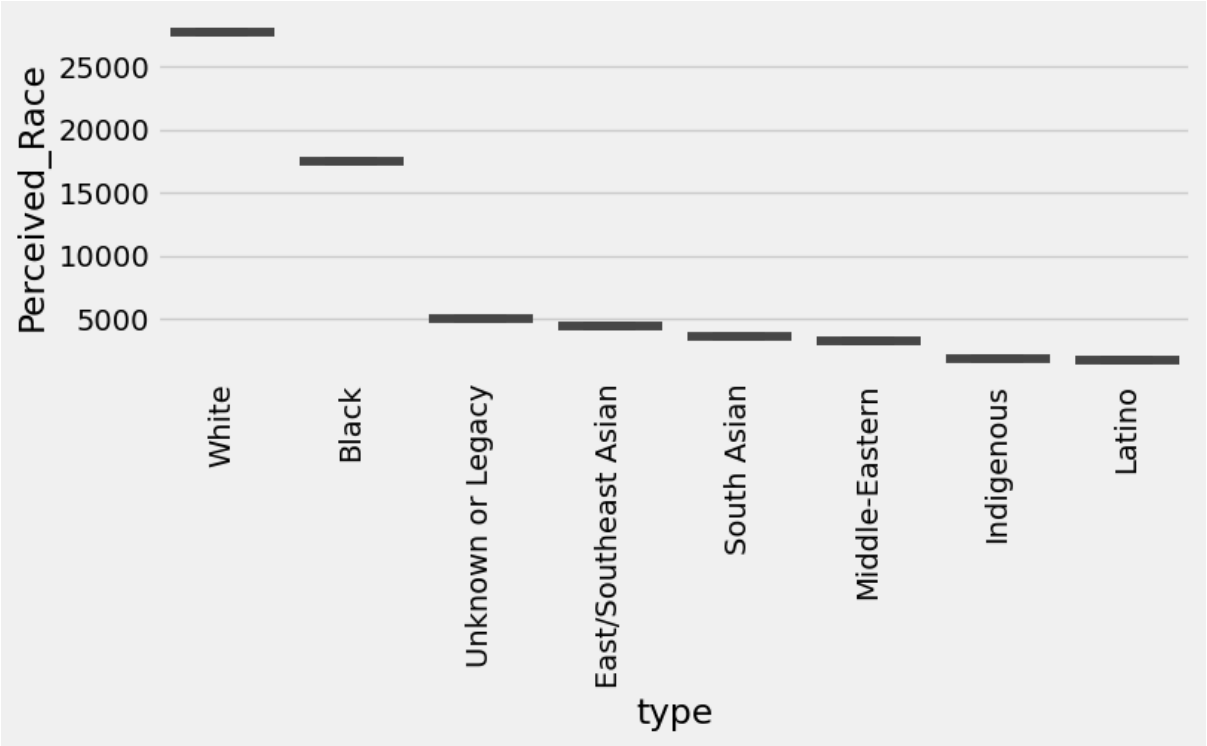
Figure 12 Tukey's HSD Pairwise Group Comparisons of the frequency of Action at Arrest among Age Group at Arrest-2

Age Group at Arrest	Comparison	Statistic	P-value	Lower CI	Upper CI
Aged 45 to 54 years	(5 - 0)	751.000	0.997	-2475.560	3977.560
	(5 - 1)	724.667	0.998	-2501.893	3951.227
	(5 - 2)	-71.167	1.000	-3297.727	3155.393
	(5 - 3)	-1141.833	0.962	-4368.393	2084.727
	(5 - 4)	-692.833	0.999	-3919.393	2533.727
	(5 - 6)	446.500	1.000	-2780.060	3673.060
	(5 - 7)	814.167	0.996	-2412.393	4040.727
	(5 - 8)	807.500	0.996	-2419.060	4034.060
Aged 55 to 64 years	(6 - 0)	304.500	1.000	-2922.060	3531.06
	(6 - 1)	278.167	1.000	-2948.393	3504.727
	(6 - 2)	-517.667	1.000	-3744.227	2708.893
	(6 - 3)	-1588.333	0.798	-4814.893	1638.227
	(6 - 4)	-1139.333	0.963	-4365.893	2087.227
	(6 - 5)	-446.500	1.000	-3673.060	2780.060
	(6 - 7)	367.667	1.000	-2858.893	3594.227
	(6 - 8)	361.000	1.000	-2865.560	3587.560
Aged 65 and older	(7 - 0)	-63.167	1.000	-3289.727	3163.393
	(7 - 1)	-89.500	1.000	-3316.060	3137.060
	(7 - 2)	-885.333	0.992	-4111.893	2341.227
	(7 - 3)	-1956.000	0.568	-5182.560	1270.560
	(7 - 4)	-1507.000	0.840	-4733.56	1719.560
	(7 - 5)	-814.167	0.996	-4040.727	2412.393
	(7 - 6)	-367.667	1.000	-3594.227	2858.893
	(7 - 8)	-6.667	1.000	-3233.227	3219.893
Aged 65 years and older	(8 - 0)	-56.500	1.000	-3283.060	3170.060
	(8 - 1)	-82.833	1.000	-3309.393	3143.727
	(8 - 2)	-878.667	0.993	-4105.227	2347.893
	(8 - 3)	-1949.333	0.573	-5175.893	1277.227
	(8 - 4)	-1500.333	0.843	-4726.893	1726.227
	(8 - 5)	-807.500	0.996	-4034.060	2419.060
	(8 - 6)	-361.000	1.000	-3587.560	2865.560
	(8 - 7)	6.667	1.000	-3219.893	3233.227

From output shown in the Figure 11 & 12, there are nine groups (Aged_Group_Arrest)) being compared. The results of the Tukey test provide pairwise comparisons between groups, giving information about the statistical significance of the differences between population means of the dependent variable(Actions_at_arrest) for different age groups (based on Aged_Group_at_Arrest). The test statistic, p-value, and 95% confidence interval are provided for each comparison. The multiple comparisons between all nine groups (based on Aged_Group_Arrest) have a p-value larger than 0.05, indicating the difference between the means of the dependent variable(Actions_at_arrest) for nine different age groups (based on Aged_Group_Arrest) are not statistically significant.

Descriptive Statistics for Research Question 3

Figure 13 Box-and Whisker plot of counts of each unique value in Perceived_Race



T-test 3

Because the box-and-whisker plot in Figure 13 shows only the distribution of counts for each unique value in the "Perceived_Race" column of the data frame, we want to run Welch's t-test with categorical attributes in the dataset. Before running the tests, we checked that the following assumptions were fulfilled: (1) a nominal two-level explanatory variable; (2) a quantitative outcome variable; (3) a normality assumption; and (4) independence of the errors. As we ran Welch's t-test, equal variance among the residuals was not assumed. Therefore, we conducted the Welch T-test to analyze whether the specific means of the number of executions of Strip Search (outcome variable) differ between specific Perceived Races (explanatory variable). The hypothesis being tested below:

H0 (Null Hypothesis): The population means of two independent groups, Perceived Race for White and South Asian, who have conducted Strip Search, are equal.
HA (Alternative Hypothesis): The population means of two independent groups, Perceived Race for White and South Asian, who have conducted Strip Search, are not equal.

Table 7 T-test results on Perceived Race (White & South Asian) and Strip Search in the Arrest & Strip Searches dataset

	Sample Size	**Mean**	**SD**	**CI**	**DF**
Perceived_Race (White)	27718	0.1286	0.334789589	(0.0462 , 0.0688)	31334

Perceived_Race (South Asian)	3613	0.0711	0.257045246		

Table 8 T-test results of comparison of StripSerch frequency between White and South Asian Perceived Race groups in Arrest & Strip Searches dataset

Test	Statistic	P-value	Conclusion
T-test on Perceived_Race(White & South Asian)	9.947766301	2.79e-23	Reject H0 as p-value is less than 0.05

The results in Table 7&8 indicate that the mean Perceived Race group of White's StripSearch Scores (31334)(M=0.13, SD=0.33) is larger than the mean Perceived Race group of South Asians' StripSearch Scores (31334) (M=0.07, SD=0.26). With alpha established at 0.05, this is a statistically significant difference as the p-value(2.79e-23) is less than 0.05, 95% CI [0.05, 0.07]. Therefore, we can reject the null hypothesis that there is no difference in the Perceived Race group of White's StripSearch Score (31334) and the Perceived Race group of South Asians' StripSearch Score (31334).

T-test 4

Another hypothesis of using the Welch T-test to analyze whether the specific means of the number of execution of Strip Search (outcome variable) differ between specific Perceived Race (explanatory variable) being tested below:

H0 (Null Hypothesis): The population means of two independent groups, Perceived Race for White and Black, who have conducted Strip Search, are equal.
HA (Alternative Hypothesis): The population means of two independent groups, Perceived Race for White and Black, who have conducted Strip Search, are not equal.

Table 9 T-test results on Perceived Race (White & Black) and Strip Search in the Arrest & Strip Searches dataset

	Sample Size	Mean	SD	CI	DF
Perceived_Race (White)	27718	0.1286	0.334789589	(-0.01667, -0.0038)	45247
Perceived_Race (Black)	17526	0.1389	0.345820614		

Table 10 T-test results of comparison of StripSerch frequency between White and Black Perceived Race groups in Arrest & Strip Searches dataset

Test	Statistic	P-value	Conclusion
T-test on Perceived_Race(White & Black)	-3.132027932	1.74e-03	Reject H0 as p-value is less than 0.05

The results in Table 9&10 indicate that the mean Perceived Race group of White's StripSearch Scores (45247)(M=0.13, SD=0.33) is less than the mean Perceived Race group of Black's StripSearch Scores (45247) (M=0.14, SD=0.35). With alpha established 0.05, this is a statistically significant difference as the p-value(1.74e-03) is less than 0.05, 95% CI [-0.017, -0.004]. Therefore, we can reject the null hypothesis that there is no difference in the Perceived Race group of White's StripSearch Score (45247) and Perceived Race group of South Asians' StripSearch Score (45247).

Two-way ANOVA

To examine the main effects of Perceived Race and Sex on StripSearch value, as well as the interaction effects between Perceived Race and Sex on StripSearch values, we will conduct Two-way ANOVA to test and based on assumpstions: (1) Normality: The data within each group should follow a normal distribution; (2) Homogeneity of variances: The variance of the data in each group should be approximately equal; (3) Independence: Observations within each group should be independent of each other; (4) Random sampling: The observations should be randomly sampled from the population. The hypothesis of three main effects being tested below:

a. The main effect of perceived race:

H0 (Null Hypothesis): The means of StripSearch values are the same across all levels of Perceived Race.
HA (Alternative Hypothesis): At least one of the mean of StripSearch values is different across all levels of Perceived Race.

b. The main effect of Sex:

H0 (Null Hypothesis): The means of StripSearch values are the same for males and females.
HA(Alternative Hypothesis): The means of StripSearch values are different for males and females.

c. Interaction between Perceived Race and Sex:

H0 (Null Hypothesis): The effect of Perceived Race on StripSearch between males and females, are the same.
HA (Alternative Hypothesis): The effect of Percieved Race on StripSearch between males and females, are not the same.

Figure 14 Two way anova between attributes of Perceived Race, Sex and StripSearch

	sum_sq	df	F	PR(>F)
C(Perceived_Race)	42.425430	7.0	58.046535	1.939933e-83
C(Sex)	7.000364	1.0	67.045357	2.700757e-16
C(Perceived_Race):C(Sex)	7.786977	7.0	10.654154	1.778725e-13
Residual	6812.593171	65247.0	NaN	NaN

Based on Figure 14 above, the results of the Two-way ANOVA table suggest that Perceived Race, Sex, and the interaction between Perceived Race and Sex all significantly affect StripSearch. The p-value for the main effects of Perceived Race(1.94e-83) and sex(2.70e-16) is smaller than the significance level of 0.05, indicating strong evidence against the null hypothesis. The p-value for the interaction between Perceived Race and sex(1.78e-13) is also smaller than the significance level of 0.05, indicating strong evidence that the effect of Perceived Race on StripSearch depends on sex and vice versa. Therefore, we can reject the null hypothesis and conclude that all three factors significantly affect Strip Search.

Discussion

Figure 15 Interaction Plot of Perceived Race and Sex on Strip Searches

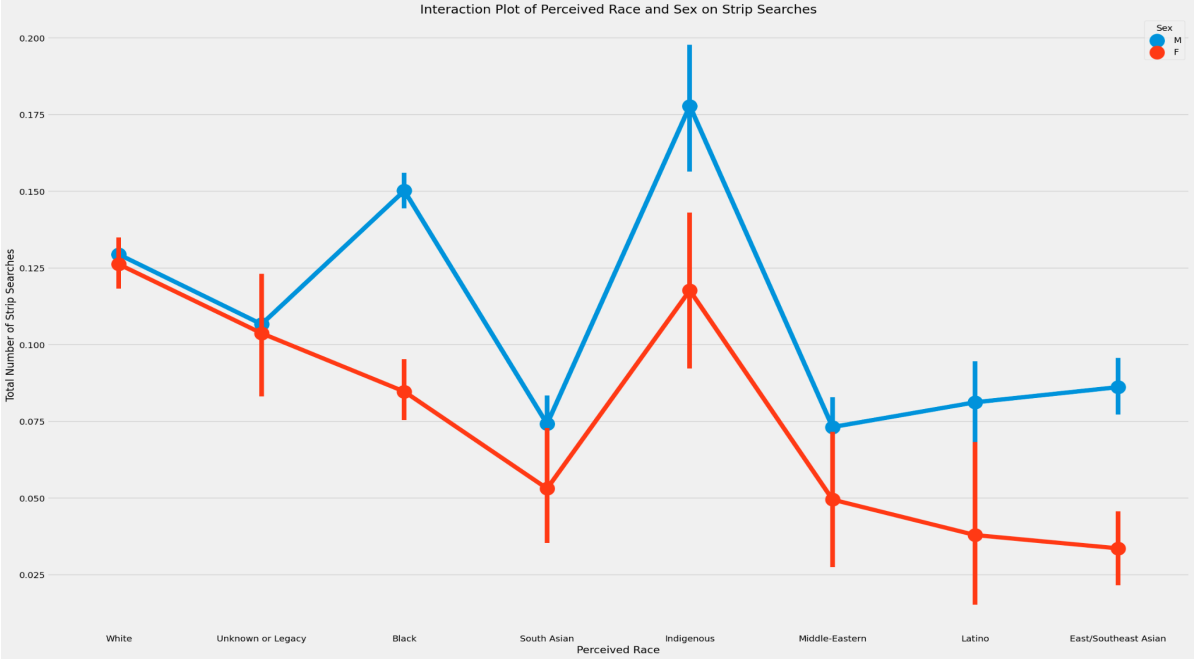


Figure 15 above displays the relationship between two categorical variables (Perceived Race&Sex) and how it affects the response variable(StripSearch). Specifically, it shows how the effect of Perceived Race on the total number of StripSearch differs between males and females. While the interaction plot does not provide any information on the statistically significant differences, the plot shows:

(a) The total number of strip searches on the Male group is higher than the Female group based on the same Perceived Race;
(b) the Perceived Race as White and Indigenous have a higher total number of StripSearces compared to Perceived Race as Black, South Asian, Middle-Eastern, Latino, and East/Southeast Asian based on the same Sex;
(c) there was a big noticeable difference in the total number StripSearches conducted on Perceived Race as Black and Indigenous between the Male and Female groups.

Conclusion

Based on the data introduction and literature, it is evident that strip searches are subject to debate regarding their use in police inspection. The study examined how Sex, Perceived Race, and Age groups at arrest interact with the chances of getting strip searched or arrested. Three research questions were formulated to achieve this, and preliminary research was conducted using descriptive statistics and T-tests. ANOVA tests were then used to test the impact of independent variables on the dependent variable.

During the research process, we do acknowledge that there are a few limitations with the datasets. First, the total observation contains 52,650 males and 12,617 females in the sample population. The imbalance in the distribution of the male and female groups would have little impact on the results of the analyses using *Sex* as an independent variable. However, since there is no perfect solution to alter the dataset, we continued analyzing the current dataset by acknowledging the existence of its flaws. The second perspective of the study that is worth noticing is that the dataset contains variables collected with unclear standards. For instance, the variable of Perceived_race is defined as the race of individuals perceived by police officers instead of self-reported by the individuals. The current data collection mode could improve with formal, written, and detailed streamlined instruction.

Overall, our research findings revealed a significant difference between the number of strip-searched males and females, with males having a higher probability of being searched (based on different occurrence categories). Additionally, the analysis showed no significant difference in the actions taken by different age groups at arrests. Finally, there was a significant difference in the total number of Strip searches conducted based on perceived race, sex, and the interaction of the two. The study's results suggest that there is still work to be done to ensure that strip searches are conducted fairly and justly and that further research is needed to understand the underlying factors that influence the disparities observed in this study.

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