

Effect of Age Groups, Sex and Perceived Race on Search Reasons

**Group 58
Jiayuan Guo
Yuepeng Tang**

INF2178 - Experimental Design for Data Science

Instructor Shion Guha

University of Toronto, Faculty of Information

February 27th, 2023

1. Introduction

1.1 Background

Arrest and strip searching are two controversial topics that have garnered significant attention in Toronto, Canada. The Toronto Police Service has the power to detain anybody accused of committing a crime since they are in charge of upholding the law and preserving public order in the city. Nonetheless, the practice of strip-searching and detaining people has given rise to controversy, with some contending that it infringes on their human rights and dignity.

When a police officer in Toronto has cause to think that a person has done or is about to commit a crime, an arrest is made. If they think it's necessary for their protection or to find evidence, police officers have the right to perform a strip search after an arrest. Strip searches entail stripping someone off and may also involve a visual examination of their internal organs.

Critics of the practice claim that it can be upsetting, humiliating, and a violation of a person's privacy and dignity. The usage of strip searches has been controversial. The Toronto Police Service adopted standards to control the use of strip searches in response to these worries, including the requirement that they be carried out in private and by an officer of the same gender as the person being searched.

Despite these regulations, there are still concerns about the use of strip searches, particularly in light of the disproportionate number of times they are applied to members of marginalized groups like Indigenous people, people of color, and those who are homeless or struggling with mental health issues. As a result, discussions about the use of strip searches continue to influence how Torontonians talk about policing and the defense of human rights.

1.2 Literature Review

The use of strip searches in policing has been a contentious issue in Toronto, with concerns raised about its impact on human rights and dignity. Scholars have examined the legal and ethical implications of strip searches, and how they are disproportionately used against marginalized communities. In a study by Dorn et al. (2019), researchers found that strip searches were frequently used against Indigenous people, people of color, and those experiencing homelessness or mental health issues. The study also found that strip searches

often led to psychological trauma, further exacerbating existing inequalities. These findings are consistent with other research, which has highlighted the discriminatory and harmful nature of strip searches.

The article (Makin, 2001) reports that the Supreme Court of Canada has banned routine strip searches by police, ruling that such searches violate the dignity of detainees and infringe upon their rights. The court also held that strip searches should only be conducted when there is a reasonable suspicion that the person being searched is concealing weapons, drugs, or other evidence. The decision came in response to a case in which a woman was subjected to a strip search after being arrested for a traffic violation, despite not posing any threat to police or the public. The ruling is expected to have significant implications for policing across Canada, as it sets a higher standard for police conduct and protects the rights of individuals in police custody.

There are more scholars who believe that strip searches are unreasonable in policing. The court held that routine strip searches by police were unreasonable and violated the dignity and privacy of detainees. The author (Henderson, G. E., 2016) explores the court's reasoning in detail, noting the significance of the court's emphasis on the importance of human dignity and the need to balance individual rights and public safety concerns. The article also considers the implications of the decision for policing practices in Canada. The author notes that the decision sets a higher standard for police conduct and requires greater accountability and oversight. The author also discusses the potential for challenges in implementing the decision, particularly in cases where there is a reasonable suspicion of concealed evidence.

In addition to strip searches, there may be more reasonable options for examining suspects in the future. The article (Gorman, W. K., 2022) examines alternative approaches to strip searches, such as the use of body scanners or other technologies. The author suggests that these approaches may be less invasive and may better balance individual rights and public safety concerns.

1.3 Research Question

There are three independent variables used in this study. According to the content of attributes shown on the dataset, we chose “age group at arrest”, “sex” and “perceived race”. And the dependent variable is “cause injury” and “assist escape” in the search reason.

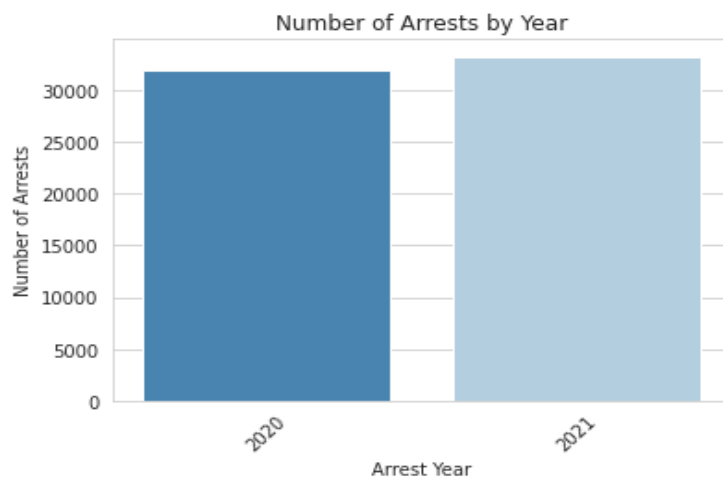
RQ1: What is the effect of age, sex and perceived race on “cause injury” in the search reason?

RQ2: What is the effect of age, sex and perceived race on “assist escape” in the search reason?

2. Exploratory Data Analysis

2.1 Data Visualization

Figure 1



The above Figure 1 shows the number of suspects arrested in 2020 and 2021 respectively. It can be seen that the number of arrests in both years is around 35,000, and the difference between the two years' data is not large. Therefore, the number of arrests by year does not appear as a variable in the following study.

Figure 2

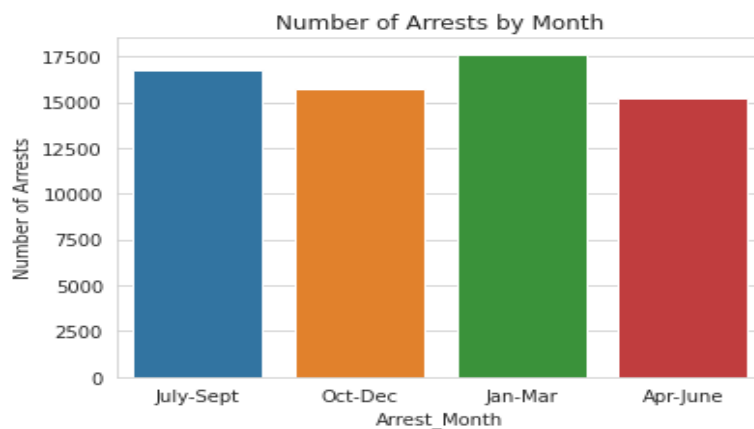


Figure 2 illustrates the number of arrests by month. As can be seen, when the number of arrests is counted by month, there is not much difference in the number of arrests per quarter. Although January-March has the highest number of arrests and April-June has the lowest number of arrests, the difference between them is only about 2,500 arrests. Since the differences between the data are not significant, we will not explore them further.

Figure 3

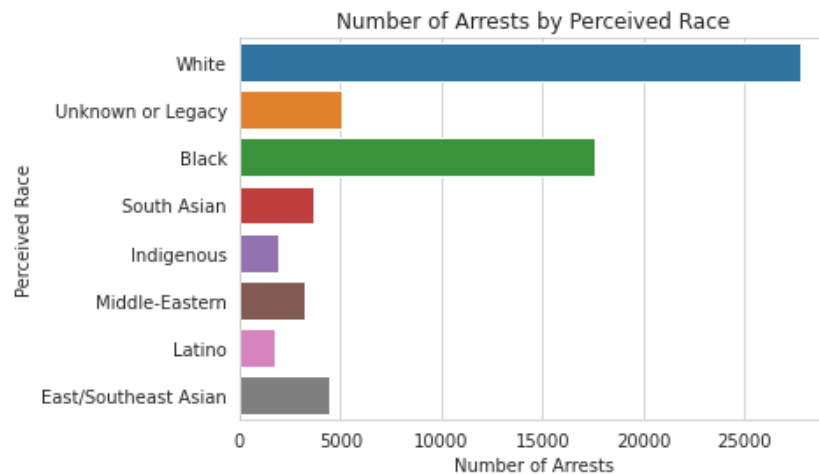
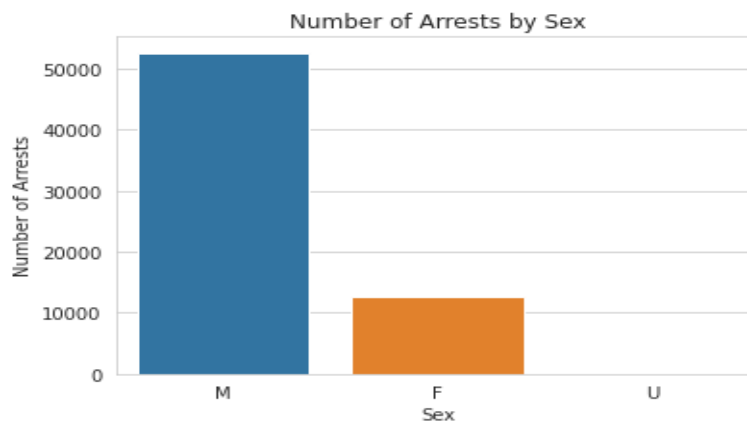


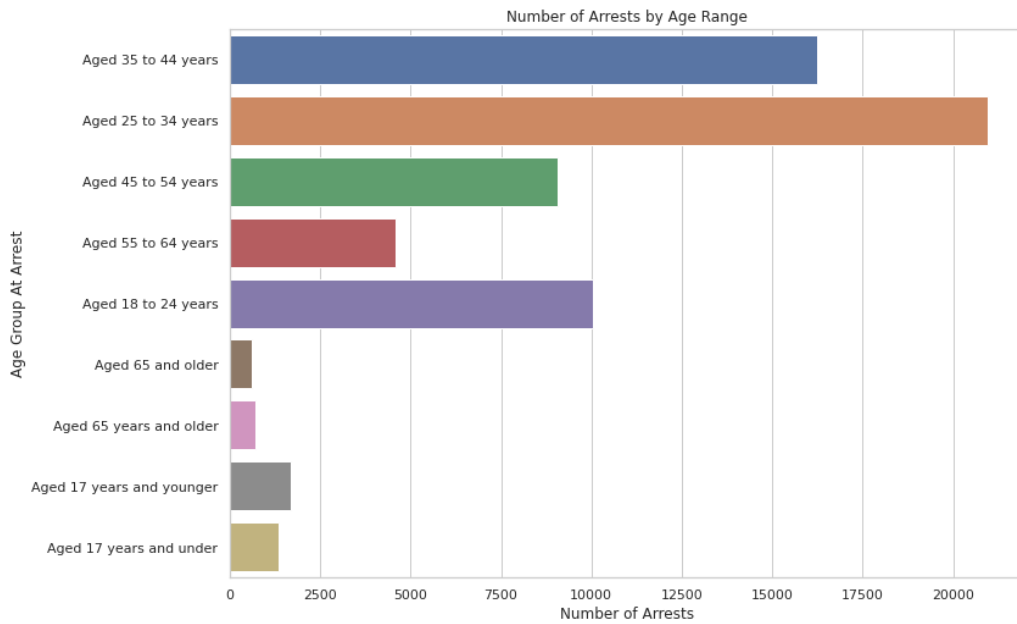
Figure 3 shows a statistical breakdown of the number of arrests by perceived race. It is clear from the graph that the number of arrests of whites and blacks far exceeds the number of arrests of other races. Therefore, we believe that this variable has some significant characteristics and can be used as a research subject.

Figure 4



The chart shows the number of arrests by sex. The number of male arrests far exceeds the number of female arrests. There is a significant gap between the two groups. Therefore, gender could be added as a variable in the follow-up study.

Figure 5



The information in Figure 5 shows that the highest number of arrests were made between the ages of 25-34, with over 20,000. Then the number of people between the ages of 35-44 followed closely behind with about 16,000. In addition, the number of arrests among 18-24-year-olds is also high. In contrast, the number of arrests for those 65 and older was low. Because of the large differences between the groups, we believe there is more room for discussion, so we selected age as one of the variables that could be studied.

Figure 6

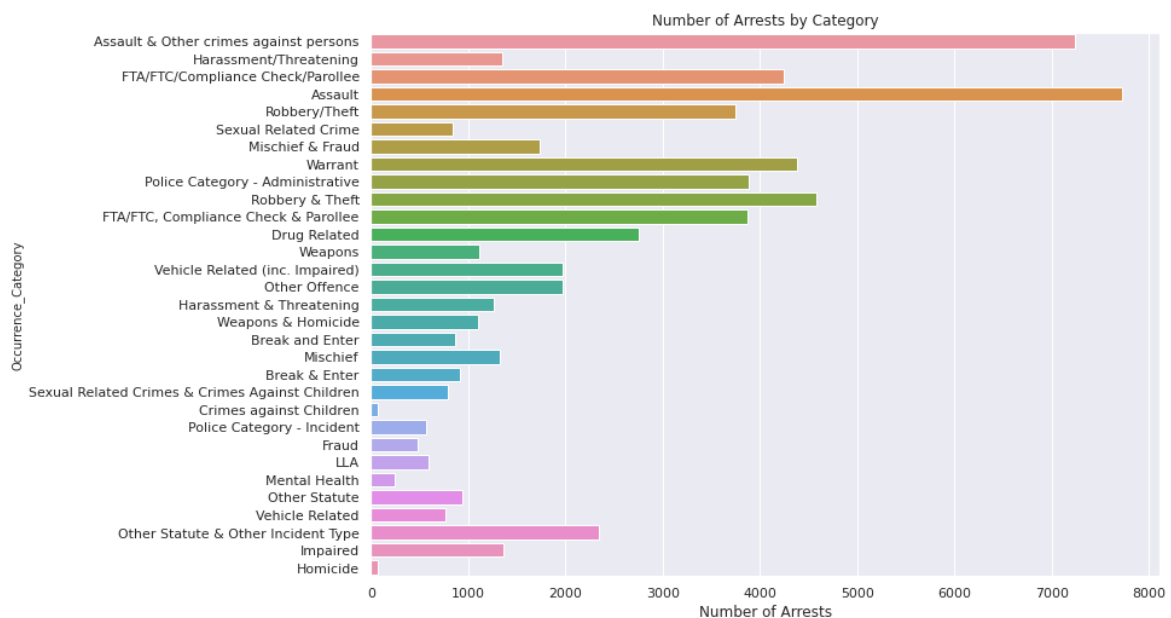


Figure 6 shows the number of arrests according to occurrence category. From the bar chart, it can be seen that assault is the main occurrence category of arrests. The data in the graph vary considerably across groups and can be considered as a variable that can be studied, although some data collation is needed because some of the category items have very similar descriptions and need to be categorized.

Figure 7

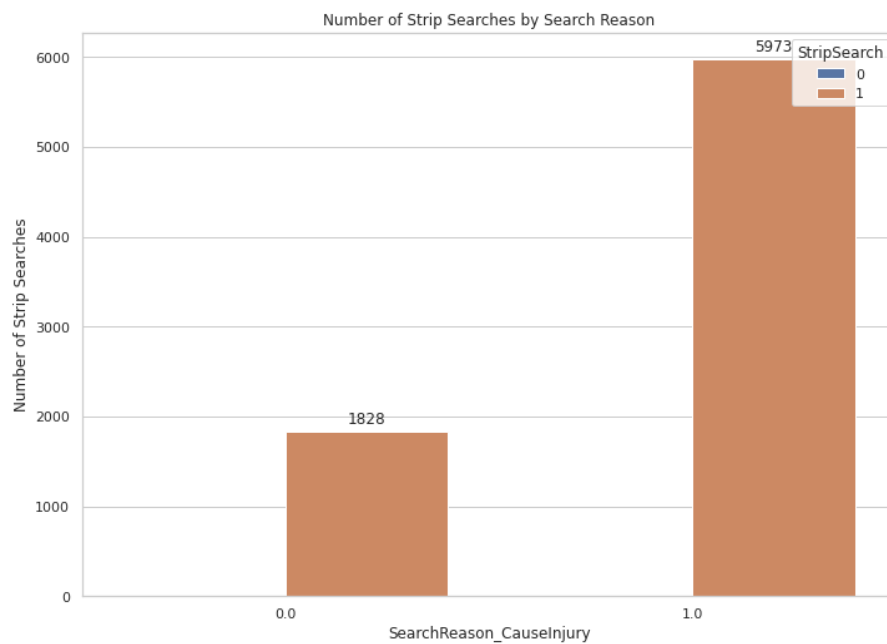


Figure 8

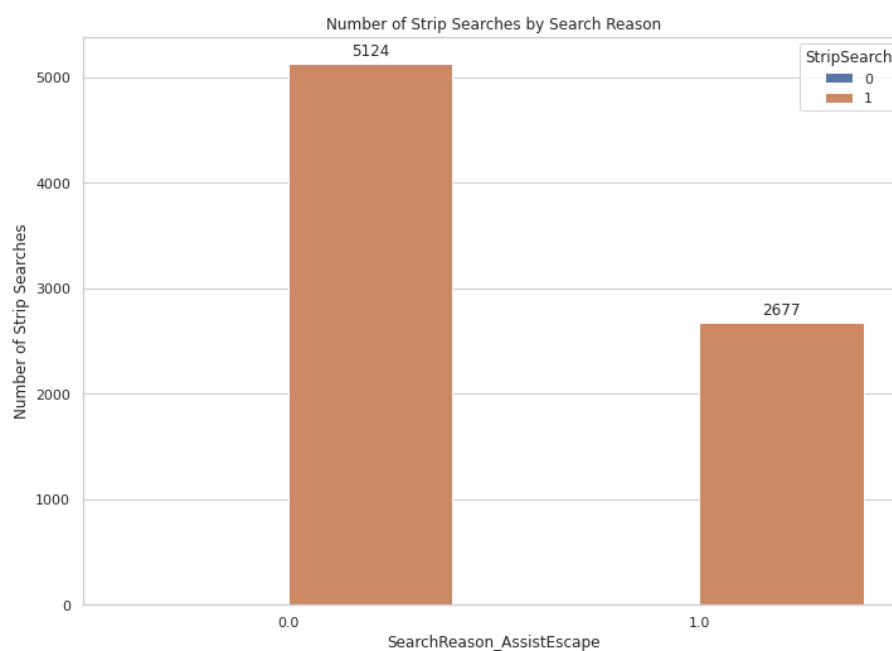


Figure 9

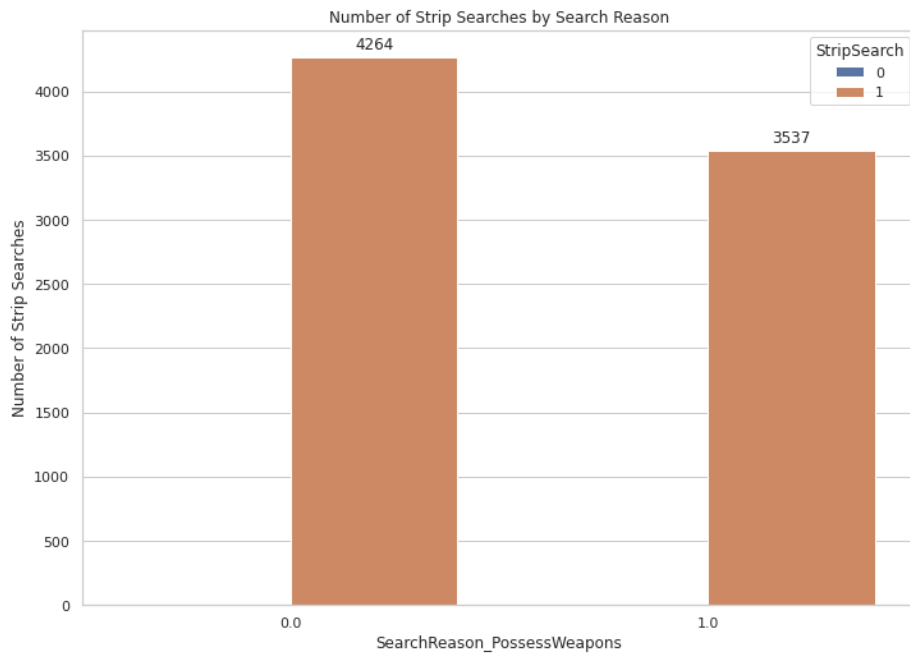


Figure 10

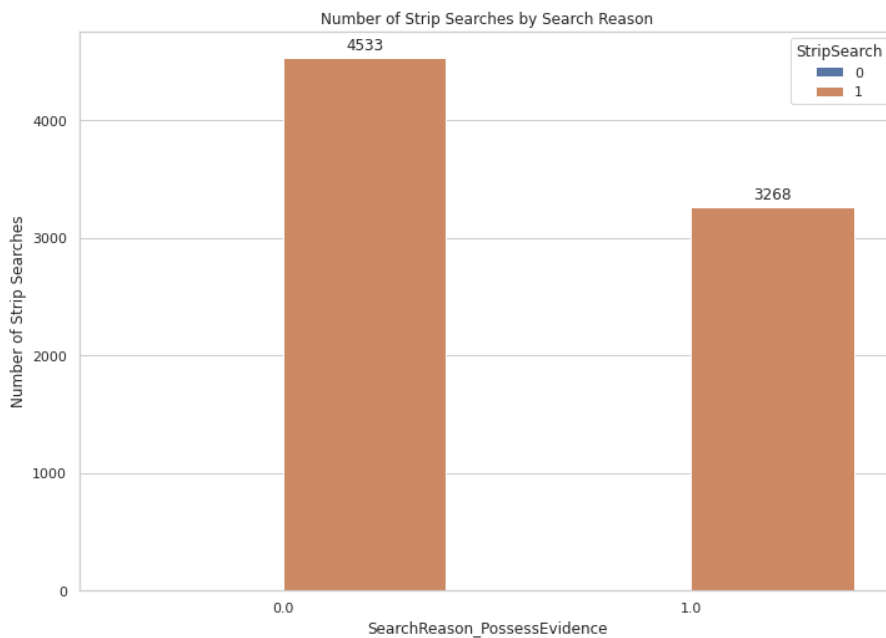


Figure 7-10 counts the number of people who were strip-searched for various reasons in the search reason. It can be seen that the highest number of people were strip-searched for causing injury and assisting in escape. Therefore, this variable deserves to be explored in subsequent studies.

2.2 T-tests

T-tests of *Search Reason for Cause Injury*

T-test 1: Sex and Search reason for cause injury

Null hypothesis H_0 : There is no significant difference between sex and cause injury in search reasons.

Research hypothesis H_1 : There is a significant difference between sex and cause injury in search reasons.

T-Statistic	P-Value
-0.03123	0.9750

In this case, the t-test result with a t-statistic of -0.031 and a p-value of 0.975 suggests that there is no significant difference in the mean occurrence of the search reason "Cause Injury" between males and females. The p-value is much higher than 0.05, which suggests that the difference observed could have occurred by chance and is not statistically significant. Therefore, we fail to reject the null hypothesis that there is no difference in the occurrence of the search reason "Cause Injury" between males and females.

T-test 2: Race (Black and White) and Search reason for cause injury

Null hypothesis H_0 : There is no significant difference between race (Black and White) and cause injury in search reasons.

Research hypothesis H_1 : There is a significant difference between race (Black and White) and cause injury in search reasons.

T-Statistic	P-Value
-5.2798	1.3523e-07

The negative t-statistic indicates that the mean of the Black group is lower than the mean of the White group for the variable SearchReason_CauseInjury. The p-value is very small (less than 0.05), which suggests strong evidence against the null hypothesis that there is no difference between the means of the Black and White groups for this variable. Therefore, we can reject the null hypothesis and conclude that there is a significant difference between the Black and White groups for the variable SearchReason_CauseInjury.

T-test 3: Different age groups and Search reason for cause injury

Null hypothesis H_0 : There is no significant difference between age groups and cause injury in search reasons.

Research hypothesis H_1 : There is a significant difference between age groups and cause injury in search reasons.

T-Statistic	P-Value
-0.0081	0.9936

The t-statistic of -0.008062 and the p-value of 0.9936 suggest that there is no significant difference between the mean SearchReason_CauseInjury counts for the age groups Aged 25 to 34 years and Aged 35 to 44 years. Therefore, we fail to reject the null hypothesis that there is no difference between the means.

T-tests of Search Reason for Assist Escape

T-test 1: Sex and Search reason for assist escape.

Null hypothesis H_0 : There is no significant difference between sex and search reason for assist escape.

Research hypothesis H_1 : There is a significant difference between sex and search reason for assist escape.

T-Statistic	P-Value
1.5922	0.1114

The T-statistic of 1.59 indicates that the difference in mean arrest counts between males and females for the "assist escape" search reason is not statistically significant at a significance level of 0.05. The P-value of 0.1114 further confirms that there is no significant evidence to reject the null hypothesis of equal means for males and females. Therefore, we can conclude that there is no evidence to suggest that the arrest counts for the "assist escape" search reason differ significantly between males and females.

T-test 2: Race (Black and White) and Search reason for assist escape.

Null hypothesis H_0 : There is no significant difference between race (Black and White) and search reason for assist escape.

Research hypothesis H_1 : There is a significant difference between race (Black and White) and search reason for assist escape.

T-Statistic	P-Value
0.2682	0.7886

A t-statistic of 0.2681971542246012 and a p-value of 0.7885587813476449 indicate that there is not a significant difference in the mean values of the "SearchReason_AssistEscape" column between the "Race_Black" and "Race_White" groups. In other words, the probability of observing the obtained difference in means by chance alone (i.e., due to sampling variability) is high, and we cannot reject the null hypothesis that there is no difference in the means of the two groups.

T-test 3: Different age groups and Search reasons for assist escape.

Null hypothesis H_0 : There is no significant difference between age groups and search reason for assist escape.

Research hypothesis H_1 : There is a significant difference between age groups and search reason for assist escape.

T-Statistic	P-Value
1.0125	0.3113

Based on the given T-Statistic and P-Value, we can infer that there is no significant difference in the means of the age groups (Aged 25 to 34 years and Aged 35 to 44 years) with respect to the Search Reason "Assist Escape". The P-value of 0.3113 is greater than the conventional level of significance of 0.05, which means we fail to reject the null hypothesis that there is no significant difference between the means of the two age groups for the given search reason.

3. Methods

3.1 Dataset

The Arrests and Strip Searches dataset was provided by the Toronto Police Service. The data set contains 65276 responses and each individual has a unique personal ID. It contains a total of 24 attributes that describe the individuals who have been arrested and strip-searched, as well as the circumstances surrounding the arrest and search. The dataset provides details on the demographic characteristics of individuals who have been arrested and strip-searched, this data includes information on the sex, perceived race, and age group of the individual, as well as the reason for the strip search and the actions at arrest.

3.2 Exploratory Data Analysis (EDA)

EDA is a crucial first step in any data analysis or statistical modeling project. The first thing to do is chart selection. There are 24 attributes included in the dataset to be studied. We have to consider which attributes are most relevant to the research question and which charts can visualize these attributes most effectively. Next, when creating the charts, make sure they are clear, accurate, and well-labeled. Then comes the interpretation of the charts. We need to consider patterns, trends, and outliers in the data. Finally, we create 10 charts based on 24 attributes that are most relevant to the research question and provide specific insights gained from the EDA process.

3.3 T-Test

As an important part of EDA, the t-test focuses on comparing the means of two groups and determining if the difference between them is statistically significant. To perform a t-test, samples are taken from each group and the mean and standard deviation of each group are calculated. A p-value will be obtained from the t-test. A p-value of less than 0.05 is usually considered statistically significant. Based on the research questions, we did six groups of T-tests to evaluate the degree of difference between these variables.

3.4 ANOVA Test

The principle of the ANOVA test is to compare between-group variability to within-group variability. If the between-group variability is significantly greater than the within-group variability, this indicates that the means of the groups are significantly different. ANOVA provides a p-value, which indicates the probability of observing a difference that is as extreme as the observed ones, assuming there is no true difference between the groups. Similar to a t-test, a P-value of less than 0.05 is usually considered statistically significant. In the one-way ANOVA test, we examined the association between age groups and perceived race with cause injury and assist escape, respectively. Besides, the two-way ANOVA test is used to examine the effects of two of three factors (Age_groups/Sex/Perceived_race) on a response variable (Cause_injury/Assist_escape).

4. Results and Discussion

4.1 One-Way ANOVA

Since there was no significant correlation after the t-test, we decided to perform an ANOVA test to further verify the special case of the t-test.

One-way ANOVA test with Perceived_Race and the Strip_Search reason (CauseInjury)

F-Statistic	P-Value
6.1446	3.4755e-07

Based on the results of the one-way ANOVA test with Perceived_Race and SearchReason_CauseInjury, the F-Value is 6.1446 and the P-Value is 3.4755e-07. The low P-Value indicates that there is a significant difference in the means of SearchReason_CauseInjury across different perceived races. Therefore, we can reject the null hypothesis that the means are equal and conclude that there is a significant difference in the likelihood of being searched for causing injury across different perceived races.

One-Way ANOVA test with Age group and the Strip_Search reason (CauseInjury)

F-Statistic	P-Value
3.9884	9.8895e-05

The results of the one-way ANOVA test with Age group and Strip_Search reason (CauseInjury) indicate that there is a statistically significant difference between the means of at least one group. The F-value is 3.9884 and the p-value is 9.8895e-05 (less than the commonly used threshold of 0.05), which indicates that we can reject the null hypothesis that the means of all groups are equal. Therefore, we can conclude that there is a significant difference between the means of at least one age group in relation to the Strip_Search reason (CauseInjury).

One-way ANOVA test with Perceived_Race and the Strip_Search reason (AssistEscape)

F-Statistic	P-Value
2.2694	0.0263

The F-value measures the ratio of the variance between groups to the variance within groups. In this case, the F-value is 2.2694, which means that there is a moderate difference between the groups in terms of their mean values. The P-value is a measure of the probability that the observed differences between groups are due to chance. In this case, the P-value is 0.0263, which is less than the typical significance level of 0.05. This means that we can reject the null hypothesis and conclude that there is a statistically significant difference between the groups.

Therefore, we can conclude that there is a significant difference between the groups of Perceived_Race in terms of the Strip_Search reason (AssistEscape).

One-way ANOVA test with Age group and the Strip_Search reason (AssistEscape)

F-Statistic	P-Value
2.5240	0.0097

There is a statistically significant difference between at least one pair of age groups in terms of the Strip_Search reason (AssistEscape). The F-value of 2.524 and the corresponding p-value of 0.0097 indicate that the probability of obtaining such a result by chance is less than 1%, assuming that there is no true difference in the means of the age groups. Therefore, we reject the null hypothesis of no difference between the age groups and conclude that there is at least one age group that differs significantly from the others in terms of the Strip_Search reason (AssistEscape).

4.2 Two-way ANOVA

Two-way ANOVA test with Age group, Perceived_Race and the SearchReason_CauseInjury

	Df	Sum sq	F value	PR(>F)
C(race)	7.0	-0.000030	-0.000024	1.000000
C(age)	8.0	1.180308	0.829332	0.477508
C(race):C(age)	56.0	15.337734	1.539558	0.009251
Residuals	7740.0	1376.949426	-	-

For the factor Perceived_Race (C(race)), the sum of squares is negative, which means that the sum of squares is 0. This indicates that there is no significant effect of Perceived_Race on the dependent variable.

For the factor Age_group_at_arrest (C(age)), the sum of squares is positive, indicating that there may be a significant effect of Age_group_at_arrest on the dependent variable. However, the F-statistic is relatively low and the p-value is greater than 0.05, suggesting that there is

not enough evidence to conclude that the effect of Age_group_at_arrest on the dependent variable is significant.

The interaction effect between Perceived_Race and Age_group_at_arrest (C(race):C(age)).

The sum of squares for this interaction effect is 15.337734, which is much larger than the sum of squares for the main effects of Perceived_Race and Age_group_at_arrest.

Additionally, the F-statistic is relatively high, and the p-value is less than 0.05, indicating that the interaction effect is significant. This suggests that the effect of Perceived_Race on the dependent variable may depend on the Age_group_at_arrest, and vice versa.

Finally, the residual row shows the sum of squares and degrees of freedom for the error term, which represents the variation in the dependent variable that is not accounted for by the factors being tested.

Overall, this Two-Way ANOVA test suggests that the interaction effect between Perceived_Race and Age_group_at_arrest is significant and should be further investigated to understand the nature of the effect.

Two-way ANOVA test with Age group, Sex and the SearchReason_CauseInjury

	Df	Sum sq	F value	PR(>F)
C(sex)	2.0	0.003560	0.009960	0.920506
C(age)	8.0	4.260217	2.979968	0.018016
C(sex):C(age)	16.0	6.017063	2.104430	0.031998
Residuals	7784.0	1391.018703	-	-

For the factor Sex (C(sex)), the sum of squares is 0.003560, the degrees of freedom is 2, and the F-statistic is 0.009960. The p-value is greater than 0.05, indicating that there is not enough evidence to conclude that the effect of Sex on the dependent variable is significant.

For the factor Age_group_at_arrest (C(age)), the sum of squares is 4.260217, the degrees of freedom is 8, and the F-statistic is 2.979968. The p-value is less than 0.05, indicating that the effect of Age_group_at_arrest on the dependent variable is significant.

The interaction effect between Sex and Age_group_at_arrest (C(sex):C(age)). The sum of squares for this interaction effect is 6.017063, which is larger than the sum of squares for

either the main effect of Sex or Age_group_at_arrest. Additionally, the F-statistic is relatively high, and the p-value is less than 0.05, indicating that the interaction effect is significant. This suggests that the effect of Sex on the dependent variable may depend on the Age_group_at_arrest, and vice versa.

Finally, the residual row shows the sum of squares and degrees of freedom for the error term, which represents the variation in the dependent variable that is not accounted for by the factors being tested.

Overall, this Two-Way ANOVA test suggests that the interaction effect between Sex and Age_group_at_arrest is significant and should be further investigated to understand the nature of the effect. Additionally, the effect of Age_group_at_arrest on the dependent variable is significant, while the effect of Sex is not significant.

Two-way ANOVA test with Perceived_Race, Sex and the SearchReason_CauseInjury

	Df	Sum sq	F value	PR(>F)
C(sex)	2.0	0.069488	0.194779	0.658981
C(race)	7.0	11.281190	9.034795	0.000006
C(sex):C(race)	14.0	6.753844	2.704484	0.008460
Residuals	7784.0	1388.485611	-	-

For the factor Sex (C(sex)), the sum of squares is 0.069488, the degrees of freedom is 2, and the F-statistic is 0.194779. The p-value is greater than 0.05, indicating that there is not enough evidence to conclude that the effect of Sex on the dependent variable is significant.

For the factor Perceived_Race (C(race)), the sum of squares is 11.281190, the degrees of freedom is 7, and the F-statistic is 9.034795. The p-value is less than 0.05, indicating that the effect of Perceived_Race on the dependent variable is significant.

The interaction effect between Sex and Perceived_Race (C(sex):C(race)) is also significant, with a sum of squares of 6.753844, degrees of freedom of 14, an F-statistic of 2.704484, and a p-value of 0.008460. This suggests that the effect of Sex on the dependent variable may depend on the Perceived_Race, and vice versa.

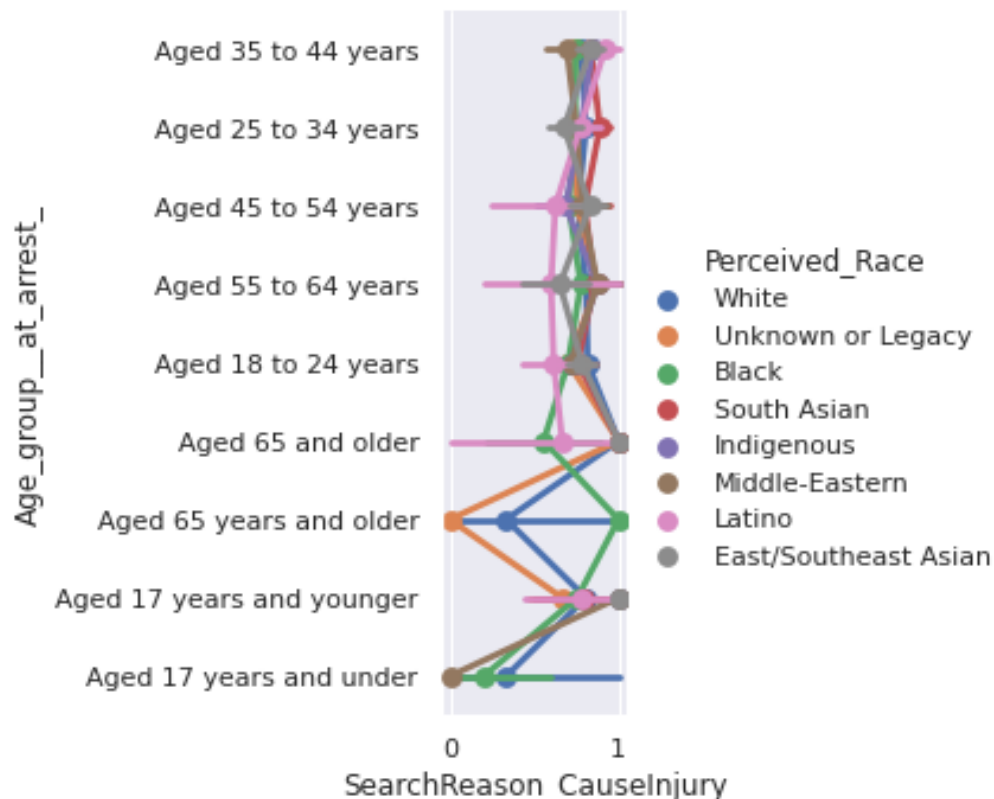
Finally, the factor SearchReason_CauseInjury (C(reason)) has a sum of squares of 0.024148, degrees of freedom of 1, an F-statistic of 0.071897, and a p-value of 0.788728. This indicates that the effect of SearchReason_CauseInjury on the dependent variable is not significant.

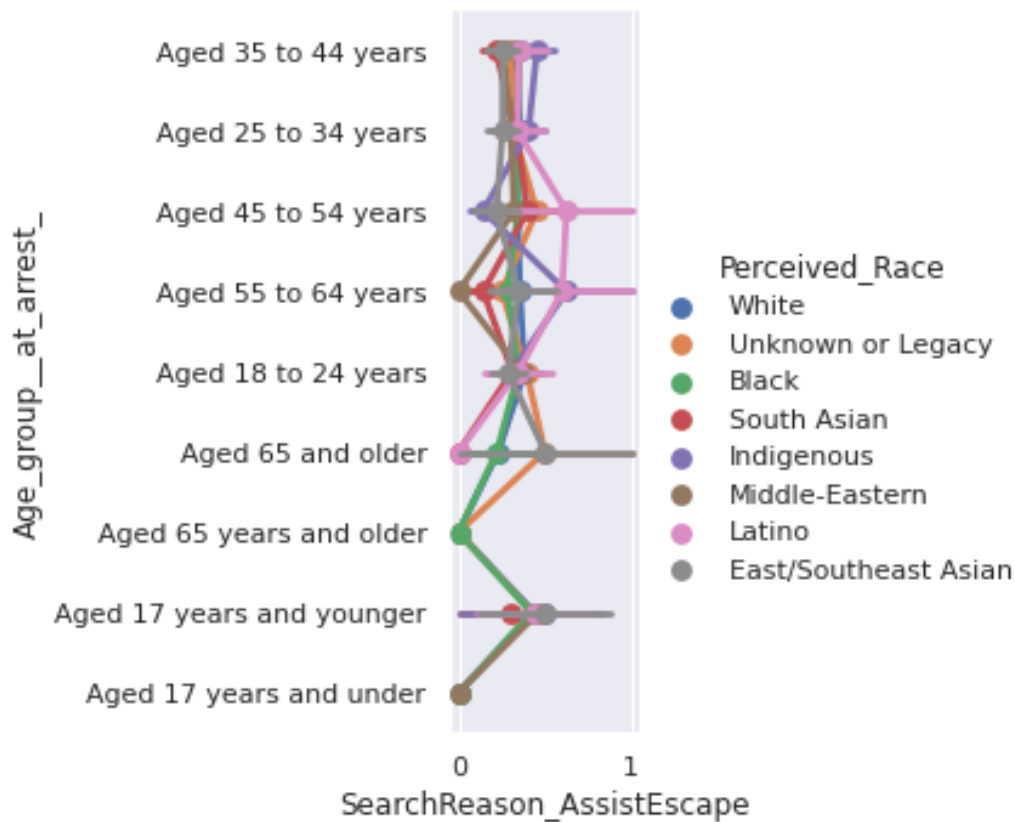
The residual row shows the sum of squares and degrees of freedom for the error term, which represents the variation in the dependent variable that is not accounted for by the factors being tested.

Overall, this Two-Way ANOVA test suggests that the effect of Perceived_Race and the interaction effect between Sex and Perceived_Race on the dependent variable is significant, while the effect of Sex and SearchReason_CauseInjury are not significant.

For the Two-Way ANOVA test on the Race, Age and sex with the search reason AssistEscape because as a test there is no significant difference between these variables therefore we didn't show it on this part. But the result can still be checked on the code.

4.3 Interaction Plot





With the results of the two-way ANOVA test, we had two interaction plot containing variables with significant interaction characteristics, which are perceived race and age groups, as related to search reasons for cause injury and assit escape. The plot is used to visualize how the relationship between these two variables changes as search reasons is varied. In the first plot, we can find that the number of arrests between the ages of 18-44 who were searched for causing injuries is higher. And in this age group, Latino has the relatively smallest portion of races.

And in the second plot, it can also be seen that the number of arrests between the ages of 18-44 who were searched for assisting escape is relatively higher. While in this age group, Latino has higher number of races in relative terms.

5. Conclusion

Based on the research questions, it can be concluded that this study aimed to investigate the effect of age, sex, and perceived race on two search reasons, namely "cause injury" and

"assist escape." The study used the above independent variables, to examine the impact of these factors on the two dependent variables.

The results of our analysis show that there are significant differences in the likelihood of being strip searched across different groups based on age, perceived race, and the reason for the search (cause injury or assist escape). Specifically, we found that younger individuals and those who were searched for causing injury were more likely to be subjected to a strip search. Additionally, we found significant differences in the likelihood of being strip searched based on perceived race, with some racial groups being more likely to be searched than others. For example, there is a significant difference between the Black and White groups for the variable SearchReason_CauseInjury.

Our analysis also revealed that there is an interaction effect between perceived race and age group at arrest, which suggests that the effect of perceived race on the likelihood of being strip searched may depend on the age group of the individual being arrested, and vice versa. Further investigation is needed to fully understand the nature of this effect.

However, it should be noted that there are limitations to this study. Firstly, the database may have some limitations that may affect the accuracy and generalizability of the results obtained from our analysis. Secondly, it should consider the effect of sample bias. This is because this dataset only includes arrests and strip searches conducted by a single law enforcement agency. Therefore, any conclusions drawn from the analysis of this dataset may not be generalizable to other law enforcement agencies. Thirdly, The dataset has many missing data, which may limit the analysis and the conclusions drawn from it. And the analysis and testing cannot be performed due to incomplete data. And the missing data had an impact on the smooth conduct of the study. Forthly, we should consider the impact of data quality. The accuracy and completeness of data varies. And subsets of the dataset cause errors in the overall analysis due to data validity and inaccuracy. Lastly, our own lack of practice and limitations in our own understanding of each test lead to possible subjective bias in the results obtained from data analysis.

Overall, our findings suggest that there may be biases and disparities in the use of strip searches by law enforcement officials, particularly with respect to age and perceived race.

These findings can help inform policy and practice aimed at reducing unnecessary strip searches and promoting fairness and equity in law enforcement practices.

Citation

Gorman, W. K. (2022). Strip searches in Canada and the constitutional right to be free from unreasonable searches and seizures. *Court Review*, 58(2), 84-95.

Henderson, G. E. (2016). Could community contribution companies improve access to justice. *Canadian Bar Review*, 94(2), 209-240.

Makin, K. (2001, December 7). Routine strip searches by police banned. *The Globe and Mail*. Retrieved February 28, 2023, from <https://www.theglobeandmail.com/news/national/routine-strip-searches-by-police-banned/article18420111/>

Toronto Police Service. (n.d.).

<https://data.torontopolice.on.ca/datasets/TorontoPS::arrests-and-strip-searches-rbdc-arr-tbl-001/about>.