

INF2178 Midterm Project

Introduction

The use of strip searches by police officers has become a topic of controversy, as concerns have been raised about the impact of strip searches on individual rights and gender equality. In this project, we are going to analyze the dataset “Arrests and Strip Searches” (RBDC-ARR-TBL-001) which is a large public dataset shared by the Toronto Police Services that can be found in the Public Safety Data Portal. A strip search is often referred to as a type of search where a police officer removes some or all of a person's clothing and visually examines their body. We are interested in finding how different variables such as race affect crime occurrence categories, and how different occurrence categories may lead to different actions at arrest. A strip search is also a significant factor in this dataset, therefore, we want to examine the circumstances in which strip searches need to be conducted. It can help us to identify whether strip searches are being used fairly and equitably in different situations. The results could also contribute to broader discussions about policing practices and the need for greater accountability and transparency in law enforcement. Ultimately, this study could provide insights about some areas where policy changes or training may be required to improve practice which could help to promote fairness and justice in the policing of Toronto communities.

Literature review

Strip searches are an intrusive form of the police search in which an individual's clothing is removed for visual inspection. The use of strip searches by the police has been controversial, with many people and groups debating their role. Michael Grewcock and Vicki Sentas argue that police departments and local governments should address the impact of strip searches on the rights of individuals, particularly young people and individuals from marginalized communities [1]. They also emphasize the importance of a more balanced and proportionate approach to strip searches that emphasizes the rights and dignity of individuals while ensuring public safety.

According to David M Tanovich, gender and race-based violence has been perpetuated by the Toronto Police Service, citing multiple cases of strip searches of women resulting in sexual assault and abuse of prosecutorial power [2]. These acts can disproportionately punish individuals with a history of sexual assault or abuse who are already at high risk for post-traumatic symptoms. In addition, an independent expert evaluation report examining the first phase of the Toronto Police Service's race-based data collection strategy showed that Black and Indigenous women were disproportionately affected by strip searches, suggesting a pattern of racialized violence by Toronto police [3].

Michelle Psutka and Elizabeth Sheehy provide a thorough analysis of police strip searches, noting that they have become a pretext for sexual assault, abuse of prosecutorial power, and other violations of individual rights [4]. The authors argue that this practice has become normalized and routine, leading to a failure to recognize the violation of these rights and dignity inherent in these searches. They argue that the Toronto police have faced criticism for their

handling of strip search complaints, including a lack of transparency and accountability; these weaknesses have contributed to public mistrust of law enforcement.

Kirkup argued that the use of strip searches conflicts with principles of Canadian law, which recognizes and protects an individual's right to physical integrity and privacy [5]. Also, the use of strip searches is contrary to Canada's principles of law and violates an individual's right to physical integrity and privacy. Kirkup noted that the use of strip searches on transgender people has been criticized for failing to recognize the complexities of gender identity and for its impact on already marginalized communities. In addition, Kirkup pointed to an imperfect legal framework surrounding strip searches, leading to confusion about the legality of these searches and a lack of accountability for officials involved in these practices.

Toronto police research on the topic of arrests and strip searches highlights issues of gender, racial violence, sexual assault, prosecutorial power and the use of strip searches [3]. Evidence shows that these searches can lead to violations of individual rights and dignity and that an imperfect legal framework surrounding them confuses people about their legality. In addition, officials who carry out these practices are not held accountable for their actions. Toronto police must take steps to address these issues by increasing transparency about their policies and practices and providing training on the proper use of strip searches as well as recognizing their impacts on marginalized communities.

Research objective and questions

We aim to investigate the potential differences in the number of strip searches conducted by the Toronto Police based on different types of demographic factors and the various circumstances of arrest in three research questions in three research questions. Our whole research will mainly focus on the top 5 crime occurrence categories including “Assault”, “Assault & Other crimes against persons”, “Robbery & Theft”, “Warrant” and “FTA/FTC/Compliance Check/Parollee”. There are 31 types of occurrence categories in total and we believe the top 5 of them have higher representation because some of the small categories could have a higher bias which impacts our result. We will analyze perceived race, gender & age, and action taken at arrest separately to identify the relationship with the number of strips. For the race, we will focus on only “White” and “Black” because they are the major groups which have the highest population in our research compared with other races. Through this study, we hope to outline any potential bias or discrimination in Toronto Police's strip search practices and try to identify any discrepancies and understand the underlying reasons behind them. We believe the research questions below can help us get insights into the dataset from different perspectives.

Research Question 1:

- How does the number of strip searches conducted by the Toronto Police based on different perceived races of “White” and “Black”?

Research Question 2:

- How does the number of strip searches conducted by the Toronto Police vary by gender and age group of suspects?

Research Question 3:

- How does the type of action taken at arrest, such as resistance or compliance, affect the number of strip searches conducted?

Dataset Description

The "Arrests and Strip Searches" dataset includes 24 attributes and a total of 65,276 records that provide information on all strip arrests and searches conducted by Toronto Police. This dataset contains information about each arrest, including the year between 2021 and 2022 and the month recorded quarterly in which it occurred, as well as the unique identifiers of the persons arrested and/or searched. The dataset also includes information about the person's race in eight different types such as White and Black; gender including male, female and unknown; age group at the time of arrest as well as whether they were under 18 years old at that time. The arrest locations are provided for each subdivision, indicating where arrests occurred within those boundaries. Some subdivisions could not be geo-coded or the arrest took place outside of the City of Toronto boundaries marked as XX.

Additionally, The dataset contains information on whether a strip search was performed, whether the person was booked to police within 24 hours of arrest, and 31 types of occurrence categories associated with the arrest including robbery & theft, assault and sexually related crime etc. The dataset also contains attributes related to actions taken at the time of arrest, including whether the person had concealed objects, was belligerent or violent, resisted arrest, was mentally unstable or potentially suicidal, assaulted police, or cooperated. Information on reasons

for searches including whether searches were to inflict harm, facilitate escape, find weapons or seek evidence are also contained in the dataset. Lastly, it contains information about any items found during searches.

Descriptive statistics

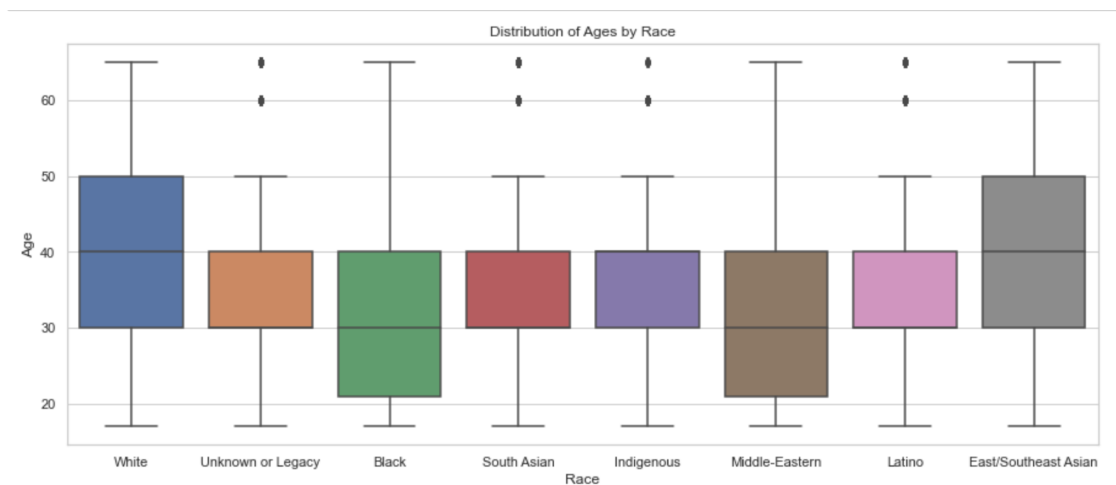


Figure 1, Distribution of ages by perceived race

The boxplot in figure 1 shows the distribution of ages at arrest for different races/ethnicities. We can see that the median age for each race/ethnicity falls between the 25th and 75th percentile range, indicating a relatively symmetrical distribution. However, we can see some variation in the age distributions across different races/ethnicities. For example, the median age for Black individuals at arrest appears to be slightly younger than that for Hispanic and

White individuals. Additionally, the interquartile range (IQR) for Black individuals appears to be slightly wider than that for other races/ethnicities. Overall, the plot suggests that there may be some differences in the ages at which individuals from different races/ethnicities are arrested.

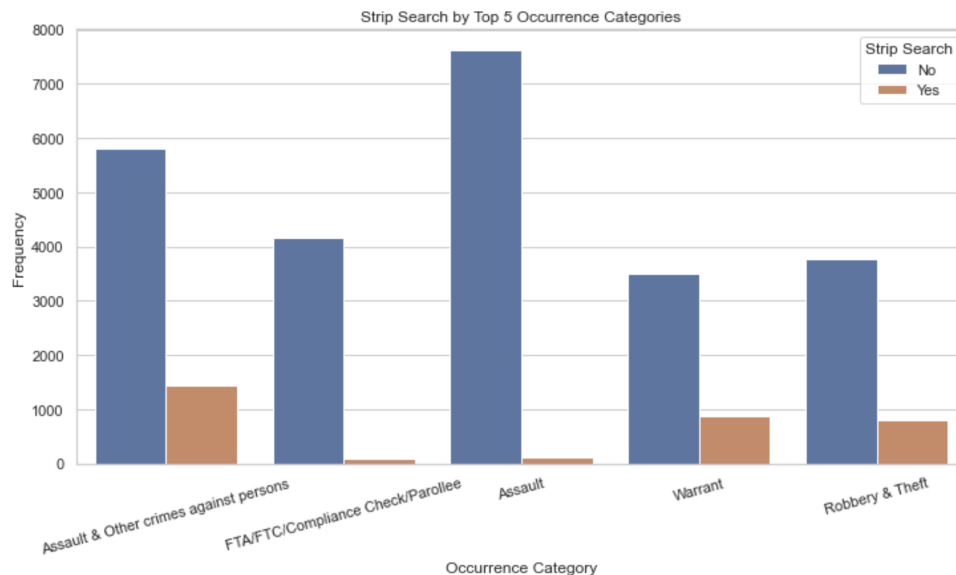


Figure 2, Frequency of conducting strip search based on top 5 crime occurrence categories.

The count plot presents the frequency of strip searches by the top 5 occurrence categories. Clearly, "Assault and Other Crimes Against a Person" has the highest number of strip searches, followed by "Weapons Offenses," "Drug and Narcotic Offenses," "Disorderly Conduct," and "Larceny/Theft Offenses." This suggests that individuals arrested for crimes related to violence, weapons, and drugs are more likely to be subjected to strip searches. In addition, we can see that the majority of occurrences in each category did not result in a strip search, as the bar for "No" is higher than the bar for "Yes" in each category. This could indicate

that strip searches are not performed in every arrest within these categories and are reserved for certain situations or individuals.

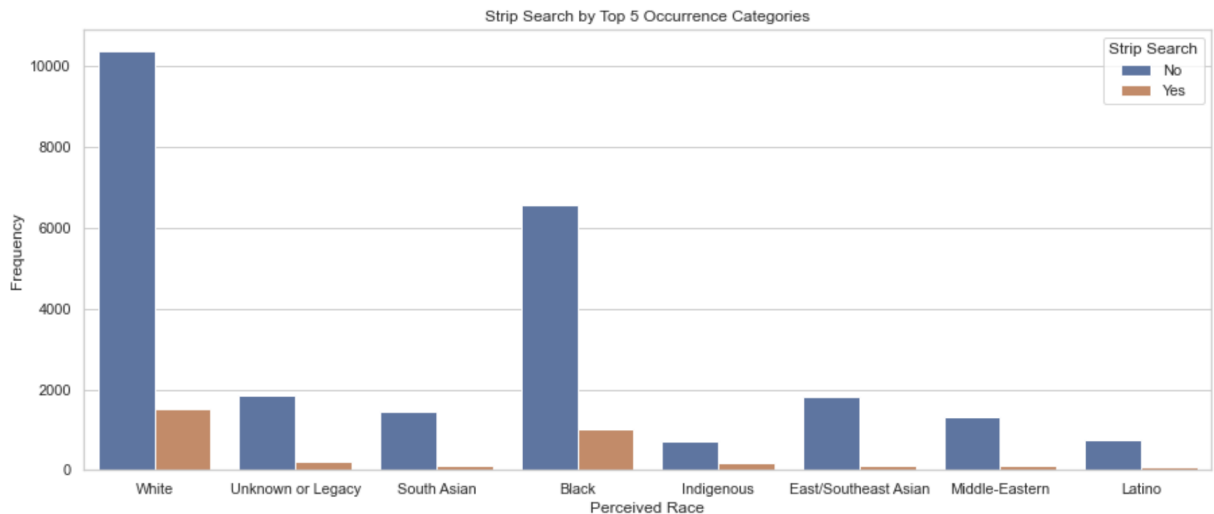


Figure 3, Frequency of conducting strip search based on perceived race

Based on the frequency of conducting strip searches based on perceived race, it appears that white individuals have the highest frequency of being searched, followed by black individuals. However, when we consider the proportion of individuals who are searched within each racial group, it is clear that black individuals have a higher proportion of being strip searched. This is definitely a concerning finding as it suggests that race may be playing a role in the decision to conduct strip searches.

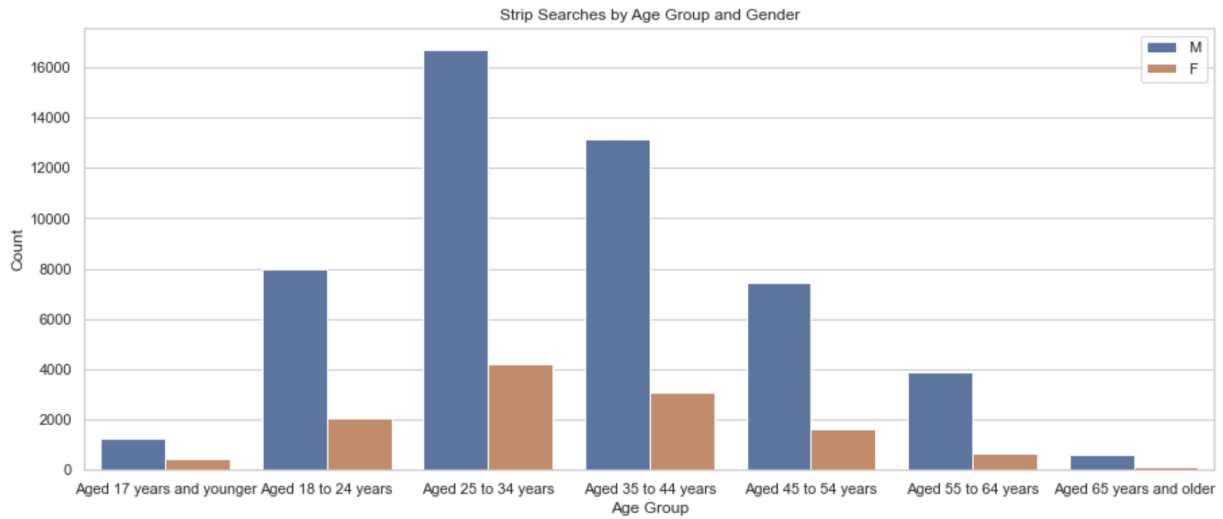


Figure 4, Frequency of conducting strip search based on age group at arrest and gender.

Figure 4 shows the distribution of strip searches by age group and gender. The plot indicates that males tend to have a higher frequency of strip searches than females in every age group from 17 years and younger to 65 years and older. The highest frequency of strip searches occurs in the 25-34 age group for both males and females, followed by the 35-44 age group. Additionally, the plot shows that the frequency of strip searches decreases as the age group increases for both males and females.

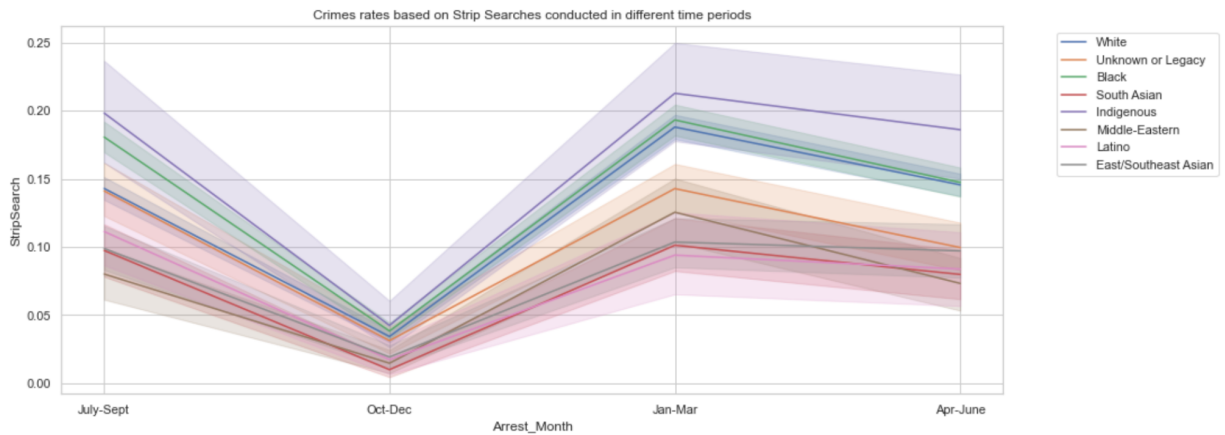


Figure 5, crime rate trends based on strip searches conducted in different months.

The line graph shows the trend of crime rates throughout the year based on strip searches conducted in different time periods by perceived race. The plot indicates that the crime rates for all races follow a similar trend, with a peak in the summer months and a decrease in the winter months. However, the plot also shows that there are disparities in the frequency of strip searches conducted on different races throughout the year. For example, the plot indicates that strip searches on Indigenous individuals occur at a higher frequency throughout the year compared to other races. Additionally, the plot shows that there is a significant spike in strip searches for Indigenous individuals during the summer months, while other races do not experience the same spike. Overall, the plot suggests that there may be racial bias in the frequency of strip searches conducted throughout the year.

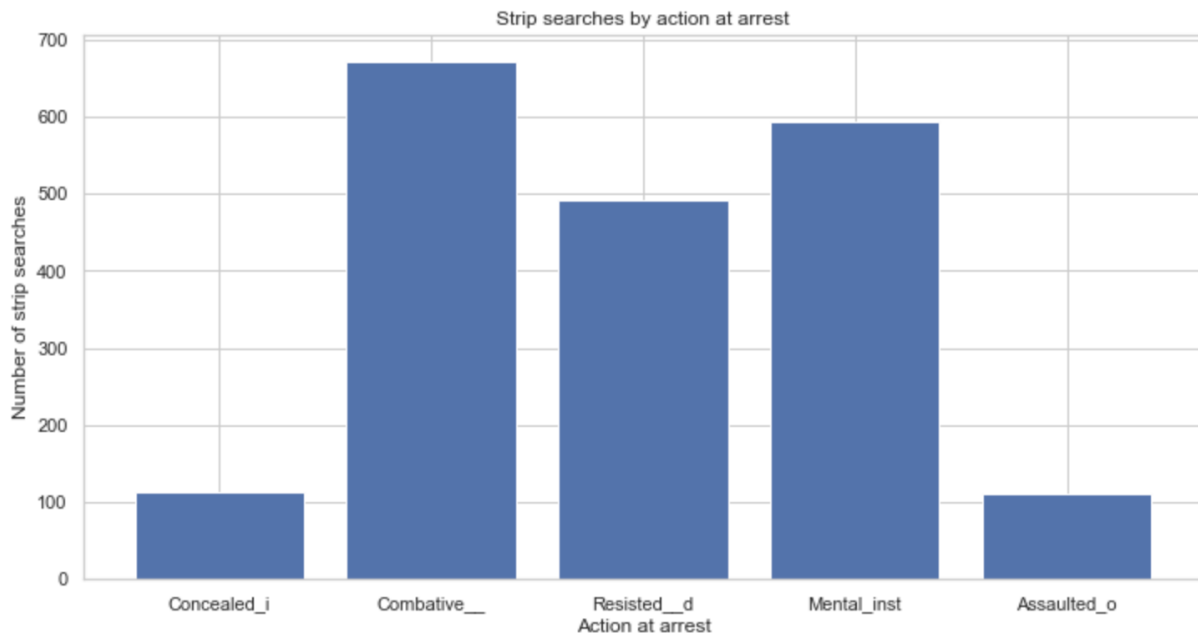


Figure 6, the number of strip searches conducted based on different actions of the arrest.

The bar plot shows the number of strip searches conducted for different actions at the time of the arrest. The plot indicates that the most common action that led to strip searches was being “Cooperative”, occurring more than five times higher than the action “Combative” ranking second. This is an important observation and suggests that even individuals who are compliant and cooperative during the time of arrest are not exempt from being subjected to strip searches. It may indicate a broader issue with the use of strip searches as a routine procedure rather than a measure taken only when necessary. The fact that cooperative individuals are still subjected to strip searches at a higher frequency compared to those who conceal items or are combative raises questions about the appropriateness and necessity of these searches. It is important to note that

the data presented in this plot does not provide information about the circumstances that led to the strip searches and whether they were conducted in a lawful and non-discriminatory manner.

Interaction plot

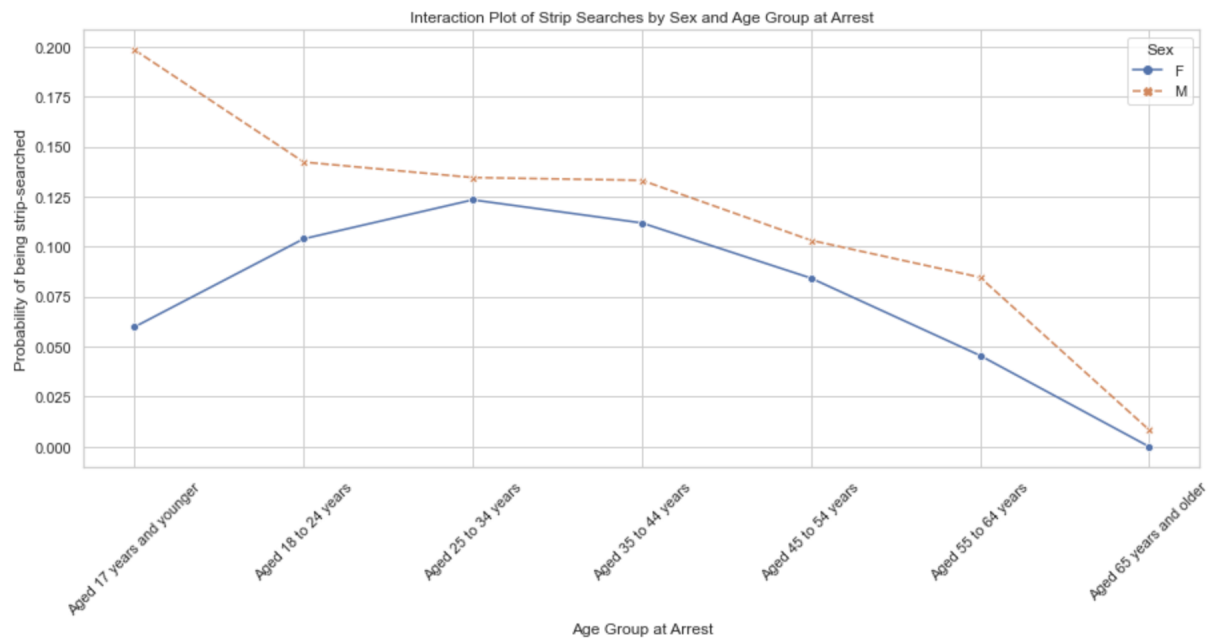


Figure 7, interaction plot of strip searches by sex and age group at arrest.

The interaction plot shows the relationship between strip searches, sex, and age group at the time of the arrest. Interestingly, the only intersections for male and female throughout the entire graph were in the “17 years and under” age group. The plot indicates that there is a significant interaction between sex and age group, where males in the younger age groups (18-24 and 25-34) have a higher mean number of strip searches compared to females in the same age groups. However, as the age group increases, the difference in the mean number of strip searches

between males and females decreases, and the frequency of strip searches decrease overall. Overall, the interaction plot suggests that sex and age group have a significant impact on the frequency of strip searches conducted at the time of arrest, with younger males being more likely to be subjected to strip searches.

T-test Interpretation:

Based on our findings from descriptive statistics and EDA, we came up with 5 t-tests to compare the means of different variables:

1. Using t-test to compare the mean of age if they were strip searched

Comparing the mean age of individuals who were strip-searched versus those who were not, we conducted a t-test and found a p-value of 4.99×10^{-20} . This value is very small and much lower than the significance level of 0.05. Hence, we can conclude that there is a significant difference in the mean age between the two groups.

2. Using t-test to compare the mean of age if they had actions at arrest

Similarly, we combined all types of actions at arrest into one variable and conducted a t-test to compare the mean age for individuals who were subject to actions at arrest versus those who were not. The t-test result revealed a p-value of 3.98×10^{-5} , indicating a significant difference in age between the two groups.

3. Using t-test to compare the mean of age committing a crime if they are male or female

Furthermore, we conducted a t-test to compare the mean age of males and females who have been arrested. The p-value result was 1.98×10^{-33} , which provides sufficient evidence to reject the null hypothesis and conclude that there is a statistically significant difference in the mean age of males and females who have been arrested.

4. Using t-test to compare the mean of age in if they were booked

To compare the mean age of individuals who were booked (i.e., arrested) versus those who were not booked (i.e., not arrested), we conducted a t-test. The output revealed a p-value of 0.000398, which is much lower than the significance level of 0.05. Hence, we can conclude that there is a statistically significant difference in the mean age between those who were booked and those who were not.

5. Using t-test to compare the mean of age in different year

Lastly, another t-test was conducted to compare the mean age of individuals arrested in the years 2020 and the year 2021. The p-value was 1.61×10^{-17} , which is less than 0.05. Therefore, we can conclude that there is a statistically significant difference in mean age between the two groups.

Methods

ANOVA (Analysis of Variance) and t-tests are both statistical methods used to compare means between two or more groups. ANOVA is used when we have more than two groups to compare, while t-tests are used when we have only two groups. Through the use of ANOVA and t-tests in this dataset, we can determine if the mean number of strip searches conducted by the Toronto Police is significantly different across different groups. This will help us answer our three research questions and test our hypotheses under the research questions, allowing us to draw conclusions about whether there are any significant differences in the number of strip searches conducted by the Toronto Police across different groups based on race, sex/age group, occurrence category, and action taken at arrest.

However, in order to conduct hypothesis testing, we would have to state the null hypothesis (H_0) and the alternative hypothesis (H_A). The null hypothesis represents the status quo, that there is no significant difference between groups or variables. The alternative hypothesis represents what we are trying to show, which is that there is a statistically significant difference between groups or variables. The corresponding null hypothesis and alternative hypothesis for each research question are stated below :

Research Question 1

- Null hypothesis: There is no significant difference in the number of strip searches conducted by the Toronto Police based on the perceived race of "White" and "Black."

- Alternate hypothesis: The number of strip searches conducted by the Toronto Police based on the perceived race of "White" and "Black" is significantly different.

Research Question 2

- Null hypothesis: The mean number of strip searches conducted by the Toronto Police is the same across all gender and age groups of suspects.
- Alternate hypothesis: The mean number of strip searches conducted by the Toronto Police varies across at least one gender or age group of suspects.

Research Question 3

- Null hypothesis: The type of action taken at arrest does not affect the number of strip searches conducted by the Toronto Police.
- Alternate hypothesis: The number of strip searches conducted by the Toronto Police varies according to the type of action taken at arrest.

The dataset used in this study was cleaned by selecting only the relevant variables for the hypothesis test, which are Perceived_Race and StripSearch. A subset of the data was selected for the present analysis, and only those cases where the perceived race of the driver was either 'White' or 'Black' were included in the analysis. This was done by filtering the data based on the 'Perceived_Race' variable using the 'isin' method.

The primary analysis was conducted to investigate whether there was a difference in the proportion of strip searches conducted on drivers of different perceived races. An analysis of

variance (ANOVA) was conducted between 'White' and 'Black' races using the 'f_oneway' function from the 'scipy.stats' module. Following the ANOVA, mean strip search proportions were calculated for each race using the 'np.mean' method, and standard deviations were calculated using the 'np.std' method. The sample sizes for each group were also calculated using the 'len' function. Additionally, the confidence intervals for the means of each group were calculated at a 95% confidence level using the 't.interval' method from the 'scipy.stats' module. To further examine group differences, a Tukey's Honest Significant Difference (HSD) test was conducted. This test allows for pairwise comparisons between groups to determine which groups differ significantly from each other. The results were reported by printing them to the console. The ANOVA results, means, and confidence intervals were printed separately with appropriate labels. Specifically, the ANOVA for strip search between White and Black is reported with the F and p values, the mean strip search proportion for White and Black were reported along with their respective 95% confidence intervals, and Tukey's HSD results were reported using the pairwise_tukeyhsd function, which provides a table of the mean differences between groups along with their corresponding confidence intervals and p-values.

The method for research question number two followed similar procedures to research question one, but used two-way ANOVA. The first step is to filter the relevant columns, which include age, gender, and strip search. Then, missing values are dropped from the dataset. A two-way ANOVA is then performed on the subset of data using the 'ols' function from the 'statsmodels' package. The ANOVA is conducted to determine if there is a significant interaction between age and gender on the likelihood of a strip search being performed. The 'C' function is

used to indicate that the variables are categorical. The results of the ANOVA are saved in a variable called 'table'. Right after the ANOVA, the results are printed using the 'print' function. The 'table' variable, which contains the results of the ANOVA, is printed to show the F-statistic, degrees of freedom, and p-value for each factor as well as the interaction term. The `typ=2` argument is used to specify that a Type II sum of squares is used in the ANOVA. Furthermore, the means and confidence intervals (CI) are calculated for the strip search variable, grouped by gender and age. The means and CI are calculated using the 'groupby' function and the 'mean' and 'apply' methods. The 'stats.t.interval' function from the 'scipy' package is used to calculate the 95% CI. The means and CI are printed to the console using the 'print' function.

Finally for the last research question, excluding the cooperative action at arrest, we combined all other types of actions at arrest into a single variable, named "Actions_at_arrest". This is done by performing a bitwise OR operation on five different columns of the original dataframe, each column corresponding to a specific type of action that may occur during an arrest. The resulting "Actions_at_arrest" variable and "StripSearch" variable are then selected from the dataframe to create a new subset. Any missing values in this subset are removed using the `dropna()` function. In addition, an analysis of variance (ANOVA) is performed on the subset to investigate the relationship between actions at arrest and strip searches. Specifically, the F-statistic and p-value are computed using the `f_oneway()` function. Following this, the means and confidence intervals (CI) for strip searches are calculated for each category of actions at arrest using the `groupby()` function. The `tconfint_mean()` function from the `DescrStatsW` class is used to compute the confidence intervals. The results of the ANOVA and the means and CIs are

printed to the console. The output includes the F-statistic and p-value for the ANOVA, the means for each category of actions at arrest, and the lower and upper bounds of the confidence intervals.

Results & Findings

The ANOVA analysis conducted for Research Question 1 examines whether there is a difference in the mean number of strip searches conducted on White and Black individuals in the dataset. The analysis shows that there is no statistically significant difference between the two groups ($F = 2.553$, $p = 0.110$), indicating that any observed difference in strip search rates is likely due to chance. In addition to the significance test, the analysis also reports the mean strip search rates, standard deviation, and 95% confidence intervals for each group. The mean strip search rates for White and Black individuals are 0.129 and 0.137, respectively, and the 95% confidence intervals suggest that the true population mean for strip search rates for both groups fall within a relatively narrow range. Therefore, we can conclude that there is no meaningful difference in strip search rates between White and Black individuals in the dataset.

For Research Question 2, the ANOVA table reports the results of a hypothesis test to determine whether the mean number of strip searches conducted by the Toronto Police varies across different age and gender groups of suspects. The table shows that the p-values for both the main effects of age group and gender are very small ($p < 0.001$), indicating strong evidence that the mean number of strip searches varies across these groups. The p-value for the interaction effect between age group and gender is also very small ($p < 0.001$), indicating that the effect of

age group on the mean number of strip searches depends on the gender of the suspect. The means and confidence intervals for each combination of gender and age group reveal that there are indeed differences in the mean number of strip searches across these groups. However, there are some missing values and warnings suggesting that some groups have very few observations, which could impact the reliability of the estimates and limit the scope of the analysis.

Finally, the results of Research Question 3 show that there is a significant difference in the number of strip searches conducted by the Toronto Police based on the type of action taken at arrest. The ANOVA analysis yields a large F-statistic of 44.93 and a very low p-value of 2.06×10^{-11} , indicating strong evidence against the null hypothesis and suggesting that there is a meaningful difference in strip search rates based on the type of action taken at arrest. The mean proportion of strip searches for individuals who have taken some action at the time of arrest is much higher (0.26) than for those who did not (0.10). The 95% confidence interval further supports this finding and suggests that the true difference in proportions between the two groups lies within a relatively narrow range.

Conclusion

The results of our ANOVA models have given us a better understanding of our research questions: “How does the number of strip searches conducted by the Toronto Police based on different perceived races of “White” and “Black”?”; “How does the number of strip searches conducted by the Toronto Police vary by gender and age group of suspects?”; “How does the type of action taken at arrest, such as resistance or compliance, affect the number of strip

searches conducted?”. In our literature review, some people arise questions about the unfair treatment between the race of “White” and “Black” by the police such as the police trend to attempt strip searches. However, we do not find any significant difference between them in our first research question.

On another hand, we find the numbers of strip searches conducted by Toronto Police are significant differences between different gender and age groups as well as people with actions taken at arrest. It confirms the finding in the literature review from the other side. People of different gender and age groups are treated unfairly in conducting strip searches. Furthermore, Toronto Police tend to conduct strip searches on people who have actions at arrest. Answering our research questions provide us with some evidence of the concerns about the unfair use of strip searches by Toronto Police officers.

Discussion

Throughout this study, we use ANOVA and t-tests to examine the significance of differences between groups in the number of strip searches conducted by the Toronto Police. The significant difference among different groups we found might be due to the population's differences which we did not consider in our study. Also, we only focus on the top 5 crime occurrence categories to avoid some bias, however, it could also lead to other biases. Furthermore, we did not examine deeper for the reasons strip searches happened which may lead to misunderstanding of the factors that contribute to the significant differences observed among

different groups in our study. For example, the use of body-worn cameras might affect the biased strip searches in which we do not have the data collected. Thus, It is difficult to identify the root causes without further investigation. The lack of comprehensive data and limited analysis methods is the biggest limitation of this study which give us a relatively limited understanding of the bias of the strip searches conducted by the Toronto Police.

One potential way to do a further investigation is to consider the demographic data of the people who were subjected to strip searches. In addition, the arrest location division in the dataset that we did not analyze, since it requires a different analysis such as geographic analysis, would provide a more comprehensive understanding of the issue. Despite the limitations mentioned above, our study still provides valuable insights into potential discrepancies in strip search practices among different groups. The findings we found suggest that strip searches need to be conducted with greater attention and oversight. One potential solution is to implement training programs that educate police officers on the negative effects of biased policing and provide them with tools to recognize and mitigate their own biases.

Reference

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