

# 2178 Midterm Project

Group 14

Youwen Xu (1006675493)

Jiayi Li (1005191374)

Faculty of Information

University of Toronto

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Prof. Shion Guha

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## **Introduction**

### **1.1 Background and Literature Review**

Strip searches and arrests are considered part of the police investigation and enforcement process. Also, this is required to be conducted only by specialized law enforcement agencies and officers. A strip search is defined as a visual inspection of an individual's entire body by police officers, and the investigation includes the removal of clothing (Toronto Police Service, 2022). The reasons for conducting strip searches and making arrests can vary depending on the specific circumstances of the area. One investigation (Derek Willis, 2020) indicated that approximately 4,000 officers in the New York City Police Department had misconduct charges. There is also a report (Barrison Law, 2021) that discussed illegal strip searches by police officers in Ontario, which would involve an invasion of privacy and have a negative impact on society.

Furthermore, a report (McNeilly, 2019) on police strip searches in Ontario mentions that there are approximately 22,000 strip searches per year, with the Toronto Police Service accounting for the majority. This report indicates that over 40% of arrests in Toronto have involved a strip search. In comparison to the other regions of Ontario, Toronto's strip search rate was also 40 times higher during 2014-2015. In this report, the importance of conducting strip searches legally is explored, along with recommendations on how to enhance the search process. Considering the case-specific and complex nature of strip searches and arrests, we will explore how influences arising from different states in police investigations predict the occurrence of strip searches and bookings. Finally, we hypothesize that analyzing the state of the person being arrested at the moment can help government departments improve the search process and reduce the potential negative impact on society. For this project, we will use a dataset from the Toronto Police Service about strip searches and arrests.

### **1.2 Research Objective and Questions**

Based on the above literature, our study will investigate how sex, race, arrested status, and booked are interrelated with strip searches. In the EDA (Exploratory data analysis) section, the descriptive statistics and t-tests will explain in detail. Through the background research and the information provided by the dataset, we have formed two research questions.

1. How are the demographic attributes of arrestees (such as race and sex) distributed?  
Do these attributes influence the strip searches of arrestees?

2. How does action at arrest affect whether the arrestee will be booked? (This includes situations where the person may not be strip searched).

Since these different factors may influence whether a person is strip-searched or only booked at the time of the arrest, we believe these questions allow for a more in-depth study of the dataset and analysis of valuable insights.

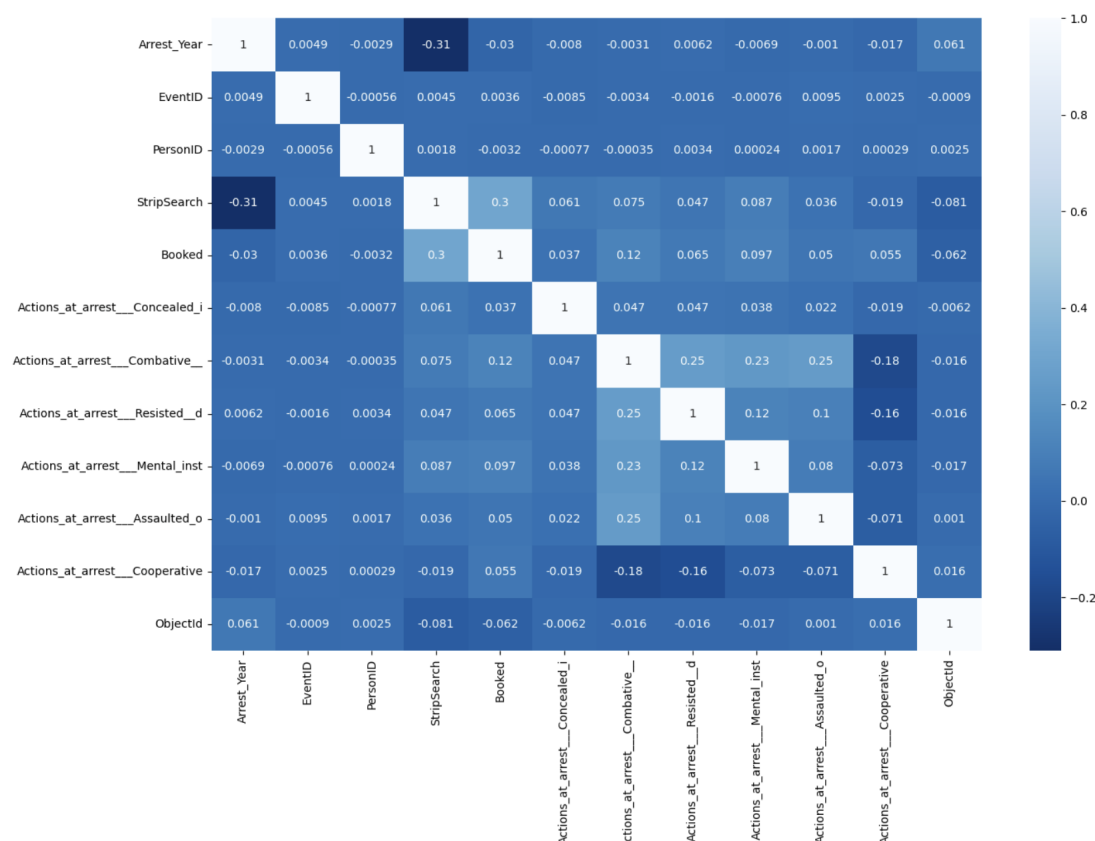
## EDA ( Exploratory data analysis )

### 2.1 Descriptive statistics

First of all, it is necessary to have a basic understanding of the dataset provided by the Toronto Police Service. We conducted a correlation plot to illustrate the correlation between every two variables.

The value of the correlation coefficient is represented by the shade of the color. A darker color indicates a stronger correlation, while a lighter color indicates a weaker correlation. Therefore, as shown in Figure 1, there is a relatively high correlation with the variables that are compared to strip search and booked.

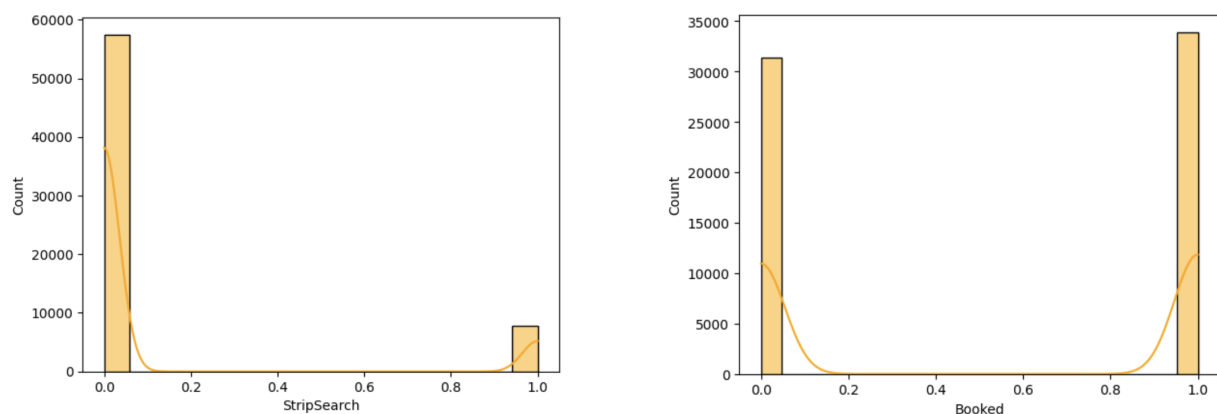
Figure 1. Correlation of Each Variable



Then, in order to explore variables with strong correlations, we plotted the histogram of strip-search and booked respectively to see their distribution (see Figure 2).

For the strip search, we can see that the tail of this distribution is longer on the right, and the left side of the distribution contains most of the data. Thus, the distribution is skewed to the right (positively skewed). This means that, there were relatively more data that were not strip searched (0 = 'No'). For the Booked, the data show that the number of booked (1 = 'Yes') is slightly higher than the number of unbooked (0 = 'No').

Figure 2: The Histogram of Strip-Search and The Histogram of Booked



Furthermore, we also created a graph on the race categories to get an insight into the background composition of the arrestees and the proportion of distribution of different races.

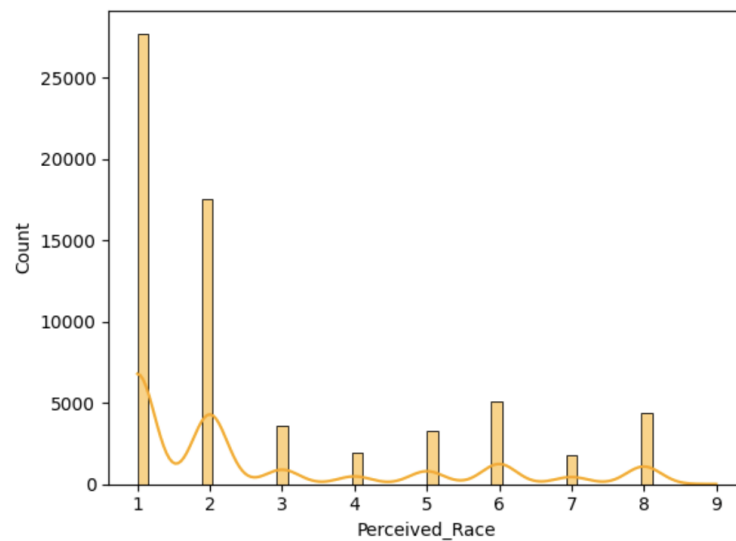
In Table 1, we can see the categories corresponding to all races. And Figure 3 shows that the highest number of races is white, with approximately 28,000, and the second highest is black, with an estimated 17,500. The relatively low number of races is Indigenous and Latino.

Table 1. Race Categories

Race	Categories
White	1
Black	2
South Asian	3
Indigenous	4
Middle-Eastern	5
Unknown or Legacy	6
Latino	7
East/Southeast Asian	8
Unknown	9

*Source:* Arrests and Strip Searches Dataset From Toronto Police Service.

Figure 3: The Histogram of Perceived Race



In the end, we also conducted a descriptive analysis of the sample size, mean, and standard deviation of some attributes in the dataset.

As shown in Table 2, the sample size of the data is 6,5276, except for race which is 65272. Here it may be due to the unknown status of some races. In addition, the mean and standard

deviation are not standardized. Therefore, it indicates that this dataset can provide statistically significant information.

Table 2. Descriptive Statistics

Variables	N	Mean	SD
Sex	6,5276	1.1936	0.3954
Race	6,5272	2.6902	2.2188
Actions at arrest (Concealed)	6,5276	0.0041	0.0637
Actions at arrest (Combative)	6,5276	0.0441	0.2054
Actions at arrest (Resisted)	6,5276	0.0383	0.1920
Actions at arrest (Mental)	6,5276	0.0334	0.1796
Booked	6,5276	0.5195	0.4996
Strip Search	6,5276	0.1195	0.3244

*Source:* Arrests and Strip Searches Dataset From Toronto Police Service.

## 2.2 T-Test

The t-test is useful to confirm whether there has a significant difference between the two groups and to analyze the relationship between the data as well as to reach a conclusion. If the p-value is less than 0.05, which indicates that there has a statistically significant difference between the two groups.

### *Sex and Strip Search*

The data set showed that the number of males was higher than females in the strip search. We conducted a t-test to analyze whether the strip searches differed by sex. The hypotheses are the following:

$H_0$  (Null Hypothesis) =  $\mu_0$  (The means of the two groups, by sex, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, by sex, are not equal)

The results we obtained show that the p-value is around 6.104e-12. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.

### ***Race and Strip Search***

The data set showed that the number of white was higher than black in the strip search. We conducted a t-test to analyze whether the strip searches differed by race. The hypotheses are the following:

$H_0$  (Null Hypothesis) =  $\mu_0$  (The means of the two groups, by race, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, by race, are not equal)

The results we obtained show that the p-value is about 0.00174. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.

### ***Action at arrest (Concealed) and Booked***

Like the above test, we conducted a t-test to analyze whether the circumstances of being booked differed based on actions that were concealed at the time of the arrest. The hypotheses are the following:

$H_0$  (Null Hypothesis) =  $\mu_0$  (The means of the two groups, concealed or not at the time of arrest, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, concealed or not at the time of arrest, are not equal)

The results we obtained show that the p-value is about 3.426e-21. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.

### ***Actions at arrest (Combative) and Booked***

Like the above test, we conducted a t-test to analyze whether the circumstances of being booked differed based on actions that were combative at the time of the arrest. The hypotheses are the following:

$H_0$  (Null Hypothesis) =  $\mu_0$  (The means of the two groups, combative or not at the time of arrest, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, combative or not at the time of arrest, are not equal)

The results we obtained show that the p-value is about 1.850e-193. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.

#### ***Actions at arrest (Resisted) and Booked***

Like the above test, we conducted a t-test to analyze whether the circumstances of being booked differed based on actions that were resisted at the time of the arrest. The hypotheses are the following:

$H_0$  (Null Hypothesis)  $= \mu_0$  (The means of the two groups, resisted or not at the time of arrest, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, resisted or not at the time of arrest, are not equal)

The results we obtained show that the p-value is about 3.099e-61. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.

#### ***Actions at arrest (Mental) and Booked***

Like the above test, we conducted a t-test to analyze whether the circumstances of being booked differed based on actions that were mental at the time of the arrest. The hypotheses are the following:

$H_0$  (Null Hypothesis)  $= \mu_0$  (The means of the two groups, mental or not at the time of arrest, are equal).

$H_A$  (Alternative Hypothesis)  $\neq \mu_0$  (The means of the two groups, mental or not at the time of arrest, are not equal)

The results we obtained show that the p-value is about 4.274e-136. And we set the alpha at 0.05. Since the p-value is less than 0.05, there is a statistically significant difference. Thus, the null hypothesis can reject.



## Method

### 3.1 Dataset description

The dataset is borrowed from the Toronto Police Service. This dataset presents all relevant information about arrests and strip searches, such as the demographics of the person arrested, occurrence category, actions at arrest, and the reason for the search.

This dataset was released on November 10, 2022, and contains a total of 65,276 records.

The dataset can be found at the following link:

<https://data.torontopolice.on.ca/datasets/TorontoPS::arrests-and-strip-searches-rbdc-arr-tbl-001/about>. (Toronto Police Service, 2022). It is important to note that in this dataset, booked is

defined as whether or not the person was booked at the police station within 24 hours of the arrest. And if there is a record of a strip search, it will also be a registered event by default.

This dataset allows for an analysis of which specific situations are more likely to result in a strip search or arrest by exploring different types of arrests.

There are many attributes included in the dataset, but we primarily want to examine the relationship between variables of sex, race, actions at arrest, strip search, and booked.

### 3.2 ANOVA Test

To determine whether the difference between the means of the strip search and the demographics of the arrestees (sex and race) is considered statistically significant, we will use the Anova Test.

As seen in Table 3, the p-value equals  $4.258e-12$ , and the F-statistic equals 7.529. Since p is less than  $\alpha = 0.05$ , it can be shown that there is enough evidence to reject the null hypothesis of Anova. It also follows that there is a statistically significant difference between the demographics of the arrestees and the means of the two groups of strip searches. On the other hand, since the F-statistic is a large number, which demonstrates that the differences between the means of the groups are equally statistically significant.

Table 3. The ANOVA Table ( Strip search as outcome variable)

	Df	Sum sq	F value	Pr(>F)
Sex: Race	16	12.577	7.529	4.258e-12***
Residuals	65255	6813.260	-	-

*Source:* Arrests and Strip Searches Dataset From Toronto Police Service.

\*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ .

As seen in Table 4, for actions at arrest are concealed and combative, the p-value equals 3.329e-03, and the F-statistic equals 8.619. Since p is less than  $\alpha = 0.05$ , it can be shown that there is enough evidence to reject the null hypothesis of Anova. It also follows that there is a statistically significant difference between the actions at arrest and the means of the two groups of booked. On the other hand, since the F-statistic is a large number, which demonstrates that the differences between the means of the groups are equally statistically significant.

In addition, for actions at arrest are Resisted and Mental, the p-value equals 5.340e-06, and the F-statistic equals 20.694. Since p is less than  $\alpha = 0.05$ , it can be shown that there is enough evidence to reject the null hypothesis of Anova. It also follows that there is a statistically significant difference between the actions at arrest and the means of the two groups of booked. On the other hand, since the F-statistic is a large number, which demonstrates that the differences between the means of the groups are equally statistically significant.

Table 4. The ANOVA Table (Booked as outcome variable)

	Df	Sum sq	F value	Pr(>F)
Concealed : Combative	1	0.899	8.619	3.329e-03***
Residuals	65272	6806.149	-	-
Resisted : Mental	1	2.157	20.694	5.340e-06***
Residuals	65272	6804.347	-	-

*Source:* Arrests and Strip Searches Dataset From Toronto Police Service.

\*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ .

### 3.3 Post-hoc tests (Tukey's HSD)

Tukey's HSD is useful for comparing means between several groups and can be used to determine whether the differences between each group are statistically significant.

As shown in Table 5, while booked as the dependent variable, all other independent variables are indicated the null hypothesis are being rejected. (The differences between the different groups were statistically significant)

Table 5. The Tukey HSD Table ( Booked as dependent variable )

	Concealed	Combative	Resisted	Mental
Reject	True	True	True	True

*Source:* Arrests and Strip Searches Dataset From Toronto Police Service.

#### *Concealed*

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj lower upper reject
-----
      0      1      0.29   0.0 0.2298 0.3501   True
-----
```

#### *Combative*

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj lower upper reject
-----
      0      1   0.2815   0.0 0.263 0.3001   True
-----
```

#### *Resisted*

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj lower upper reject
-----
      0      1   0.168   0.0 0.1481 0.1879   True
-----
```

#### *Mental*

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj lower upper reject
-----
      0      1   0.2697   0.0 0.2484 0.2909   True
-----
```

-----

As shown in Table 6, while strip search as the dependent variable, sex and some race (independent variables) groups are indicated the null hypothesis are rejected. (The differences between the different groups were statistically significant)

Note that some groups of race also indicated that the null hypothesis are not being rejected. (The differences between the different groups were not statistically significant)

Table 6. The Tukey HSD Table ( Strip search as dependent variable )

	Sex(1:2)	Race(1:9)	Race(2:4)	Race(2:9)	Race(3:5)	Race(3:7)	Race(3:8)	Race(3:9)
Reject	True	False	False	False	False	False	False	False

	Race(4:9)	Race(5:7)	Race(5:8)	Race(6:9)	Race(7:8)	Race(7:9)	Race(8:9)
Reject	False	False	False	False	False	False	False

Note: Other group of Race are all True.

Source: Arrests and Strip Searches Dataset From Toronto Police Service.

#### Sex

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj  lower  upper  reject
-----
      1      2  -0.0221   0.0 -0.0296 -0.0146   True
      1      3  -0.1238 0.4862 -0.3772  0.1296  False
      2      3  -0.1017 0.6147 -0.3551  0.1517  False
-----
```

#### Race

Multiple Comparison of Means - Tukey HSD, FWER=0.05

```
=====
group1 group2 meandiff p-adj  lower  upper  reject
-----
      1      2   0.0102 0.0285  0.0006  0.0199   True
      1      3  -0.0575   0.0 -0.0752 -0.0398   True
      1      4   0.0296 0.0032   0.006  0.0532   True
-----
```

1	5	-0.0582	0.0	-0.0768	-0.0396	True
1	6	-0.0226	0.0002	-0.038	-0.0073	True
1	7	-0.054	0.0	-0.0786	-0.0294	True
1	8	-0.0514	0.0	-0.0677	-0.0351	True
1	9	0.1214	0.998	-0.3803	0.6231	False
2	3	-0.0677	0.0	-0.0861	-0.0494	True
2	4	0.0193	0.2339	-0.0047	0.0434	False
2	5	-0.0684	0.0	-0.0876	-0.0493	True
2	6	-0.0329	0.0	-0.0489	-0.0169	True
2	7	-0.0642	0.0	-0.0893	-0.0392	True
...						
7	8	0.0026	1.0	-0.0257	0.0308	False
7	9	0.1753	0.9768	-0.3269	0.6776	False
8	9	0.1728	0.9787	-0.3291	0.6746	False

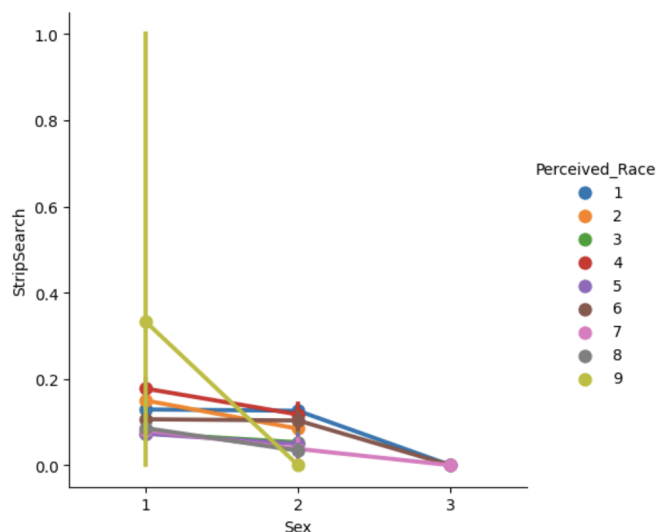
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## Result

### 4.1 Interaction plots

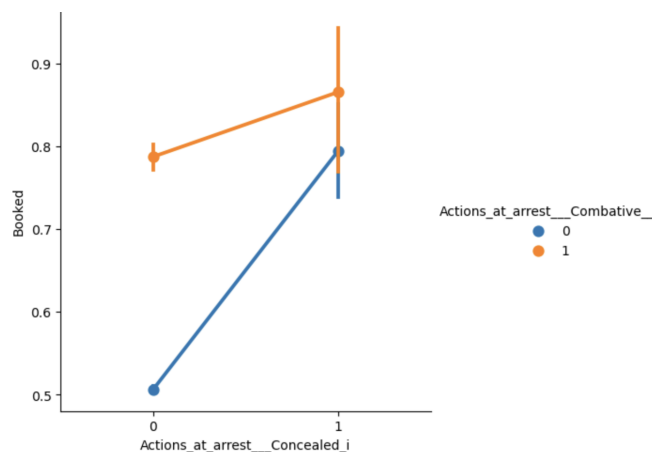
As shown in Figure 4, we can see how the relationship between the different variables changes. It is worth noting that the trend for all race variables is decreasing, which means that regardless of race, there are more males than females in terms of sex. This also includes a smaller fraction of unknown sexes. (1 = male, 2 = female, 3 = unknown on x-axis.) On the other hand, we found that except for the unknown race (9), the indigenous (4) and Black races had higher records of strip searches.

Figure 4: The Interaction Plot of Strip Search and Sex with Perceived Race.



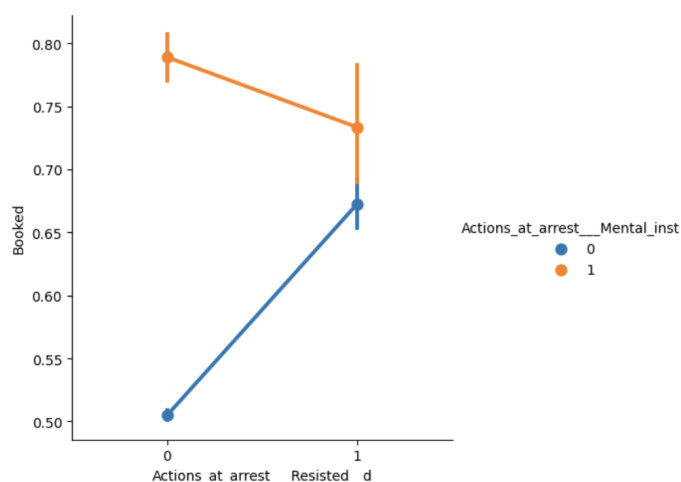
As shown in Figure 5, We found that when actions at the time of arrest were concealed, they usually also carried stronger combative actions. This indicates that the chance of being booked increases in this arrested condition. (0 = No, 1 = Yes)

Figure 5: The Interaction Plot of Booked and Actions at Arrest (Concealed) with Action at Arrest (Combative)



As shown in Figure 6, we found that arrests with mental issues had a high record of being booked. We also observed that when the action at the time of arrest was resisted, it also usually carried a high level of mental issue. This shows that in this case, the arrest is usually booked. (0 = No, 1 = Yes)

Figure 6: The Interaction Plot of Booked and Actions at Arrest (Resisted) with Action at Arrest (Mental)



## **Discussion and Conclusion**

Based on a dataset of strip searches and arrests provided by the Toronto Police Service (Toronto Police Service, 2022), we want to analyze the conditions under which strip searches and booked are more likely to occur. This will allow us to reach more accurate conclusions to help the community or government improve their policies and reduce the negative social impact of unnecessary searches that may occur. In our study, we explore the demographics (sex and race) of arrestees to determine whether they are likely to be strip searched. As well as by studying the actions taken at the time of the arrest to determine if they would be booked. However, some limitations may be present in the data set that may make our results slightly biased.

With the Anova Test and Tukey's HSD, we confirmed the selected variables were statistically significant among each other on the condition that they were analyzed to improve the accuracy of the results. The obtained analysis also demonstrated the existence of meaningful differences and relationships between the variables.

Based on these results, we expect to obtain the features and reasons for the population being strip searched and booked. Then make suggestions for improving the process. For instance, by analyzing the results, we suggest establishing specific search procedures for the racial groups that occur with high frequency, reducing the unfair treatment that may arise while also improving the accuracy of the searches. This is because responsible and ethical search procedures are the only way to minimize bias and unintended consequences.

### **5.1 Limitation**

Fristly, there are some information about race and sex that shown as unknown, which may result in building models that are not good enough for their degree.

Secondly, the records collected may lead to slightly biased results due to certain issues with the booked templates in the dataset.

### **5.2 Conclusion**

Strip searches and arrests have always happened every day in our society. The reasons for these arrests and the demographic characteristics of the people involved have also been the

focus of governmental and social attention. In this study, we applied a dataset provided by the Toronto Police Service, which included 6,5276 records, to analyze the influence of the demographics of arrestees on strip searches and actions on being booked at the time of arrest, respectively. Firstly, we performed an EDA on the data to obtain the distribution and correlation between the different variables in the dataset. After that, we performed t-tests, ANOVA tests, and Tukey's HSD. In this process, we show that there was a difference between each group's means. And confirm that they were statistically significant with each other. Lastly, the most intuitive relationships between the data were shown through interaction plots. We can conclude that more males than females are recorded as being strip searched. White, Black and Indigenous have the most significant proportion. When arrested action having a combative characteristic is most likely to be booked.



## Rerference

Arrests and strip searches (RBDC-arr-TBL-001). (2022, November 10). Retrieved February 25, 2023, from

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