INF2178 Final Group Project

Strip-Search and Number of Strip-Seached Times: Exploring the Role of Sex, Youth Status, and Actions at Arrested

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1. Introduction

Crime is a serious problem that threatens public safety, and it is important to take appropriate measures to ensure the safety of citizens. When people are arrested, the police may choose to strip-search them. They are required to take off all or most of their clothes so that the police can check if they are carrying any weapons, possessing any drugs, etc. The strip-searched rate of people arrested by the Toronto police was around 26% in 2000 and 22% in 2020(Lemke, 2022). This implies about 1 in 4 arrested people have been subjected to a strip-searched by the Toronto police. However, strip searches can be a controversial issue because of their potential to violate the privacy and dignity of individuals.

Prior research suggests that strip searches may cause racial and sexual trauma(Lemke, 2023). However, illegal strip searches do occur. In March 2023, CBC News reported on a class action lawsuit regarding strip search violations. The news noted, this class action lawsuit alleges hundreds of thousands of illegal strip searches by Canadian police officers over the past three decades(Fraser, 2023). Therefore, this report wanted to examine whether there was a relationship between strip searches and the demographic factors of the arrestees, or their actions at arrested. By conducting this study, we hope to provide insights of the relationships between demographic attributes and strip searches and to provide insights into the development of policies and practices related to arrests and strip searches.

2. Literature Review

The article, "*RACE, CRIME AND INJUSTICE? Strip Search and the Treatment of Suspects in Custody*", was published in 2004. This article analyzed the use of strip searches in Britain. They calculated the probability of being strip-searched by gender, race, and age groups based on the Kilburn police data. The author stated that about 7% of arrested females were strip-searched, and 12% of arrested males were strip-searched(Newburn et al., 2004). The strip-searched rate for males is higher than for females. In terms of age groups, the authors split the age group into '16 and younger', '17 to 23', '24 to 30, etc. From their analysis, the '17 to 23' age group has the highest rate of being strip-searched, which is 18%. On the other hand, the strip-searched rate for the '16 and younger' group is 7%. Therefore, in Newburn et al.'s analysis, the strip-searched probability is lower for '16 and younger' compared to the '17 to 23' age group.

For the first research question that is stated below, we want to examine the relationship between sex and the number of strip search while controlling the effect of number of arrested times. We found that in 2019, James P. Smith published a research paper, "*The Long-Term Economic Impact of Criminalization in American Childhoods*". In the research, the author calculated the multiple arrested probability before the age of 26 by race, gender, education level and age group. In terms of gender, the author concludes man is more common to be arrested multiple times compared to women in the US(Smith, 2019). Additionally, the author finds that younger

individuals who have a criminal record are more likely to have multiple arrests than those who were older at the time of their first offence(Smith, 2019).

3. Dataset Description

In this project, we used the 'Arrests and Strip Searches (RBDC-ARR-TBL-001)' dataset from the Toronto Police Service website (https://data.torontopolice.on.ca/datasets/TorontoPS::arrests-and-strip-searches-rbdc-arr-tbl-001/explore?showTable=true). This data set is collected and published by the Toronto Police Service. The purpose for the Toronto police to share this data is they want to make the police data accessible to anyone publicly(TPS Open Data, 2018).

This data set contains 65276 rows and 24 columns about arrests and strip search information from January 2020 to December 2021. Each row contains event ID, arrest ID, person ID, demographic information(e.g. age, sex, race), time at arrest, strip-searched or not, actions when arrested, search reason, and items found. The types of attributes in this data set are integers(IDs), binaries, and categorical. The full list of all attributes in this data set is listed in the appendix with the type of the data (Appendix A).

4. Research Objective and Questions

In the preliminary exploration of this data set, we found that each person is assigned a unique person ID, and he or she could have been arrested and strip-searched multiple times. We want to evaluate how demographic attributes, 'sex', interacted with the number of strip-searched times. Also, we want to evaluate does strip-search have a relationship with the demographic attributes, 'sex' and 'youth status', and action when arrested. For this report, we proposed the following two research questions:

- RQ1: Does the number of strip searches differ significantly between males and females after controlling for the effect of the number of arrests?

- RQ2: What is the association between being subjected to strip searches and the sex(male or female), youth status (youth or adult), and action taken at the time of arrest of individuals who have been arrested?

We are going to conduct T-tests, Chi-Squared test of independence, power analysis, logistic regression, and ANCOVA for these two research questions in the following sections.

5. EDA

5.1 Descriptive Statistics

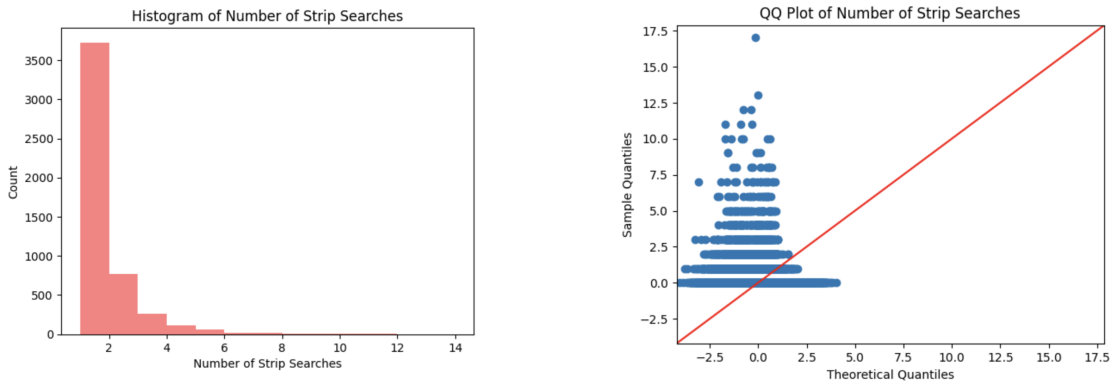
Table 1. Descriptive Statistics of Selected Variables for RQ 1

	N	Mean(SD)	%	Min	Max
Number of Arrested Times	37326	1.736(2.012)		1	54
Male's Number of Arrested Times	29656	1.763(2.040)		1	54
Female's Number of Arrested Times	7670	1.633(1.900)		1	32
Number of Strip Searched Times	37326	0.196(0.645)		0	17
Male's Number of Strip Searched Times	29656	0.207(0.661)		0	17
Female's Number of Strip Searched Times	7670	0.157(0.574)		0	11
Sex					
Male	29656		79.451%		
Female	7670		20.549%		

From Table 1, we see a large difference between the sample size of males and females and between the sample size of youth and not youth. The mean of males' number of arrested times is different from females' by 0.13. Also, the mean of the number of strip-searched times for males is 0.207, which is higher compared to females (0.157).

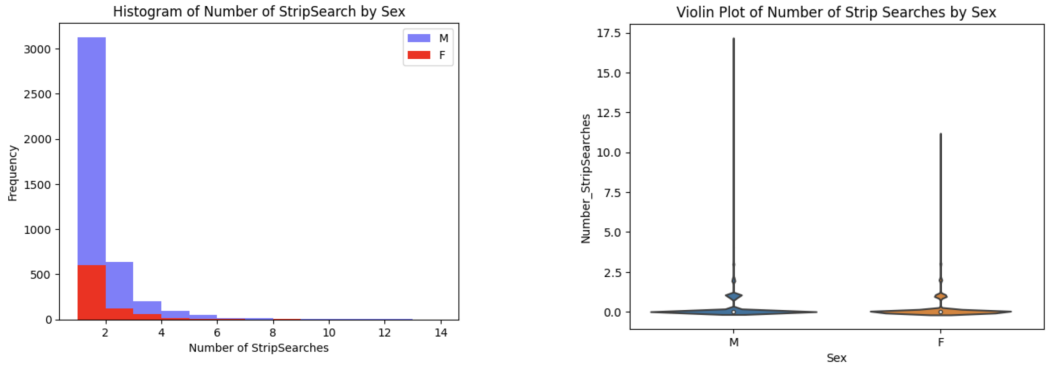
The independent variables are 'sex' and 'youth'. 'Sex' is a categorical variable that indicates the sex of the arrested person. The original data set contains nine rows of 'U' for sex, but the sample size of 'U' is small, so we did not analyze this category. Therefore, the two categories for 'sex' are male(M) and female(F). 'Youth' is also a categorical variable. It indicates if the person is arrested under 18 or not. If the person was 17 years old or younger when arrested, he/she is classified as 'youth'. If the youth status of the person when arrested is equal to or over 18 years old, he/she is classified as 'Not a youth'.

Figure 1. Histogram and Q-Q plot of Number of Strip-Searched Times



In order to explore the distribution of the dependent variable Number of Strip Searches, we conducted the histogram and QQ plot. According to Figure 1, it shows that the distribution for the Number of Strip Searches is right-skewed with one mode, and a majority of persons had either zero or one strip search conducted on them. And based on the QQ plot shown, the distribution of dependent variable is not normally distributed, which will be further discussed as a limitation.

Figure 2. Histogram and Violin Plot of Number of Strip-Searched Times By Sex



The histogram of the Number of Strip Search by Sex in Figure 2 suggests that the distribution of dependent variable by sex are right-skewed for both male (purple) and female (red) with one mode, indicating that there is a substantial proportion of both male and female with zero time strip search. Similarly, the violin plot of Number of Strip Searches reveals the same distribution as the histogram. It clearly shows that the density of the distribution is higher for males than females, which means a higher proportion of males have a higher number of strip searches compared to females.

Figure 3. Histogram and Q-Q plot of Number of Arrested Times

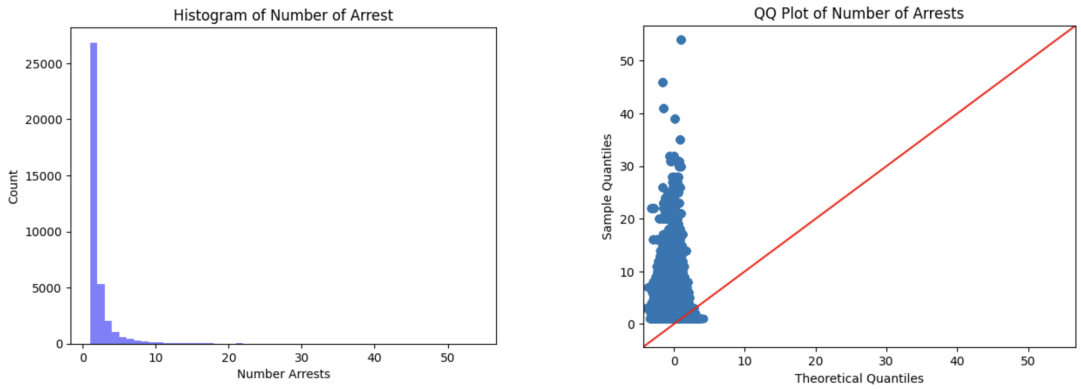


Figure 3 shows the histogram and QQ plot of arrested times. The histogram shows that the distribution of arrested times is right-skewed, and the mode is 1. The QQ plot suggests the distribution of the number of arrested times is not normal.

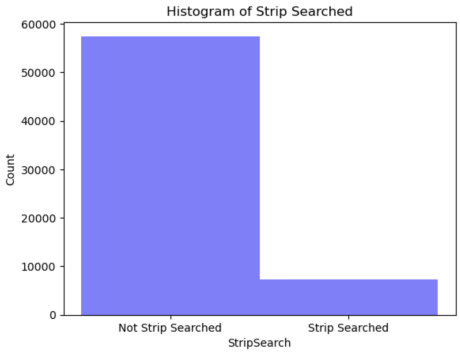
Table 2. Descriptive Statistics of Selected Variables for RQ2

	N	**%**
Total Number of Observations	64798	
Strip Search		
Strip Searched	7332	11.315%
Not Strip Searched	57466	88.685%
Youth Status		
Youth When Arrested	3023	4.665%
Not a Youth When Arrested	61775	95.335%
Sex		
Male	52256	80.644%
Female	12542	19.356%
Actions		
Concealed items	226	0.349%
Combative, violent or spitter/biter	2880	4.445%
Resisted, defensive or escape risk	2502	3.861%
Mental instability or possibly suicidal	2177	3.360%

Assaulted officer	415	0.640%
Cooperative	29106	44.918%

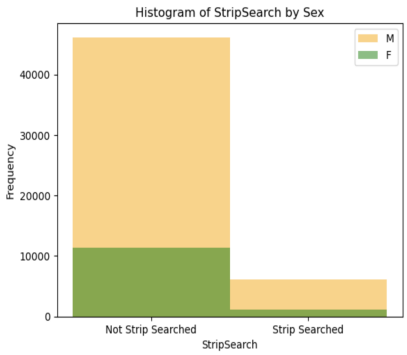
Table two shows four categorical variables that is selected for the research question two. It contains the frequency and the number of `Strip Search`, `Youth Status`, `Sex`, and `Actions`, and they are all categorical variables. The total number of observations is 64798. In this dataset, about one in ten people is strip-searched by the police. About 5% of observations are youth when arrested(age under 19), and about 20% of observations are from the female group. The original data set contains nine rows of 'U' for sex. However, the sample size of 'U' is small, so we did not analyze this category. Therefore, the two categories for 'sex' are male(M) and female(F). Also, 45% of the observations' actions at arrested were cooperative, and all other actions were below 5%.

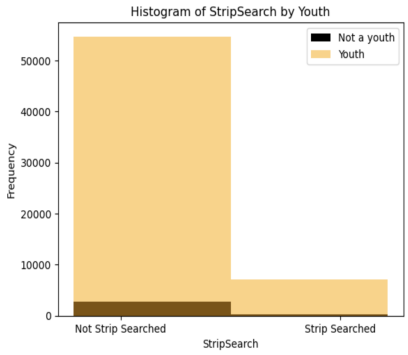
Figure 4. Histogram of Strip-Searched



To better understand the distribution of Strip Search, the histogram of strip-searched was plotted. As Figure 4 shows, the majority of individuals were not strip searched, with only a small minority having been subjected to strip searches. Furthermore, there is a significant imbalance in the distribution of individuals on both sides.

Figure 5. Histograms of Strip-Searched By Youth and Sex





In addition, histograms of strip search by sex and youth status were plotted as well. As shown above, for both males and females, the frequency of not strip searched is higher than strip searched. A similar phenomenon for youth and not youth. The distribution of strip search for individual groups follows the distribution of the whole dataset.

Figure 6. Histograms of Actions at Arrested

The distribution of actions, as shown in the histograms above, indicates that the action-cooperative category is relatively evenly distributed, whereas the other five actions exhibit an imbalanced distribution. Specifically, the frequency of "No" is higher than "Yes" for all actions.

Figure 7. Proportion of Strip-Searched Indivisuals by Sex and Youth Status

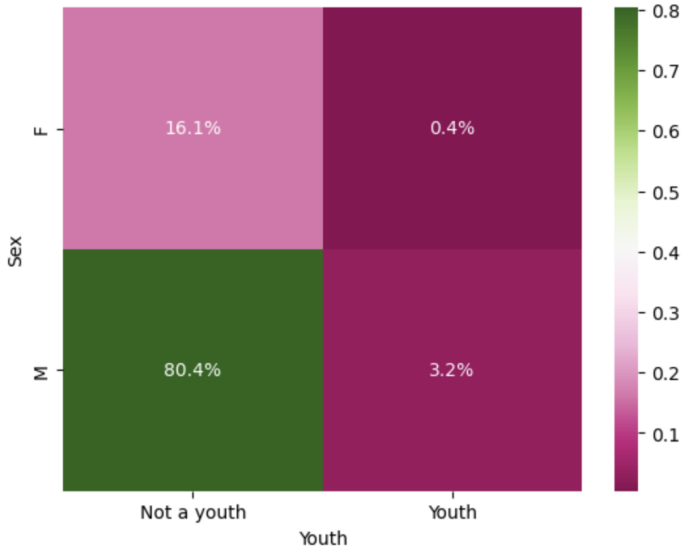


Figure 7 is a heatmap that shows the proportion of strip-searched individuals by sex and youth status. 80% of strip-searched individuals were adult males, and only 0.4% of strip-searched individuals were youth females.

Figure 8. Proportion of Strip-Searched Indivisuals by Youth Status, Sex, and Actions at Arrested

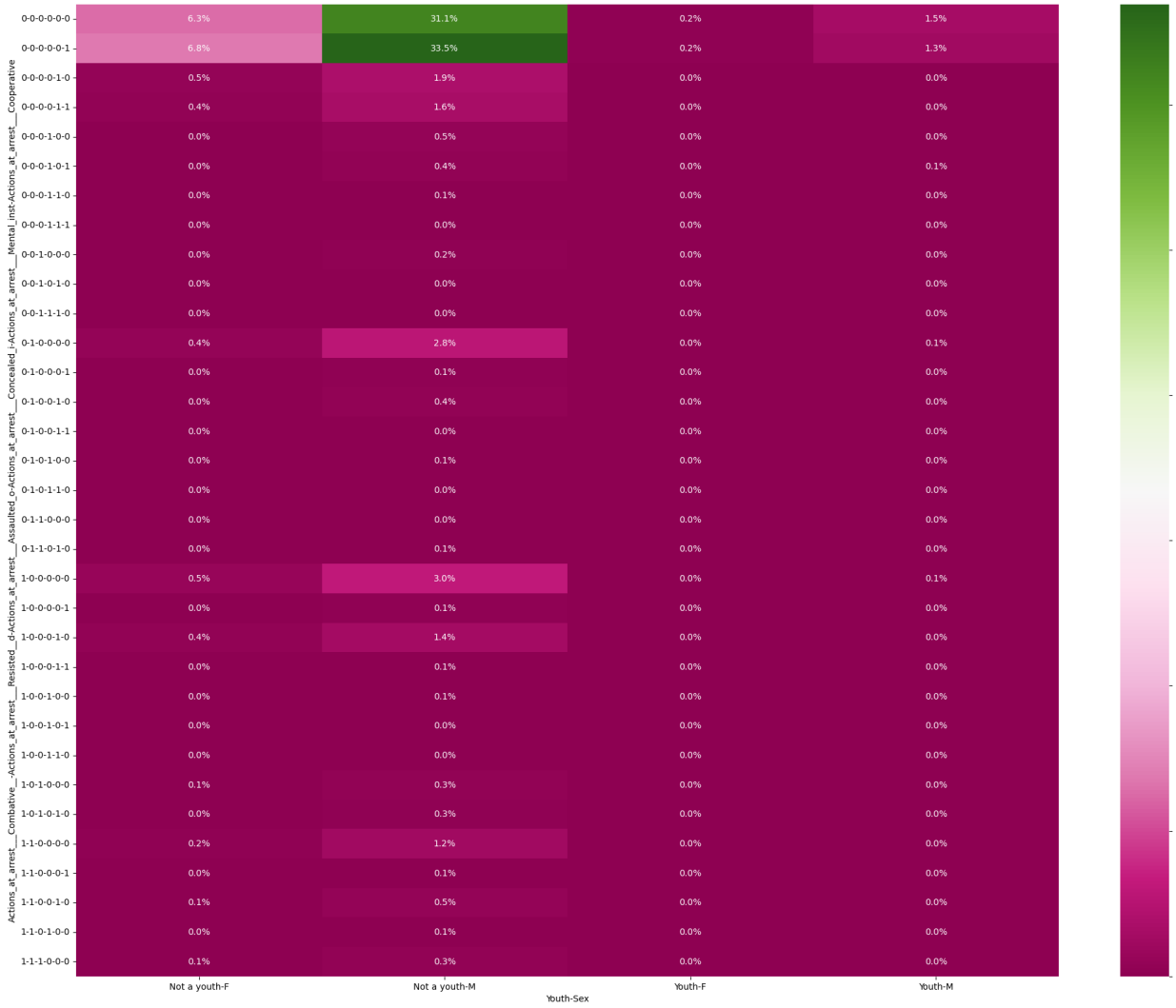


Figure 9 is a heatmap that shows the proportion of strip-searched indivisuals by sex, youth status, and actions when arrested. 31.1% of strip-searched individuals were adult males who did not take any actions. Also, 33.5% of strip-searched individuals were adult males who only took the action cooperative. About 6.3% of strip-searched individuals were adult females who did not take any actions, and 6.8% were adult females who only took the action cooperative. All other groups' proportions were below 5%.

5.2 Two Sample T-Tests

Sex and the Number of Strip Searched Times

From table 1, histograms, and violin plots, we noticed that there are differences between males' and females' mean number of strip-searched times. We conducted Welch's t-test to analyze whether there is a significant difference between males' and females' number of strip-searched times, assuming the variance is not equal. The following hypothesis was tested:

H0 (Null Hypothesis): The population mean of the two independent groups, male and female, are equal. ($\mu 1 = \mu 2$)

H1(Alternative Hypothesis): The population mean of the two independent groups, male and female, are not equal. ($\mu 1 \neq \mu 2$)

The pre-determined signfificance level is 0.05($\alpha = 0.05$). The t-statistic is 6.49, and the p-value is 8.85e-11, 95% CI [0.034, 0.064]. We set the significance level as 0.05. The p-value is smaller than 0.05, which is statistically significant, so we have enough evidence to reject the null hypothesis. There is a significant difference in the number of strip searched times between men and women.

5.3 Chi-squared Test of Independence

Before conducting the logistic regression, we want to examine the association between the independent variables and strip search (dependent variable). By conducting the chi-squared test, we can get the estimation of the magnitude and the direction of the association between them. The pre-determined significance level is 0.05($\alpha = 0.05$).

Sex and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and sex.

H1(Alternative Hypothesis): There is an association between strip search and sex.

The Chi-Squared statistic is 43.718, and the corresponding p-value is 3.79e-11. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip searches and sex.

Youth Status and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and youth status.

H1(Alternative Hypothesis): There is an association between strip search and youth status.

The Chi-Squared statistic is 22.439, and the corresponding p-value is 2.17e-06. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and youth status.

Action(Concealed items) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and concealed items.

H1(Alternative Hypothesis): There is an association between strip search and concealed items.

The Chi-Squared statistic is 261.66, and the corresponding p-value is 7.44e-59. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and concealed items.

Action(Combative, violent or spitter/biter) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and combative, violent or spitter/biter.

H1(Alternative Hypothesis): There is an association between strip search and combative, violent or spitter/biter.

The Chi-Squared statistic is 432.56, and the corresponding p-value is 4.50e-96. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and combative, violent or spitter/biter.

Action(Resisted, defensive, or escape risk) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and resisted, defensive or escape risk.

H1(Alternative Hypothesis): There is an association between strip search and resisted, defensive or escape risk.

The Chi-Squared statistic is 179.92, and the corresponding p-value is 5.05e-41. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and resisted, defensive or escape risk.

Action(Mental instability or possibly suicidal) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and mental instability or possibly suicidal.

H1(Alternative Hypothesis): There is an association between strip search and mental instability or possibly suicidal.

The Chi-Squared statistic is 567.61, and the corresponding p-value is 1.86e-125. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and mental instability or possibly suicidal.

Action(Assaulted officer) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and assaulted officer.

H1(Alternative Hypothesis): There is an association between strip search and assaulted officer.

The Chi-Squared statistic is 97.58, and the corresponding p-value is 5.18e-23. The p-value is smaller than 0.05, so we reject the null hypothesis. In other words, we found that there is an association between strip search and assaulted officer.

Action(Cooperative) and Strip Search

The following hypothesis was tested:

H0 (Null Hypothesis): There is no association between strip search and cooperative.

H1(Alternative Hypothesis): There is an association between strip search and cooperative.

The Chi-Squared statistic is 0.074, and the corresponding p-value is 0.78. The p-value is larger than 0.05, so we fail to reject the null hypothesis. In other words, we found that there is no association between strip search and cooperative.

6. Method

6.1 Research Question One — ANCOVA

The result of Welch's t-test suggests there is a significant difference between the number of strip searched times for males and females group. To answer the first research question, does the number of strip searches differs significantly between males and females after controlling for the effect of the number of arrests, we decided to conduct an ANCOVA. The outcome variable is the number of strip searched times, and the independent variable is sex(male, female). The covariate variable is the number of arrested times. This ANCOVA model estimated the effect of sex (male or female) and the number of arrested times on the number of strip searched times, while controlling for the effect of the number of arrested times. The following hypothesis was tested:

H0 (Null Hypothesis): The mean number of strip searches does not differ significantly between males and females after controlling for the effect of the number of arrests.

H1(Alternative Hypothesis): The mean number of strip searches differs significantly between males and females after controlling for the effect of the number of arrests.

Before we conducted this ANCOVA model using Python, we first check the assumptions and calculated the required sample size by using the power analysis technique.

6.1.1 Assumption Check

Before performing ANCOVA, it is essential to verify its assumptions. ANCOVA's dependent variable is the number of strip searched, which is continuous and ranges from 1 to 13. Sex is the independent variable and comprises two categorical and independent groups. In addition, we

selected the number of arrests as the covariate, which is also a continuous variable. Since we treat each arrest as an independent observation, there is no interdependence between the observations within each sex group.

Then the Shapiro-Wilk test and Levene's test were conducted to check the normality and homogeneity of variances. The pre-determined significance level for both test are 0.05($\alpha = 0.05$) For the Shapiro-Wilk test of number of strip searched times, the following hypothesis were tested:

H0 (Null Hypothesis): The sample is normally distributed.

H1(Alternative Hypothesis): The sample is not normally distributed.

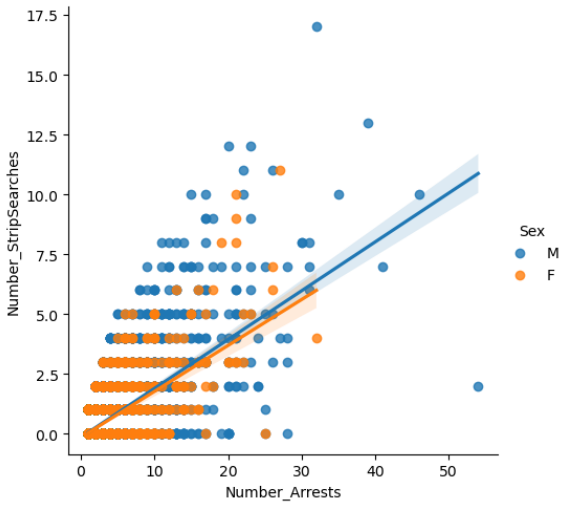
The statistic for the Shapiro-Wilk test is 0.611, and its corresponding p-value is 0.0. Based on the results, we found that the dependent variable is not normally distributed. For the Levene's test, the following hypothesis were tested:

H0 (Null Hypothesis): The variance between the two groups(male and female) are equal.

H1(Alternative Hypothesis): The variance between the two groups(male and female) are not equal.

The results of Levene's test showed the statistic is 111.3 with a p-value of 5.46e-26, which means we have enough evidence to reject the null hypothesis that the variance is equal. In order to check the homogeneity of regression slopes, we performed the ANOVA. The p-value for interaction (number of arrested times: Sex) is 0.0003, which is significant. Therefore, we reject the null hypothesis that there is no interaction between the number of arrests and sex. We plotted the scatter plot with a regression line to check if the relationship between the covariate(number of arrested times) and the dependent variable(number of strip-search times)at each group of sex is linear.

Figure 9 . Scatter Plot with Regression Line of Dependent Variable and the Covariate by Sex



And it was found not to be perfectly linear. These issues will be discussed in the limitation.

6.1.2 Power Analysis

Prior to computing an ANCOVA to analyze whether the number of strip-searched times (outcome variable) differed between females and males (two-level explanatory variable), we calculated the effect size of the explanatory variable using Cohen's D metric, which was 0.0765.

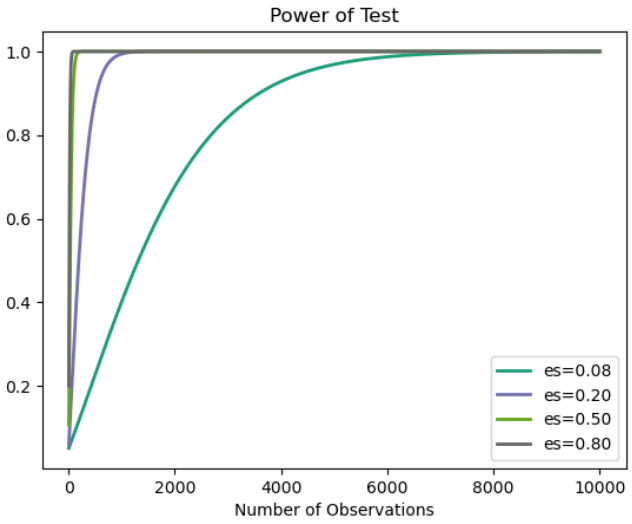
Table 3. Sample Size Required

	Required Sample Size	Actual Sample Size
Female	1686.629	7670
Male	6521.340	29656

After obtaining the effect size, the required sample size was computed using the obtained effect size and establishing the statistical power at 80%. The results indicated the required sample size is 1686.629 for the female group, while the required sample size is 6521.340 for the male group. The sample size provided in the dataset is 7670 and 29656, respectively, which means we have a sufficient sample size.

Then, we plotted the power curve shown below. The four lines in the power curve plot represent effect sizes at 0.08, 0.2, 0.5, and 0.8. For the actual sample size in the data set, the power is close to 1.0 at all effect sizes. Combine with the calculated required sample size above, we conclude that we have sufficient sample size.

Figure 10. Power Curve



6.2 Research Question Two — Logistic Regression

We decided to conduct a logistic regression for the second research question, what is the association between being subjected to strip searches and the sex(male or female), youth status (youth or adult), and action taken at the time of arrest of individuals who have been arrested. The outcome variable is a binary variable `strip search`, and the independent variables are sex, youth status, and action taken at the time of the arrest. The logistic regression model estimates the association between each independent variable and the likelihood of being subjected to strip searches while controlling for the effects of the other independent variables in the model. The following hypothesis was tested:

H0 (Null Hypothesis): There is no significant association between being subjected to strip searches and the sex, youth status, and action taken at the time of arrest of individuals who have been arrested.

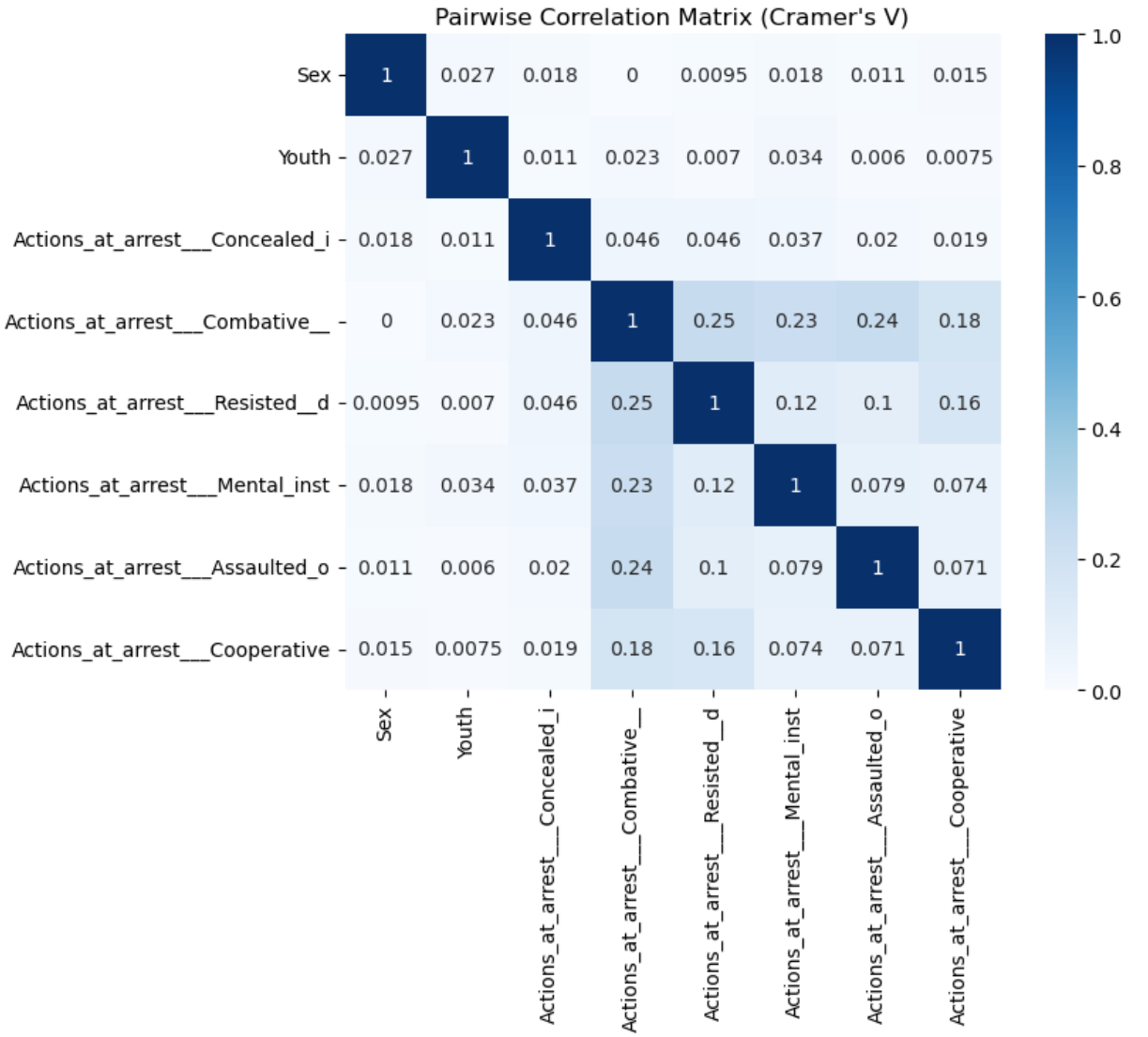
H1(Alternative Hypothesis): There is a significant association between being subjected to strip searches and at least one of the independent variables (sex, youth status, and action taken at the time of arrest of individuals who have been arrested).

We separated the dataset into the training dataset(n=51838) and the test dataset(n=12960). We build this model based on the training dataset and obtained the model summary. We calculated the odds ratio of each independent variable to interpret the result. Then, we applied the model to the test dataset and check the accuracy of our model. Lastly, we plotted the confusion matrix and the prediction interval.

6.2.1 Assumption Check

Before we build this logistic model using Python, we first check the assumptions. The first assumption is a binary logistic regression requires a binary outcome variable(*Logistic regression assumptions* 2022). As shown in the EDA section, strip search is a binary variable which exactly only take two possible outcome variable, strip-searched(1) and not strip-searched(0). Then, the logistic regression requires independent observations(*Logistic regression assumptions* 2022). In this dataset, some people are arrested multiple times but may be strip-searched or not each time. We will address this problem in the limitation. In addition, we calculated Cramer's V and plotted the heatmap to check if there exists a multicollinearity problem(association among independent variables).

Figure 11. Power Curve



The heatmap above shows the Carmaer's V statistics. The statistics for action combative and action resisted are higher than 0.1 but smaller than 0.3. This represents moderate degree of association. Other than action combative and action resisted rows, all of other the Cramer's V statistics are smaller than 0.1 which suggested that there is little or no association between the independent variables for the logistic regression. We will address the moderate association problem in the limitation. Also, logistic regression requires linear relationship between the independent variable and the logit of dependent variable(*Logistic regression assumptions* 2022). However, our independent variables are binary, so this assumption does not apply. The last assumption is large sample size. In our training dataset, there are 51838 observations, which is a large dataset.

7. Results and Findings

7.1 ANCOVA

Table 4. ANCOVA Result for RQ1

	Source	SS	DF	F	p-unc	np2
0	Sex	3.2557	1	12.9999	0.0003	0.0003
1	Number_Arrests	6157.7517	1	24587.7058	0.0000	0.3971
2	Residual	9347.1822	37323	N/A	N/A	N/A

ANCOVA was performed for research question 1. We hypothesized that the sex(female, male) would be able to predict the number of strip searched times. The result of the ANCOVA is shown in Table 4. The p-values for sex and the number of arrested times are both less than the significance level of 0.05, with values of 0.0003 and 0.0, respectively. It indicates that the null hypothesis is rejected and there are significant differences in the mean number of strip searches between males and females while controlling the effect of the number of arrests. In addtion, we can conclude that independent variable Sex (F-value = 12.9999) and convariate Number_Arrests (F-value = 24587.7058) both have a significant impact on the dependent variable, number of strip searches.

7.2 Logistic Regression

Table 5. Logistic Regression Results for RQ 2

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	-2.4187	0.038	-63.759	0.000	-2.493	-2.344
Youth	-0.2622	0.075	-3.500	0.000	-0.409	-0.115
Sex	0.2267	0.038	6.002	0.000	0.153	0.301
Concealed items	1.5440	0.144	10.757	0.000	1.263	1.825
Combative, violent or spitter/biter	0.6176	0.060	10.267	0.000	0.500	0.736
Resisted, defensive or escape risk	0.4457	0.063	7.103	0.000	0.323	0.569
Mental instability or possibly suicidal	0.8532	0.060	14.127	0.000	0.735	0.972
Assaulted officer	0.4258	0.135	3.150	0.002	0.161	0.691
Cooperative	0.1243	0.030	4.212	0.000	0.066	0.182

We perform a logistic regression to examine the effects of youth status, sex, and actions at arrested on the likelihood that a person is subjective to strip-search. The result we obtained is shown in table 5. The following is the interpretation of the coefficients:

The coefficient for youth status is -0.2622, which means that compared to adults(at arrested), the log odds of a youth to be subjected to strip search is 0.2622 lower. The coefficient for youth is statistically significant because the p-value is 0.000, which is smaller than 0.05.

The coefficient for sex is 0.2267, which means that compared to female, the log odds of a male to be subjected to strip search is 0.2267 higher. The coefficient for sex is statistically significant because the p-value is 0.000, which is smaller than 0.05.

The coefficient for concealed items(action at arrested) is 1.544, which means that compared to people who did not conceal items at arrested, the log odds of a person who concealed items to be subjected to a strip search is 1.544 higher. The coefficient for concealed items(action at arrested) is statistically significant because the p-value is 0.000, which is smaller than 0.05.

The coefficient for being combative, violent, or a spitter/biter(action at arrest) is 0.6176. This means that compared to people who did not exhibit these actions at the time of arrest, the log odds of a person who did exhibit these actions to be subjected to a strip search are 0.6176 higher. The coefficient for the action of combative, violent, or a spitter/biter at the time of arrest is statistically significant, as indicated by the p-value of 0.000, which is less than 0.05.

The coefficient for actions including resisted, defensive or escape risk at arrested is 0.4457. This means that compared to people who did not exhibit these actions at the time of arrest, the log odds of a person who did exhibit these actions to be subjected to a strip search are 0.4457 higher. The coefficient for the action of resisted, defensive or escape risk at the time of arrest is statistically significant, as indicated by the p-value of 0.000, which is less than 0.05.

The coefficient for actions including mental instability or possibly suicidal at arrested is 0.8532. This means that compared to people who did not exhibit these actions at the time of arrest, the log odds of a person who did exhibit these actions to be subjected to a strip search are 0.8532 higher. The coefficient for the action of mental instability or possibly suicidal at the time of arrest is statistically significant, as indicated by the p-value of 0.000, which is less than 0.05.

The coefficient for actions of assaulted officers at arrested is 0.4258. This means that compared to people who did not exhibit these actions at the time of arrest, the log odds of a person who did exhibit these actions to be subjected to a strip search are 0.4258 higher. The coefficient for the action of assaulted officers at the time of arrest is statistically significant, as indicated by the p-value of 0.002, which is less than 0.05.

The coefficient for actions of cooperative at arrested is 0.1243. This means that compared to people who did not exhibit these actions at the time of arrest, the log odds of a person who did exhibit these actions to be subjected to a strip search are 0.1243 higher. The coefficient for the action of cooperative at the time of arrest is statistically significant, as indicated by the p-value of 0.000, which is less than 0.05.

Table 6. Odds Ratio

	Lower CI	**Upper CI**	**OR**
Intercept	0.0827	0.0959	0.0890
Youth	0.6643	0.8910	0.7694
Sex	1.1649	1.3508	1.2544
Concealed items	3.5349	6.2048	4.6833
Combative, violent or spitter/biter	1.6482	2.0865	1.8545
Resisted, defensive or escape risk	1.3809	1.7659	1.5616
Mental instability or possibly suicidal	2.0850	2.6420	2.3471
Assaulted officer	1.1745	1.9953	1.5309
Cooperative	1.0687	1.1998	1.1324

Table 6 indicated that the odds ratio for independent variables. We took the exponent of the coefficients and obtained the odds ratio. The odds ratio for the effect of Youth on the strip search is 0.7694 which is smaller than 1, suggesting that the odds of being subjected to strip searches for youth are 0.7694 times the odds for adults after controlling for youth and actions at arrests, which means youth are less likely to be subjected to strip search than adults. And the confidence interval for Youth is [0.6643, 0.8910], indicating that we can be 95% confident that the true odds ratio of youth falls between 0.6643 and 0.8910.

The odds ratio for the effect of Sex on the strip search is 1.2544 which is larger than 1, suggesting that the odds of being subjected to strip searches for males are 1.2544 times higher than the odds for females after controlling for youth and actions at arrests, in other words, males are more likely to be subjected to strip search than females. And the confidence interval for Sex is [1.1649, 1.3508], indicating that we can be 95% confident that the true odds ratio of sex falls between 1.1649 and 1.3508.

The odds ratio for the effect of concealed at arrests on the strip search is 4.6833 which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who

concealed something at the time of arrest are 4.6833 times higher than the odds for individuals who did not conceal anything after controlling for youth, sex and other actions at arrests, in other words, individuals who concealed something at the time of arrest are more likely to be subjected to strip search compared to those who did not conceal anything. And the confidence interval for concealed at arrests is [3.5349, 6.2048], indicating that we can be 95% confident that the true odds ratio of concealed at arrests falls between 3.5349 and 6.2048.

The odds ratio for the effect of being combative, violent, or a spitter/biter at arrests on the strip search is 1.8545, which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who were combative, violent, or a spitter/biter at the time of arrest are 1.8545 times higher than the odds for individuals who is not combative after controlling for youth, sex and other actions at arrests, in other words, individuals who was combative at the time of arrest are more likely to be subjected to strip search compared to those who is not combative. And the confidence interval for combative at arrests is [1.6482, 2.0865], indicating that we can be 95% confident that the true odds ratio of being combative, violent, or a spitter/biter at arrests falls between 1.6482 and 2.0865.

The odds ratio for the effect of resisted, defensive or escape risk at arrests on the strip search is 1.5616 which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who were resisted at the time of arrest are 1.5616 times higher than the odds for individuals who is not resisted after controlling for youth, sex and other actions at arrests, in other words, individuals who was resisted at the time of arrest are more likely to be subjected to strip search compared to those who was not resisted. And the confidence interval for combative at arrests is [1.3809, 1. 7659], indicating that we can be 95% confident that the true odds ratio of resisted, defensive or escape risk at arrests falls between 1.3809 and 1. 7659.

The odds ratio for the effect of mental instability or possibly suicidal at arrests on the strip search is 2.3471 which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who had mental instability or possibly suicidal at the time of arrest are 2.3471 times higher than the odds for individuals who is not resisted after controlling for youth, sex and other actions at arrests, in other words, individuals who had mental instability or possibly suicidal at the time of arrest are more likely to be subjected to strip search compared to those who did not have mental instability or possibly suicidal. And the confidence interval for mental instability or possibly suicidal at arrests is [2.0850, 2.6420], indicating that we can be 95% confident that the true odds ratio of mental instability or possibly suicidal at arrests falls between 2.0850 and 2.6420.

The odds ratio for the effect of assaulted officers at arrests on the strip search is 1.5309 which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who assaulted officers at the time of arrest are 1.5309 times higher than the odds for individuals who

did not assault officers after controlling for youth, sex and other actions at arrests, in other words, individuals who assaulted officers at the time of arrest are more likely to be subjected to strip search compared to those who did not assaulted officers. And the confidence interval for assaulted officers at arrests is [1.1745, 1.9953], indicating that we can be 95% confident that the true odds ratio of assaulted officers at arrests falls between1.1745 and 1.9953.

The odds ratio for the effect of being cooperative at arrests on the strip search is 1.1324 which is larger than 1, suggesting that the odds of being subjected to strip searches for individuals who was cooperative at the time of arrest are 1.1324 times higher than the odds for individuals who was not cooperative after controlling for youth, sex and other actions at arrests, in other words, individuals who was cooperative at the time of arrest are more likely to be subjected to strip search compared to those who was not cooperative. And the confidence interval for assaulted officers at arrests is [1. 0687, 1.1998], indicating that we can be 95% confident that the true odds ratio of assaulted officers at arrests falls between 1. 0687 and 1.1998.

As mentioned in the method section, we trained the model with the training dataset, then applied the model to the test dataset to get an estimation of how well this model when predicting a new dataset. The test accuracy for the logistic model is approximately 0.88. Then, we created the confusion matrix of our logistic regression model, as shown in the figure 12.

Figure 12. Confusion Matrix for Logistic Regression Model

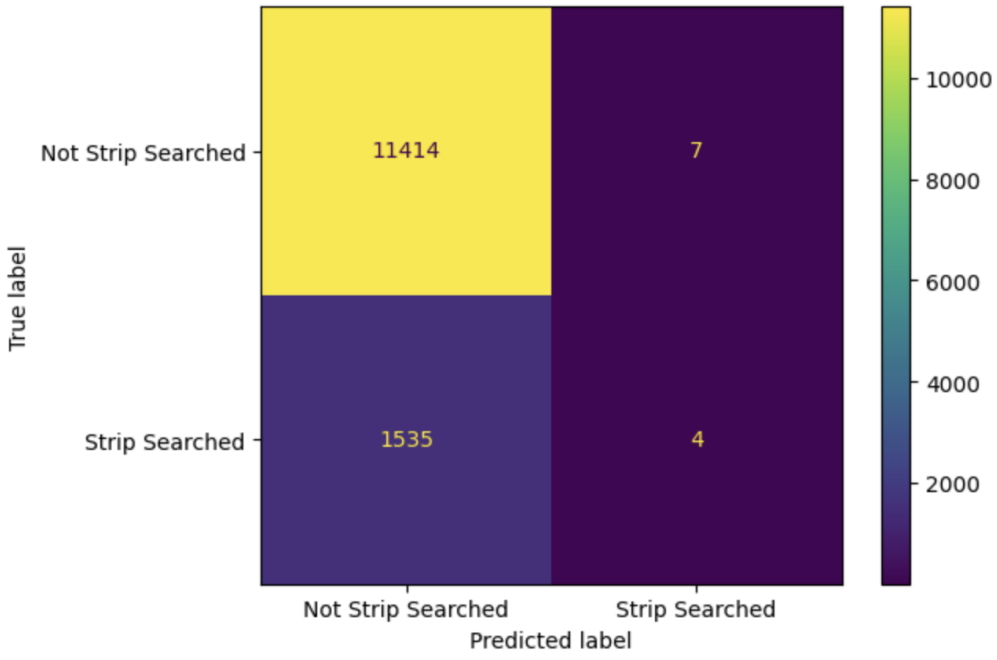
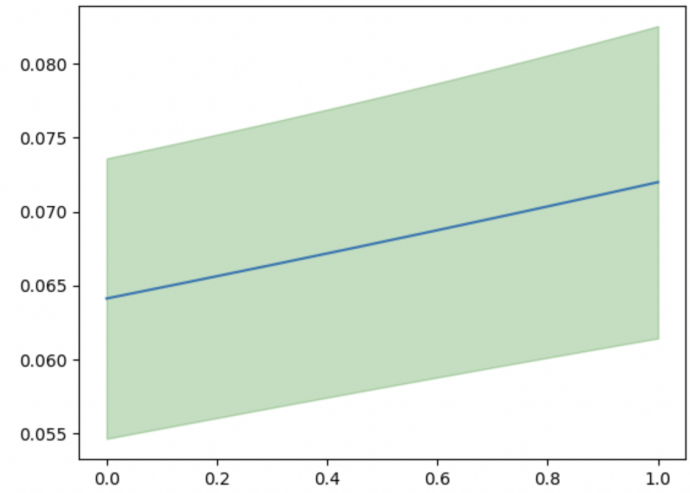


Figure 13 illustrates the prediction interval for logistic regression. The predicted probabilities are represented by the blue line, while the upper and lower limits of the prediction interval are denoted by the green area. As depicted in the figure, the wider green area in this prediction interval indicates greater uncertainty in the model.

Figure 13. Prediction Interval for Logistic Regression Model



8. Discussion

8.1 Limitations

This study has some limitations that should be considered. First of all, this study is only based on the dataset from the Toronto police from the year 2020 to 2021. Therefore, the result may not be applicable for other time ranges or other areas. Then, as mentioned previously, some assumptions for the ANCOVA and Logistic regression was not met. In the first research question, we checked the normality and homogeneity of the dependent variable, number of strip searched times. Based on the statistical test result, this assumption was not met. This may have negative impacts on the accuracy and reliability of our findings. Additionally, the homogeneity of regression slopes assumption was not met, as indicated by the significant interaction between the number of arrests and sex, which could have also impacted the ANCOVA result. Another limitation was the lack of independence among observations in the logistic regression model because there were some individuals being arrested multiple times. For those who have been arrested multiple times, some independent variables, such as sex, may appear multiple times and affect our model's accuracy. To solve this issue in the future, we may manually select and only keep one record in the dataset or we could use a multilevel logistic regression model. Furthermore, we calculated the Cramer's V to check the if any of the independent variables in our dataset is not independent from each other. The Cramer's V statistics we obtained suggests that indicated there exists a multicollinearity problem in our logistic regression. In order to solve this issue in the future, we can perform a separate logistic regression for those variables that is highly correlated with the other ones.

8.2 Findings Discussion

For the first research question, our findings suggest that after controlling for the effect of the number of arrests, sex has a significant effect on the number of strip searches. This suggests that there might be gender bias in the decision-making process of conducting strip searches. The outcome highlights possible concerns about biases in the criminal justice system and the arrest process, which may disproportionately impact particular social groups. However, this may be caused by the gender's difference in the type of crime they may commit. We can analyze the relationship between the type of crime and sex in future studies. It is important to note that our findings do not prove that gender discrimination exists when police officers conduct strip searches. More research is needed to establish the reasons for the observed effect of gender on the number of strip searches.

In the second research question, our results suggested there is a significant association between the likelihood of individuals being subjected to strip searches and the factors including gender, age, and actions at the time of arrest. Based on our result, men and adults are more likely to be subjected to strip searches compared to women and youth, respectively. This implies there may exists potential biases when police conducting the strip-search. However, we need for further study and research into the factors that contribute to the differences. Additionally, we found that individuals who have actions that is listed in research question two toward the police at the time of arrest are more likely to be strip-searched. This finding raises the concern about the use of strip searches as a punitive measure instead of as a necessary security measure.

9. Conclusion

The goal of this report is to evaluate the impact of sex on the number of strip searches and the influence of sex, youth status, and actions at arrest on strip searches based on Toronto's Polices data. We formulated two research questions. The first one is "Does the number of strip searches differ significantly between males and females after controlling for the effect of the number of arrests?". To answer this question, we performed ANCOVA, and our findings indicated that sex does have a significant effect on the number of strip searches, even after controlling the number of arrests covariate. Our second research question is, "What is the association between being subjected to strip searches and the sex(male or female), youth status (youth or adult), and action taken at the time of arrest of individuals who have been arrested?". Based on our result, we discovered that males are more likely to be subjected to strip searches compared to females. In addition, adults are more likely to be subjected to strip searches than youths. Lastly, we found that individuals who take actions, including concealed items, combative, violent or spitter/biter resisted, defensive or escape risk, mental instability or possibly suicidal, assaulted officer, and cooperative, are more likely to be strip-searched by the police.

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Appendix

Appendix A. Full List of Attributes and the Data Type in the 'Arrests and Strip Searches' Data Set

Attributes	Data Type
Arrested_Year	Integer
Arrested_Month	Object-Categorical
EventID	Integer
ArrestID	Integer
PersonID	Integer
Perceived_Race	Object-Categorical
Sex	Object-Categorical
Age_group_at_Arrest	Object-Categorical
Youth_at_arrest_uner_18_years	Object-Categorical
ArrestLocDiv	Object-Categorical
StripSearch	Binary
Booked	Binary
Occurrence_Category	Object-Categorical
Actions_at_arrest_Concealed_i	Binary
Actions_at_arrest_Combative	Binary
Actions_at_arrest_Resisted_d	Binary
Actions_at_arrest_Mental_inst	Binary
Actions_at_arrest_Assaulted_o	Binary
Actions_at_arrest_Cooperative	Binary
SearchReason_CauseInjury	Binary
SearchReason_AssistEscape	Binary
SearchReason_PossessWeapons	Binary
SearchReason_PossessEvidence	Binary
ItemsFound	Binary