Study on the factors impact on number of arrests and strip search

INF2178_FinalProject

Jieyi Chen 1005401076
YiJing Zhou 1009685627

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Faculty of Information
University of Toronto

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Table of Contents

1. Introduction

1.1 Background

For many years, experts, policymakers, and the general public have been interested in and concerned about law enforcement practices and their influence on various demographic groups. The potential discrepancy in arrest rates between males and females when race and age group are two aspects of this larger issue that merit more investigation. Understanding these inequalities can provide useful insights into the efficacy of existing enforcement techniques, potential biases, and underlying socioeconomic variables that may contribute to disparities in arrest rates.

Numerous studies have shown that males are more likely than females to be detained, and this gender discrepancy has remained throughout time. However, these findings do not take into consideration other characteristics that may influence arrest rates, such as race and age. In numerous jurisdictions, racial and ethnic minorities, particularly Black and Indigenous people, have been found to have greater arrest rates than their White counterparts. Furthermore, younger people are more prone to be involved in illegal activities, resulting in greater arrest rates for this age group.

The statistical research tries to shed light on whether the observed variations in arrest rates between males and females can be related to these demographic characteristics or if there is an underlying gender discrepancy that needs additional investigation by controlling for ethnicity and age group. The findings of this study could contribute to the creation of more equitable law enforcement policies and procedures, as well as to ongoing discussions concerning gender, ethnicity, and age in the context of criminal justice.

In this study, we will evaluate Toronto Police Service arrest data to see if there is a significant difference in the number of people arrested between males and females after controlling for ethnicity and age group. We can better address potential biases and work towards a fairer criminal justice system if we understand the factors that contribute to discrepancies in arrest rates.

1.2 Literature Review

Steffensmeier et al. (2005) studied the gender disparity in arrests for various racial and ethnic groupings while adjusting for age. They discovered that the gender discrepancy in arrest rates was more pronounced among Black and Hispanic communities than among White populations. This conclusion implies that the association between gender and arrest rates may be modified by

ethnicity and age, which should be considered when analyzing arrest data. Huebner and Bynum (2008) examined arrest data from a big urban center in the United States, focusing on age-specific arrest rates across different ethnic and gender categories. Their findings suggested that arrest rates for both males and females reduced with age, with younger people experiencing higher arrest rates than older people. Furthermore, they discovered that the gender gap in arrest rates was greater among Black people than among White people, emphasizing the necessity of controlling for race when studying gender variations in arrest rates.

Brennan and Spohn (2012) investigated the interplay of gender, race, and age in arrest rates. According to their findings, Black females had greater arrest rates than White females across all age categories. Furthermore, they discovered that the gender disparity in arrest rates was greater for Black people than for White people, implying that the confluence of gender, race, and age plays a substantial role in creating arrest rate discrepancies. Schwartz et al. (2009) evaluated the association between juvenile arrest rates and gender, race, age, and offense type. Males were arrested at a higher rate than females for all offense types, but the gender disparity was more pronounced for violent offenses. Furthermore, they discovered that the gender disparity in arrest rates differed between racial and ethnic groupings as well as age groups, emphasizing the necessity of taking these demographic characteristics into account when studying the association between gender and arrest rates.

1.3 Research Objective and Questions

This project aims to investigate the relationship between number of arrests and gender while controlling for the race and age group. This project also aims to investigate the impact of the individual's age (Youth vs Adult) on the likelihood of being strip searched. These questions were developed based on the knowledge gained from our literature review and preliminary analysis of the dataset (see the below Descriptive Statistics and T-Tests section for the exploratory data analysis).

- RQ1: Is there a difference in the number of people arrested (outcome variable) between male and female (two-level explanatory variable) after controlling for the race and age group (covariates) .

- RQ2: Does the suspect's age (two-level explanatory variable)(whether or not the suspect is a youth) have an impact on the likelihood of a strip search (outcome variable) being conducted during an arrest?

2. Exploratory Data Analysis

2.1 Descriptive Statistics

The "Arrests and Strip Searches (RBDC-ARR-TBL-001)" dataset includes a total of 65276 records, each of which represents an arrest and/or strip search conducted by the Toronto Police Service. The dataset includes 25 variables related to demographic information, the arrest, and the strip search.

In order to understand the dataset, we produced the following barplot to identify the patterns in the distribution of arrests among different genders, different racial groups and different age groups (Figure1- Figure 3). Unsurprisingly, consistently with what we found from the literature review, males have higher amounts of arrests than females and younger group people have higher amounts of arrests than older group people. It was interesting to note that white people have the highest number of arrests which is in contrast with the literature review saying that black people have a higher amount of arrests than white people. We also used bar plots to identify the distribution of youths vs. adults among the dataset and any possible patterns on the likelihood of being strip searched for youths vs. adults and found that the strip search rate is higher in adults than in youths.

Figure 1

Number of arrests by Sex

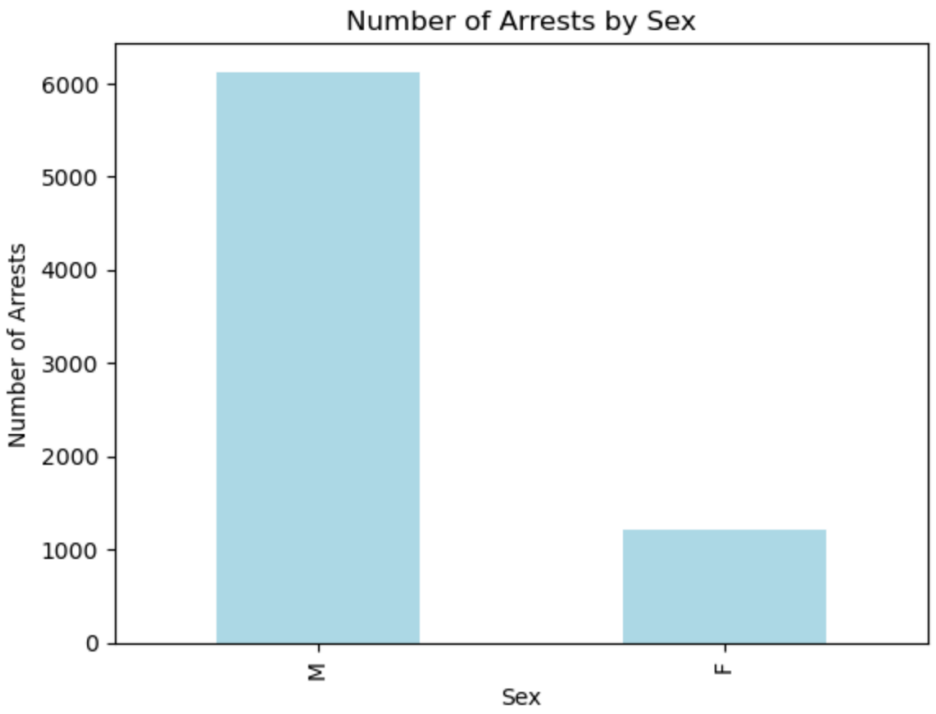
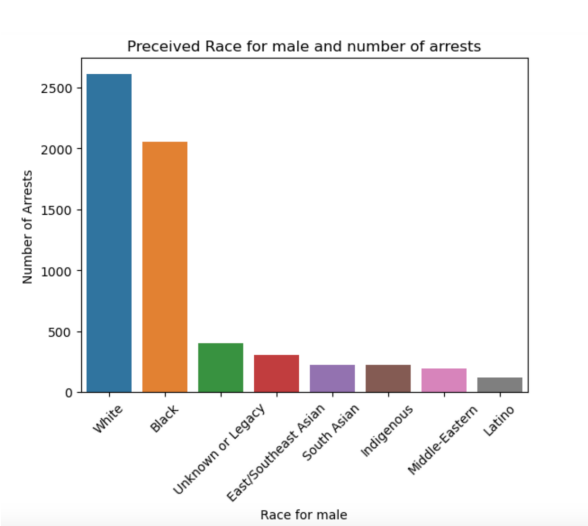


Figure 2

The number of arrests and different race groups for males and females



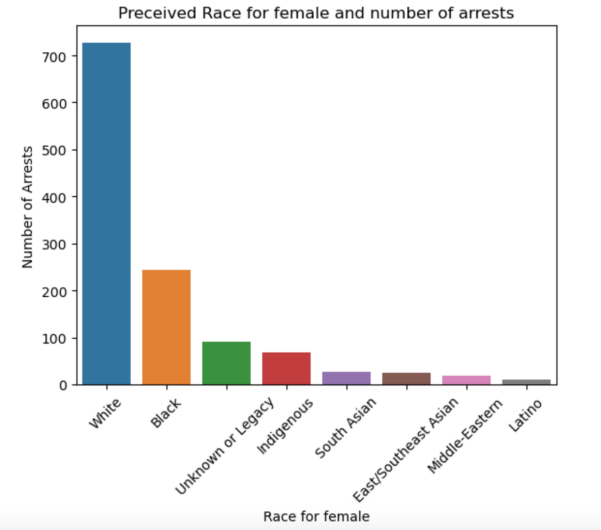


Figure 3

The number of arrests and different age groups for males and females

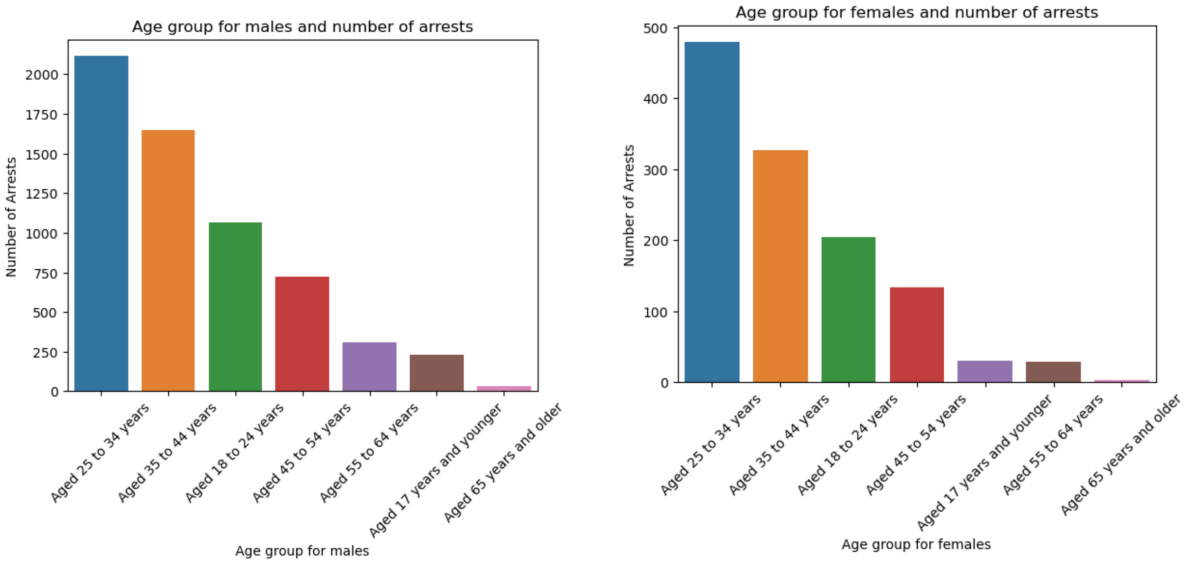


Figure 4

Frequency Distribution of Youth at Arrest

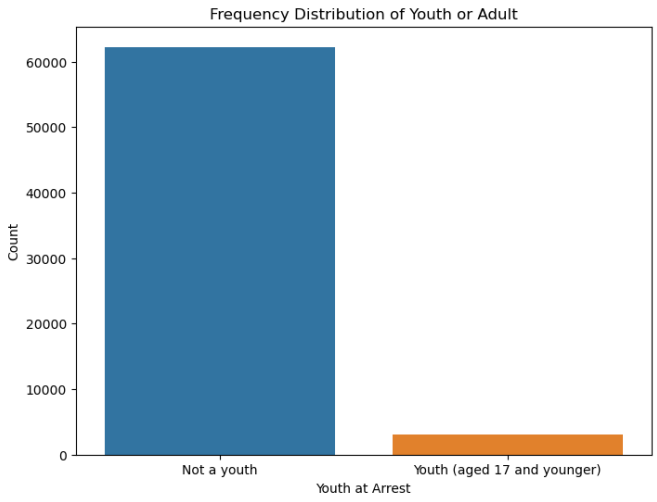


Table 1

Frequency Table for Youth at Arrest

Youth or Adult	Freq
Not a youth	62234
Youth (aged 17 and younger)	3042

Figure 4. looks at the frequency distribution of youths at arrest vs. adults at arrest. The number of individuals that are youths at arrest is significantly smaller than the number of individuals that are adults at arrest. From Table 1., which is the frequency table for youths at arrest, we can see that the number of individuals that are not a youth is 62234, which is significantly greater than the number of individuals that are youths, 3042.

Figure 5

Stacked Plot for Strip Searches for Youth at Arrest

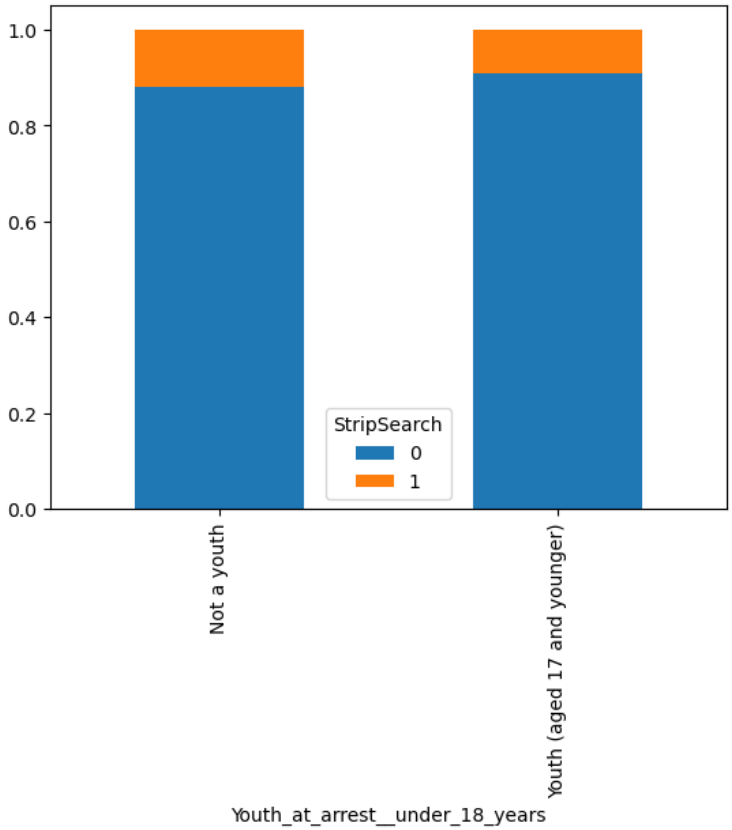


Figure 5. looks at the proportion of individuals being strip searched in youths and the proportion of individuals being strip searched in adults. From this stacked plot, we can see that the proportion strip searched for youths (aged 17 and younger) is less than the proportion strip searched for adults.

Figure 6

Distribution of Youth at Arrest, Distribution of Strip Search, Strip Search Rate by Youth or Not Youth

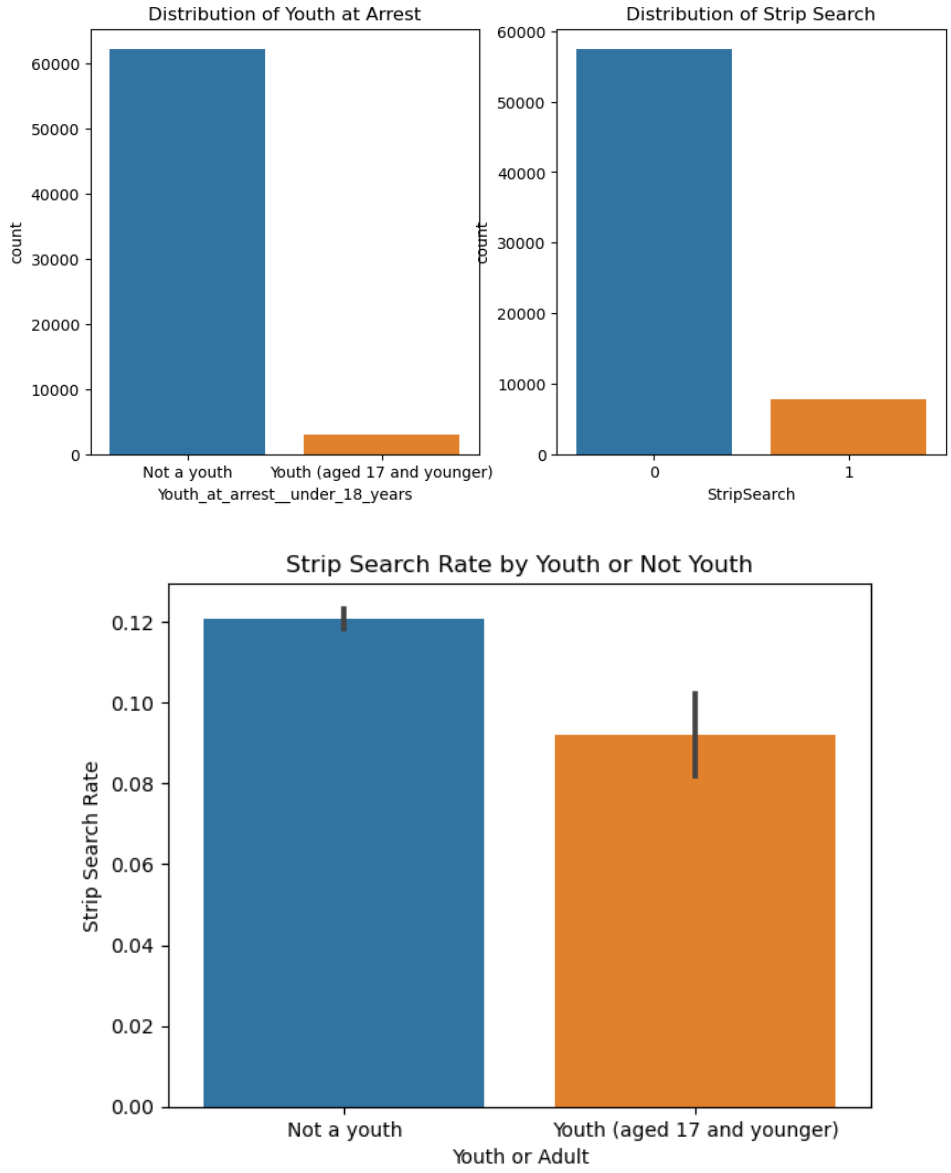


Figure 6 shows the distribution of youths and adults in the dataset, the distribution of strip searched and not strip searched in the dataset, and the strip search rate in youths and adults. From the plots, we can see that the number of arrests for adults is significantly larger than the number of arrests for youths. We can also see that the number of strip searches is significantly less than the number of no strip searches. The plot of strip search rate, we see that the strip search rate for youths is lower than the strip search rate for adults.

2.2 T-Tests

Before performing the t-test on the categorical variables in the dataset, we ensured that the following assumptions were met:

1) A nominal two-level explanatory variable;
2) A quantitative outcome variable;
3) Normality assumption;
4) Independence of errors

After we checked all of the assumptions, we used T-Test to do further analysis. The following paragraphs summarize some of the most notable results from our t-tests.

Perceived race group by Sex

We conducted a T-Test to analyze whether there was a statistically significant difference between the mean perceived race group (outcome variable) between males and females (two-level explanatory variable). The following hypothesis is tested:

> **Null hypothesis:** The population mean of perceived race groups are the same for males and females.
>
> **Alternative hypothesis:** The population mean of perceived race groups are different between males and females.

The p-value is 0.082 which is larger than 0.05, therefore we fail to reject the null hypothesis, indicating that there is not a significant difference between the population mean of perceived race groups for males and females. The t-value is positive indicates the mean perceived race for males is higher than the mean perceived race for females. Therefore, we fail to reject the null hypothesis and conclude that there is no evidence to suggest that there is a significant difference in perceived race groups between males and females.

Age group at arrest by Sex

We conducted a T-Test to analyze whether there was a statistically significant difference between the mean age group at arrest (outcome variable) between males and females (two-level explanatory variable). The following hypothesis is tested:

> **Null hypothesis:** The population mean of age groups at arrest is the same for males and females.
>
> **Alternative hypothesis:** The population mean of age groups at arrest is different for males and females.

The p-value for all the age groups at arrest is larger than 0.05, therefore we fail to reject the null hypothesis, indicating that there is not a significant difference between the population mean of age groups at arrest for males and females. The t-value is positive indicates the mean age group at arrest for males is higher than the mean age group at arrest for females. Therefore, we fail to reject the null hypothesis and conclude that there is no evidence to suggest that there is a significant difference in age group at arrests between males and females.

Youth at Arrest and Strip Search

We conducted a Welch's T-Test to analyze whether there was a statistically significant difference between the mean of individuals who undergo strip searches (outcome variable) for individuals that are youths at arrest (aged 17 and under) and individuals that are not youths at arrest (two-level explanatory variable). The following hypothesis is tested:

> **Null hypothesis:** The population mean of individuals who undergo strip search is the same for youths and adults.
>
> **Alternative hypothesis:** The population mean of individuals who undergo strip search is different for youths and adults.

The result indicates the mean of individuals who undergo strip searches for youths (M = 0.092045, SD = 0.289137) is lower than the mean of individuals who undergo strip searches for adults (M = 0.120850, SD = 0.325956). The p-value is 1.731e-06 which is smaller than 0.05, therefore we have strong evidence to reject the null hypothesis, indicating that there is a difference between the population mean of individuals who undergo strip search for youths and adults. From the statistics, it can be seen that it is more likely for an individual to undergo strip search if the individual is an adult at arrest.

3. Methods

3.1 Dataset Description

The "Arrests and Strip Searches (RBDC-ARR-TBL-001)" dataset is provided by the Toronto Police Service and contains information on arrests and strip searches conducted by the Toronto Police Service. The dataset contains a total of 65276 records, each of which represents an arrest and/or a strip search conducted by the police. The dataset can be downloaded through the link: https://data.torontopolice.on.ca/datasets/TorontoPS::arrests-and-strip-searches-rbdc-arr-tbl-001/about. The dataset contains 25 variables including arrest year, arrest month, eventID, arrestID, personID, race, sex, age group, arrest type, the reason for arrest, action at arrested, division, youth at arrest, strip searches, item found. In order to analyze the relationship between the number of arrests and sex while controlling the age and race group by using ANCOVA , we grouped the number of arrests by sex, age group and race group.

The dataset can be used to investigate the impact of various factors on the experience of strip searches, such as gender and age, and to identify potential issues related to bias, discrimination, or misuse of strip searches. The findings of this analysis can help inform policy and practice regarding arrests and strip searches, ensuring that these practices are fair and respectful.

3.2 ANCOVA

3.2.1 Assumption Check

Before performing the One-way ANCOVA test, we ensured that the following assumptions were met:

1) Independence of errors;
2) Linearity between dependent variable and the covariates;
3) Normality assumption;
4) Homogeneity of variances;
5) Homogeneity of regression slopes.

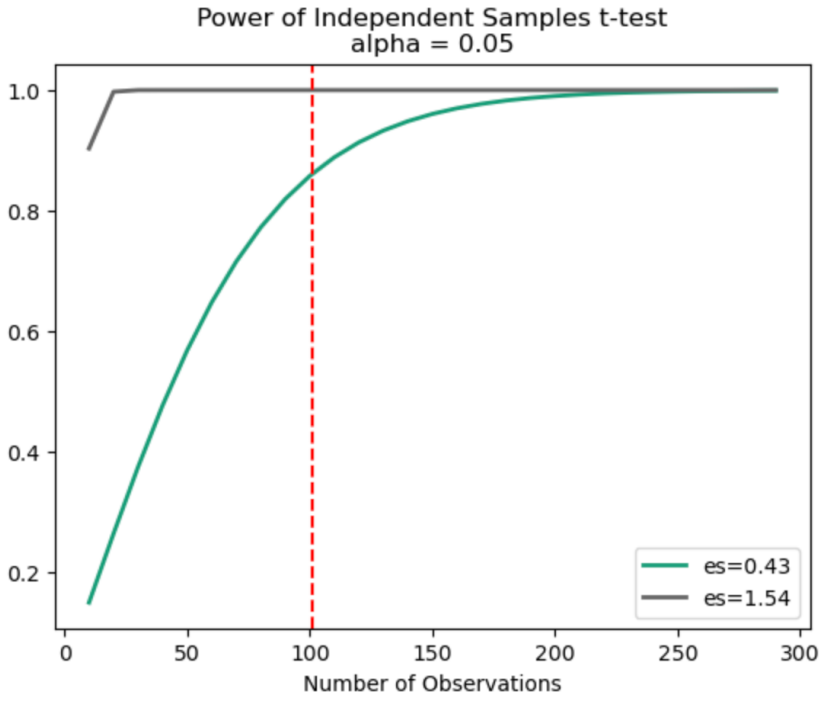
After we checked all assumptions, we used one-way ANCOVA to do further analysis. The following paragraphs summarize some of the most notable results from our one-way ANCOVA analysis.

3.2.2 Power Analysis

In order to determine the appropriate sample size for our study, a power analysis was conducted using Python. Based on previous research, we have the effect size from 0.43-1.54 (calculated from standard deviation of male and female) for the one-way ANCOVA. We set the alpha level at 0.05 and desired statistical power at 0.80. The results of the power analysis are shown in Figure 7 as below. Our study involved one group in the independent variable (Male and Female) and two continuous covariates (Race group and Age group). The power analysis indicated that a minimum total sample size is 100 was required to achieve the desired statistical power of 0.80. Our actual sample size is 1622 exceeds this recommendation, suggesting that our study is adequately powered to detect the effect of interest.

Figure 7

Power Analysis for Logistic Regression



3.2.3 ANCOVA Test

To determine whether there is a significant difference in the number of arrests between males and females, after controlling for the age and race group. We conducted one-way ANCOVA analysis and the following hypothesis is tested:

> **Null hypothesis:** There is no significant difference in the number of arrests between males and females, after controlling for the age and race group.
>
> **Alternative hypothesis:** There is significant difference in the number of arrests between males and females, after controlling for the age and race group.

In our study, we have one independent group (males and females) and one continuous variable of interest (number of arrests). Based on the literature review, we think that age and race group might account for some differences in the number of arrests, therefore we added it to the analysis

as covariates. After confirming that our variable of interest is normal and our data meet the other assumptions of one-way ANCOVA, we proceed with the analysis.

The null hypothesis, which is statistical lingo for what would happen if males and females have different numbers of arrests on average after accounting for the effect of race and age group. We are trying to determine if males and females would have different numbers of arrests after controlling for the race and age group.

After the experiment is over, we compare the one group on our variable of interest (number of arrests) using a one-way ANCOVA. When we run the analysis, we get an F-statistic and a p-value. The F-statistic is a measure of how different the one group is on the number of arrests after accounting for age and race group.

A p-value is the chance of seeing our results assuming neither of the sex actually changes the number of arrests. A p-value less than or equal to 0.05 means that our result is statistically significant and we can trust that the difference is not due to chance alone. If the F-statistic is high and the p-value is low, it means that the number of arrests was significantly different in sex.

3.3 Logistic Regression

3.3.1 Assumption Check

Before performing the logistic regression analysis on the variables in the dataset, we ensured that the following assumptions were met:

1) Independence of errors;
2) Linearity in the logit for continuous variables;
3) Absence of multicollinearity;
4) Lack of strong influential outliers.

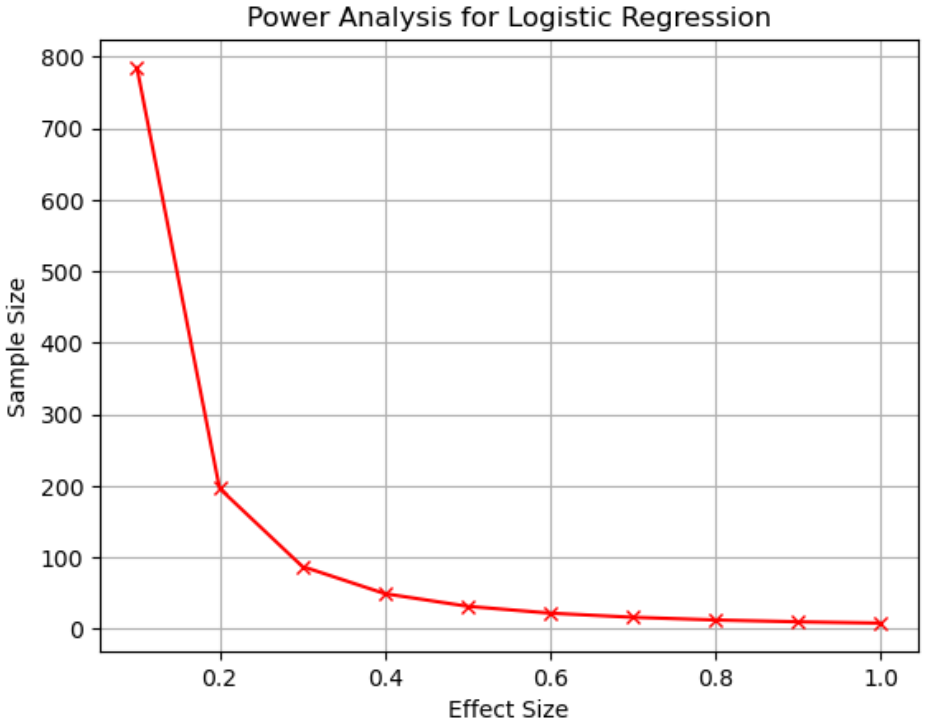
After we checked all assumptions, we used logistic regression to do further analysis. The following paragraphs summarize some of the most notable results from our logistic regression analysis.

3.3.2 Power Analysis

A power analysis was conducted to determine the sample size needed for the logistic regression analysis. The range of effect sizes considered was from 0.1 to 1, with 10 equally spaced intervals. The significance level is set at 0.05. The desired power was set at 0.8. The results of the power analysis are shown in Figure 8. The sample size needed to achieve the desired power of 0.8 increases as the effect size decreases. Based on the results of the power analysis, it is evident that larger sample sizes are required to achieve adequate power for detecting smaller effect sizes, while smaller sample sizes may be sufficient for detecting larger effect sizes.

Figure 8

Power Analysis for Logistic Regression



3.3.3 Logistic Regression Analysis

We conducted logistic regression analysis to analyze whether there is significant relationship between the age of the individual at the time of arrest (Youth vs. Adult; two-level explanatory variable) and the probability of a strip search (outcome variable) being conducted. The following hypothesis is tested:

> **Null hypothesis:** There is no significant relationship between the age of the individual at the time of arrest (youth vs. adult) and the probability of a strip search being conducted.
>
> **Alternative hypothesis:** There is a significant relationship between the age of the individual at the time of arrest (youth vs. adult) and the probability of a strip search being conducted.

Since the outcome variable is binary, logistic regression analysis is a suitable method for addressing RQ2. We performed logistic regression analysis using the 'Logit' function from the 'statsmodels' library in Python, after encoding the explanatory variable (Youth_at_arrest__under_18_years) using one-hot encoding with 'pd.get_dummies()' function. The first dummy variable is dropped to avoid multicollinearity in the logistic regression model. The model will give us the estimated coefficients of the model and the odds ratio can be calculated by taking the exponential of the estimated coefficients.

4. Results and Findings

In RQ1, we found that there is a significant difference in the number of arrests on average performed between males and females, after controlling for the race and age group. From the One-Way ANCOVA results table below we could note that for the p-value is 4.56e-05 which is smaller than 0.05 means that our result is statistically significant and we can trust that the difference is not due to chance alone. The F-statistic is 18.45 which is high and the p-value is low, it means that the number of arrests on average was significantly different between males and females. Therefore, we could conclude that there is a significant difference in the number of arrests between males and females, after controlling for the age and race group.

Table 2

One-Way ANCOVA Results

RQ1 One-Way ANCOVA results

Variables	sum_sq	df	F	PR(>F)	np2
Sex	2.624882e+05	1.0	18.452291	4.56E-05	1.77E-01
Perceived_Race	2.568032e+04	1.0	1.805265	1.826118e-0	2.06E-02
Age_group__at_arrest_	1.00E+04	1.0	0.704231	4.04E-01	8.12E-03
Residual	1.22E+06	1622.0	NaN	NaN	NaN

In RQ2, we found that there is a significant relationship between the age of the individual at the time of arrest (youth vs. adult) and the probability of a strip search being conducted. (1) The estimated coefficient for the explanatory variable (Youth at Arrest) is -0.304518, which suggests that being categorized as “youth” at the time of arrest (as opposed to being categorized as “not a youth”) is associated with a decrease in the log-odds of a strip search being conducted by 0.304518 units. (2) The estimated odds ratio for the explanatory variable (Youth at Arrest) is 0.737478, which means that being categorized as “youth” at the time of arrest (as opposed to being categorized as “not a youth”) is associated with a decrease in the odds of a strip search being conducted by approximately 26.25% (100% - 73.75%). Overall, the results suggest that being categorized as “youth” at the time of arrest is associated with a decrease in the likelihood of a strip search being conducted, compared to being categorized as “not a youth”, after controlling for other variables in the model. Table 3 shows the results for the logistic regression analysis. Thus, we can conclude that an individual is less likely to be strip searched if the individual is a youth as compared to if the individual is an adult.

Table 3

Results for Logistic Regression Analysis

Logit Regression Results	
Dep. Variable: StripSearch	No. Observations: 65276
Model: Logit	Df Residuals: 65274
Method: MLE	Df Model: 1
	Pseudo R-squ.: 0.0005130
	Log-Likelihood: -23875
converged: True	LL-Null: -23887
Covariance Type: nonrobust	LLR p-value: 7.404e-07
Coefficient: -0.304518	Odds Ratios: 0.737478

5. Discussion and Limitation

The first research question aimed to analyze whether there is significant difference in the number of people arrested between males and females, while controlling for race and age group. Our ANCOVA analysis revealed a significant main effect of sex on the number of arrests and indicated that males were arrested more frequently than females after accounting for race and age group. This finding is consistent with prior research indicating that males tend to have higher arrest rates compared to females (Steffensmeier & Allan, 1996; Heidensohn, 2000). Our results extend these findings by demonstrating that gender differences in arrest rates persist even after controlling for potential confounding factors, such as race and age group. The theoretical implication of our findings is that gender may play an important role in shaping criminal behavior or criminal justice system responses, as suggested by gendered theories of crime (Chesney-Lind & Pasko, 2013). Practically, our results highlight the need to further investigate and address gender disparities in arrest rates and criminal justice outcomes. Future research could explore the underlying factors driving gender differences in arrest rates, such as socialization processes, peer influences, or differential treatment by law enforcement.

The second research question aims to analyze whether the individual's age (Youth vs Adult) has a significant relationship with the likelihood of the individual being strip searched. The logistic regression showed that there is a significant relationship between the individual's age (Youth vs

Adult) and the likelihood of being strip searched. RQ2 showed that youths are less likely to be strip searched as compared to adults.

Despite our study's noteworthy findings, certain limitations should be addressed. For starters, our analysis relied on arrest statistics, which may not accurately reflect the total degree of criminal behavior in the public. Self-report surveys or other data sources could provide a more complete picture of gender variations in criminal activities. Second, while we adjusted for race and age, we did not account for other potential confounding variables such socioeconomic position or neighborhood features. Additional factors that may influence arrest rates should be measured and controlled for in future study. Third, because our study is cross-sectional, we are unable to draw causal inferences about the relationship between gender, race, age group, and arrest rates.

However, there exist some limitations to this analysis since the number of adults in the dataset is significantly greater than the number of youths in the dataset. Due to the fact that the sample size for youths is relatively small, the results might not be completely representative to the entire population.

6. Conclusion

In conlusion, in our first research question we investigated whether there was a significant difference in the number of people arrested between males and females, after controlling for race and age group. The One-Way ANCOVA results revealed a statistically significant effect of sex on the number of arrests [F= 18.45, p = 4.56e-05]. This finding indicates that, on average, males were arrested more frequently than females, even after controlling for race and age group. Our findings add to the current literature on gender inequalities in arrest rates, implying that gender may play a role in determining criminal behavior or criminal justice system reactions. These findings have practical significance for policymakers and practitioners working to promote a more fair justice system, as they highlight the importance of further investigating and addressing the variables that contribute to gender variations in arrest rates. After adjusting for ethnicity and age group, our One-Way ANCOVA analysis revealed a significant difference in the number of arrests between males and females. This study emphasizes the importance of taking sex into

account when analyzing arrest trends and informs future research and policy measures aimed at eliminating gender inequities in the criminal justice system.

In our second research question, we found that (1) being categorized as “youth” (as opposed to being categorized as “not a youth”) is associated with a decrease in the log-odds of a strip search being conducted by 0.304518 units (2) being categorized as “youth” (as opposed to being categorized as “not a youth”) is associated with a decrease in the odds of a strip search being conducted by approximately 26.25% (3) an individual is less likely to be strip searched if the individual is a youth as compared to if the individual is an adult. However, it is important to also consider the possible limitations when interpreting these results/findings.

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