**INF 2178 MIDTERM WRITEUP**

**Group 52: Cunrong Liu, Huayu Wu**

**Instructor:  Shion Guha**

**Table of Contents**

**Introduction**

As the main force for investigating and preventing crimes, the police are often faced with various critical situations. In order to stop harmful behaviors promptly, and protect the personal safety of citizens and policemen as well as the property safety of citizens and the country, the law grants the police the power to use force. Detailed data on police activity, including the identities and backgrounds of suspects or arrestees, is kept in U.S. federal and state records. Statistics show that 90 percent of those killed by police in the past five years were radicals (Published by Statista Research Department & 2, 2023), with the highest rate of radicals being black compared to other races. But an individual's behavior during an arrest may be influenced by different factors, including their personal history and experiences, their mental health, the circumstances under which they were arrested, and their interactions with law enforcement officers. Through this dataset, our motivation is to examine some behaviors of different ages, genders, and skin colors when they are arrested, and to study whether certain groups have a greater probability of showing negative arrest actions when they are arrested and whether different ages, genders and skin colors are encountered when they are arrested. Differential treatment, which is mainly manifested in strip searches. This facilitates discussions around issues related to policing and community policing. The studies are important because they raise issues related to fairness and justice in the criminal justice system and stereotypes about certain groups. By studying the ways that race, gender, and age intersect with criminal justice practice, we can work towards a more just and equitable system that treats all individuals with fairness and dignity. In this report, our main test methods include: T-test, One-way ANOVA and Two-way ANOVA. We mainly studied the relationship with negative arrest actions based on race, age, and gender. Our research questions are two:

Do negative arrest actions have anything to do with race, and what influences strip searches?

Do negative arrest actions have a relationship with sex and age?


**Literature review**

There has always been a dispute between race and arrest. The research from D'Alessio and Stolzenberg in 2003 assessed the effect of race on the probability of arrest for nearly 340,000 crimes and found that white and black criminals were arrested at roughly similar rates (D'Alessio & Stolzenberg, 2003). The rise in black arrests might simply reflect their greater involvement in crime, rather than racism by law enforcement officers. The analysis showed that whites were more likely than blacks to be arrested for robbery, aggravated assault, and common assault (D'Alessio & Stolzenberg, 2003). There was no significant difference in arrest rates between blacks and whites for rape. And this analysis refuted the point that police bias affected the arrest

rate of blacks. D'Alessio also stated that black citizens' distrust of the police is also one of the reasons for this problem because black citizens were unwilling to report or testify about crimes committed by other black citizens, which led to an increase in the arrest rate of white criminals (D'Alessio & Stolzenberg, 2003). In addition, whites generally had higher expectations for arrests. In the second article：who commits crime, different aspects of the causes and associations between crime rates are described. Firstly, it mentioned that the crime rate of men was much higher than that of women and this significant difference could be attributed to the socialization of gender roles and the chances of boys spending nights out alone more than girls (Newburn, 2018). Secondly, age also affected crime rates as well especially at a young age around teens to twenties. Teenagers and older adults who lack full-time employment were also more likely than other age groups to commit crimes to obtain money when they need it (Newburn, 2018). Thirdly, the crime rate influenced by social class is not as clear as the first two (Newburn, 2018). It was interesting that in the arrest data, poor people were more likely than rich people to commit a street crime but rich people were more likely than poor people to commit a white-collar crime which was more harmful than street crime. Therefore, from this perspective, the relationship between social class and crime was not significant because of different emphases. The fourth point was urban vs rural residential and urban had higher crime rates than rural areas. The key factor was that urban had a high population density. The last point was race. The article mentioned race was bound to be associated with racial discrimination. But over time, the race differences in crime were also related to the previous reasons. For example, whites commit more white-collar crimes. What's more, the average level of African-Americans and Hispanics was poorer than whites, which may lead to high street crime rates. Experienced racism also led to anger and frustration that fuel criminal behavior. In the third article, Piquero and Brame used official records and self-report data from samples of serious juvenile offenders in Philadelphia and Phoenix to better understand the relationship between race and criminal activity in 2008. (Piquero & Brame, 2008) stated that in the research, white men in Philadelphia self-reported crime more frequently than Hispanics and blacks, while the results for men and women in Phoenix were similar to those for women in Philadelphia. Median self-reported crime frequencies did not appear to differ between racial groups. In the analysis of crime diversity scores, scores among Philadelphia male racial groups were greater than self-reported crime frequency (Piquero&Brame, 2008). The black crime rate was only a small part of Phoenix males. Overall, prior-year arrest brigades did not differ significantly between racial and ethnic groups and self-reported criminal diversity was positively associated with expected official arrests (Piquero&Brame, 2008).

**EDA**

1. Descriptive Statistics:

| | Race | Sex | Age | Occurrence category | Action at arrest: concealed items | Action at arrest:Combative, violent or spitter/biter | Action at arrest: resistd, defensive or escape risk | Action at arrest: mental instability | Action at arrest: assaulted officer | Action at arrest: cooperative | Total adverse actions | Strip search |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 | 64615 |
| Mean | NaN | NaN | NaN | NaN | 0.0041 | 0.0444 | 0.0385 | 0.0336 | 0.0064 | 0.5506 | 1.9233 | 0.113 |
| Std | NaN | NaN | NaN | NaN | 0.0639 | 0.2060 | 0.1923 | 0.1802 | 0.0797 | 0.4974 | 1.4537 | 0.317 |
| Min | NaN | NaN | NaN | NaN | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 |
| Max | NaN | NaN | NaN | NaN | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 11.0000 | 1.0000 |

2. Data Visualization:
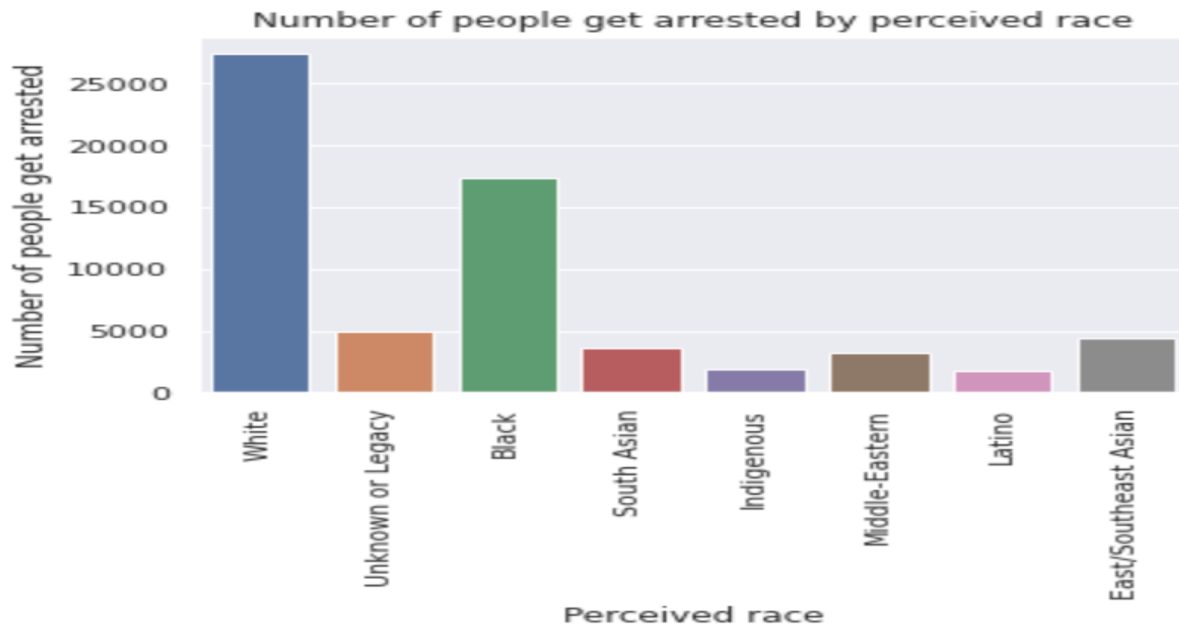
Plot 1: Number of people get arrested by perceived race

In this plot, the x-axis represents the different races of the arrested individuals, while the y-axis shows the total number of people get arrested by the police. It can be seen that white people account for the largest proportion, followed by black and brown people.
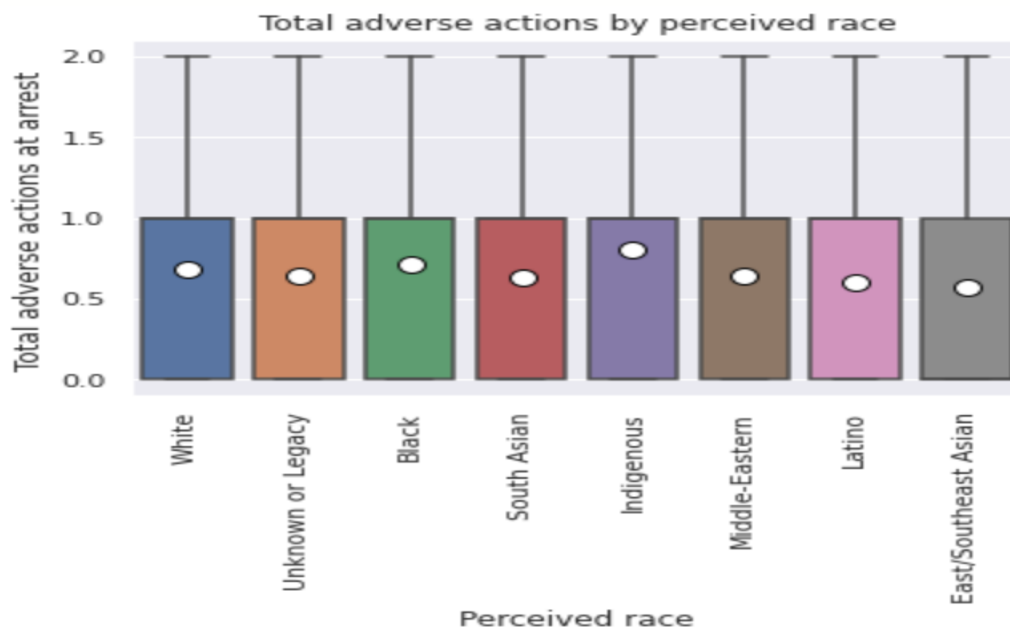


plot 2: Total adverse action by perceived race

This plot is a box chart that displays the distribution of total adverse actions at arrest by perceived race. The x-axis represents the different perceived races, and the y-axis represents the total adverse actions at arrest. Median values for black and indigenous individuals were slightly higher than those for other races, suggesting that these groups tend to have more negativity behavior when arrested.
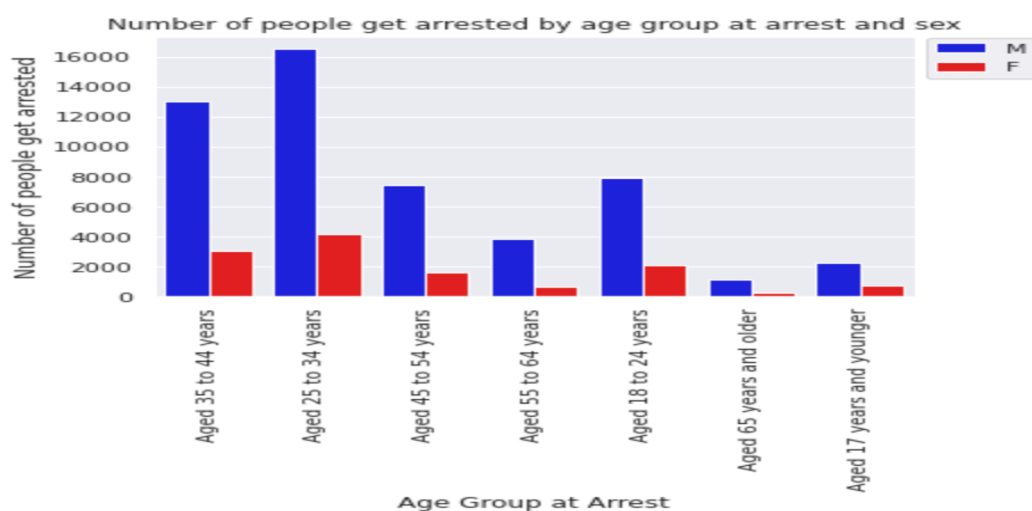


Plot 3: Number of people get arrested by age group at arrest and sex

This boxplot shows the number of arrests by age group and gender at the time of the arrest. The x-axis represents the age group at arrest, while the y-axis represents the number of people who get arrested. The bars are grouped by gender, with blue representing males and red representing females. The plot shows that the 25-34 age group made the most arrests, followed by the 35-44 age group. The number of arrests is the lowest in the two age groups : Aged 65 and older & aged 17 years and younger.
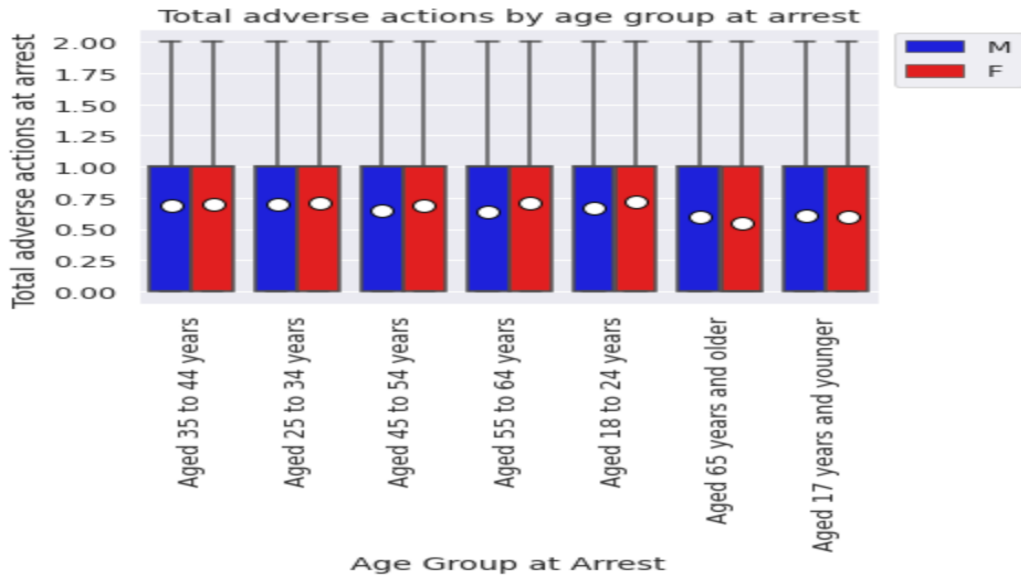
Plot 4: Total adverse actions by age group at arrest

This is a box plot that shows the distribution of the total adverse actions at arrest for different age groups at arrest. The x-axis represents the age group at the time of arrest, and the y-axis represents the total adverse actions at arrest. The plot is split into two groups based on sex, with males shown in blue and females shown in red. Median values for individual in aged 25 to 34 years and aged in 18 to 24 were slightly higher than those for other age group, suggesting that these groups tend to have more negativity behavior when arrested. And the median is lowest as age goes beyond 65, or when they are below 18.
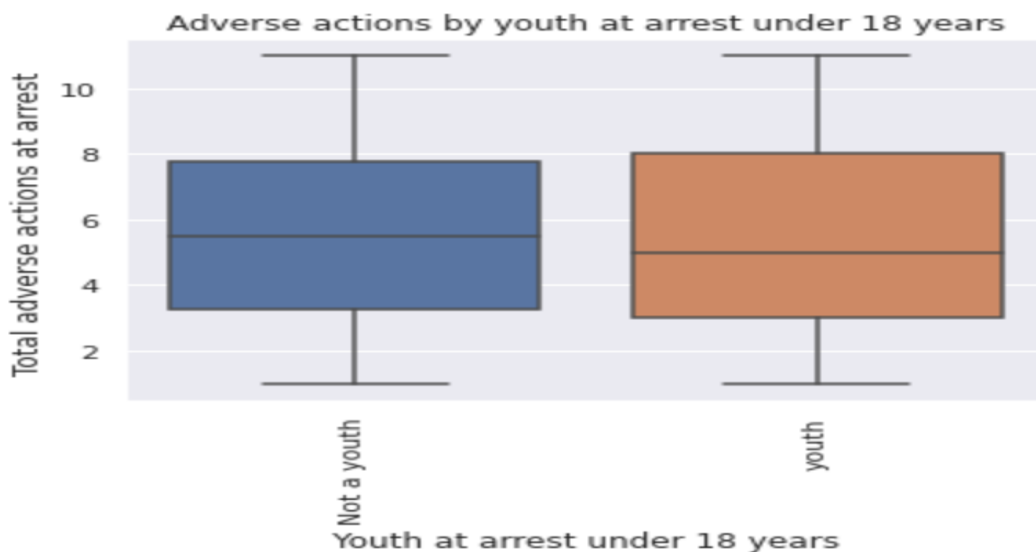
This plot shows the distribution of the total adverse actions at arrest taken by police against youth at the time of their arrest, based on whether they were youths or not. From this graph, we can observe that people who are not youth have a slightly higher median rate of misconduct than adults when they are arrested.

3. T-test (T):

Because t-tests are able to provide statistical measures of the significance of the difference between two means while taking into account the variability in the data, therefore, we ran Welch's t-tests with the categorical attributes in the dataset. We chose Welch's t-test instead of the student's t-test since equal variance among the residuals was not assumed. We checked the assumptions before implementing Welch's t-test and confirmed that the observations are independent, the data for each group are normally distributed, and there are no significant outliers. The following paragraphs demonstrate the way we ran the t-test as well as the results of the t-tests.

*Sex and adverse actions at arrest*

We conducted the first t-test to analyze whether the suspects' adverse actions(outcome variables) at arrest differ between males and females (Two-level explanatory variables). The hypothesis being tested are the following:

H0 (Null Hypothesis): The population means of the two independent groups, female suspects and male suspects are equal.

Ha (Alternative Hypothesis): The population means of the two independent groups, female suspects and male suspects are different.

```
    statistic     pvalue    Mean F     Mean M        sd F        sd M  \
 0   3.147228   0.001651   0.69584   0.673128    0.725651    0.720153

                                                      CI           DOF
 0  (0.008567046580899382, 0.03685724390388165)   18850.712659
```

Table 1: T-test Sex and adverse actions at arrest result

The results indicate that the mean adverse actions at arrest for female suspects (M=0.6958, SD=0.7257) are higher than the mean adverse actions at arrest for male suspects (M=0.6731, SD=0.7202). With alpha established at 0.05, this is a statistically significant difference as the

p-value (0.00165) is less than 0.05, 95% CI [0.0086, 0.0369]. Therefore, we can reject the null hypothesis that there is no difference in adverse actions at arrest for female suspects and male suspects.

*Age(Youth) and adverse actions at arrest*

We conducted the Second t-test to analyze whether the suspects' adverse actions(outcome variables) at arrest differ between youth and adults(Two-level explanatory variables). The hypothesis being tested are the following:

H0 (Null Hypothesis): The population means of the two independent groups, youth suspects and adult suspects are equal.

Ha (Alternative Hypothesis): The population means of the two independent groups, youth suspects and adult suspects are different.

```
    statistic          pvalue    Mean Y     Mean A       sd Y        sd A  \
0   -6.646632   3.477880e-11   0.602258   0.681249   0.63222   0.725195

                                          CI
0   (-0.10229304318502694, -0.05569026418524628)
```

Table 2: T-test Age(Youth) and adverse actions at arrest result

The results indicate that the mean adverse actions at arrest for youth suspects (M=0.6023, SD=0.6812) are higher than the mean adverse actions at arrest for adult suspects (M=0.6322, SD=0.7252). With alpha established at 0.05, this is a statistically significant difference as the p-value (3.47e^-11) is less than 0.05, 95% CI [-0.1023, -0.0557]. Therefore, we can reject the null hypothesis that there is no difference in adverse actions at arrest for youth suspects and adult suspects.

*Asian&other race and adverse actions at arrest*

We conducted the third t-test to analyze whether the suspects' adverse actions(outcome variables) at arrest differ between Asian and other races. The hypotheses being tested are the following:

H0 (Null Hypothesis): The population means of the two independent groups, Asian suspects and other races suspects are equal.

Ha (Alternative Hypothesis): The population means of the two independent groups, Asian suspects and other races suspects are different.

```
      statistic        pvalue    Mean A    Mean O      sd A      sd O   CIlower   \
0   -7.236391  4.850913e-13  0.593961  0.677241  0.650295  0.738973 -0.105838

      CIhigher
0   -0.060721
```

Table 3: T-test Asian&other race and adverse actions at arrest result

The results indicate that the mean adverse actions at arrest for Asian suspects (M=0.5940, SD=0.6503) are lower than the mean adverse actions at arrest for other races suspects (M=0.6772, SD=0.7390). With alpha established at 0.05, this is a statistically significant difference as the p-value (4.85e^-13) is less than 0.05, 95% CI [-0.1058, -0.0607]. Therefore, we can reject the null hypothesis that there is no difference in adverse actions at arrest for Asian suspects and other races suspects.

*Black&White race and adverse actions at arrest*

We conducted the fourth t-test to analyze whether the suspects' adverse actions(outcome variables) at arrest differ between Black and White. The hypotheses being tested are the following:

H0 (Null Hypothesis): The population means of the two independent groups, Black suspects and White suspects are equal.

Ha (Alternative Hypothesis): The population means of the two independent groups, Black suspects and White suspects are different.

```
      statistic    pvalue    Mean W    Mean B      sd W      sd B   CIlower   \
0   -4.582654  0.000005  0.683439  0.716344  0.726564  0.748612 -0.046979

      CIhigher
0   -0.018832
```

Table 4: T-test Black&White race and adverse actions at arrest result

The results indicate that the mean adverse actions at arrest for White suspects (M=0.6834, SD=0.7266) are lower than the mean adverse actions at arrest for Black suspects (M=0.7163, SD=0.7486). With alpha established at 0.05, this is a statistically significant difference as the p-value (0.000005) is less than 0.05, 95% CI [-0.0470, -0.0188]. Therefore, we can reject the null hypothesis that there is no difference in adverse actions at arrest for Black suspects and White suspects.

*Asian&Black race and adverse actions at arrest*

We conducted the fifth t-test to analyze whether the suspects' adverse actions(outcome variables) at arrest differ between Asian and Black (Two-level explanatory variables). The hypotheses being tested are the following:

H0 (Null Hypothesis): The population means of the two independent groups, Asian suspects and Black suspects are equal.

Ha (Alternative Hypothesis): The population means of the two independent groups, Asian suspects and Black suspects are different.

```
    statistic           pvalue    Mean A    Mean B        sd A        sd B    CIlower  \
0  -13.252695    6.750427e-40    0.593961    0.716344    0.650295    0.748612  -0.140483

    CIhigher
0  -0.104282
```

Table 5: T-test Asian&Black race and adverse actions at arrest result

The results indicate that the mean adverse actions at arrest for Asian suspects (M=0.5940, SD=0.6503) are lower than the mean adverse actions at arrest for Black suspects (M=0.7163, SD=0.7486). With alpha established at 0.05, this is a statistically significant difference as the p-value (6.75e^-40) is less than 0.05, 95% CI [-0.1405, -0.1043]. Therefore, we can reject the null hypothesis that there is no difference in adverse actions at arrest for Asian suspects and Black suspects.

*T-test concluding remarks*

From the above two T-tests, we found that the suspects' mean value of total adverse actions at arrest was statistically significant depending on their gender, age and race.

**Research Design and Methods**

Dataset Description:

The Arrests and Strip Searches (RBDC-ARR-TBL-001) dataset contains information about all arrests and strip searches conducted by the Toronto Police Service between 2020 and 2021. This data includes the arrestee's age, race, gender, behavior at the time of arrest, and the reason for the search, as well as the location, time, and case code of the arrest.

Dependent variables: The dependent variable (DV) was not clearly defined. However, By performing data cleaning, We combine several variables, including Actions at arrest - Concealed items, Actions at arrest - Combative, violent or spitter/biter, Actions at arrest - Resisted, defensive or escape risk, Actions at arrest - Mental instability or possibly suicidal, Actions at

arrest - Assaulted officer and Actions at arrest - Cooperative. we can consider the number of adverse arrest actions (Total adverse actions) as a potential DV reflecting negative arrest actions during the arrest.

Independent variables: Age group at arrest, Sex, Race

Based on our findings from the descriptive analysis and T-tests, we will use inferential statistical tests to explore our research questions.

Research question 1: From the EDA, the boxplot of total adverse actions at arrest vs perceived race illustrates that there is no big difference between each race group. We would like to use one-way ANOVA to explore if race has a relationship with total adverse actions at arrest, and how it influences total adverse actions at arrest. We checked the assumption before conducting the one-way ANOVA and confirmed that the data are independent, the distributions have the same variance and the responses for each factor level have a normal population distribution.

- H0 (Null Hypothesis): The population means of total adverse actions at arrest are equal for each perceived race.
- Ha (Alternative Hypothesis): The population means of total adverse actions at arrest of at least one perceived race are different from other perceived races.

Research question 2: From the T-test, we found that the suspects' mean value of total adverse actions at arrest was statistically significant depending on their gender as well as their age. Therefore, we would like to use two-way ANOVA to explore how the combination of gender and age changes the suspects' mean value of total adverse actions at arrest. We checked the assumption before conducting the one-way ANOVA and confirmed that the data are independent, the distributions have the same variance and the responses for each factor level have a normal population distribution.

- H0 (Null Hypothesis): The population means of total adverse actions at arrest are equal for each gender/age combination.
- Ha (Alternative Hypothesis): The population means of total adverse actions at arrest of at least one gender/age combination are different from other combinations.


**Results and Findings**

RQ1: A one-way ANOVA was performed to compare the effect of race on total adverse actions at arrest. It revealed that there was a statistically significant difference in the mean of total adverse actions at arrest at least two groups ($F(3, 59609) = [52.26]$, $p = 9.9925e-34$). Tukey's HSD Test for multiple comparisons found that the mean value of total adverse actions at arrest was significantly different between Asian and Black($p = 0.001$, 95% C.I. = [0.0972, 0.1476]),

Asian and other races(p = 0.001, 95% C.I. = [0.0526, 0.1139]), Asian and White(p = 0.001, 95% C.I. = [0.0658, 0.1132]), Black and other races(p = 0.001, 95% C.I. = [-0.0656, -0.0126]), black and white(p = 0.001, 95% C.I. = [-0.0510, -0.0148]). There was no statistically significant difference in the mean value of total adverse actions at arrest between other races and White (p=0.9).

| | sum_sq | df | F | PR(>F) |
|---|---|---|---|---|
| C(Perceived_Race) | 82.378001 | 3.0 | 52.263776 | 9.992512e-34 |
| Residual | 31318.507041 | 59609.0 | NaN | NaN |

Table 6: one-way ANOVA, race and total adverse actions at arrest result

```
Multiple Comparison of Means - Tukey HSD, FWER=0.05
====================================================
group1 group2 meandiff p-adj  lower   upper   reject
----------------------------------------------------
 Asian  Black   0.1224 0.001  0.0972  0.1476   True
 Asian  Other   0.0833 0.001  0.0526  0.1139   True
 Asian  White   0.0895 0.001  0.0658  0.1132   True
 Black  Other  -0.0391 0.001 -0.0656 -0.0126   True
 Black  White  -0.0329 0.001  -0.051 -0.0148   True
 Other  White   0.0062   0.9 -0.0189  0.0313  False
----------------------------------------------------
```

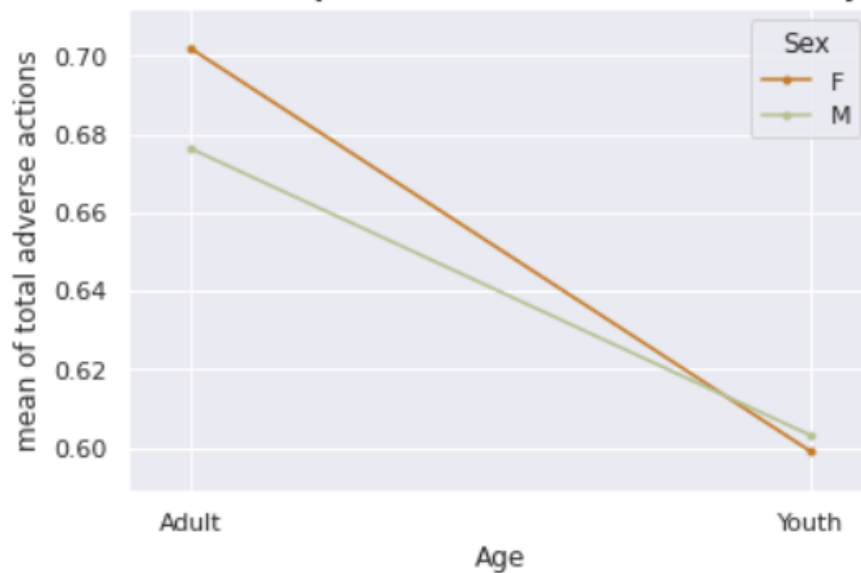Table 7: Tukey HSD for one-way ANOVA

RQ2: A two-way ANOVA was performed to analyze the effect of gender and age on total adverse actions at arrest. It revealed that there was not a statistically significant interaction between the effects of gender and age ($F_{(1, 64602)} = 0.88$, $p = 0.348$). Therefore, we fail to reject the null hypothesis that the mean total adverse actions at arrest are equal among gender and age combinations, and there is no need to perform the Tukey test. Additionally, simple main effects analysis showed that gender has a statistically significant effect on total adverse actions at arrest. ($F_{(1, 64602)} = 11.0602$, $p = 8.825e^{-04}$). Another Simple main effects analysis showed that age has a statistically significant effect on total adverse actions at arrest. ($F_{(1, 64602)} = 35.4814$, $p = 2.588e^{-09}$). While the interaction plot does not provide any information on the statistically significant differences, the plot showed that the adult suspects have a higher mean of

total adverse actions than the youth suspects. Furthermore, the graph also showed that the female adult suspects have a higher mean of total adverse actions than the male adult suspects.

| | sum_sq | df | F | PR(>F) |
|---|---|---|---|---|
| C(Sex) | 5.749983 | 1.0 | 11.060177 | 8.825084e-04 |
| C(Youth_at_arrest__under_18_years) | 18.446134 | 1.0 | 35.481411 | 2.588235e-09 |
| C(Sex):C(Youth_at_arrest__under_18_years) | 0.457811 | 1.0 | 0.880606 | 3.480392e-01 |
| Residual | 33585.393357 | 64602.0 | NaN | NaN |

Table 8: two-way ANOVA, gender, age and total adverse actions at arrest result



Plot 6: Interaction Plot to show suspects' mean total adverse actions by gender and age

**Discussion:**

RQ1 explored the effect of race on the total adverse actions at arrest. The one-way ANOVA test showed that there was a statistically significant difference in the mean of total adverse actions at arrest between at least two racial groups. The Tukey HSD test was conducted to perform multiple comparisons, and it revealed that the mean value of total adverse actions at arrest was significantly different between Asian and Black, Asian and other races, Asian and White, Black and other races, and Black and White. However, there was no statistically significant difference between other races and White. These findings suggest that overall adverse behavior at the time

of arrest is racially biased. The fact that some racial groups had higher averages for overall bad behavior at the time of arrest suggests that they were disproportionately affected by police actions during the arrest process. This may be due to a variety of reasons, including conscious or unconscious bias, prejudice or racial profiling. It is important to acknowledge and address this issue to ensure fair and equitable treatment for all, regardless of race. The second analysis examines the impact of age and gender on total adverse actions at arrest. The results suggest that there is no interaction between age and gender, indicating that the effects of gender and age are independent. However, gender and age individually have a statistically significant effect on the total adverse actions at arrest. The graph shows that adult suspects have a higher mean of total adverse actions than youth suspects, which may be due to the perception that adult suspects pose a greater threat. Moreover, the graph shows that female adult suspects have a higher mean of total adverse actions than male adult suspects, indicating that gender bias may also exist in law enforcement.Likewise, these findings highlight the existence of implicit biases in law enforcement that may affect the treatment of individuals based on race, age, and gender. These biases can lead to discrepancies in the total number of adverse actions taken by law enforcement, with serious consequences for suspects.

**Conclusion:**

In this report, We use a dataset from the Toronto Police Service to explore the link between arrestee age, gender, race and arrestee behavior at the time of arrest.  Through our analysis, we found that the adverse actions by arrestees at the time of arrest varied by race, gender, and age. First, the results of the analysis showed that female suspects were more likely to engage in negative arrest actions during arrest than male suspects. Second, younger suspects tend to take fewer negative adverse actions at the time of arrest than adult suspects. Furthermore, our results show that blacks tend to be arrested at a higher rate than whites and Asians, and they also tend to engage in more negative adverse behavior during their arrests. But it's not accurate to generalize an individual's behavior at the time of arrest simply by race, age or gender. Because, an individual's behavior during arrest may also be influenced by other factors, including their personal history, their mental health, and the circumstances of their arrest. Or the behavior of individuals may also be influenced by their living environment and cultural background, including poverty, discrimination, etc. Therefore, while studying such problems, these problems should also be considered in the test, or some variables should be controlled to improve the accuracy of the results. Therefore, we should abandon the stereotypes of some social groups, treat them with tolerance, and strive to create a fair and peaceful society.

**Reference**:

Tim Newburn. 2018. 3. who commits crime? *Criminology: A Very Short Introduction* (2018), 24–38. DOI:http://dx.doi.org/10.1093/actrade/9780199643257.003.0003

S.J. D'Alessio and L. Stolzenberg. 2003. Race and the probability of arrest. *Social Forces* 81, 4 (2003), 1381–1397. DOI:http://dx.doi.org/10.1353/sof.2003.0051

Alex R. Piquero and Robert W. Brame. 2008. Assessing the race–crime and ethnicity–crime relationship in a sample of serious adolescent delinquents. *Crime & Delinquency* 54, 3 (2008), 390–422. DOI:http://dx.doi.org/10.1177/0011128707307219

Anon. Arrests and strip searches (RBDC-arr-TBL-001). Retrieved February 21, 2023 from https://data.torontopolice.on.ca/datasets/TorontoPS::arrests-and-strip-searches-rbdc-arr-tbl-001/about

Published by Statista Research Department and Feb 2. 2023. People shot to death by U.S. police, by race 2023. (February 2023). Retrieved February 28, 2023 from https://www.statista.com/statistics/585152/people-shot-to-death-by-us-police-by-race/