

Predicting Arrests Following Terry Stops: Analyzing Factors Influencing Police Decision- Making

Name: OUKO BRIAN

Class: DSF-PT07

TM: SAMUEL KARU

INTRODUCTION

This project explores the dynamics of Terry Stops, brief detentions based on reasonable suspicion, which have been a common yet contentious law enforcement practice since the 1968 Supreme Court ruling in *Terry v. Ohio*. Leveraging data analytics and machine learning, our aim is to develop a predictive model to assess the likelihood of an arrest following a Terry Stop, considering factors such as weapon presence, time of day, and demographic details like race and gender. Our analysis seeks to uncover patterns that can help refine policing practices, address potential biases, and contribute to the ongoing discourse on police reform and racial equity. Through a transparent and ethically grounded approach, we aim to provide insights that inform policy, enhance police training, and foster trust between law enforcement and communities.



Business Understanding

Problem Statement

Law enforcement agencies are facing scrutiny over their stop-and-frisk practices, particularly regarding potential biases in arrest decisions. There's a need to understand the factors that influence whether an arrest is made following a Terry Stop to ensure fair and effective policing. This project aims to use data analysis and machine learning to shed light on the factors influencing arrest decisions during Terry Stops, potentially uncovering patterns that could help improve police practices and address concerns about bias in law enforcement.

Objective

- Develop a machine learning model to predict whether an arrest will be made after a Terry Stop.
- Identify key factors that contribute to arrest decisions.
- Analyze if and how demographic factors (race, gender) correlate with arrest outcomes.
- Provide insights to help law enforcement agencies improve their decision-making processes and address potential biases

Stakeholders

- Law enforcement agencies
- Police officers
- Policy makers
- Community leaders and civil rights organizations
- General public

Data Sources

- Dataset was obtained from Seattle Government which can be accessed using this link
 - (https://data.seattle.gov/Public-Safety/Terry-Stops/28ny-9ts8/data_preview)
- Terry Stops dataset containing information on:
 - Presence of weapons
 - Time of day of the call
 - Demographic information (race, gender) of subjects and officers
 - Arrest outcomes

Ethical Consideration

- Handling sensitive demographic data responsibly
- Addressing potential biases in the dataset and model
- Ensuring transparency in methodology and findings
- Considering the broader societal implications of the analysis

Success Criteria

- Develop a classifier with high accuracy in predicting arrests
- Provide actionable insights for improving police practices
- Contribute to the ongoing dialogue about fair policing and potential biases in law enforcement

Methodology

- **1. Data Collection and Inspection:** Gathering the necessary data from the provided dataset.
- **2. Data Cleaning and Preparation:** Cleaning the data to handle missing values, outliers, and incorrect data types.
- **3. Exploratory Data Analysis (EDA):** Analyzing the data to find patterns, relationships, and insights.
- **4. Data Preprocessing:** This includes Feature Selection, Target Variable Encoding, Time Conversion and Categorical Encoding.
- **5. Data Splitting:** Splitting data into Training and Testing sets using the 70/30 ratio.
- **6. Model Selection and Training:** Come up with model choice and model training.
- **7. Model Evaluation:** Check on Accuracy and Classification Report
- **8. Discussion and Next Steps:** Model Performance Analysis and Future work

Data Inspection and Understanding

- Data Inspection
 - The Dataset contains 60984 records and 23 columns
 - Detailed description of each column in description.txt file in Data Folder
 - Majority of the column Data types are objects (19) and only 4 integers



Data Preprocessing

Handling Missing Values

...	Missing Values	Percentage
Weapon Type	57114	93.654073
Initial Call Type	13473	22.092680
Final Call Type	13473	22.092680
Call Type	13473	22.092680
Sector	10770	17.660370
Beat	10764	17.650531
Precinct	10619	17.412764
Subject Age Group	2200	3.607504
Subject Perceived Race	1816	2.977830
Officer Squad	561	0.919913
Frisk Flag	478	0.783812
Subject Perceived Gender	243	0.398465
Officer ID	24	0.039355

Imputation of Missing Values

- Imputed the following variables with placeholder –Unknown to indicate that the value is missing:
 - Initial Call Type
 - Final Call Type
 - Call Type
 - Precinct
 - Sector
 - Beat
 - Weapon

Data Cleaning

- We performed some data cleaning and standardization on some of the columns in our DataFrame
 - Weapon Type:
 - None/Not Applicable – N/A
 - Firearm (unk type) – Firearm unk
 - Firearm Other – Other Firearm
 - Club, Blackjack, Brass Knuckles – Club/Blackjack/Brass Knuckles
 - Subject Perceived Gender:
 - Unable to Determine – Unknown
 - Officer Race:
 - Two or More Races – Multi-Racial

Data Transformation

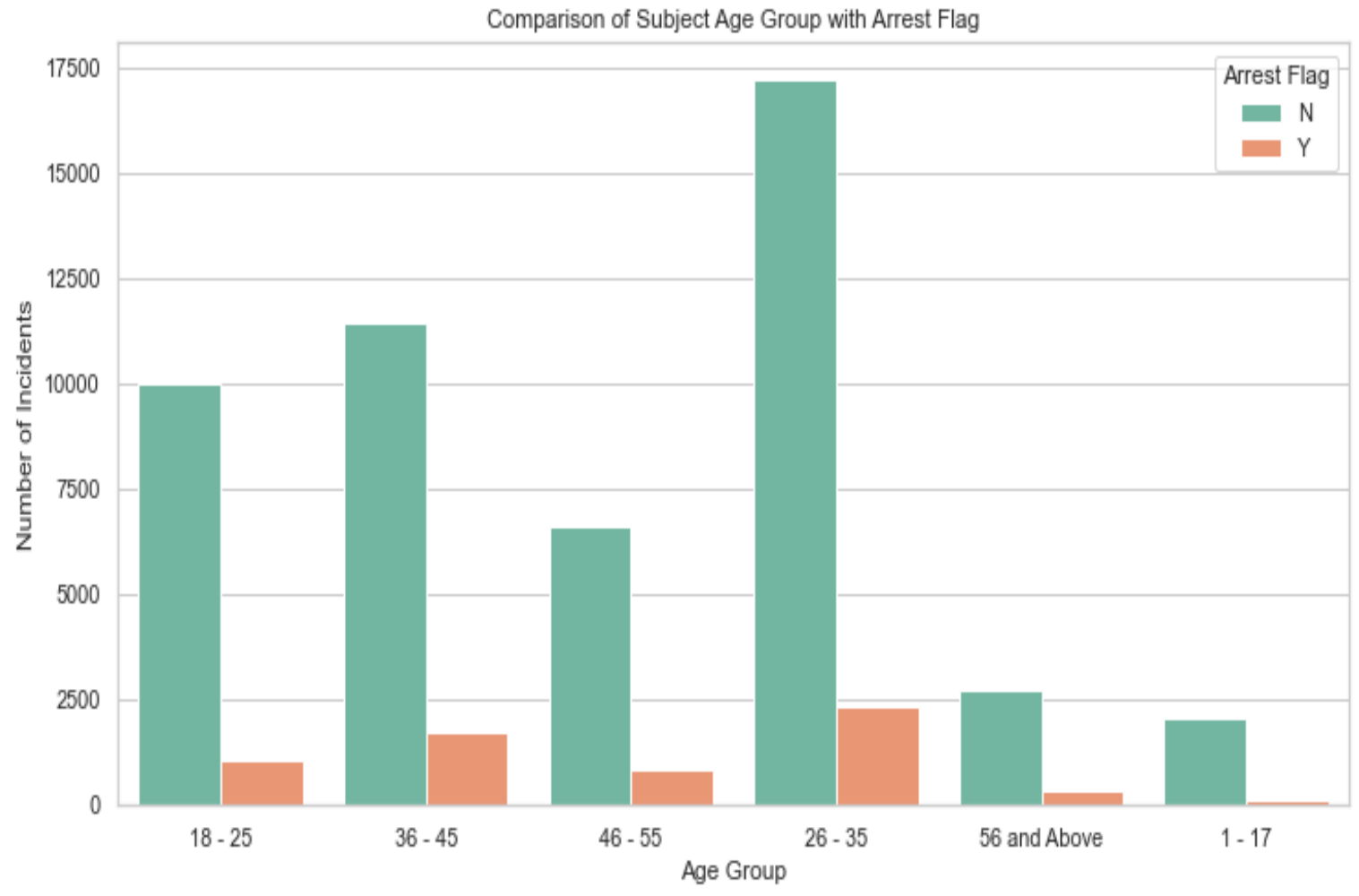
- Handled Reported Date and Reported Time columns which were Dtype objects to date time format

Exploratory Data Analysis

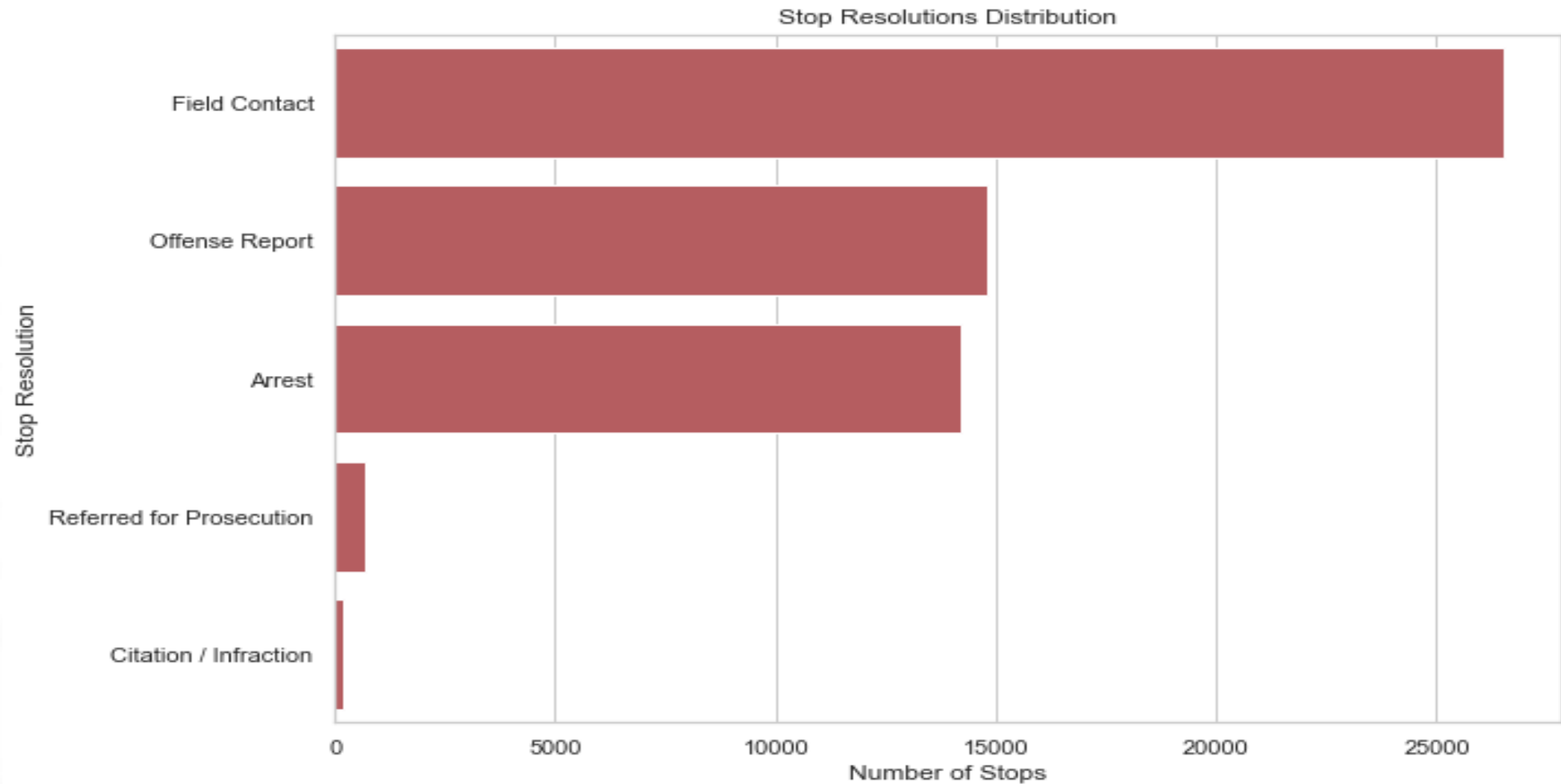


Subject Age Group and Arrest Flag Comparison

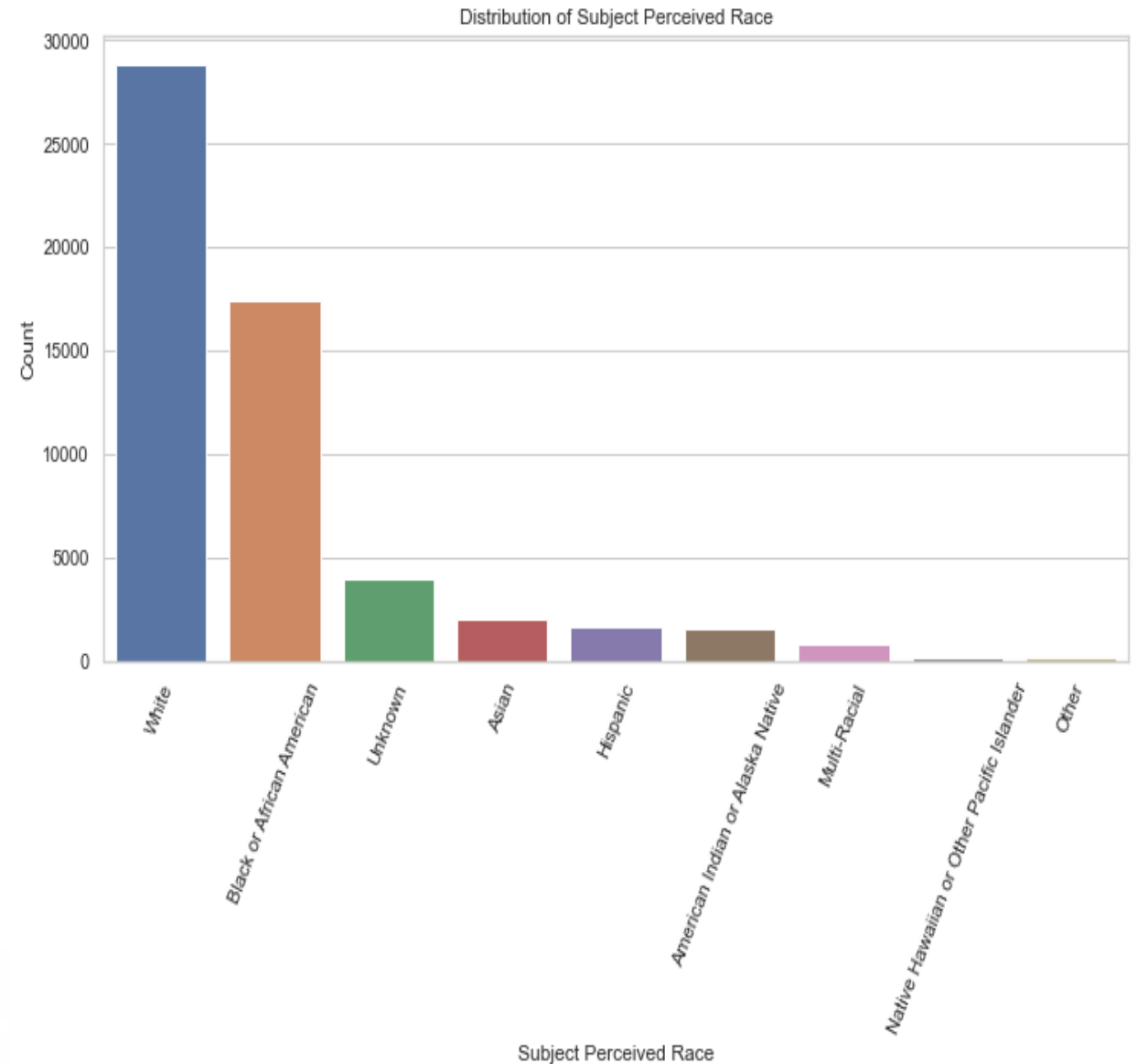
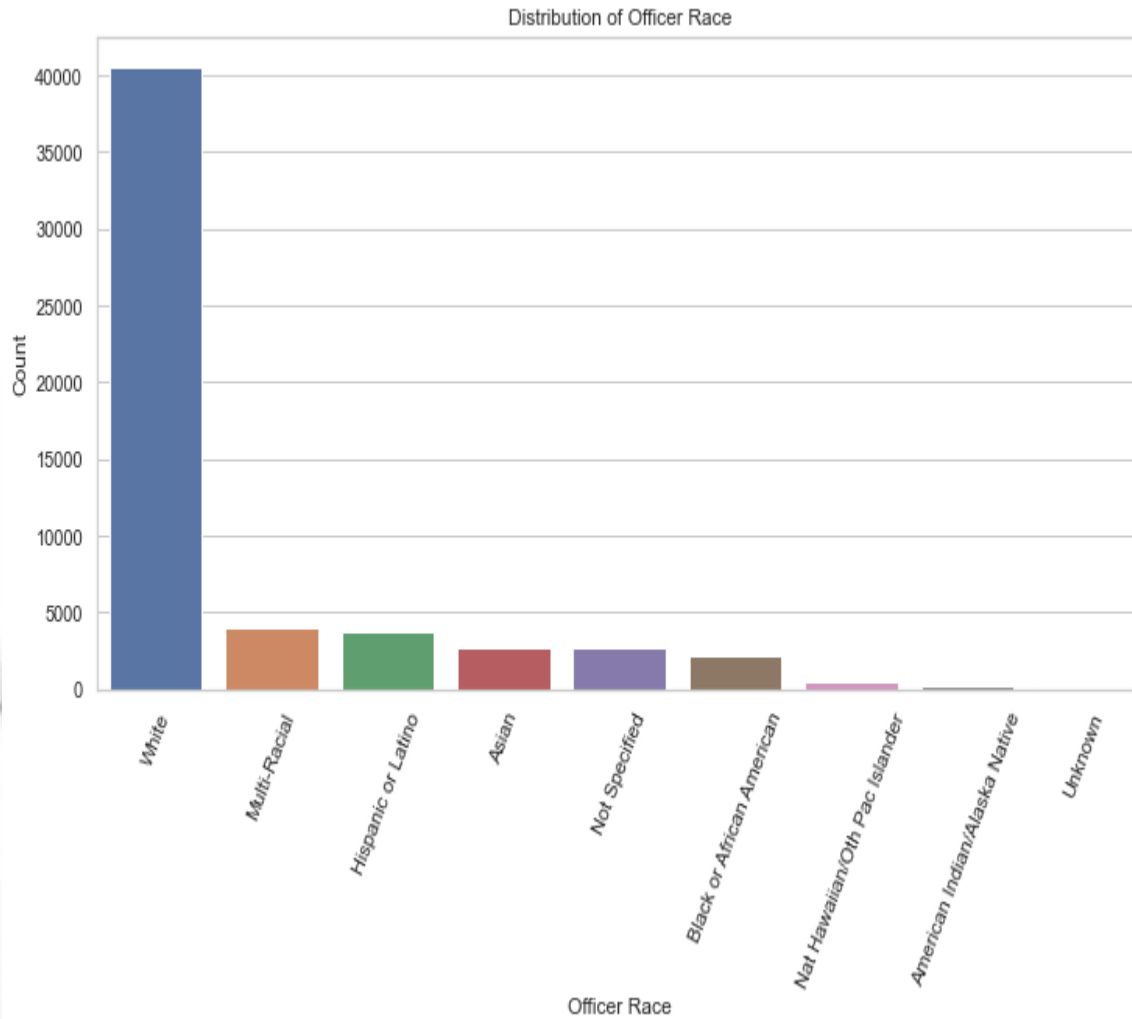
The output shows that Subjects aged between 26-35 years faced highest number of Stops that led to Arrests followed closely by those aged between 36-45 years and 18- 25 years. The rest of the age group's counts are relatively small



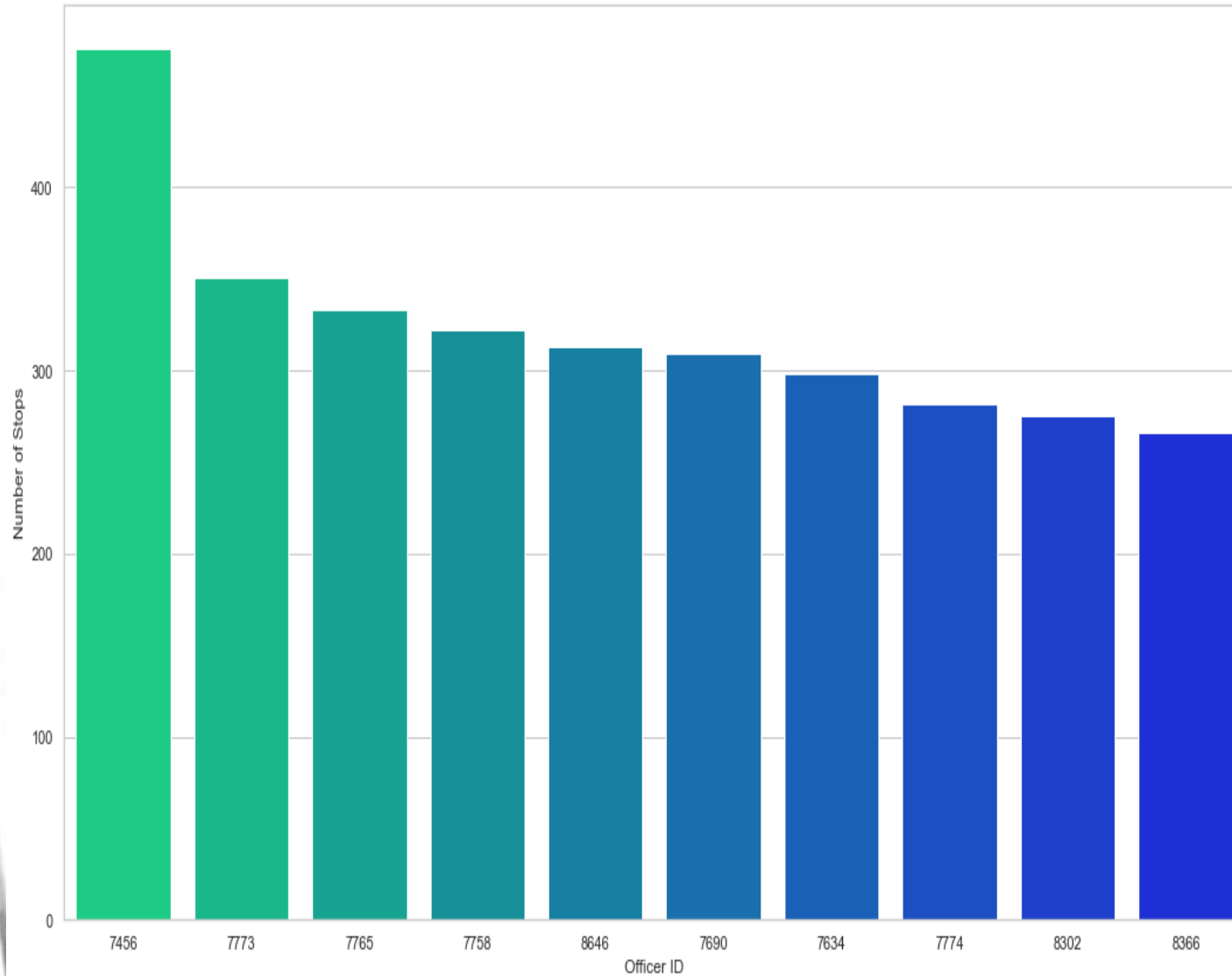
Stop Resolution Comparison



Distribution of Races for both Officers and Subjects



Top 10 Officers by Number of Stops



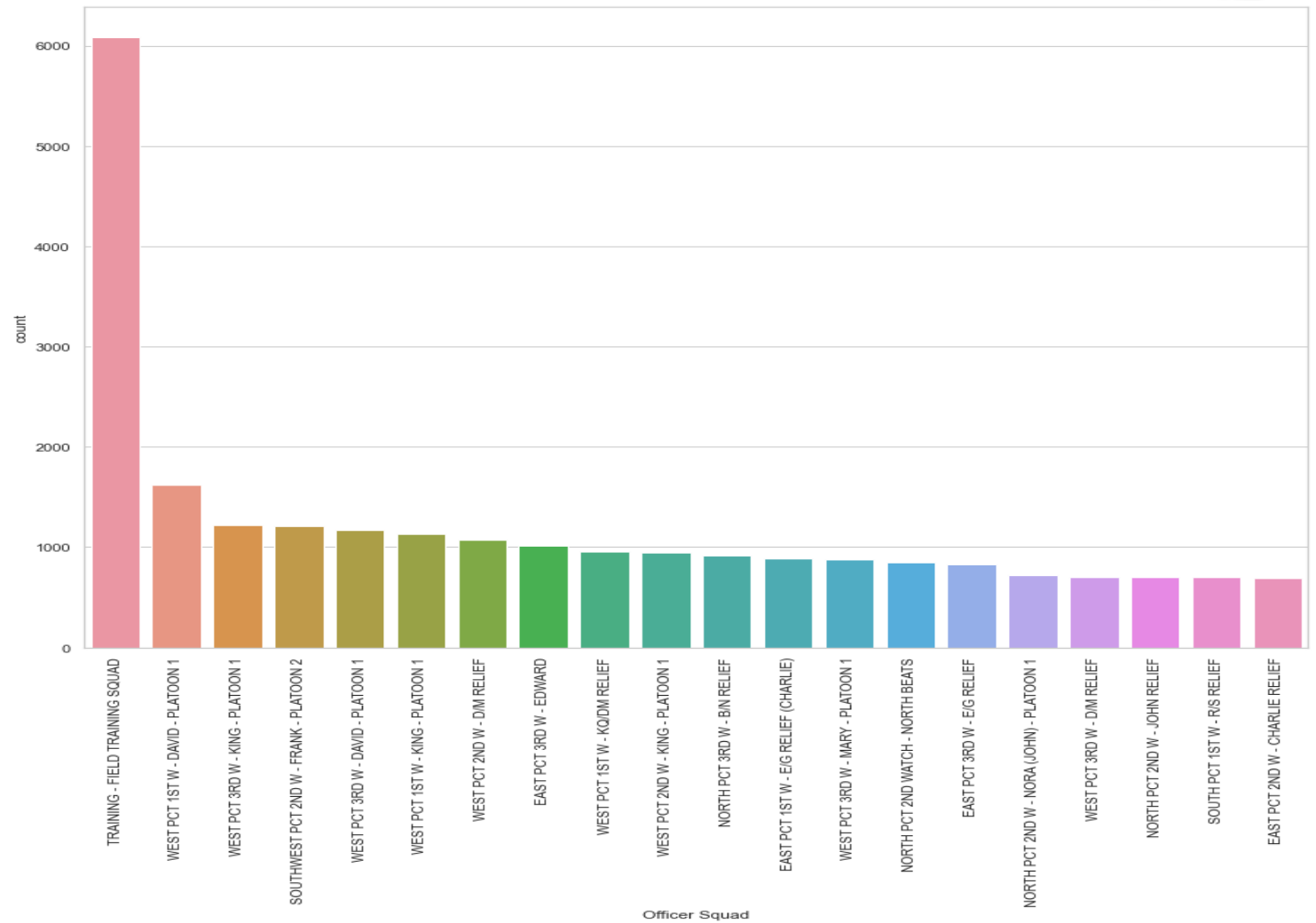
Stops by Officer

Officer ID 7456 conducted the most stops, with over 500 stops. This is significantly higher than the other officers in the top 10.

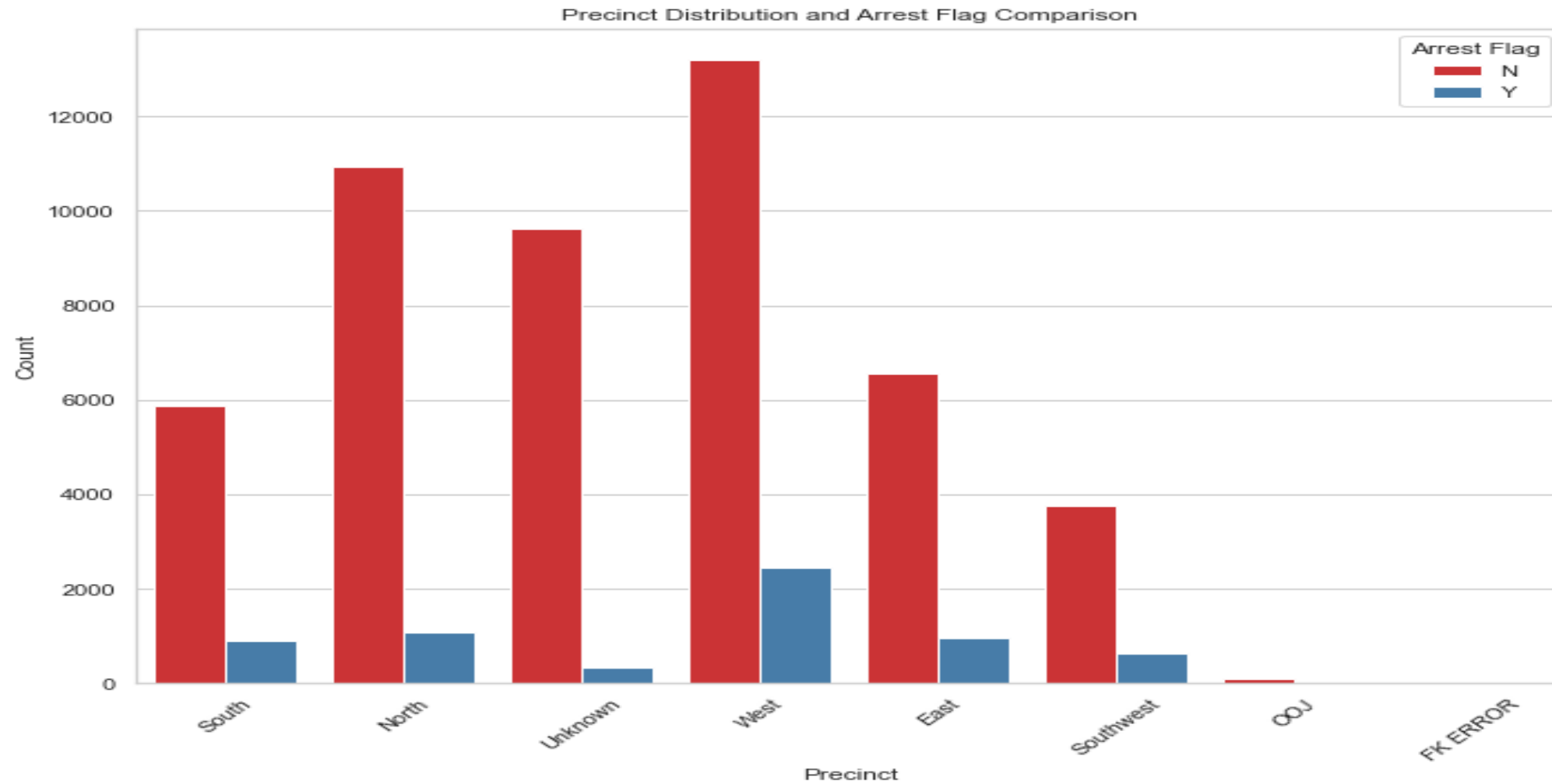
- The remaining officers (7773, 7634, 7690, 8646, 7765, 7758, 8366, 8302, 7774) have a relatively similar number of stops, all ranging between approximately 300 and 350 stops.
- The difference in the number of stops between Officer 7456 and the other officers is substantial, indicating that this officer conducted considerably more stops than others in the top 10 list

Stops by Officer Squad

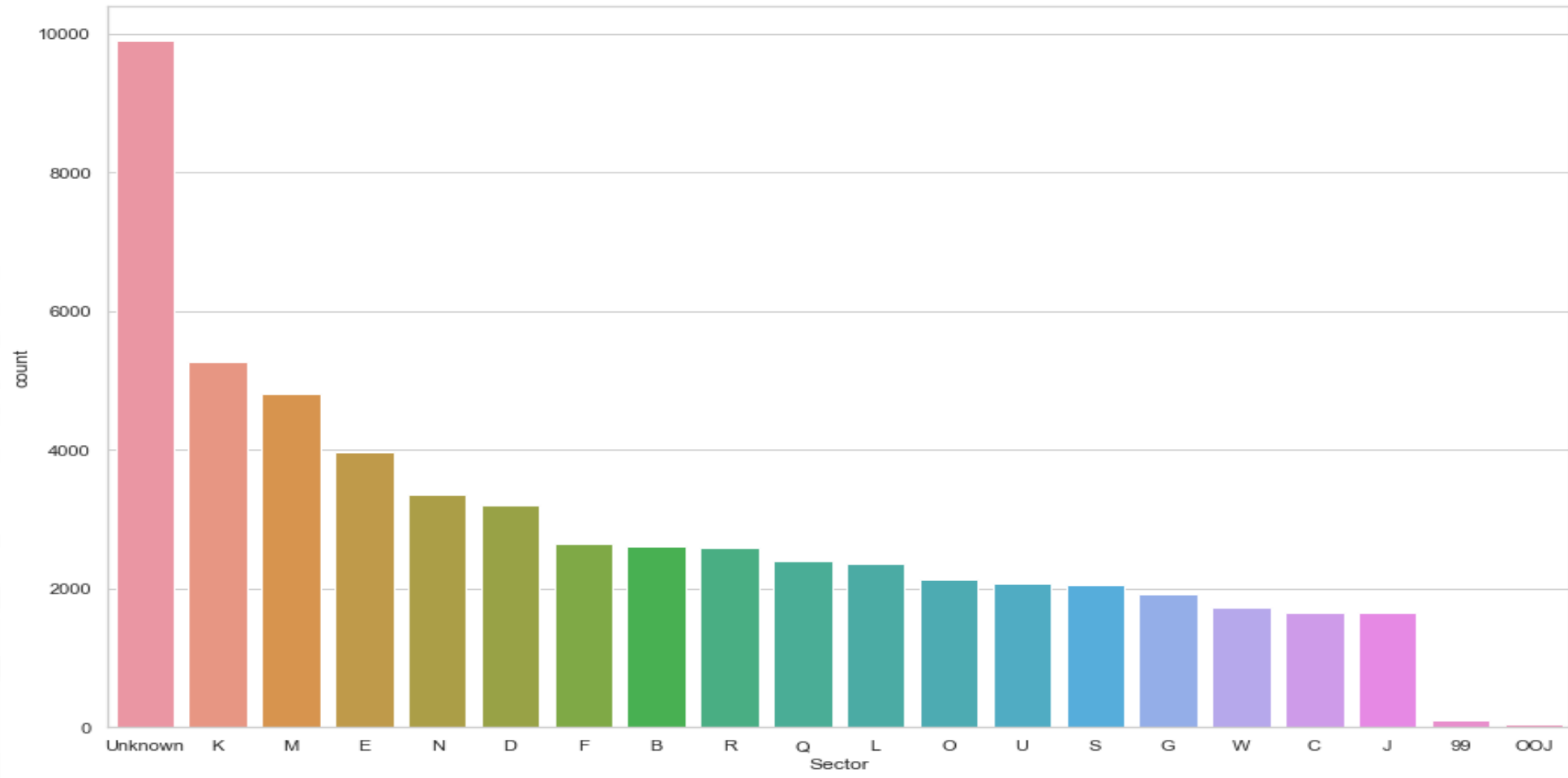
- The data suggests that different squads have varying levels of involvement in stops, which could reflect their differing roles within the police force.
- The high number of stops associated with training squads may indicate that a significant portion of stops is conducted by officers who are still undergoing training, which could have implications for the overall approach and experience level during stops



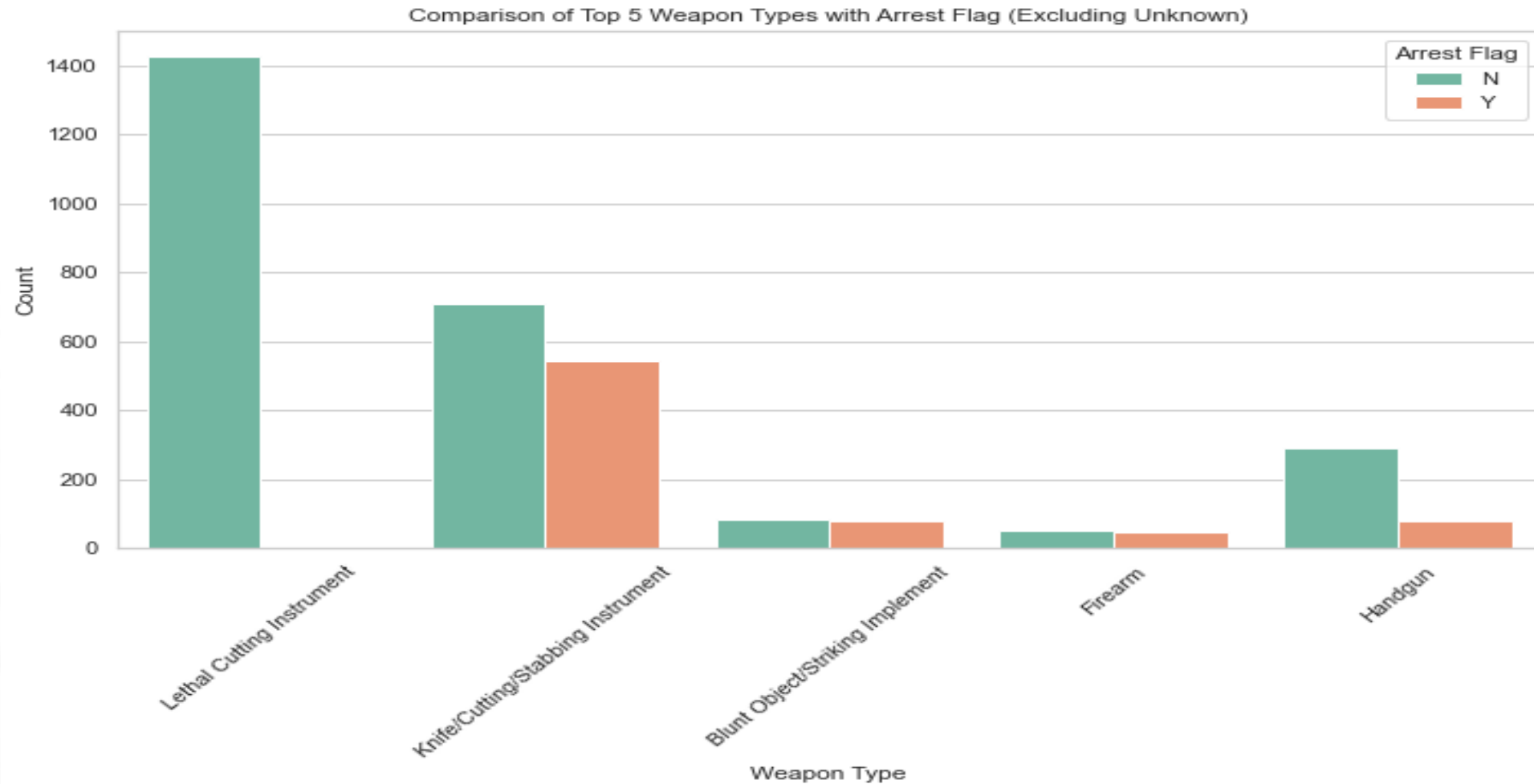
Stops by Precinct



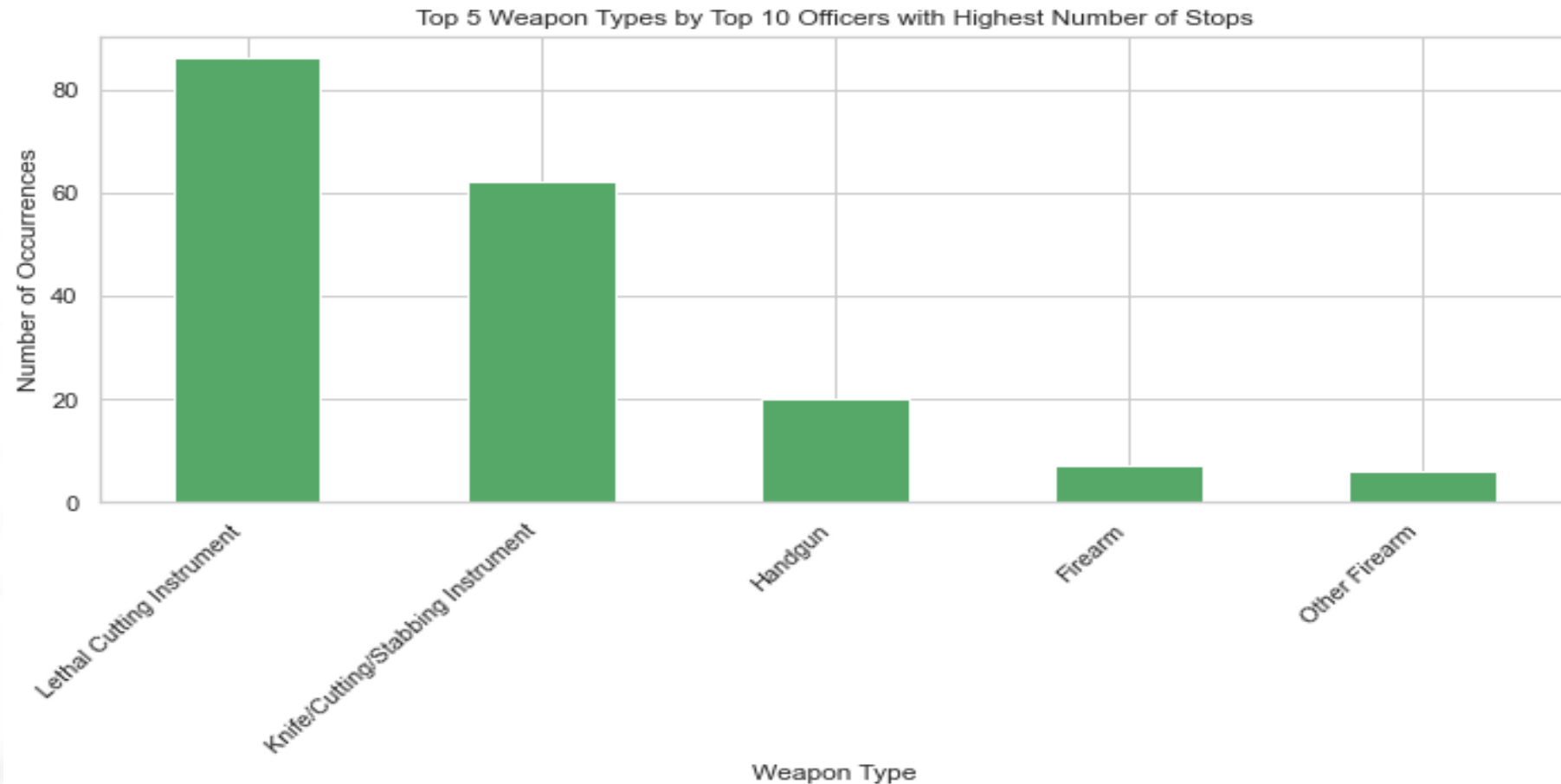
Occurrence by Sector



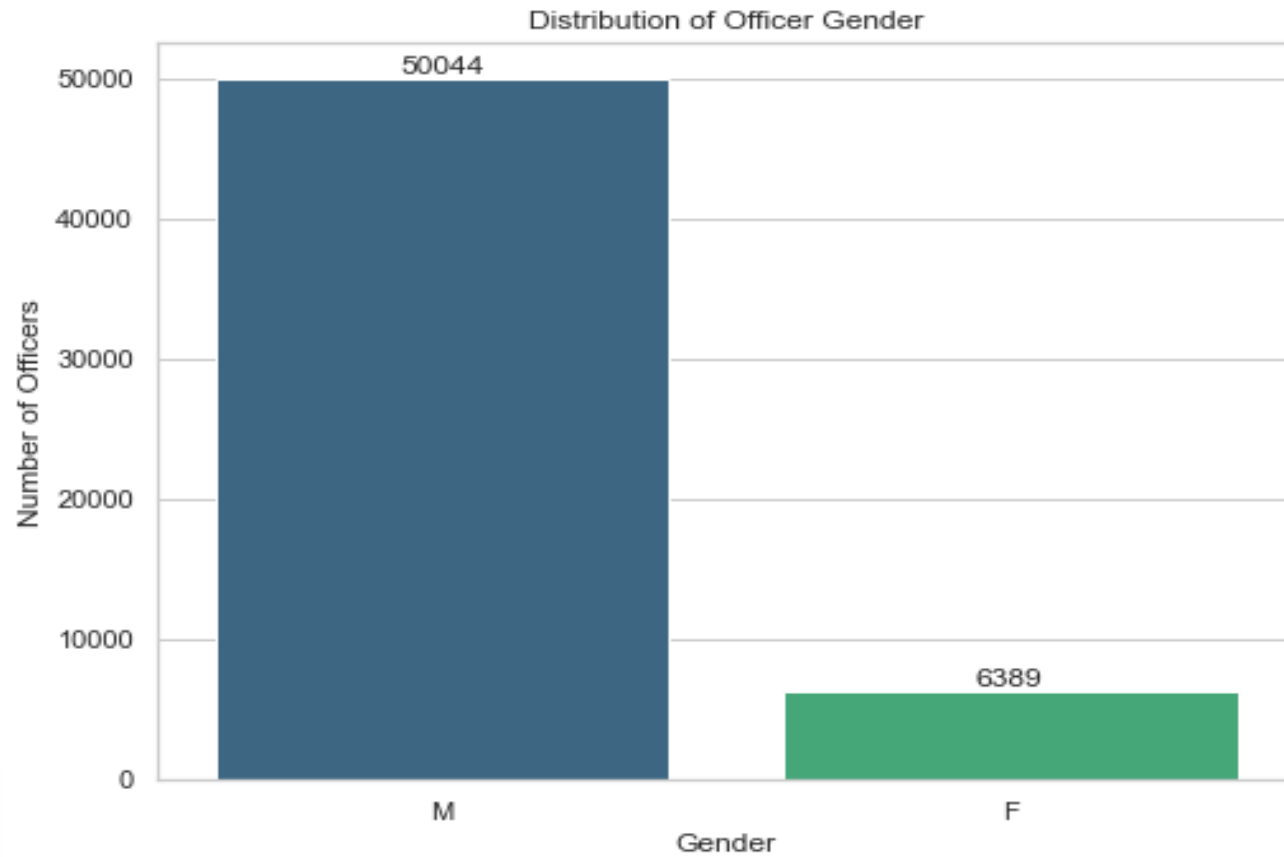
Top 5 Weapon Type and Arrest Flag Comparison



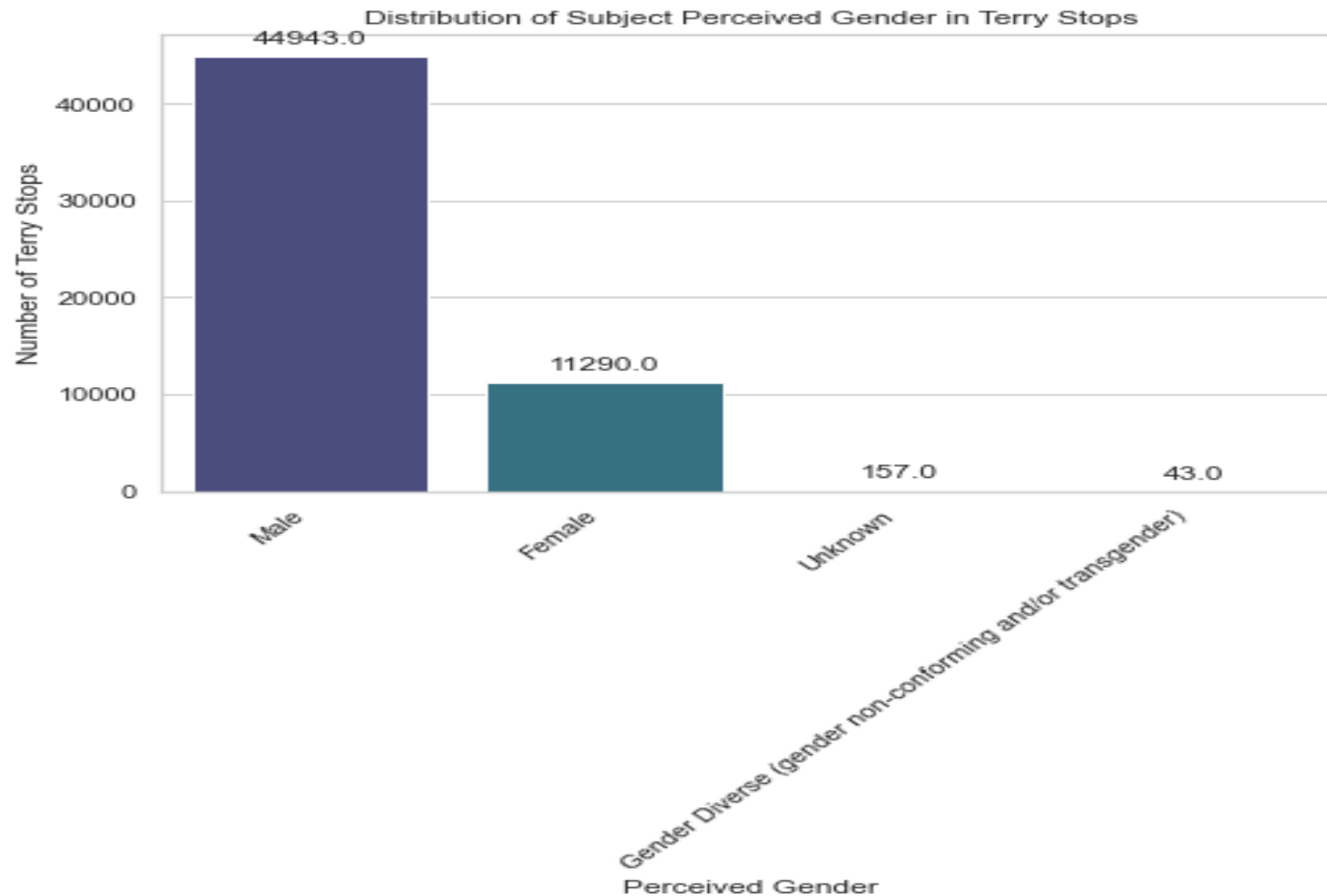
Top 5 Weapon Types by Top 10 Officers with Highest Number of Stops



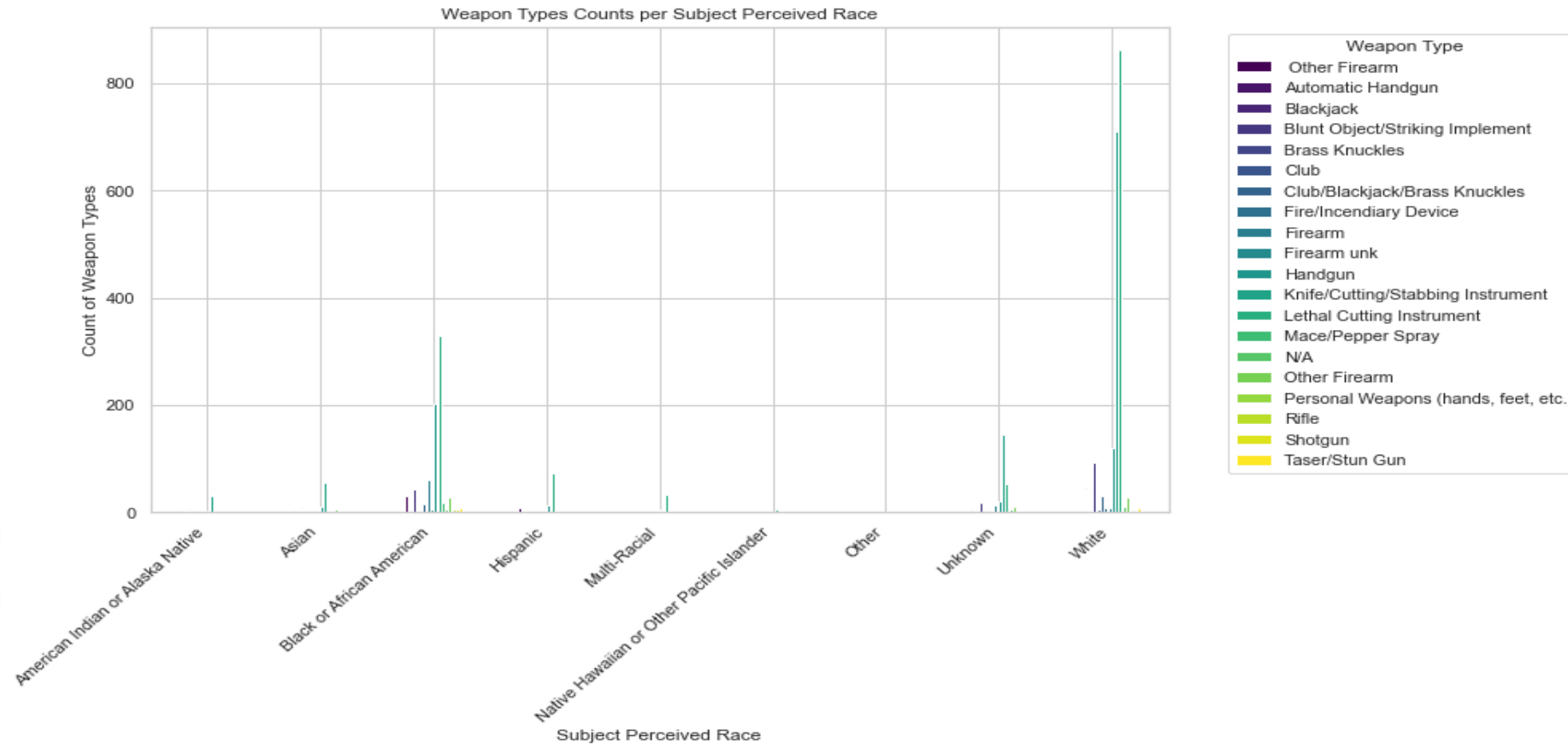
Distribution of Genders of Officers at the Stops



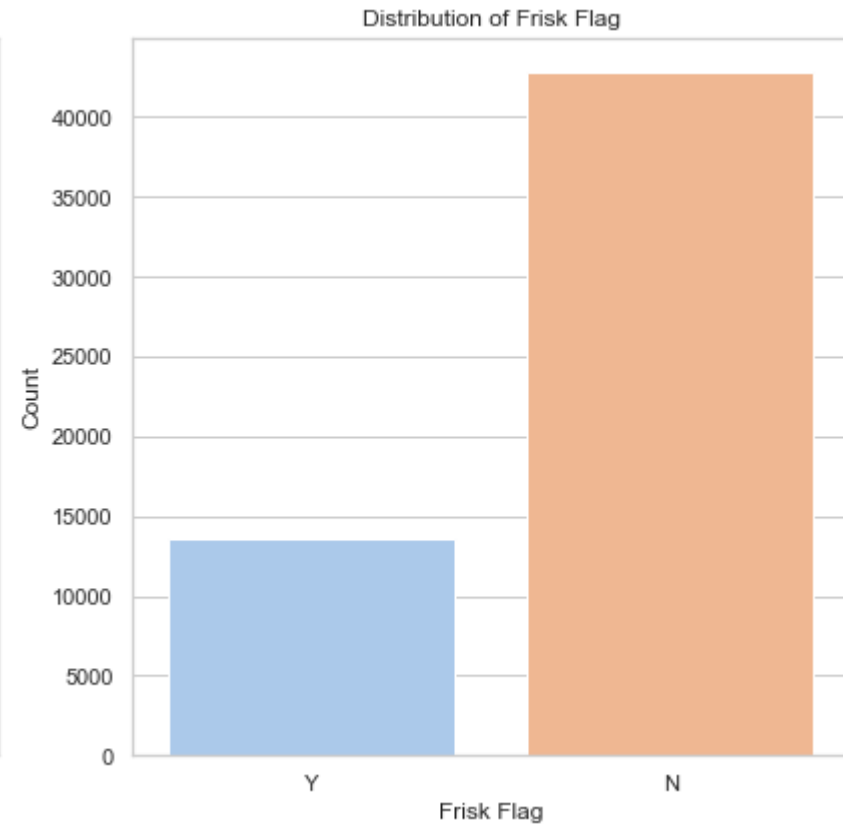
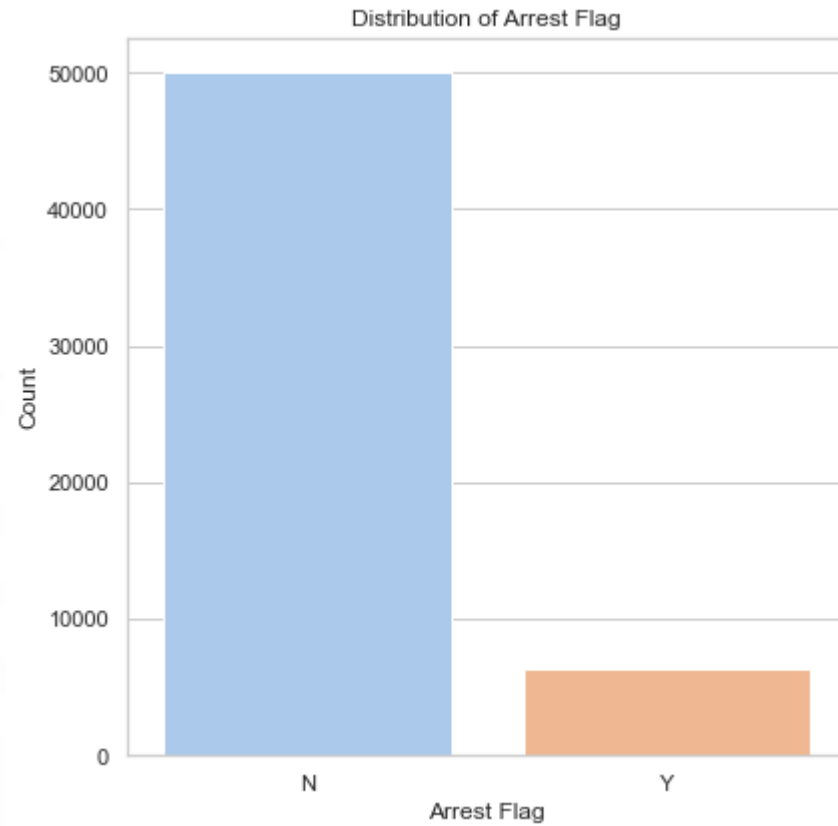
Distribution of Subject Perceived Gender in Terry Stops



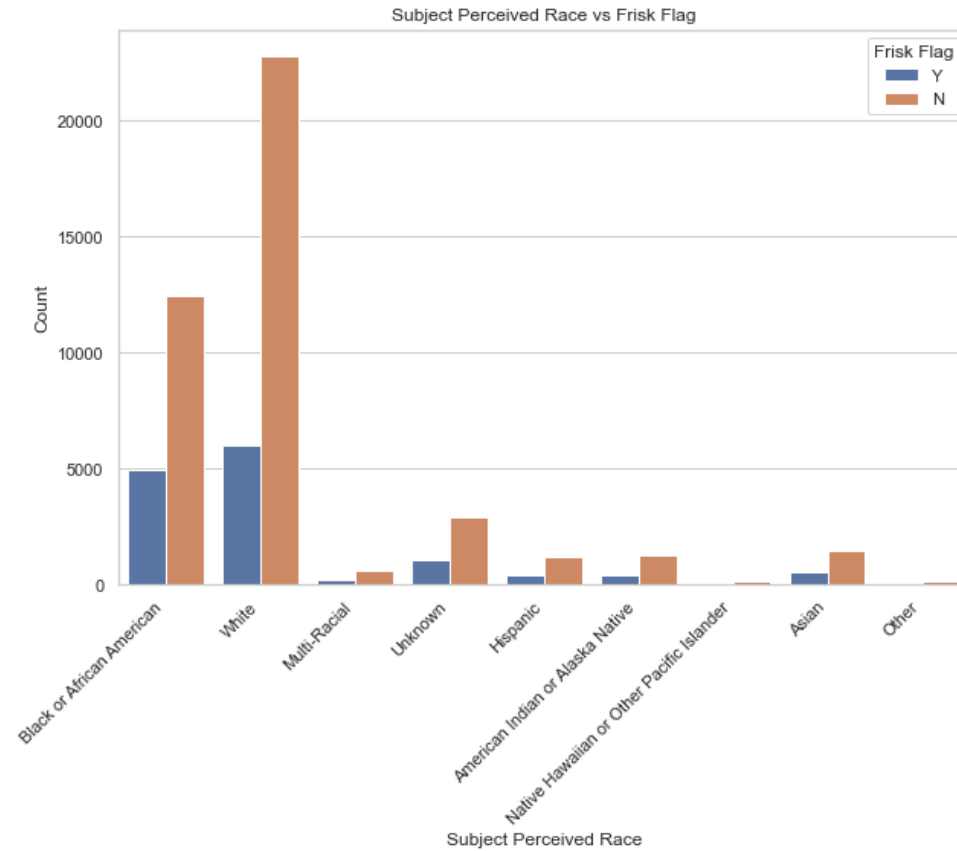
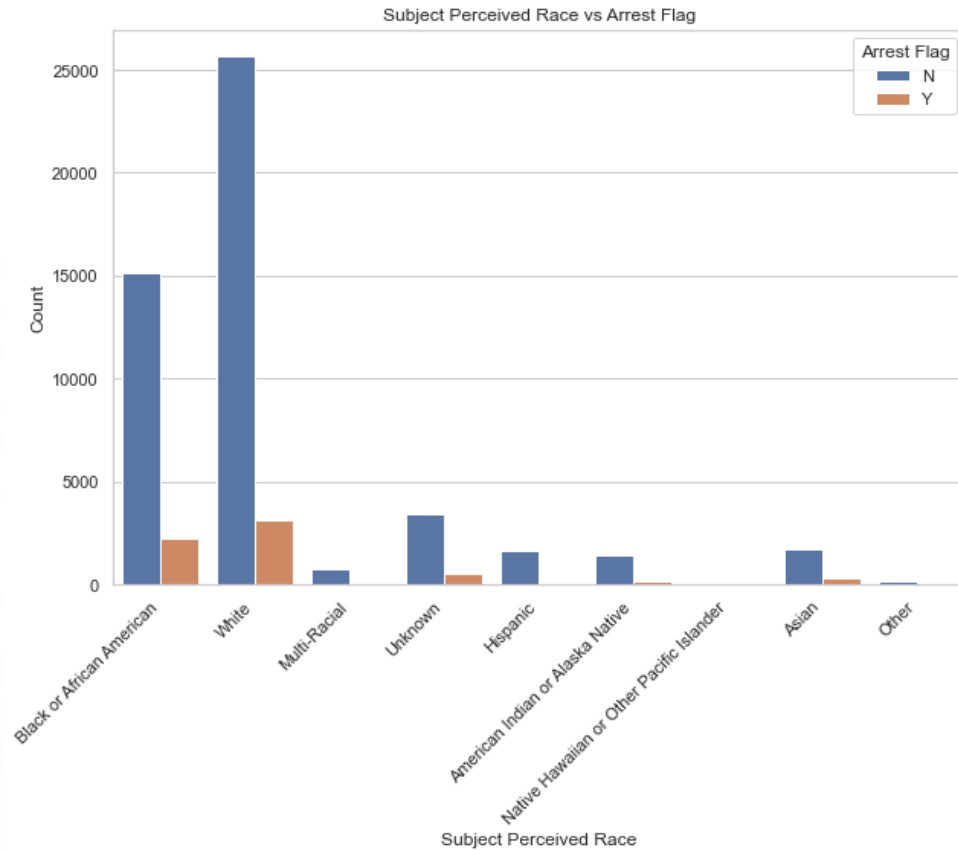
Weapon Types Count Per Subject Perceived Race



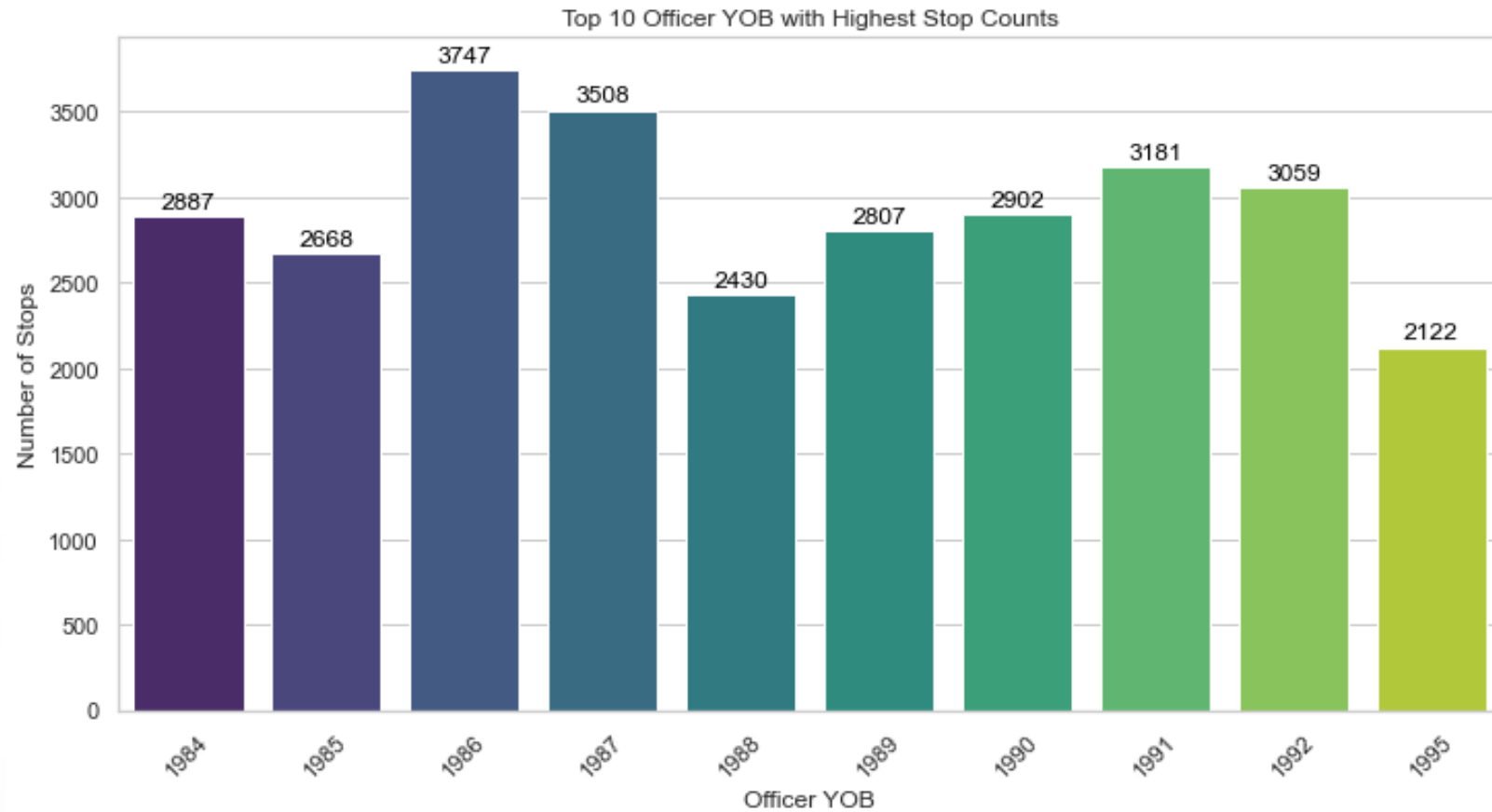
Arrest Flag and Frisk Flag Comparison



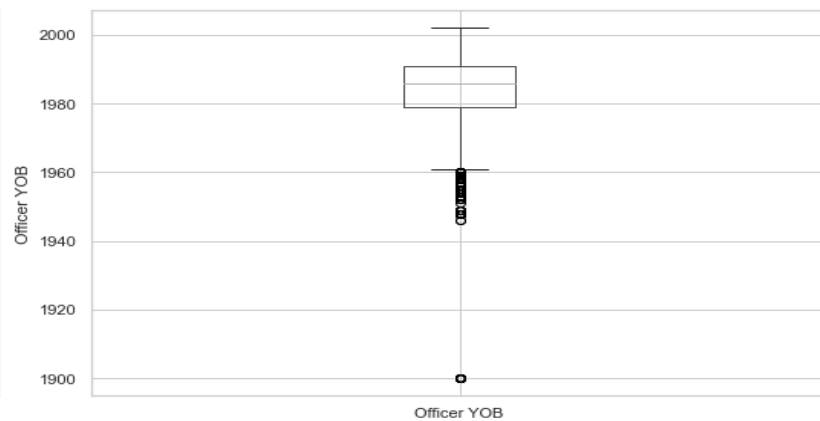
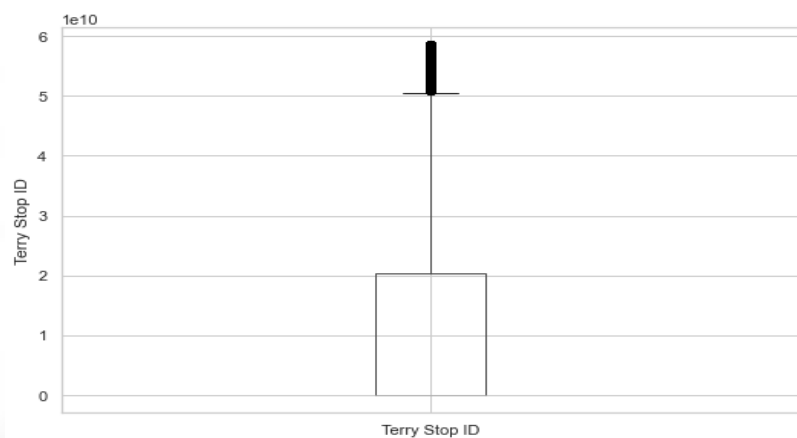
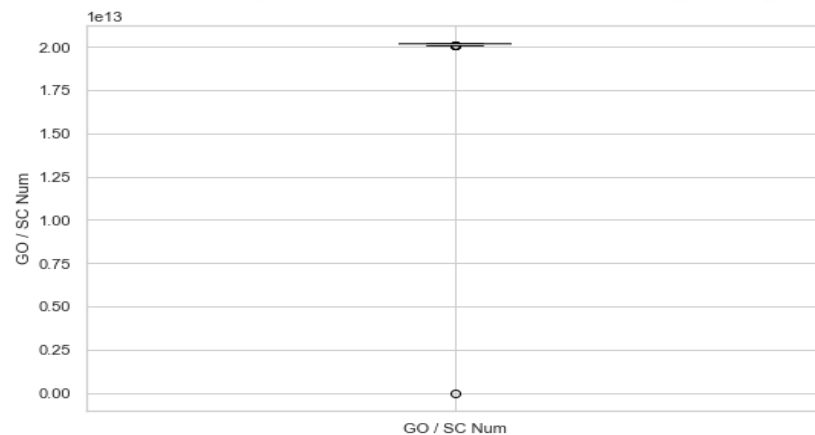
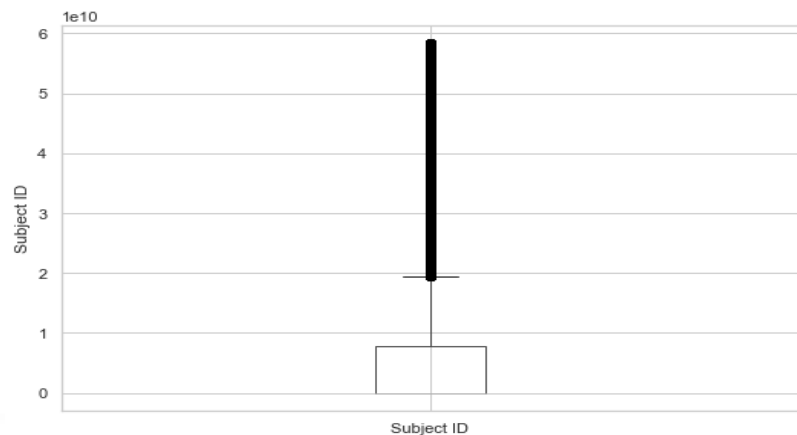
Frisk Flag and Arrest Flag Comparison against Subject Perceived Race



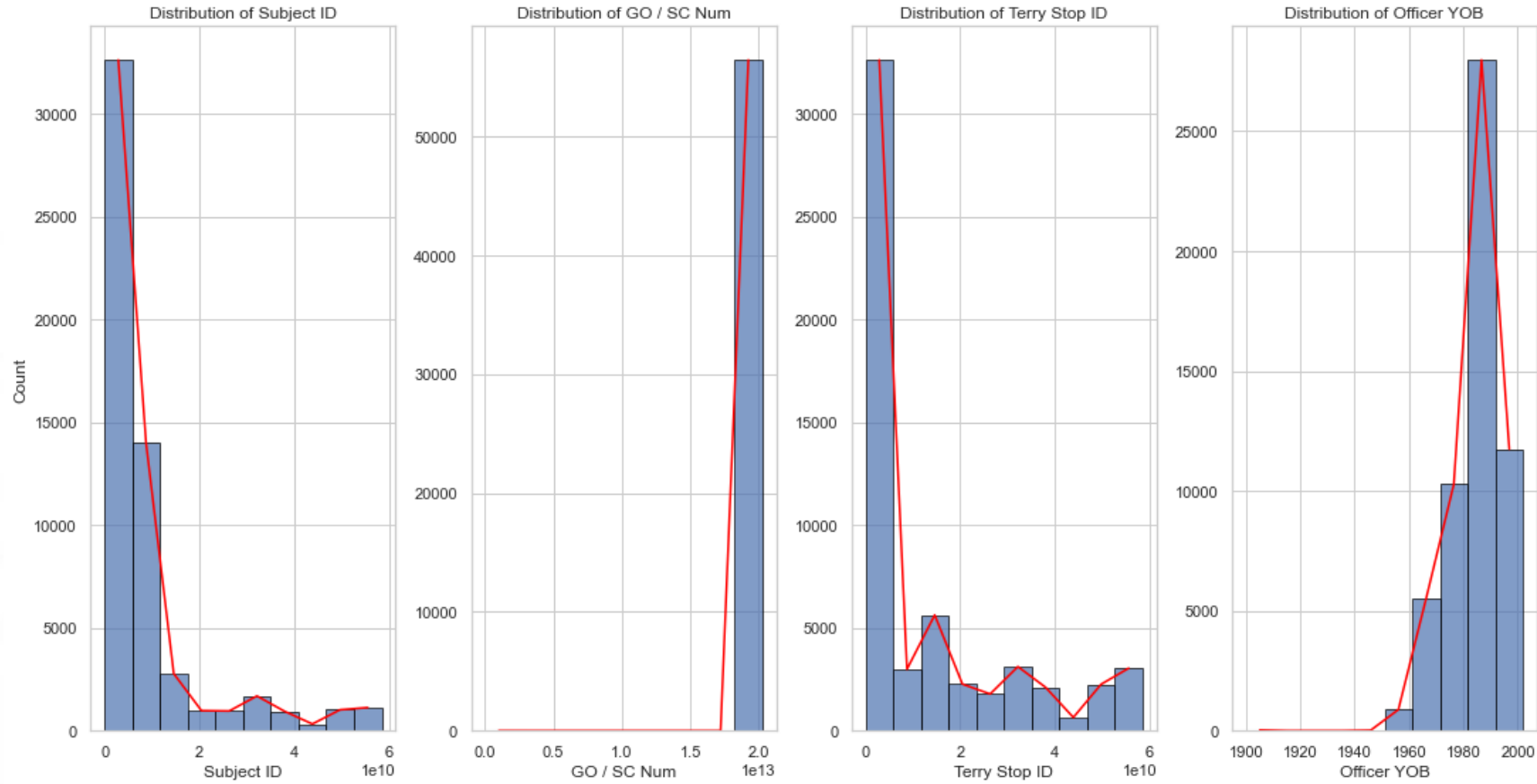
Top 10 Officer YOB with Highest Stop Counts



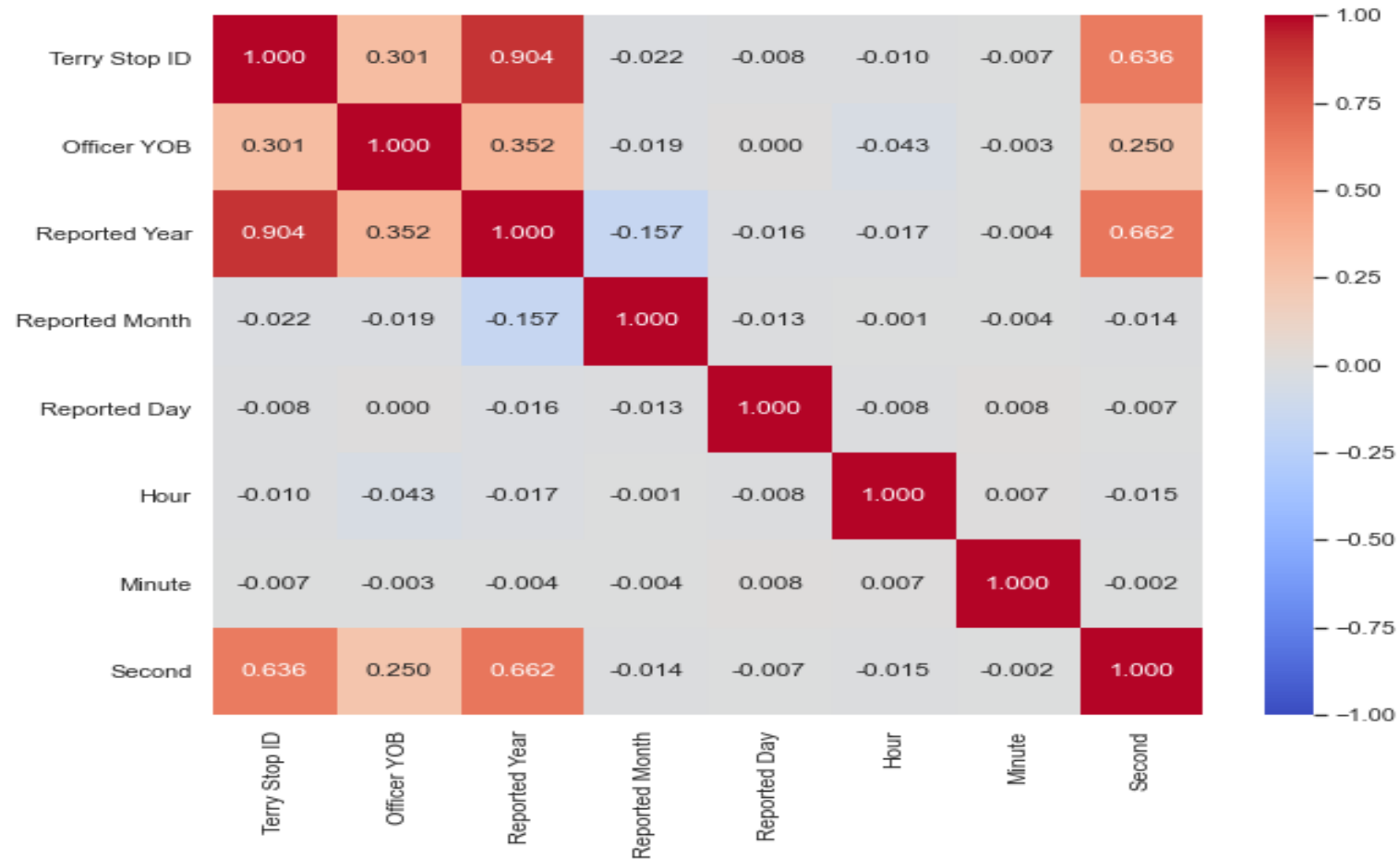
Potential Outliers



Variables with Outliers Distribution



Correlation of Numeric Variables



Feature Engineering

- Engineered creation of new columns for:
 - Reported Year
 - Reported Month
 - Reported Day
 - Hour
 - Minute
 - Second

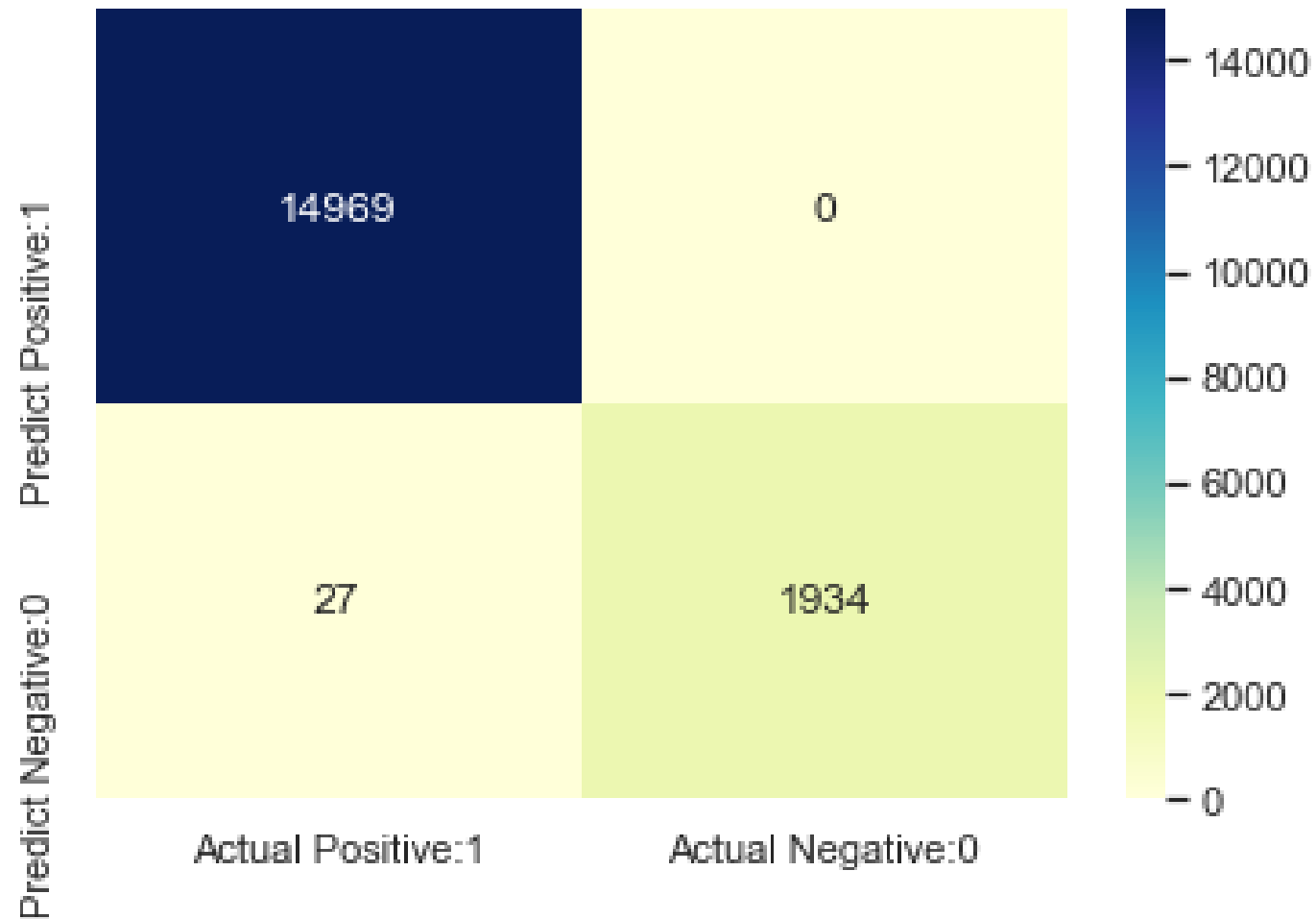
Feature Selection

- Arrest Flag was our target and the rest of the variables were our predictors
- Used MinMaxScaler for feature scaling

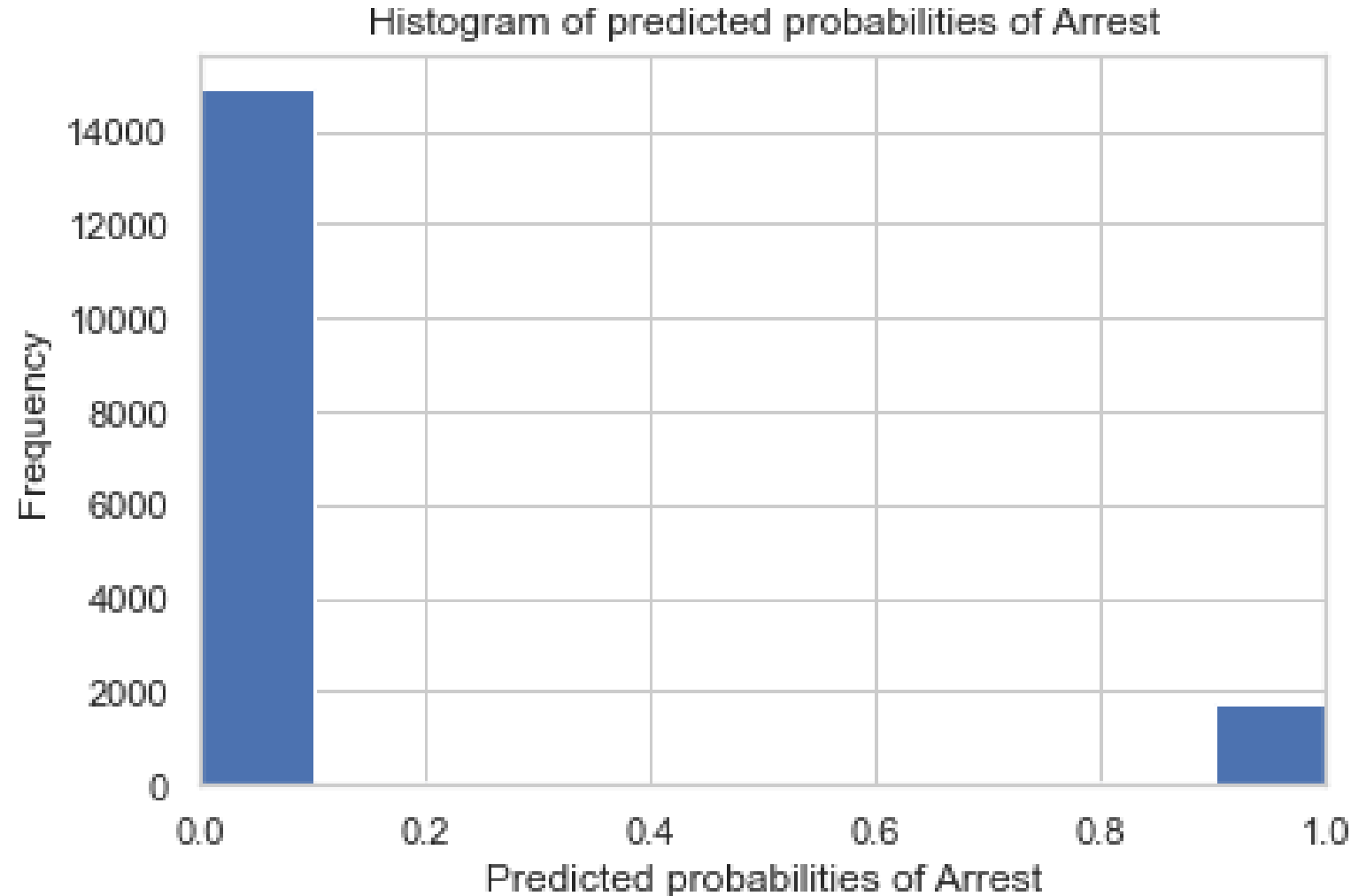
Model Training

- Used Logistic Regression Model
 - Model accuracy score is 99.84%
- Used RFE to select top 200 features
- Used Decision Tree Model
 - Model Accuracy Score is 99.98%

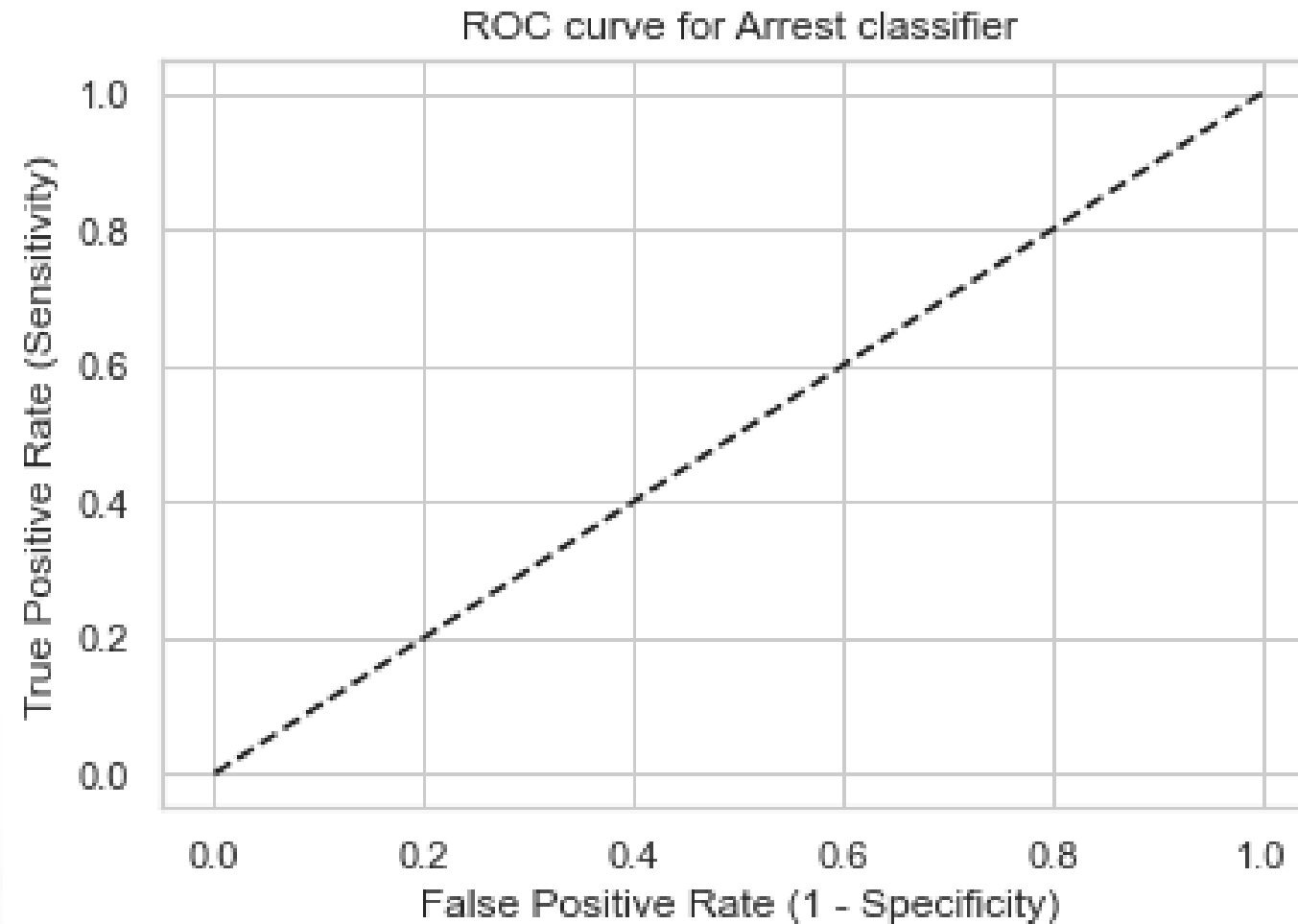
Confusion Matrix for Logistic Regression Model



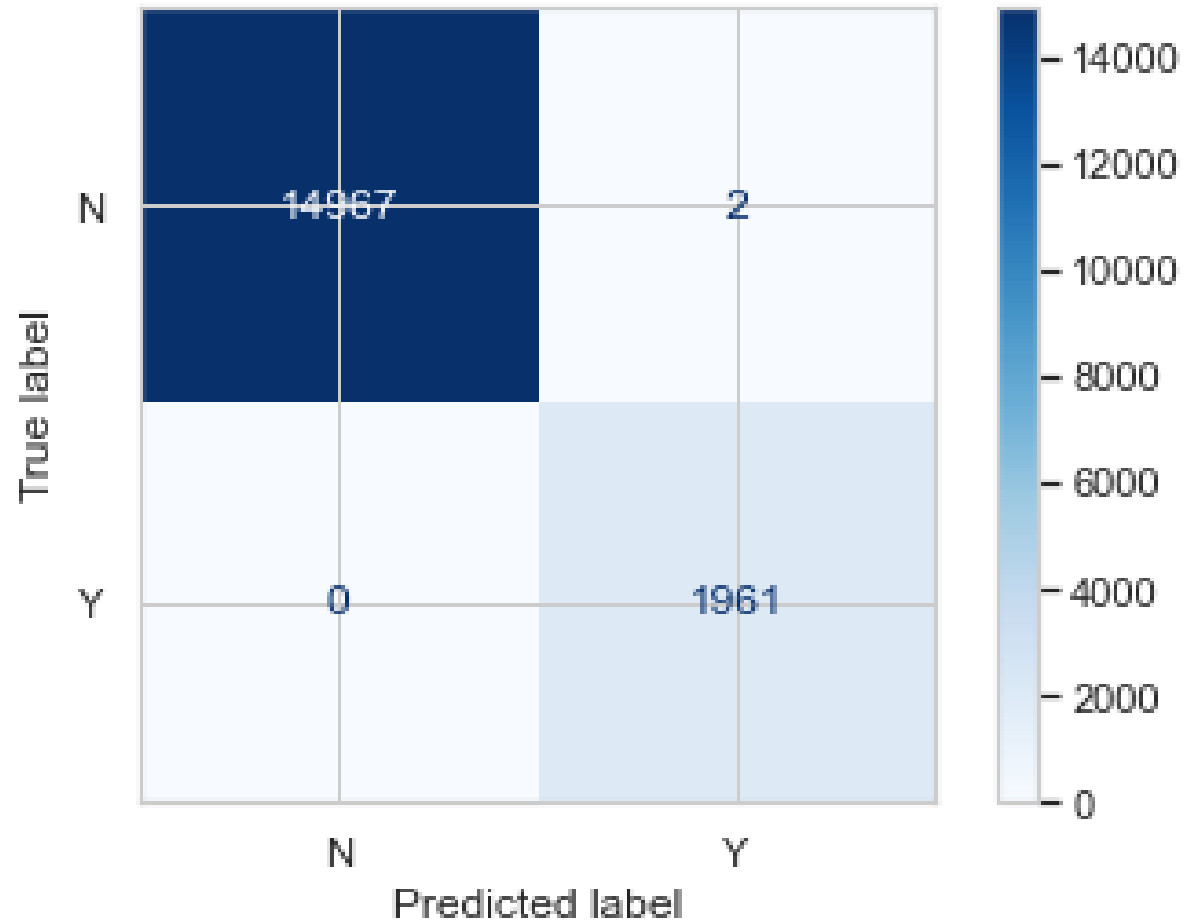
Histogram of Predicted Probabilities of Arrest



ROC - AUC



Confusion Matrix for Decision Tress Model



Result and Conclusion

- The logistic regression model accuracy score is 0.9984 whereas Decision Tree model accuracy score is 0.9993.
- Decision Tree model have done a very good job in predicting whether or not there will be an Arrest in any Terry Stop for it has the highest accuracy.
- The model shows no sign of overfitting in both models.
- Increasing the value of C results in Logistic Regression resulted in higher training set accuracy

END
THANK YOU