STA210 SP'24 Final Project

Exploring 2023 Stop and Frisk Data in NYC

amaris

Introduction:

Background:

The stop-and-frisk program in New York City, administered by the NYPD, allows officers to detain, question, and potentially search individuals suspected of carrying weapons or contraband. This initiative has sparked significant controversy due to concerns of racial profiling. In 2017, 90% of those stopped were African-American or Latino, primarily aged between 14 and 24. Despite efforts to address racial disparities, such as policy reforms, the disproportionate impact of the stop-and-frisk program persists, highlighting potential underlying factors like implicit bias.

Implicit bias, also known as implicit prejudice or implicit attitude, is a negative attitude, of which one is not consciously aware, against a specific social group. It is thought to be shaped by experience and based on learned associations between particular qualities and social categories, including race and/gender/age etc. Individuals' perceptions and behaviors can be influenced by the implicit biases they hold, even if they are unaware they hold such biases.

Dataset:

Each stop made by the NYPD requires officers to complete a detailed form, documenting various aspects of the encounter. Since 2017, these forms have been electronically recorded and stored in an NYPD database. The dataset contains information such as the stop's location, officer details, characteristics of the stopped individual (including age, race, gender, etc.), frisk/search details, and the officer's description of the individual's demeanor during the stop.

Our analysis will utilize the most recently released NYPD annual report from the source: https://www.nyc.gov/site/nypd/stats/reports-analysis/stopfrisk.page, containing 82 variables and 16,871 observations.

Project Motivation & Research Question:

Among the 82 variables, a variable of particular interest is "demeanor of person stopped" - where the police utilize 1 - 2 adjectives to describe stop subject "demeanor". Common adjectives include "calm", "nervous", "agitated", "aggressive", etc. It should be noted that these descriptions are self-generated instead of the police choosing from a pre-defined set of adjectives. We propose that these "demeanor" adjectives are indicative of the police officers' perception of the stopped subject.

This project aims to investigate the relationship between physical/demographical characteristics of stopped individuals and the demeanor adjectives assigned by police officers. Specifically, we will explore:

- How do officer-assigned demeanor adjectives vary across different demographic groups (age, race, gender)?
- Are there correlations between certain physical characteristics and the types of demeanor descriptions used by officers during stops?
- Additionally, we will briefly examine whether demeanor descriptions influence subsequent police behaviors, such as frisking, searching, or requesting consent.

By analyzing these relationships, we seek to shed light on potential implicit biases affecting police interactions during stop-and-frisk encounters. Understanding these dynamics is crucial for addressing systemic biases and ensuring fair and equitable policing practices.

Variables Introduction:

Predictor variables of interest:

SUSPECT_REPORTED_AGE (chr and transformed to num): the age of suspect

SUSPECT_SEX (chr): female or male

SUSPECT_RACE_DESCRIPTION (chr): includes 7 categories: American Indian/Alaskan Native, Asian/Pacific Islander, Black, Black Hispanic, Middle Eastern/Southwest Asian, White, White Hispanic

SUSPECT_HEIGHT (chr and transformed to num): the height of suspect by feet

SUSPECT_WEIGHT (chr and transformed to num): the weight of suspect by pounds

SUSPECT_BODY_BUILD_TYPE (chr): includes categories: HEA(Heavy), MED(Medium), THN(Thin), U(Unknown), XXX(body type not applicable/placeholder value indicating missing data)

SUSPECT_EYE_COLOR (chr): includes categories: BLK(Black), BLU(Blue), BRO(Brown), GRN(Green), GRY(Grey), HAZ(Hazel), MUL(Multicolored), OTH(Other), PNK(Pink)

SUSPECT_HAIR_COLOR (chr): includes categories: BLD (Bald), BLK (Black), BLN (Blonde), BRO (Brown), GRN(Green), GRY (Gray), ORG (Orange), PLE (Purple), PNK(Pink), RED(Red), SDY(Sandy), WHI (White), XXX (Unknown/Unspecified - often used when the suspect's hair color is not recorded or unclear), ZZZ (could be an unusual or placeholder value indicating an error or missing data).

Note: The interpretation of categorical variables is based on conventions and assumptions due to the absence of a specific codebook for the dataset. Numeric variables (age, height, weight) are obtained through suspect report, while other categorical variables may reflect subjective perceptions of police or suspect report.

Variables of interest for exploratory analysis:

FRISKED_FLAG (chr): indicates whether or not the suspect was frisked (N = No, Y = Yes)

SEARCH_FLAG (chr): indicates whether or not the suspect was searched (N = No, Y = Yes)

ASK_FOR_CONSENT_FLG (chr): indicates whether the police asked for subject consent for the frisk/search behaviors after stop (N = No, Y = Yes)

Data Cleaning & New Variable Creation

Upon reviewing the dataset, we identified a total of 1589 unique demeanor descriptions. To streamline our analysis, we focused on demeanor descriptions that appeared 10 or more times, aiming to capture meaningful trends and patterns. We then categorized these 69 demeanor descriptions into 5 broader categories based on their semantic similarities. While we recognize that the categorizations can be rather arbitrary, the groupings based on similarities in emotional or behavioral context allows for a more concise representation suitable for further analysis.

1. Calm/Neutral Demeanor: This category includes descriptions indicating a relaxed, cooperative, or normal state of mind.

- CALM - NORMAL - APPARENTLY NORMAL - RELAXED - QUIET - UNDERSTANDING - CALM AND COOPERATIVE - CALM AND COMPLIANT - CALM AND UNDERSTANDING - CALM COOPERATIVE - CALMED - NEUTRAL - CALM COMPLIANT - CALM UNDERSTANDING - APP NORMAL - COMPLIANT - APPARENT NORMAL

2. Nervous/Anxious Demeanor: Descriptions reflecting anxiety, nervousness, or apprehension.

- NERVOUS - ANXIOUS - VERY NERVOUS - EXTREMELY NERVOUS - PHYSICALLY NERVOUS - NERVOUS SCARED - NERVOUS OUT OF BREATH - AGGITATED - SCARED - SUSPICIOUS - APPREHENSIVE - WORRIED - NERVOUSE

3. Angry/Confrontational Demeanor: This category comprises descriptions indicating anger, aggression, or hostility.

- UPSET - ANNOYED - ANGRY - AGITATED - AGGRESSIVE - COMBATIVE - IRATE - IRRITATED - AGGRAVATED - HOSTILE - MAD - AGGRESSIVE/NERVOUS - UNCOOPERATIVE - IRRATE - AGGRESIVE - ARGUMENTATIVE - DEFENSIVE - NON COMPLIANT

4. Confused/Disoriented Demeanor: Descriptions suggesting confusion, surprise, or disorientation.

- CONFUSED - SURPRISED - SHOCKED - INTOXICATED - INTOX - ERRATIC - OUT OF BREATH

5. Indifferent Demeanor: Descriptions suggesting withdrawal

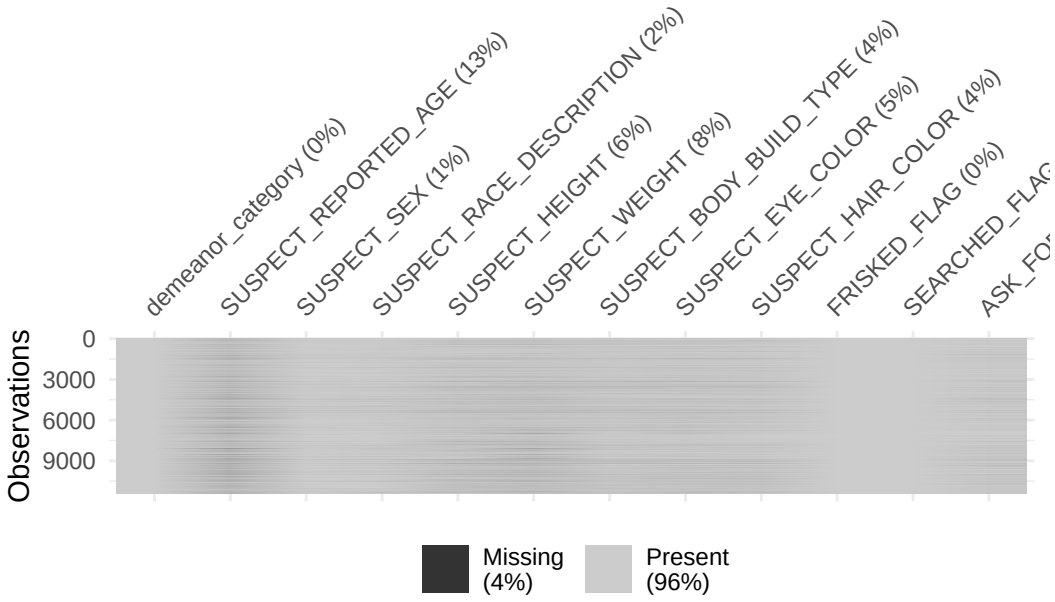
- INDIFFERENT - EVASIVE - TIRED

Note: The following descriptions do not fit well into the above categories: Defensive (21), Laughing (16), Crying (14), Excited (14), Talkative (22) Given that the low relative frequencies (indicated in the brackets), we decided to remove them along with NAs (NA, N/A).

```
stop_and_frisk_cleaned <- stop_and_frisk|>
   mutate(demeanor_category = case_when( #categorizing demeanor
    DEMEANOR_OF_PERSON_STOPPED %in% c(
      "CALM", "NORMAL", "APPARENTLY NORMAL", "RELAXED", "QUIET","UNDERSTANDING",
      "CALM AND COOPERATIVE", "CALM AND COMPLIANT", "CALM AND UNDERSTANDING",
      "CALM COOPERATIVE", "CALMED", "NEUTRAL", "CALM COMPLIANT", "CALM UNDERSTANDING",
      "APP NORMAL", "COMPLIANT", "APPARENT NORMAL"
      ) ~ "Calm/Neutral",
    DEMEANOR_OF_PERSON_STOPPED %in% c(
      "NERVOUS", "ANXIOUS", "VERY NERVOUS", "EXTREMELY NERVOUS","PHYSICALLY NERVOUS",
      "NERVOUS SCARED", "NERVOUS OUT OF BREATH", "AGGITATED", "SCARED", "SUSPICIOUS",
      "APPREHENSIVE", "WORRIED", "NERVOUSE"
      ) ~ "Nervous/Anxious",
    DEMEANOR_OF_PERSON_STOPPED %in% c(
      "UPSET", "ANNOYED", "ANGRY", "AGITATED", "AGGRESSIVE", "COMBATIVE", "IRATE",
      "IRRITATED", "AGGRAVATED", "HOSTILE", "MAD", "AGGRESSIVE/NERVOUS", "UNCOOPERATIVE",
      "IRRATE", "AGGRESSIVE", "ARGUMENTATIVE", "DEFENSIVE", "NON COMPLIANT"
      ) ~ "Angry/Confrontational",
    DEMEANOR_OF_PERSON_STOPPED %in% c(
      "CONFUSED", "SURPRISED", "SHOCKED", "INTOXICATED", "INTOX", "ERRATIC", "OUT OF BREAT
      ) ~ "Confused/Disoriented",
    DEMEANOR_OF_PERSON_STOPPED %in% c(
      "INDIFFERENT", "EVASIVE", "TIRED"
```

```
      ) ~ "Indifferent",
    TRUE ~ "Other/NA"  # Default case for any other demeanor not matching the above
  )) |>
  select(#Selecting relevant variables
    demeanor_category, SUSPECT_REPORTED_AGE, SUSPECT_SEX, SUSPECT_RACE_DESCRIPTION,
    SUSPECT_HEIGHT,SUSPECT_WEIGHT, SUSPECT_BODY_BUILD_TYPE, SUSPECT_EYE_COLOR,
    SUSPECT_HAIR_COLOR,FRISKED_FLAG, SEARCHED_FLAG, ASK_FOR_CONSENT_FLG
    ) |>
  filter(demeanor_category != "Other/NA")
```

```
#Visualizing Missingness in Cleaned Dataset
stop_and_frisk_cleaned <- stop_and_frisk_cleaned %>%
  mutate_all(~ na_if(., "(null)"))
library(naniar)
vis_miss(stop_and_frisk_cleaned)
```




```
# Among our variables of interest, no variable contains a significant amount of missing va
```

Exploratory Data Analysis

Variable Selection

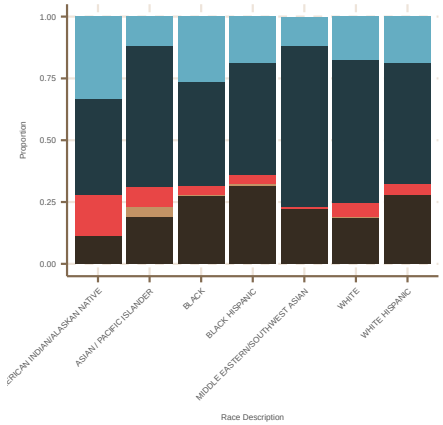
```
install.packages("gridExtra")  # Install gridExtra for arranging plots
library(gridExtra)

# Filter out rows with missing values in necessary columns
cleaned_data <- stop_and_frisk_cleaned %>%
  filter(!is.na(SUSPECT_RACE_DESCRIPTION),
         !is.na(SUSPECT_SEX),
         !is.na(SUSPECT_BODY_BUILD_TYPE),
         !is.na(SUSPECT_EYE_COLOR),
         !is.na(SUSPECT_HAIR_COLOR))

# Create individual ggplot visualizations
plot1 <- cleaned_data %>%
  ggplot(aes(x = SUSPECT_RACE_DESCRIPTION, fill = demeanor_category)) +
  geom_bar(position = "fill") +
  labs(x = "Race Description", y = "Proportion", title = "Likelihood of being in each cate
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
        axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
        axis.title = element_text(size = 4),  # Adjust text size for axis titles
        plot.title = element_text(size = 5),
        plot.subtitle = element_text(size = 3),
        legend.title = element_text(size = 4),
        legend.text = element_text(size = 4)) # Adjust text size for plot title

plot2 <- cleaned_data %>%
  ggplot(aes(x = SUSPECT_SEX, fill = demeanor_category)) +
  geom_bar(position = "fill") +
  labs(x = "Sex", y = "Proportion", title = "Likelihood of being in each category varies a
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
        axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
        axis.title = element_text(size = 4),  # Adjust text size for axis titles
        plot.title = element_text(size = 5),
        plot.subtitle = element_text(size = 3),
        legend.title = element_text(size = 4),
        legend.text = element_text(size = 4))  # Adjust text size for plot title

plot3 <- cleaned_data %>%
  ggplot(aes(x = SUSPECT_BODY_BUILD_TYPE, fill = demeanor_category)) +
```

```
  geom_bar(position = "fill") +
  labs(x = "Body Type", y = "Proportion", title = "Not very significant difference across
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
        axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
        axis.title = element_text(size = 4),  # Adjust text size for axis titles
        plot.title = element_text(size = 5),
        plot.subtitle = element_text(size = 3),
        legend.title = element_text(size = 4),
        legend.text = element_text(size = 4)) # Adjust text size for plot title

plot4 <- cleaned_data %>%
  ggplot(aes(x = SUSPECT_EYE_COLOR, fill = demeanor_category)) +
  geom_bar(position = "fill") +
  labs(x = "Eye Color", y = "Proportion", title = "Likelihood of being in each category va
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
        axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
        axis.title = element_text(size = 4),  # Adjust text size for axis titles
        plot.title = element_text(size = 5),
        legend.title = element_text(size = 4),
        legend.text = element_text(size = 4)) # Adjust text size for plot title

plot5 <- cleaned_data %>%
  ggplot(aes(x = SUSPECT_HAIR_COLOR, fill = demeanor_category)) +
  geom_bar(position = "fill") +
  labs(x = "Hair Color", y = "Proportion", title = "Likelihood of being in each category v
  theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
        axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
        axis.title = element_text(size = 4),  # Adjust text size for axis titles
        plot.title = element_text(size = 5),
        legend.title = element_text(size = 4),
        legend.text = element_text(size = 4)) # Adjust text size for plot title

# Arrange plots in a 2x2 grid and adjust size
grid.arrange(plot1, plot2, plot3, plot4, plot5, ncol = 2, top = "Categorical Predictors'Re
```

Categorical Predictors'Relationships with Demeanor Category

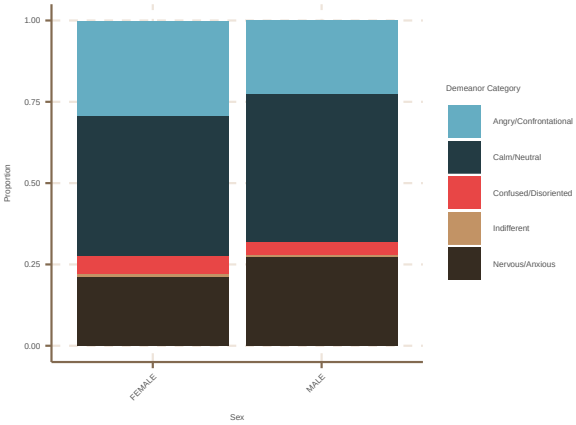
Likelihood of being in each category varies across race

e.g., black /hispanic most likely 'Nervous/Anxious', asian most likely 'Calm/Neutral'



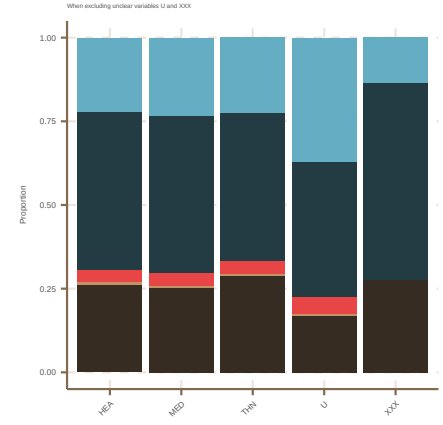
Likelihood of being in each category varies across gender

e.g., female more likely 'Angry/Confrontational', male more likely 'Nervous/Anxious'

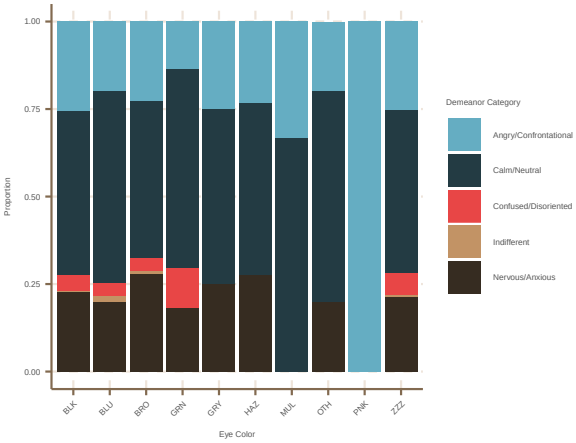


Not very significant difference across body types

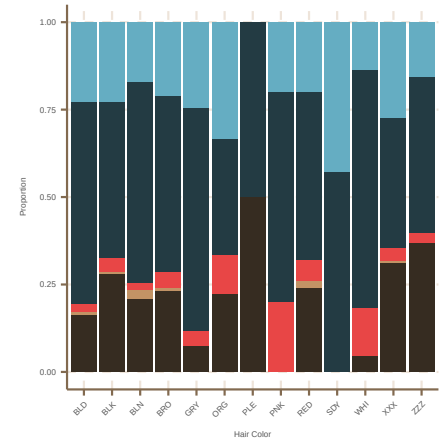
When excluding unclear variables U and XXX



Likelihood of being in each category varies across eye color



Likelihood of being in each category varies across hair color



```
• stop_and_frisk_cleaned <- stop_and_frisk_cleaned |>
    mutate(SUSPECT_REPORTED_AGE = as.numeric(SUSPECT_REPORTED_AGE),
           SUSPECT_HEIGHT = as.numeric(SUSPECT_HEIGHT),
           SUSPECT_WEIGHT = as.numeric(SUSPECT_WEIGHT)
           )

  plot6 <- ggplot(data = stop_and_frisk_cleaned, aes(x = demeanor_category, y = SUSPECT
    geom_boxplot() +
    labs(x = "Demeanor Category", y = "Suspect Age", title = "Distribution of Suspect A
      theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
          axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
          axis.title = element_text(size = 4),  # Adjust text size for axis titles
          plot.title = element_text(size = 5)) +
      guides(fill = FALSE)
```

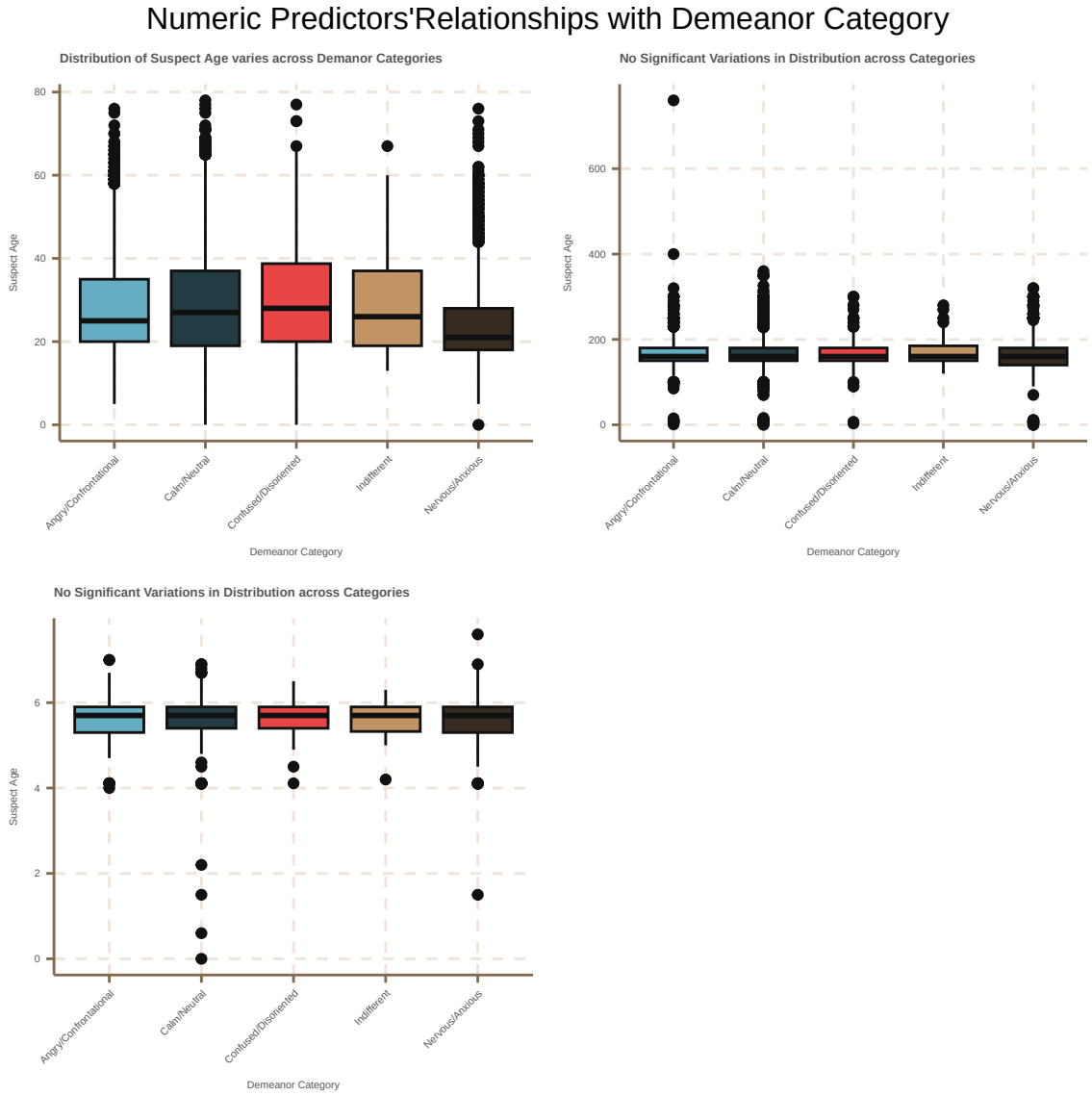
```
Warning: The `<scale>` argument of `guides()` cannot be `FALSE`. Use "none" instead as
of ggplot2 3.3.4.
```

```
  plot7 <- ggplot(data = stop_and_frisk_cleaned, aes(x = demeanor_category, y = SUSPECT
    geom_boxplot() +
    labs(x = "Demeanor Category", y = "Suspect Age", title = "No Significant Variations
    theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
          axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
          axis.title = element_text(size = 4),  # Adjust text size for axis titles
          plot.title = element_text(size = 5))+
      guides(fill = FALSE)

  plot8 <- ggplot(data = stop_and_frisk_cleaned, aes(x = demeanor_category, y = SUSPECT
    geom_boxplot() +
    labs(x = "Demeanor Category", y = "Suspect Age", title = "No Significant Variations
    theme(axis.text.x = element_text(angle = 45, hjust = 1, size = 4),
          axis.text.y = element_text(size = 4),  # Adjust text size for y-axis labels
          axis.title = element_text(size = 4),  # Adjust text size for axis titles
          plot.title = element_text(size = 5)) +
      guides(fill = FALSE)

  grid.arrange(plot6, plot7, plot8, ncol = 2, top = "Numeric Predictors'Relationships w
```

```
Warning: Removed 1494 rows containing non-finite outside the scale range
(`stat_boxplot()`).
```

```
Warning: Removed 941 rows containing non-finite outside the scale range
```

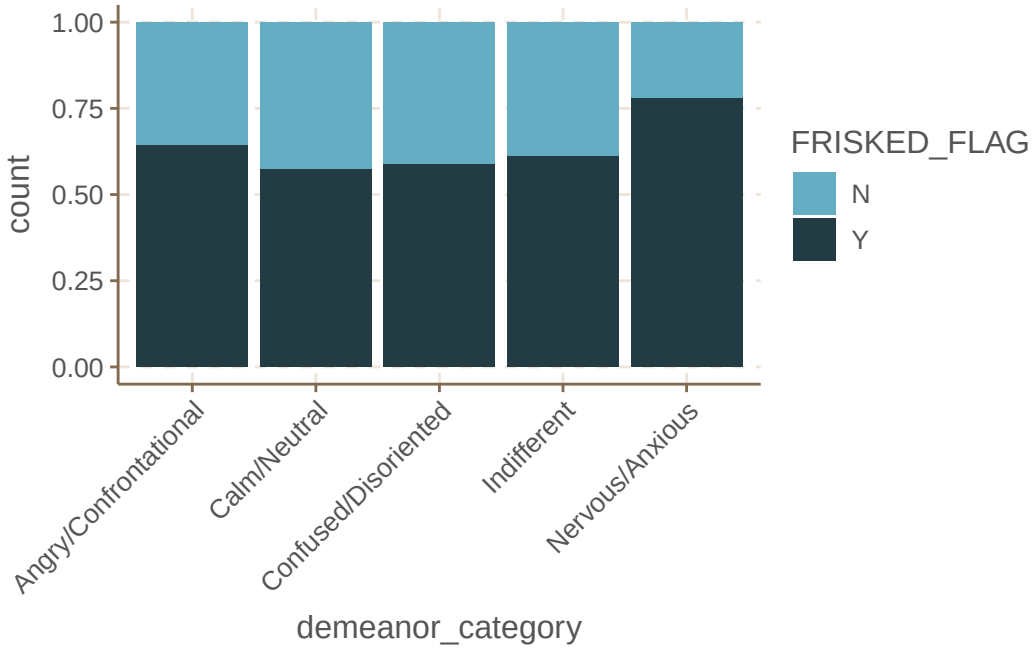
```
(`stat_boxplot()`).

Warning: Removed 702 rows containing non-finite outside the scale range
(`stat_boxplot()`).
```



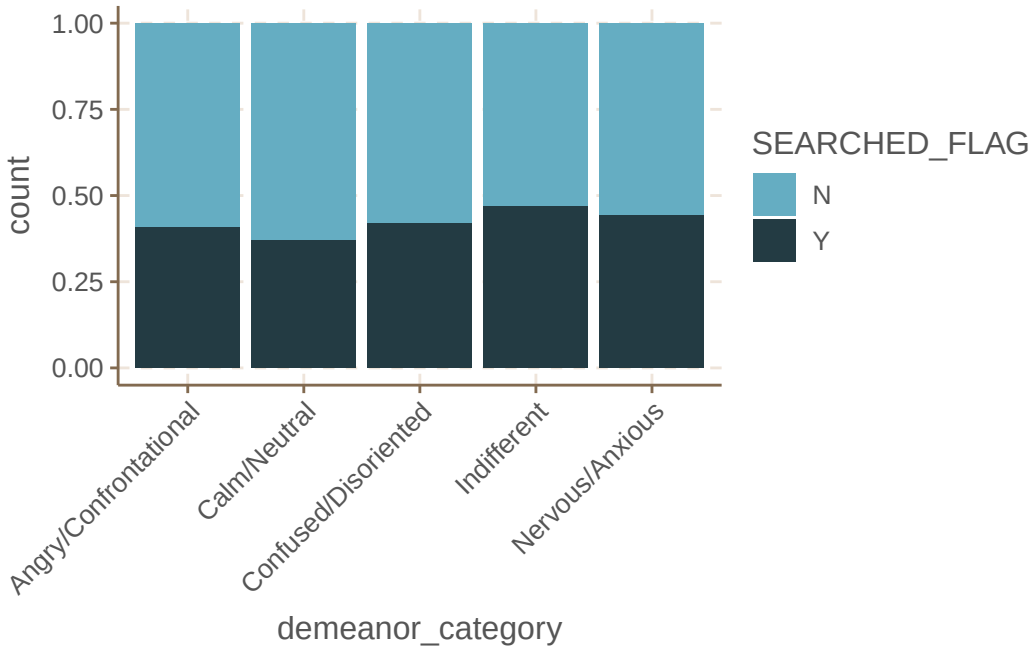
Variable Selection Reasoning:

```
#maybe move this forward
stop_and_frisk_cleaned |>
```

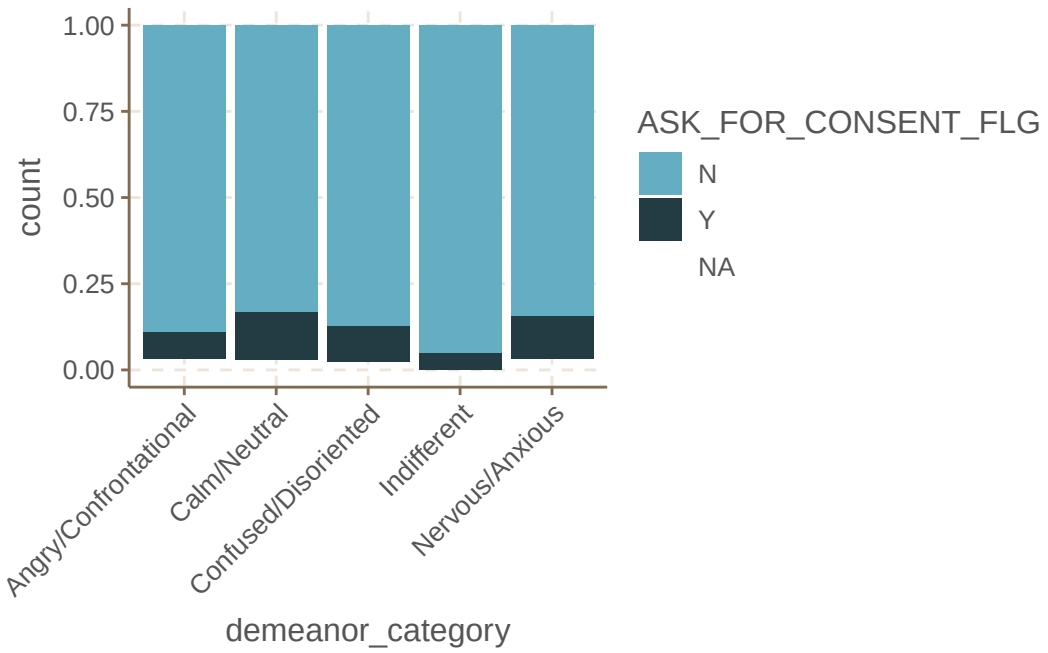
```
  ggplot(aes(x = demeanor_category, fill = FRISKED_FLAG)) +
  geom_bar(position = "fill") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```




```
stop_and_frisk_cleaned |>
  ggplot(aes(x = demeanor_category, fill = SEARCHED_FLAG)) +
  geom_bar(position = "fill") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```




```
stop_and_frisk_cleaned |>
  ggplot(aes(x = demeanor_category, fill = ASK_FOR_CONSENT_FLG)) +
  geom_bar(position = "fill") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))
```



Interpretation:

Methodology:

Why Multinomial Regression Model?

The primary variable of interest, "demeanor category", consists of groups of categorical descriptors that are assigned by police officers. These descriptors are neither ordinal (they simply represent clusters of adjectives with similar characteristics) nor binary (e.g., calm vs. not calm) but rather fall into multiple distinct categories.

Multinomial regression allows us to assess how demographic/physical appearance predictors influence the likelihood of being assigned different demeanor categories compared to a reference category (set as calm/neutral). We can interpret the model coefficients to understand the direction and magnitude of these relationships.

```
library(nnet)
# Set calm/neutral as baseline
stop_and_frisk_cleaned$demeanor_category <- factor(stop_and_frisk_cleaned$demeanor_categor
mtest <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_DE
```

```
# weights:  155 (120 variable)
```

```
initial  value 15370.132064
iter  10 value 12354.940189
iter  20 value 11564.898190
iter  30 value 11306.709240
iter  40 value 11242.182943
iter  50 value 11201.239959
iter  60 value 11190.982313
iter  70 value 11190.551769
iter  80 value 11190.320487
iter  90 value 11190.206823
final  value 11190.203908
converged
```

Assessing multicolinearity & interactions:

Excluding incidents of hair dye and contact lenses, basing off common sense, we suspect a multicolinearity between race and eye color or hair color. Eye color and hair color also contain 9 and 14 categories respectively, largely complicating the coefficient displays of our model.

```
stop_and_frisk_cleaned$demeanor_category <- factor(stop_and_frisk_cleaned$demeanor_categor
stop_and_frisk_cleaned <- na.omit(stop_and_frisk_cleaned)

mtest1 <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_D
```

```
# weights:  50 (36 variable)
initial  value 14641.056689
iter  10 value 11441.484538
iter  20 value 10887.247851
iter  30 value 10744.997398
iter  40 value 10705.238769
iter  50 value 10705.065536
iter  60 value 10705.025915
iter  60 value 10705.025831
iter  60 value 10705.025831
final  value 10705.025831
converged
```

```
mtest2 <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_D
```

```
# weights:  95 (72 variable)
initial  value 14641.056689
```

```
iter  10 value 11399.953060
iter  20 value 10976.798446
iter  30 value 10745.458705
iter  40 value 10703.245151
iter  50 value 10685.675253
iter  60 value 10682.722193
iter  70 value 10682.584887
iter  80 value 10682.563648
final  value 10682.563455
converged
```

```
mtest3 <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_D
```

```
# weights:  155 (120 variable)
initial  value 14641.056689
iter  10 value 11440.374708
iter  20 value 10945.222495
iter  30 value 10748.546495
iter  40 value 10684.488511
iter  50 value 10657.258032
iter  60 value 10649.522304
iter  70 value 10648.733008
iter  80 value 10648.497591
iter  90 value 10648.355485
final  value 10648.350799
converged
```

```
anova_result1 <- anova(mtest1, mtest2, mtest3)

mtest4 <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_D
```

```
# weights:  110 (84 variable)
initial  value 14641.056689
iter  10 value 11412.309157
iter  20 value 10971.484114
iter  30 value 10733.951681
iter  40 value 10701.155682
iter  50 value 10672.995207
iter  60 value 10671.772974
iter  70 value 10671.523296
```

```
iter  80 value 10671.489499
final  value 10671.489148
converged
```

```
anova_result2 <- anova(mtest1, mtest4)
```

Interpretation:

Model 1 vs. Model 2 (adding suspect eye color to race):

- **P-value (Pr(Chi))**: 0.14621930
  - The p-value (0.14621930) suggests that adding `SUSPECT_EYE_COLOR` to the model (from Model 1 to Model 2) does not result in a statistically significant improvement in model fit (at the conventional significance level of 0.05).

Model 2 vs. Model 3 (adding suspect hair color to eye color & race):

- **P-value (Pr(Chi))**: 0.02794697
  - The p-value (0.02794697) indicates that adding `SUSPECT_HAIR_COLOR` to the model (from Model 2 to Model 3) results in a statistically significant improvement in model fit (at the conventional significance level of 0.05).

Model 1 vs. Model 4 (adding suspect hair color to race):

- **P-value (Pr(Chi))**: 0.03577523
  - The p-value (0.02794697) indicates that adding `SUSPECT_HAIR_COLOR` to the model results in a statistically significant improvement in model fit (at the conventional significance level of 0.05).

We decided to delete "hair color" from the predictor variables.

Assumption Diagnostics

Irrelevance of Independent Alternatives Assumption?

The IIA assumption implies that the relative preference or probability of choosing one category over another is independent of the presence or characteristics of other categories in the choice set. For example the probability of police assigning an individual of given demographic/physical appearance to "Calm/neutral" over "Nervous/Anxious" is independent from the presence/absence of the category "Indifferent".

Linear relationship between continuous variables and the logit transformation of the outcome variable?

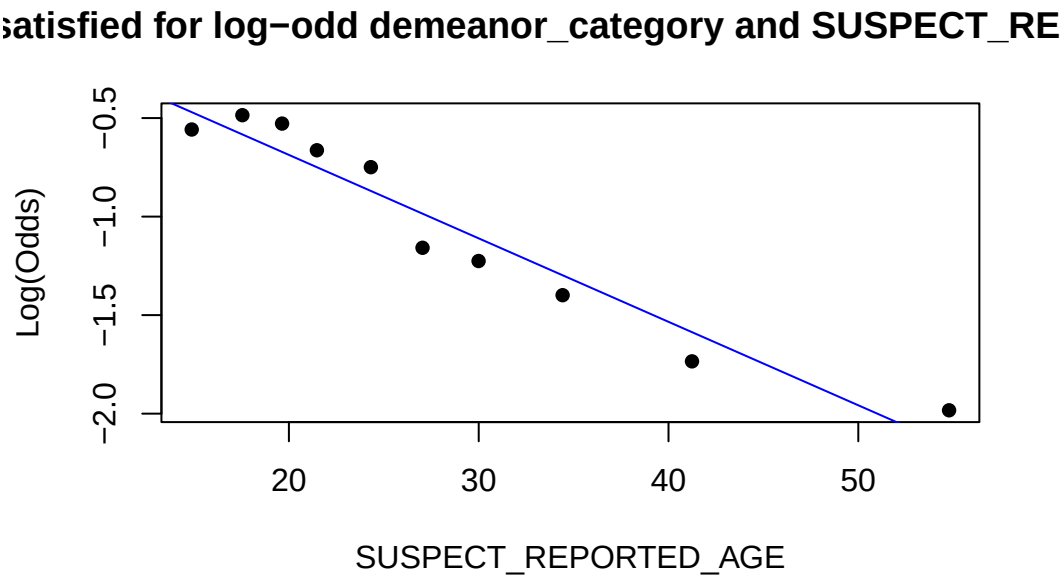
```
install.packages("devtools")
```

```
Installing package into '/home/guest/R/x86_64-pc-linux-gnu-library/4.3'
(as 'lib' is unspecified)
```

```
devtools::install_github("statmanrobin/Stat2Data")
```

```
Skipping install of 'Stat2Data' from a github remote, the SHA1 (3fe987c7) has not changed sin
  Use `force = TRUE` to force installation
```

```
library(Stat2Data)
  emplogitplot1(demeanor_category ~ SUSPECT_REPORTED_AGE,
                data = stop_and_frisk_cleaned,
                ngroups = 10,
                main = "Linearity satisfied for log-odd demeanor_category and SUSPECT_REPO
                )
```



Result

```
mfinal <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_D
```

```
# weights:  110 (84 variable)
initial  value 14641.056689
iter  10 value 11412.309157
iter  20 value 10971.484114
iter  30 value 10733.951681
iter  40 value 10701.155682
iter  50 value 10672.995207
iter  60 value 10671.772974
iter  70 value 10671.523296
iter  80 value 10671.489499
final  value 10671.489148
converged
```

```
summary(mfinal)
```

```
Call:
multinom(formula = demeanor_category ~ SUSPECT_REPORTED_AGE +
    SUSPECT_SEX + SUSPECT_RACE_DESCRIPTION + SUSPECT_HAIR_COLOR,
    data = stop_and_frisk_cleaned)

Coefficients:
                     (Intercept) SUSPECT_REPORTED_AGE SUSPECT_SEXMALE
Nervous/Anxious        0.01695811         -0.042543582       0.1143035
Angry/Confrontational -0.45182058         -0.002831759      -0.3300198
Confused/Disoriented  -1.83744294          0.008042736      -0.3245742
Indifferent           -9.10596437         -0.004146931      -0.1340090
                     SUSPECT_RACE_DESCRIPTIONASIAN / PACIFIC ISLANDER
Nervous/Anxious                                            0.1165216
Angry/Confrontational                                     -1.0479628
Confused/Disoriented                                      -0.9372544
Indifferent                                                7.1236466
                     SUSPECT_RACE_DESCRIPTIONBLACK
Nervous/Anxious                          0.5354716
Angry/Confrontational                    0.1608729
Confused/Disoriented                    -1.3286137
Indifferent                              5.3758331
```

```
                    SUSPECT_RACE_DESCRIPTIONBLACK HISPANIC
Nervous/Anxious                                  0.6391787
Angry/Confrontational                           -0.2016313
Confused/Disoriented                            -1.5938041
Indifferent                                      5.6712591
                    SUSPECT_RACE_DESCRIPTIONMIDDLE EASTERN/SOUTHWEST ASIAN
Nervous/Anxious                                                  -0.2004389
Angry/Confrontational                                            -1.2276365
Confused/Disoriented                                             -2.8653023
Indifferent                                                      -6.4644813
                    SUSPECT_RACE_DESCRIPTIONWHITE
Nervous/Anxious                         0.1742579
Angry/Confrontational                  -0.4321404
Confused/Disoriented                   -1.1952678
Indifferent                             4.8371091
                    SUSPECT_RACE_DESCRIPTIONWHITE HISPANIC
Nervous/Anxious                                  0.4660528
Angry/Confrontational                           -0.3369109
Confused/Disoriented                            -1.4243220
Indifferent                                      4.5341510
                    SUSPECT_HAIR_COLORBLK SUSPECT_HAIR_COLORBLN
Nervous/Anxious                0.003441623            -0.2356335
Angry/Confrontational          0.147871965            -0.1612911
Confused/Disoriented           0.817635265            -0.3565815
Indifferent                   -0.407188405             1.1786388
                    SUSPECT_HAIR_COLORBRO SUSPECT_HAIR_COLORGRY
Nervous/Anxious                -0.11379642           -0.35523873
Angry/Confrontational           0.18945534            0.07698733
Confused/Disoriented            0.90119749            0.43950101
Indifferent                     0.07125463           -7.21547027
                    SUSPECT_HAIR_COLORORG SUSPECT_HAIR_COLORPLE
Nervous/Anxious                -0.4571677             0.7987439
Angry/Confrontational           0.3392415           -17.9510093
Confused/Disoriented            1.9444618           -12.5993116
Indifferent                   -11.4537715            -6.7841897
                    SUSPECT_HAIR_COLORPNK SUSPECT_HAIR_COLORRED
Nervous/Anxious                -17.5826083          -0.076175594
Angry/Confrontational           -0.3568012          -0.008934897
Confused/Disoriented             1.8965336           0.587060019
Indifferent                    -12.4007672           0.890066416
                    SUSPECT_HAIR_COLORSDY SUSPECT_HAIR_COLORWHI
Nervous/Anxious                -18.4759158            -0.8560116
Angry/Confrontational            0.2491789            -0.1615604
```

```
Confused/Disoriented           -14.7638634             1.5919234
Indifferent                    -12.9824825           -13.9364234
                    SUSPECT_HAIR_COLORXXX SUSPECT_HAIR_COLORZZZ
Nervous/Anxious                 0.3701923             0.5167834
Angry/Confrontational           0.5243158            -0.3546765
Confused/Disoriented            1.0036870             0.3337953
Indifferent                     0.3455830           -10.0921077

Std. Errors:
                    (Intercept) SUSPECT_REPORTED_AGE SUSPECT_SEXMALE
Nervous/Anxious       0.8581425          0.002722397       0.1190838
Angry/Confrontational 0.7410952          0.002439957       0.1093863
Confused/Disoriented  0.9532281          0.004708373       0.2079957
Indifferent           0.8277054          0.011618762       0.5122228
                    SUSPECT_RACE_DESCRIPTIONASIAN / PACIFIC ISLANDER
Nervous/Anxious                                           0.8498220
Angry/Confrontational                                     0.7552202
Confused/Disoriented                                      0.8700772
Indifferent                                               0.3825180
                    SUSPECT_RACE_DESCRIPTIONBLACK
Nervous/Anxious                         0.8262199
Angry/Confrontational                   0.7087544
Confused/Disoriented                    0.8215503
Indifferent                             0.2565377
                    SUSPECT_RACE_DESCRIPTIONBLACK HISPANIC
Nervous/Anxious                                  0.8292082
Angry/Confrontational                            0.7138933
Confused/Disoriented                             0.8421220
Indifferent                                      0.3606831
                    SUSPECT_RACE_DESCRIPTIONMIDDLE EASTERN/SOUTHWEST ASIAN
Nervous/Anxious                                                 8.723853e-01
Angry/Confrontational                                           8.028861e-01
Confused/Disoriented                                            1.299085e+00
Indifferent                                                     2.044484e-06
                    SUSPECT_RACE_DESCRIPTIONWHITE
Nervous/Anxious                         0.8341582
Angry/Confrontational                   0.7178333
Confused/Disoriented                    0.8415953
Indifferent                             0.5069771
                    SUSPECT_RACE_DESCRIPTIONWHITE HISPANIC
Nervous/Anxious                                  0.8274433
Angry/Confrontational                            0.7108710
Confused/Disoriented                             0.8273135
```

```
Indifferent                                    0.3956554
                     SUSPECT_HAIR_COLORBLK SUSPECT_HAIR_COLORBLN
Nervous/Anxious                  0.1637925             0.3146318
Angry/Confrontational            0.1495769             0.3148147
Confused/Disoriented             0.3775459             0.8197258
Indifferent                      0.6473282             0.9123472
                     SUSPECT_HAIR_COLORBRO SUSPECT_HAIR_COLORGRY
Nervous/Anxious                  0.1839946           0.347244895
Angry/Confrontational            0.1730203           0.245383924
Confused/Disoriented             0.4086463           0.535993104
Indifferent                      0.7439750           0.001578182
                     SUSPECT_HAIR_COLORORG SUSPECT_HAIR_COLORPLE
Nervous/Anxious                1.179602e+00          1.518935e+00
Angry/Confrontational          9.352750e-01          1.336934e-08
Confused/Disoriented           1.221828e+00          3.389185e-07
Indifferent                    1.101218e-06          5.099504e-05
                     SUSPECT_HAIR_COLORPNK SUSPECT_HAIR_COLORRED
Nervous/Anxious                2.255176e-08             0.4143470
Angry/Confrontational          1.172001e+00             0.4174201
Confused/Disoriented           1.227510e+00             0.8397188
Indifferent                    3.816108e-07             1.2567769
                     SUSPECT_HAIR_COLORSDY SUSPECT_HAIR_COLORWHI
Nervous/Anxious                3.977977e-09          1.079802e+00
Angry/Confrontational          8.930904e-01          6.659059e-01
Confused/Disoriented           5.257464e-08          7.517723e-01
Indifferent                    2.351685e-07          1.896014e-07
                     SUSPECT_HAIR_COLORXXX SUSPECT_HAIR_COLORZZZ
Nervous/Anxious                  0.1832616          4.188355e-01
Angry/Confrontational            0.1727214          5.352358e-01
Confused/Disoriented             0.4186227          1.096198e+00
Indifferent                      0.7313541          2.232503e-05

Residual Deviance: 21342.98
AIC: 21510.98
```

```r
#Statistical Significance?

coefficients_final <- coef(mfinal)
standard_errors_final <- sqrt(diag(vcov(mfinal)))

z <- coefficients_final/ standard_errors_final
p <- (1 - pnorm(abs(z), 0, 1)) * 2
```

```
print(p)
```

```
                    (Intercept) SUSPECT_REPORTED_AGE SUSPECT_SEXMALE
Nervous/Anxious       0.9842337            0.9589336      0.89012933
Angry/Confrontational 0.0000000            0.9972752      0.04391886
Confused/Disoriented  0.0000000            0.9926442      0.30225961
Indifferent           0.0000000            0.9960334      0.46641066
                    SUSPECT_RACE_DESCRIPTIONASIAN / PACIFIC ISLANDER
Nervous/Anxious                                            0.7372024
Angry/Confrontational                                      0.3743236
Confused/Disoriented                                       0.5372036
Indifferent                                                0.0000000
                    SUSPECT_RACE_DESCRIPTIONBLACK
Nervous/Anxious                         0.1962441
Angry/Confrontational                   0.0000000
Confused/Disoriented                    0.2185385
Indifferent                             0.0000000
                    SUSPECT_RACE_DESCRIPTIONBLACK HISPANIC
Nervous/Anxious                                 0.1269887
Angry/Confrontational                           0.7855666
Confused/Disoriented                            0.0000000
Indifferent                                     0.0000000
                    SUSPECT_RACE_DESCRIPTIONMIDDLE EASTERN/SOUTHWEST ASIAN
Nervous/Anxious                                                7.906978e-01
Angry/Confrontational                                          8.325501e-02
Confused/Disoriented                                           5.979249e-05
Indifferent                                                    8.881784e-16
                    SUSPECT_RACE_DESCRIPTIONWHITE
Nervous/Anxious                      8.081950e-01
Angry/Confrontational                5.432520e-01
Confused/Disoriented                 1.332268e-15
Indifferent                          0.000000e+00
                    SUSPECT_RACE_DESCRIPTIONWHITE HISPANIC
Nervous/Anxious                                 0.007067836
Angry/Confrontational                           0.169753964
Confused/Disoriented                            0.127785931
Indifferent                                     0.000000000
                    SUSPECT_HAIR_COLORBLK SUSPECT_HAIR_COLORBLN
Nervous/Anxious                 0.9976570             0.1724920
Angry/Confrontational           0.7231499             0.7631508
```

Confused/Disoriented	0.3599227	0.7083464
Indifferent	0.5408816	0.0000000
	SUSPECT_HAIR_COLORBRO	SUSPECT_HAIR_COLORGRY
Nervous/Anxious	0.5843036	0.7845050
Angry/Confrontational	0.8276274	0.9271129
Confused/Disoriented	0.2726644	0.5952533
Indifferent	0.9325689	0.0000000
	SUSPECT_HAIR_COLORORG	SUSPECT_HAIR_COLORPLE
Nervous/Anxious	0.5770437167	0
Angry/Confrontational	0.4064486629	0
Confused/Disoriented	0.0002858754	0
Indifferent	0.0000000000	0
	SUSPECT_HAIR_COLORPNK	SUSPECT_HAIR_COLORRED
Nervous/Anxious	0.00000000	5.517498e-11
Angry/Confrontational	0.39403562	9.860829e-01
Confused/Disoriented	0.08361223	1.248514e-01
Indifferent	0.00000000	5.213601e-04
	SUSPECT_HAIR_COLORSDY	SUSPECT_HAIR_COLORWHI
Nervous/Anxious	0	0.18604281
Angry/Confrontational	0	0.85944389
Confused/Disoriented	0	0.03237465
Indifferent	0	0.00000000
	SUSPECT_HAIR_COLORXXX	SUSPECT_HAIR_COLORZZZ
Nervous/Anxious	0.000000	0.0000000
Angry/Confrontational	0.000000	0.0000000
Confused/Disoriented	0.000000	0.6480972
Indifferent	0.783335	0.0000000

Key Interpretations:

Overall trend in model:

Criteria - Salient Slope + Statistical Significance:

Note: Primary objective is prediction, so we will not be assessing model predictive power through CV tests.

Discussion

Overall conclusions from analysis are clearly described, and the model results are put into the larger context of the subject matter and original research question. There is thoughtful consideration of potential limitations of the data and/or analysis, and ideas for future work are clearly described.

Pattern

Evaluate Model - testing + training

limitations:

-missingness - excluding a huge proportion of data…

-definition of categories

-“reported age”, weight - rather arbitrary when considering what’s a “physical characteristic”

proportions + numbers (problem with representation)

variable selection process - based on visualizations

incomplete understanding of dataset

e.g., potential violation of independence

Ideas for future work:

more focus on behavior vs. characteristics

explore other behavior variables

implicit bias is hard to measure

less focused aspects like hair color + extending to accessory + outfits? (detailed description variable)