

STA210 SP'24 Final Project

Exploring 2023 Stop and Frisk Data in NYC

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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/demographic 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.

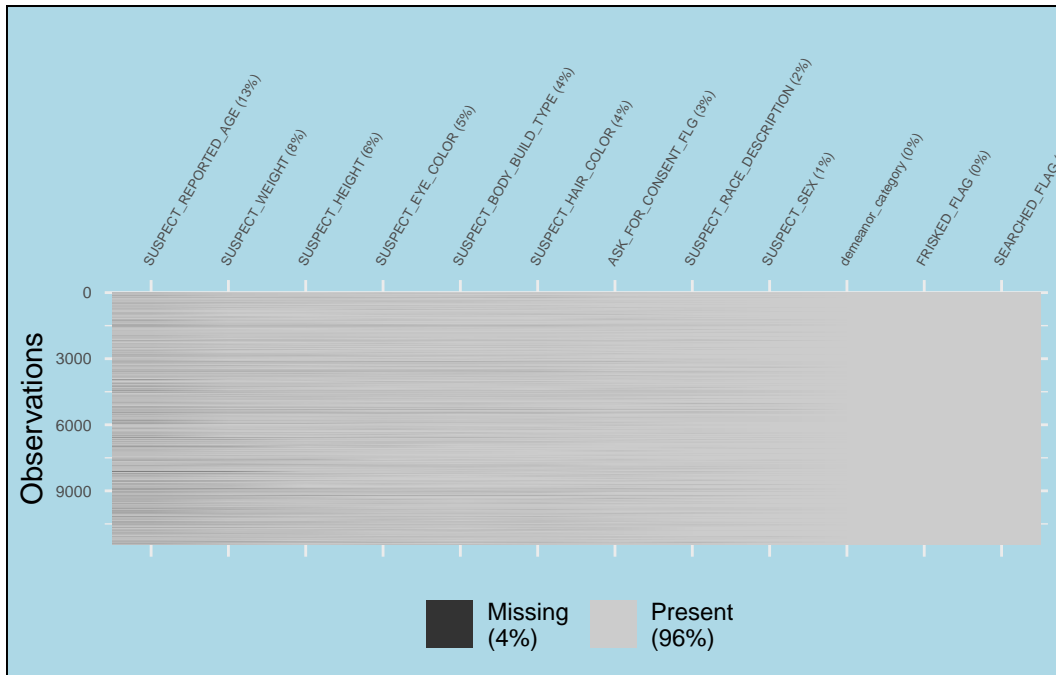
- CONFUSED - SURPRISED - SHOCKED - INTOXICATED - INTOX - ERRATIC - OUT OF BREATH

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).

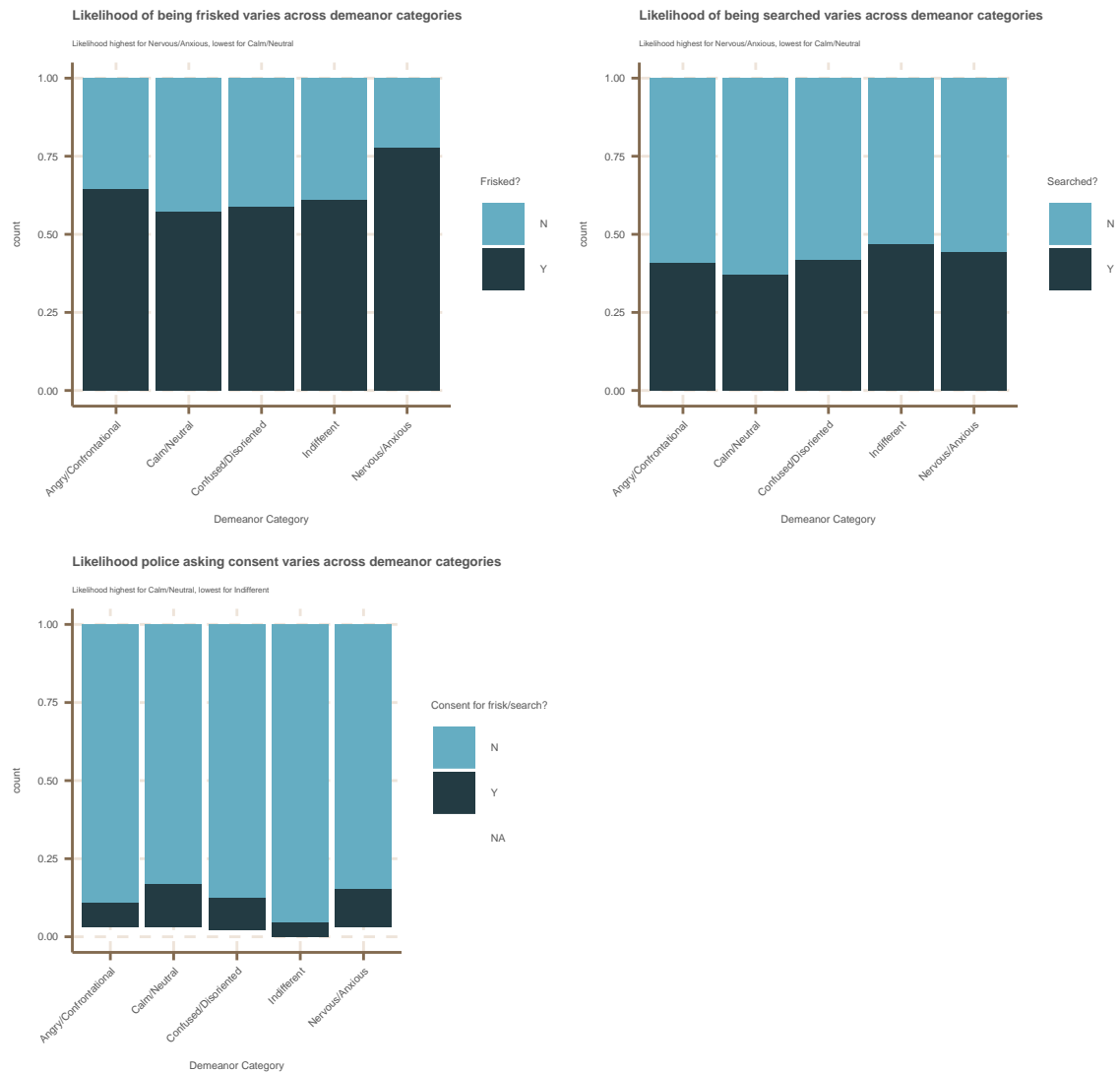
The following graph visualizes the missingness in our newly generated data set (stop_and_frisk_cleaned) consisting of our created variable “demeanor category” and other predictors variables/variables for exploratory analysis of interest:



Among our variables of interest, no variable contains a significant amount of missing values that would require specialized handling. Therefore, for subsequent exploratory analysis, we will use listwise deletion to remove observations with missing values (NA).

Exploratory Data Analysis

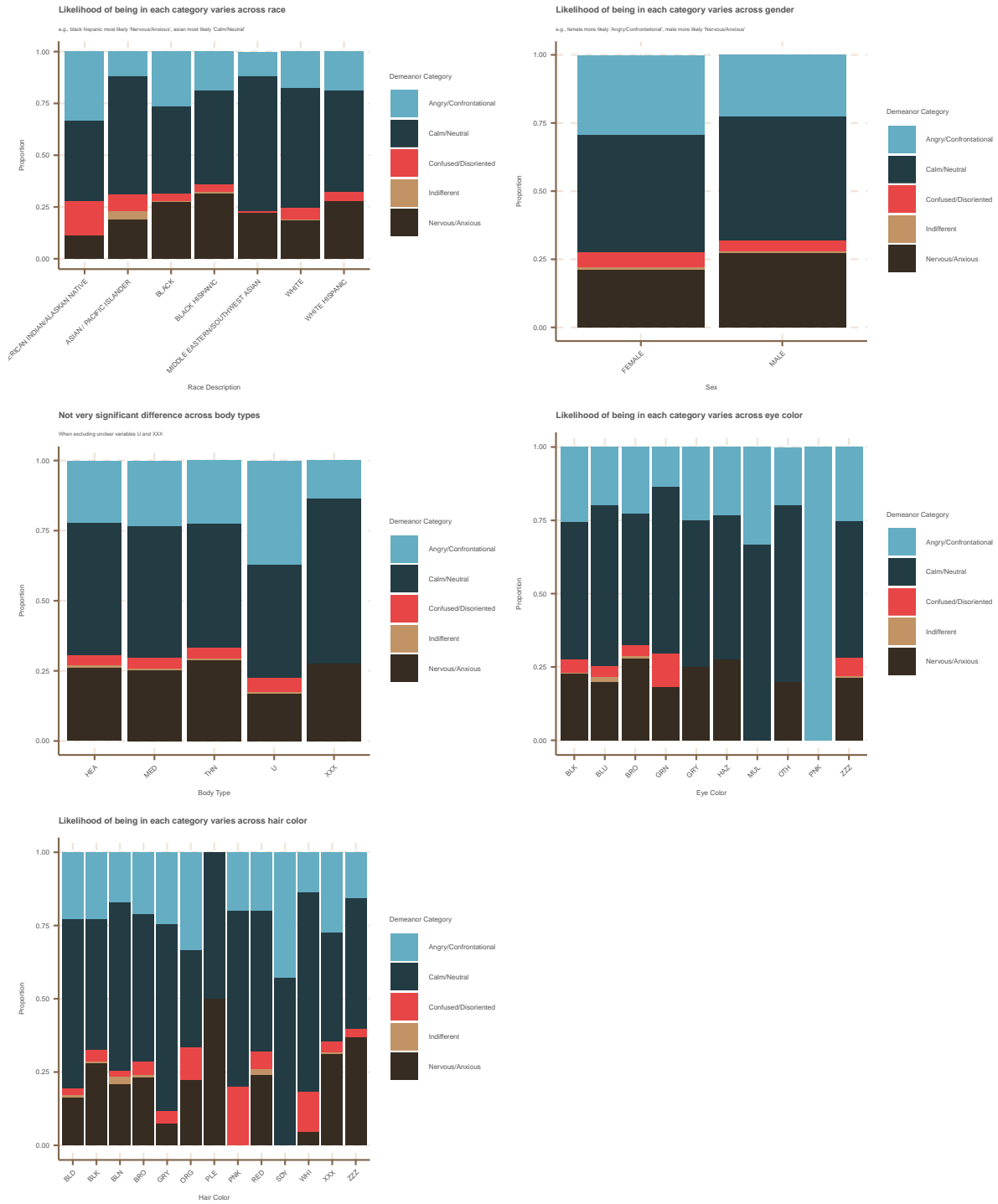
Categorical Predictors' Relationships with Demeanor Category



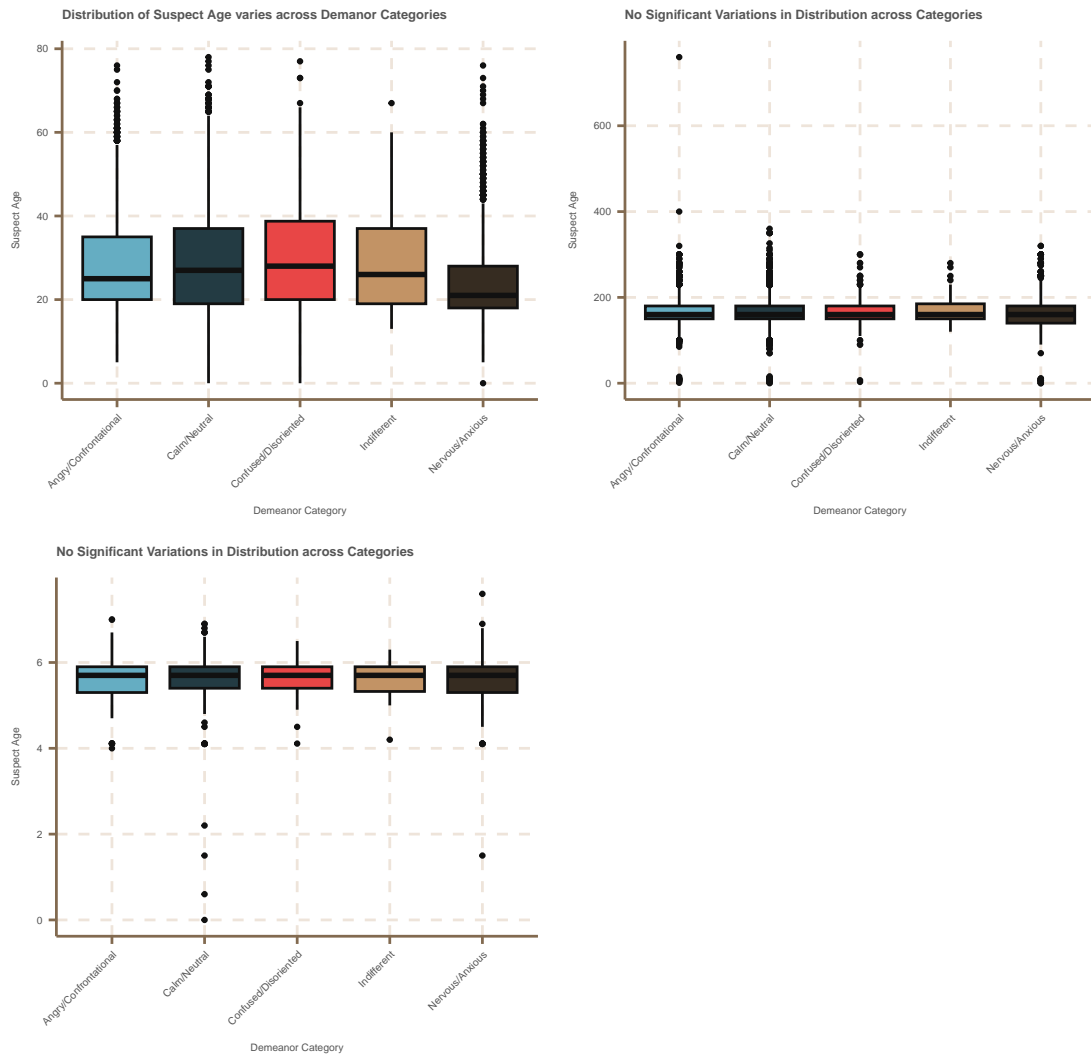
Summary:

Variable Selection

Categorical Predictors' Relationships with Demeanor Category



Numeric Predictors' Relationships with Demeanor Category



Methodology:

Initial Model (code chunk demo):

```
library(nnet)
# Set calm/neutral as baseline
stop_and_frisk_cleaned$demeanor_category <- factor(stop_and_frisk_cleaned$demeanor_category, levels = c("Calm/Neutral", "Angry/Confrontational", "Confused/Disoriented", "Indifferent", "Nervous/Anxious"))
# Fitting the model
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
```

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.

Assessing multicollinearity & interactions:

Excluding incidents of hair dye and contact lenses, basing off common sense, we suspect a multicollinearity 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. Thus, we decided to construct the following nested models to conduct nested F-tests:

```
mtest1 <- demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_DESCRIPTION
mtest2 <- demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_DESCRIPTION
mtest3 <- demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_DESCRIPTION
mtest4 <- demeanor_category ~ SUSPECT_REPORTED_AGE + SUSPECT_SEX + SUSPECT_RACE_DESCRIPTION
```

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.

After conducting nested test on the variables (age, sex, race, hair color), 2 interactions emerged as statistically significant:

SUSPECT_REPORTED_AGE * SUSPECT_RACE_DESCRIPTION (p-value: 0.002785438)

SUSPECT_SEX * SUSPECT_RACE_DESCRIPTION (p-value: 0.0153514)

We also conducted a nested - test incorporating both interactions. When compared with original model, the p-value is 0.0003565872.

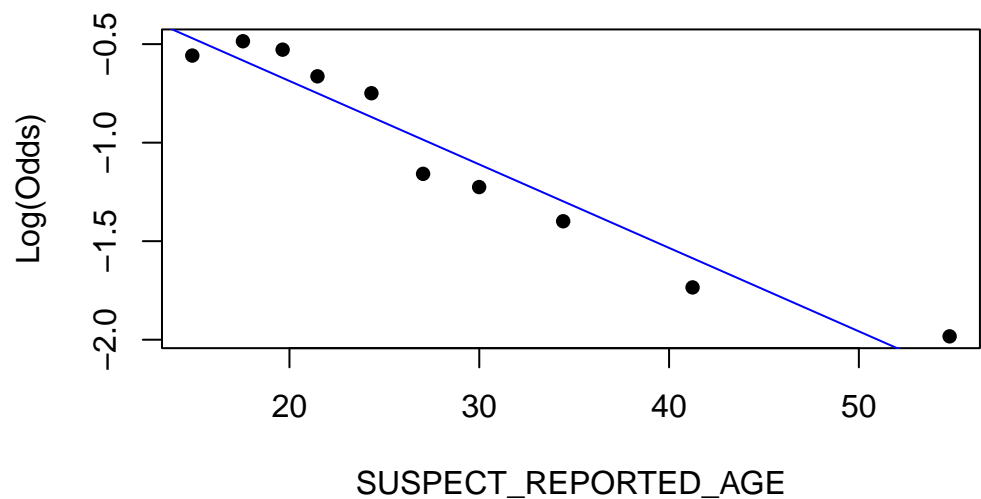
Assumption Diagnostics

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?

satisfied for log-odd demeanor_category and SUSPECT_RE



Result

Code Chunk Demo:

```
mfinal <- multinom(demeanor_category ~ SUSPECT_REPORTED_AGE * SUSPECT_RACE_DESCRIPTION + S
```

	(Intercept)	SUSPECT_REPORTED_AGE
Nervous/Anxious	2.074329e-01	0.998874845
Angry/Confrontational	0.000000e+00	0.999683406
Confused/Disoriented	1.543762e-03	0.948867462
Indifferent	1.649397e-06	0.001521946
	SUSPECT_RACE_DESCRIPTIONASIAN / PACIFIC ISLANDER	
Nervous/Anxious		1.373802e-02
Angry/Confrontational		0.000000e+00
Confused/Disoriented		0.000000e+00
Indifferent		3.208927e-07
	SUSPECT_RACE_DESCRIPTIONBLACK	
Nervous/Anxious		1.275695e-07
Angry/Confrontational		4.603811e-02
Confused/Disoriented		3.411883e-01
Indifferent		0.000000e+00

	SUSPECT_RACE_DESCRIPTIONBLACK HISPANIC	
Nervous/Anxious	2.302750e-07	
Angry/Confrontational	0.000000e+00	
Confused/Disoriented	1.341882e-07	
Indifferent	1.275963e-07	
	SUSPECT_RACE_DESCRIPTIONMIDDLE EASTERN/SOUTHWEST ASIAN	
Nervous/Anxious	0.00000000	
Angry/Confrontational	0.00000000	
Confused/Disoriented	0.09729225	
Indifferent	0.00000000	
	SUSPECT_RACE_DESCRIPTIONWHITE	
Nervous/Anxious	0.000000e+00	
Angry/Confrontational	0.000000e+00	
Confused/Disoriented	0.000000e+00	
Indifferent	1.800178e-08	
	SUSPECT_RACE_DESCRIPTIONWHITE HISPANIC SUSPECT_SEXMALE	
Nervous/Anxious	0.10493071	0.86670374
Angry/Confrontational	0.21316715	0.08683497
Confused/Disoriented	0.36283630	0.12771664
Indifferent	0.06299667	0.11735551
	SUSPECT_HAIR_COLORBLK SUSPECT_HAIR_COLORBLN	
Nervous/Anxious	0.9989470	7.714560e-01
Angry/Confrontational	0.8868866	8.415172e-01
Confused/Disoriented	0.4388217	2.156885e-02
Indifferent	0.6649250	5.531418e-06
	SUSPECT_HAIR_COLORBRO SUSPECT_HAIR_COLORGRY	
Nervous/Anxious	0.4530985	0.7258954
Angry/Confrontational	0.4315107	0.8181795
Confused/Disoriented	0.3387865	0.6450254
Indifferent	0.0000000	0.0000000
	SUSPECT_HAIR_COLORORG SUSPECT_HAIR_COLORPLE	
Nervous/Anxious	0.00274117	1.598721e-14
Angry/Confrontational	0.54328360	0.000000e+00
Confused/Disoriented	0.00000000	0.000000e+00
Indifferent	0.00000000	0.000000e+00
	SUSPECT_HAIR_COLORPNK SUSPECT_HAIR_COLORRED	
Nervous/Anxious	9.037215e-14	0.9382373
Angry/Confrontational	7.576877e-01	0.9925412
Confused/Disoriented	6.490295e-02	0.4054539
Indifferent	1.939431e-02	0.0000000
	SUSPECT_HAIR_COLORSDY SUSPECT_HAIR_COLORWHI	
Nervous/Anxious	9.677856e-10	0.28459093
Angry/Confrontational	7.412510e-01	0.99153444

Confused/Disoriented	3.687055e-10	0.04857807
Indifferent	2.840160e-02	0.00000000
	SUSPECT_HAIR_COLORXXX	SUSPECT_HAIR_COLORZZZ
Nervous/Anxious	0.66758136	0.00000000
Angry/Confrontational	0.20140848	0.7627536
Confused/Disoriented	0.06328786	0.7224576
Indifferent	0.84937643	0.00000000
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	ASIAN / PACIFIC ISLANDER
Nervous/Anxious		0.9392487
Angry/Confrontational		0.9821562
Confused/Disoriented		0.9522908
Indifferent		0.00000000
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	BLACK
Nervous/Anxious		0.2866918
Angry/Confrontational		0.9708854
Confused/Disoriented		0.6147933
Indifferent		0.00000000
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	BLACK HISPANIC
Nervous/Anxious		1.377982e-01
Angry/Confrontational		9.892153e-01
Confused/Disoriented		9.270474e-01
Indifferent		2.366298e-05
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	MIDDLE EASTERN/SOUTHWEST ASIAN
Nervous/Anxious		0.99999999
Angry/Confrontational		0.99999999
Confused/Disoriented		0.87999999
Indifferent		0.00000000
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	WHITE
Nervous/Anxious		9.272277e-02
Angry/Confrontational		9.925171e-01
Confused/Disoriented		9.484858e-01
Indifferent		1.342723e-09
	SUSPECT_REPORTED_AGE:SUSPECT_RACE_DESCRIPTION	WHITE HISPANIC
Nervous/Anxious		NaN
Angry/Confrontational		9.936795e-01
Confused/Disoriented		9.653548e-01
Indifferent		4.677814e-12
	SUSPECT_RACE_DESCRIPTION	ASIAN / PACIFIC ISLANDER:SUSPECT_SEX
Nervous/Anxious		2.041336e-01
Angry/Confrontational		3.218564e-07
Confused/Disoriented		5.042788e-02
Indifferent		0.000000e+00
	SUSPECT_RACE_DESCRIPTION	BLACK:SUSPECT_SEX
		MALE

Nervous/Anxious	0.0000000	
Angry/Confrontational	0.0000000	
Confused/Disoriented	0.0000000	
Indifferent	0.5908934	
	SUSPECT_RACE_DESCRIPTIONBLACK HISPANIC:SUSPECT_SEXMALE	
Nervous/Anxious		0
Angry/Confrontational		0
Confused/Disoriented		0
Indifferent		0
	SUSPECT_RACE_DESCRIPTIONMIDDLE EASTERN/SOUTHWEST ASIAN:SUSPECT_SEXMALE	
Nervous/Anxious		0
Angry/Confrontational		0
Confused/Disoriented		0
Indifferent		0
	SUSPECT_RACE_DESCRIPTIONWHITE:SUSPECT_SEXMALE	
Nervous/Anxious	0.000000e+00	
Angry/Confrontational	0.000000e+00	
Confused/Disoriented	9.475178e-01	
Indifferent	2.817258e-09	
	SUSPECT_RACE_DESCRIPTIONWHITE HISPANIC:SUSPECT_SEXMALE	
Nervous/Anxious	0.8639366	
Angry/Confrontational	0.0000000	
Confused/Disoriented	0.4512173	
Indifferent	0.0120308	

Demeanor Category	Nervous/Anxious	Angry/Confrontational	Confused/Disoriented	Indifferent
Intercept	-1.357961	-2.574885	-4.397465	-5.154604
Suspect Reported Age	0.0015998	0.0004343	0.0721559	-3.4518449
Suspect Race Description				
Asian/Pacific Islander	2.6196405	-6.0470772	2.7054023	0.9408073
Black	1.8471642	2.3456529	4.60E-02	0.9788497
Black/Hispanic	2.146802	1.502495	-5.699634	-0.969537
Eastern/Southwest Asian	-6.587708	-4.8590558	-0.1155008	-0.7297636
White	1.584095	2.389086	1.105668	-7.307296
White Hispanic	1.7366437	1.3894598	0.9961909	2.032628
Suspect Sex (Male)	0.1811834	1.6683763	0.0950122	1.5772839
Suspect Hair Color				
BLK	-0.0012809	0.1493579	0.8146357	-0.4427067
BLN	-0.2888799	-0.192376	-0.3444254	1.4432382
BRO	-0.1302301	0.1945156	0.9009926	-0.1233213
GRY	-0.4151041	0.0970203	0.4151971	-9.4475966
ORG	-0.5188745	0.3253842	1.9466363	-2.803536
PLE	0.48335	-6.5322632	-3.052476	-0.5771634
PNK	-7.5096135	-0.2984995	1.8990211	-2.4619188
RED	-0.0766335	0.0092048	0.7188939	1.5073034
SDY	-7.5073787	0.2745248	-4.9162777	-3.2378873
WHI	-1.0548416	-0.0093757	1.533168	-5.5341932
XXX	0.3526712	0.5223206	1.0017605	0.232247
ZZZ	0.5074013	0 -0.3725622	0.2993954	-5.0264888
Reported Age : Race				
Asian/Pacific Islander	-0.0595987	0.0093822	-0.065851	3.5491124
Black	-0.0465586	-0.0017063	-0.0650443	3.4291996
Black Hispanic	-0.0657873	-0.0143534	-0.0736641	3.3171812
Eastern/Southwest Asian	0.0168902	0.0074	-0.1283	-17.8129
White	-0.0262191	-0.0131513	-0.0652337	3.4875826
White Hispanic	-0.0385404	-0.0055927	-0.0561416	3.4155661
Sex : Race				
Asian/Pacific Islander	-0.8611104	4.7634296	-1.5388762	-3.9992826
Black	0.0660896	-2.1144329	-0.5461502	-0.6852422
Black Hispanic	0.3795238	-1.2319529	6.5939248	4.1618072
Eastern/Southwest Asian	6.1076465	3.4887836	0.9471221	-0.723731
White	-0.7075574	-2.4384277	-0.0600145	5.2589031
White Hispanic	-0.0988109	-1.5035782	-0.533243	-2.3348775

Note: The spreadsheet displays the coefficients generated by the multinomial regression model “mfinal”. Coefficients highlighted in light blue has a p-value lower than the 0.05 significance threshold. P-values close to the threshold/displayed as 0.0 (likely due to scarcity of relevant observations) are indicated on the right.

Since the primary objective of our exploration is not prediction, we will not be assessing model predictive power through CV tests.

Key Interpretations:

Overall trend in model:

Criteria - Salient Slope + Statistical Significance:

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)