# Visualize Officers and Their Shift Assignments

High degree of correlation between officer age and officer experience

- The correlation between age and officer experience is: 0.7805253.
- As a result, I consider age and officer experience relatively interchangeable as variables. For the visualizations below, I plan on using officer age. I believe that no matter which variable I use, a similar story would emerge.
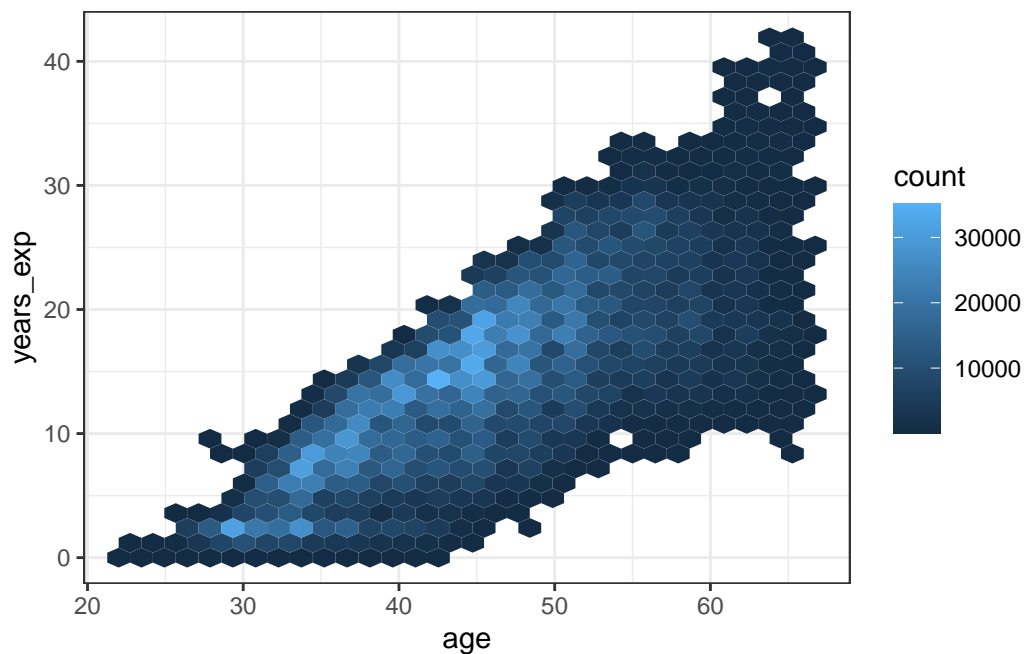
Visualizing Results

What are the demographic breakdowns of active patrol officers?
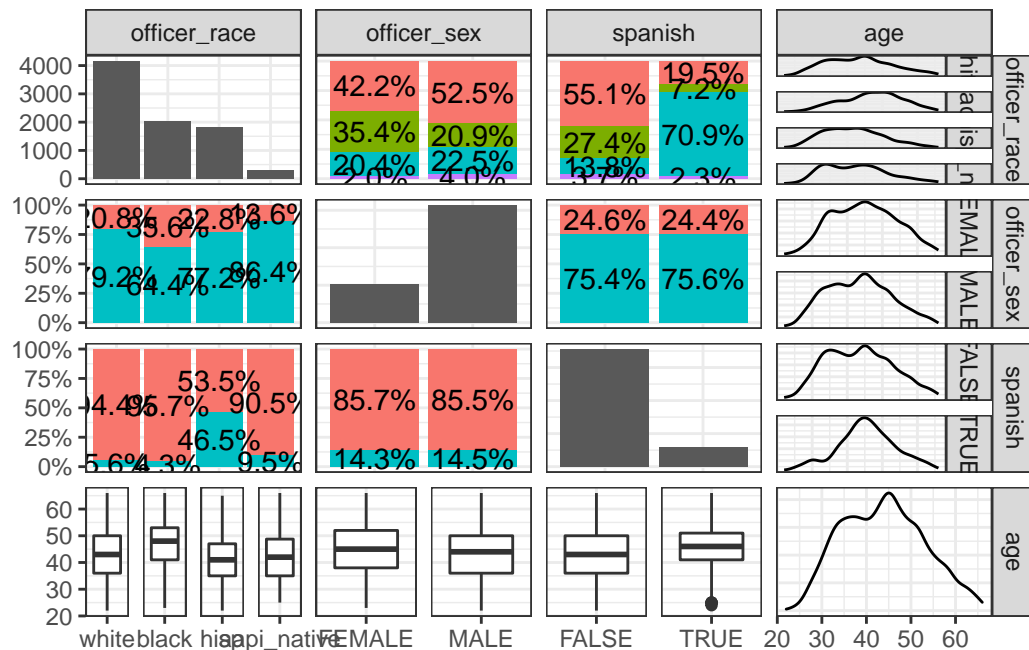
There are 8319 active patrol officers from 2012 - 2015.

RACE * About 50% of all active patrol officers are White, 24.5% are Black, 22% are Hispanic, and 3.5% are Asian-American/Pacific Islander/Native American. * When looking at race and sex, AAPI/Native Americans, White Americans, and Hispanic Americans have roughly an 80/20 split when it comes to male/female representation. Black Americans actually have a 65/35 split. Interestingly, white women are not the majority among women but a plurality. Black women officers are over-represented based on the patrol officer population average for men vs. women. * Not surprisingly, Hispanic Americans are the most common racial group among those who speak Spanish (71% of those who speak Spanish are Hispanic). Roughly 46.5% of all Hispanic officer speak Spanish while most other racial groups have around 5-10% of their groups being able to speak Spanish. * Black Officers are, on average, older than officers from other racial groups with the average officer age being around 47 - 48. Hispanic and AAPI/Native American officers tend to be younger with average ages around 40 - 42. White officers are in the middle with an average age around 45.

SEX * 75% of officers are male. * Male and female officers have very similar age distributions.

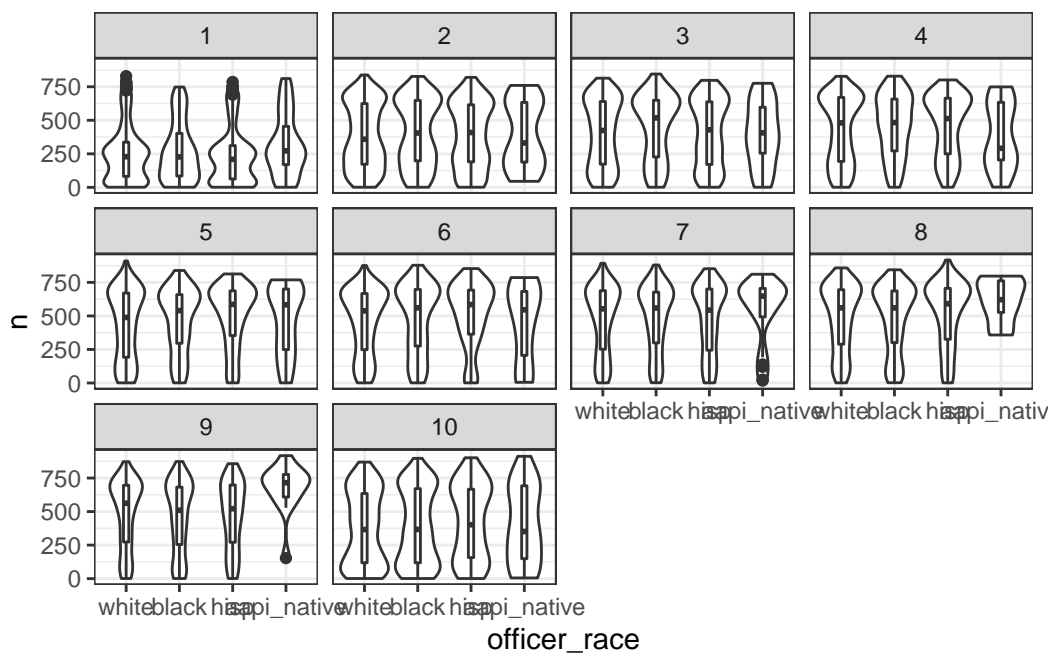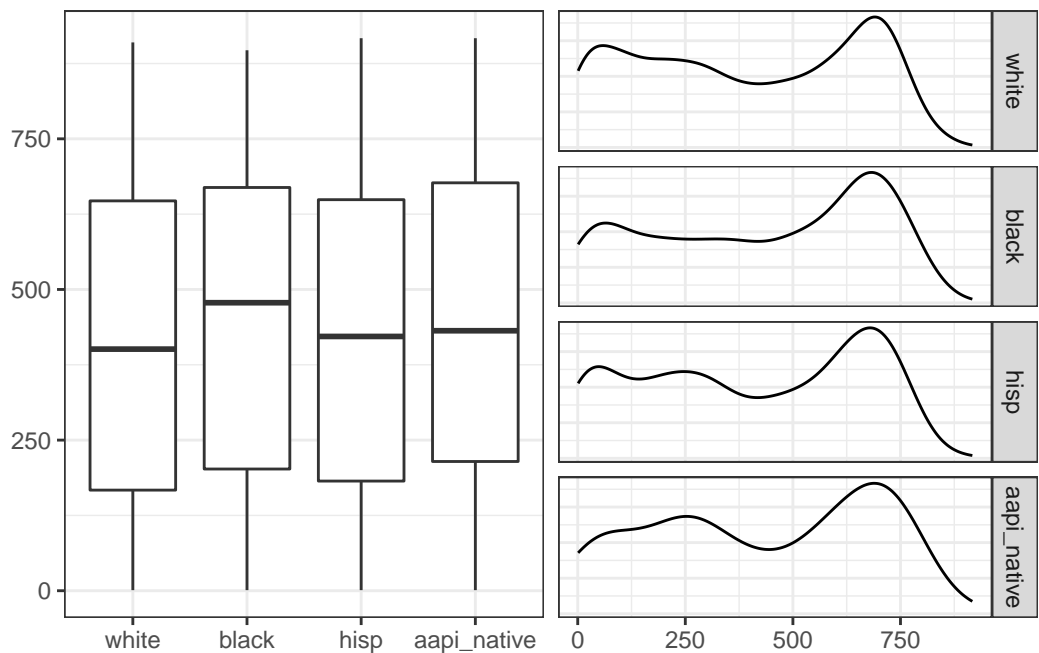**SPANISH SPEAKING ABILITY** * 85% of officers do not speak Spanish. * There does not appear to be any major differences in age or sex between those who do and do not speak Spanish.

AGE * The mean officer age is 43.8807549 with a standard deviation of around 9.1351538 years.

NUMBER OF SHIFTS
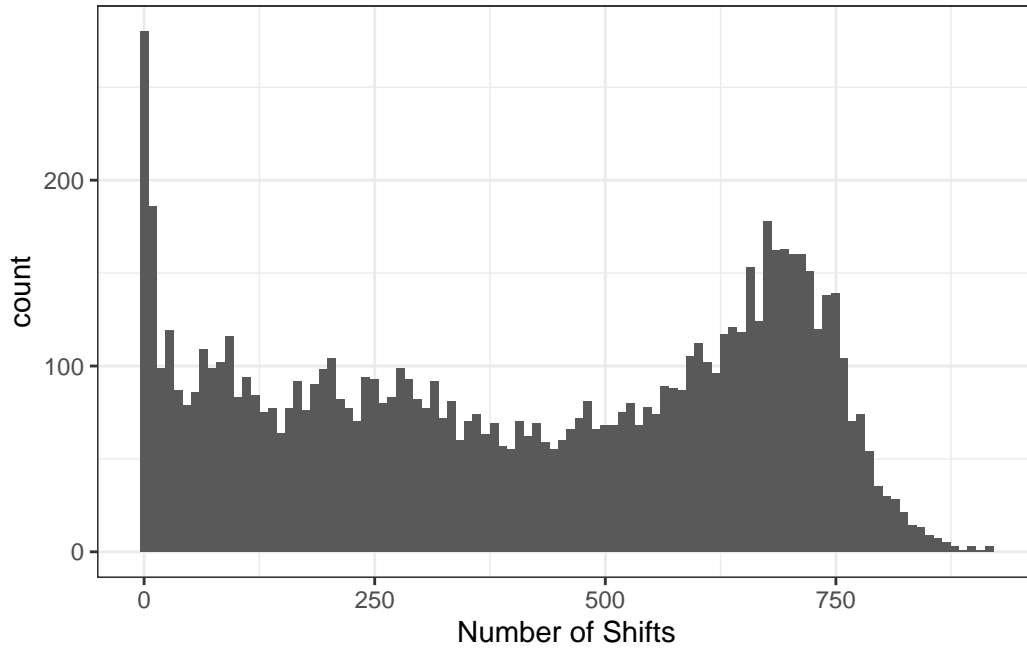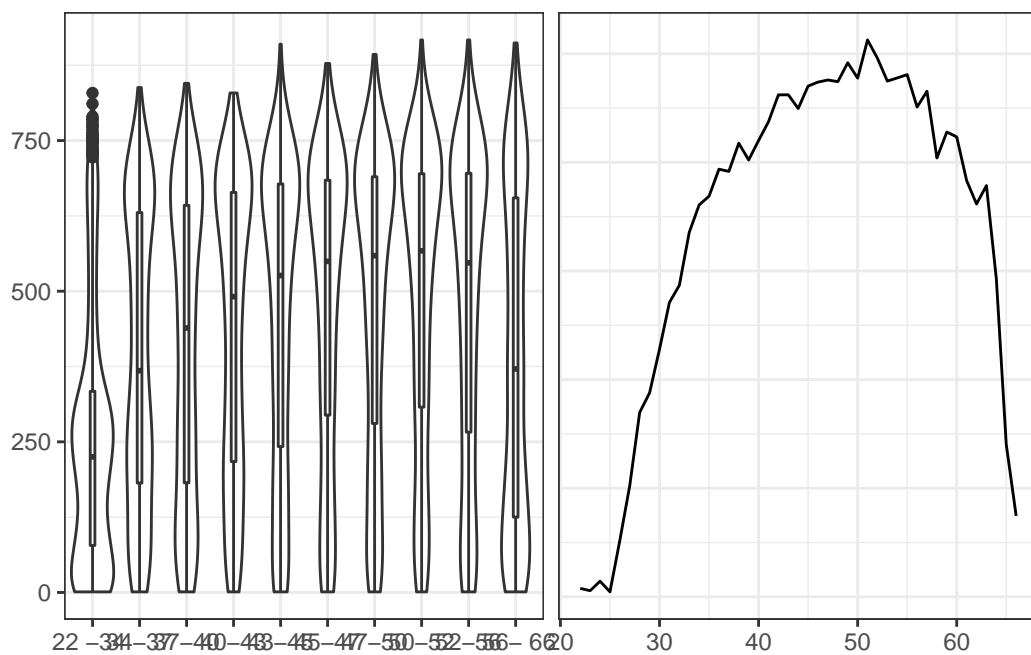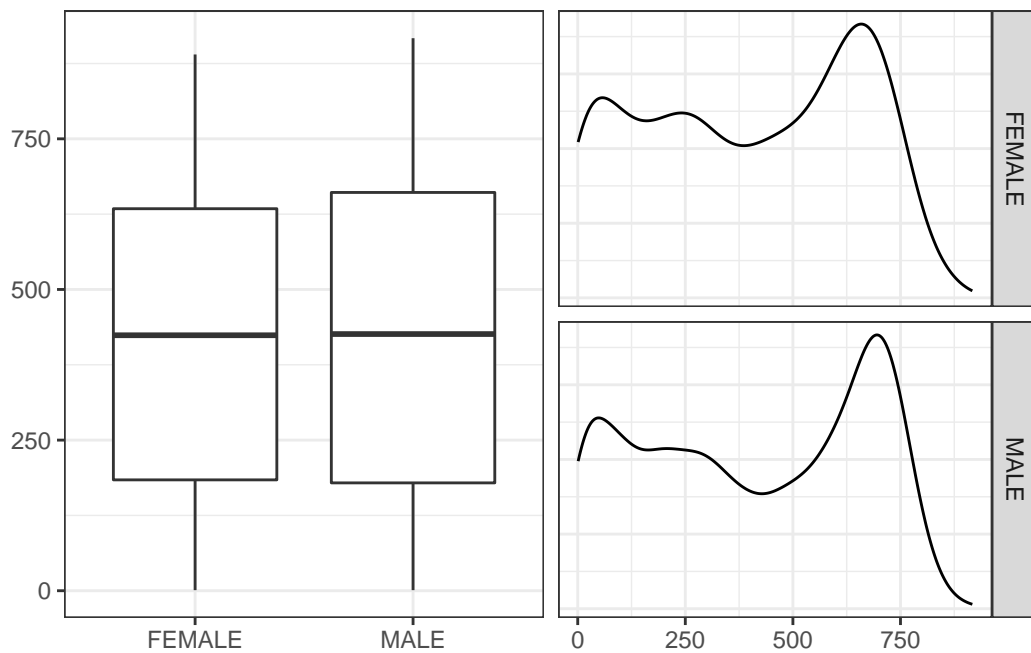
SEX

Looking by sex, there does not appear to be any substantive differences in the distributions in the number of shifts worked.

	Number of Shift Assignments (OLS)
(Intercept)	−1325.662 (54.394)***
officer_raceblack	10.612 (6.609)
officer_racehisp	11.591 (6.718)+
officer_raceaapi_native	28.928 (14.419)*
officer_sexMALE	20.135 (6.154)**
age	74.188 (2.472)***
I(age^2)	−0.767 (0.027)***
Num.Obs.	8328
R2	0.125
R2 Adj.	0.125
AIC	114 845.6
BIC	114 901.8
Log.Lik.	−57 414.809
F	198.655
RMSE	238.81

P-values are denoted by symbols: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
Standard Errors in parentheses.

	Number of Shift Assignments (Negative Binomial)
(Intercept)	1.161 (0.230)
officer_raceblack	1.020 (0.025)
officer_racehisp	1.017 (0.025)
officer_raceaapi_native	1.083 (0.057)
officer_sexMALE	1.054 (0.024)*
age	1.286 (0.012)***
I(age^2)	0.997 (0.000)***
Num.Obs.	8328
AIC	116 003.0
BIC	116 059.2
Log.Lik.	−57 993.506
F	164.911
RMSE	1.06

P-values are denoted by symbols: + p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
Standard Errors in parentheses. Coefficients are odds ratios.

AGE

Looking by age, there are some interesting patterns which emerge. First, officers in their early forties to mid fifties have the highest number of shifts. Second, officers 40 and younger and 60 and older have comparatively fewer shifts. However, most officers are between the ages of 40 and 60. It is possible officers ages 40 - 60 simply have the most shifts because they are the most common age group.

Another way of thinking about this is to imagine every officer was only assigned 1 shift over this four year period. There would not be any difference in the amount of shifts assigned to officers by age, but we would still see officers aged 40 - 60 having the most shifts.

To account for this issue, I bucket officers into 10 equally sized age range buckets i.e., each of these buckets has the same number of officers. I then graph a violin plot for each age range showing the distribution of the number of shifts. Here we see evidence of the fact that younger officers do indeed get assigned to less shifts as do older officers.

RACE

Looking by race, we see Black officers have the highest average number of shifts with the median number of shifts for Black officers around 485. Next are AAPI/Native American officers who have median number of shifts around 437. Then there are Hispanic officers who have a median number of shifts around 420. Finally, there are White officers who have a median number of shifts around 400. Could these differences in the number of shifts be related to the different age distributions within each racial group? This is a point we will turn to next.

AGE AND RACE

Looking at age and race, it does not appear to be the case that that any particular racial group has substantively more shifts than any other racial group for any given age bucket. This leads me to believe that age may, at least, partially explain why certain minority groups seem to be getting more shift assignments.

The regression models demonstrate to me that age/experience is the major variable in terms of explaining the number of shifts an officer is assigned.

Length of shifts

age_range	mean	sd
22 - 34	9.015419	0.3663422
34 - 37	8.971651	0.4243296
37 - 40	8.963495	0.3524884
40 - 43	8.943266	0.3408343
43 - 45	8.933112	0.3619911
45 - 47	8.915813	0.4526401
47 - 50	8.900788	0.3649474
50 - 52	8.905952	0.4332510
52 - 56	8.871664	0.3950219
56 - 66	8.878203	0.3583734

| officer_race	mean	sd
white	8.937452	0.3839241
black	8.902856	0.4165791
hisp	8.941215	0.3361297
aapi_native	8.954917	0.5176194

officer_sex	mean	sd
FEMALE	8.885023	0.4193755
MALE	8.944285	0.3778005

The overwhelming number of shifts are 9 hours. There are some ***trends*** indicated by the above tables where some groups have slightly small shift lengths than other groups. However, the differences are so small it is hard to determine how substantive they really are.

One interesting trend I will note is there is a pretty monotonic decrease in average shift length as the age of the officer on patrol increases. The same caveat applies, though, from the previous bullet point. The decreases in average shift length are so small it is hard to determine how substantive they really are.

SHIFT TIMING
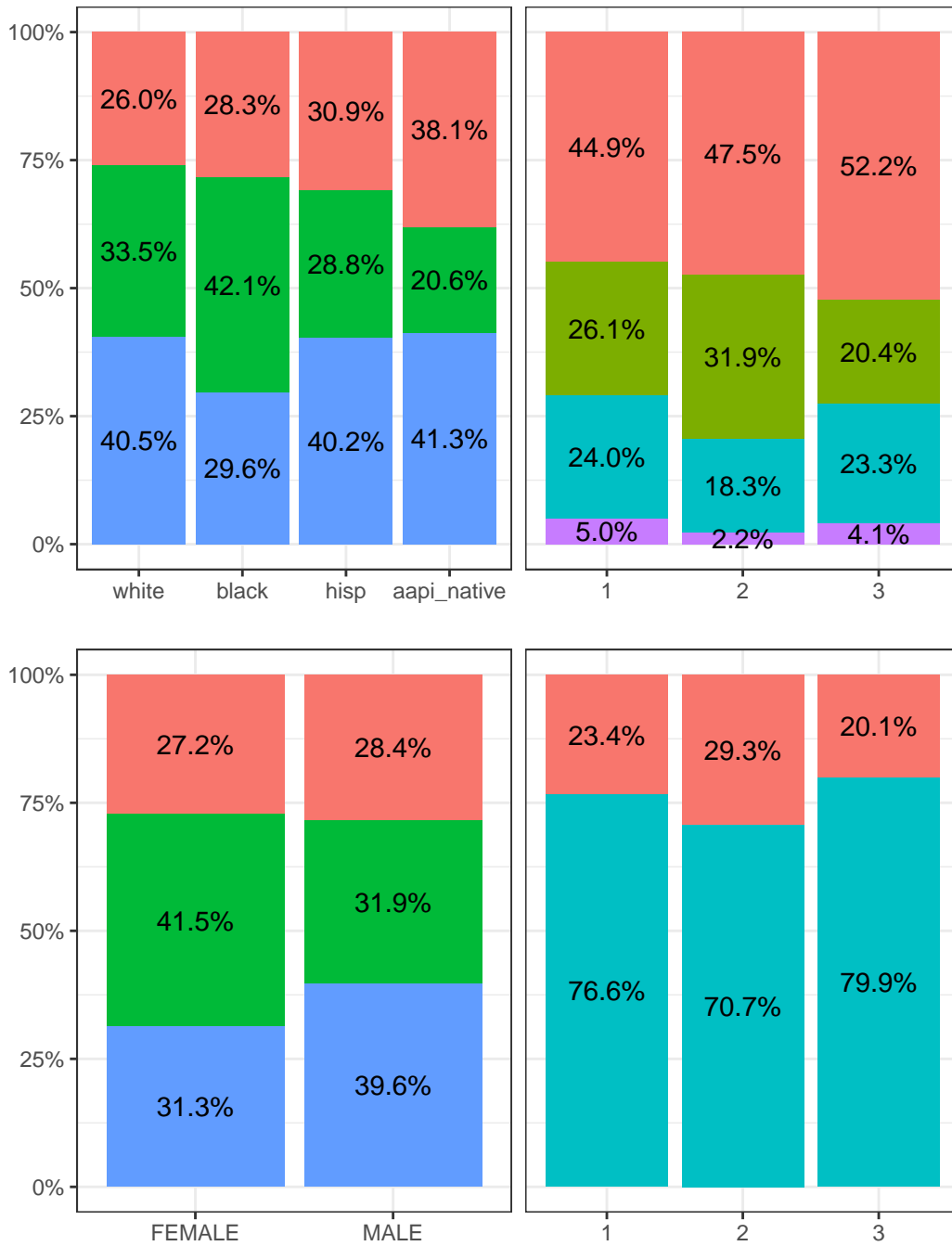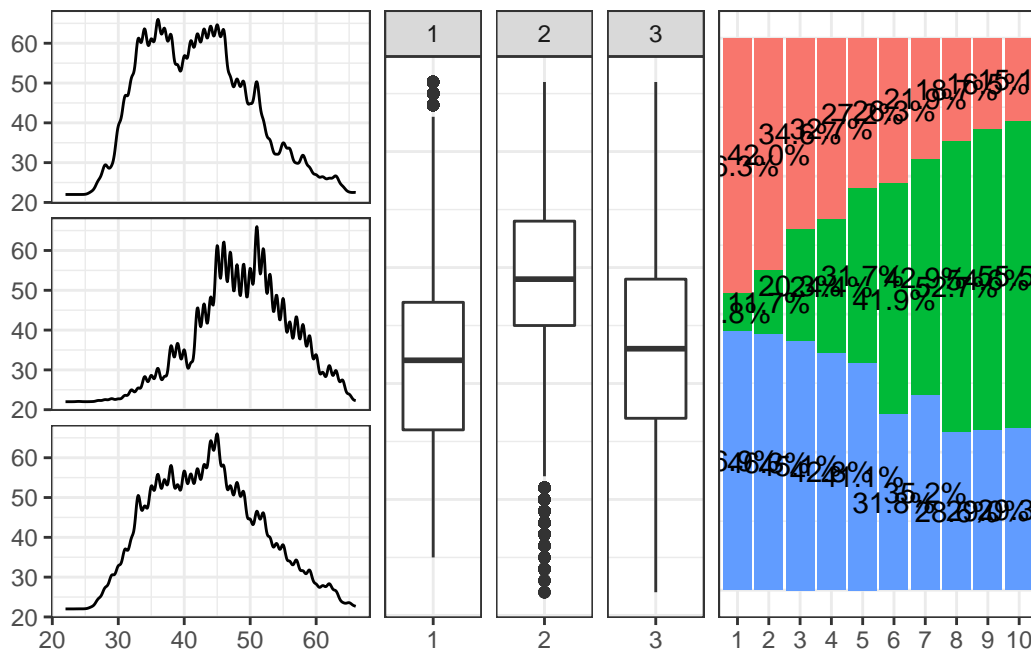
1st shift is from the evening until the morning (typically starts from 8pm - 10pm and goes until 5 - 7am), 2nd shift is from the morning until the afternoon/early evening (typically starts from 5am - 9am and goes until 2pm - 6pm), and 3rd shift is from the afternoon until the evening (typically starts from 2pm - 5pm and goes until 11pm - 2am). We do see differences by age, race, and sex in terms of how patrol officers get assigned to shifts.

RACE

We see that White officers and Hispanic officers have roughly similar shift assignment patterns. 25% - 30% of all shift assignments for White/Hispanic officers were 1st shift. 29% - 33.5% of all shifts assignments for them were 2nd shift. 40.5% of all shift assignments for these officers were third shift.

Black officers have different shift assignment patterns, though. 40% of their shift assignments were 2nd shift. Meanwhile, Black officers had the 1st and 3rd shifts assigned to them 28% and 30% of the time, respectively.

So the big difference between the racial/ethnic groups is that White and Hispanic officers' most common shift is 3rd shift while it is 2nd shift for Black officers. This could be, again, related to the fact that Black officers tend to be older than officers from other racial groups, and as will be explored below, older officers tend to be assigned the second shift.

SEX

The most common shift for female officers is 2nd shift while the most common shift for male officers is 3rd shift.

AGE

The most interesting pattern to emerge is that we see older officers are much, much more likely to be working the 2nd shift as opposed to the 1st or 3rd shift. Looking at the youngest age bracket, younger officers almost never work the 2nd shift and instead are almost equally assigned to the 1st and 3rd shifts. The rate of decline for 1st shift is sharper for 1st shift than for 3rd shift, but both decline in probability of assignment as we move up the age bracket pretty quickly.
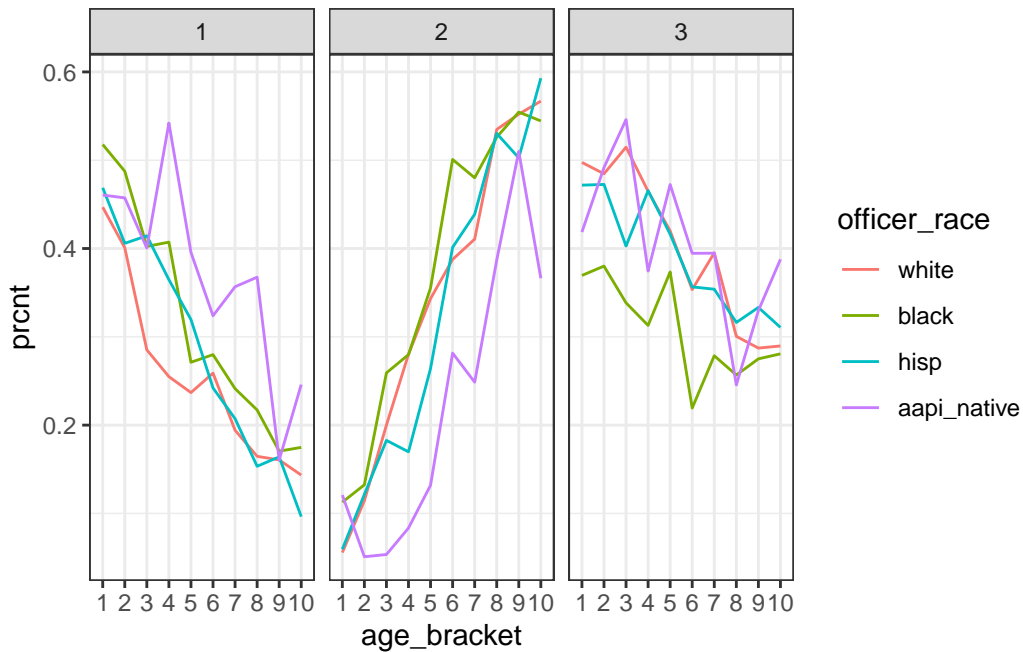
AGE AND RACE

This line plot is the one most convincing to me that it is an age effect and not a racial effect we are observing when we see Black officers working mostly 2nd shifts (because they have an older age distribution and older officers are more likely to get 2nd shift). We see that nearly every racial/ethnic group has similar declines in 1st and 3rd shift assignments and similar increases in 2nd shift assignments for older officers.

```
# weights:  24 (14 variable)
initial  value 3755309.483269
iter  10 value 3537234.952875
iter  20 value 3456379.291840
iter  20 value 3456379.287562
iter  20 value 3456379.287522
final  value 3456379.287522
converged
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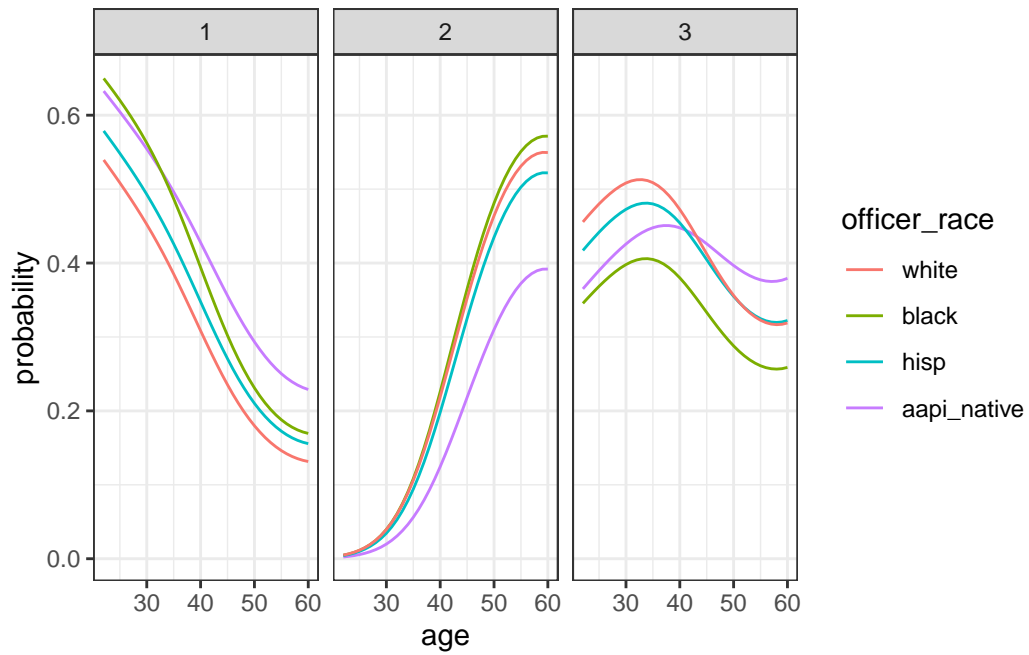
MULTINOMIAL REGRESSION

There is evidence of a race and age effect, but the age effect seems to be the more important variable.