Detecting Bias in Traffic Searches: Insights from false searches of innocent drivers

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In an analysis of 100 million traffic stops from 25 police departments, we found racial bias in all feasible real world scenarios. Bias was found in Durham County NC, 10 out of 14 state police departments, and 9 out of 10 local departments across the United States.

INTRODUCTION

- The absence of a known contraband rate limits researchers' ability to model police search behavior.
- Our model of police bias considers two different incomplete 2x2 tables, one for each race of driver.
- We consider the space of all possible 2x2 tables, created by letting the number of unsearched drivers who were carrying contraband vary from the smallest to the largest possible value.
- We then estimate false alarm and hit rates for every feasible *x*-value and compare racial differences.

TESTS OF RACIAL BIAS

Our Proposed Test of Bias

OVERLAPPING CONDITION TEST

Q. Is there any **overlap in the feasible false alarms** for Black drivers and the feasible false alarms for White drivers? (i.e., if FA_b **dominates** FA_w => racial bias)

$$min(FA_{White}) \leq max(FA_{Black})$$

Previous Tests of Bias

BENCHMARK TEST

Q. Does the **probability of search** differ for White and Black drivers?

$$P_{Black}(S) \neq P_{White}(S)$$

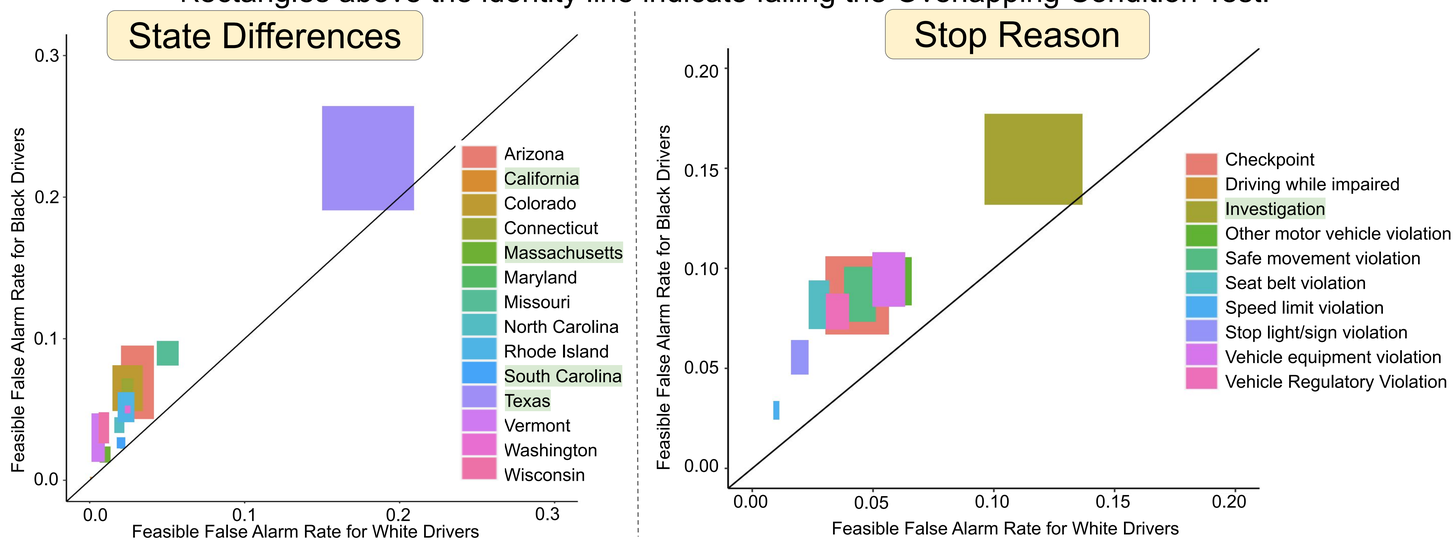
OUTCOME TEST

Q. Does the **likelihood of finding contraband given you searched** differ for White and Black drivers?

$$\frac{P_{Black}(S \cap C)}{P_{Black}(S)} \neq \frac{P_{White}(S \cap C)}{P_{White}(S)}$$

OVERLAPPING CONDITION TEST RESULTS

Rectangles above the identity line indicate failing the Overlapping Condition Test.



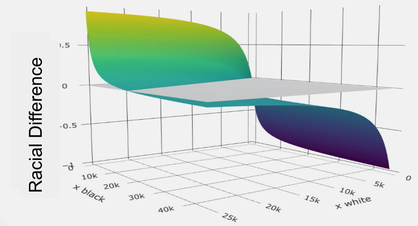
MODEL INTUITION

Traffic stops by race in Durham County, NC (2001-2015)

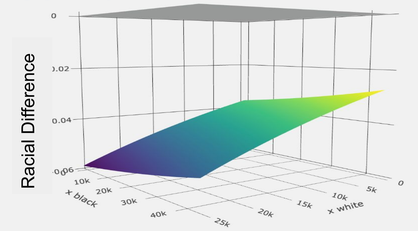
White Drivers	Contraband	No Contraband	Total
Search	957	2565	3522
No Search	*X*	93893-X	93983
Total	957+X	96458-X	97415

Black Drivers	Contraband	No Contraband	Total
Search	4230	11170	15382
No Search	*X*	165469-X	165469
Total	4230+X	176648-X	326,024

Hit Rate



False Alarm Rate



BAYESIAN APPROACH

- What if we use the odds ratio to define the outcome test?

$$\frac{P(C|S)}{P(\bar{C}|S)}$$

- Using bayes formula and canceling out like terms we obtain the likelihood ratio (hit rate/false alarm rate) multiplied by the population contraband odds.

$$\frac{P(S|C)}{P(S|\bar{C})} \cdot \frac{P(C)}{P(\bar{C})}$$

- While this looks like we are using all cells of the 2x2 table. Simple algebra with the unknown cells of the 2x2 table yields a relationship *only using the known cells of the 2x2 table.*
- This means, that any critique of the outcome test applies to this Bayesian formulation of posterior probability.

MODEL COMPARISONS

This table shows three scenarios where the previous tests agree or conflict with each other and our proposed model.

State	PPV_W	PPV_B	Outcome Test	S_W	S_B	Benchmark Test	Max FA_W	Min Fa_B	Overlapping Condition Test
AZ	.527	.575	No Bias	.042	.096	Bias	.041	.043	Fail
CA	.722	.648	Bias	.001	.002	Bias	.001	.001	Pass
TX	.343	.356	No Bias	.022	.026	Bias	.022	.022	Pass

CONCLUSIONS

- The Overlapping Condition Test offers new insights into racial bias beyond existing measures.
- Police officers are engaging in false alarm rate bias against Black drivers.