Rebuttal of Expert Reports Prepared by John Lamberth and John MacDonald in re *United States v. Terry S. Johnson*

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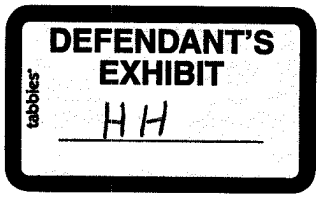

1 Summary

The reports of Dr. Lamberth and Dr. MacDonald are flawed, and the problems are sufficiently serious that their conclusions cannot be relied upon. The major problems in Lamberth's report include (a) a false premise, (b) the lack of record linkage, (c) biased estimates, and (d) problematic validity and reliability. The major problems in MacDonald's report include (a) a false premise, (b) the lack of record linkage, (c) the lack of an adequate internal benchmark, and (d) an incorrect understanding of the protocol for driver search following a stop. The impact of these mistakes is large, and is likely to invalidate their conclusions.

This rebuttal does not address the expert report of Margo Frasier, since that report did not undertake a statistical analysis.

2 Overview

Both Lamberth and MacDonald assume that the best available measure for discrimination is whether the stop and citation rates for Latinos are the same as for non-Latinos. This is a false premise: the better criterion is whether the stop and citation rates for Latinos are higher in Alamance County than they are in comparable jurisdictions. Research cited in my previous report (p. 7, l. 15-28, and Fig. 1, p. 8, Fig. 2, p. 14) support the presumption that Latinos and non-Latinos are not equally likely to violate traffic laws. Perhaps this disparity is because ethnicity is associated with socio-economic class and driver education, both of which are plausibly related to traffic violations.

In one portion of his report, Lamberth uses a different measure for discrimination. He attempts to determine whether, among the population of drivers who are violating the law, Latinos

are stopped at higher rates than non-Latinos. But this argument assumes that all violations are equivalent—exceeding the speed limit by 5 mile per hour and 50 miles per hour are not comparable offenses. Also, Lamberth's argument rests upon visual identification of ethnicity in moving cars under variable lighting conditions—as detailed below, I believe this is not credible.

Both Lamberth and MacDonald use a list of Hispanic surnames from the Census to estimate the ethnicity of people who receive traffic citations. As shown below, ethnic classification by surname has an error rate of at least 15% to 20%. In contrast, record-linkage to the traffic stop database would have provided near-perfect matching of citation with ethnicity.

The DOJ complaint concerns traffic stops and checkpoints. Lamberth bases his analysis on citations, not the traffic stop reports. Since citations are outcomes, they cannot directly address the issue of whether the stops are inappropriate. In his report, Lamberth often uses the terms interchangeably, converting legally irrelevant citations into legally relevant stops. Further, Lamberth's counts include many, many citation charges for non-traffic offenses, such as fighting or purchasing alcohol for a minor, and these should also be irrelevant to the substance of the complaint.

Lamberth's estimates of Hispanic citation rates are biased. First, he counts each charge separately, but a citation to one individual can carry multiple charges. There is no evidence supporting Lamberth's assumption that Hispanics and non-Hispanics have the same average number of charges per citation. Second, 13 of the 22 sites he uses for his ethnic observations are inside municipalities, and officers apply discretion differently when outside their primary region of jurisdiction. But Lamberth aggregates the citation (charge) counts across all 22 sites.

Regarding validity and reliability, Lamberth reports that two of his observers, after training, showed 100% inter-rater reliability. And he asserts that his observer sampled 14,706 drivers, and was able to accurately identify their ethnicity in all but 10 cases. This observations were made under a range of lighting conditions (7:00 a.m. to 1:00 a.m.), sometimes with heavy traffic, and despite tinted windshields, motorcycle helmets, and so forth. He provides no information at all on the validity of these ethnic classifications. This seems much too good to be true.

MacDonald attempts to create an "internal benchmark" in which officers with similar duties are compared to each other in order to determine if any show abnormal patterns. His methodology has been applied to study large police districts, but it breaks down in Alamance County, where

there are relatively few deputies and few have similar responsibilities. A clear indication of the failure of this benchmark is that it has flagged one officer as suspicious, but not his partner, although these two had substantially similar stop and citation records with respect to Latinos and non-Latinos. Also, the other officers named in MadDonald's report as suspicious have atypical work patterns, so no internal benchmark would be appropriate for them.

Finally, MacDonald's analysis does not take account of the protocol for search. A search can occur for probable cause (e.g., if the officer smells marijuana during a speeding stop), and these searches are likely to discover contraband. Also, a search automatically occurs if a driver is arrested. Drivers without licenses who cannot establish their identity are arrested as a matter of policy, and searched incident to arrest. These searches are much less likely to discover contraband. It follows that, in aggregate, Latino searches are less likely to be productive.

There are other issues, more minor than these. Details are provided in the following specific rebuttals.

Regarding language, Lambreth tends to use the term Hispanic to describe the population which Sheriff Johnson has been alleged to profile, and MacDonald uses the term Latino. In some cases this can cause confusion (e.g., the Hispanic surname database, which is not tuned to reflect name frequencies in the Latino community). In my responses below I use the same term as the author of the report under discussion.

3 Specific Responses to Lamberth

1. (p. 2, l. 12-14.) Lamberth says: "I conducted ... statistical analyses to determine whether ACSO disproportionately stopped and cited Hispanic motorists..."

   As stated, his premise is misleading. If Hispanics are stopped in disproportionate numbers, it may be because they are being improperly profiled, but it may also be because they are disproportionately breaking the law, or live, work and drive in areas with higher levels of surveillance. In particular, Hispanics in Alamance County are disproportionately younger, male, and of lower socio-economic status, which are all factors that, at the national level, are associated with driving infractions.

2. (p. 2, l. 17-20.) Lamberth says "The field study was conducted on the following roadways: ..."

   The three roadways Lamberth selected traverse both the city of Graham and the surrounding county. Of the 22 sites Lamberth selects, 13 are in a municipality, and thus outside the ACSO's primary area of jurisdiction. A deputy is less likely to make stops inside the city; in particular, deputies on patrol (i.e., those most likely to write traffic citations) spend their time in one of six districts, and could only perform a traffic stop inside Graham when driving between the ACSO and their district. (The exceptions are joint checkpoints run with municipal law enforcement agencies and the gang task force, both of which would charge disproportionate numbers of Hispanics.) The statistical implications of this bias in Lamberth's design are complex; spuriously high Hispanic citation rates would occur if Hispanics were more likely to work outside the city, or inside the city at hours that correspond to shift changes by the deputies.

3. (p. 2, l. 23, p. 3, l. 1.) Lamberth says "On Highway 70, Latino drivers were 7.13 times as likely as non-Latino drivers to be cited for traffic violations..."

   Given the biased design described in item 2, the summary rates (7.13 times as likely on Highway 70, 6.5 times as likely on Highway 87, 6.0 times as likely on Highway 49) are not meaningful.

4. (p. 3, l. 13-17) Lamberth says "... my analysis is based on the citation database."

   The citation database includes many, many, charges that are not related to driving. Appendix 1 shows all the citations that occurred at Highway 87 North and Gerringer Mill Road, which Lamberth used as a site and which he says had the largest number of citations on Highway 87. Lamberth treats these 92 charges as separate citations to 92 individuals, and assumes that all of these individuals are drivers. This makes two mistakes. First, out of the 92 charges, 30 of them (32.6%) are not traffic violations. Second, it is probable that some individuals received multiple charges. Both mistakes are serious and invalidate the numbers that Lamberth reports.

   The DOJ complaint concerns improper traffic stops and checkpoints. But Lamberth's anal-

ysis includes citations for fighting, drug possession, public lewdness, and so forth. His analysis is incommensurate with the accusation.

5. (p. 3, l. 19-20) Lamberth says "... of the 10,468 entries on the list, 13 were reported as being Hispanic."

   The citation database should not include ethnicity. The state of North Carolina traffic citation form (see Fig. 2, p. 18) chooses not capture that information, and the ACSO must comply. The 13 cases in which ethnicity is recorded must be data entry errors.

6. (p. 5, l. 9-10) Lamberth says "I used these [Hispanic surname] percentages to calculate the exact probability that the names in ACSO's citation database are Hispanic."

   The error rates in surname matching are known at the national level. For men, Wei, Virnig, John and Morgan (2006) report a true positive rate of 85% to 87%, and for women, they report a true positive rate of 79% to 82%. (Gender difference is expected, since women often take the name of their husband). Thus the national false declaration rate for identifying Hispanics from surnames is between 15% and 20%. The error rate will probably be larger at the county level, since the classification rules are based on the U.S. Hispanic population, not Alamance County Latino names.

7. (p. 5, l. 14, p. 6, l. 1-2) Lamberth says "This percentage was used as the best estimate for the percentage of Hispanics..."

   This estimate of the percentage of Hispanics in the citation database is flawed. A single stop can lead to multiple charges of the same person; e.g., for driving without a license, driving under the influence, and speeding. Each of these is a separate line in the citation database. Instead of the 10,468 "citations" Lamberth lists (p. 3, l. 13), there are actually 8,168 unique events, mostly corresponding to distinct individuals (but surely some people are cited more than once during this five year time period). Unless Lamberth linked citations by names and addresses, which is not stated in his report, the estimate is unreliable. If Hispanics and non-Hispanics are equally likely to commit multiple driving offenses, then Lamberth's estimate would not be biased. But if the number of citations per stop is, say, inversely related to socio-economic status, then Lamberth's technique will overestimate the number

of Hispanics.

8. (p. 6, l. 3-4) Lamberth says "As an alternative method of surname analysis..."

   Actually, the preferred method for estimating the proportion of (distinct) Hispanics in the citation database is to use record linkage (Fellegi and Sunter, 1969). Record linkage is a well-established tool used by the U.S. Bureau of the Census and many other statistical organizations. One writes or downloads a trivially simple program to match details in the citation database (such as date, time, officer's name, offense, and so forth) to the same details in the traffic stop report database, which also includes ethnicity (see Fig. 3, p. 19). Aside from data entry typos (which can be handled robustly) there will be virtually no error for a community of the size of Alamance County.

9. (p. 7, l. 1-2) Lamberth says "... a court held that those motorists who were violating the law were the group that should be consdered as the benchmark for comparing police stops of motorists."

   Here, Lamberth is more correctly basing the claim of disproportionality upon the percentage of violators, rather than the population percentages. This is a reversal from his previous calculations, as discussed above in rebuttal 1. However, the best measure requires a risk-adjusted measure of exposure, which is not available.

10. (p. 7, l. 4-5) Lamberth says "... racial/ethnic benchmarks for roadways are quite stable for rather long periods..."

    In fact, the benchmark does not appear to be stable in Alamance County. The DOJ states in their complaint that the ACSO was 4 times more likely to stop a Latino on one road, 9 times more likely on another, and 10 times more likely on a third, and those roads were subsequently identified as US 70, NC 49, and NC 87, respectively. However, Lamberth finds that the ACSO is 7.13, 6.5, and 6.0 times more likely to cite a Latino driver on these roads. Presumably the differences in these numbers reflect variation between estimates from his first and second surveys.

11. (p. 7, l. 11-16) Lamberth says "The three roadways surveyed were ..."

These roads are not representative of the county, and these sites are not representative of the roads. For example, the roads are located in the northern part of Alamance County, not the south. And 13 of the 22 sites are outside the ACSO region of primary jurisdiction. This means that Lamberth's argument for disparate treatment depends critically upon his ability to identify the ethnic composition of the drivers on these roads during his surveys. (That is, his design captures non-representative demography, but he can still make his case if he is able to show that Hispanics are disproportionately stopped relative to other drivers at those locations and times. But that requires accurate observational discrimination of Hispanic and non-Hispanic drivers.)

12. (p. 9, l. 19-20) Lamberth says "The results of three tests indicated perfect agreement between the two raters."

    I do not believe these results. Perfect inter-rater reliability is almost unheard of in statistics, and the same is true in Dr. Lamberth's field of psychology.

    In his 2013 report to the city of Kalamazoo (p. 23, footnote 18), and in his 2006 report to the Metropolitan Police Department of Washington, D.C. (p. 31, footnote 20), Lamberth says that he trains his raters to achieve an inter-rater reliability of 80%. If he has now trained raters to achieve perfect agreement, then his methodology has radically improved.

    Fridell (2004, chp. 9, p. 164) summarizes two studies of attempts to determine race and ethnicity from stationary observation sites of the kind used by Lamberth. Lange, Blackman and Johnson (2001) report that a third of the data had to be discarded because race/ethnicity could not be reliably determined. Engel and Calnon (2003, personal communication to Fridell) claimed 97% agreement among raters on distinguishing "white" from "nonwhite" (during the day with clear weather).

13. (p. 10, l. 1-4) Lamberth says "... we encountered 14,706 vehicles, and identified the race/ethnicity in all but 10 of them."

    I do not believe these results either. As mentioned, Lange, Blackman and Johnson (2001) could not classify one third of the drivers in their survey. Nor can I confidently identify ethnicity under the conditions Lamberth's observer encountered (night, fog, rain, heavy

traffic, overcast skies, and so forth, based on archived weather data at `www.friendlyforecast.com/usa/archive/`).

Of the 14,706 vehicles, some surely had tinted windows, or were helmeted motorcyclists. Before I can accept the claim that all but 10 were correctly classified according to a criterion as subtle as ethnicity, I would need a gold standard test. The blinded (in the experimental design sense) observer would have to correctly identify the ethnicities of a known sample of about 100 drivers under the conditions Lamberth describes.

Under these circumstances, I do not believe that Lamberth's methodology satisfies any of the five criteria needed to meet the Daubert standard for admissibility of expert witness testimony. Specifically:

- *Is the method falsifiable, refutable, and/or testable?* Lamberth's method is falsifiable, through a blinded study of the kind described above. However, he has not tested it, nor has anyone else, to the best of my knowledge.
- *Has it been subjected to peer review and publication?* Related work by Lamberth (Kadane and Lamberth, 2009) has been published in a peer-reviewed journal, but it focused on visual identification of African-Americans, which is an easier challenge. (Lamberth lists a 2013 paper in *Population*, but I was not able to find it on Google Scholar—perhaps it has been accepted but not yet published.)
- *Is the error rate known?* No. It is not.
- *Are there standards and protocols for the method?* Lamberth says that he has training procedures, but these are not specified. Lange, Blackman and Johnson (2001) and Engel and Calnon (2003) have apparently undertaken similar surveys and report wildly different levels of confident identification. I do not know of any other researchers who have established standards for guessing ethnicity in fast-moving vehicles under poor lighting conditions.
- *Is the methodology generally accepted in the scientific community?* No, it is not.

14. (p. 10, l. 10-11) Lamberth says "On US 70, 4.2% of violators were Hispanic; on NC 87, 4.2% of violators were Hispanic; on NC 49, 4.7% of violators were Hispanic."

Lamberth is aggregating across the sites on the same road. This deviates from his previous methodology; in his 2006 report to the Metropolitan Police Department in Washington, D.C. (p. 47) he writes:

> It is often helpful from a practical point of view to aggregate the data from all locations and provide an overall odds ratio. We provide this aggregate odds ratio but caution that it is for descriptive, not analytic, purposes, as not all statistical assumptions for further statistical tests can be met with these aggregated data.

Here, aggregation creates problems since the sites along the same road are in different primary jurisdictions and could easily have different usage rates between Hispanics and non-Hispanics by time of day (e.g., when a school day, or a textile mill shift, begins or ends).

15. (p. 10, l. 14-15) Lamberth says "Hispanic drivers were violating laws at a lower rate than they were driving on that roadway."

    Lamberth finds lower violation rates for Hispanics on two roads, and an insignificant difference on the third. This could be true, but it is not consistent with other studies that find higher violation rates for Hispanics.

    Figure 1 shows a bar chart of the ratio of the proportion of the Hispanic population that received citations to the proportion of non-Hispanics who received citations, for 11 central North Carolina counties during the 2008-2013 time period. About one-third of these counties have ratios larger than 1, indicating that Hispanics are more likely to receive traffic citations; Alamance County has the fourth largest ratio, but it is dwarfed by Randolph and Orange Counties, and much smaller than Chatam County.

16. (p. 12-17) In these pages, Lamberth summarizes his findings, providing estimates of the degree to which Latinos were targeted on three highways and at Graham Hopedale Road site.

    All of these conclusions depend upon the Lamberth's benchmarks, and the benchmarks depend upon (1) his observer's accuracy in estimating ethnicity in cars driving on the highway, and (2) whether or not the drivers on the roads at the time that ethnicity is assessed

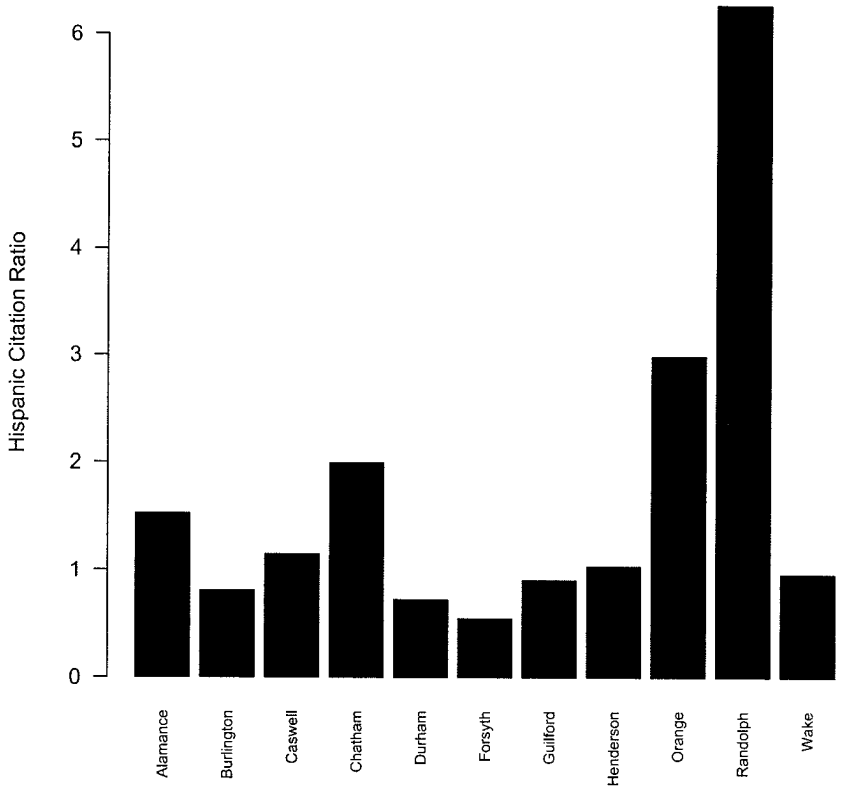

Figure 1: A bar chart of the ratio of the proportion of Hispanics who receive citations to the proportion of non-Hispanics who receive citations, by county.

reflects the true daily mix of drivers on that road. For example, if the site is near a largely White high school and the observation time coincides with the end of the school day, then the benchmark will underestimate the number of Hispanics on the road). Also

`www.maxpreps.com/high-schools/western-alamance-warriors-⊕ (elon,nc)/football/calendar`

indicates that there was a high school football game on Sept. 28, 2012 at Western Alamance County High School, which, according to

`www.zillow.com/alamance-county-nc/schools/western-alamance⊕ -high-school-50185/`

is 6% Hispanic. Lamberth's observer was at this site on that day, which could heavily salt

his counts with non-Hispanic drivers.

17. (p. 12, l. 6) Lamberth says "The citation database contained 10,467 citation numbers..."

    Lamberth uses the 10,468 charges in the citation database to estimate the number of Hispanic violators in these locations. But often a citation leads to more than one charge, so Hispanics (and others) are being overcounted. Additionally, of the 10,468 charges, 6,610 are not linked to a map location, and it is unclear how Lamberth uses that. In fact, the citation database includes many non-traffic offenses, such as domestic disturbance, and these have precise addresses; the cases without map locations are more likely to be traffic stops.

18. (p. 12, l. 8-10) Lamberth says "The breakdown [in citations] by year was quite uneven."

    The low numbers in 2008 and 2007 are due to the transition from the Positron database management system to the OSSI system. Numbers before August, 2008 are unreliable or not available. The dip in 2011 is explained by Deputy Wilkerson's deposition (p. 57), which indicates that the Special Operations Unit lost two of the four officers in 2011, and regained them in 2012. (The Special Operations Unit assists most of the other units; in particular, they run checkpoints and do traffic patrols when not otherwise assigned.)

19. (p. 12, l. 20-21) Lamberth says "There were 503 citations on this roadway." After removing those that occurred between 1:00 a.m. and 7:00 a.m., he has 457 "stops".

    Here and elsewhere, Lamberth sometimes uses "citations" and "stops" interchangeably. These should be kept distinct—the DOJ complaint concerns improper stops, whereas citations sometimes result from a stop, but cannot speak to whether the stop was appropriate.

20. (p. 13, l. 7) Lamberth says "After removing these 35 stops there were 422 stops for the analysis."

    This is misleading in two ways. First, the wording falsely appears to address the complaint, since he claims to be counting stops, but in fact he is counting citations, which are mute about whether the stop resulted from profiling.

    Second, these 422 citations occurred over a five-year period starting from August, 2008. That means that on one of the busiest roads in Alamance County, ACSO deputies wrote

about 1.8 tickets per week, in total. Some of these were probably written to Hispanics, but by any yardstick, this level of activity is hardly aggressive profiling.

21. (p. 14, l. 4, 10) Lamberth describes z-scores.

    Lamberth's z-score calculations assume the accuracy of the benchmark, which depends upon both the incredible claims of the observer to accurate ethnic identification and the absence of bias in the timing of the site measurements.

22. (p. 15, l. 7) Ibid.

23. (p. 15, l. 17) Lamberth says "ACSO made 657 stops ... and 20.77% were of Hispanics."

    Again, Lamberth's language erroneously conflates legally irrelevant citations with legally relevant stops. Further, over the 4.5 years covered in this period, his estimate implies that on NC Highway 49 the ACSO issued 0.58 Hispanic citations per week, of which some were surely justified. This is not statistically consistent with an active policy of targeted discrimination.

24. (p. 16, l. 4-5) Lamberth says "Traffic was rather light at this particular location..."

    In fact, it is astonishingly light. The DOT reports 20,000 vehicles per day at that intersection; see

    `http://www.ncdot.gov/travel/statemapping/trafficvolumemaps/`

    Lamberth's observer counted 380 cars during 15 time intervals of 15 minutes each, amounting to 3.75 hours. One would expect him to see approximately $(3.75/24) \times 20{,}000 = 3{,}125$ cars (actually, one expects more, since no counts were made between 1:00 a.m. and 7:00 a.m.).

25. (p. 16, l. 17) Lamberth says "there were 135 citations" that were within the time scope of his benchmark between US 70 and Apple Street Extension.

    Actually, there are 135 citation charges; some of these are surely multiple charges to the same person during a single stop. More importantly, 86 of these citation charges occurred during a checkpoint. These are not comparable to Lamberth's benchmark and should be

excluded. (Also, Hispanics are more likely to be charged at a checkpoint for not having an operator's license.)

This site is at the entrance to one of the two bridges that funnel traffic between northern Alamance County and the city of Burlington. As such, it is a commonly used checkpoint site. There is an Hispanic community near that site, but he permutation test of checkpoint locations in my original report found no evidence that Hispanic communities are targeted by checkpoint locations. This propinquity appears to be incidental, and not an intentional siting of the checkpoint near an Hispanic community.

26. (p. 17, l. 11) Lamberth compares the citation (charge) rate between Graham Hopedale Road and the nearby Apple Street Trailer Park.

    The Graham Hopedale Road and Apple Street Trailer Park comparison is misleading. The Graham Hopedale site is in the city, whereas the Apple Street Trailer Park is in the county; the county is their primary jurisdiction area, but not the city, so ACSO deputies will write more tickets in the county.

    Also, it is notable that during the five-year period in question, the ACSO issued 44 speeding citations at the Graham Hopedale site. Of these, 20 were made during a three-hour window on August 5, 2011, as part of a back-to-school crackdown on speeding. Excluding these shows that the ACSO traffic enforcement rate inside the city is low, as is consistent with this not being their area of primary jurisdiction. More broadly, it shows how much variability there can be in citation rates at one of Lamberth's sites due to exogenous circumstances.

4 Specific Responses to MacDonald

1. (p. 2, l. 27-29) MacDonald, says "... I relied upon the stop, citation, and arrest databases. Each database was analyzed separately, because there was not a unique record locator to provide an exact link across databases."

    As discussed under Lamberth, items 7 and 9, there is about a 15% to 20% national error rate in Hispanic surname classification, and the preferred method for this situation would be Fellegi-Sunter record linkage. Linkage would have shown the ethnicity perceived by

the deputy. Free on-line software for record linkage is available (e.g., FRIL from Pawel Jurczyk at Emory University, or `the-link-king.com`) but this case is simple with well-structured data fields, so I think an undergraduate could program it in a few hours.

2. (p. 3, l. 14) MacDonald shows the regression equation that he uses on multiple occasions.

   In MacDonald's equation, the response variable 'Outcome' is a probability and must lie between 0 and 1. But the righthand side of the equation is a standard multiple regression, which can give negative values or values greater than 1. I am sure that MacDonald must know that the traditional model in this situation is logistic regression, in which the Outcome probability is transformed as $\ln \text{Outcome}/1 - \text{Outcome}$ and then fit by a multiple linear regression model. Even so, the analyst should make some assessment of whether the model provides a good fit to the data.

3. (p. 4, l. 5-7) MacDonald accepts the false premise that Latinos should be stopped and cited at the same rate as non-Latinos.

   If the results reported had been obtained from an appropriate logistic regression analysis, then the numbers would still not necessarily indicate profiling or prejudice. First, the DOJ allegation is that ACSO deputies are stopping Latinos in a discriminatory way; but MacDonald's analysis only concerns outcomes after the stop, and these depend upon other factors. Second, essentially all vehicle stops (both checkpoint and traffic) require that one show license and registration; by NC law, undocumented Latinos do not have that, necessarily leading to higher rates of citation or arrest that are unrelated to to reason for the vehicle stop. Finally, it is quite possible for different ethnicities to have different degrees of criminal behavior, resulting in more citations or arrests for the same reason behind the stop; e.g., criminal behavior is often associated with low socio-economic status. So a stop for a Latino driver who is following too closely may disproportionately find that there is no driver's license, or a DUI violation, or the possession of drug paraphernalia.

   Referring back to Fig. 1, the frequent large excess in Latino citations calls into question MacDonald's assumption that the correct benchmark for Latino citation counts is non-Latino citation counts.

4. (p. 4, l. 8-12, and l. 26) MacDonald says "The significant differences between Latinos and non-Latinos in the contraband yields of searches suggests that officers are applying a lower threshold for searching Latinos."

   MacDonald misunderstands the arrest protocol. When a driver arrested for not having a driver's license, or for intoxication, or for any other reason, the driver is automatically searched for weapons, drugs and so forth, even though there is no expectation that such will be found.

   The fact that 85% of Hispanic surnamed searches do not find drugs probably reflects the fact that Latinos are much more likely to be driving without a license, or more likely to be arrested for offenses not related to contraband (see p. 7, l. 15-28 of my initial report).

5. (p. 4 l. 28) MacDonald cites a t-statistic.

   I am sure the MacDonald knows that the t-test is not appropriate for comparing proportions. When my undergraduates do this, they are marked wrong. The correct large-sample test is the z-test, and if accuracy is important, one numerically integrates the beta function or uses the Clopper-Pearson tables, both of which are easily available on various websites.

6. (p. 5, l. 2-3) MacDonald says "This approach [controlling for the reason for the stop] removes any observable difference in search outcomes that may be driven by differences in the reasons for stopping drivers."

   MacDonald's approach does not remove differences in search outcomes by controlling for the stop reason. If a Latino and a non-Latino driver are both stopped for speeding, the Latino driver will be less likely to produce a driver's license.

   ACSO deputies are directed to arrest a driver whose identity cannot be verified (since citations ought not be written to a fake identity). Often, there are alternative ways for the driver to self-identify; e.g., if the driver owns a license but left it at home, the deputy can access the picture on-line. (Since ACSO writes many NOL citations, clearly many people are able to establish their identity in some alternative way.) But if the driver has never had a license, then the challenges are substantially greater; unsurprisingly, undocumented immigrants will fail in greater proportions.

This leads to ethnically disproportionate driver and vehicle searches, but searches incident to NOL arrest are unlikely to find drugs, creating a large difference in search outcomes.

7. (p. 5, l. 8-16) MacDonald provides estimates for disparity in the Latino outcomes for citations and arrests.

   All of these claims are based upon a flawed regression model, and all concern post-stop outcomes, which are not the basis for the complaint against the ACSO. But if one ignores those points, MacDonald is assuming that the offense rate for Latinos should be the same as for the non-Latino community, and there is no factual basis for that assumption.

8. (p. 5, l. 29) MacDonald gives more detail about the regression analysis he used in studying the productivity of searches.

   MacDonald's footnote 4 indicates that, in this case, he also used a logistic regression model. This model is preferable to his other regression analyses, which use standard multiple regression models that are inappropriate for estimating percentages or probabilities.

9. (p. 5, l. 31) MacDonald describes an ANOVA test.

   It appears that MacDonald did a one-way ANOVA with zeros and ones as the dependent values. This is not appropriate; one uses an arcsine square-root transformation to normalize data that are proportions, but the best method is described in Miller (chp. 6).

10. (p. 6, l. 7-16) MacDonald argues for the soundness of his use of differential discovery rates in contraband searches to provide evidence for prejudicial policing.

    As mentioned previously, the protocol for search after arrest implies that searches of Latinos will necessarily be less productive. A stop for speeding could lead to an NOL arrest and a search incident to arrest, or a consent search, or the officer may develop probable cause to search. MacDonald should have used data from the field in the search form (see Fig. 4, which is on the back of the Traffic Stop form). This form indicates the reason for the search, showing whether or not there was an expectation that contraband would be discovered, or whether the search was incident to arrest.

    MacDonald's Nash equilibrium argument is rebutted by many, many papers in behavioral

economics (cf. Camerer, 2003); people are simply not rational expected utility maximizers (e.g., they often take foolish chances). MacDonald agrees with me that there are racial differences in offense rates and kinds (l. 15-16), but he is wrong to suppose that conditioning on the reason for the stop controls for those differences.

11. (p. 6, l. 18) MacDonald compares the mean percentages of Latino searches that find drugs with non-Latino searches that find drugs.

    This is a problematic comparison. MacDonald includes only drivers in his statistical test, but his "findings of contraband" data includes contraband found on passengers. We do not know how many cars had passengers, the number of passengers, and how that may be related to the initial violation that triggered the stop.

    In a traffic stop, there is normally no reason to search a passenger. A passenger would be searched only if there were probable cause; e.g., if there is marijuana smoke in the vehicle. In those circumstances there is high probability that contraband will be found, and MacDonald will count this as a productive search. This tends to increase the rate of productive searches among non-Latino drivers, creating a spuriously large disparity with Latino drivers who are searched incident to arrest for, say, an NOL violation.

12. (p. 6, l. 33) MacDonald reports a t-statistic.

    Again, MacDonald performs a t-test instead of the conventional z-test or Clopper-Pearson test.

13. (p. 7, l. 4-6) MacDonald reports an ANOVA test.

    MacDonald reports an ANOVA that compares 10 types of stop counts between Latino and non-Latino drivers. Presumably he has one count for each type-ethnicity combination, which would make it impossible to do ANOVA. Perhaps he is taking the annual counts, or some such thing, but that would not be a clumsy workaround; instead he wants to do a multiple comparisons test of the kind described in Miller (chp. 6).

    More strongly, comparing contraband yields gives a biased comparison. As previously described, Latinos are less likely to have licenses, thus more likely to be searched incident

to arrest, and unlike other searches, search incident to arrest is not purposed to discover contraband.

14. (p. 7, l. 13-23) MacDonald compares the checkpoint stop rate between Latinos and non-Latinos, and the rates of contraband discovery.

    I've been over this before, and apologize for being tedious. The issue arises on the subsequent page and in the summary, but I shan't address it again. *At essentially all checkpoints, drivers must show their licenses. Those without a license are either arrested or cited, depending upon whether they can prove their identity in some other way. If arrested, the driver is automatically searched, without expectation of contraband. So Latinos will have higher rates of non-contraband searches.* The high rate of checkpoint-initiated Latino stops compared to non-Latinos is consistent with this explanation.

    During this five-year period, 188 of the 454 (41%) Hispanic traffic stop searches were incident to arrest, and for these searches discovery of contraband would not be a usual expectation. In contrast, among non-Hispanics, 484 of 2,309 traffic stop searches (21%) were incident to arrest. Since a much higher proportion of Hispanics are searched incident to arrest at traffic stops, difference in the rate of productive search is not a sign of profiling or targeting.

    Similarly, at checkpoint searches, 58 out of 91 (64%) Hispanic searches are incident to arrest. For non-Hispanics, 70 out of 345 (20%) checkpoint searches were incident to arrest. Again, Hispanics are being searched more often in circumstances where contraband is not expected. Thus, a difference in the rates of productive search is not a sign of profiling or targeting.

15. (p. 9, l. 2-4) MacDonald says "The internal benchmark method used in this assessment is similar to the one applied in ... Cincinnati, Ohio and New York City."

    Coincidentally, I was the editor of the *Journal of the American Statistical Association* when Ridgeway and MacDonald's paper on doubly robust internal benchmarking was accepted. It is a good paper, but requires a much larger population of similar officers in order to reach reliable conclusions. Specifically, police departments in Cincinnati and New York City

have many more officers than does the ACSO. The critical issue is how to construct the weighted comparison group of officers. MacDonald's report does not detail the weighting scheme, but since there is typically one officer per shift in each of the six districts for which ACSO has primary jurisdiction, and since those districts vary in ethnicity, workforces, road types, and so forth, it is difficult to believe that one could could construct a valid weighted comparison group (this could be checked by a simulation study, of course). And since many factors change over the course of a day, one cannot even use the three officers assigned to same district during different shifts as the comparators.

One example of the difficulty in using this methodology is Deputy Troy Anthony, who is later identified as an outlier. During this time period he was assigned to Patrol, to Special Operations, and to Vice. His comparison group should be a time-weighted mixture of officers with similar duties.

16. (p. 10, l. 7-8) MacDonald says "A total of 12 officers were flagged as statistical outliers..."

    As indicated in footnote 26, the criterion for being an outlier is based upon the normal or 'bell-shaped' distribution. But deputies in the ACSO have very different duties; MacDonald rightly excludes those who make very few stops, but among those who made 50 or more, it would be quite plausible for the distribution to be multimodal. In that case, use of a z-score criterion would tend to flag those officers whose duties led them to make more stops.

17. (p. 10, l. 22-23) MacDonald says "Out of 10,409 citations ... only 13 were reported as ... 'Hispanic'."

    The ACSO, as required by the state of North Carolina, follows the U.S. Census Bureau in distinguishing race from ethnicity. The 13 reports of 'H' and the one report of 'Latino' are data entry errors.

18. (p. 10, l. 29-30) Some of these 12 officers were in the ACSO task force on gangs, or at checkpoints, or perhaps assigned to districts with larger Latino populations. These would naturally seem different from colleagues with other duties.

    More broadly, MacDonald's inclusion criterion is 50 or more stops during a five-year period

is problematic. This will include many officers whose duties rarely entail traffic stops. A deputy who worked a checkpoint once during this five year interval could easily have five Latino citations, or a 10% rate.

Finally, MacDonald only considers citations that are linked to specific locations. But this actually excludes many traffic stops, where no street number or geolocation is automatically available. From MacDonald's description of his protocol, he is including, for example, nearly all of the (many) citations written by Jon Villanova, a School Resource Officer, that are located at the school address. But these citations are drugs, fighting, and so forth, and not for traffic offenses.

19. (p. 11, l. 1-7) MacDonald describes his use of surnames to estimate the ethnicity of people in the citation database.

    I have already indicated my concerns about the use of surname matching rather than record linkage.

20. (p. 11, l. 8-16) MacDonald applies his benchmarking method to citation data.

    The issues previously stated regarding the internal benchmarking method for stops also apply to citations. It appears that this analysis attempted to control for time of day, but almost surely pooled across districts and perhaps duties.

    MacDonald focuses on specific offenses—inspection, NOL, speeding, and "other". If Latinos are more likely to commit some of these offenses, then MacDonald's comparison is unfair. And at least the NOL offenses are more likely to be committed by Latinos.

21. (p. 10, l. 17-18) MacDonald applies his benchmarking method to arrest data.

    Looking at arrests by deputies who have made 50 or more stops is misleading. It would be better to look at arrests that stem from traffic stops. As it stands, MacDonald's method would include officers who made 50 traffic stops, but all of whose arrests resulted from serving warrants for, say, failure to appear.

22. (p. 11, l. 22-23) MacDonald names three officers as outliers.

    I agree. Outliers should be scrutinized.

In this case, I note that Deputies Wilkerson and Ray were the two ACSO officers with primary responsibility for checkpoint operations during most of this time period.

Since MacDonald finds that most Latino stops occur at checkpoints, it is not surprising that Wilkerson stands out from the rest, but it *is* surprising that Ray does not. Ray had 1440 stops and 1073 citations; Wilkerson had 1656 stops and 1032 citations. From the traffic stop database, Wilkerson stopped 233 Hispanics over a five-year period (less than one per week). Ray stopped 256 Hispanics. So although Ray stopped fewer people than Wilkerson, the traffic stop database shows he stopped more Hispanics. If MacDonald's methodology were sound, and if it validly mapped a connection between legally irrelevant citations and legally relevant stops, then it should surely have flagged Officer Ray as an outlier.

Officers Ray and Wilkerson worked together; their duties and outcomes were almost identical, and they should have been compared to the same control group. Any anlysis that flagged one should have flagged the other.

Regarding Officer Anthony, he made 460 stops, with 315 citations and 173 arrests. According to his deposition, he primarily worked in the Special Operations group, which chiefly back up other units. Their single most common task is traffic enforcement, and they usually run checkpoint operations. As indicated by data from other central North Carolina counties, both activities are more likely to lead to stops and citations for Latinos.

Regarding Officer McGill, she wrote 260 citations and made 408 charges (not citations). Her number of citations is not unusual: Officers Anthony, Apple, Gaither, Wilkerson, Ray and others have all cited more people than she. But Officer McGill is unusual in that she writes multiple charges per citation. Since MacDonald confuses charges with citations, his analysis makes her stand out. But there is no evidence that she is stopping or checkpointing an unusually large weight-adjusted proportion of Hispanic drivers, which is the conclusion that MacDonald reaches.

In short, for at least two of the outlier deputies, their duties were such that one would expect large numbers of Latino stops, citations, and arrests. It appears that the weighted comparison group did not succeed in creating a valid internal benchmark.

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This report was prepared by David L. Banks.

Dec. 19, 2012

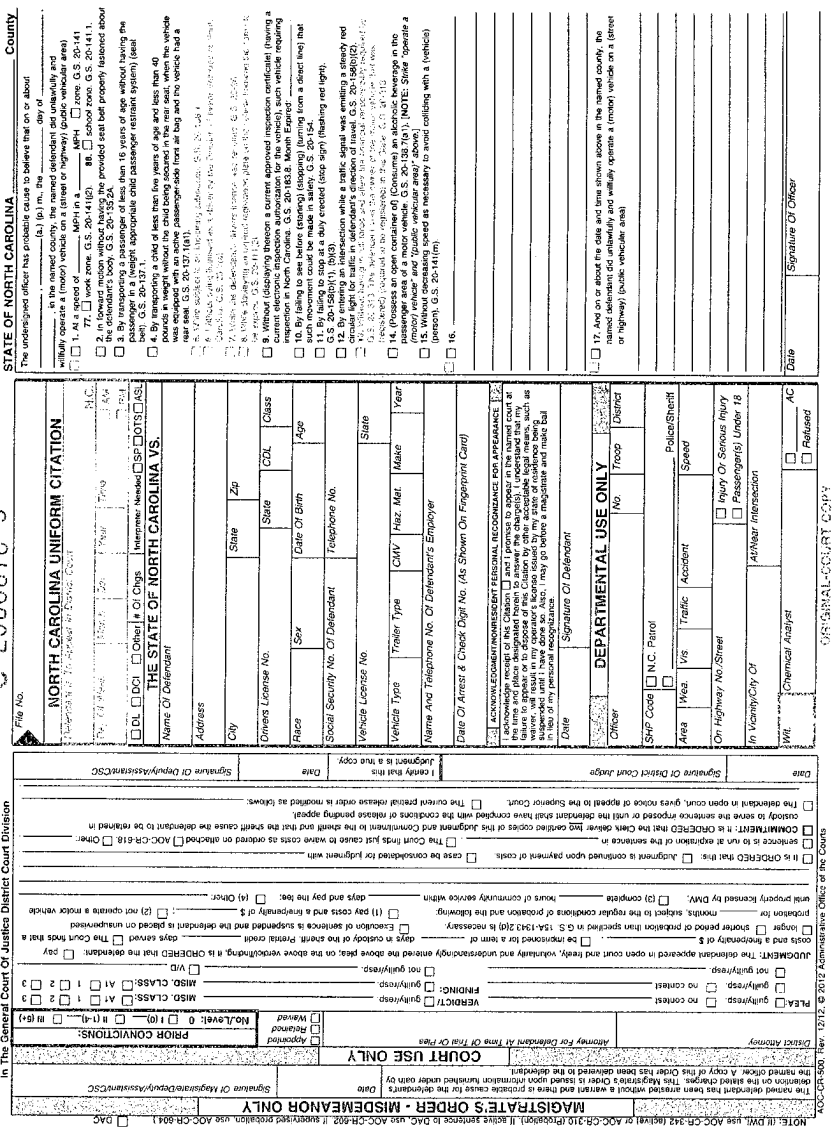
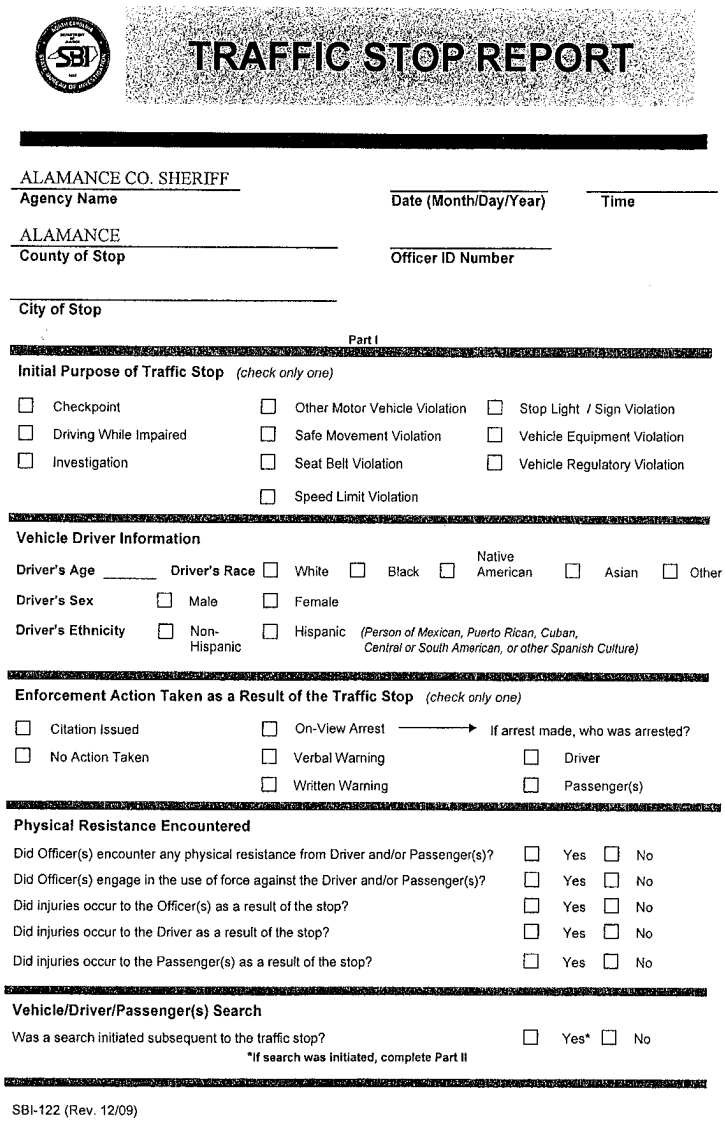


Figure 2: The North Carolina Citation Form.



TRAFFIC STOP REPORT

ALAMANCE CO. SHERIFF
Agency Name

Date (Month/Day/Year) **Time**

ALAMANCE
County of Stop

Officer ID Number

City of Stop

Part I

Initial Purpose of Traffic Stop *(check only one)*

☐ Checkpoint ☐ Other Motor Vehicle Violation ☐ Stop Light / Sign Violation
☐ Driving While Impaired ☐ Safe Movement Violation ☐ Vehicle Equipment Violation
☐ Investigation ☐ Seat Belt Violation ☐ Vehicle Regulatory Violation
☐ Speed Limit Violation

Vehicle Driver Information

Driver's Age _____ **Driver's Race** ☐ White ☐ Black ☐ Native American ☐ Asian ☐ Other

Driver's Sex ☐ Male ☐ Female

Driver's Ethnicity ☐ Non-Hispanic ☐ Hispanic *(Person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish Culture)*

Enforcement Action Taken as a Result of the Traffic Stop *(check only one)*

☐ Citation Issued ☐ On-View Arrest → If arrest made, who was arrested?
☐ No Action Taken ☐ Verbal Warning ☐ Driver
☐ Written Warning ☐ Passenger(s)

Physical Resistance Encountered

Did Officer(s) encounter any physical resistance from Driver and/or Passenger(s)? ☐ Yes ☐ No
Did Officer(s) engage in the use of force against the Driver and/or Passenger(s)? ☐ Yes ☐ No
Did injuries occur to the Officer(s) as a result of the stop? ☐ Yes ☐ No
Did injuries occur to the Driver as a result of the stop? ☐ Yes ☐ No
Did injuries occur to the Passenger(s) as a result of the stop? ☐ Yes ☐ No

Vehicle/Driver/Passenger(s) Search

Was a search initiated subsequent to the traffic stop? ☐ Yes* ☐ No
***If search was initiated, complete Part II**

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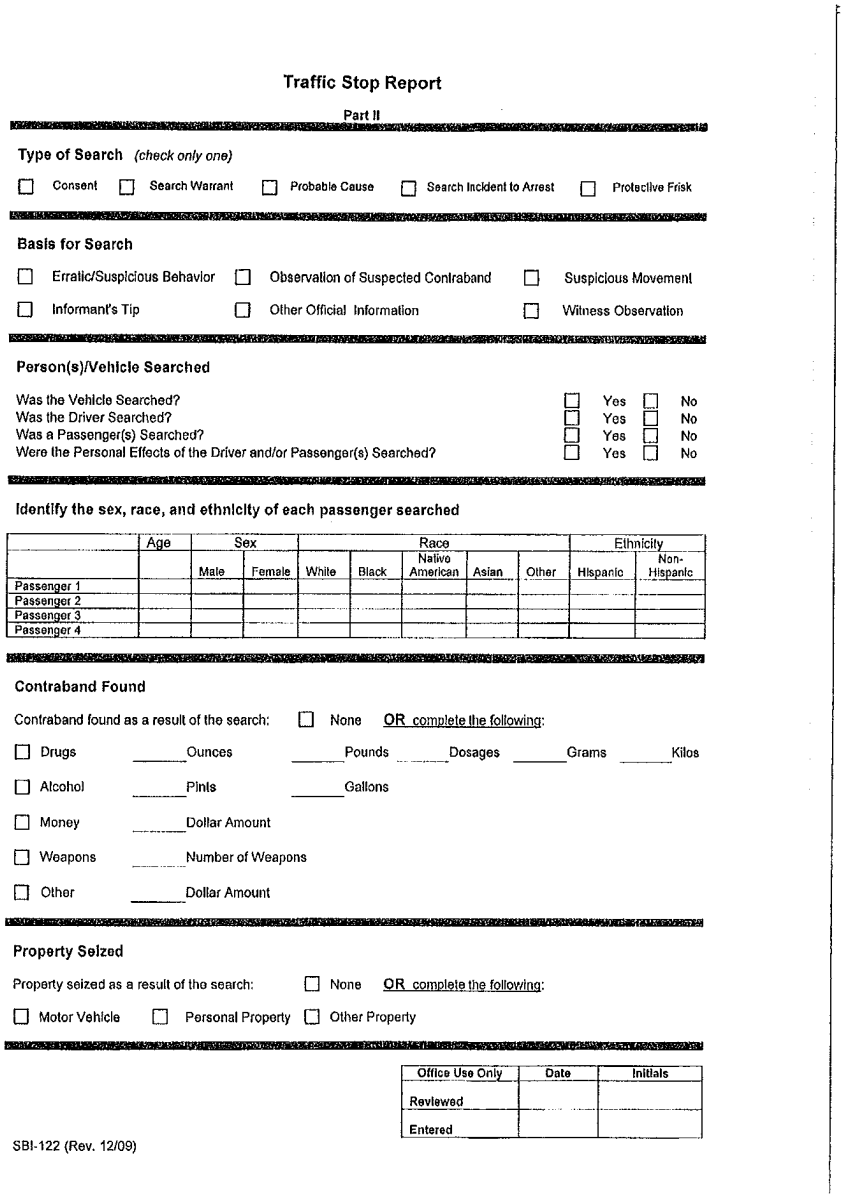
Figure 3: The North Carolina Traffic Stop Form.



Traffic Stop Report

Part II

Type of Search *(check only one)*

☐ Consent ☐ Search Warrant ☐ Probable Cause ☐ Search Incident to Arrest ☐ Protective Frisk

Basis for Search

☐ Erratic/Suspicious Behavior ☐ Observation of Suspected Contraband ☐ Suspicious Movement

☐ Informant's Tip ☐ Other Official Information ☐ Witness Observation

Person(s)/Vehicle Searched

Was the Vehicle Searched?	☐ Yes	☐ No
Was the Driver Searched?	☐ Yes	☐ No
Was a Passenger(s) Searched?	☐ Yes	☐ No
Were the Personal Effects of the Driver and/or Passenger(s) Searched?	☐ Yes	☐ No

Identify the sex, race, and ethnicity of each passenger searched

	Age	Sex		Race					Ethnicity	
		Male	Female	White	Black	Native American	Asian	Other	Hispanic	Non-Hispanic
Passenger 1										
Passenger 2										
Passenger 3										
Passenger 4										

Contraband Found

Contraband found as a result of the search: ☐ None **OR** complete the following:

☐ Drugs _____Ounces _____Pounds _____Dosages _____Grams _____Kilos

☐ Alcohol _____Pints _____Gallons

☐ Money _____Dollar Amount

☐ Weapons _____Number of Weapons

☐ Other _____Dollar Amount

Property Seized

Property seized as a result of the search: ☐ None **OR** complete the following:

☐ Motor Vehicle ☐ Personal Property ☐ Other Property

Office Use Only	Date	Initials
Reviewed		
Entered		

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Figure 4: The North Carolina Search Form (on the back of the North Carolina Traffic Stop Form.

Appendix A: All 93 citations from U.S. 87 North and Gerringer Mill Road, between July 7, 2008 and October 4, 2013. Lamberth identifies this location as having the most citations on Highway 87. It is one of the sites used in his ethnic observation study.

87 N / DURHAM ST EXT	PWISD MARIJUANA
HWY 87 N / OLD 87	INSPECTION - EXPIRED
HWY 87 N / OLD 87	NO OPERATOR LICENSE (MOTORCYCLE)
HWY 87 N / OLD 87	INSPECTION - EXPIRED
HWY 87 N / OLD HWY 87	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N NC 87 / GERRINGER MILL R	SPEEDING - EXCEEDING STATED LIMIT
1731 N NC HWY 87 / WESTER	RECKLESS DRIVING
NC 87 N / OLD 87 HWY	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/OLD NC 87 HW	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/FARMINGTON I	SPEEDING - EXCEEDING STATED LIMIT
N 87 / GARRISON MILL	SEAT BELTS MANDATORY ADULT
N 87 / GERRINGER MILL RD	DRIVING WHILE LICENSE REVOKED
87 / BARBER RD	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/PHIBBS RD	NO OPERATOR LICENSE
N NC 87 HWY	LARCENY
N 87 HWY / NORTHCREST DF	DRIVING WHILE LICENSE REVOKED
GERRINGER MILL RD / N 87 H	SPEEDING - EXCEEDING STATED LIMIT
C HWY 87 / WESTERN HIGH S	WEAPONS ON CAMPUS OR OTHER EDUCATIONAL PROPERTY
N NC 87 HWY / WESTERN HIC	ASSAULT INFLICTING SERIOUS INJURY
N NC 87 HWY	TRESPASS (SECOND DEGREE)
N HWY 87 / ELDON CT	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N HWY 87 / BARBER RD	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/BARBER RD	DRIVING WHILE LICENSE REVOKED
N 87 HWY / PHIBBS RD	LIQUOR-POSS BY MINOR
N 87 / DURHAM ST	SPEEDING - EXCEEDING STATED LIMIT
DURHAM ST / N 87 HWY	DRIVING WHILE LICENSE REVOKED
N 87 HWY / GERRINGER MILL	SIMPLE ASSAULT
DURHAM ST / N 87	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY	ASSAULT-SIMPLE
87 N / PHIBBS RD	DRIVING WHILE LICENSE REVOKED
N 87 HWY / GERRINGER MILL	POSSESSION OF DRUG PARAPHERNALIA
N NC 87 HWY/GERRINGER MI	POSSESSION OF DRUG PARAPHERNALIA
HWY 87 N/GEERINGER MILL	LIQUOR-POSS BY MINOR
N 87 HWY/GERRINGER MILL I	SIMPLE ASSAULT
N NC 87 HWY/GERRINGER MI	SPEEDING - EXCEEDING STATED LIMIT
WAHS/ 1731 N NC 87	OBSCENITY - EXHIBITING HARMFUL PERFORMACE - MINORS
N 87 HWY/GERRINGER ST	NO OPERATOR LICENSE
WESTERN ALA HIGH SCH/N 8	POSS MARIJUANA UP TO 1/2 OZ
WESTERN ALA HIGH SCH/N 8	ASSAULT INFLICTING SERIOUS INJURY
N NC 87/GERRINGER RD	DRIVING WHILE LICENSE REVOKED
N 87 HWY/OLD NC 87	NO OPERATOR LICENSE
N 87 HWY/DURHAM ST EXT	NO OPERATOR LICENSE
N NC 87 HWY/GERRINGER MI	DISPENSING PRES DRUG W/O LICENSE AS PHARMACIST
N NC 87 HWY/GERRINGER ST	SPEEDING - EXCEEDING STATED LIMIT
N 87 HWY/GERRINGER MILL I	INSPECTION - EXPIRED
DURHAM ST/HWY 87 N	SPEEDING - EXCEEDING STATED LIMIT
N 87 HWY/ELDON LN	DRIVING WHILE LICENSE REVOKED
N 87/OLD 87	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N 87 NC HWY/BARBER RD	LITTERING
N NC 87/OLD NC 87	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N 87 HWY/PHIBBS RD	SPEEDING - EXCEEDING STATED LIMIT
DURHAM ST EXT/N NC 87 HW	LITTERING
N NC 87 HWY/OLD NC 87 HW	POSS MARIJUANA UP TO 1/2 OZ
HWY 87N/HILLVIEW FARM RD	SPEEDING - EXCEEDING STATED LIMIT
N 87 HWY / OLD 87	SPEEDING - EXCEEDING STATED LIMIT

N 87 HWY / GERINGER MILL F	DRIVING WHILE LICENSE REVOKED
N 87 HWY / BARBER RD	CARELESS AND RECKLESS DRIVING
N NC 87 HWY/BARBER RD	FOLLOWING TOO CLOSELY
N 87 HWY / OLD 87	NO FINANCIAL RESPONSIBILITY
N 87 HWY / BARBER RD	SPEEDING - EXCEEDING STATED LIMIT
N 87 HWY / ELDON	NO OPERATOR LICENSE
DURHAM ST EXT / N NC 87	INSPECTION - EXPIRED
N NC 87 HWY/GERRINGER ST	DRIVING WHILE LICENSE REVOKED
DURHAM ST EXT / N 87 NC	DRIVING WHILE LICENSE REVOKED
OLD NC 87 HWY/N NC 87 HW	DRIVING WHILE LICENSE REVOKED
N NC 87/GERRINGER	OPEN CONTAINER-PROHIBITED
N 87 NC / BROKEN ARROW LI	NO OPERATOR LICENSE
NC 87 N/PHIBBS RD	CARELESS AND RECKLESS DRIVING
N 87 HWY / GERRINGER MILL	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY	SALE/GIVE F-WN/LQ/MXBV TO <21
N 87 NC / OLD 87 NC	DRIVING WHILE LICENSE REVOKED
N 87 NC HWY / KANGAROO G	POSSESSION OF DRUG PARAPHERNALIA
N NC 87 HWY/GERRINGER MI	CARRYING CONCEALED GUN
N 87 NC / GERRINGER MILL	NO OPERATOR LICENSE
N 87 HWY / ELDON DR	NO OPERATOR LICENSE
N NC 87 HWY/OLD NC 87 HW	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
DURHAM ST EXT/N NC 87 HW	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/ELDON DR	DRIVING WHILE LICENSE REVOKED
GERRINGER MILL RD/N NC 87	SPEEDING - EXCEEDING STATED LIMIT
N NC 87 HWY/BARBER RD	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N NC 87 HWY / ELDON DR	DISPLAY FICTITIOUS/REVOLKED/SUSPENDED REGISTRATION
N NC 87 HWY/OLD NC 87 HW	OPERATING VEHICLE ON HIGHWAY WITHOUT REGISTRATION
N NC 87 HWY KANGAROO	PERSON OVER LAWFUL AGE AIDING MINOR TO BUY ALCOHOL
N NC 87 HWY KANGAROO	PERSON OVER LAWFUL AGE AIDING MINOR TO BUY ALCOHOL
N 87 HWY / N CREST MARKET	PERSON OVER LAWFUL AGE AIDING MINOR TO BUY ALCOHOL
N NC 87 HWY/DURHAM ST EX	FAILURE TO DIM ETC. BEAMS OF HEADLAMPS
N NC 87 HWY/FARMINGTON I	DRIVING WHILE LICENSE REVOKED
N 87 NC / GERRINGER MILL	DRIVING WHILE LICENSE REVOKED
N NC 87 HWY/ELDON DR	PASSING - IMPROPER (WHERE SIGNS FORBID)
N NC 87 HWY/GERRINGER ST	OPEN CONTAINER-PROHIBITED
N NC 87 HWY/GERRINGER MI	DISORDERLY CONDUCT (NON-SPECIFIC) DISTURBING THE PEACE
N NC 87 HWY/GERRINGER MI	ENGAGING IN FIGHTING IN PUBLIC
GERRINGER MILL RD/N NC 87	INSPECTION - EXPIRED