EVALUATING FAIRNESS IN TRAFFIC STOPS

BY THE

ANN ARBOR POLICE DEPARTMENT

FINAL REPORT

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A report prepared for the City of Ann Arbor

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

- This study was a detailed analysis of stops conducted by the Ann Arbor Police Department to look for evidence of a pattern of practice regarding bias-based policing. No evidence of such a pattern of practice was revealed.

- In April, 2018, the Dolan Consulting Group (DCG) was contracted by the City of Ann Arbor to examine the motor vehicle stops made by the Ann Arbor Police Department for any signs of biased policing.

- DCG obtained data from the Ann Arbor Police Department on all motor vehicle stops made by that department during 2017. These data specifically included the date, time, location, and legal justification for the stop, as well as the sex and race of the driver stopped.

- These data revealed that during 2017, the 119 officers of the Ann Arbor Police Department performed 13,662 motor vehicle stops for observed traffic violations, and another 350 motor vehicle stops for criminal investigative justifications (such as probable cause or vehicles matching descriptions in crimes). None of these stops were missing data on the race or sex of the driver.

- Analysis revealed that more than 44% of the persons involved in motor vehicle crashes within Ann Arbor resided outside of the community, thus rendering U.S. Census data useless as a benchmark for comparison to these stops.

- The sex and race of drivers involved in motor vehicle crashes that occurred within Ann Arbor during 2017 were considered a sample of the driving population within the city. These crash drivers, therefore, were used as a benchmark for comparison to police motor vehicle stops for observed traffic violations. Data on the race and sex of 7,405 crash drivers within Ann Arbor composed this benchmark. Because the crash data also included the date, time, and location of the crash, benchmarks could be created for each district and for various periods of the day.

- A separate benchmark measure was used for comparison to the criminal investigative stops made by the police. Since these stops were to have been driven by criminal behavior, not traffic violations, a benchmark of criminal activity was needed. The description of crime suspects reported by members of the public who were witnesses or victims of crimes within Ann Arbor during 2017 were used as this benchmark. Descriptions of 4,749 suspects reported in crimes within Ann Arbor during 2017 that included both the suspect's apparent race and sex were obtained from the criminal case records of the Ann Arbor Police Department. These suspects were used as a benchmark for comparison to police motor vehicle stops for criminal investigative reasons. Because these data also included the date, time, and location of the crime, benchmarks could be created for each district and for various periods of the day.

- Police stops of motor vehicles were then examined by type of stop (traffic violation versus criminal investigation), district, and time of day. The Ann Arbor Police Department divides the city into four distinct patrol districts.

- The analysis revealed little stop disparity overall, despite drilling down to the district level, time of day, and reason for stop. Disproportionate stopping was only revealed within three demographic groups, and these disparities were isolated in time, location, or reason for stop. Finally, all stop disparities proved to be both statistically and substantively small in regard to the proportion of the group stopped.

- The analysis revealed that male drivers were stopped for traffic violations at a higher rate than was anticipated based on the rate of male driver involvement in vehicle crashes, but this male stop disparity was isolated to three of the four districts, between the hours of 5:00 p.m. and 11:00 p.m., and only during certain months of the year. This male stop disparity was estimated to have resulted in 365 more male drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark. Male drivers were estimated to have been 6% more likely to have been stopped by the police than one would have expected based on the benchmarks used.

- The analysis revealed that white drivers were stopped during criminal investigative stops at a higher rate than was anticipated based on the proportion of criminal suspects that members of the public indicated were white. This disparity was found across all four districts and during most times of the day, but only during certain months of the year. This white driver disparity was estimated to have resulted in 49 more white drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark. White drivers were estimated to have been 0.5% more likely to have been stopped than one would have expected based on the benchmarks used.

- The analysis revealed that African-American drivers were stopped for traffic violations at a higher rate than was anticipated based on the rate of African-American driver involvement in vehicle crashes. This disparity, however, was isolated to District B, between 11:00 p.m. and 5:00 a.m., and only during certain months of the year. This African-American driver disparity was estimated to have resulted in 19 more African-American drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark. African-American drivers were estimated to have been 1% more likely to have been stopped than one would have expected based on the benchmarks used.

- No evidence was revealed to suggest that Asian-American and Pacific Islander drivers were stopped disproportionately in any district at any time of the day.

- Because so few stops involved drivers identified as Native American, Hispanic, Multiracial, or Other, there were too few cases within each group to analyze each group individually. Furthermore, because they were in such small numbers, sometimes there was no representation of each group at all within the stops or benchmark for a district or time

block. As a result, all of these stops were combined into an 'all other groups' category that included such an array of within-group diversity.

- No evidence was revealed to suggest that drivers included in the 'all other groups' category were stopped disproportionately in any district at any time of the day.

PART I. INTRODUCTION

The purpose of this report is to conduct an impartial examination of the practices of the Ann Arbor Police Department with regard to unbiased policing. Specifically, this report will briefly assess the Ann Arbor P.D.'s practices with regard to national standards for addressing bias-based profiling, then engage in a detailed analysis of the vehicle stops conducted by Ann Arbor police officers during 2017. These stops will be analyzed by district and time of day, using appropriate comparison benchmarks, to determine if any evidence exists of persistent bias in vehicle stops based on driver sex or race. While this report cannot say whether or not an individual police officer made a stop, or stops, based on gender or racial animus, it can reveal if the general pattern of vehicle stops revealed a disproportionate focus on drivers of a specific race or sex during 2017.

Bias-Based Profiling

The Police Executive Research Forum describes bias-based policing as the intentional practice by an individual law enforcement officer who incorporates prejudicial judgments based on race, ethnicity, gender, sexual orientation, economic status, religious beliefs, or age that are inappropriately applied in the performance of his/her duties.[1] The most well-known aspect of bias-based policing is often referred to as racial profiling, or "driving while black." The American Civil Liberties Union (ACLU) defines racial profiling in the following manner:

> "'Racial profiling' refers to the practice by law enforcement officials of targeting individuals for suspicion of crime based on the individual's race, ethnicity, religion or national origin. Racial profiling, generally, as practiced by police, is the reliance on a group of characteristics they believe to be associated with crime. Examples of racial profiling are the use of race to determine which drivers to stop for minor traffic violations (commonly referred to as 'driving while black or brown')."[2]

The term 'racial profiling', and the phrase "Driving While Black", rose to prominence in public discourse during the 1990s, in the wake of the War on Drugs, when legal cases began to argue law enforcement officers intentionally targeted racial minorities for traffic stops in an effort to curb the trafficking and sale of drugs in the United States.[3]

Public opinion polls have revealed that most Americans are vehemently opposed to law enforcement officers using only an individual's race or sex, rather than that person's actual behavior, when determining who to stop or detain. Survey research has revealed that between 70% and 100% of Americans are opposed to racial profiling in police stops on the highways or in

[1] Fridell, L. (2004). *By the Numbers: A Guide for Analyzing Race Data from Vehicle Stops.* Washington, DC: Police Executive Research Forum.
[2] American Civil Liberties Union (2018). *Definition of Racial Profiling*. Available at: https://www.aclu.org/other/racial-profiling-definition?redirect=racial-profiling-definition
[3] Harris, D. (1999). The stories, the statistics, and the law: Why 'Driving While Black' matters. *Minnesota Law Review, 84*, 265–326.

airports.[4] While persons of color tend to oppose racial profiling more strongly than do whites, numerous studies have revealed at least 70% of whites also strongly oppose racial profiling.[5]

Unfortunately, these same surveys of Americans have also consistently revealed that most people believe that the practice of racial profiling by the police is widespread in the nation.[6] Furthermore, several hundred studies have been conducted to date that potential examined racial disparities in traffic stops conducted by the police. While many of these studies have suffered from significant methodological weaknesses, the vast majority of these studies have revealed that male drivers, and African-American drivers are stopped at much higher rates than one would expect based on their representation among the driving population.[7]

Public perceptions about the prevalence of racial profiling, and the consistent research findings that also suggest its occurrence, have likely contributed to the significant decline in public confidence in the police. Gallup Poll data reveal that for the last three decades, only about 50-60% of Americans say that they have "a great deal" or "quite a lot" of confidence in their local police. By comparison, during the 1960s and 1970s, almost 80% of Americans indicated that they had confidence in the police.[8]

In a democracy like the U.S., the police only derive their authority from the consent of the people. In order to regain the confidence of the majority of the American public, the law enforcement profession needs to consistently be transparent with its constituents and routinely engage in honest self-examination of policies and practices that may result in unfair outcomes for citizens.[9]

In response to concerns about biased policing and racial profiling, the International Association of Chiefs of Police (IACP) has issued a policy statement on the issue that states: "Persons having contact with members of law enforcement shall be treated in a fair, impartial, equitable, and objective manner, in accordance with law, and without consideration of their individual demographics."[10] The IACP has called on all law enforcement agencies to adopt a formal written policy on unbiased policing. Likewise, the Commission on Accreditation for Law Enforcement Agencies (CALEA), the national accreditation body for police departments, has issued a formal policy statement against the use of racial profiling, and includes unbiased policing as part of its

[4] See, for example: Cochran, J. C., & Warren, P. Y. (2012). Racial, ethnic, and gender differences in perceptions of the police. *Journal of Contemporary Criminal Justice, 28(2)*, 206-227; Gabbidon, S. L., Penn, E. B., Jordan, K. L., & Higgins, G. E. (2009). The influence of race / ethnicity on the perceived prevalence and support for racial profiling at airports. *Criminal Justice Policy Review, 20(3)*, 344-358; Reitzer, J., & Piquero, A. R. (2006). Does it exist: studying citizens' attitudes of racial profiling. *Police Quarterly, 9(2)*, 161-183; Weitzer, R., & Tuch, S. A. (2002). Perceptions of racial profiling: race, class, and personal experience. *Criminology, 40(2)*, 435-456; Zhao, J. S. Yung-Lein, L., Ling, R., & Lawton, B. (2015). The impact of race / ethnicity and quality-of-life policing on public attitudes toward racially biased policing and traffic stops. *Crime and Delinquency, 61(3)*, 350-374.
[5] Ibid.
[6] Ibid.
[7] Smith, M. R., Rojek, J. J., Petrocelli, M., & Withrow, B. (2017). Measuring disparities in police activities: a state of the art review. *Policing: An International Journal of Police Strategies & Management, 40(2)*, 166-183.
[8] Norman, J. (2017). *Confidence in the Police Back at Historical Average*. Omaha, NE: Gallup.
[9] Police Executive Research Forum (2016). *Advice from Police Chiefs and Community Leaders on Building Trust: Ask for Help, Work Together, and Show Respect*. Washington, DC: Police Executive Research Forum.
[10] International Association of Chiefs of Police (2018). *Unbiased Policing Policy Statement*. Alexandria, VA: IACP. Available at: http://www.theiacp.org/model-policy/model_policy/unbiased-policing/

accreditation standards.[11] In fact, in order for law enforcement agencies to achieve CALEA accreditation, they must comply with the following standards:

- The agency has a written directive governing bias based profiling and, at a minimum, includes the following provisions:
    - A prohibition against bias based profiling in traffic contacts, field contacts, and in asset seizure and forfeiture efforts;
    - Training agency enforcement personnel in bias based profiling issues, including legal aspects;
    - Corrective measures if bias-based profiling occurs;
    - A documented administrative review of agency practices.[12]

This CALEA standard will be the standard used in this report through which to judge the responsiveness of the Ann Arbor Police Department to the issue of bias-based profiling.

Written Directive

CALEA standards recommend law enforcement agencies have a written directive governing bias based profiling that includes a prohibition against such activity. Some time ago, the Ann Arbor Police Department established formal written policies prohibiting discrimination or biased officer actions. These formal policies are *Policy and Procedure Order 001-012 Non-Discrimination Policy*, and *Order 001-017 Non-Biased Policing*. Copies of these policies can be found within Appendices B and C of this report.

In summary, the department's non-discrimination policy (*Order 001-012*) is the agency's policy statement on civil rights. It requires all Ann Arbor Police Department personnel to observe, uphold, and enforce all laws pertaining to the individual rights of all persons. It also requires personnel to exercise their authority (i.e., investigative action, search, seizure, arrest, and use of force) without regard for race, color, ethnicity, religion, sex, sexual orientation, or disability. This policy has been in effect for 19 years, having been established in 1999

The department's unbiased policing policy (*Order 001-017*) has been in effect for 17 years, being instituted in 2001. This policy reaffirms the agency's commitment to non-biased policing and establishes procedures to assure the public that the law is enforced in an equitable manner. These procedures include officer training regarding non-biased policing, supervisory review of officer enforcement actions, and the formal investigation of citizen complaints regarding biased officer actions.

This policy order also clarifies the only circumstances in which officers may consider race, ethnicity, gender, sexual orientation, religion, cultural group, or age. Specifically, officer may take into account the reported race, ethnicity, gender, sexual orientation, religion, cultural group, or age of an individual when based on trustworthy, locally relevant information that links a person to a particular unlawful incident.

[11] Commission on Accreditation for Law Enforcement Agencies (2018). *CALEA Standards for Law Enforcement Agencies*. Gainesville, VA: CALEA. Available at: http://www.calea.org/content/standards-titles
[12] CALEA Standard 1.2.9

An example of such a circumstance would be an officer responding to a suspect description in a "be on the lookout" report broadcast about a crime that has just occurred. As an illustration, imagine a loss prevention manager at a store calls the police to report a shoplifting has just occurred. A white female in her late thirties has just grabbed several dresses from a rack and has ran out of the store. It would be legitimately within this policy for an officer within the vicinity to be closely observing for white females, especially those carrying bundled clothing or a bag that could contain bundled clothing. Another illustration might be officers being informed about a string of armed robberies of convenience stores and gas stations on the west side of town, all committed by an Asian male of slight build, in his early twenties, who was wearing a red coat. By this policy, officers patrolling the west side of the city could legitimately closely observe for an Asian man matching this age and clothing description near gas stations and convenience stores.

Training

CALEA standards require the training of agency enforcement personnel in bias based profiling issues, including legal aspects. The department's unbiased policing policy (*Order 001-017*) mandates such training for all personnel and over the last several years personnel have received numerous hours of training regarding cultural diversity, implicit bias, autism awareness, and legal updates.

Corrective Measures

CALEA standards require corrective measures if bias-based profiling occurs. Violations of the Ann Arbor Police Department's *Order 001-012 Non-Discrimination Policy*, or *Order 001-017 Non-Biased Policing* can result in employee discipline up to, and including, termination depending on the weight of the evidence and the severity of the offense.

Administrative Review of Practices

Finally, CALEA recommend a routine documented administrative review of agency practices regarding potential biased policing. A thorough review of stops made by department personnel, especially one that uses appropriate benchmarks, is complex, time-consuming, and costly. Nevertheless, the Ann Arbor Police Department has continued to engage in such external reviews for signs of biased policing. In 2004, Lamberth Consulting was hired to examine Ann Arbor Police Department traffic stops for patterns of racial bias. Using researchers to observe drivers traveling the roadways of Ann Arbor, Lamberth Consulting collected data on the races of more than 19,400 drivers traveling within the city. This benchmark was compared to more than 8,000 vehicle stops conducted by Ann Arbor officers. This study concluded that there was no evidence overall that the Ann Arbor Police Department was targeting African-American motorists for stops.[13]

In 2016, the Hillard Heintze consulting firm was contracted to conduct an assessment of the Ann Arbor Police Department's efforts toward community engagement. This assessment emphasized public surveys and focus groups with members of the community, rather than statistically

[13] Lamberth, J. C. (2004). *Ann Arbor Traffic Stop Data Collection Methods and Analysis Study*. Chadds Ford, PA: Lamberth Consulting LLC.

examining racial demographics of drivers involved in traffic stops. This assessment produced a list of recommended improvements that the Ann Arbor Police Department is currently implementing, it also commented on the professionalism of the department personnel and higher than average level of existing community engagement efforts.[14]

As the last formal analysis of traffic stops data was conducted 16 years ago, and the Hillard Heintze assessment appeared to lack such an analysis, the Dolan Consulting Group was contracted in 2018 to conduct the current examination of vehicle stops.

Empirically Examining Biased Policing Behavior

The methodologies first established for empirically examining evidence for racial profiling and other biased policing behavior have their origin in civil right court cases. In the early 1990s, in the case of *State of New Jersey v. Pedro Soto et al.,* a criminal defense attorney for 19 Hispanic and African-American defendants moved to suppress evidence from traffic stops deemed to be discriminatory enforcement that amounted to racial profiling. The attorney contracted with a research firm that gathered and analyzed data on the racial composition of drivers traveling the New Jersey Turnpike, and stops along the Turnpike by troopers with the New Jersey State Police. This analysis suggested that stops by troopers involved proportionately far more African-American and Hispanic drivers that were observed driving along the Turnpike. While 12-20% of the drivers on the turnpike were observed to be African-American or Hispanic, 40-50% of the stops by troopers on that highway were members of those racial / ethnic groups. Based on this analysis of traffic stops, the New Jersey Superior Court judge granted the motion to suppress and stated, "Unrebutted statistical evidence of disproportionate traffic stops against African-American motorists established de facto policy of targeting blacks for investigation and arrest and thus established selective enforcement violating the equal protection and due process clauses."[15]

During the same era, in the case of *Wilkins v. Maryland State Police*, Wilkins, assisted by the American Civil Liberties Union, sued the Maryland State Police for violating his civil rights after being stopped, detained, and questioned at length about possible drug transportation by state troopers. As part of the case, evidence was presented that compared the racial composition of drivers found traveling Interstate Highway 95, with the racial composition of drivers stopped on that highway by Maryland state troopers. Just as in the *Soto* case, significant racial disparities were revealed between the percentage of drivers on I-95 that were observed to be African-Americans, and the percentage of drivers stopped that were African-American. Based heavily on this statistical evidence, the Maryland District Court ruled in favor of Wilkins.[16]

Since these two cases, numerous traffic stop data analyses have been conducted by academics, research firms, law enforcement agencies, the American Civil Liberties Union, and the National Association for the Advancement of Colored People. While many of these studies have suffered methodological weaknesses, these studies have revealed a generally consistent trend of racial disparities in vehicle stops, especially disparities involving African-Americans. While such

[14] Hillard Heintze (2017). *Ann Arbor Police Department Independent Analysis of Community Engagement Practices*. Chicago, IL: Hillard Heintze LTD.
[15] *State of New Jersey v. Pedro Soto et al.*, 734 A.2d 350 (1996).
[16] *Wilkins v. Maryland State Police*, MJG 93-468 D. Md. (1993)

disparities do not necessarily indicate that law enforcement officers are relying on a driver's race as the primary factor when deciding to stop motorists, it does offer circumstantial evidence of racial disparities in the treatment of people by the police based on race.[17]

Following the traditional practice first established in the Wilkins and Soto cases, and perpetuated by literally hundreds of later studies, the present analysis compared the racial composition of the drivers stopped by the Ann Arbor Police Department with the drivers found traveling the roadways of this city. Comparisons were made to see if the proportion of drivers by sex or race were stopped at a rate notably higher than expected based on who is driving in Ann Arbor. The focus of this analysis was to determine if any demographic category group of race or sex was stopped at a notably higher rate than expected, and determine if any such disparities found were behavioral trends across time or brief occurrences. The next section of this report describes our methodology in greater detail.

[17] Smith, M.R., Rojek, J., Petrocelli, M. & Withrow, B.L. (2017). Measuring disparities in police activities: A state of the art review. *Policing: An International Journal of Police Strategies and Management, 40(2)*, 166-183; Tillyer, R., Engel, R. S., & Calnon-Cherkauskas, J. (2010). Best practices in vehicle stop data collection and analysis. *Policing: An International Journal of Police Strategies and Management, 33(1)*, 69-92.

PART II. METHODOLOGY

This section describes the research methodology used to examine the vehicle stops made by the Ann Arbor police for patterns of sex or racial bias. The methods described in this section are based on the current state of the art methods in scholarly research regarding racial profiling issues. These methodological standards have evolved over three decades of social scientific research into racially biased policing involving traffic stops.[18]

Study Site

This analysis involves stops conducted within the city of Ann Arbor by personnel of the Ann Arbor Police Department. As of 2017, the U.S. Census Bureau estimated the population of Ann Arbor as 121,477 permanent inhabitants, but the actual population is assumed to be larger due to students attending the University of Michigan who still declare their parent's address as their permanent home address, thus not being counted within the Census Bureau numbers. The city measures approximately 28 square miles in size, with a high population density 4,094 persons per square mile (the national average is 88 people per square mile).

Other law enforcement agencies also conduct vehicle stops within the borders of Ann Arbor, including the Michigan State Police, Washtenaw County Sheriff's Department, University of Michigan Police Department, and various federal law enforcement agencies. When the community has concerns about unequal treatment by the police within Ann Arbor, it is important to keep in mind that stops by these other agencies also occur, and these other agencies might follow practices that differ from those of the Ann Arbor Police Department. This study does not include stops made by these other law enforcement agencies. It only involves stops made by the Ann Arbor Police Department during 2017.

As of June, 2018, the Ann Arbor Police Department employed 142 personnel, 119 of which were sworn officers with arrest powers and 23 were civilian administrative staff. During 2017, the sworn personnel of this department made 13,662 vehicle stops for committing traffic violations, and 350 vehicle stops for criminal investigative reasons. These stops were primarily made by patrol officers assigned to the patrol division, and members of the Special Services Section that provides flexible police resources for additional traffic enforcement, such as traffic control outside of sporting events or protecting school crosswalks as grade school students arrive and depart. A much smaller number of stops were conducted by personnel assigned to other units, such as command personnel, training personnel, or community engagement personnel.

Benchmarks

Examining the gender and racial proportions of those drivers stopped by officers of the Ann Arbor Police Department has no intuitive meaning unless these proportions are compared to some sort of benchmark measure. This is how one determines if a certain percentage of drivers stopped by a

[18] Smith, M.R., Rojek, J., Petrocelli, M. & Withrow, B.L. (2017). Measuring disparities in police activities: A state of the art review. *Policing: An International Journal of Police Strategies and Management, 40(2)*, 166-183; Tillyer, R., Engel, R. S., & Calnon-Cherkauskas, J. (2010). Best practices in vehicle stop data collection and analysis. *Policing: An International Journal of Police Strategies and Management, 33(1)*, 69-92.

law enforcement agency that are African-Americans is "too many." A benchmark for police vehicle stops must be a measure of the racial proportions of the persons actually at risk for being legitimately stopped by the police.[19] In other words, a benchmark for police stops for traffic violations must represent the racial proportions of drivers traveling the roadways of the jurisdiction and committing traffic violations. On the other hand, the benchmark for police vehicle stops for criminal investigative purposes must be a measure of the racial proportions of those reported by community members to be committing crimes within the jurisdiction.

Traffic Violation Stop Benchmark

One of the legal justifications law enforcement officers have for stopping and detaining a motorist is for the observance of a traffic violation. Section 257.742 of the Michigan state statutes, under the traffic laws, states:

"A police officer who witnesses a person violating this act or a local ordinance substantially corresponding to this act, which violation is a civil infraction, may stop the person, detain the person temporarily for purposes of making a record of vehicle check, and prepare and subscribe, as soon as possible and as completely as possible, an original and 3 copies of a written citation, which shall be a notice to appear in court for 1 or more civil infractions." MCL 257.742(1)

Under this statutory authority, members of the Ann Arbor Police Department may stop and detain anyone they witness committing a traffic violation. As traffic violations tend to be plentiful, the issue with regard to biased policing is whether officers are stopping a broad cross section of the traffic violations they witness, or are they prone to select traffic violators of a particular race or gender from the variety of traffic violators visible. A benchmark measure is needed, therefore, that can reveal the gender and racial composition of the motorists traveling the roadways within Ann Arbor with which to compare to the police stops for traffic violations.

While the earliest research studies regarding racial profiling used U.S. Census data as the benchmark, this method was quickly revealed as significantly flawed.[20] Extensive research has consistently revealed that a community's roadway driving population does not resemble the U.S. Census population of that community. One study of 315,705 traffic stops made in Pennsylvania, for example, revealed that 95.5% of drivers stopped were outside of their home zip code when stopped by the police.[21] As a result, almost 96% of these drivers were not included within the Census data for the place where they were stopped.

Another study observed drivers on the roadways of a suburb in the Metro Detroit area and revealed that, depending on the time of day and roadway observed, up to 49% of the drivers observed in the town were African-Americans, while the U. S. Census population for the town was only 3%

[19] Engel, R. S., & Calnon, J. M. (2004). Comparing benchmark methodologies for police-citizen contacts: traffic stop data collection for the Pennsylvania State Police. *Police Quarterly, 7(1)*, 97-125.
[20] Engel & Calnon (2004); Grogger, J., & Ridgeway, G. (2006). Testing for racial profiling in traffic stops from behind a veil of darkness. *Journal of the American Statistical Association, 101(475)*, 878-887; Smith, M. R., Rojek, J. J., Petrocelli, M., & Withrow, B. (2017). Measuring disparities in police activities: a state of the art review. *Policing: An International Journal of Police Strategies & Management, 40(2)*, 166-183.
[21] Engel, R. S., Calnon, J. M., Tillyer, R., Johnson, R. R., Liu, L., Wang, X. (2005). *Project on Police-Citizen Contacts: Year 2 Final Report*. Cincinnati, OH: University of Cincinnati.

African-American.[22] Relying on Census data would have greatly under-represented the proportion of actual African-American drivers on the roadway within that jurisdiction. A different study used data from automatic red-light cameras in Virginia Beach, Virginia. Positioned in a part of the city that had a 19% African-American population according to U.S. Census data, 31% of the vehicles caught running red lights by the automated cameras were registered to African-American drivers.[23] In other words, African-American drivers were observed on the roadways 65% more often than the Census data would have predicted. Studies such as these led a 2006 study published by the American Statistical Association to conclude that Census data or Bureau of Motor Vehicles data based on place of residence was inappropriate for use in traffic stops data analysis for biased policing.[24]

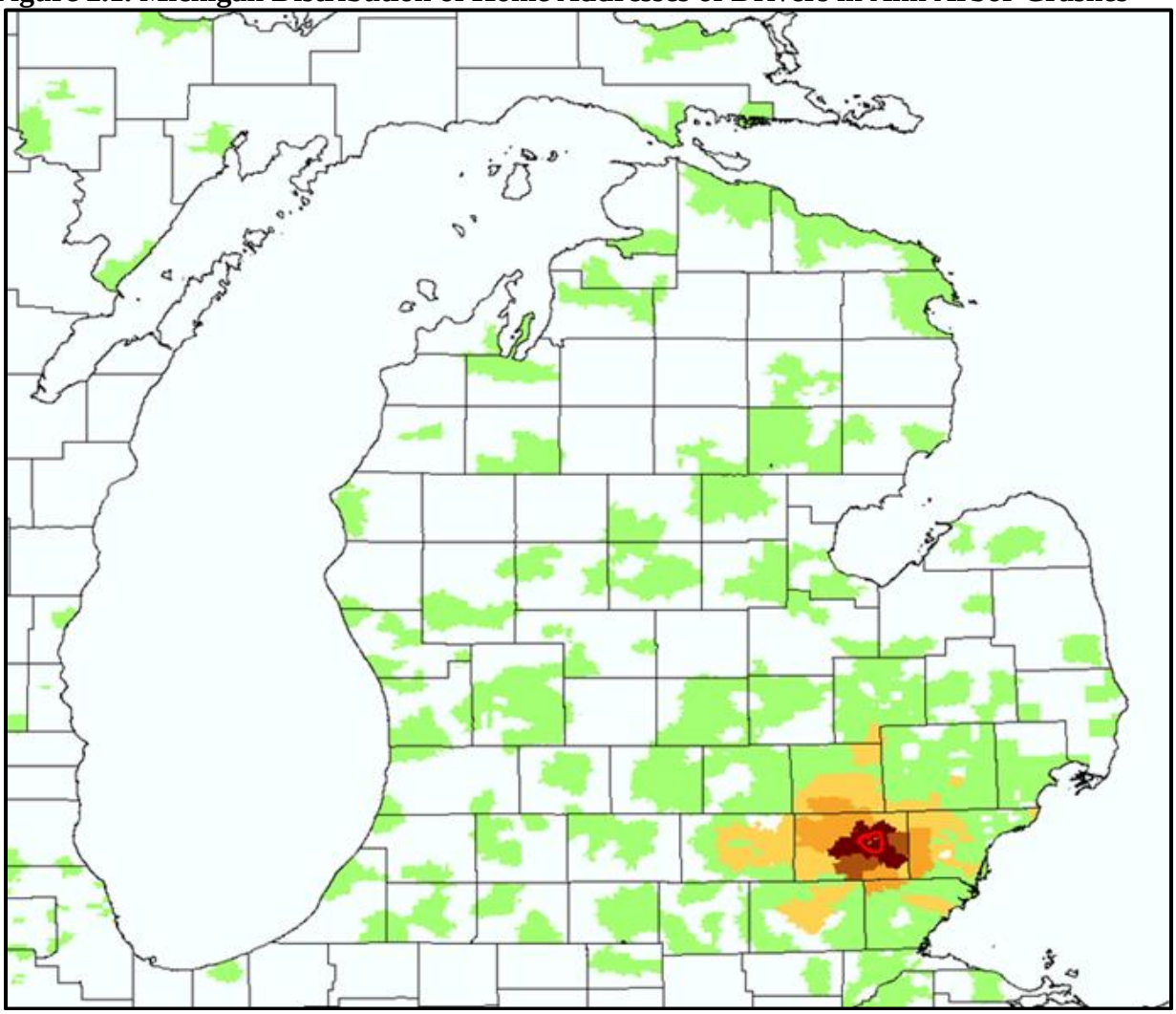
It should not be a surprise that U.S. Census data does not resemble the driving population within any community. People have automobiles so that they can travel beyond their own neighborhood, and in doing so they render Census data as an invalid measure of the driving population in any given place. Ann Arbor is no exception. A large proportion of the community is made up of university students from across the nation who only reside in Ann Arbor temporarily, thus never declaring permanent residency in this community and, therefore, not being included within the community's U.S. Census data. According to materials publicly available from the University of Michigan, the university enrolls approximately 30,000 students, almost half of which are not Michigan residents. Ann Arbor also is a magnet community for academic events, the arts, entertainment, recreation, and shopping, drawing many people from across the state, the nation, and the world. The people driving within the boundaries of Ann Arbor include far more than the people who permanently live within Ann Arbor.

The Ann Arbor Police Department examined the home address zip codes of drivers involved in vehicle crashed within Ann Arbor during 2017. This examination revealed that **44.9%** of the drivers involved in vehicle crashes within Ann Arbor lived in a zip code outside of the city. This could be interpreted to mean that almost every other driver on the streets of Ann Arbor is not a permanent resident of the city, and thus not measured as a member of the Ann Arbor community within the Census data.

Figure 2.1 below is a density map of the zip code distribution of these crash drivers across the state of Michigan alone. As can be seen in this density map, people from all across the state can be found driving in Ann Arbor, and this graphic does not even include the national level of distribution of drivers found in Ann Arbor. For these reasons, an alternative to Census data must be used for a benchmark of drivers in Ann Arbor.

[22] Meehan, A. J., & Ponder, M. (2002). How roadway composition matters in analyzing police data on racial profiling. *Police Quarterly, 5(3)*, 306-333.
[23] Herbert-Martinez, K. L., & Porter, B. E. (2006). Characterizing red light runners following implementation of a photo enforcement program. *Accident Analysis & Prevention, 38*, 862-870.
[24] Grogger & Ridgeway (2006).

Figure 2.1. Michigan Distribution of Home Addresses of Drivers in Ann Arbor Crashes



Source: Jason McKinley, City of Ann Arbor
Green = 1-10 Ann Arbor crash drivers are from this zip code
Yellow = 11-30 Ann Arbor crash drivers are from this zip code
Orange = 30-100 Ann Arbor crash drivers are from this zip code
Brown = 100-224 Ann Arbor crash drivers are from this zip code
Red = 225 or more

Because of the inability of Census data to represent the driving population within any community, some researchers have attempted to conduct roadway observations in order to create a traffic stop benchmark. These roadway observations, however, have proved to have a number of significant limitations. First, conducting roadway observations is costly as they involve hiring, training, validating, and paying research assistants to conduct these roadway observations in a scientific manner.[25] Second, determining the race of passing motorists in moving vehicles requires clear

[25] Engel & Calnon (2004); Smith et al. (2017); Withrow, B. L. (2005). *Racial Profiling: From Rhetoric to Reason*. New Yorn, NY: Prentice Hall.

lines of sight, good lighting conditions, and a lack of window glare. As such, this limits the locations, times of day, and weather conditions under which these roadway observations can be made.[26] Third, the ability of research assistants to determine the actual sex, race, or ethnicity of a passing motorist traveling at a high rate of speed is questionable, and most studies using roadway observations have reported being unable to determine the race of 18-30% of the drivers observed.[27]

The current state of the art benchmark for traffic stops, therefore, has become drivers involved in vehicle crashes. Vehicle crashes are a sample, or "snapshot," of the driving population within any geographic area. Because crashes happen for a variety of contributing reasons – one's own poor driving behavior, the poor driving behavior of other drivers, weather conditions, roadway maintenance conditions, and mechanical failures – vehicle crashes are almost a random sample of the people using the roadways in a geographic area. Vehicle crashes can be used, therefore, to determine the racial composition of drivers using the roadways – the information needed as a benchmark for traffic violation stops by the police.[28]

Using drivers in vehicle crashes is a superior benchmark because it is inexpensive, not requiring employing a team of researchers to gather these data. Instead, officers simply record the sex and race of drivers as they complete their accident report forms. While roadway observations are limited by darkness and weather conditions, investigations of motor vehicle crashes continue under these conditions. While roadway observations of traffic drivers are limited to areas with clear lines of sight, traffic crashes can potentially occur anywhere and congregate in areas with the greatest traffic flow. Finally, while it is difficult to determine the sex and race of a driver passing at high speed inside a moving vehicle, officers investigating crashes interact with crash drivers face-to-face and see their driver's licenses – thus improving the accuracy of determining the driver's sex and race.[29]

Realizing the benefit of using crash data as a benchmark measure for traffic violation stops, the Ann Arbor Police Department began tracking and recording the sex and race of drivers involved in the motor vehicle crashes the department's officers investigated, beginning on January 1, 2017. As a result, for this study the Ann Arbor Police Department was able to provide data on 7,405 vehicle crashes that occurred within the boundaries of Ann Arbor. These data revealed the sex and race of each driver involved in the crashes, as well as the date, time, and locations of the crashes, so that these data could be disaggregated geographically to the district level, or temporally to the time of day.

Table 2.1 compares the demographic makeup of the residents of Ann Arbor, as reported by the U.S. Census Bureau for 2017, with the racial composition of the drivers involved in crashes on the roadways of Ann Arbor during 2017. While males, for example, constitute 50% of the population of Ann Arbor, the crash data suggests that almost 52% of the drivers on Ann Arbor roadways are

[26] Ibid.
[27] Meehan & Ponder (2002); Lange, J. E., Johnson, M. B., & Voas, R. B. (2005). Testing the racial profiling hypothesis for seemingly disparate traffic stops on the New Jersey turnpike. *Justice Quarterly, 22(2)*, 194-223.
[28] Alpert, G. P., Smith, M. R., & Dunham, R. G. (2004). Toward a better benchmark: assessing the utility of not-at-fault traffic crash data in racial profiling research. Justice Research and Policy, 6(1), 43-69; Smith et al. (2017); Withrow, B. L., & Williams, H. (2015). Proposing a benchmark based on vehicle collision data in racial profiling research. *Criminal Justice Review, 40(4)*, 449-469.
[29] Alpert et al. (2004); Smith et al. (2017); Withrow & Williams (2015).

male. Likewise, while non-Hispanic whites (simply referred to as "whites" from here on) make up almost 69% of the Ann Arbor population, while the crash data suggests that 78% of drivers on Ann Arbor roadways are white.

Table 2.1 Comparison of Census to Crash Driver Data

	2017 U.S. Census Data Estimate of Ann Arbor (N = 121,477)	2017 Drivers in Crashes within Ann Arbor (N = 7,405)
Sex		
Female	50.0%	48.4%
Male	50.0%	51.6%
Race / Ethnicity		
White or Caucasian (Non-Hispanic)	68.7%	78.1%
African-American or Black (Non-Hispanic)	7.3%	11.9%
Asian or Pacific Islander (Non-Hispanic)	15.7%	7.5%
All other groups (including Hispanics, Native Americans, and multiracial)	8.3%	2.5%

This comparison demonstrates, yet again, the fallacy of using U.S. Census data as a benchmark for traffic violation stops. Males are 4% more likely to be driving on the roadways than expected based on their representation among the Census data population. Whites are almost 14% more likely to be driving on Ann Arbor's roadways than expected based on their representation among the Census data population. African-Americans are 63% more likely to be driving on Ann Arbor's roadways than expected based on their representation among the Census data population. Asian-Americans and Pacific Islanders are 52% *less likely* to be driving on Ann Arbor's roadways than expected based on their representation among the Census data population. These crash data will serve as the benchmark for examining stops for traffic violations made by officers of the Ann Arbor Police Department during calendar year 2017.

Criminal Investigative Stop Benchmark

Observing a traffic violation is not the only legal justification police officers in Ann Arbor have for stopping a motor vehicle. The Fourth Amendment to the U.S. Constitution grants law enforcement officers the legal authority to seize individuals and search their belongings when probable cause exists that these individuals have committed a crime. Probable cause is defined as sufficient reason, based upon known facts, to believe a crime has been committed, and is sufficient evidence for a law enforcement officer to make an arrest without a warrant.[30] Therefore, when an Ann Arbor police officer observes a vehicle occupant commit a criminal act, or a victim or witness

[30] Handler, J. G. (1994). *Ballentine's Law Dictionary*. Albany, NY: Delmar.

to a crime identifies to the officer that a vehicle occupant has committed a crime, the police officer may immediately stop and detain that vehicle. In such a situation, the officer does not need to wait for the vehicle to first violate a traffic law before stopping the vehicle.

Law enforcement officers may also stop vehicles based on reasonable suspicion of criminal activity. Under the authority of the U.S. Supreme Court ruling in the case of *Terry v. Ohio*, when law enforcement officers have reasonable suspicion to believe that a driver has committed a violation of a traffic law, they may stop the vehicle, temporarily detain all of its occupants, and investigate the potential criminal violation.[31] Reasonable suspicion is a lower standard of proof than probable cause, and is defined as suspicion that an individual is engaged in a crime based on clearly articulable facts (not a mere hunch) and a totality of the circumstances viewed from the officer's perspective.[32] A common example of a stop based on reasonable suspicion is stopping a vehicle that matches the description of one recently used in the commission of a nearby crime.

Imagine an officer hears a radio broadcast that an armed robbery has just occurred at a convenience store about 20 blocks away. The radio broadcast indicates a white male in a green sweatshirt robbed the store at gunpoint and fled the scene in a blue Honda Civic or Accord that was driven by an accomplice. Moments later, the officer sees a blue Honda Accord pass by with two white males inside, and the passenger of the car is wearing a green sweatshirt. As the car passes the officer, the officer sees both vehicle occupants staring at her. As the officer follows the car, she observes it make numerous turns down side streets. The passenger is turned around in his seat, watching her patrol car through the back window of the Honda. While the officer may still elect to wait until she observes a valid traffic violation before stopping the vehicle, the officer could also legally stop the car at this point based on reasonable suspicion alone. These individuals may, or may not, be the armed robbers, but enough articulable facts exist (nervous behavior and race, sex, clothing, and vehicle match) to permit an investigative stop.

The legal justification and motivation for stops on criminal investigative purposes, therefore, are unassociated with traffic violations and strictly associated with criminal violations. As a result, those who should be legally and ethically at risk for criminal investigative stops would be those individuals found committing crimes within Ann Arbor, not the general population of persons found driving within Ann Arbor. A crime-specific benchmark is needed for an analysis of criminal investigative stops conducted by the Ann Arbor Police Department. As was the case with the benchmark for traffic violation stops, U.S. Census data use is inappropriate for the same reasons. Not everyone found committing crimes within Ann Arbor has a permanent residence within Ann Arbor. An unknown number of persons committing crimes in Ann Arbor came from outside the community, so U.S. Census data may not reflect the sex, race, and ethnic composition of these criminal offenders.

Criminal arrest data is also inappropriate for use as a criminal investigative stop benchmark. The purpose of this study is to explore for racial disparities in stops that might suggest biased policing against a particular group. If officers were to act prejudicially against a particular group in their enforcement actions, then that group would be overrepresented among arrests due to this prejudice, not necessarily because of a higher representation among offenders. Because of the possibility that

[31] *Terry v. Ohio*, 392 U.S. 1 (1968).
[32] Handler (1994).

officers could be biased in their arrests, using arrests as a benchmark would present a tautological error.

Crime victims' descriptions of criminal suspects, therefore, were used as the benchmark for criminal investigative stops in this study. When a crime is reported to the police by a member of the public, oftentimes the victim or a witness is able to provide a physical description of the offender, or offenders, involved. All crime reports taken by the Ann Arbor Police Department during 2017 were examined for cases that included suspect physical description information from a witness or victim. Members of the public reported physical descriptions involving sex and race of 4,749 criminal suspects to the Ann Arbor Police Department during 2017. As these suspect descriptions can be disaggregated by police district and time of day, these descriptions served as the benchmark for criminal investigative stops within this study.

Table 2.2 Comparison of Census to Crime Witness Descriptions of Suspects Data

	2017 Census Data Estimate of Ann Arbor (N = 121,477)	**2017 Criminal Suspect Descriptions within Ann Arbor (N = 4,749)**
Sex		
Female	50.0%	26.4%
Male	50.0%	73.6%
Race / Ethnicity		
White or Caucasian (Non-Hispanic)	68.7%	48.7%
African-American or Black (Non-Hispanic)	7.3%	40.5%
Asian or Pacific Islander (Non-Hispanic)	15.7%	1.5%
All other groups (including Hispanics, Native Americans, and multiracial)	8.3%	9.3%

Table 2.2 compares the criminal suspect descriptions provided by members of the public in Ann Arbor, with the descriptions of the permanent residents of Ann Arbor as reported by the U.S. Census Bureau. Yet again, a comparison with Census statistics reveals the inappropriateness of such data as a benchmark representation of the offenders the people in Ann Arbor are reporting to the police. Males were 47% more likely to be reported as criminal offender suspects than their representation among Ann Arbor residents would predict. African-Americans were 455% more likely to be reported as criminal offender suspects than their representation among Ann Arbor residents would predict. Finally, Asian-Americans and Pacific Islanders are 90% *less likely* to be reported as criminal offender suspects than their representation among Ann Arbor residents would predict. These pronounced differences should not be surprising when one considers the fluidity of

people passing through Ann Arbor for a multitude of reasons, and its proximity to Detroit, the nation's twenty-first largest city.

Group Classification

As the crux of this analysis is the determination of whether or not members of different sex or racial groups receive disparate treatment in vehicle stops made by the Ann Arbor Police Department, group classification is important. Unfortunately, the various records systems used as data sources for this project used different racial and ethnic coding schemes. This lack of conformity in race classifications required some minor reclassification so that all of the data sources used the same race classification scheme.

Data collected regarding drivers involved in crashes, and descriptions of suspects in reported crimes, used the official coding racial and ethnic coding schemes developed by anthropologists, used widely in the social sciences, and adopted by the federal government as its standard in 1997 by the Clinton Administration. This is the classification scheme used for decades by the U.S. Census and the U.S. Department of Justice.[33] These race classifications are described by the U.S. Census Bureau as follows:

White – A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

Black or African-American – A person having origins in any of the Black racial groups of Africa.

American Indian or Alaska Native – A person having origins in any of the original peoples of North and South America (including Central America) and who maintains tribal affiliation or community attachment.

Asian – A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

Native Hawaiian or Other Pacific Islander – A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.[34]

Individuals completing federal government forms may also select 'Multiracial,' but must also select one of the above five races as a primary racial identity. Beyond these five races, federal government forms also often ask individuals to identify their ethnicity. Race is biological in nature and refers to shared physical qualities of one's ancestors generally viewed as distinct by society. This includes such biological attributes as skin pigment, hair color and texture, eye color and shape, nose shape, etc.[35] Ethnicity, on the other hand, refers to one's culture of origin, such as a common

[33] U.S. Census Bureau (2018). About Race. Washington, DC: U.S. Census Bureau. Retrieved from: https://www.census.gov/topics/population/race/about.html
[34] Ibid.
[35] American Anthropological Association (1998). *American Anthropological Association Statement on Race*. Washington, DC: American Anthropological Association.

ancestry, language, history, or nation. Hispanic / Latino / Latina is an example of one such ethnicity, as is Chinese, Arabic, or German. The U.S. Census Bureau recognizes more than one hundred different ethnicities.[36]

While the race coding scheme (but not the ethnicity coding scheme) was used for the benchmark data on criminal suspects reported by members of the public and drivers involved in crashes, a less regimented coding scheme was used for vehicle stops. As part of a regional records management agreement, records related to Ann Arbor vehicle stops are recoded and maintained by the Oakland County's Courts and Law Enforcement Management Information System (CLEMIS). CLEMIS uses its own race and ethnicity classification scheme that differs slightly from the official scheme recognized by social scientists and the federal government.

In the data for stops and crashes, the race and ethnic categories offered by CLEMIS were found to be used rather inconsistently by officers. In addition to the five race categories recognized by the U.S. Census Bureau, we found some examples of officers using the categories of 'Middle Eastern' while the Census Bureau classifies most people from the Middle East as White. Officer also occasionally used 'Hispanic' (which is an ethnicity separate from race), and 'Multiracial.' Luckily these three unrecognized racial categories occurred infrequently and appeared in less than 10% of the total vehicle stops.

It is important to note here that ***none*** of the vehicle stop cases recorded by the Ann Arbor Police Department during 2017 were missing any race or sex description data. Missing data on these key variables is a common problem within traffic stop data collection studies.[37] Furthermore, when Lamberth Consulting conducted its traffic stop data analysis in Ann Abor during 2004, almost a quarter of stop records were missing driver race or sex data at that time.[38] Clearly the completeness of the traffic stop data recorded by the Ann Arbor Police Department during 2017 is above average and markedly improved over the data completeness the department exhibited in 2004.

In order to develop a consistent and meaningful classification scheme across data sources that resembled, as much as possible, the official designations of race, the following categorizations were made in this study. Individuals were classified as 'white' if the data used the designation 'white.' Also, the few persons designated as 'Middle Eastern' were also classified as 'white' as the U.S. Census Bureau classifies most people from the Middle Eastern region as whites. Individuals were classified as 'African-American or Black' if the data used either of these titles as the race designation. Individuals were classified as 'Asian or Pacific Islander' if the data identified them as Asian-American, Native Hawaiian, or Pacific Islander. Native Hawaiian and Pacific Islander categories were merged with Asians because they were too few in number to analyze independently (less than 1% of the data in most cases), and because of many shared cultural histories across these groups.[39]

[36] Healey, J. F., Stepnick, A. (2014). *Diversity and Society: Race, Ethnicity, and Gender*. Thousand Oaks, CA: Sage.
[37] Withrow (2005).
[38] Lamberth (2004).
[39] Hazama, D. O., & Kemeiji, J. O. (2008). *The Japanese in Hawai'i: Okage Sama De*. Los Angeles, CA: Bess; Levathes, L. (1997). *When China Ruled the Seas: The Treasure Fleet of the Dragon Throne, 1405-1433*. London, UK: Oxford University Press.

This classification scheme left a small residual group of cases (less than 5% of all vehicle stops) classified as either 'Native American', 'Hispanic', 'Other', or 'Multiracial'. As each of these categorizations by themselves were too few in number to analyze with any statistical significance, they were merged together into an 'Other' category. Admittedly, this is far from a perfect solution, as individuals classified as 'Multiracial' may be very different in race and ethnicity from Native Americans or Hispanics. Nevertheless, a better option was not currently available. As a result, extreme caution should be used when drawing conclusions about disparities involving this group as any persons labelled Multiracial may very well have actually had a primary classification as white, Asian, African-American, or Native American.

Driver sex was measured as simply male or female. Regarding driver gender, we are sensitive to the current national debate on the recognition of a variety of genders. We were limited, however, to the two sex categories presented by the data.[40] All of the data sources within this analysis classified individuals as either male or female. As a result, the analysis of gender here was also limited to comparisons of only male to female categories.

Disaggregation

Many studies of racial disparities in traffic stops involve statistical aggregation bias. Aggregation bias, sometimes also referred to as 'ecological fallacy,' refers to the information distortion that occurs in the substitution of aggregate (i.e., citywide) data for micro-level (i.e., district, beat, or shift) data.[41] If more vehicle stops occur in one police district than in another, for example, and the district with more stops has more drivers of a certain race, then that racial representation will be inflated when compared to a benchmark that is measured more evenly across the city. Likewise, if more stops occur during one period of the day, and that time has more drivers of a certain race, then that racial representation will be proportionally inflated when summed together with other time periods across the day.

This statistical error is very likely when examining activity generated by law enforcement organizations due to differential deployment patterns.[42] In order to enable more efficient service delivery, most law enforcement agencies divide their jurisdiction into different geographic regions. These regions usually differ by geographic size because they are usually based on population densities and call for service demand rather than geographic area size.[43] Because they are based on population or call for service density, each geographic area tends to have unique issues with regard to crime and disorder which influence how actively officers stop vehicles.[44] In one district, for example, officers may respond to a larger number of crime and disturbance calls, having less free time to conduct traffic enforcement duties. Such a district will likely have fewer total vehicle

[40] Healey & Stepnick (2014).
[41] Clark, W. A. V., & Avery, K. L. (1976). The effects of data aggregation in statistical analysis. *Geographical Analysis, 8*, 428-438; King, G. (2015). *A Solution to the Ecological Inference Problem: Reconstructing Individual Behavior from Aggregate Data*. Princeton, NJ: Princeton University Press.
[42] Withrow, B.L. (2004). Race-based policing: A descriptive analysis of the Wichita stop study. *Police Practice and Research, 5(3)*, 223-240.
[43] Swanson, C. R., Territo, L. J., & Taylor, R. E. (2011). *Police Administration: Structures, Processes, and Behavior*. New York, NY: Pearson.
[44] Klinger, D. A. (1997). Negotiating order in patrol work: An ecological theory of police response to deviance. *Criminology, 35(2)*, 277-306.

stops than other districts, but a greater proportion of stops will be criminal investigative stops rather than traffic violation stops. If racial representation among drivers on the roadway differs from district to district, the racial representation in the district with the most stops will be over-inflated if all stops are simply summed together in a citywide analysis.

The same is true for temporal variation in both driver demographics on the road and number of vehicle stops made by the police. One recent analysis of drivers on the roadways in Grand Rapids, Michigan revealed that the proportion of African-American motorists rose dramatically during the 11:00 p.m. to 3:00 a.m. time frame. In fact, in one district within that study, African-Americans made up more than 90% of drivers from 11:00 p.m. to 3:00 a.m., but no more than 40% of drivers the rest of the day.[45] It is likely all racial groups have fluctuating representation patterns within the driving population throughout the day.

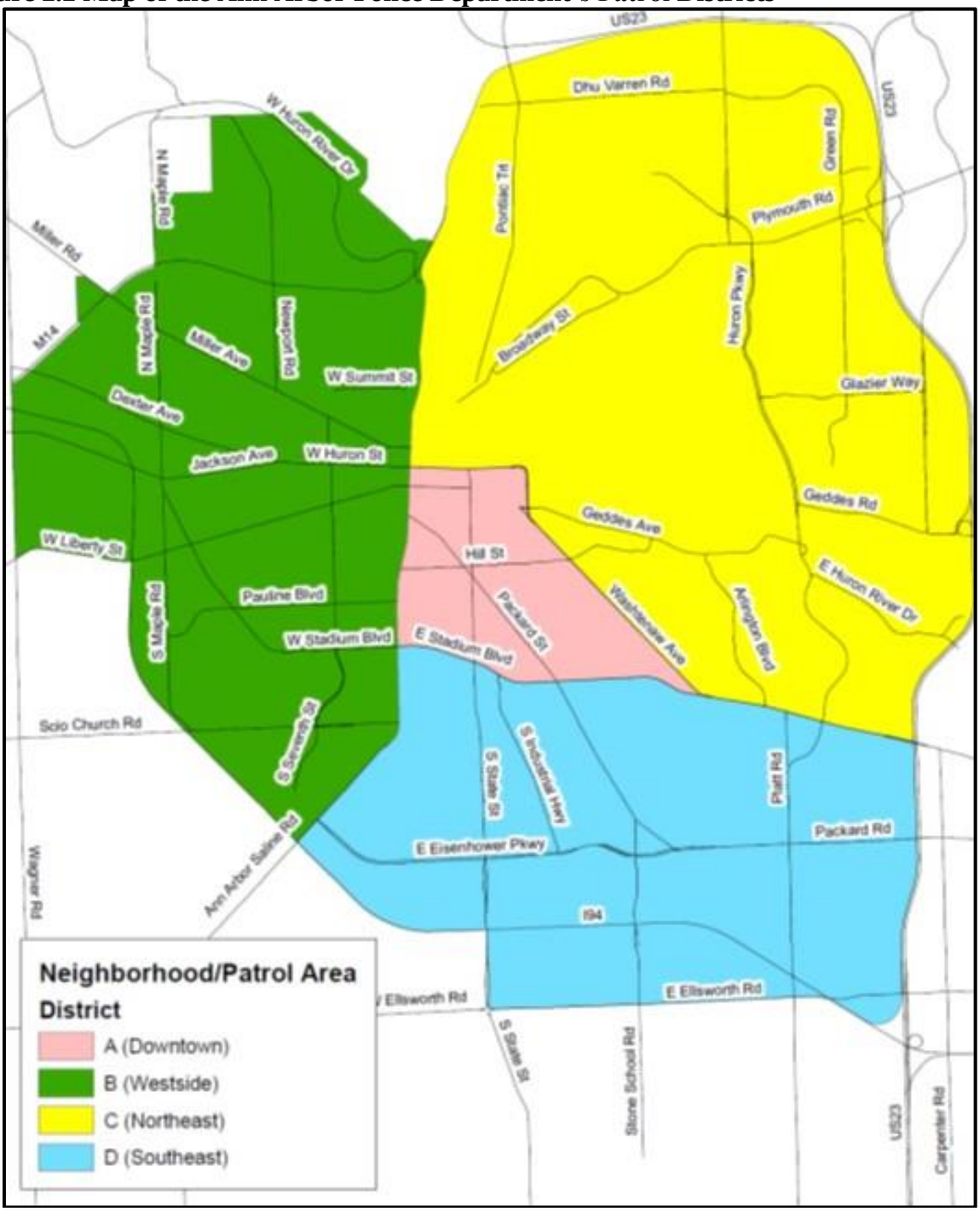
The present analysis, therefore, disaggregated (separated out) our data in several ways in order to reduce the effects of aggregation bias. First, stops for traffic violations were separated out from criminal investigative stops. Each of these two types of stops were analyzed separately and compared with its own appropriate benchmark (drivers in cashes or criminal suspect descriptions). Within each of these separate analyses, stops were disaggregated further by district and time of day. The Ann Arbor Police Department subdivides the city into four distinct geographic districts (Districts A, B, C, D). These districts vary in size from approximately 3.5 square miles, to almost 11 square miles. Each district was analyzed separately.

Figure 2.2 is a map of the City of Ann Arbor, with the boundaries of these four these districts delineated. Within each district there are smaller geographical patrol assignments (often called 'beats' in police vernacular), and examining stops down to this beat level would have likely further reduced the problem of aggregation bias. Unfortunately, however, the very small number of cases available for analysis at the beat level (only a couple of stops per day) prevented such an analysis, especially after disaggregating by time of day. If we had aggregated further, down to the beat level, some beats would have no stops during certain times of day, and no crashes to use as a benchmark for these stops. Statistical significance would also be difficult to compute with such small samples for analysis. Therefore, geographic disaggregation was limited to only the district level.

Each district was further disaggregated, however, by time of day. Disaggregating by each hour of the day would have, again, created the same statistical barriers as were encountered if we had aggregated down to the beat level – too few cases to analyze statistically. Instead, stops for traffic violations were disaggregated by four, 6-hour blocks of time, beginning at the start of the earliest commuter rush for persons who start work at 6:00 a.m. Therefore, traffic violation stops within each district were disaggregated to the time blocks of 5:01 a.m. to 11:00 a.m., 11:01 a.m. to 5:00 p.m., 5:01 p.m. to 11:00 p.m., and 11:01 p.m. to 5:00 a.m.

[45] Lamberth, J. (2017). *Grand Rapids Implicit Bias Training and Traffic Stop Analysis*. Philadelphia, PA: Lamberth Consulting.

Figure 2.2 Map of the Ann Arbor Police Department's Patrol Districts



Dividing the day into these four time blocks also made intuitive sense as these time blocks correspond with common daily social life activities. The 5:01 a.m. to 11:00 a.m. period represents the time when a majority of people travel to work or school. The 11:01 a.m. to 5:00 p.m. period represents when a majority of people are performing their primary daily activity, such as work,

schooling, or childcare. The 5:01 p.m. to 11:00 p.m. period represents a majority of the population's end of day activities, such as traveling home, having dinner, and socializing time. The last period, 11:01 p.m. to 5:00 a.m. represents nightlife culture. Dividing each district's traffic violation stops by these four time blocks still left us with enough cases to statistically analyze, and it reduced some of the effects of aggregation bias.

When examining criminal investigative stops, however, there were far fewer stops to analyze. As a result, it was necessary to only disaggregate these stops by district and two 12-hour blocks of time. These two blocks of time consisted of a daytime block from 5:01 a.m. to 5:00 p.m., and an evening / night block from 5:01 p.m. to 5:00 a.m. Dividing each district's criminal investigative stops by these two time blocks still left us with enough cases to statistically analyze while still reduced some degree of aggregation bias.

Statistical Analysis

While the vehicle stops analyzed in this report include the entire population of vehicle stops made by patrol officers with the Ann Arbor Police Department during 2017, the benchmark data used (crash drivers or criminal suspect descriptions) are only samples, not the entire population of all drivers and all criminal suspects. Crash drivers are used as a representation of drivers found on the roadways of Ann Arbor, but these crash drivers do not constitute *every* the driver on the roadways of Ann Arbor, only a representative *sample* of those drivers. Likewise, the descriptions of criminal suspects reported to the police by members of the public are used as a benchmark comparison for those committing crimes within Ann Arbor. These criminal suspects do not constitute *all* persons committing crimes within Ann Arbor, only a representative *sample* of the people committing crimes within Ann Arbor.

As these are only samples, it is inherent that they contain some measure of sampling error because they do not include every case in the population.[46] As a simple illustration, we know that approximately 50% of the U.S. population is female. If we did not know that, but we surveyed a random sample of 3 individuals about their sex, the laws of probability tell us we would get either 0 males and 3 females (100% female), 1 male and 2 females (66% female), 2 males and 1 female (33% female), or 3 males and 0 females (0% female). First, because of this small sample size, it is impossible to achieve the actual correct answer of 50% female. Furthermore, while the odds are highest that we would find 2 males and 1 female (33% female), or 1 male and 2 females (66% female), it is still possible that we could get no females (0% female) or 3 females (100% female) simply by chance.

While this was a simplified example used for clarity of explanation, and larger samples tend to help reduce the amount of sampling error, all samples continue to have sampling error to some degree. In other words, if we have a sample of 7,000 drivers in crashes out of a population of 1,000,000 people who drove within Ann Arbor during the year, and 12% of crash drivers were found to be African-American, then it is likely that *around* 12% of all the drivers who drove in Ann Arbor that year were African-Americans, but it is still possible our sample had a few

[46] Blalock, H. M. (1979). *Social Statistics*. New York, NY: McGraw-Hill; Henry, G. T. (1990). *Practical Sampling: Applied Social Research Methods*. Los Angeles, CA: Sage.

percentage points more, or a few less, African-American drivers than were in the actual large population of 1 million drivers.

To resolve the issue of sampling error, social scientists use statistical techniques. Statistical tests, based on the mathematics of random sampling, can estimate the degree of likelihood our sample matches that of the population being studied. Recall that in our example of trying to determine the proportion of women in the U.S., we used an extremely small sample of 3 individuals. If we increased our sample size to 10 randomly selected individuals, two changes would occur. First, being an even number, a sample of 10 would allow us the possibility of actually finding a 50-50% outcome, just like in the real population. Second, the larger sample size increases the odds we would get a result closer to the real outcome in the population. There is still a possibility of, by chance alone, drawing a random sample that includes zero, 1, 2, 3, 7, 8, 9, or 10 females. While drawing such a sample is less likely, it is still possible. The likelihood, or odds, have increased, however, that out sample would have 4 females (40%), 5 females (50%), or 6 females (60%), since 50% is the real distribution in the population from which we are sampling.

Statistical tests can tell us, based on our sample size and the number of categories we are examining (2 in this example – male and female), how likely the proportion of females we found in our sample is actually the true proportion. The bigger the sample gets, the greater confidence we can have in our sample, as if we drew a sample of 100, rather than 10, we would have even more opportunities to get a result closer to 50% female. The problem remains, however, that if we drew thousands of random samples, we would still occasionally end up getting unusual samples with small or overly large percentages of women simply by chance. Based on the mathematical laws of probability, statistical tests can estimate how confident we can be that our sample represents the real truth found within the population.

When using such statistical tests, researchers must select a level of error they are willing to tolerate with regard to statistical significance. For example, if we used a sample of 10 people and found that 30% were female, how confident would you like to be before making a public statement that the U.S. population is 30% female? Would you be willing to make this statement if you were 51% sure (meaning there is a 49% chance your sample was wrong)? How about 90% sure (still meaning there is a 10% chance your sample is wrong)? Because biased policing is such a serious issue, in the present study we elected to use the standard of 99.9% sure, meaning there is only a 0.1% chance (a 1 in 1,000 chance) that any statistically significant racial disparities found were the result of an imperfect sample. In other words, we can be 99.9% sure that any racial disparities that were found to be statistically significant are real disparities that exist, and not a result of sampling error.

In addition to selecting a 99.9% confidence level, the statistical test we selected in this analysis was the binomial test. The binomial test is used to determine whether there is a statistically significant difference between the known proportion in the population and the observed proportion in the sample.

In other words, we know what percentage of all traffic violation stops made by the Ann Arbor Police Department were of African-American drivers. This is not a sample, it is the true population of all stops that were conducted. What we want to know is how close does this compare to our benchmark *sample* of drivers involved in crashes in Ann Arbor? These crash drivers are a good

representation of the drivers on the roadways of Ann Arbor, but because this is only a sample, it is not a perfect representation of the driving population. The proportion of crash drivers that were African-Americans is probably close to the actual proportion of drivers on the roadway that were African-American, but not the exact proportion. Therefore the proportion of stops that were African-American drivers and the proportion of crash drivers that were African-American probably would never be a perfect match due to sampling error alone, much less other factors that might cause disparities.

The binomial test involves a mathematical calculation that considers the degree of difference between the percentage of African-Americans occurring in the stops, and the percentage of African-American drivers occurring in the benchmark sample. The binomial test also considers the sample size in its calculation, as larger samples tend to have less sampling error than smaller samples. Finally, the binomial test considers the confidence level we have selected (in this case 99.9% confident of our results). Using these three pieces of information, the binomial test can reveal if any proportional differences between the stops and the benchmark for any demographic group is within the margin of error for sampling error, or is a large enough disparity to warrant our concern.[47]

As our concern here is that particular demographic groups might be targeted for higher rates of stopping based on their sex or race, we only employed a one-tailed test of the binomial distribution. This means we only explored if a group was "over stopped" compared to the groups representation within the benchmark. We did not address whether or not a group was "under stopped." The reason for avoiding any discussion of "under stopping" is it might lead to the conclusion that any demographic group should become the target of more aggressive enforcement based on that groups' sex or race. For example, several times we found that the percentage of stops that were African-American drivers was far lower than one would expect based on the benchmark for that district and time of day. What should officers do in response to that under-stopping disparity? Should officers concentrate on trying to find and stop more African-American drivers in order bring stops of this group closer to the benchmark measure? We believe most people would answer "no" to this question. Therefore we only explored whether or not a group was "over stopped" when compared to the benchmark.

It is important to also note that there is a lack of agreement among statisticians about what sample sizes are best for using the binomial test. While statisticians agree that a different test, Pearson's Chi-square test, is better suited for comparing percentages between a population and a larger sample, statisticians do not agree on what constitutes the cutoff between a large and small sample.[48] In order to ensure that the right test was conducted, all of the binomial test calculations conducted within this study were repeated using the Chi-square test. In every case, the Chi-square tests produced the same outcomes as the binomial tests. In other words, if the binomial test suggested that a disparity between the benchmark and the stops was statistically significant, the Chi-square test did as well, and vice versa.

[47] Blalock (1979); Ritchey, F. (2007). *The Statistical Imagination: Elementary Statistics for the Social Sciences*. New York, NY: McGraw Hill.
[48] Howell, D. C. (2007). *Statistical Methods for Psychology*. Belmont, CA: Thomson; Ritchey (2007).

When statistically significant disparities were detected, a second step was taken in order to determine the consistency of this pattern. In other words, was this a persistent occurrence, or an isolated event? When statistically significant disparities were found, the proportion of stops involving that group for that district and time of day was then graphed by month across the year. The proportion of that group in the benchmark for that district and time of day was also graphed by month across the year alongside the stops graph. This allowed us to examine when the proportion of stops involving that group dramatically exceeded the benchmark for that group. We examined if this disparity was a trend across all twelve months – indicating a routine practice of bias by officers – or was a sporadic event – suggesting the possibility of other factors contributing to this disparity.

Finally, when statistically significant disparities were discovered, we attempted to quantify the actual, substantive human impact of these disparities. We sought to determine how many more human beings were subjected to stops by the police than would have been expected based on the benchmark. This allowed us to speak to the human cost of persons stopped and detained.

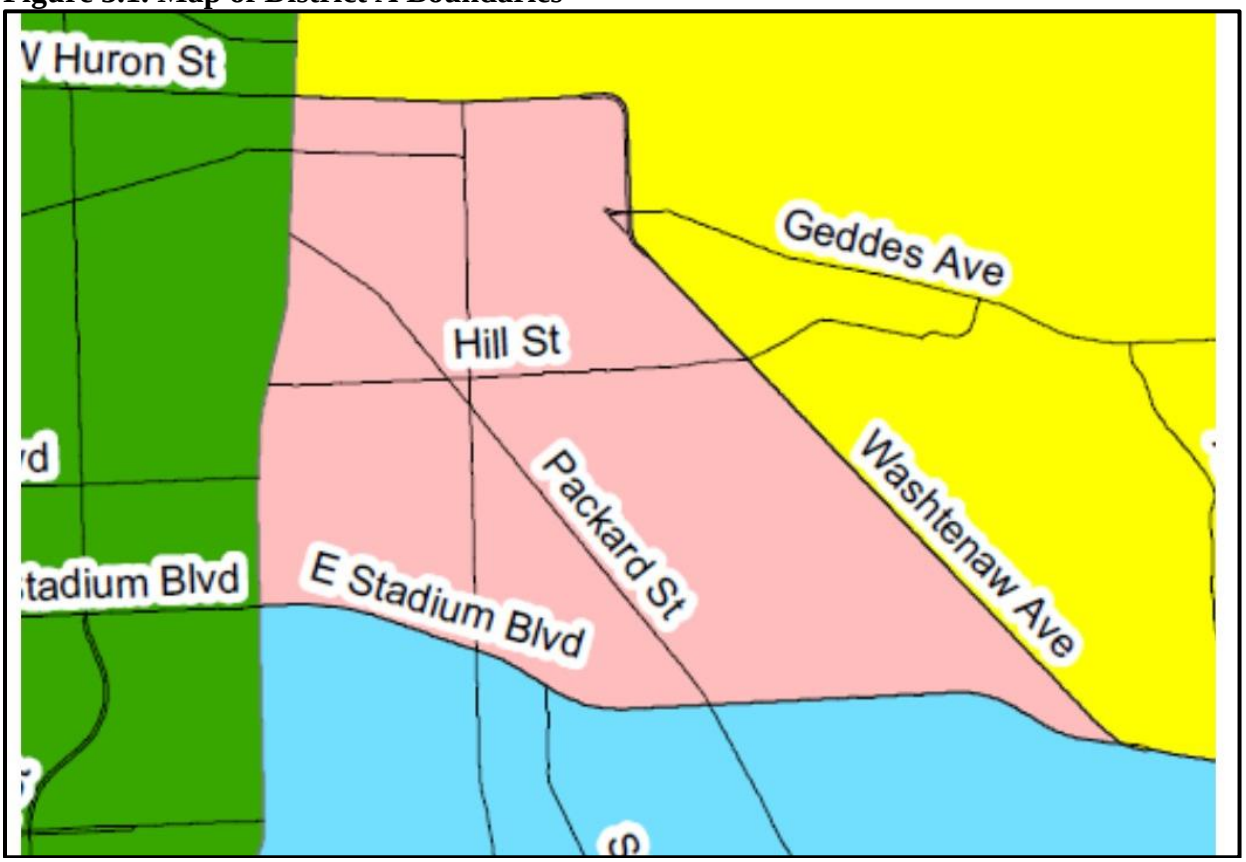
Summary

In this section we described in detail the methods used in this analysis of vehicle stops conducted by the Ann Arbor Police Department. These methods are the current practices agreed upon by the social scientific community studying this social issue. In the following sections we will reveal four findings by each of the four police patrol districts within the city.

PART III. DISTRICT A (DOWNTOWN)

District A is the downtown district. It is the smallest district geographically, encompassing about one eighth of the city's square mileage. District A is bordered on the north by East Huron Street, on the east by Washtenaw Avenue, on the south by East Stadium Boulevard, and on the west by South Main Street. The area within District A is dominated by the University of Michigan's main campus, and the downtown office and business district. The university, business, and office activities contribute to the racial and gender diversity of the drivers on the roadways of District A, and attract many people from outside of the district.

Figure 3.1. Map of District A Boundaries



During 2017, officers of the Ann Arbor Police Department made 2,505 vehicle stops for traffic violations, and 76 criminal investigative vehicle stops, within District A. The benchmark measures for District A consisted of 1,412 drivers involved in crashes within the district, and victim-witness descriptions of 1,699 criminal suspects reported within District A. As described earlier, the stops for traffic violations were disaggregated by time of day (by four, 6-hour time blocks), and compared to the crash driver benchmark – also disaggregated by time of day. Stops for criminal investigatory purposes, because they were far fewer in number, were disaggregated by only two, 12-hour time blocks, and compared to the criminal suspect benchmark, disaggregated by time of

day. Stops were examined by sex, and then by each race category, in order to determine if there was any individual group was stopped disproportionately to their representation expected by the relevant benchmark.

If a group was found to be disproportionately *more* likely to be stopped than expected based on the benchmark for those stops, such a finding would warrant further investigation. When such outcomes were encountered, analysis delved further and examined this disparity by month of the year in order to determine if this stop disparity is a consistent pattern of behavior, or an outcome that was an isolated event.

Stops of Male Drivers

The vast majority of the existing social scientific research on sex disparities in police vehicle stops has revealed male drivers are significantly more likely to be stopped than female drivers.[49] This may be due in part to differences in driving aggressiveness. Per mile driven, males are 119% more likely than females to be involved in a fatal motor vehicle crash.[50] Observational research of drivers has also consistently revealed a higher proportion of male drivers speed as compared to female drivers, and male speeders tend to travel at higher speeds than do female speeders.[51]

Disproportionate stopping of males that has been found in numerous studies may also be related to sex differences in rates of criminal offending. Surveys of the public have revealed that, compared to females, males are roughly 600% more likely to have admitted committing a theft, 165% more likely to have used illegal drugs, 780% more likely to have sold illegal drugs, 540% more likely to have committed robbery, and 1,000% more likely to have committed an assault.[52]

Stops of Males for Traffic Violations

During 2017, Ann Arbor officers performed 2,505 stops for traffic violations within District A. Of these stops, 1,559 involved a male driver. That same year, 1,412 vehicles were involved in motor vehicle crashes within District A, 782 of which had been driven by a male driver. Table 3.1 displays the data on the traffic violation stops of males that occurred within District A during 2017. The first column of this table lists the four, 6-hour time blocks used for disaggregation. The second column involves the percentage of male drivers actually stopped. Within this column, the numbers in parentheses indicate the actual number of males stopped out of the total number of traffic violation stops that occurred within that district and time block. The third column involves the

[49] Farrell, A. (2015). Explaining leniency: organizational predictors of the differential treatment of men and women in traffic stops. *Crime and Delinquency, 61*, 509-537; Norvich, M., Kringen, A. L., & Hunt, G. (2018). "They can't search her": How gender imbalances in the police force contrinute to perceptions of procedural unfairness. *Feminist Criminology, 13(3)*, 260-286; Ryan, M. E. (2016). Frisky business: race, gender, and police activity during traffic stops. *European Journal of Law and Economics, 41*, 65-83.

[50] Braver, E. A. (2003). Race, Hispanic origin, and socioeconomic status in relation to motor vehicle occupant death rates and risk factors among adults. *Accident Analysis and Prevention, 35(3)*, 295-309.

[51] Engel, R. S., Calnon, J. M., Tillyer, R., Johnson, R. R., Liu, L., Wang, X. (2005). *Project on Police-Citizen Contacts: Year 2 Final Report*. Cincinnati, OH: University of Cincinnati; Smith, W., Tomaskovic-Devey, D., Zingraff, M., Mason, H., Warren, P., & Wright, C. (2004). *The North Carolina Highway Traffic Study*. Washington, DC: National Institute of Justice; Tillyer, R. & Engel, R. S. (2012). Racial differences in speeding patterns: exploring the differential offending hypothesis. *Journal of Criminal Justice, 40*, 285-295.

[52] Felson, R. B., Deane, G., Armstrong, D. P. (2008). Do theories of crime and violence explain race differences in delinquency? *Social Science Research, 37*, 624-641.

benchmark of drivers in crashes within District A, and the percentage of those drivers that were male by time block. The numbers in parentheses indicate the actual number of male crash drivers out of the total number of crashes that occurred within that district and time block.

The fourth column reveals the percentage difference between the stops made and the benchmark for these stops. A positive number means stops were at a proportion higher than the benchmark, and negative numbers mean stops were at a rate lower than the benchmark. The final column indicates whether or not any differences between the proportion stopped and the proportion in the benchmark are true statistically significant differences, and not simply the result of sampling error. Time blocks that produces statistically significant disparities will be highlighted in yellow.

As was described earlier, the binomial statistical test was used to account for the fact that the benchmark was based on a sample. As a result of being a sample, it has some level of sampling error that prevents it from perfectly representing the driving population. A one-tailed test was performed in each case, as our concern rests in whether or not a particular demographic group is disproportionately stopped *more* often than was expected, not less. Some degree of disparity between the benchmark and the actual drivers stopped is likely to occur due to this sampling error. The binomial test accounts for the amount of anticipated sampling error in the sample size. Using a confidence level of 99.9%, if any positive disparity is found to be statistically significant by the binomial test, then we can be 99.9% confident this is a real difference between the proportion of drivers stopped and the proportion of drivers expected based on the benchmark, not a result of sampling error.

It is important to remind the reader that statistically significant disparity is not necessarily evidence of biased policing. To be sure, statistically significant disparities need to be examined closely, and biased policing activity is one potential cause of disparity, especially if disparities are consistent across place and time. In other words, disparities in the form of being stopped more than expected should cause one to investigate further to determine if biased policing is the cause, or if some legitimate explanation is the cause.

As Table 3.1 reveals, no statistically significant disparities were found by driver sex for the 5:01 a.m. to 11:00 a.m. time block, or the 11:01 a.m. to 5:00 p.m. time block for District A. This is unlike the vast majority of previous studies of stop disparities in police traffic stops, which consistently reveal males being stopped disproportionately more often than females.[53] In the 5:01 p.m. to 11:00 p.m. time slot, however, traffic violation stops of male drivers were 9.2 percentage points higher than the benchmark measure of traffic crash drivers would predict, and this disparity was statistically significant. The 11:01 p.m. to 5:00 a.m. time slot saw traffic violation stops of male drivers 13.1 percentage points higher than the benchmark measure would have predicted, and this disparity too was statistically significant. This result demanded further investigation.

[53] Farrell (2015); Norvich et al. (2018); Ryan (2016).

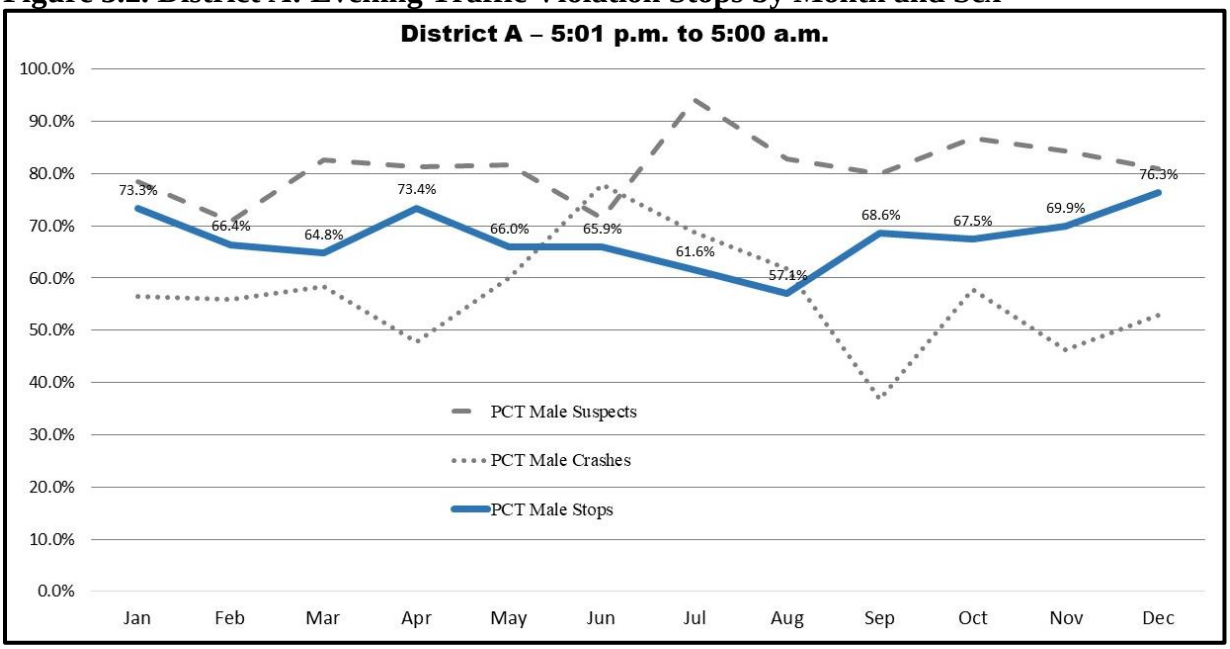
Table 3.1. District A: Male Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	54.5% (243 out of 446 total drivers)	54.2% (156 out of 288 total crash drivers)	+0.3	No
11:01 a.m. – 5:00 p.m.	54.2% (354 out of 653 total drivers)	55.4% (322 out of 581 total crash drivers)	-1.2	No
5:01 p.m. – 11:00 p.m.	64.0% (530 out of 828 total drivers)	54.8% (242 out of 442 total crash drivers)	+9.2	**YES**
11:01 p.m. – 5:00 a.m.	74.7% (432 out pf 578 total drivers)	61.4% (62 out of 101 total crash drivers)	+13.1	**YES**

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

The percentage of District A's traffic violation stops for males within these two consecutive time periods were graphed across the twelve months of the year. This was done to examine whether the stop disparity of males in District A from 5:01 p.m. to 5:00 a.m. was a consistent pattern of police practice or an inconsistent event. This graph is displayed in Figure 3.2 below. Overlaid atop this graph is also the percentage of male crash drivers, and the percentage of criminal suspects who were male, by month within District A during these times of day (5:01 p.m. to 5:00 a.m.). This graph revealed several things.

Figure 3.2. District A: Evening Traffic Violation Stops by Month and Sex



First, it reveals the disparity of stops of male drivers was not a consistent pattern as it fluctuated from month to month. The three months with the highest disparities were December, April, and January. Three months with no disparities were May, June, July, and August. Interestingly, male drivers were stopped for traffic violations at disproportionately high rates, as compared to male drivers involved in crashes, during the same time period corresponding to the fall and winter terms at the University of Michigan. During the months when a majority of the undergraduate students were away, this disparity in the stops of males disappeared. While we can be 99.9% confident that disparities occurred during the months of January through April, and September through December, we cannot be sure of what caused these male disparities.

Second, note that in Figure 3.2 the dashed line representing the percentage of criminal suspects who were male, by month, is consistently higher than the proportion of traffic violation stops that were male. During the 5:01 p.m. to 5:00 a.m. time period in District A, criminal suspects fluctuated between a low of 72% male and a high of 95% male. Perhaps some of these traffic violation stops were, in fact, stops in which the officers involved relied on a traffic violation for justification with the true motive of investigating for criminal activity.

In the case of *Whren v. United States* (1996), the U.S. Supreme court ruled that conducting a valid stop of a driver for a true traffic violation as a cause for investigating criminal activity is legal.[54] Officers may have enough facts and circumstances to legally justify a stop based on the legal standard of reasonable suspicion, but they may still be reluctant to stop a vehicle in case this proves to be the wrong vehicle.

In the Part II Methodology section above, we used an illustration of an officer observing a vehicle and its passenger that match the description of a recent nearby armed robbery suspect. This physical description fit the person and vehicle the officer observed, but it was also a vague description that might have matched several persons within the city at that time. If she elects to stop the vehicle based on reasonable suspicion alone, and it turns out that she has stopped the wrong vehicle, the occupants of the vehicle might not understand the situation. They were stopped because of their car, their clothing, and their physical appearance, not because they did anything wrong. They may be more likely to become offended and develop a lower sense of legitimacy in the police.

As a result, officers might be more likely to wait for an observed traffic violation before stopping vehicles that they already could have legitimately stopped for a criminal investigatory reason. The traffic violation stops of males within District A, therefore, may actually include an unknown number of stops that were really criminal investigative in nature, not simply for traffic safety purposes.

Three facts support this possibility. First, the proportion of males stopped for traffic violations never exceeded the benchmark for the proportion of males who were criminal suspects in District A from 5:01 p.m. through 5:00 a.m. In other words, if criminal suspects had been used as the benchmark, then there would have been no statistically significant stops disparities for male traffic violation stops. Second, this male stop disparity occurred during the hours of the day that correspond with increased reports of crime. Crime, especially violent crime, routinely increases

[54] *Whren v. United States*, 517 U.S. 806 (1996).

during the late afternoon and subsides during the early morning hours.[55] Third, when the purely criminal investigative stops were examined (to be described in much greater detail below), no statistically significant racial disparities were revealed. This suggested that more criminal investigative stops of males could have been made before any statistically significant sex disparities occurred. What this theory does not explain, however, was why these male traffic violation stop disparities only coincided with the months of the primary academic year for the University of Michigan, the primary event hub of District A.

One should also ask about the substantive significance of these disparities. In other words, approximately how many actual people were impacted by these disparities? In District A, between the hours of 5:01 p.m. and 5:00 a.m., officers made 1,406 vehicle stops for traffic violation reasons. Of these stops, 962 (68.4%) involved a male driver. According to the benchmark of drivers involved in crashes during this same 12-hour period of each day, 56% of the drivers stopped were expected to have been male. Since there were 1,406 stops made, 56% would have predicted 787 stops of males rather than the 962 that actually occurred. Subtracting 787 from 962 reveals that 175 more male drivers were stopped in District A during 2017 than would have been expected based on male involvement in vehicle crashes. As this disparity was concentrated in the eight months of January through April and September through December, this produces an average of approximately 22 more male drivers stopped than would have been expected during the months of the standard University of Michigan academic year. This also breaks down to an average of 1.2 more male stops than was expected each day (out of the 142 days of the months impacted). The substantive impact of this stop disparity, therefore, was mild.

Criminal Investigative Stops of Males

Next we turn to an examination of male stops for purely criminal investigative reasons within District A. During 2017, officers conducting vehicle stops within District A made 76 stops for purely criminal investigative reasons without having witnessed a traffic violation first. Of these stops, 55 involved a male driver. Members of the public also reported to the police the physical descriptions of 1,699 suspects in crimes within District A during 2017. Of these suspect descriptions, 1,366 were male. Table 3.2 displays the statistics of these stops compared to the benchmark of criminal suspect descriptions as reported by members of the public, disaggregated by two, 12-hour time blocks.

As this table reveals, there were no statistically significant disparities in stops of male drivers for purely criminal investigative reasons. During the daytime period of 5:01 a.m. to 5:00 p.m., males were actually stopped less often than expected by the benchmark of suspect descriptions. During the evening and early morning period of 5:01 p.m. to 5:00 a.m., the percentage of criminal investigative stops of males was almost identical to that of the benchmark sample measure of suspect descriptions. No evidence of statistically significant positive disparities involving male drivers was revealed regarding these types of vehicle stops within District A.

[55] Grubesic, T. H., & Mack, E. A. (2008). Spatio-temporal interaction of urban crime. *Journal of Quantitative Criminology, 24(3)*, 285-306; Ratcliffe, J. H. (2002). Aoristic signatures and the spatio-temporal analysis of high volume crime patterns. *Journal of Quantitative Criminology, 18(1)*, 23-43.

Table 3.2. District A: Male Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Male Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	55.2% (16 out of 29 total drivers)	79.2% (607 out of 766 total suspects)	-24.0	No
5:01 p.m. – 5:00 a.m.	83.0% (39 out of 47 total drivers)	81.3% (759 out of 933 total suspects)	+1.7	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Male Stops Summary

In summary, within District A, stops of males showed disparity, but only for certain types of stops during certain times of the day and certain months of the year. Furthermore, the substantive impact of this stop disparity was also relatively small. Stops for purely criminal investigative reasons, regardless of time of day, showed no evidence of bias for stopping males. Likewise, stops for traffic violations from 5:01 a.m. to 5:00 p.m., also showed no evidence of bias for stopping males. Stops from 5:01 p.m. to 5:00 a.m., however showed that males were statistically significantly more likely to be stopped than their involvement in motor vehicle crashes would have predicted. Further analysis by month of the year revealed that these stop disparities of males only occurred during the months that the University of Michigan was in normal semester session. Based on the crash driver benchmark estimate, approximately 175 more male drivers were stopped than expected. This averages out to a disparity of 22 male traffic violation stops per month (about 1 per day) within District A during the university academic year.

Stops of White Drivers

Most who have concerns about biased policing tend to assume that traffic violations by non-white drivers are targeted for stops, and violations by white drivers are more likely to be overlooked by officers.[56] This perspective simply assumes that white drivers being disproportionately stopped is an impossibility. Other scholars have argued, however, that bias-based policing has more to do with stopping people who are "out of place," such as stopping white drivers in impoverished, predominantly non-white neighborhoods on the assumption that the white drivers are there to buy drugs, purchase stolen property, or find a prostitute.[57] Since biased policing might be related to simply being of a different race than the race of those typically found in an area, stops of white drivers were also examined.

[5656] Harris, D. (1999). The stories, the statistics, and the law: Why "Driving While Black" matters. *Minnesota Law Review, 84(2),* 265–326; Harris, D. (1999). *Driving While Black: Racial Profiling on Our Nation's Highways*. New York, NY: American Civil Liberties Union.

[57] Johnson, R. R., & Morgan, M. A. (2013). Suspicion formation among police officers: an international literature review. *Criminal Justice Studies, 26(1),* 99-114; Withrow, B. L. (2004). "Driving While Different": A potential theoretical explanation for race-based policing. *Criminal Justice Policy Review, 15(3),* 344-364.

Stops of White Drivers for Traffic Violations

Out of the 2,505 traffic violation stops that occurred within District A, 1,851 involved a white driver. Of the 1,412 vehicles involved in crashes within District A, 1,090 involved a white driver. Table 3.3 displays the data on the traffic violation stops of white drivers that occurred within District A during 2017.

Just as in the earlier section addressing male drivers, the first column of this table lists the time blocks used for disaggregation. The second column involves the percentage of white drivers actually stopped, with the numbers in parentheses indicating the actual number of whites stopped out of the total number of traffic violation stops that occurred within that district and time block. The third column involves the benchmark of white drivers in crashes within District A by time block, with the numbers in parentheses indicating the actual number of white crash drivers out of the total number of crashes that occurred within time block. The fourth column reveals the percentage difference between the stops made and the benchmark for these stops. The final column indicates whether or not any differences between the proportion stopped and the proportion in the benchmark are statistically significant differences, and not simply the result of sampling error.

Table 3.3. District A: White Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	77.6% (346 out of 446 total drivers)	77.1% (222 out of 288 total crash drivers)	+0.3	No
11:01 a.m. – 5:00 p.m.	79.3% (518 out of 653 total drivers)	79.3% (461 out of 581 total crash drivers)	0.0	No
5:01 p.m. – 11:00 p.m.	74.0% (613 out of 828 total drivers)	75.6% (334 out of 442 total crash drivers)	+1.6	No
11:01 p.m. – 5:00 a.m.	64.7% (374 out of 578 total drivers)	72.3% (73 out of 101 total crash drivers)	-7.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As Table 3.3 reveals, no evidence was found to indicate white drivers were disproportionately stopped for traffic violations within District A. (No evidence was found that white drivers were greatly under-stopped either.) During each of the four, 6-hour time blocks, the percentage of traffic violation stops that were of white drivers generally conformed to the percentage of drivers in vehicle crashes that were white. Any differences were small and statistically nonsignificant, meaning these differences likely occurred due to sampling error.

Criminal Investigative Stops of White Drivers

Next, stops of white drivers for purely criminal investigatory reasons, without a traffic violation having occurred, were examined. Of the 76 criminal investigative stops that occurred within District A during 2017, 48 involved white drivers. Of the benchmark measure of 1,699 criminal suspects reported in District A, 1,026 were white. The statistics related to this examination of

criminal investigative stops are revealed in Table 3.4 below. As this table shows, statistically significant disparity in the criminal investigative stops of white drivers occurred within District A during the 5:01 a.m. to 5:00 p.m. time period. During this time period, almost 83% of the drivers in investigative stops were white, while only 62% of the criminal suspect descriptions reported by members of the public involved whites. During the evening and nighttime hours, however, no statistically significant disparity was found regarding criminal investigative stops of whites.

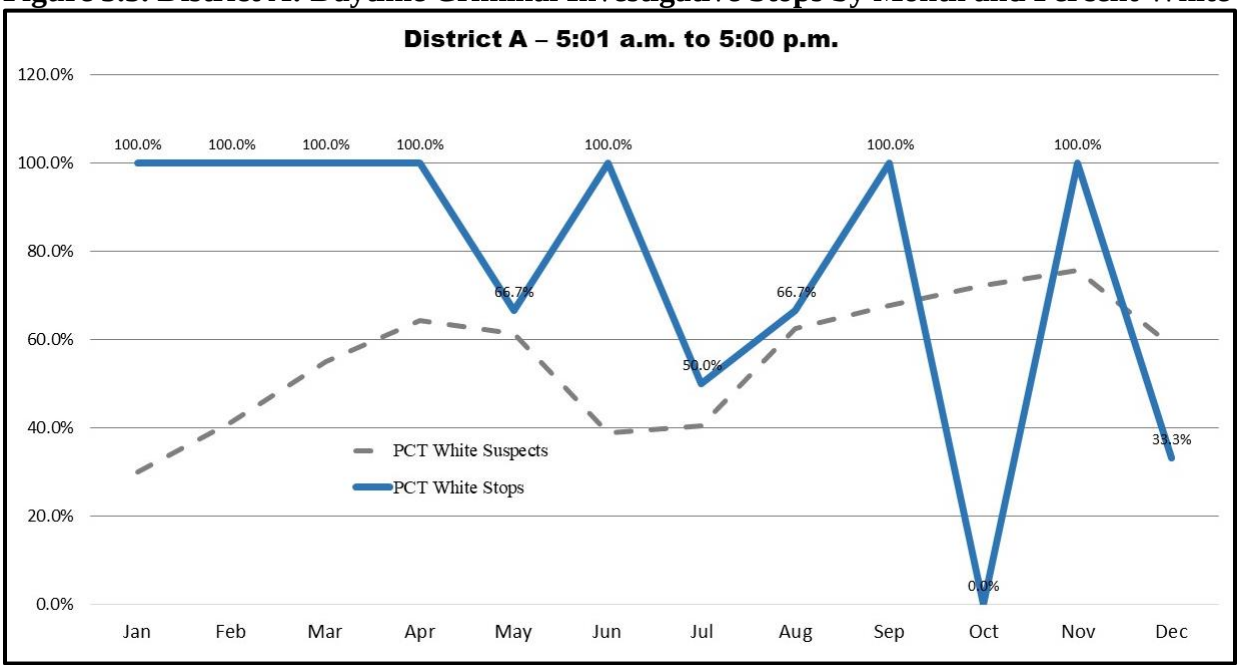
Table 3.4. District A: White Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	82.8% (24 out of 29 total drivers)	62.1% (476 out of 766 total suspects)	+20.7	**YES**
5:01 p.m. – 5:00 a.m.	51.1% (24 out of 47 total drivers)	59.0% (550 out of 933 total suspects)	-7.9	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As was done when disparities were discovered involving stops of male drivers, this disparity of criminal investigatory stops involving white drivers was examined by month. This was done to determine if there was any stability in this disparity to suggest a pattern of biased practice. Figure 3.3 reveals a graph of the percentage of criminal investigative stops for white drivers, by month, within District A and between 5:01 a.m. and 5:00 p.m. Overlaid atop this graph is also the benchmark, the percentage of male criminal suspects, by month, within District A during this same time of day.

Figure 3.3. District A: Daytime Criminal Investigative Stops by Month and Percent White



As this figure reveals, the proportion of criminal investigative stops involving white drivers was significantly higher than the proportion of criminal suspects that were white for seven of the twelve months of the year. Criminal investigative stops were much higher than expected (based on our benchmark) during January, February, March, April, June, September, and November. The proportion of white drivers stopped was lower than expected during October and December, and about equal to benchmark expectations during May, July, and August. These erratic monthly fluctuations reveal no consistency in the pattern of disparity involving white drivers. White drivers were the subject of criminal investigative stops in District A during the daytime at higher rates than expected during some months, but not other months, following no discernable pattern.

The real human cost of these disparities were then examined. In District A, between the hours of 5:01 a.m. and 5:00 p.m., only 29 purely criminal investigative stops were conducted by Ann Arbor officers during 2017. Of these stops, 24 stops (82.8%) involved a white driver. According to the benchmark for those hours of the day within District A, we expected that 62.1% of these stops (18 actual stops) would have involved a white driver. Subtracting 18 from 24 leaves a difference of 6 stops. In other words, for 2017, within District A, during the hours of 5:01 a.m. to 5:00 p.m., Ann Arbor officers stopped 6 more white drivers in criminal investigative stops than we would have expected based on our benchmark. The substantive impact of this disparity, therefore, is extremely small and amounting to one more stop than expected every other month of the year. Despite being a statistically significant difference in numeric values, 6 more individuals stopped by the police over the course of a year is a substantively small disparity in terms of humans inconvenienced.

White Stops Summary

Within District A, stops of white drivers showed little to no disparity. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage

of drivers stopped for traffic violations who were white, roughly matched the proportion of drivers involved in crashes who were white. Stops for purely criminal investigative reasons, during evening and late morning hours of the day, also showed no evidence of bias for stopping white drivers. The proportion of persons stopped who were white, roughly matched the proportion of criminal suspects who were reportedly white.

In criminal investigative stops from 5:01 a.m. to 5:00 p.m., white drivers were stopped more often than would have been expected based on the suspect descriptions benchmarks. Deeper examination of this statistically significant finding revealed this disparity was inconsistent by month of the year. No consistent pattern regarding this disparity was revealed. Furthermore, the substantive outcome of this disparity only resulted in one stop more than expected every two months, or only 6 additional stops of white drivers per year. This was a very small degree of racial disparity involving white drivers in District A.

Stops of African-American Drivers

The primary focus of most accusations of biased-based policing and racial profiling have to do with accusations that law enforcement officers target African-Americans for vehicle stops. These accusations suggest that some police officers select vehicles for stops based on a belief African-American drivers are more likely to be engaged in crime. As a result, this is the racial group some would expect to experience the greatest disparities related to stops by the police.[58]

Stops of African-American Drivers for Traffic Violations

Of the stops for traffic violations that occurred in District A, 359 involved African-American drivers. Of the vehicles involved in motor vehicle crashes within District A, 175 involved African-American drivers. Table 3.5 reveals the statistics related to the traffic violation stops of African-American drivers within District A.

Table 3.5. District A: African-American Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	12.3% (55 out of 446 total drivers)	12.8% (37 out of 288 total crash drivers)	-0.5	No
11:01 a.m. – 5:00 p.m.	10.0% (65 out of 653 total drivers)	12.4% (72 out of 581 total crash drivers)	-2.4	No
5:01 p.m. – 11:00 p.m.	13.2% (109 out of 828 total drivers)	10.6% (47 out of 442 total crash drivers)	+2.6	No
11:01 p.m. – 5:00 a.m.	22.5% (130 out of 578 total drivers)	18.8% (19 out of 101 total crash drivers)	+3.7	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

[58] Harris (1999); Smith et al. (2017); Withrow (2005).

Note that this table reveals no evidence of disparities in disproportionate stops of African-American drivers for traffic violations within District A. During each of the four time periods, stops of African-American drivers were only within a couple percentage points of the benchmark of African-American drivers involved in crashes, and half of the time African-American drivers were stopped at percentages lower than the benchmark. One may also note that African-American drivers were stopped at percentages lower than the benchmark during the hours of the day with the most daylight, offering the most opportunities to see the race of the driver before making a stop. This further suggests that officers in District A did not target African-American drivers for traffic violation stops.

Criminal Investigative Stops of African-American Drivers

Of the criminal investigative stops that occurred within District A, 16 involved an African-American driver. Of the criminal suspect descriptions reported within District A, 512 involved an African-American suspect. Table 3.6 reveals the statistical data related to the purely criminal investigative stops of African-American drivers within District A. As was the case with criminal investigative stops of males and whites, these stops were based solely on criminal investigative reasons without having observed a traffic violation. Yet again, no statistically significant stop disparities of disproportionate stops were revealed for African-American drivers. In fact, when compared to the proportion of reported criminal suspects in District A who were African-Americans, African-Americans were stopped at a lower percentage than they were reported in this benchmark.

Table 3.6. District A: African-American Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	13.8% (4 out of 29 total drivers)	25.3% (194 out of 766 total suspects)	-11.5	No
5:01 p.m. – 5:00 a.m.	25.5% (12 out of 47 total drivers)	34.1% (318 out of 933 total suspects)	-8.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

African-American Stops Summary

In summary, within District A, stops of African-American drivers showed no disparities. Stops for traffic violations, regardless of time of day, occurred at rates of almost perfect parity with the benchmark of crash drivers for District A by time of day, with stops during daylight occurring at rates even below the benchmark. Likewise, criminal investigative stops of African-American drivers occurred at lower rates that the benchmark of African-American criminal suspect descriptions would have predicted. As a result, this analysis showed no evidence of bias or disproportionate treatment regarding the stopping African-American drivers within District A.

Stops of Asian-American and Pacific Islander Drivers

Although often merged into the category "other" in most studies of biased-based policing because they often represent less than 5% of a population, persons of Asian or Pacific Islander ancestry made up a proportion of the population of Ann Arbor that is larger than in most communities across the nation. It was important, therefore, to examine the treatment of this group within vehicle stops by the Ann Arbor Police Department.

Stops of Asian-American and Pacific Islander Drivers for Traffic Violations

During 2017, of the traffic violation stops that occurred within District A, 204 involved Asian-American or Pacific Islander drivers. Of the vehicles involved in vehicle crashes within District A, 110 had an Asian-American or Pacific Islander driver. Table 3.7 below displays the statistical data involving traffic violation stops of Asian-American and Pacific Islander drivers within District A. As this table demonstrates, no statistically significant racial disparities involving disproportionate stops was revealed. Regardless of time of day, the proportion of stops for traffic violations within District A that involved Asian-American and Pacific Islander drivers displayed almost parity with the proportion of drivers involved in crashes who were Asian-Americans or Pacific Islanders. The percentage points between the benchmarks and the traffic violation stops, by time of day, varied by only a miniscule number of percentage points from the benchmark measures of crash drivers.

Table 3.7. District A: Asian-American & Pacific Islander Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	8.8% (30 out of 446 total drivers)	7.6% (22 out of 288 total crash drivers)	+1.2	No
11:01 a.m. – 5:00 p.m.	7.8% (51 out of 653 total drivers)	6.5% (38 out of 581 total crash drivers)	+1.3	No
5:01 p.m. – 11:00 p.m.	8.9% (74 out of 828 total drivers)	9.9% (44 out of 442 total crash drivers)	-1.0	No
11:01 p.m. – 5:00 a.m.	8.4% (49 out of 578 total drivers)	5.9% (6 out of 101 total crash drivers)	+2.5	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of Asian-American and Pacific Islander Drivers

Only four of the criminal investigative stops that occurred within District A involved an Asian-American or Pacific Islander driver. Of the criminal suspect descriptions given within District A, only 36 involved an Asian-American of Pacific Islander criminal suspect. Table 3.8 shows the statistical information associated with criminal investigatory stops of Asian-American and Pacific Islander drivers within District A. As the table reveals, again, no statistically significant disparity

in disproportionate stops existed involving criminal investigative stops of Asian-American and Pacific Islander drivers.

Table 3.8. District A: Asian-American & Pacific Islander Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	0.0% (0 out of 29 total drivers)	2.6% (20 out of 766 total suspects)	-2.6	No
5:01 p.m. – 5:00 a.m.	8.5% (4 out of 47 total drivers)	1.7% (16 out of 933 total suspects)	+6.8	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Asian-American and Pacific Islander Stops Summary

In summary, regardless of time of day within District A, traffic violation stops of Asian-American and Pacific Islander drivers showed no evidence of disparate treatment. Furthermore, stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers within District A.

Stops of All Other Group Drivers

As was described within the methodology section of this report, only a very small proportion of stops involved persons who officers had classified as Hispanic, Native American, Unknown, or Multiracial. As a result, there were too few cases to analyze each group individually, so these cases were merged together into a group classified as 'all other groups.' As mentioned earlier in the Methodology section of this report, because of the extreme diversity of this group, no statistical tests were performed because of the potentially tremendous racial differences between the individuals within the benchmark sample and the individuals stopped by the police. For example, a crash driver classified by officers as 'unknown' or 'multiracial' may have actually self-identified as Asian, while another stopped driver classified 'unknown' or 'multiracial' by officers may have self-identified as African-American.

These racial differences would not be inconsequential when compared to benchmarks with different proportions of individuals from different groups. As a result, if statistically significant disparities were revealed within the 'all other groups' stops, it would be impossible to know if these were true disparities or different levels of representation of the various groups found within this category of the benchmark..

Stops of All Other Groups Drivers for Traffic Violations

During 2017 within District A, only 91 traffic violation stops, and 37 crash vehicles involved drivers who were persons from all other remaining racial or ethnic category groups. Table 3.9 below displays the statistical information related to these stops. As can be seen within this table, even though no binomial or chi-square tests were conducted, the proportion of drivers stopped for

traffic violations varied no more than 1.2 percentage points from the benchmark proportion of crash drivers. This difference was extremely small and inconsequential. Clearly there were no concerns about disparity here.

Table 3.9. District A: All Other Groups Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	3.4% (15 out of 446 total drivers)	2.4% (7 out of 288 total crash drivers)	+1.0	---
11:01 a.m. – 5:00 p.m.	2.9% (19 out of 653 total drivers)	1.7% (10 out of 581 total crash drivers)	+1.2	---
5:01 p.m. – 11:00 p.m.	3.9% (32 out of 828 total drivers)	3.9% (17 out of 442 total crash drivers)	0.0	---
11:01 p.m. – 5:00 a.m.	4.2% (25 out of 578 total drivers)	3.0% (3 out of 101 total crash drivers)	+1.2	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of All Other Group Drivers

Only 8 criminal investigative stops within District A during 2017 involved persons from this 'all other groups' category, while 125 suspect descriptions involved persons from this category. Table 3.10 reveals the statistical information associated with the criminal investigative stops involving this 'all other groups' category, minus the binomial test for statistical significance. As only one such stop occurred during the daytime hours, and only seven stops occurred during the evening and nighttime hours, the differences between the stops and benchmark of criminal suspects were inconsequential, as adding or subtracting a single stop could create an exaggerated change in the percentage of stops due to this very small sample size.

Table 3.10. District A: All Other Groups Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	3.5% (1 out of 29 total drivers)	9.9% (76 out of 766 total suspects)	-6.4	---
5:01 p.m. – 5:00 a.m.	14.9% (7 out of 47 total drivers)	5.3% (49 out of 933 total suspects)	+9.6	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

It is also interesting to note that during daylight hours, when officers are more likely to be able to determine the driver's race before the stop, stops of this group were below the benchmark

expectation. During the hours of the day with the least light, proportionately more stops of this group occurred, but not at a rate notably higher than the benchmark prediction.

All Other Groups Stops Summary

Regardless of time of day, stops for traffic violations or criminal investigative reasons showed no evidence to suggest bias for stopping drivers of this mixed race / ethnicity group within District A.

Summary for District A

During 2017, officers of the Ann Arbor Police Department made 2,505 vehicle stops for traffic violations and 76 criminal investigative vehicle stops within District A. The benchmark measures for District A consisted of 1,412 drivers involved in crashes within the district, and victim-witness descriptions of 1,699 crime suspects.

Regarding stops of males, some disparity was revealed. Stops for purely criminal investigative reasons, regardless of time of day, showed no evidence of bias for stopping males. Likewise, stops for traffic violations from 5:01 a.m. to 5:00 p.m., also showed no evidence of bias for stopping males. Stops from 5:01 p.m. to 5:00 a.m., however, showed that males were statistically significantly more likely to be stopped than their involvement in motor vehicle crashes would have predicted. Further analysis by month of the year revealed that these stop disparities of males only occurred during the months that the University of Michigan was in normal semester session (fall and winter terms). Based on the crash driver benchmark estimate, approximately 175 more male drivers were stopped than anticipated based on the crash driver benchmark. This averages out to a disparity of more 22 male traffic violation stops than expected per month (about 1 per day) within District A during the university academic year.

Regarding stops of white drivers, a small amount of disparity in stops was revealed. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage of drivers stopped for traffic violations who were white, roughly matched the proportion of drivers involved in crashes who were white. Stops for purely criminal investigative reasons, during evening and late morning hours of the day, also showed no evidence of bias for stopping white drivers. The proportion of persons stopped who were white, roughly matched the proportion of criminal suspects who were reportedly white. Criminal investigative stops from 5:01 a.m. to 5:00 p.m., however, showed white drivers were stopped more often than would have been expected based on the suspect descriptions benchmarks. This disparity was inconsistent by month of the year and no consistent pattern regarding this disparity was revealed. The substantive outcome of this disparity only resulted in one stop more than expected every two months, or only 6 additional stops of white drivers per year.

Regarding stops of African-American drivers, no evidence of stop disparities was found. Stops for traffic violations, regardless of time of day, occurred at rates of almost perfect parity with the benchmark of crash drivers for District A by time of day, with stops during daylight occurring at rates even below the benchmark. Likewise, criminal investigative stops of African-American drivers occurred at lower rates that the benchmark of African-American criminal suspect descriptions would have predicted.

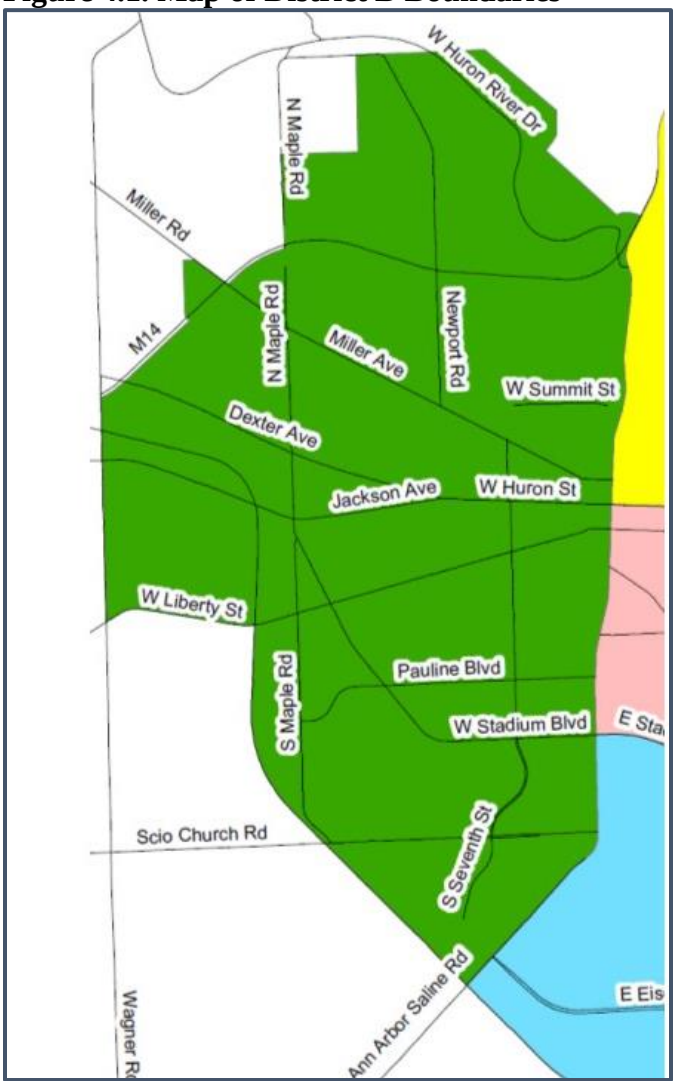
Regarding stops of Asian-American and Pacific Islander drivers, no evidence of stop disparities was found. Regardless of time of day, within District A, traffic violation stops of Asian-American and Pacific Islander drivers were in statistically similar proportions to the representation of Asian-American and Pacific Islander drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers, as the proportion of individuals stopped was statistically similar to the proportion of criminal suspects.

Regarding stops of individuals from all other remaining racial and ethnic groups, no evidence existed to suggest disparities in stops. Regardless of time of day, stops for traffic violations or criminal investigative reasons, showed no evidence to suggest bias for stopping drivers of this mixed race / ethnicity group within District A.

PART IV. DISTRICT B

District B is the district encompassing the west side of the city. It is the largest district in terms of area, encompassing almost three-eighths of the city's square mileage. District B is bordered on the north by the northern city limit, and on the west and southwest by the western city limit. The district's eastern boundary is Main Street (starting just south of Barton Shore Road and running south to Scio Church Road), and Ann Arbor Saline Road (from Scio Church Road through I-94). The area within District B is predominantly residential, and contains the historic neighborhoods of Allmendinger Hills, Eberwhite, Garden Homes, Germantown, Old West Side, Selma, Upper Water Hill, Water Hill, and Wildwood Park. Nevertheless, District B borders the west side of the University of Michigan and, most notably, its football stadium.

Figure 4.1. Map of District B Boundaries



During 2017, officers of the Ann Arbor Police Department made 2,666 vehicle stops for traffic violations, and 73 criminal investigative vehicle stops, within District B. The benchmark measures for District B consisted of 1,865 drivers involved in crashes within the district, and victim-witness descriptions of 905 criminal suspects reported within District B.

Stops of Male Drivers

Recall that within District A, stop disparities regarding male drivers were revealed, but only for traffic violation stops made between 5:01 p.m. and 5:00 a.m., and only during the months of the University of Michigan academic year. We were interested to see if the influence of the University of Michigan school year also played some role in stops of males within District B, as this district borders the campus and contains much off-campus student housing.

Stops of Males for Traffic Violations

Of the 2,666 stops for traffic violations Ann Arbor officers made within District B during 2017, 1,478 involved a male driver. That same year, of the 1,865 vehicles were involved in motor vehicle crashes within District B, 966 of which had been driven by a male driver. Table 4.1 below displays the data on the traffic violation stops of males that occurred within District B during 2017. As this table reveals, no statistically significant disparities were found by driver sex for three of the four 6-hour time blocks of the day. The proportion of traffic violation stop drivers who were male was statistically similar to the proportion of crash drivers who were male for every time period of the day except the 5:01 p.m. to 11:00 p.m. time period.

Table 4.1. District B: Male Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	52.8% (568 out of 1,075 total drivers)	53.4% (221 out of 414 total crash drivers)	+1.6	No
11:01 a.m. – 5:00 p.m.	54.0% (464 out of 892 total drivers)	50.9% (421 out of 827 total crash drivers)	+3.1	No
5:01 p.m. – 11:00 p.m.	61.2% (316 out of 516 total drivers)	48.8% (273 out of 559 total crash drivers)	+12.4	**YES**
11:01 p.m. – 5:00 a.m.	71.0% (130 out of 183 total drivers)	78.5% (51 out of 65 total crash drivers)	-7.5	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

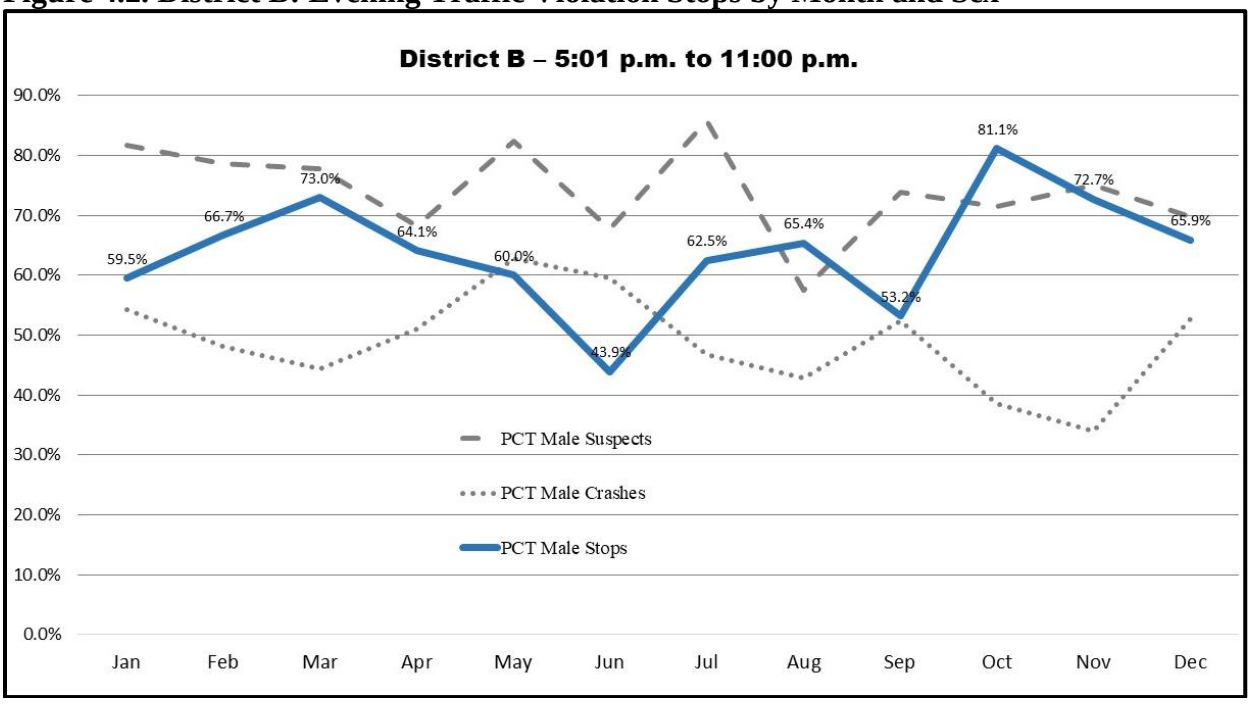
This time block of male stop disparity for District B was one of the same two time periods that saw male stop disparity within District A. In District A, however, males were also disproportionately stopped during the 11:01 p.m. to 5:00 a.m. time block. This was not the case within District B, which actually saw stops of males fall below the benchmark measure from 11:01

p.m. to 5:00 a.m. Just as with District A, this District B disparity result demanded further investigation.

The percentage of District B traffic violation stops for males made between 5:01 p.m. and 11:00 p.m. was graphed across the twelve months of the year to examine whether the stop disparity of males was a consistent pattern of police practice or an inconsistent event. This graph is displayed in Figure 4.1 below. Overlaid atop this graph is also the benchmarks of the percentage of male crash drivers, and the percentage of criminal suspects, who were male, by month for that 6-hour time block within District B.

This graph revealed a much less consistent pattern of male stop disparity than was found within District A. Stops of male drivers during the 5:01 p.m. to 11:00 p.m. time block for District B were statistically significantly higher than the benchmark of male involvement in crashes would have predicted, but only during the months of February, March, April, July, August, October, November, and December. Unlike in District A, these male stop disparities do not occur seamlessly with the University of Michigan academic year, as disparities occurred during two of the summer months and during two of the academic session months there were no male stop disparities at all. As was discussed in section describing stops in District A, perhaps some of these stops were motivated by criminal investigation motives, but the officers waited for a traffic violation before initiating these stops. Therefore, a comparison to the criminal suspect benchmark in Figure 4.2 might also prove useful.

Figure 4.2. District B: Evening Traffic Violation Stops by Month and Sex



As can be seen in Figure 4.2, the proportion of criminal suspects that were described as male was very high for every month of the year, except for August. The proportion of traffic violation stops

that involved a male driver, however, did not correspond well with the proportion of male criminal suspects reported. In fact, the proportion of drivers who were stopped for traffic violations who were male exceeded the proportion of suspects who were male during August and October. The conclusion, therefore, is that males were disproportionately stopped within District B, during the 5:01 p.m. to 11:00 p.m. time block during eight months of the year, but not for the remaining four months of the year.

The substantive impact of these stops was then calculated. The benchmark of male involvement in vehicle crashes predicted that approximately 48.8% of the drivers on the roadway in District B during the 5:01 p.m. to 11:00 p.m. time block would have been male. As there were 516 vehicle stops made during this time block during 2017, we would expect that approximately 48.8% of these stops, or 252 drivers, would have been male. In actuality, 316 male drivers were stopped in District B during this time block, or **64** more male drivers stopped than expected over the course of the year. As these disparities occurred over only eight months of the year, this averages out to 8 more stops than expected by the benchmark for male drivers during each month that a disparity took place. This substantive impact was relatively small.

Criminal Investigative Stops of Males

During 2017, officers operating within District B made 76 stops for purely criminal investigative reasons without having witnessed a traffic violation first. Of these stops, 46 involved a male driver. Members of the public also reported to the police the physical descriptions of 905 suspects in crimes within District B during 2017. Of these suspect descriptions, 666 were male. Table 4.2 displays the statistical information for these stops compared to the benchmark of criminal suspect descriptions as reported by members of the public, disaggregated by two, 12-hour time blocks.

As this table reveals, there were no statistically significant disparities in stops of male drivers in District B for purely criminal investigative reasons. In fact, during both time periods, males were actually stopped slightly less often than expected by the benchmark of suspect descriptions. This further hints that some of the disparity in traffic violation stops was the result of officers focusing stops on male drivers for criminal investigative reasons, but waiting to observe a traffic violation before initiating the stop. Nevertheless, no evidence of statistically significant disparities involving male drivers was revealed regarding criminal investigative stops within District B.

Table 4.2. District B: Male Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	57.1% (16 out of 28 total drivers)	73.2% (344 out of 470 total suspects)	-16.1	No
5:01 p.m. – 5:00 a.m.	66.7% (30 out of 45 total drivers)	74.0% (322 out of 435 total suspects)	-7.3	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Male Stops Summary

In summary, within District B, stops of males showed a small amount of disparity. This disparity was limited to stops for traffic violations that occurred between 5:01 p.m. and 11:00 p.m., during only eight specific months of the year. The pattern of these months appeared somewhat sporadic, and the substantive impact of this disparity was 64 more male drivers stopped over the course of the year than was expected by the crash driver benchmark. During all other times of the day, no evidence was found of sex disparities in traffic violation stops, and no evidence was found of sex disparities in criminal investigative stops during any period of the day for District B.

Stops of White Drivers

Recall that in District A, no disparities were revealed regarding whites stopped for traffic violations. However, District A did reveal that whites were disproportionately stopped for criminal investigative reason between 5:01 a.m. and 5:00 p.m. This disparity occurred inconsistently across only seven months of the year. We were interested to see if this pattern reappeared within District B.

Stops of White Drivers for Traffic Violations

Out of the 2,666 traffic violation stops that occurred within District B, 2,103 involved a white driver. Of the 1,865 vehicles involved in crashes within District B, 1,515 involved a white driver. Table 4.3 displays the numeric figures on the traffic violation stops of white drivers that occurred within District B during 2017. Just as was the case in District A, no statistically significant racial disparities in stops were revealed regarding traffic violation stops of white drivers. During each of the four, 6-hour time blocks, the percentage of traffic violation stops that involved white drivers was statistically similar to the percentage of drivers in vehicle crashes that were white. Any differences were small enough to be statistically insignificant, meaning these differences likely occurred due to sampling error.

Table 4.3. District B: White Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	79.9% (859 out of 1,075 total drivers)	81.8% (339 out of 414 total crash drivers)	-1.9	No
11:01 a.m. – 5:00 p.m.	80.9% (722 out of 892 total drivers)	81.6% (675 out of 827 total crash drivers)	-0.7	No
5:01 p.m. – 11:00 p.m.	77.9% (402 out of 516 total drivers)	83.7% (468 out of 559 total crash drivers)	-5.8	No
11:01 p.m. – 5:00 a.m.	65.6% (120 out of 183 total drivers)	75.4% (43 out of 65 total crash drivers)	-9.8	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of White Drivers

While no disparities of white drivers were revealed when examining traffic violation stops, disparity was discovered when examining criminal investigative stops during the daylight portion of the day, just as had been the case in District A. Of the 73 criminal investigative stops that occurred within District B during 2017, 51 involved white drivers. Of the benchmark measure of 905 criminal suspects reported in District B, 484 were white. The statistical information related to this examination of criminal investigative stops is revealed in Table 4.4 below.

Table 4.4. District B: White Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	78.6% (22 out of 28 total drivers)	44.9% (211 out of 470 total suspects)	+33.7	**YES**
5:01 p.m. – 5:00 a.m.	64.4% (29 out of 45 total drivers)	57.5% (273 out of 474 total suspects)	+6.9	No

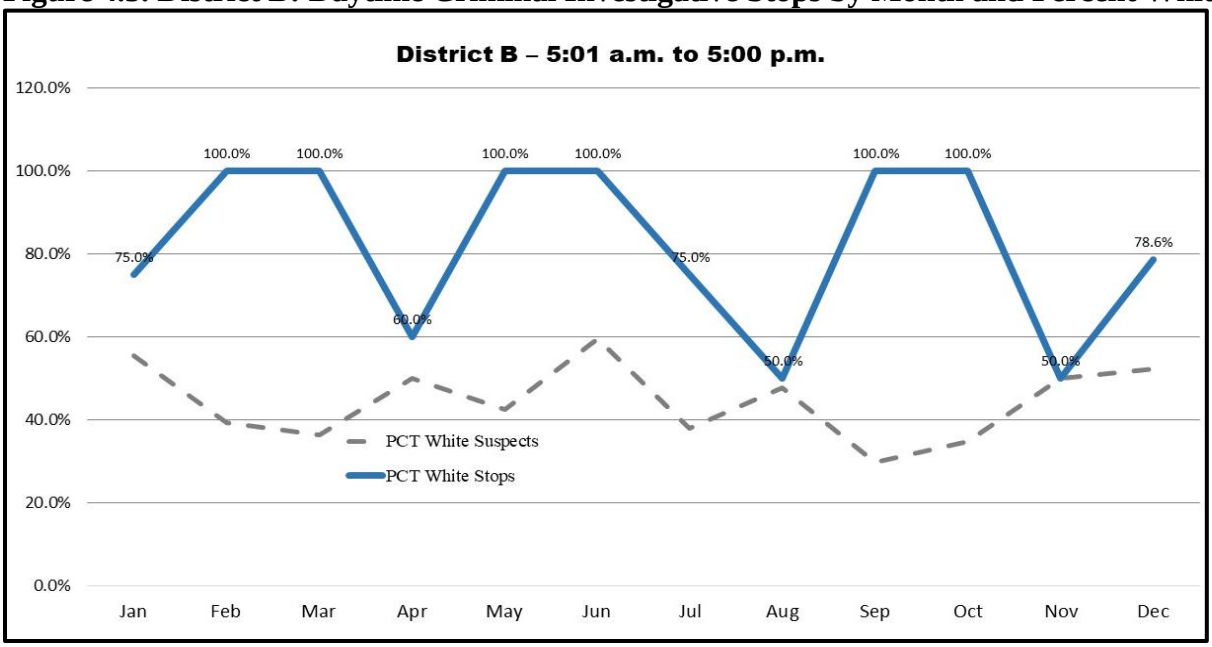
Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As this table shows, statistically significant disparity in criminal investigative stops of white drivers occurred within District B during the 5:01 a.m. to 5:00 p.m. time period, the same pattern revealed in District A. During the evening and nighttime hours, however, no statistically significant disparity was found regarding criminal investigative stops of whites. As before, this suggests that during the hours of the day when officers were more likely to be able to determine the race of the driver before making the stop, due to sunlight, disparate stops of white drivers were more likely to occur. This disparity of criminal investigatory stops involving white drivers was then examined by month to determine if there was any stability in this disparity to suggest a pattern of biased practice.

Figure 4.3 below reveals a graph of the percentage of criminal investigative stops for white drivers, by month, within District B and between 5:01 a.m. and 5:00 p.m. Overlaid atop this graph is also the benchmark, the percentage of male criminal suspects, by month, within District B during this same time of day.

This figure reveals that the proportion of criminal investigative stops involving white drivers was significantly higher than the proportion of criminal suspects that were described as white for all but three months of the year. Criminal investigative stops were much higher than expected (based on the suspect benchmark) during the majority of the year. Despite there being three months where this disparity was not statistically significant, the proportion of whites stopped never fell below the proportion of stops predicted by the benchmark. This suggests a fairly consistent pattern of disproportionate contact with white drivers during criminal investigative stops in District B from 5:01 a.m. to 5:00 p.m.

Figure 4.3. District B: Daytime Criminal Investigative Stops by Month and Percent White



The real human cost of these disparities were then examined. In District B, between the hours of 5:01 a.m. and 5:00 p.m., only 28 stops were conducted based on criminal investigative reasons during 2017. Of these stops, 22 stops (78.6%) involved a white driver. According to the benchmark for those hours of the day within District B, we would have expected that 44.9% of these stops (13 actual stops) would have involved a white driver. Subtracting 13 from 22 leaves a difference of 9 stops. In other words, for 2017, within District B, during the hours of 5:01 a.m. to 5:00 p.m., Ann Arbor officers stopped **9** more white drivers in criminal investigative stops than we would have expected based on our benchmark. Spread across the nine months when statistically significant disparities occurred, this averages out to only one more stop of a white driver than expected during each of those months. Despite being a statistically significant difference in numeric values, 9 more individuals stopped by the police over the course of a year is a substantively small disparity.

White Stops Summary

Stops of white drivers within District B showed little disparity. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage of drivers stopped for traffic violations who were white, roughly matched the proportion of drivers involved in crashes who were white. Stops for purely criminal investigative reasons, during evening and late morning hours of the day, also showed no evidence of bias for stopping white drivers. The proportion of persons stopped who were white, roughly matched the proportion of criminal suspects who were reportedly white.

When examining criminal investigative stops from 5:01 a.m. to 5:00 p.m., white drivers in District B were stopped more often than would have been expected based on the suspect descriptions benchmarks. Deeper examination of this statistically significant finding revealed this disparity was

consistent across most months of the year. The substantive outcome of this disparity, however, only resulted in nine more criminal investigative stops of white drivers over the year.

Stops of African-American Drivers

Recall that the examination of stops within District A revealed no statistically significant disparities involving stops of African-American drivers. In fact, both traffic violation and criminal investigative stops revealed that African-American drivers tended to be stopped at a rate lower than that predicted by either the crash driver or suspect description benchmarks. We were interested to see if this trend was also found when examining stops conducted within District B.

Stops of African-American Drivers for Traffic Violations

Of the stops for traffic violations that occurred in District B, 306 involved African-American drivers. Of the vehicles involved in motor vehicle crashes within District B, 187 involved African-American drivers. Table 4.5 below reveals the statistical information related to the traffic violation stops of African-American drivers within District B. This table reveals no evidence of disparities in disproportionate stops of African-American drivers for traffic violations within District B during three of the four time blocks. During three time periods, stops of African-American drivers were only within a couple percentage points of the benchmark of African-American drivers involved in crashes. One may also note that African-American drivers were not stopped at disproportionate levels during the hours of the day with the most daylight, offering the most opportunities to see the race of the driver before making a stop.

Table 4.5. District B: African-American Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	10.7% (115 out of 1,075 total drivers)	10.1% (42 out of 414 total crash drivers)	+0.6	No
11:01 a.m. – 5:00 p.m.	9.1% (81 out of 892 total drivers)	10.3% (85 out of 827 total crash drivers)	-1.2	No
5:01 p.m. – 11:00 p.m.	11.6% (60 out of 516 total drivers)	8.8% (49 out of 559 total crash drivers)	+2.8	No
11:01 p.m. – 5:00 a.m.	27.3% (50 out of 183 total drivers)	16.9% (11 out of 65 total crash drivers)	+10.4	**YES**

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

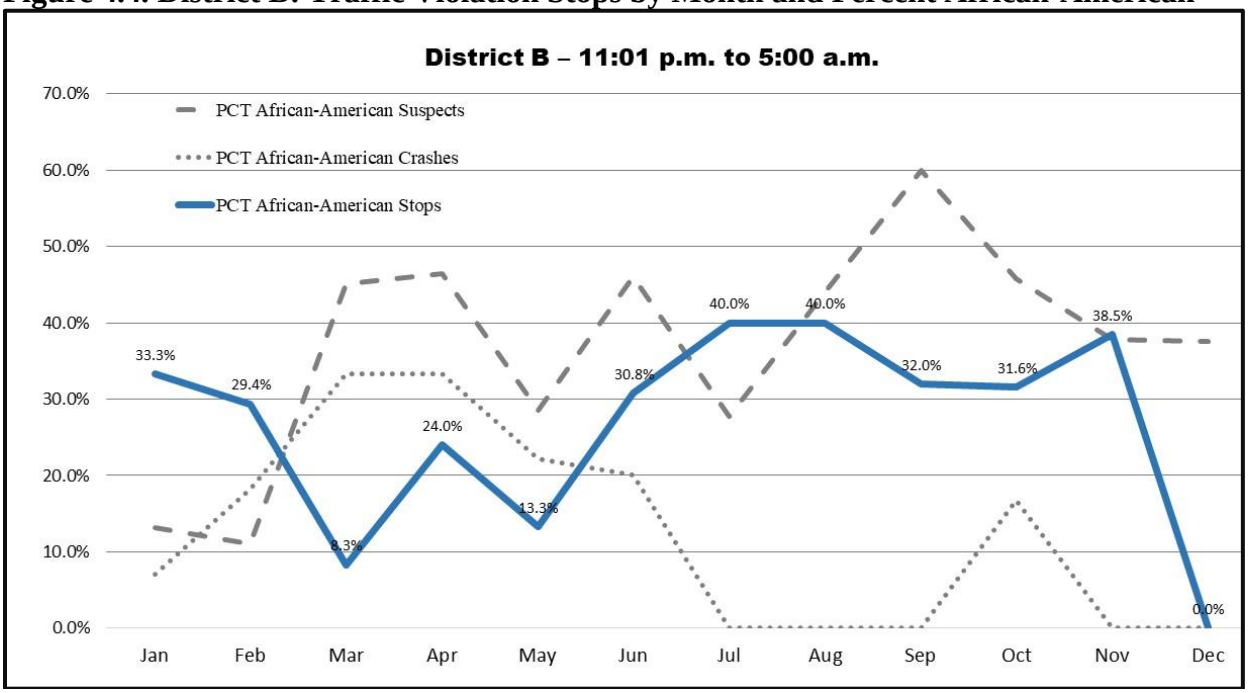
Statistically significant disparity for African-American drivers was revealed, however, for traffic violation stops that occurred between 11:01 p.m. and 5:00 a.m. Being that this difference was statistically significant, we are 99.9% sure that this disparity was not the result of sampling error. It is interesting, however, that this disparity occurred during the period of the day when it would be most difficult to determine the race of a driver before initiating a stop due to darkness. In order

to examine this disparity more closely, the percentage of District B traffic violation stops involving African-American drivers made between 11:01 p.m. and 5:00 a.m. was graphed across the twelve months of the year to examine whether this stop disparity was a consistent pattern of police practice or an inconsistent event. This graph is displayed in Figure 4.4 below.

Overlaid atop this graph is also the benchmarks of the percentage of African-American crash drivers, and the percentage of criminal suspects, who were African-American, by month for that 6-hour time block within District B. When compared to the proportion of crash drivers between 11:01 p.m. and 5:00 a.m. in District B who were African-American, the proportion of traffic violation stops involving African-American drivers was statistically significantly higher than expected during eight months of the year (January, February, June, July, August, September, October, and November).

As with the disparities we have examined before, one might argue that some of these traffic violation stops were actually criminal investigative in nature, yet the officer waited until observing a valid traffic violation before initiating the stop. This possibility can be explored in Figure 4.4 by comparing the proportion of reported criminal suspects who were African-American (the dashed line) with the proportion of traffic violation stops that involved African-Americans.

Figure 4.4. District B: Traffic Violation Stops by Month and Percent African-American



As this graph reveals, the proportion of African-Americans stopped significantly exceeded the proportion of suspects who were African-Americans during the months of January, February, and July. As a result, the evidence does not completely support the suggestion that criminal investigative motives explain this disparity.

The substantive impact of this stop disparity was then estimated. Between 11:01 p.m. and 5:00 a.m. within District B, Ann Arbor officers made 183 traffic violation stops during 2017, of which 50 drivers (27.3%) involved African-American drivers. The benchmark of drivers involved in traffic crashes for that district and time block suggested that 16.9% of the drivers on the roadway were African-Americans, creating an expectation that only 31 stops of African-Americans would have occurred. Subtracting 31 from 50, the difference is 19, suggesting that across 2017, approximately **19** more African-American drivers were stopped in District B than would have been expected based on our crash driver benchmark. As disparities only occurred during either of the months, dividing 19 stops by eight months produces an average of 2.4 more stops per month of African-American drivers during those months. As with the disparities previously detected regarding male drivers and white drivers, the substantive impact of the human inconvenience from this disparity was relatively low.

Criminal Investigative Stops of African-American Drivers

Of the criminal investigative stops that occurred within District B, 16 involved an African-American driver. Of the criminal suspect descriptions reported within District B, 382 involved an African-American suspect. Table 4.6 reveals the statistical data related to the purely criminal investigative stops of African-American drivers within District B. Recall that these stops were based solely on criminal investigative reasons without having observed a traffic violation. In this case, no statistically significant disproportionate stops were revealed for African-American drivers. In fact, when compared to the proportion of reported criminal suspects in District C who were African-Americans, drivers who were African-American were stopped at a *much* lower percentage than they were expected by this benchmark. So despite the disparity in traffic violation stops revealed within one of the time blocks for District B, no evidence of disparity impacting African-American drivers stopped for criminal investigative reasons was revealed.

Table 4.6. District B: African-American Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	17.9% (5 out of 28 total drivers)	43.0% (202 out of 470 total suspects)	-25.1	No
5:01 p.m. – 5:00 a.m.	24.4% (11 out of 45 total drivers)	40.0% (180 out of 474 total suspects)	-15.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

African-American Stops Summary

In summary, within District B, stops of African-American drivers showed no disparities when examining criminal investigative stops. Likewise, stops of African-American drivers showed no disparities when examining traffic violation stops made between 5:01 a.m. and 11:00 p.m. During the darkest hour of the day, however, African-Americans were disproportionately represented among drivers stopped for traffic violations between 11:01 p.m. and 5:00 a.m. While this racial disparity impacting African-American drivers occurred during most of the months of the year, it

is estimated that it only resulted in 19 more stops than would have been expected for the entire year within District B.

Stops of Asian-American and Pacific Islander Drivers

In our examination of District A, no evidence of racial disparities in stops regarding Asian-American and Pacific Islander drivers was found. Regardless of time of day or type of stop (traffic violation or criminal investigative stop), the proportion of Asian-American and Pacific Islander drivers stopped was statistically similar to the proportion of Asian-American and Pacific Islander drivers found within the benchmarks used within that district.

Stops of Asian-American and Pacific Islander Drivers for Traffic Violations

During 2017, of the traffic violation stops that occurred within District B, 183 involved Asian-American or Pacific Islander drivers. Of the vehicles involved in vehicle crashes within District B, 108 had an Asian-American or Pacific Islander driver. Table 4.7 below displays the statistical data involving traffic violation stops of Asian-American and Pacific Islander drivers within District B. As this table exhibits, no statistically significant racial disparities involving disproportionate stops was revealed. Regardless of time of day, the proportion of stops for traffic violations within District A that involved Asian-American and Pacific Islander drivers displayed statistically similar proportions to drivers involved in crashes who were Asian-Americans or Pacific Islanders. The percentage points between the benchmarks and the traffic violation stops, by time of day, varied by no more than 2.9 percentage – well within the margin of error for sampling error.

Table 4.7. District B: Asian-American and Pacific Islander Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	6.5% (70 out of 1,075 total drivers)	6.5% (27 out of 414 total crash drivers)	0.0	No
11:01 a.m. – 5:00 p.m.	7.1% (63 out of 892 total drivers)	5.8% (48 out of 827 total crash drivers)	+1.3	No
5:01 p.m. – 11:00 p.m.	8.1% (42 out of 516 total drivers)	5.2% (29 out of 559 total crash drivers)	+2.9	No
11:01 p.m. – 5:00 a.m.	4.4% (8 out of 183 total drivers)	6.2% (4 out of 65 total crash drivers)	-1.8	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of Asian-American and Pacific Islander Drivers

Only one of the criminal investigative stops that occurred within District B involved an Asian-American or Pacific Islander driver. Of the criminal suspect descriptions given within District B,

only 12 involved an Asian-American of Pacific Islander suspected of a crime. Table 4.8 shows the statistical information associated with criminal investigatory stops of Asian-American and Pacific Islander drivers within District A. Once again this table reveals no statistically significant disparity in disproportionate stops existed involving criminal investigative stops of Asian-American and Pacific Islander drivers.

Table 4.8. District B: Asian-American and Pacific Islander Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	0.0% (0 out of 28 total drivers)	1.1% (5 out of 470 total suspects)	-1.1	No
5:01 p.m. – 5:00 a.m.	2.2% (1 out of 45 total drivers)	1.5% (7 out of 474 total suspects)	+0.7	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Asian-American and Pacific Islander Stops Summary

In summary, regardless of time of day within District B, traffic violation stops of Asian-American and Pacific Islander drivers showed no evidence of disparate treatment. Furthermore, stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers within District B.

Stops of All Other Group Drivers

Our analysis of District A revealed that drivers from the remaining racial and ethnic categorizations were stopped at very similar proportions to which they were also involved in traffic crashes or described by members of the public as suspects in crimes within that district. Similar findings resulted here within District B.

Stops of All Other Groups Drivers for Traffic Violations

During 2017 within District B, only 74 traffic violation stops, and 87 crash vehicles involved drivers who were persons from all other remaining racial or ethnic category groups. Table 4.9 below displays the numeric information related to these stops. As can be seen within this table, even though no binomial or chi-square tests were conducted, the proportion of drivers stopped for traffic violations were all *less* than the benchmark proportion of crash drivers. This difference was also small and inconsequential. These figures suggest there was no evidence of disparity here.

Table 4.9. District B: All Other Groups Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	2.9% (31 out of 1,075 total drivers)	1.5% (6 out of 414 total crash drivers)	-1.3	---
11:01 a.m. – 5:00 p.m.	2.9% (26 out of 892 total drivers)	5.8% (48 out of 827 total crash drivers)	-2.9	---
5:01 p.m. – 11:00 p.m.	2.3% (12 out of 516 total drivers)	5.2% (29 out of 559 total crash drivers)	-2.9	---
11:01 p.m. – 5:00 a.m.	2.7% (5 out of 183 total drivers)	6.2% (4 out of 65 total crash drivers)	-3.5	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of All Other Group Drivers

Only 5 criminal investigative stops within District B during 2017 involved persons from the 'all other groups' category, while 87 described suspects involved persons from this category. Table 4.10 reveals the numeric information associated with the criminal investigative stops involving this 'all other groups' category, minus the binomial test for statistical significance. As only one such stop occurred during the daytime hours, and four stops occurred during the evening and nighttime hours, the differences between the stops and benchmark of criminal suspects were inconsequential, as adding or subtracting a single stop could create an exaggerated change in the percentage of stops due to this very small sample size. Again it is noted that during daylight hours, when officers are more likely to be able to determine the driver's race before the stop, stops of this group fell below the benchmark expectation. During the hours of the day with the least light, stops were much closer to the benchmark prediction. As such, no evidence existed to suggest any disparity in stops of this group of drivers.

Table 4.10. District B: All Other Groups Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	3.6% (1 out of 28 total drivers)	10.9% (51 out of 470 total suspects)	-7.3	---
5:01 p.m. – 5:00 a.m.	8.9% (4 out of 45 total drivers)	7.6% (36 out of 474 total suspects)	+1.3	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

All Other Groups Stops Summary

Regardless of time of day, stops for traffic violations or criminal investigative reasons showed no evidence to suggest bias for stopping drivers of this mixed group of race / ethnicity drivers within District B.

Summary for District B

During 2017, officers of the Ann Arbor Police Department made 2,666 vehicle stops for traffic violations and 73 criminal investigative vehicle stops within District B. The benchmark measures for District B consisted of 1,865 drivers involved in crashes within the district, and victim-witness descriptions of 905 crime suspects.

Regarding stops of males, a small amount of disparity was revealed. Stops for purely criminal investigative reasons, regardless of time of day, showed no evidence of bias for stopping males. Likewise, stops for traffic violations from 11:01 p.m. to 5:00 p.m. (three-quarter of the day), also showed no evidence of bias for stopping males. Stops from 5:01 p.m. to 11:00 p.m., however, showed that males were statistically significantly more likely to be stopped than their involvement in motor vehicle crashes would have predicted. Further analysis by month of the year revealed that these stop disparities appeared somewhat sporadic, and the substantive impact of this disparity was estimated to have been **64** more male drivers stopped over the course of the year than was expected by the crash driver benchmark.

Regarding stops of white drivers, a very small amount of disparity in stops was revealed. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage of drivers stopped for traffic violations who were white, roughly matched the proportion of drivers involved in crashes who were white. Stops for purely criminal investigative reasons, during evening and late morning hours of the day, also showed no evidence of bias for stopping white drivers. The proportion of persons stopped who were white, roughly matched the proportion of criminal suspects who were reportedly white. Criminal investigative stops between 5:01 a.m. to 5:00 p.m., however, showed white drivers were stopped more often than would have been expected based on the suspect descriptions benchmarks. While this disparity was consistent across most months of the year, it is estimated to have only resulted in **9** more criminal investigative stops of white drivers than were expected over the course of the year.

Regarding stops of African-American drivers in District B, a small amount of stop disparity was revealed. Stops of African-American drivers showed no disparities with regard to criminal investigative stops, no matter the time of day. Stops of African-American drivers also showed no disparities regarding traffic violation stops made between 5:01 a.m. and 11:00 p.m. (three-quarters of the day). However, African-Americans were disproportionately represented among drivers stopped for traffic violations between 11:01 p.m. and 5:00 a.m. While this racial disparity of African-American drivers occurred during most of the months of the year, it is estimated that it only resulted in **19** more stops for the entire year than would have been expected within District B.

Regarding stops of Asian-American and Pacific Islander drivers, no evidence of stop disparities was found. Regardless of time of day, within District B, traffic violation stops of Asian-American

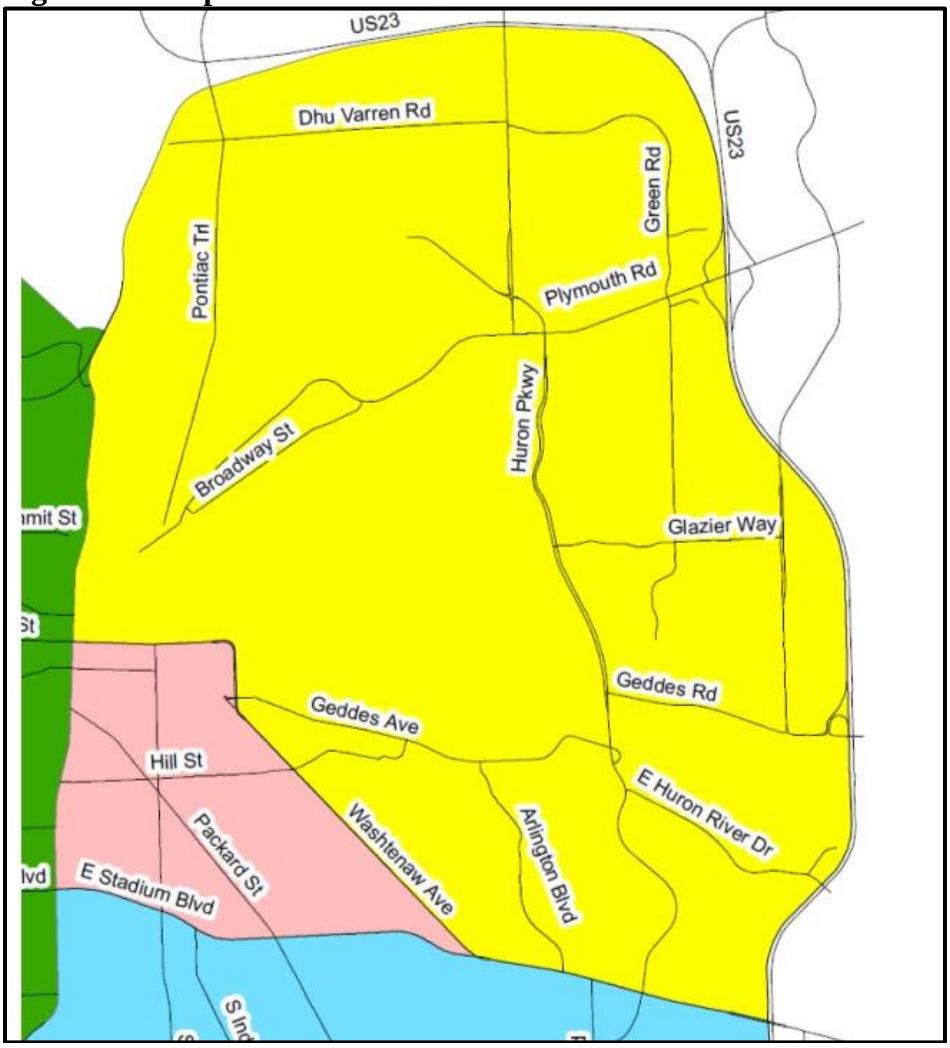
and Pacific Islander drivers were in statistically similar proportions to the representation of Asian-American and Pacific Islander drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers, as the proportion of individuals stopped was statistically similar to the proportion of criminal suspects.

Regarding stops of individuals from all other remaining racial and ethnic groups, no evidence existed to suggest any disparities in stops. Regardless of time of day, stops for traffic violations or criminal investigative reasons showed no evidence to suggest bias for stopping drivers of this mixed group of races and ethnicities within District B.

PART V. DISTRICT C

District C is the district encompassing the east side of the city. It encompasses almost a quarter of the city's land area. District C is bordered on the north by the northern city limit, and on the east by the eastern city limit. The district's western boundary is Highway M14 from the U.S. 23 split to Barton Shore Road, then Main Street running south to East Huron Street. The border continues along East Huron Street to Washtenaw Avenue, then follows Washtenaw Avenue down to the three-way intersection where Washtenaw Avenue meets East Stadium Boulevard. The southern boundary of District C is Washtenaw Avenue between East Stadium Boulevard and the eastern city limit. The area within District C is mix of residential properties, commercial (especially retail) properties, and health care facilities. This district includes the Arborland Shopping Center, University of Michigan Medical Centers, University of Michigan North Campus, Veterans Administration Medical Center, and the historic neighborhoods of Kerrytown and Old Fourth Ward. District C also borders the east side of the University of Michigan main campus.

Figure 5.1. Map of District C Boundaries



During 2017, officers of the Ann Arbor Police Department made 5,262 vehicle stops for traffic violations, and 91 criminal investigative vehicle stops, within District C. The benchmark measures for District C consisted of 2,286 drivers involved in crashes within the district, and victim-witness descriptions of 727 criminal suspects reported within District C.

Stops of Male Drivers

Recall that within Districts A and B, stop disparities regarding male drivers were revealed. Males were disproportionately stopped for traffic violations during the nighttime hours (5:01 p.m. to 5:00 a.m.) within District A during the months of the university school year. Males were also disproportionately stopped for traffic violations within District B during the evening hours (5:01 p.m. to 11:00 p.m.) sporadically across a few months. The examination of male stops within District C revealed a very different outcome.

Stops of Males for Traffic Violations

Of the 5,262 stops for traffic violations Ann Arbor officers made within District C during 2017, 2,765 involved a male driver. That same year, 2,286 vehicles were involved in motor vehicle crashes within District C, 1,175 of which had been driven by a male driver. Table 5.1 below displays the statistical data on the traffic violation stops of males that occurred within District C during 2017.

Table 5.1. District C: Male Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	49.1% (803 out of 1,637 total drivers)	51.4% (304 out of 592 total crash drivers)	-2.3	No
11:01 a.m. – 5:00 p.m.	50.4% (1,250 out of 2,482 total drivers)	49.8% (491 out of 985 total crash drivers)	+0.6	No
5:01 p.m. – 11:00 p.m.	59.8% (538 out of 900 total drivers)	51.5% (322 out of 625 total crash drivers)	+8.3	No
11:01 p.m. – 5:00 a.m.	71.6% (174 out of 243 total drivers)	69.0% (58 out of 84 total crash drivers)	+2.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Unlike Districts A and B, this table reveals no statistically significant disparities regarding traffic violation stops of males within District C. No disparity in stops of male drivers were found in any of the four 6-hour time blocks of the day. The proportion of traffic violation stop drivers who were male was statistically similar to the proportion of crash drivers who were male for every time period. Any percentage differences with the benchmark of crash drivers were within the margin of error explained by sampling error.

Criminal Investigative Stops of Males

During 2017, officers operating within District C made 91 stops for purely criminal investigative reasons without having witnessed a traffic violation first. Of these stops, 61 involved a male driver. Members of the public also reported to the police the physical descriptions of 727 suspects in crimes within District C during 2017. Of these suspect descriptions, 552 were male. Table 5.2 displays the statistical information for these stops compared to the benchmark of criminal suspect descriptions as reported by members of the public, disaggregated by two, 12-hour time blocks.

This table reveals that, like the traffic violation stops, there were no statistically significant disparities in stops of male drivers in District C for purely criminal investigative reasons. In fact, during both time periods, males were actually stopped slightly less often than expected by the benchmark of suspect descriptions. No evidence of disparities involving male drivers was revealed regarding criminal investigative stops within District C.

Table 5.2. District C: Male Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	64.1% (25 out of 39 total drivers)	73.9% (257 out of 348 total suspects)	-9.8	No
5:01 p.m. – 5:00 a.m.	69.2% (36 out of 52 total drivers)	77.8% (295 out of 379 total suspects)	-8.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Male Stops Summary

While a small amount of disparity regarding males stopped for traffic violations was revealed within Districts A and B, no such disparity was revealed within District C. During each of the four time blocks examined, the proportion of males stopped for traffic violations was statistically similar to the proportion of males involved as drivers in motor vehicle crashes. Likewise, no disparities were found regarding criminal investigative stops within District C. During each of the two time blocks examined, the proportion of criminal investigative stops that involved male drivers was statistically similar to the proportion of criminal suspects reported to be male within District C. Therefore, no evidence was found of sex disparities in stops for District C.

Stops of White Drivers

Recall that in Districts A and B, no disparities were revealed regarding white drivers stopped for traffic violations. In both Districts A and B, however, white drivers were disproportionately represented in criminal investigative stops during the 5:01 a.m. to 5:00 p.m. time block. This disparity occurred inconsistently across the months of the year within those districts. A somewhat similar pattern was also revealed within District C.

Stops of White Drivers for Traffic Violations

Out of the 5,262 traffic violation stops that occurred within District C, 3,847 involved a white driver. Of the 2,286 vehicles involved in crashes within District C, 1,761 involved a white driver. Table 5.3 below displays the numeric figures on the traffic violation stops of white drivers that occurred within District C during 2017.

Table 5.3. District C: White Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	74.5% (1,220 out of 1,637 total drivers)	77.0% (456 out of 592 total crash drivers)	-2.5	No
11:01 a.m. – 5:00 p.m.	74.4% (1,847 out of 2,482 total drivers)	78.5% (773 out of 985 total crash drivers)	-4.1	No
5:01 p.m. – 11:00 p.m.	70.1% (631 out of 900 total drivers)	75.2% (470 out of 625 total crash drivers)	-5.1	No
11:01 p.m. – 5:00 a.m.	61.3% (149 out of 243 total drivers)	73.8% (62 out of 84 total crash drivers)	-12.5	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Just as was the case in Districts A and B, no statistically significant racial disparities in stops were revealed regarding traffic violation stops of white drivers within District C. During each of the four, 6-hour time blocks, the percentage of traffic violation stops that involved white drivers was statistically similar to the percentage of drivers in vehicle crashes that were white. Most of the percentage differences were small enough to be statistically insignificant, meaning these differences likely occurred due to sampling error. The only exception was the 11:01 p.m. to 5:00 a.m. time block, but this percentage difference was negative, meaning whites were less likely to be stopped than would have been expected based on the crash driver benchmark.

Criminal Investigative Stops of White Drivers

A different pattern was revealed regarding criminal investigative stops of white drivers within District C. Of the 91 criminal investigative stops that occurred within District C during 2017, 58 involved white drivers. Of the benchmark measure of 727 criminal suspects reported within District C, 324 were white. The statistical information related to this examination of criminal investigative stops of white drivers in District C is revealed in Table 5.4 below. As this table demonstrates, statistically significant disparity in criminal investigative stops of white drivers occurred within District C during both time blocks. While Districts A and B revealed disproportionate stops of white drivers in criminal investigative stops during the daylight 5:01 a.m. to 5:00 p.m. time block, this disparity within District C was found to occur during all periods of the day. In fact, within District C, the degree of stop disparity of white drivers was higher in the evening and nighttime hours than during the daytime hours (25.4 percentage points versus 11.0 percentage points).

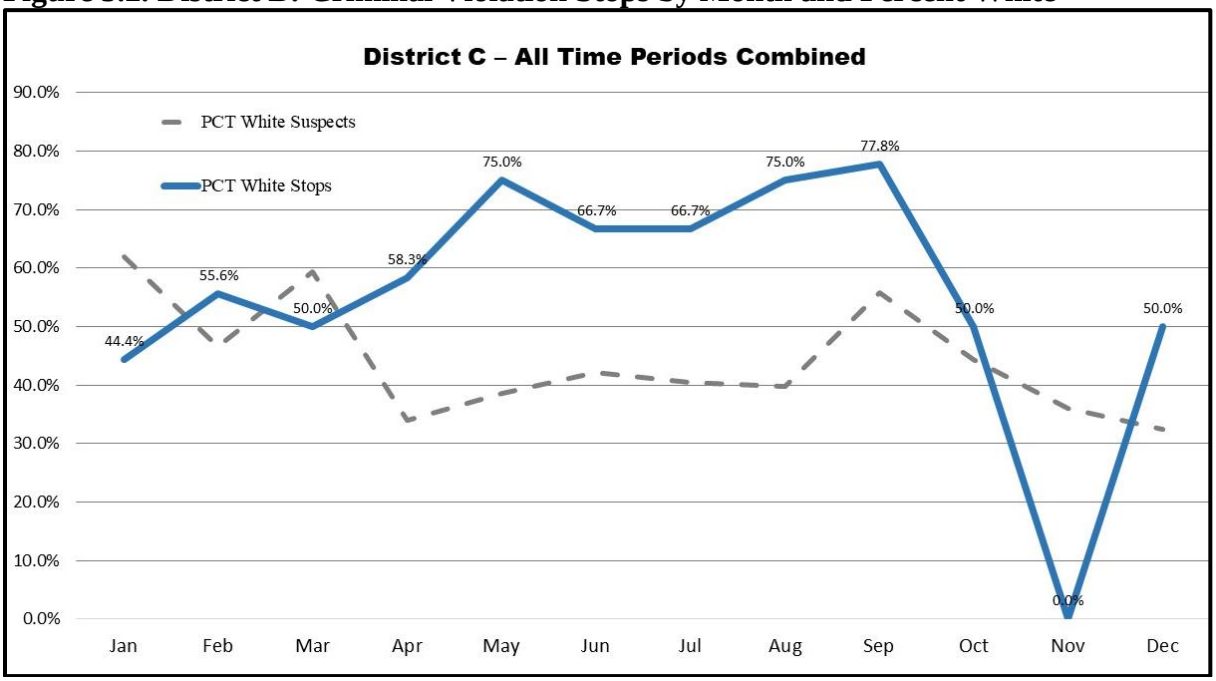
Table 5.4. District C: White Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	56.4% (22 out of 39 total drivers)	45.4% (158 out of 348 total suspects)	+11.0	**YES**
5:01 p.m. – 5:00 a.m.	69.2% (36 out of 52 total drivers)	43.8% (166 out of 379 total suspects)	+25.4	**YES**

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As was done in the examination of other disparities, this disparity of criminal investigatory stops involving white drivers was examined by month to determine if there was any stability in this disparity to suggest a pattern of biased practice. Figure 5.2 below reveals a graph of the percentage of criminal investigative stops for white drivers, by month, within District C for both time blocks combined. Overlaid atop this graph is also the benchmark, the percentage of white criminal suspects, by month, within District C for both time blocks.

Figure 5.2. District B: Criminal Violation Stops by Month and Percent White



This figure reveals that the proportion of criminal investigative stops involving white drivers was significantly higher than the proportion of criminal suspects that were described as white for seven months of the year. This graph also reveals that this disproportionate stopping of white drivers was concentrated during the summer months. During April through September, criminal investigative

stops of white drivers were statistically significantly higher than would have been expected based the proportion of criminal suspects reported to have been white.

The real human cost of these disparities of white drivers was then examined. In District C, 91 stops were conducted based on criminal investigative reasons during 2017. Of these stops, 58 (63.7%) involved a white driver. The benchmark for those District C criminal investigative stops consisted of 727 criminal suspect descriptions reported to the police by members of the public. Of these crime suspect descriptions, 324 (44.6%) described a white individual. Based on this benchmark, we would have expected that approximately 44.6% of the 91 criminal investigative stops would have involved a white driver, or approximately 41 white drivers stopped rather than the 58 stops that actually occurred. Subtracting 41 from 58 reveals that this criminal investigative stop resulted in approximately **17** more stops of white drivers within District C than we would have expected over the course of the year. In other words, there were less than two more stops than expected each month. While this stops disparity was statistically significant, the substantive significance of this disparity was small – only one or two more stops each month than anticipated.

White Stops Summary

Stops of white drivers within District C showed little disparity. As was found in Districts A and B, stops for traffic violations within District C, regardless of time of day, revealed no evidence of bias for stopping white drivers. Stops for purely criminal investigative reasons, however, did reveal a disproportionate stopping of white drivers. Like was found within Districts A and B, white drivers were disproportionately stopped for criminal investigative reasons within District C. Unlike Districts A and B, however, this white driver disparity was revealed within both time blocks of the day. Deeper examination of this statistically significant finding revealed that this disparity was concentrated during April through September, but the substantive outcome of this disparity, only resulted in approximately **17** more criminal investigative stops of white drivers over the year.

Stops of African-American Drivers

Recall that the examination of stops of African-American drivers within District A revealed no statistically significant disparities for either traffic violation stops or criminal investigative stops. District B also revealed no disparity in criminal investigative stops of African-American drivers. District B traffic violation stops of African-American drivers, however, did reveal a small amount of statistically significant disparity that was limited to certain months of the year and the 11:01 p.m. to 5:00 a.m. time block. No such disparity involving African-American drivers was revealed within District C.

Stops of African-American Drivers for Traffic Violations

Of the 5,262 stops for traffic violations that occurred within District C, 631 involved African-American drivers. Of the 2,286 vehicles involved in motor vehicle crashes within District C, 248 involved African-American drivers. Table 5.5 below reveals the statistical information related to the traffic violation stops of African-American drivers within District C. This table reveals no evidence of disparities in disproportionate stops of African-American drivers for traffic violations within District C during each of the four time blocks. The proportions of traffic violation stops involving African-American drivers were statistically similar to the proportion of drivers in crashes who were African-Americans. All percentage differences were within the margin of error

for sampling error. Therefore, no evidence was found here of disproportionate stops involving African-American drivers.

Table 5.5. District C: African-American Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	9.5% (155 out of 1,637 total drivers)	11.7% (69 out of 592 total crash drivers)	-2.2	No
11:01 a.m. – 5:00 p.m.	12.2% (303 out of 2,482 total drivers)	11.0% (108 out of 985 total crash drivers)	+1.2	No
5:01 p.m. – 11:00 p.m.	13.1% (118 out of 900 total drivers)	9.3% (58 out of 625 total crash drivers)	+3.8	No
11:01 p.m. – 5:00 a.m.	22.5% (55 out of 243 total drivers)	15.5% (13 out of 84 total crash drivers)	+7.0	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of African-American Drivers

Of the 91 criminal investigative stops that occurred within District C, only 26 involved an African-American driver. Of the 727 criminal suspect descriptions reported within District C, 293 involved a description of an African-American suspect. Table 5.6 below reveals the statistical data related to the purely criminal investigative stops of African-American drivers within District C.

Table 5.6. District C: African-American Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	35.9% (14 out of 39 total drivers)	37.4% (130 out of 348 total suspects)	-1.5	No
5:01 p.m. – 5:00 a.m.	23.1% (12 out of 52 total drivers)	43.0% (163 out of 379 total suspects)	-19.9	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Recall that these stops were based solely on criminal investigative reasons without having observed a traffic violation. In this case, no statistically significant stop disparities of disproportionate stops were revealed for African-American drivers. In fact, when compared to the proportion of reported criminal suspects in District C who were African-Americans during the 5:01 p.m. to 5:00 a.m. time block, drivers who were African-American were stopped at a *much* lower percentage than was expected by the benchmark. In other words, no evidence of

disproportionate stops of African-American drivers was revealed with regard to criminal investigative stops within District C.

African-American Stops Summary

Examination of stops within District C revealed no evidence of racial disparities involving disproportionate stops of African-American drivers. The proportion of traffic violation stops that involved African-American drivers was statistically similar to the proportion of drivers involved in crashes who were African-Americans. Examination of criminal investigative stops further revealed that the proportion of drivers stopped who were African-Americans was lower than the proportion of criminal suspects who were reported to have been African-Americans. In summary, no evidence was revealed to suggest any disproportionate stopping of African-American drivers within District C.

Stops of Asian-American and Pacific Islander Drivers

In the earlier examinations of Districts A and B, no evidence of racial disparities in stops regarding Asian-American and Pacific Islander drivers were revealed. Regardless of time of day or type of stop (traffic violation or criminal investigative stop), the proportion of Asian-American and Pacific Islander drivers stopped was statistically similar to the proportion of Asian-American and Pacific Islander drivers found within the benchmarks used within that district. This trend appeared again in our examination of District C.

Stops of Asian-American and Pacific Islander Drivers for Traffic Violations

During 2017, of the traffic violation stops that occurred within District C, 619 involved Asian-American or Pacific Islander drivers. Of the vehicles involved in vehicle crashes within District C, 221 had an Asian-American or Pacific Islander driver. Table 5.7 below displays the statistical data involving traffic violation stops of Asian-American and Pacific Islander drivers within District C.

Table 5.7. District C: Asian-American and Pacific Islander Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	13.3% (218 out of 1,637 total drivers)	8.8% (52 out of 592 total crash drivers)	+4.5	No
11:01 a.m. – 5:00 p.m.	10.8% (267 out of 2,482 total drivers)	7.9% (78 out of 985 total crash drivers)	+2.9	No
5:01 p.m. – 11:00 p.m.	12.2% (110 out of 900 total drivers)	13.4% (84 out of 625 total crash drivers)	-1.2	No
11:01 p.m. – 5:00 a.m.	9.9% (24 out of 243 total drivers)	8.3% (7 out of 84 total crash drivers)	+1.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As this table exhibits, no statistically significant racial disparities involving disproportionate stops of Asian-American or Pacific Islander drivers were revealed. Regardless of time of day, the proportion of stops for traffic violations within District C that involved Asian-American and Pacific Islander drivers displayed statistically similar proportions to drivers involved in crashes who were Asian-Americans or Pacific Islanders. The percentage point differences between the benchmarks and the traffic violation stops, by time of day, were well within the margin of error for sampling error.

Criminal Investigative Stops of Asian-American and Pacific Islander Drivers

Only 3 of the criminal investigative stops that occurred within District C involved an Asian-American or Pacific Islander driver. Of the criminal suspect descriptions given by members of the public within District C, only 12 involved an Asian-American of Pacific Islander suspected of a crime. Table 5.8 shows the statistical information associated with criminal investigatory stops of Asian-American and Pacific Islander drivers within District C. Once again this table reveals no statistically significant disparity in disproportionate stops existed involving criminal investigative stops of Asian-American and Pacific Islander drivers. The proportion of those stopped were statistically similar to the proportion of those found within the benchmark by time of day for District C.

Table 5.8. District C: Asian-American and Pacific Islander Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	2.6% (1 out of 39 total drivers)	0.9% (3 out of 348 total suspects)	+1.7	No
5:01 p.m. – 5:00 a.m.	3.9% (2 out of 52 total drivers)	2.4% (9 out of 379 total suspects)	+1.5	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Asian-American and Pacific Islander Stops Summary

In summary, regardless of time of day within District C, or type of stop involved (traffic violation stop versus criminal investigative stop), stops of Asian-American and Pacific Islander drivers showed no evidence of disparate treatment within District C.

Stops of All Other Group Drivers

Our analysis of Districts A and B both revealed that drivers from the remaining racial and ethnic categorizations were stopped at very similar proportions to which they were also involved in traffic crashes, or described by members of the public as suspects in crimes within each district. Similar findings resulted here within District C.

Stops of All Other Groups Drivers for Traffic Violations

During 2017 within District C, of the 5,262 traffic violation stops that occurred, only 165 involved persons from all of these other groups. Of the 2,286 vehicles involved in crashes within District C, only 57 involved drivers who were persons from all other remaining racial or ethnic category groups. Table 5.9 below displays the numeric information related to these stops. As can be seen within this table, even though no binomial or chi-square tests were conducted, the proportion of drivers stopped for traffic violations were all within a few percentage points of the crash driver benchmark. These differences were small and statistically inconsequential. These figures suggest there was no evidence of disparity involving traffic violation stops involving drivers of all remaining racial and ethnic groups.

Table 5.9. District C: All Other Group Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	2.7% (44 out of 1,637 total drivers)	2.5% (15 out of 592 total crash drivers)	+0.2	---
11:01 a.m. – 5:00 p.m.	2.6% (65 out of 2,482 total drivers)	2.7% (27 out of 985 total crash drivers)	-0.1	---
5:01 p.m. – 11:00 p.m.	4.6% (41 out of 900 total drivers)	2.1% (13 out of 625 total crash drivers)	-2.5	---
11:01 p.m. – 5:00 a.m.	6.2% (15 out of 243 total drivers)	2.4% (2 out of 84 total crash drivers)	+3.8	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of All Other Group Drivers

Only 4 criminal investigative stops within District C during 2017 involved persons from the 'all other groups' category, and 99 criminal suspects were described by members of the public as being persons from this category. Table 5.10 reveals the numeric information associated with the criminal investigative stops involving this 'all other groups' category, minus the binomial test for statistical significance.

As only two stops occurred during the daytime hours, and two more stops occurred during the evening and nighttime hours over the course of the entire year, the differences between the stops and benchmark of criminal suspects were inconsequential. In fact, the proportion of stops that consisted of persons within this group were consistently lower than the proportion of criminal suspect descriptions involving persons from this group. As a result, no evidence of racial disparities was found involving criminal investigative stops of persons falling into the all other races and ethnicities group.

Table 5.10. District C: All Other Groups Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	5.1% (2 out of 39 total drivers)	16.7% (58 out of 348 total suspects)	-11.6	---
5:01 p.m. – 5:00 a.m.	3.9% (2 out of 52 total drivers)	10.8% (41 out of 379 total suspects)	-6.9	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

All Other Groups Stops Summary

Regardless of time of day, stops for traffic violations and criminal investigative stops showed no evidence to suggest bias for stopping drivers of this mixed group of race / ethnicity drivers within District C.

Summary for District C

During 2017, officers of the Ann Arbor Police Department made 5,262 vehicle stops for traffic violations and 91 criminal investigative vehicle stops within District C. The benchmark measures for District C consisted of 2,286 drivers involved in crashes within the district, and victim-witness descriptions of 727 crime suspects.

Regarding stops of male drivers, no evidence of stop disparities was found. Regardless of time of day, within District C, traffic violation stops of male drivers were in statistically similar proportions to the representation of male drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping male drivers, as the proportion of males stopped was statistically similar to the proportion of male criminal suspects.

Regarding stops of white drivers, a small amount of disparity in stops was revealed. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage of drivers stopped for traffic violations who were white was statistically similar to the proportion of drivers involved in crashes who were white. Criminal investigative stops, however, showed white drivers were stopped more often than would have been expected based on the suspect descriptions benchmarks. While this disparity was consistent across both time blocks of the day, and was concentrated most during the summer months. This stop disparity is estimated to have only resulted in **17** more criminal investigative stops of white drivers than were expected over the course of the year.

Regarding stops of African-American drivers, no evidence of stop disparities was found. Regardless of time of day, within District C, traffic violation stops of African-American drivers were in statistically similar proportions to the representation of African-American drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping African-American drivers. In fact, criminal investigative stops of

African-American drivers were lower than would have been expected based on the criminal suspect benchmark.

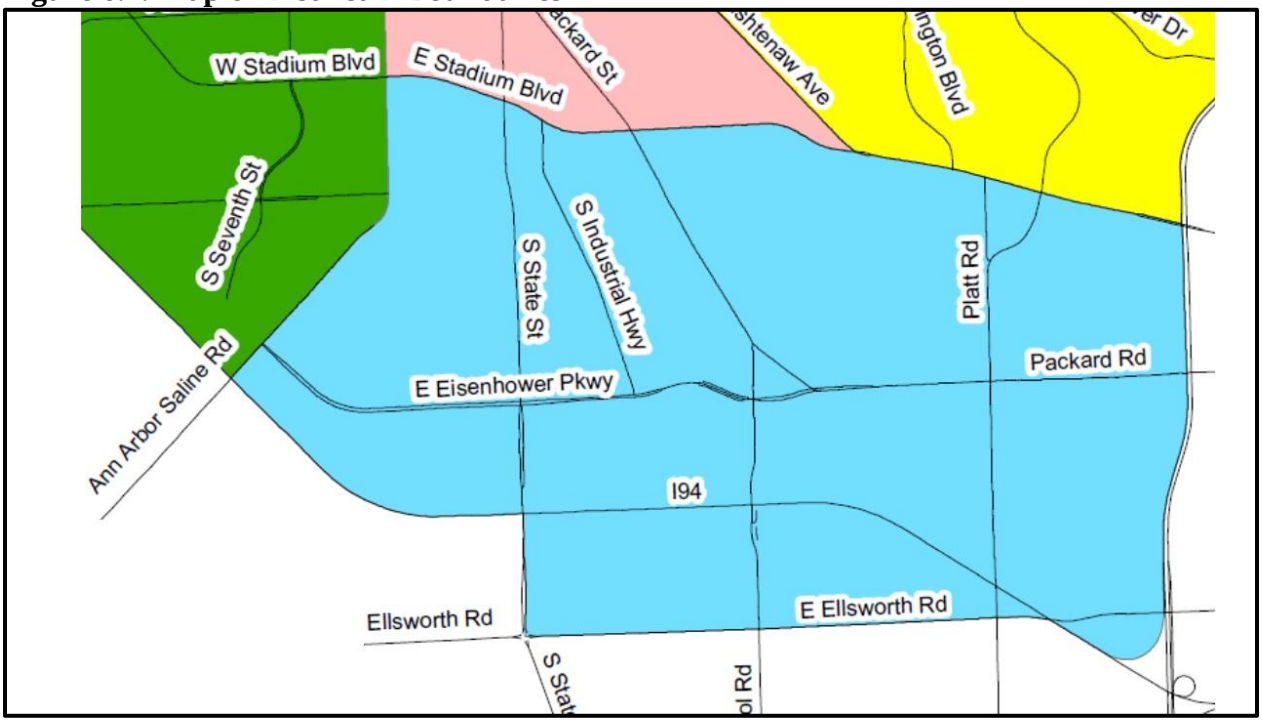
Regarding stops of Asian-American and Pacific Islander drivers, no evidence of stop disparities was found. Regardless of time of day, within District C, traffic violation stops of Asian-American and Pacific Islander drivers were in statistically similar proportions to the representation of Asian-American and Pacific Islander drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers, as the proportion of individuals stopped was statistically similar to the proportion of criminal suspects within District C.

Regarding stops of individuals from all other remaining racial and ethnic groups, no evidence existed to suggest any disparities in stops. Regardless of time of day, stops for traffic violations or criminal investigative reasons showed no evidence to suggest bias for stopping drivers of this mixed group of races and ethnicities within District C.

PART VI. DISTRICT D

District D encompasses the southern quarter of Ann Arbor's land area. District D is bordered on the north by East Stadium Boulevard, and on the east by the eastern city limit and U.S. Highway 23. The district's western boundary is South Main Street from East Stadium Boulevard to Scio Church Road, Ann Arbor Saline Road, Interstate Highway I-94 from Ann Arbor Saline to South State Street, and finally South State Street down to Ellsworth Road. The southern boundary of District D is alternately East Ellsworth Road and I-94.

Figure 6.1. Map of District D Boundaries



The area within District D is primarily residential and commercial (especially retail). This District includes Briarwood Mall, Arlington Square Shopping District, and the historic neighborhoods of Allen, Georgetown, and the Stone School area. During 2017, officers of the Ann Arbor Police Department made 3,228 vehicle stops for traffic violations, and 110 criminal investigative vehicle stops, within District D. The benchmark measures for District D consisted of 1,841 drivers involved in crashes within the district, and victim-witness descriptions of 1,380 criminal suspects reported within District D.

Stops of Male Drivers

Recall that within Districts A and B, stop disparities regarding male drivers were revealed, while no male stop disparities were revealed within District C. The examination of male stops within District D revealed a pattern more similar to those revealed within Districts A and B.

Stops of Males for Traffic Violations

Of the 3,228 stops for traffic violations Ann Arbor officers made within District D during 2017, 1,697 involved a male driver. That same year, of the 1,841 vehicles that were involved in motor vehicle crashes within District D, 900 had been driven by a male driver. Table 6.1 below displays the statistical data on the traffic violation stops of males that occurred within District D during 2017.

Table 6.1. District D: Male Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	47.5% (424 out of 893 total drivers)	48.2% (185 out of 384 total crash drivers)	-0.7	No
11:01 a.m. – 5:00 p.m.	47.5% (595 out of 1,254 total drivers)	47.6% (401 out of 843 total crash drivers)	-0.1	No
5:01 p.m. – 11:00 p.m.	60.8% (494 out of 812 total drivers)	50.8% (287 out of 565 total crash drivers)	+10.0	**YES**
11:01 p.m. – 5:00 a.m.	68.4% (184 out of 269 total drivers)	55.1% (27 out of 49 total crash drivers)	+13.3	**YES**

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

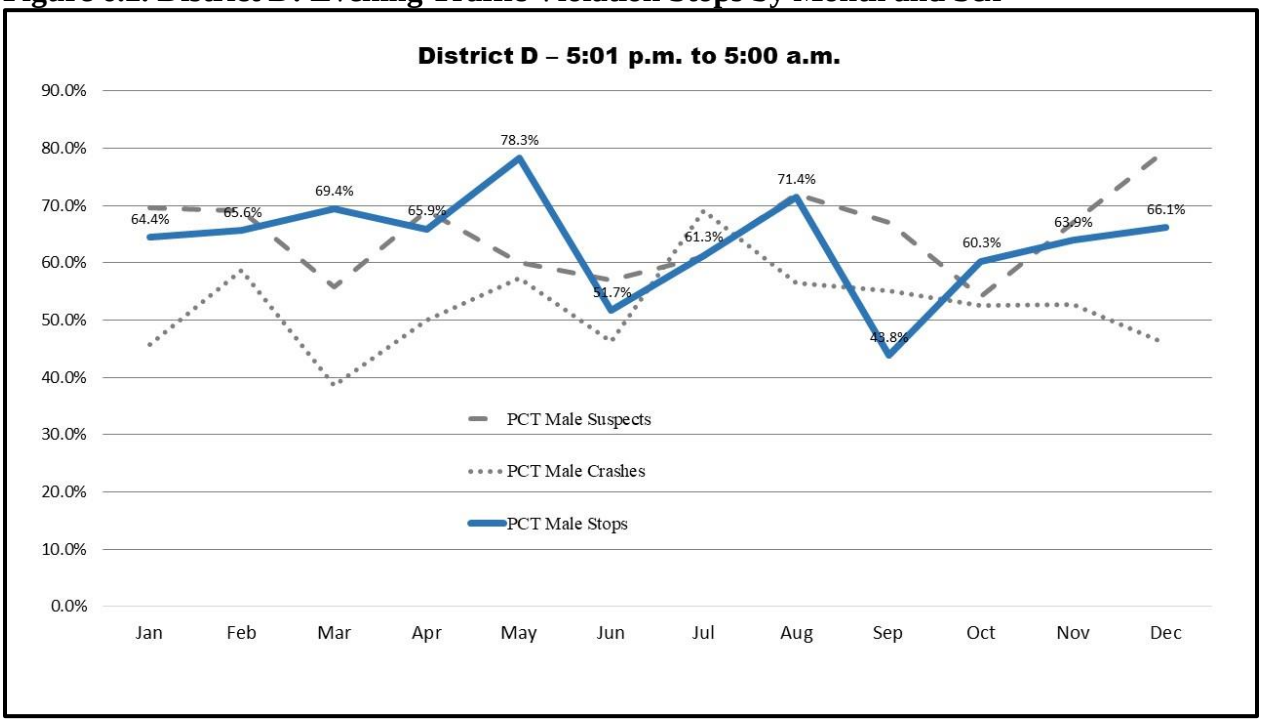
As Table 6.1 reveals, no statistically significant disparities were found by driver sex for the 5:01 a.m. to 11:00 a.m. time block, or the 11:01 a.m. to 5:00 p.m. time block for District D. During the 5:01 p.m. to 11:00 p.m. and 11:01 p.m. to 5:00 a.m. time slots, however, traffic violation stops of male drivers were higher than the benchmark measure of traffic crash drivers would have predicted. In other words, statistically significant disproportionate stops of male drivers occurred within District D during the 5:01 p.m. to 5:00 a.m. time period. Yet again, this disparity occurred during the times of day with the least daylight, when it was the most difficult for officers to determine the race of the driver before making the traffic violation stop.

To explore this traffic violation stop disparity in greater detail, the percentage of District D's traffic violation stops for males within these two consecutive time periods were graphed across the twelve months of the year. This was done to examine whether the stop disparity of males in District D from 5:01 p.m. to 5:00 a.m. was a consistent pattern of police practice or an inconsistent event. This graph is displayed in Figure 6.2 below. Overlaid atop this graph is also the percentage of male crash drivers, and the percentage of criminal suspects who were male, by month, within District D during these times of day (5:01 p.m. to 5:00 a.m.).

Observe that within Figure 6.2 the solid line is the proportion of traffic violation stops that involved a male driver. The dotted line reveals the percentage of crash drivers that were male. The percentage of traffic violation stops that involved males was statistically significantly higher than the proportion of male crash drivers for every month except June, July, and September, suggesting

that this trend – while somewhat sporadic – occurred over the majority of the year. The dashed line in the graph represents the proportion of criminal suspect descriptions for the district and time period that involved male suspects. The traffic violation stop patterns for males more closely resembles this crime benchmark line, suggesting that some of these traffic violation stops may have had a criminal investigative intent, yet stops during March, May, and October even exceeded this criminal suspect benchmark.

Figure 6.2. District D: Evening Traffic Violation Stops by Month and Sex



The substantive significance of these disparities in terms of actual humans stopped was then calculated. Between 5:01 p.m. and 5:00 a.m. in District D, 1,081 traffic violation stops took place, of which 678 (62.7%) involved male drivers. The benchmark for these stops involved 614 drivers involved in crashes, of which 314 (51.1%) were male. This benchmark would have predicted approximately 51.1% of the stops would be of male drivers, or 552 male drivers rather than the 678 stops of male drivers that actually occurred. Subtracting 552 from 678 reveals that approximately **126** more male drivers were stopped than expected over the course of the year within District D. This averages out to between two and three more male stops than expected every week during the time block of 5:01 p.m. to 5:00 a.m. in District D.

Criminal Investigative Stops of Males

Next we turn to an examination of male stops for purely criminal investigative reasons within District D. During 2017, officers conducting vehicle stops within District D made 110 stops for criminal investigative reasons. Of these stops, 66 involved a male driver. Members of the public also reported to the police the physical descriptions of 1,380 suspects in crimes within District D during 2017. Of these suspect descriptions, 868 were male. Table 6.2 displays the statistical

information of these stops compared to the benchmark of criminal suspect descriptions as reported by members of the public, disaggregated by two, 12-hour time blocks.

Table 6.2. District D: Male Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	56.6% (30 out of 53 total drivers)	60.0% (370 out of 617 total suspects)	-3.4	No
5:00 p.m. – 5:01 a.m.	63.2% (36 out of 57 total drivers)	65.3% (498 out of 763 total suspects)	-2.1	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As Table 6.2 reveals, despite the disparities in traffic violation stops of male drivers, no such stops disparities were revealed with regard to criminal investigative stops. The proportion of criminal investigative stops that involved male drivers was statistically similar to the proportion of suspects in crimes that were reported to have been male. Any percentage differences were well within the margin of error for sampling error.

Male Stops Summary

In summary, within District D, stop disparity was revealed for traffic violation stops of males during the evening and nighttime hours of the day (5:01 p.m. through 5:00 a.m.). The pattern of disparity in stops was somewhat sporadic across the months of the year, and the substantive impact of this disparity was **126** more male drivers stopped over the course of the year than was expected by the crash driver benchmark. During all other times of the day, no evidence was found of sex disparities in traffic violation stops, and no evidence was found of sex disparities in criminal investigative stops during any period of the day for District D.

Stops of White Drivers

Recall that in District A, no disparities were revealed regarding whites stopped for traffic violations. However, District A did reveal that whites were disproportionately stopped for criminal investigative reason between 5:01 a.m. and 5:00 p.m. This disparity occurred inconsistently across only seven months of the year. We were interested to see if this pattern reappeared within District D.

Stops of White Drivers for Traffic Violations

Of the 3,228 traffic violation stops that occurred within District D, 2,316 involved a white driver. Of the 1,841 vehicles involved in crashes within District D, 1,454 involved a white driver. Table 6.3 displays the numeric figures on the traffic violation stops of white drivers that occurred within District D during 2017. Just as was the case in Districts A, B, and C, no statistically significant racial disparities in stops were revealed regarding traffic violation stops of white drivers. During each of the four, 6-hour time blocks, the percentage of traffic violation stops that involved white drivers was statistically similar to the percentage of drivers in vehicle crashes that were white. Any

differences were small enough to be statistically insignificant, meaning these differences likely occurred due to sampling error.

Table 6.3. District D: White Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	74.0% (661 out of 893 total drivers)	78.4% (301 out of 384 total crash drivers)	-4.4	No
11:01 a.m. – 5:00 p.m.	75.4% (946 out of 1,254 total drivers)	77.9% (657 out of 843 total crash drivers)	-2.5	No
5:01 p.m. – 11:00 p.m.	68.7% (558 out of 812 total drivers)	74.0% (468 out of 565 total crash drivers)	-5.3	No
11:01 p.m. – 5:00 a.m.	56.1% (151 out of 269 total drivers)	57.2% (28 out of 49 total crash drivers)	-1.1	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of White Drivers

Of the 110 criminal investigative stops that occurred within District D during 2017, 58 involved white drivers. Of the benchmark measure of 1,380 criminal suspects reported within District D, 509 were white. The statistical information related to this examination of criminal investigative stops is revealed in Table 6.4 below.

Table 6.4. District D: White Drivers in Criminal Investigative Stops

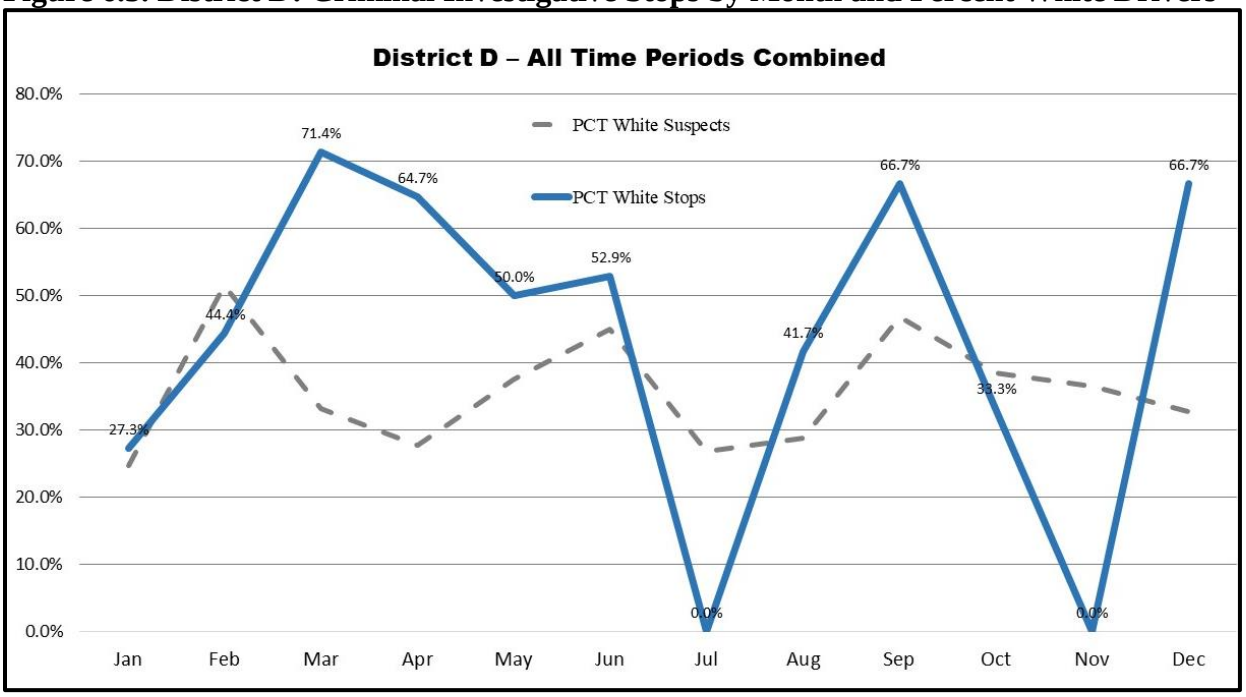
Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	52.8% (28 out of 53 total drivers)	36.5% (225 out of 617 total suspects)	+16.3	**YES**
5:00 p.m. – 5:01 a.m.	52.6% (30 out of 57 total drivers)	37.2% (284 out of 763 total suspects)	+15.4	**YES**

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Up to this point, all of the previously examined districts revealed that white drivers were disproportionately stopped during criminal investigative stops, especially during stops made during daylight hours. This trend continued with our analysis of District D. As was the case within District C, criminal investigative stops within District D revealed disproportionate stopping of white drivers during both time blocks.

As was done in the examination of other disparities, this disparity of criminal investigatory stops involving white drivers was examined by month to determine if there was any stability in this disparity to suggest a pattern of biased practice. Figure 6.3 below reveals a graph of the percentage of criminal investigative stops for white drivers, by month, within District D for both time blocks combined. Overlaid atop this graph is also the benchmark, the percentage of white criminal suspects, by month, within District D for both time blocks.

Figure 6.3. District D: Criminal Investigative Stops by Month and Percent White Drivers



This figure reveals that the proportion of criminal investigative stops involving white drivers was significantly higher than the proportion of criminal suspects that were described as white for seven months of the year (March, April, May, June, September, and December). The real human cost of these disparities of white drivers was then examined. In District D, 110 stops were conducted based on criminal investigative reasons during 2017. Of these stops, 58 (52.7%) involved a white driver. The benchmark for those District D criminal investigative stops consisted of 1,380 criminal suspect descriptions reported to the police by members of the public. Of these crime suspect descriptions, 509 (36.9%) described a white individual. Based on this benchmark, we would have expected that approximately 36.9% of the 110 criminal investigative stops would have involved a white driver, or approximately 41 white drivers stopped rather than the 58 stops that actually occurred. Subtracting 41 from 58 reveals that this criminal investigative stop resulted in approximately **17** more stops of white drivers within District D than we would have expected over the course of the year. In other words, there were less than two more stops than expected each month. While this stops disparity was statistically significant, the substantive significance of this disparity was small – only one or two more stops each month than anticipated.

White Stops Summary

Stops of white drivers within District D showed some disparity. As was found in Districts A, B, and C, stops for traffic violations within District D, regardless of time of day, revealed no evidence of bias for stopping white drivers. Stops for purely criminal investigative reasons, however, did reveal a disproportionate stopping of white drivers. Like was found within Districts A, B, and C, white drivers were disproportionately stopped for criminal investigative reasons within District D. White driver disparity was revealed within both time blocks of the day within District D. Deeper examination of this statistically significant finding revealed that this disparity was sporadic across the months of the year, and the substantive outcome of this disparity resulted in approximately **17** more criminal investigative stops of white drivers over the year.

Stops of African-American Drivers

Recall that the examination of stops of African-American drivers within District A and C revealed no statistically significant disparities for either traffic violation stops or criminal investigative stops. District B also revealed no disparity in criminal investigative stops of African-American drivers, but did reveal a small amount of statistically significant disparity in traffic violation stops that was limited to certain months of the year during the 11:01 p.m. to 5:00 a.m. time block. No disparities involving African-American drivers were revealed within District D.

Stops of African-American Drivers for Traffic Violations

Of the 3,228 stops for traffic violations that occurred within District D, 569 involved African-American drivers. Of the 1,841 vehicles involved in motor vehicle crashes within District D, 272 involved African-American drivers. Table 6.5 below reveals the statistical information related to the traffic violation stops of African-American drivers within District D.

Table 6.5. District D: African-American Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	14.4% (129 out of 893 total drivers)	13.8% (53 out of 384 total crash drivers)	+0.6	No
11:01 a.m. – 5:00 p.m.	14.7% (184 out of 1,254 total drivers)	14.4% (121 out of 843 total crash drivers)	+0.3	No
5:01 p.m. – 11:00 p.m.	20.4% (166 out of 812 total drivers)	14.7% (83 out of 565 total crash drivers)	+5.7	No
11:01 p.m. – 5:00 a.m.	33.5% (90 out of 269 total drivers)	30.6% (15 out of 49 total crash drivers)	+2.9	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Table 6.5 reveals no evidence of disproportionate stops of African-American drivers for traffic violations within District D during each of the four time blocks. The proportions of traffic violation

stops involving African-American drivers were statistically similar to the proportion of drivers in crashes who were African-Americans. All percentage differences were within the margin of error for sampling error. Therefore, no evidence was found here of disproportionate stops involving African-American drivers concerning traffic violation stops.

Criminal Investigative Stops of African-American Drivers

Of the 110 criminal investigative stops that occurred within District D, only 43 involved an African-American driver. Of the 1,380 criminal suspect descriptions reported within District D, 728 involved a description of an African-American suspect. Table 6.6 below reveals the statistical data related to the criminal investigative stops of African-American drivers within District D.

Table 6.6. District D: African-American Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	43.4% (23 out of 53 total drivers)	51.9% (320 out of 617 total suspects)	-8.5	No
5:00 p.m. – 5:01 a.m.	35.1% (20 out of 57 total drivers)	53.5% (408 out of 763 total suspects)	-18.2	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As Table 6.6 demonstrates, no disproportionate stopping was revealed for African-American drivers. In fact, when compared to the proportion of reported criminal suspects in District D who were African-Americans, drivers who were African-American were stopped at a lower percentage than was expected by the benchmark. In other words, no evidence of disproportionate stopping of African-American drivers was revealed with regard to criminal investigative stops within District D.

African-American Stops Summary

Examination of stops within District D revealed no evidence of racial disparities involving disproportionate stops of African-American drivers. The proportion of traffic violation stops that involved African-American drivers was statistically similar to the proportion of drivers involved in crashes who were African-Americans. Examination of criminal investigative stops further revealed that the proportion of drivers stopped who were African-Americans was actually lower than the proportion of criminal suspects who were reported to have been African-Americans. In summary, no evidence was revealed to suggest any disproportionate stopping of African-American drivers within District D.

Stops of Asian-American and Pacific Islander Drivers

In the earlier examinations of Districts A, B, and C Districts, no evidence of racial disparities involving stops of Asian-American and Pacific Islander drivers were revealed. Regardless of time of day or type of stop (traffic violation or criminal investigative stop), the proportion of Asian-American and Pacific Islander drivers stopped was statistically similar to the proportion of Asian-

American and Pacific Islander drivers found within the benchmarks used within those districts. This trend appeared again in our examination of District D.

Stops of Asian-American and Pacific Islander Drivers for Traffic Violations

During 2017, of the traffic violation stops that occurred within District D, 208 involved Asian-American or Pacific Islander drivers. Of the vehicles involved in vehicle crashes within District D, 109 had an Asian-American or Pacific Islander driver. Table 6.7 below displays the statistical data involving traffic violation stops of Asian-American and Pacific Islander drivers within District D.

Table 6.7. District D: Asian-American and Pacific Islander Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	7.7% (69 out of 893 total drivers)	3.9% (15 out of 384 total crash drivers)	+3.8	No
11:01 a.m. – 5:00 p.m.	6.1% (77 out of 1,254 total drivers)	5.7% (48 out of 843 total crash drivers)	+0.4	No
5:01 p.m. – 11:00 p.m.	6.0% (49 out of 812 total drivers)	7.3% (41 out of 565 total crash drivers)	-1.6	No
11:01 p.m. – 5:00 a.m.	4.8% (13 out of 269 total drivers)	10.2% (5 out of 49 total crash drivers)	-5.4	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As this table discloses, no statistically significant racial disparities involving disproportionate stops of Asian-American or Pacific Islander drivers occurred. Regardless of time of day, the proportion of stops for traffic violations within District D that involved Asian-American and Pacific Islander drivers had statistically similar proportions to drivers involved in crashes who were Asian-Americans or Pacific Islanders. The percentage point differences between the benchmarks and the traffic violation stops, by time of day, were well within the margin of error for sampling error.

Criminal Investigative Stops of Asian-American and Pacific Islander Drivers

Only two of the criminal investigative stops that occurred within District D involved an Asian-American or Pacific Islander driver. Of the criminal suspect descriptions given by members of the public within District D, only 12 involved an Asian-Americans of Pacific Islanders suspected of a crime. Table 6.8 shows the statistical information associated with criminal investigatory stops of Asian-American and Pacific Islander drivers within District D. Once again this table reveals no statistically significant disparity in disproportionate stops existed involving criminal investigative stops of Asian-American and Pacific Islander drivers. The proportion of those stopped were statistically similar to the proportion of those found within the benchmark by time of day for District D.

Table 6.8. District D: Asian-American and Pacific Islander Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	1.9% (1 out of 53 total drivers)	0.8% (5 out of 617 total suspects)	-1.1	No
5:00 p.m. – 5:01 a.m.	1.8% (1 out of 57 total drivers)	0.9% (7 out of 763 total suspects)	-0.9	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Asian-American and Pacific Islander Stops Summary

In summary, regardless of time of day within District C, or type of stop involved (traffic violation stop versus criminal investigative stop), stops of Asian-American and Pacific Islander drivers showed no evidence of disparate treatment within District C.

Stops of All Other Group Drivers

The earlier analysis of Districts A, B, and C all revealed that drivers from the remaining racial and ethnic categorizations were stopped at very similar proportions to which they were also involved in traffic crashes, or described by members of the public as suspects in crimes within each district. Similar findings again resulted here within District D.

Stops of All Other Groups Drivers for Traffic Violations

During 2017 within District D, of the 3,228 traffic violation stops that occurred, only 81 involved persons from all of these other group categorizations. Of the 1,841 vehicles involved in crashes within District D, only 41 involved drivers who were persons categorized among the remaining racial or ethnic category groups. Table 6.9 below displays the numeric information related to these stops.

As can be seen within this table, even though no binomial or chi-square tests were conducted, the proportion of drivers stopped for traffic violations were all within a few percentage points of the crash driver benchmark. These differences were small and statistically inconsequential. These figures suggest there was no evidence of disparity involving traffic violation stops involving drivers of all remaining racial and ethnic groups.

Table 6.9. District D: All Other Groups Drivers Stopped for Traffic Violations

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Crash Drivers)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 11:00 a.m.	3.8% (34 out of 893 total drivers)	3.9% (15 out of 384 total crash drivers)	-0.1	No
11:01 a.m. – 5:00 p.m.	3.8% (47 out of 1,254 total drivers)	3.1% (26 out of 843 total crash drivers)	+0.7	No
5:01 p.m. – 11:00 p.m.	4.8% (39 out of 812 total drivers)	4.1% (23 out of 565 total crash drivers)	+0.7	No
11:01 p.m. – 5:00 a.m.	5.6% (15 out of 269 total drivers)	2.0% (1 out of 49 total crash drivers)	+3.6	No

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

Criminal Investigative Stops of All Other Group Drivers

Only 6 criminal investigative stops within District D during 2017 involved persons from the 'all other groups' category, and 131 criminal suspects were described by members of the public as being persons from this category. Table 6.10 reveals the numeric information associated with the criminal investigative stops involving this 'all other groups' category, minus the binomial test for statistical significance.

Table 6.10. District D: All Other Groups Drivers in Criminal Investigative Stops

Time	Pct. of Traffic Stops (Actual Drivers Stopped)	Pct. of Benchmark (Number of Criminal Suspects)	Percentage Point Difference	Binomial One-tailed Test Statistically Significant?
5:01 a.m. – 5:00 p.m.	1.9% (1 out of 53 total drivers)	10.9% (67 out of 617 total suspects)	-9.0	---
5:01 p.m. – 5:00 a.m.	8.8% (5 out of 57 total drivers)	8.4% (64 out of 763 total suspects)	+0.4	---

Significance level threshold is $p < .001$, or 99.9% confident that the disparity did not occur by chance.

As only two stops occurred during the daytime hours, and two more stops occurred during the evening and nighttime hours over the course of the entire year, the differences between the stops and benchmark of criminal suspects were inconsequential. In fact, the proportion of stops that consisted of persons within this group were consistently lower than the proportion of criminal suspect descriptions involving persons from this group during the 5:01 a.m. to 5:00 p.m. time block. As a result, no evidence of racial disparities was found involving criminal investigative stops of persons falling into the all other races and ethnicities group.

All Other Groups Stops Summary

Regardless of time of day, stops for traffic violations and criminal investigative stops showed no evidence to suggest bias for stopping drivers of this mixed group of race / ethnicity drivers within District D.

Summary for District D

During 2017, officers of the Ann Arbor Police Department made 3,228 vehicle stops for traffic violations and 110 criminal investigative vehicle stops within District D. The benchmark measures for District D consisted of 1,841 drivers involved in crashes within the district, and victim-witness descriptions of 1,380 crime suspects.

Regarding stops of male drivers, disparities were found. During the later hours of the day, from 5:01 p.m. to 5:00 a.m., male drivers were disproportionately stopped for traffic violation stops within District D. It was estimated that these disparities resulted in **126** more stops of male drivers than would have been anticipated based on the benchmark of crash drivers. No sex disparities were revealed, however, regarding traffic violation stops from 5:01 a.m. to 5:00 p.m. Likewise, regardless of time of day, within District D, criminal investigative stops of male drivers were in statistically similar proportions to the representation of male drivers involved in crashes.

Regarding stops of white drivers, a small amount of disparity in stops was revealed. Stops for traffic violations, regardless of time of day, revealed no evidence of bias for stopping white drivers. The percentage of drivers stopped for traffic violations who were white was statistically similar to the proportion of drivers involved in crashes who were white. Criminal investigative stops, however, showed white drivers were stopped more often than would have been expected based on the suspect descriptions benchmarks. While this disparity was consistent across both time blocks of the day, it was estimated to have only resulted in **17** more criminal investigative stops of white drivers than were expected over the course of the year.

Regarding stops of African-American drivers, no evidence of stop disparities was found. Regardless of time of day, within District D, traffic violation stops of African-American drivers were in statistically similar proportions to the representation of African-American drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping African-American drivers. In fact, criminal investigative stops of African-American drivers were lower than would have been expected based on the criminal suspect benchmark.

Regarding stops of Asian-American and Pacific Islander drivers, no evidence of stop disparities was found. Regardless of time of day, within District D, traffic violation stops of Asian-American and Pacific Islander drivers were in statistically similar proportions to the representation of Asian-American and Pacific Islander drivers involved in crashes. Stops for criminal investigative reasons, regardless of time of day, also showed no evidence of bias for stopping Asian-American and Pacific Islander drivers, as the proportion of individuals stopped was statistically similar to the proportion of criminal suspects within District D.

Regarding stops of individuals from all other remaining racial and ethnic groups, no evidence existed to suggest any disparities in stops. Regardless of time of day, stops for traffic violations or criminal investigative reasons showed no evidence to suggest bias for stopping drivers of this mixed group of races and ethnicities within District D.

PART VII. SUMMARY

In this brief final section, we will summarize the findings on the rate and nature of the stop disparities that were revealed. This summarization will be grouped by each demographic category and will reveal the total extent of each disparity in terms of humans actually effected.

Stops of Male Drivers

Male drivers were revealed to be stopped for traffic violations at a higher rate than was anticipated based on the rate of male driver involvement in vehicle crashes. Males were disproportionately stopped for traffic violations within Districts A, B, and D, primarily between the hours of 5:00 p.m. and 11:00 p.m., but only during certain months of the year. Within District A, which envelops the University of Michigan's main campus, these disproportionate stops were found to be the highest, and only occurred during the months of the university's academic year. The amount of disproportionate stopping of male drivers for traffic violations was less pronounced, but still statistically significant, within Districts B and D, and revealed no real pattern for the months when these disparities occurred.

Traffic violation stops within District C, the east side of the city, revealed no statistically significant disparities regarding the stopping of male drivers. Across each of the time blocks of the day, the proportion of male drivers stopped for traffic violations was statistically similar to the proportion of drivers in crashes who were male. Likewise, bias for the stopping of male drivers was revealed between 5:00 a.m. and 5:00 p.m. within Districts A, B, and D. Finally, stops based on criminal investigative authority, rather than traffic violations, revealed no disparities regarding male drivers. The percentage of male drivers encountered during criminal investigative stops across all periods of the day and all four districts were statistically similar to the proportion of males within criminal suspect descriptions reported to the police by members of the public.

When compared to the proportion of stops estimated by male involvement in motor vehicle crashes, the traffic violation stop disparities revealed within Districts A, B, and D were estimated to have resulted in **365** more male drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark (175 in District A, 64 in District B, and 126 in District D). Since there were 6,281 total stops of male drivers made by the Ann Arbor Police Department during 2017, this suggests that, had there been no statistically significant disparity, only about 5,916 male drivers would have been stopped. Put another way, male drivers were 6% more likely to have been stopped than one would have expected based on the benchmarks used in this analysis (6,281 ÷ 5,916 = 1.06).

Stops of White Drivers

White drivers were revealed to be stopped during criminal investigative stops at a higher rate than was anticipated based on the proportion of criminal suspects that members of the public indicated were white. White drivers were disproportionately detained in criminal investigative stops within all four districts. These disproportionate stops were concentrated during the daytime hours of 5:00

a.m. to 5:00 p.m. within Districts A and B, yet occurred during all time blocks within Districts C and D. Analysis by month showed only a sporadic pattern to this stop disparity.

Traffic violation stops, however, revealed no evidence of disproportionate stops of white drivers during any of the four districts. Across each of the four districts, and within each time block of the day, the proportion of white drivers stopped for traffic violations was statistically similar to the proportion of drivers in crashes who were white. Likewise, no bias was revealed for the stopping of white drivers in criminal investigative stops between 5:00 p.m. and 5:00 a.m. within Districts A or B.

When compared to the proportion of stops estimated by white representation among criminal suspect descriptions provided by members of the public, the criminal investigative stop disparities revealed were estimated to have resulted in **49** more white drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark (6 in District A, 9 in District B, 17 in District C, and 17 in District D). Since there were 10,332 total stops of white drivers made by the Ann Arbor Police Department during 2017, this suggests that, had there been no statistically significant disparity, only about 10,283 white drivers would have been stopped. Put another way, white drivers were only 0.5% more likely to have been stopped than one would have expected based on the benchmarks used in this analysis (10,332 ÷ 10,283 = 1.005).

Stops of African-American Drivers

African-American drivers were revealed to be stopped for traffic violations at a higher rate than was anticipated based on the rate of African-American driver involvement in vehicle crashes. This disparity, however, was isolated to sporadic months within only one district and only one time block of the day. African-American drivers were disproportionately stopped for traffic violations within District B between the hours of 11:00 p.m. and 5:00 a.m., but only during certain months of the year.

Traffic violation stops within District B within all of the remaining time blocks of the day revealed no statistically significant disparities regarding the stopping of African-American drivers. No disproportionate stopping of African-American drivers for traffic violations was revealed within the other districts, regardless of time block examined. The proportion of African-American drivers stopped for traffic violations was statistically similar to the proportion of drivers in crashes who were African-American.

Regarding criminal investigative stops, no disproportionate stopping of African-American drivers was observed within any of the four districts at any point of the day. In fact, across all four districts a trend was revealed that the proportion of African-American drivers detained by criminal investigative stops was consistently lower than the proportion of African-Americans included in suspect descriptions given to the police by members of the public. A trend was also revealed that African-American representation among traffic violation stops performed during daylight hours (when officers may be more likely to determine the driver's race before making a stop) was lower than predicted by the benchmark, not higher as one would expect if racial profiling were occurring.

When compared to the proportion of stops estimated by African-American involvement in motor vehicle crashes, the traffic violation stop disparity revealed within District B was estimated to have resulted in **19** more African-American drivers stopped by the Ann Arbor Police Department during 2017 than would have been expected based on the benchmark. Since there were 1,966 total stops of African-American drivers made by the Ann Arbor Police Department during 2017, this suggests that, had there been no statistically significant disparity, only about 1,947 African-American drivers would have been stopped. Put another way, African-American drivers were 1% more likely to have been stopped than one would have expected based on the benchmarks used in this analysis (1,966 ÷ 1,947 = 1.01).

Stops of Asian-Americans and Pacific Islander Drivers

No evidence was revealed to suggest that Asian-American and Pacific Islander drivers were stopped disproportionately. When examining traffic violation stops, regardless of district or time block of the day, the proportion of drivers stopped who were Asian-Americans and Pacific Islanders was statistically similar to the proportion of drivers involved in crashes who were Asian-American and Pacific Islander. When examining criminal investigative stops, regardless of district or time block of the day, the proportion of drivers stopped who were Asian-Americans and Pacific Islanders was statistically similar to the proportion of criminal suspect descriptions members of the public described as Asian-American and Pacific Islander.

Stops of All Other Remaining Group Drivers

Because so few stops involved drivers identified as Native American, Hispanic, Multiracial, or Other, there were too few cases within each group to analyze each group individually. Furthermore, because they were in such small numbers, sometimes there was no representation of each group at all within the stops or benchmark for a district or time block. As a result, recall that all of these stops were combined into an 'all other groups' category that included such an array of within-group diversity, that statistical comparisons with this group would have been inappropriate. Surprisingly, when examining only the percentages in the stops and the benchmarks, the representation of individuals within this 'all other groups' for vehicle stops was always less than, or similar to, the representation of this group in the benchmarks.

When examining traffic violation stops, regardless of district or time block of the day, the proportion of drivers stopped who were included within the 'all other groups' category was lower or similar to the proportion of drivers involved in crashes who were included within the 'all other groups' category. When examining criminal investigative stops, regardless of district or time block of the day, the proportion of drivers stopped who were included within the 'all other groups' category was lower or similar to the proportion of criminal suspect descriptions members of the public described as included within the 'all other groups' category.

Disparity Summary

Overall, group disparities within vehicle stops by the Ann Arbor Police Department were very small. The greatest disparity occurred among male drivers, who were estimated to have been 6% more likely to be stopped than expected if no bias was present. The second greatest disparity was

revealed among African-American drivers, who were estimated to have been 1% more likely to have been stopped than expected if no bias was present. The least amount of disparity involved white drivers, who were estimated to have been 0.5% more likely to have been stopped if no bias was present. No disparities were revealed regarding stops of Asian-American and Pacific Islander drivers, or those drivers included within the 'all other groups' category.

APPENDIX A: AUTHOR BIOGRAPHICAL SKETCHES

The Dolan Consulting Group (DCG) LLC is an organization of public policy experts who address issues related to public service provision organizations, such as law enforcement agencies, corrections agencies, fire departments, emergency medical services, hospitals, and school districts. We provide services such as assessments, training, and research with the goal of improving the operations and outputs of these agencies through evidence-based solutions. Our staff include former public safety leaders, attorneys, and statisticians, all of whom also have real world experience working in government and conducting quality training. The staff assigned to this specific project involved Dr. Richard Johnson and Dr. Mark Morgan.

Richard R. Johnson, Ph.D.
Dr. Johnson is the head of research for the Dolan Consulting Group, LLC. He holds an undergraduate degree in public policy / criminal justice from the School of Public and Environmental Affairs (SPEA) at Indiana University, a master's degree in criminology from Indiana State University, and a doctorate in criminal justice from the University of Cincinnati with concentrations in policing and administration. Dr. Johnson served 10 years as a faculty member of the criminal justice program at the University of Toledo, leaving at the rank of tenured full professor. He has also served as an adjunct faculty member for the criminal justice programs at the University of Cincinnati, University of Toledo, and the University of Michigan at Dearborn.

Dr. Johnson has conducted numerous research studies on a variety of criminal justice related topics. He has authored more than 50 articles in peer-reviewed academic research journals, such as *Justice Quarterly*, *Crime & Delinquency*, *Journal of Criminal Justice*, *Criminal Justice and Behavior*, *Police Quarterly*, *Criminal Justice Review*, and *Policing*. He has been the recipient of federal, state, and local research grants and completed the U.S. Bureau of Justice Assistance's Research Fellows Academy. He has received several university awards and accolades for his research. In addition to conducting research, Dr. Johnson has taught research methods and statistics courses at the undergraduate and graduate levels for more than a decade.

Dr. Johnson has extensive experience conducting research studies of, and for, law enforcement and corrections agencies. In the past, Dr. Johnson served on research teams examining potential racial profiling for the Pennsylvania State Police, Cleveland Bureau of Police, and Arizona Department of Public Safety. Dr. Johnson has also lead research projects on a variety of other law enforcement topics that have involved more than 40 law enforcement agencies, including the city police departments in Akron, Columbus, Dayton, and Toledo in Ohio, Knoxville, Tennessee, Louisville, Kentucky, and Raleigh, North Carolina.

Dr. Johnson was responsible for oversight, direction, and implementation of this entire project. He designed this research evaluation, supervised the data collection and processing, conducted the actual data analyses, and wrote the majority of this final report. Dr. Johnson was also responsible for all communication with the Chief of Police, and directed the work of the research associate.

Mark A. Morgan, Ph.D.
Dr. Morgan is a researcher with the Dolan Consulting Group, LLC, and a faculty member in the criminal justice program at Miami University in Ohio. He holds an undergraduate degree and master's degree in criminal justice from the University of Toledo, and a doctorate in criminal justice from the University of Cincinnati. Dr. Morgan has conducted numerous research studies on a variety of criminal justice related topics, including racial disparities in grade school discipline.

Dr. Morgan has authored 10 articles in peer-reviewed academic research journals, such as *Justice Quarterly*, *Journal of Criminal Justice*, *Youth Violence and Juvenile Justice*, and *Criminal Justice Studies*. He has served as a research assistant on federal, state, and local research grants. In addition to conducting research, Dr. Morgan has taught research methods and statistics courses at the undergraduate level for several years.

Dr. Morgan was responsible for cleaning the data received, preparing it for appropriate analysis, coding stops and benchmarks by location and time, double-checking all math calculations, and assisting with writing of the report.

APPENDIX B – ANN ARBOR POLICE NON-BIASED POLICING POLICY

	POLICY AND PROCEDURAL ORDER	**001-017**
	Non - Biased Policing	Page 1 of 3
	Issued By: Chief James Baird	
Effective: 11/19/2001	**Updated**: 09/25/2017	**CALEA Standards**
Last Reviewed: 09/25/2017		1.2.9

I. Purpose

The purpose of this policy is to reaffirm the department's commitment to non-biased policing, to clarify the circumstances in which officers can consider race ,ethnicity, gender, sexual orientation, religion, cultural group or age when making law enforcement decisions, and to reinforce procedures that serve to assure the public that we are providing service and enforcing laws in an equitable way.

II. Policy

Investigative detentions, traffic stops, arrests, searches and property seizures by officers will be based on a standard of reasonable suspicion or probable cause in accordance with the Fourth Amendment of the U. S. Constitution. Officers must be able to articulate specific facts and circumstances that support reasonable suspicion or probable cause for investigative detentions, traffic stops, arrests, nonconsensual searches and property seizures.

Except as provided below, officers shall not consider race, ethnicity, gender, sexual orientation, religion, cultural group or age in establishing either reasonable suspicion or probable cause. Similarly, officers shall not consider race/ethnicity in deciding to initiate even those nonconsensual encounters that do not amount to legal detentions or to request consent to search.

Officers may take into account the reported race, ethnicity, gender, sexual orientation, religion, cultural group or ageof a specific suspect or suspects based on trustworthy, locally relevant information that links a person or persons of a specific race/ethnicity to a particular unlawful incident(s). Race/ethnicity will never be used as the sole basis for probable cause or reasonable suspicion.

Race, ethnicity, gender, sexual orientation, religion, cultural group or age will not be motivating factors in making law enforcement decisions.

III. Procedures

A. To prevent inappropriate perceptions of biased law enforcement, each officer shall do the following when conducting pedestrian and vehicle stops:

1. Be courteous and professional.

a. Introduce him or herself to the citizen, providing name and agency affiliation.

b. State the reason for the stop as soon as practical, unless providing this information will compromise officer or public safety.

c. During vehicle stops, the officer will provide this information before asking the driver for his or her license and registration.

B. The officer will ensure that the detention is no longer than necessary to take appropriate action for the known or suspected offense and that the citizen understands the purpose of reasonable delays.

C. The officer will answer questions the citizen may have, including explaining options for traffic citation disposition if relevant.

D. The officer will apologize and/or explain if he or she determines that the individual was not involved in the activity that gave rise to the investigatory stop.

E. Officers who violate this policy or engage in any type of biased policing may be subject to disciplinary action up to and including discharge in accordance with contractual agreements.

IV. Responsibility and Corrective Measures

A. It is the responsibility of supervisors to properly review the actions and reports of subordinates, and to ensure no department employee is permitted to engage in bias profiling or other discriminatory practices.

B. All complaints alleging bias or discrimination shall be thoroughly investigated in accordance with P&P 052-001(Complaints about Employee Conduct or Department Directives)

C. Any sustained complaints will be subject to disciplinary action.

V. Training

A. The department is committed to providing timely training to all sworn personnel as a part of its on-going commitment to non-biased policing. Training may include topics such as:

1. Appropriate practices and procedures
2. Supervisory issues
3. Cultural diversity
4. Communications skills and De-escalation
5. Legal aspects of bias based profiling
6. Implicit Bias

B. Specific training will be provided to new hires in the in-house academy and on an annual basis for all sworn personnel. Training will be achieved through a variety of forums to include: In-Service Training, Roll Call Training, Online Training, Department meetings and any other means deemed applicable.

VI. Annual Review and Summary

A. The Office of Professional Standards shall annually provide to the Chief of Police a summary of the prior full calendar year's internal affairs investigations and citizen complaints, which include a listing of those complaints that allege any form of bias or discrimination.

B. Each Division Commander will conduct continual administrative review of department practices to ensure bias profiling is not occurring and/or to identify and analyze cases where it may have occurred. Sources for this review will include citizen complaints, citizen concerns, referrals from department personnel and any other communications received by the agency related to this topic.

C. Each respective Division Commander shall submit a memo to the Chief of Police detailing the results of the aforementioned review. The review will indicate whether policy, training, or disciplinary issues should be addressed.

APPENDIX C – ANN ARBOR POLICE NON-DISCRIMINATION POLICY

	POLICY AND PROCEDURAL ORDER	**001-012**
	Non-Discrimination Policy	Page 1 of 2
	Issued By: Chief James Baird	
Effective: 11/05/1999	**Updated:** 02/28/2018	**CALEA Standards**
Last Reviewed: 02/28/2018		1.2.9

I. Purpose

The purpose of this order is to establish a departmental policy statement on civil rights. This topic is also addressed in other directives. This policy statement is intended to reaffirm the department's determination to observe, uphold, and enforce all laws pertaining to the individual rights of persons without regard to race, color, ethnicity, religion, sex, sexual orientation or disability.

II. Policy

It is the policy of the Ann Arbor Police Department to ensure that rights guaranteed by the Federal and State Constitutions and Federal and State Statutes and local ordinance are protected for all persons, regardless of race, color, cultural or ethnic background, religion, sex, sexual orientation or disability. When such rights are infringed upon by violence, threats, or other harassment, the department will use its resources, in accordance with the law and existing policy and procedures, to identify the perpetrators, and where possible, arrest and prosecute those responsible.

All acts of violence or threats against ones civil rights are viewed as serious. Investigations into these incidents will be given prompt attention. These acts generate fear and concern among victims and the public and have the potential for reoccurring, escalating and possibly triggering counter-violence.

III. Individual Rights

A. All individuals are guaranteed protection against unlawful arrest and unreasonable search or seizure under the federal and state constitutions.

B. Ann Arbor Police personnel will be scrupulous in adhering to an individual's constitutional rights during criminal investigations.

C. Implicit in uniform enforcement of law is the element of evenhandedness in its application. The amount of force used or the method employed to secure compliance with the law or to make arrests is governed by the particular situation. Similar circumstances require similar treatment in all areas of the city and for all groups and individuals.

D. Members of the department come into contact with persons of diverse ethnic and sociological backgrounds. All persons within the city, whether transient or resident, and regardless of background, have in common the need for the protection afforded by fair and impartial law enforcement services.

E. The practice of racial profiling, defined as unlawful stops of people by the police driven primarily by race, color, gender, sexual orientation cultural orethnic background, is strictly prohibited.

IV. Enforcement

In order to respond to varying law enforcement needs in the different parts of the city, the department must have flexibility in deployment and methods of enforcement; however, enforcement policies should be developed on a city-wide basis, and applied uniformly in all areas.

V. Persons Arrested

All arrestees are guaranteed certain basic constitutional safeguards.

The public has the right to expect efficient, fair, and impartial law enforcement. Therefore, any allegations of or acts of misconduct by department personnel will be thoroughly investigated and properly adjudicated to assure adherence to these expectations.

VI. Responsibility

It is the responsibility of each employee of the Ann Arbor Police Department to familiarize themselves with the laws, ordinances and department directives pertaining to the constitutional and legal rights of individuals and protection of groups to ensure recognition, understanding and compliance.

This replaces P&P 001-012 dated November 5, 1999.