CY 2012 Motor Vehicle Stop Data Collection Analysis

Final Report

Metropolitan Nashville Police Department
Nashville and Davidson County

August 9, 2013

Prepared by
Crime Analysis Section

Table of Contents

Metropolitan Nashville Police Department, Nashville, Tennessee
Vehicle Stop Data Collection Analysis

Introduction

On January 1st 2001, the Metropolitan Nashville Police Department, Nashville, Tennessee began collecting vehicle stop data and volunteered to participate in the State of Tennessee Traffic Stop Data Collection Program. The State form was modified to add Metropolitan Nashville Police Department (MNPD) specific information, which included the address of the stop, complaint number, ticket number, residency of the driver, officer employee identification number, and driver's license number.

All Metropolitan Nashville Police Department officers were required to complete *MNPD Form 252 – Vehicle Stops Data Form*, whenever a vehicle was stopped. This included moving traffic violations, vehicle equipment violations, and investigative reasons. Each record denotes if a citation was issued, an arrest was made, or a search was conducted. The officer initiating the stop used their personal judgment to determine race and ethnicity of the driver, as recorded on the form.

The major reason to collect vehicle stop data is to analyze whether officers are engaging a disproportionate amount of drivers according to the race/ethnicity breakdown of Davidson County. One quagmire in analyzing vehicle stop data is that officers exercise an enormous amount of discretion in deciding with whom to engage for certain violations (e.g., failing to signal, lane-changing violations). For this reason, information on the officer and situations that occurred during the engagement was collected.

The Metropolitan Nashville Police Department has demonstrated an open commitment to unbiased policing. The Department recognized the need to collect vehicle stop information well before the State initiated a pilot test program. It was coincidental that the Department was able to take part in the 2001 pilot test. The Department has long committed to building trust and credibility for police in the community.

The Metropolitan Nashville Police Department, Strategic Development Division produces weekly reports that list the number of vehicle stops, citations, and arrests made for each Precinct and Detail. This report attempts to go beyond 'bean counting' by examining relationships between vehicle stop data and other factors (police workload, crime, and licensed drivers).

Purpose

To address the methodology used and results from the analysis of the Metropolitan Nashville Police Department's (MNPD) evaluation of the CY 2012 Motor Vehicle Stop Data Collection Program. This assessment emphasized an analysis of Black, White, and Hispanic licensed drivers in Davidson County.

Executive Summary

Law enforcement agencies across the country continue to be challenged to establish viable and reliable methods to explain why disproportionate amounts of vehicle stops of racial/ethnic minorities occur within a jurisdiction. While a single best way to analyze motor vehicle stop data has yet to be established, special care has been taken to assure that individual motorists and officers can not be identified in this study—the dataset is only analyzed in the aggregate. The purpose of this study was to assess whether the department as a whole was acting professionally—not identify or isolate the conduct of individual officers.

Empirical data collected for motor vehicle stops yield inconclusive results, do not determine causation, and can be easily misinterpreted. Although a higher percent of Black than White drivers were stopped when compared to Davidson County's licensed driver statistics, causation cannot be fully explained. However if one examines correlation coefficients of vehicle stops to police workload, crime, description of criminal suspects, and licensed drivers, the empirical differences can be better clarified.

A Geographic Information System (GIS) was used to evaluate spatial relationships of the motor vehicle stop data. Use of a uniform grid (equal area per grid cell) with addresses of licensed drivers proved to be more valid than using U.S. Bureau of Census boundaries and population. The grid method compared the locations of vehicle stops, crime, and police workload against the addresses listed on driver licenses of Black, White, and Hispanic drivers.

Additionally, the Crime Analysis Section analyzed the Pearson correlation coefficient of vehicle stop data for several different sets of variables. The Pearson coefficient (Pearson's r) is a measure of the correlation between two variables, resulting in a value between +1 and −1. It is a widely used statistic for measuring the strength of linear dependence between two variables.

There is sufficient evidence to suggest that the locations where police resources were deployed and suspects were described are strongly correlated with the locations where Black, White, and Hispanic drivers were stopped. This is significant because locations where police resources are deployed are generally determined based on calls for service and reported incident location data. A *VERY HIGH* positive correlation exists between residential addresses of Black licensed

drivers and the geographic locations where police resources were deployed. On the other hand, a *MODERATE* positive correlation exists between the residential address of White and Hispanic licensed drivers and the geographic locations where police resources were deployed. These relationships may help explain why a disproportionate amount of Black drivers were stopped. Unfortunately, locations with higher police officer presence may provide opportunities for police to engage Black drivers more often than drivers of other races/ethnicities.

Hispanic drivers represent 4.8% of the total vehicle stops in 2012, and make up an estimated 8.1% of the population age 16 and older. A significantly higher percentage of Hispanic drivers were arrested as a result of a vehicle stop, when compared to White and Black drivers. However, an analysis of arrest charges shows that most drivers arrested during a vehicle stop—88.8% of Hispanic drivers and 71.4% of Non-Hispanic drivers—were charged with a driver's license-related violation (i.e. driving without a license, or driving on a suspended, canceled, or revoked license).

Data Analysis and Results

Vehicle Stop Analyses summarize data collected from MNPD Form 252 (Vehicle Stops Data Form) as either the hard copy form or by using the InPursuit eForm application in RMS. The MNPD Information Technology Division provides the Crime Analysis Section access to data tables of this information residing on a SQL server. In total, the MNPD Crime Analysis Section analyzed 445,143 vehicle stop records in 2012—173,880 were Black drivers, 258,716 were White drivers, and 21,445 were Hispanic drivers. Although the following race categories were not evaluated in this study, there were 5,869 Asian/Pacific Islanders, 382 American Indian/Alaskans, and 6,296 "Other" drivers stopped while operating a motor vehicle. 15.5% of the drivers who were stopped were issued citations, and 6.6% of vehicle stops (29,371) resulted in an arrest (physical and/or citation arrest). Arrests made as a result of a vehicle stop represented 32.7% of all arrests (89,954) made in Davidson County in 2012. This is a slight decrease from 2011, when arrests made as a result of a vehicle stop (28,261) represented 33.2% of all Davidson County arrests (85,085). This high count of chargeable offenses resulting from traffic stops supports the efficacy of the traffic stop as an enforcement tool—irrespective of citation issuance vs. warning.

State of Tennessee driver license data for Davidson County residents were compared to the vehicle stop information. The MNPD Crime Analysis Section used SPSS statistical software and ArcView Geographic Information System (GIS) mapping software to gain a clearer understanding of the comparative relationships. SPSS is a statistical analysis software package widely used in the social sciences. Similarly, ESRI ArcView GIS is a leading software package for examining spatial relationships among mapped datasets. *Only correlation (the relationship) between data variables could be demonstrated; causation cannot be proved.*

Limitations and Assumptions

- Census data only represents the race and ethnicity of residents within the jurisdiction by census tract and census block and is not an accurate representation of the driver demographics in an area.
- Driver license race information was regarded as a more valid measure than census population information, but does not account for hot spot law enforcement initiatives.
- The movement of licensed drivers after a driver license is issued may impact the validity of the data.
- Information on licensed drivers who reside outside of the area being studied (e.g., census tract, grid, Davidson County) who are driving on local roads is unknown.
- It is impractical for a Police Department with such a large jurisdiction as Nashville (525 square miles) to conduct observational-type surveys on race and ethnicity of drivers on all of the major roads within the county. In

addition, it is extremely difficult to determine the race/ethnicity of drivers based solely on an observer's perception of a moving motor vehicle's driver.

- More police are deployed in areas with high Calls for Service volume.
- Annual workload assessments are performed to determine the optimum allocation of Patrol Zone Officers. The primary type of information used to perform the analysis is minutes of officer activity by location. The overall trend demonstrates that patrol zones (beats) are smaller towards the inner city and larger in the more rural areas near the county line. Thus, more officers are deployed towards the inner city, based on demand for police services.

Vehicle Stops to Population

Davidson County's demographic characteristics change significantly during the 10-year gap between decennial censuses. Therefore, population projections from the 2009-2011 American Community Survey (ACS) 3-year sample dataset were used for a more valid estimate of populations. For the purpose of this study, population counts of individuals age 16 and over were derived from the ACS. These population counts are depicted in **Table 1**.

Table 1. 2011 American Community Survey Population Estimates (Three Year Estimate)

	Black	***White***	***Hispanic***	***Estimated Total Population***
All Ages	174,050	394,047	61,024	628,179
16 Years & Up	131,529	331,906	41,112	504,722

Source: ACS 2009-2011 (3-Year Sample) Tables DP05, B23001, B23002A, B23002B, and B23002I.

One might expect traffic stops to be distributed proportionately among the various race/ethnicity categories. However, vehicle stops for Black drivers accounted for 39.1% of all stops, even though the ACS reported that 26.1% of total population in Davidson County (age 16 and over) was Black—a difference of 13.0%. Vehicle stops for White drivers accounted for 58.1% of all stops, for a racial group representing 65.8% of total population—a difference of -7.6%. Disparities for Hispanic drivers were less notable—a difference of -3.3% was observed when comparing vehicle stops (4.8% of all stops) to race (8.1% of total population). Caution must be exercised so that one does not rely solely on these numbers. Other factors that may contribute to the differences include police workload, hotspot policing, description of criminal suspects, and crime by geographic locations. Demographic comparisons are depicted in **Table 2** (Black Drivers Stopped), **Table 3** (White Drivers Stopped) and **Table 4** (Hispanic Drivers Stopped).

Table 2. Difference in Percent of Vehicle Stops to Population Type by Black Drivers

	Percent of Vehicle Stops (Black)	*2011 Population Estimate 16 and Up (Black)*	*Difference between Stops and 16 and Up Population*
Black Drivers Stopped	39.1%	26.1%	13.0%

Table 3. Difference in Percent of Vehicle Stops to Population Type by White Drivers

	Percent of Vehicle Stops (White)	*2011 Population Estimate 16 and Up (White)*	*Difference between Stops and 16 and Up Population*
White Drivers Stopped	58.1%	65.8%	-7.6%

Table 4. Difference in Percent of Vehicle Stops to Population Type by Hispanic Drivers

	Percent of Vehicle Stops (Hispanic)	*2011 Population Estimate 16 and Up (Hispanic)*	*Difference between Stops and 16 and Up Population*
Hispanic Drivers Stopped	4.8%	8.1%	-3.3%

An additional finding shows that Hispanic drivers were searched and arrested at a higher rate than White and Black drivers. 3.7% of Hispanic drivers gave consent to search compared to 2.3% of Non-Hispanic drivers. 2.1% of Hispanic drivers were searched incident-to-arrest compared to 0.9% of Non-Hispanic drivers. 0.5% of Hispanic drivers were searched due to evidence in plain view compared to 0.7% of Non-Hispanic drivers. 27.3% of vehicle stops for Hispanic drivers resulted in arrest (physical arrest or misdemeanor citation arrest), compared to 5.4% for White drivers and 8.6% for Black drivers.

A detailed examination of arrest charges shows that most arrests resulting from a vehicle stop included a driver's license-related violation. Of the 5,846 stops involving the arrest of a Hispanic driver, 5,191 (88.8%) included a violation of the provisions of TCA Title 55, Chapter 50 (offenses include: *TCA 55-50-301* driving without a license, and *TCA 55-50-504 (a)* driving on a suspended, canceled, or revoked license). Of the 23,525 stops involving the arrest of a non-Hispanic driver, 16,797 (71.4%) involved violations of TCA Title 55, Chapter 50.

Table 5. Percentage of Drivers Who Were Issued Citations, Searched, or Arrested

	Vehicle Stops	*Percent of Stops Issued Traffic Citations*	*Percent of Stops Searched*	*Percent of Stops Arrested*
White Drivers	258,716	17.5%	2.3%	5.4%
Black Drivers	173,880	12.3%	4.2%	8.6%
Hispanic Drivers	21,445	14.9%	5.0%	27.3%
County Total	445,143	15.5%	3.0%	6.6%

Geographic Information Systems (GIS) Analysis

The MNPD Crime Analysis Section used Geographic Information System (GIS) software to map densities of vehicle stop, crime, population, and police workload information. Through an automated geocoding process, the geographic locations of vehicle stops were plotted in the GIS. During this process, 421,549 (94.7%) of the total 445,143 vehicle stop locations during CY 2012 were successfully matched to a location on the map. This is regarded as a high geocoding rate and is made possible because the address data originates from MNPD's Computer Aided Dispatch system, which verifies addresses as records are created by officers in the field.

Police patrol personnel are allocated to areas based on the demand for police services, with consideration taken for the severity of each offense type. The demand for police services is greater towards the inner city. Patrol zones near the inner city are smaller than the zones nearer the county line. Furthermore, additional police resources in the form of Crime Suppression Officers, DUI Task Force, Flex Officers, Walking & Bike Officers, and Special Events Officers (e.g. Motorcycle Officers) are routinely assigned in and around the inner city area. In essence, there are more police field officers available in the inner city than towards the county line. A map of patrol zone/beat officer boundaries can be found in **Appendix A.**

Additionally, the geographic distribution of licensed driver residences remains diverse across Davidson County. The demographic characteristics of areas where higher concentrations of police officers are deployed are significantly different than areas containing lower concentrations of officers.

Vehicle stop, crime, driver license, and police workload information were assessed using uniform grids. This methodology was preferred over a method incorporating census tracts, because each grid cell encompassed an equal area (1.6 square miles, for this analysis). A z-score was assigned to each grid cell in each dataset, allowing for density analysis, which provides a straightforward approach to

understanding the information quickly. The addresses of Black, White, and Hispanic licensed drivers for the State of Tennessee were geocoded and aggregated by grid cell. U.S. Census Bureau demographic information could not be accurately interpreted to grids, since these counts are summarized at the county level.

Grid maps are included in **Appendix B**. By viewing these maps, several observations can be noted. Higher concentrations of vehicle stops occurred in the inner city area. Likewise, in the inner city, the maps depict higher concentrations of minutes of officer activity, number of officers at incidents, and index crimes as defined by Uniform Crime Report guidelines. Each race and ethnicity licensed driver population significantly differs from the others. The grid density patterns between Black licensed drivers and police workload and vehicle stop information demonstrates a closer relationship than those for White licensed drivers. The racial demographics in areas where there are higher concentrations of police officers deployed are different than areas with lower concentrations of officers.

Small-scale versions of the grid maps are shown in **Appendix B**. Larger 42" x 60" map sheets that provide greater detail are available for viewing at the Metropolitan Nashville Police Department, Crime Analysis Section.

Correlation Coefficients

The MNPD Crime Analysis Section used SPSS statistical software to calculate bivariate correlation coefficients of the variables being tested. The coefficient of correlation allowed us to compare the linear relationship between vehicle stop information against police workload, crime, and race. The Crime Analysis Section analyzed Pearson correlation coefficient values of vehicle stop data for several different sets of variables. The Pearson coefficient (Pearson's r) is a measure of the linear dependence of two variables, resulting in a value between +1 and −1. Correlation in no way can be used to determine *causation*.

Pearson correlation coefficients were calculated to determine *r* values and were found to be significant at the 0.01 (2 tailed) level. When the *r* value equals 0, there is no relationship between the two variables. The closer the *r* value gets to 1 or -1, the greater the relationship between the two variables. **Table 6** shows seven levels of magnitude for interpreting the Pearson Correlation Coefficient, ranging from *WEAK* to *VERY STRONG*.

Table 6. Pearson Correlation Coefficient Magnitude

Correlation Coefficient (r value) Range	*Interpretation*
0.000 - 0.299	Weak Positive Correlation
0.300 - 0.499	Moderate Positive Correlation
0.500 - 0.549	High Positive Correlation
0.550 - 0.649	Very High Positive Correlation
0.650 - 0.749	Moderately Strong Positive Correlation
0.750 - 0.849	Strong Positive Correlation
0.850 - 1.000	Very Strong Positive Correlation

The correlation coefficients **(See Tables 7 – 14)** allow us to make more precise interpretations of the relationships of the density grids displayed on the maps. In essence, there was sufficient evidence to conclude the following regarding the grid density maps:

- A *STRONG* to *VERY STRONG* positive correlation exists between where Black and Hispanic suspects are described by victims on incident reports and where Black and Hispanic drivers are stopped, issued citations, searched, and arrested. A *VERY HIGH* to *STRONG* positive correlation exists between where White suspects are described by victims on incident reports and where White drivers are stopped, issued citations, searched, and arrested **(See Table 9)**.
- A *VERY STRONG* positive correlation exists between police workload (the number of officers at incidents & minutes of officer activity) and the overall numbers of vehicle stops, arrests, searches, and reported crimes (Violent and Property Part I offenses). A *STRONG* positive correlation exists between police workload (the number of officers at incidents & minutes of officer activity) and the number of citations issued from vehicle stops. This supports the logic that MNPD police engage in an increased amount of activity in areas where there is a higher concentration of police officers **(See Table 11)**.
- A *VERY STRONG* positive correlation exists between crime incidents (Violent and Property Part I offenses) and the overall numbers of vehicle stops, arrests, and searches. A *MODERATELY STRONG* positive correlation exists between Violent Part I offenses and citations issued from vehicle stops. A *STRONG* positive correlation exists between Property Part I offenses and citations issued from vehicle stops. This supports the logic that MNPD police engage in an increased amount of activity in areas with higher numbers of reported crime incidents **(See Table 12)**.

- A *MODERATELY STRONG* to *VERY STRONG* positive correlation exists between drug incident locations and where Black drivers are stopped, issued citations, arrested, and searched. A *VERY HIGH to STRONG* positive correlation exists between drug incident locations and where White drivers are stopped, issued citations, arrested, and searched. A *MODERATE* positive correlation exists between drug incident locations and where Hispanic drivers are stopped, issued citations, arrested, and searched **(See Table 8)**.
- A *VERY HIGH* to *MODERATELY STRONG* positive correlation exists between where Black licensed drivers live compared to where violent, property, and drug crimes occur, and where police resources are deployed. These correlations are consistently higher than measurements for where White and Hispanic drivers live compared to where violent, property, and drug crimes occur, and where police resources are deployed **(See Table 10)**.
- A *MODERATE* to *HIGH* positive correlation exists between where White and Hispanic licensed drivers live compared to where violent and property crimes occur, and where police resources are deployed. A *WEAK* to *MODERATE* positive correlation exists between where White and Hispanic licensed drivers live and drug incident locations **(See Table 10)**.
- A *MODERATE* to *HIGH* positive correlation exists between where White licensed drivers live and where White drivers are stopped, issued citations, arrested, and searched due to the vehicle stop **(See Table 13)**.
- A *VERY HIGH* to *MODERATELY STRONG* positive correlation exists between where Black licensed drivers live and where Black drivers are stopped, issued citations, arrested, and searched due to the vehicle stop **(See Table 13)**.
- A *MODERATELY STRONG* to *STRONG* positive correlation exists between where Hispanic licensed drivers live and where Hispanic drivers are stopped, issued citations, arrested, and searched due to the vehicle stop **(See Table 13)**.
- *WEAK* and *MODERATE* positive correlations exist between where White licensed drivers live and where Black and Hispanic (respectively) drivers are stopped. A *HIGH* positive correlation exists between where White licensed drivers live and where White drivers are stopped **(See Table 14)**.
- A *MODERATE* positive correlation exists between where Black licensed drivers live and where Hispanic and White drivers are stopped. A *MODERATELY STRONG* positive correlation exists between where Black licensed drivers live and where Black drivers are stopped **(See Table 14)**.

- *WEAK* and *MODERATE* positive correlations exists between where Hispanic licensed drivers live and where Black and White (respectively) drivers are stopped. A *STRONG* positive correlation exists between where Hispanic licensed drivers live and where Hispanic drivers are stopped **(See Table 14)**.

Table 7. The Bivariate Correlation Coefficients of CY 2012 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (Black)	0.930	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.846	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.924	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.936	Very Strong Positive Correlation
	Vehicle Stops (White)	0.924	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.696	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.771	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.890	Very Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.556	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.605	Very High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.440	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.467	Moderate Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (Black)	0.925	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.837	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.924	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.938	Very Strong Positive Correlation
	Vehicle Stops (White)	0.905	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.680	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.749	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.878	Very Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.530	High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.581	Very High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.415	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.445	Moderate Positive Correlation

Table 8. The Bivariate Correlation Coefficients of CY 2012 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (Black)	0.917	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.778	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.927	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.951	Very Strong Positive Correlation
	Vehicle Stops (White)	0.835	Strong Positive Correlation
	Citations Issued from Stops (White)	0.606	Very High Positive Correlation
	Arrests Made from Stops (White)	0.754	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.849	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.560	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.580	Very High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.464	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.492	Moderate Positive Correlation
Property Part One Incidents	Vehicle Stops (Black)	0.836	Strong Positive Correlation
	Citations Issued from Stops (Black)	0.781	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.809	Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.820	Strong Positive Correlation
	Vehicle Stops (White)	0.898	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.698	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.772	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.862	Very Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.588	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.634	Very High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.472	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.487	Moderate Positive Correlation
Drug Incidents	Vehicle Stops (Black)	0.874	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.748	Moderately Strong Positive Correlation
	Arrests Made from Stops (Black)	0.892	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.933	Very Strong Positive Correlation
	Vehicle Stops (White)	0.823	Strong Positive Correlation
	Citations Issued from Stops (White)	0.585	Very High Positive Correlation
	Arrests Made from Stops (White)	0.697	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.843	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.475	Moderate Positive Correlation
	Citations Issued from Stops (Hispanic)	0.499	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.372	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.408	Moderate Positive Correlation

Table 9. The Bivariate Correlation Coefficients of CY 2012 Vehicle Stops to Suspects by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Black Suspects Described By Victim	Vehicle Stops (Black)	0.927	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.793	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.922	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.926	Very Strong Positive Correlation
	Licensed Drivers (Black)	0.739	Moderately Strong Positive Correlation
	Vehicle Stops (White)	0.795	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.472	Moderate Positive Correlation
White Suspects Described By Victim	Vehicle Stops (White)	0.771	Strong Positive Correlation
	Citations Issued from Stops (White)	0.604	Very High Positive Correlation
	Arrests Made from Stops (White)	0.800	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.815	Strong Positive Correlation
	Licensed Drivers (White)	0.551	Very High Positive Correlation
	Vehicle Stops (Black)	0.567	Very High Positive Correlation
	Vehicle Stops (Hispanic)	0.668	Moderately Strong Positive Correlation
Hispanic Suspects Described By Victim	Vehicle Stops (Hispanic)	0.883	Very Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.792	Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.852	Very Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.860	Very Strong Positive Correlation
	Licensed Drivers (Hispanic)	0.862	Very Strong Positive Correlation
	Vehicle Stops (White)	0.553	Very High Positive Correlation
	Vehicle Stops (Black)	0.354	Moderate Positive Correlation

Table 10. The Bivariate Correlation Coefficients of CY 2012 Police Workload to Licensed Drivers by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Violent Part One Incidents	0.711	Moderately Strong Positive Correlation
	Property Part One Incidents	0.702	Moderately Strong Positive Correlation
	Drug Incidents	0.576	Very High Positive Correlation
	Number of Officers at Incidents	0.647	Very High Positive Correlation
	Minutes of Officer Activity	0.637	Very High Positive Correlation
Licensed Drivers (White)	Violent Part One Incidents	0.339	Moderate Positive Correlation
	Property Part One Incidents	0.541	High Positive Correlation
	Drug Incidents	0.271	Weak Positive Correlation
	Number of Officers at Incidents	0.407	Moderate Positive Correlation
	Minutes of Officer Activity	0.374	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Violent Part One Incidents	0.430	Moderate Positive Correlation
	Property Part One Incidents	0.497	Moderate Positive Correlation
	Drug Incidents	0.304	Moderate Positive Correlation
	Number of Officers at Incidents	0.388	Moderate Positive Correlation
	Minutes of Officer Activity	0.366	Moderate Positive Correlation

Table 11. The Bivariate Correlation Coefficients of CY 2012 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (All Stops)	0.979	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.783	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.951	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.970	Very Strong Positive Correlation
	Violent Part One Incidents	0.966	Very Strong Positive Correlation
	Property Part One Incidents	0.935	Very Strong Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (All Stops)	0.966	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.769	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.940	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.967	Very Strong Positive Correlation
	Violent Part One Incidents	0.972	Very Strong Positive Correlation
	Property Part One Incidents	0.920	Very Strong Positive Correlation

Table 12. The Bivariate Correlation Coefficients of CY 2012 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (All Stops)	0.922	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.696	Moderately Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.945	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.963	Very Strong Positive Correlation
Property Part One Incidents	Vehicle Stops (All Stops)	0.920	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.761	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.879	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.885	Very Strong Positive Correlation

Table 13. The Bivariate Correlation Coefficients of CY 2012 Licensed Driver Addresses to Vehicle Stops, Citations, Arrests, and Searches by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Vehicle Stops (Black)	0.670	Moderately Strong Positive Correlation
	Citations Issued from Stops (Black)	0.554	Very High Positive Correlation
	Arrests Made from Stops (Black)	0.647	Very High Positive Correlation
	Searches from Vehicle Stops (Black)	0.652	Moderately Strong Positive Correlation
Licensed Drivers (White)	Vehicle Stops (White)	0.506	High Positive Correlation
	Citations Issued from Stops (White)	0.445	Moderate Positive Correlation
	Arrests Made from Stops (White)	0.437	Moderate Positive Correlation
	Searches from Vehicle Stops (White)	0.429	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Hispanic)	0.824	Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.723	Moderately Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.823	Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.821	Strong Positive Correlation

Table 14. The Bivariate Correlation Coefficients of CY 2012 Licensed Driver Addresses to Vehicle Stops by Race by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Vehicle Stops (Black)	0.670	Moderately Strong Positive Correlation
	Vehicle Stops (White)	0.496	Moderate Positive Correlation
	Vehicle Stops (Hispanic)	0.430	Moderate Positive Correlation
Licensed Drivers (White)	Vehicle Stops (Black)	0.241	Weak Positive Correlation
	Vehicle Stops (White)	0.506	High Positive Correlation
	Vehicle Stops (Hispanic)	0.373	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Black)	0.291	Weak Positive Correlation
	Vehicle Stops (White)	0.452	Moderate Positive Correlation
	Vehicle Stops (Hispanic)	0.824	Strong Positive Correlation

Conclusions

This study attempted to establish a viable and reliable method of measuring if there was a disproportionate amount of vehicle stops of racial/ethnic minorities within Davidson County. However, this issue is not as straightforward as one may anticipate. It is not possible to identify and explain all of the independent factors that may affect this issue.

Empirical evidence yields inconclusive results and can be easily misinterpreted. Caution must be exercised if one simply takes into account that a disproportionate percent of vehicles were stopped with Black drivers than White drivers when compared to population counts for Davidson County. Vehicle stops for Black drivers accounted for 39.1% of all stops, while the Census reported that 26.1% of Davidson County's population (age 16 and over) was Black—a difference of 13.0%. Vehicle stops for White drivers accounted for 58.1% of all stops, for a racial group representing 65.8% of total population—a difference of -7.6%. Vehicle stops for Hispanic drivers accounted for 4.8% of all stops, for a racial group representing 8.1% of total population—a difference of -3.3%. This disproportionate percentage appears to be explained by the belief that hotspot policing provides more opportunity for officers to engage with members of communities within areas that have a higher volume of crime incidents and officer activity.

The MNPD Crime Analysis Section used ArcView GIS software to map the densities of vehicle stop, crime, population, and police workload information. The grid method compared the locations of vehicle stop, crime, and police workload information against the addresses of Black, White, and Hispanic licensed drivers. By viewing the grid density maps, it is quite apparent that higher concentrations of vehicle stops occurred in the inner city area. Likewise, the maps depicted a higher concentration of minutes of officer activity, and number of officers at incidents, and crime (Part I offenses) in the inner city area. The grid density of the addresses of Black licensed drivers demonstrates a significantly different pattern than White licensed drivers. The grid densities between Black licensed driver addresses and police workload, crime, and vehicle stop information displays closer patterns than those for White licensed drivers.

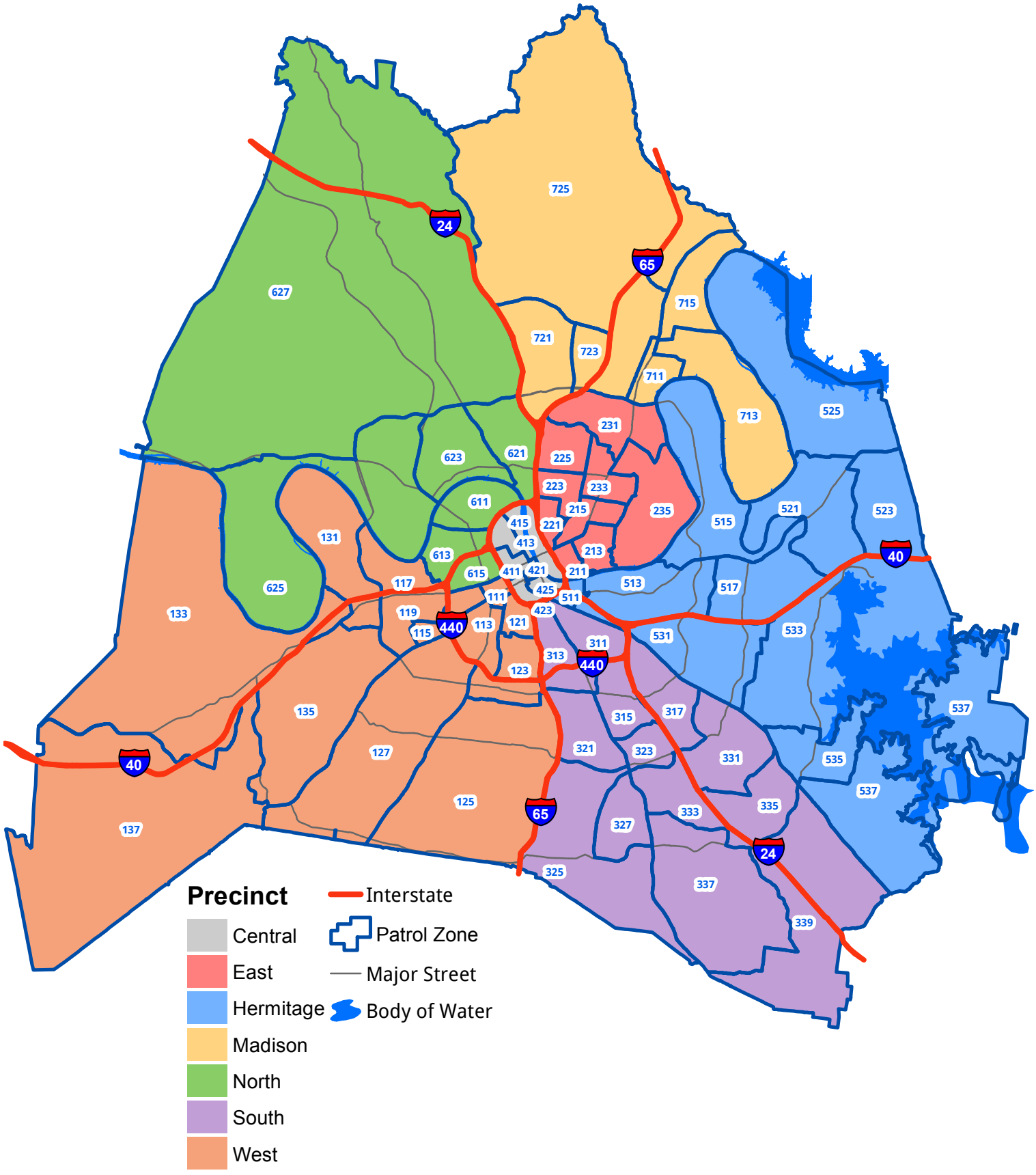
The MNPD Crime Analysis Section used SPSS statistical software to calculate Pearson correlation coefficients for several different variables recorded in the traffic stop data. The coefficient of the correlation allowed us to compare the linear relationship between vehicle stop information against police workload, crime, and race. Correlation in no way can be used to determine *causation*. Results of the correlation analysis showed that:

- A *STRONG* to *VERY STRONG* positive correlation exists between where Black suspects are described and where Black drivers are stopped, cited, searched, and arrested. A *STRONG* to *VERY STRONG* positive correlation exists between where Hispanic suspects are described and where Hispanic drivers are stopped, cited, searched, and arrested. A *VERY HIGH* to *STRONG* positive correlation exists between where White suspects are described and where White drivers are stopped, cited, searched, and arrested **(See Table 9).**
- A *MODERATELY STRONG* to *STRONG* positive correlation exists between where Hispanic licensed drivers live and where Hispanic drivers are stopped, issued citations, arrested, and searched due to the vehicle stop. A *VERY HIGH to MODERATELY STRONG* positive correlation exists between where Black licensed drivers live and where Black drivers are stopped, issued citations, arrested, and searched due to the vehicle stop. A *MODERATE to HIGH* positive correlation exists between where White licensed drivers live and where White drivers are stopped, issued citations, arrested, and searched due to the vehicle stop **(See Table 13)**
- Black motorists are being stopped at a higher rate in locations where Black licensed drivers live, White motorists are being stopped at a higher rate in locations where White licensed drivers live, and Hispanic motorists are being stopped at a higher rate where Hispanic licensed drivers live **(See Table 14).**
- A *VERY HIGH* positive correlation exists between residential addresses of Black licensed drivers and the geographic locations where police resources are deployed. On the other hand, a *MODERATE* positive correlation exists between the residential address of White and Hispanic licensed drivers and the geographic locations where police resources are deployed **(See Table 10).**
- A *STRONG to VERY STRONG* positive correlation exists between police workload (the number of officers at incidents & minutes of officer activity) and the overall numbers of vehicle stops, citations, arrests, searches, and reported crimes (Violent and Property Part I offenses) **(See Table 11)**. This supports the logic that MNPD police engage in an increased amount of activity in areas where there is a higher concentration of police officers.

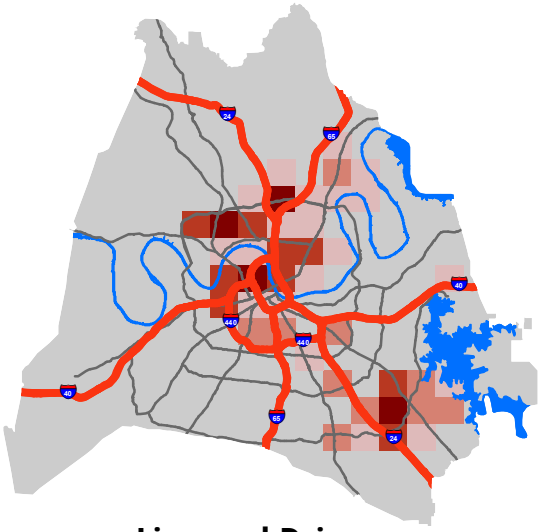
These relationships may help explain why a disproportionate amount of Black drivers were stopped. MNPD police resources are deployed at a higher rate in locations where crimes are reported and locations with a higher demand for police services. Unfortunately, locations with higher police officer presence may provide opportunities for police to engage Black drivers more often than White drivers since a significantly high correlation exists in locations where Black drivers live and where police resources are deployed. It should be noted that when stopped, Black drivers were issued citations at a lower rate (12.3%) than White and Hispanic drivers (17.5% and 15.5%, respectively).

A significantly higher percentage of Hispanic drivers were arrested as a result of a vehicle stop when compared to Non-Hispanic drivers. However, this disparity can partially be explained due to the observation that 88.8% of Hispanic drivers (and 71.4% of Non-Hispanic drivers) arrested during a vehicle shop were charged with a driver's license-related violation, such as driving without a license, or driving on a suspended, canceled, or revoked license.

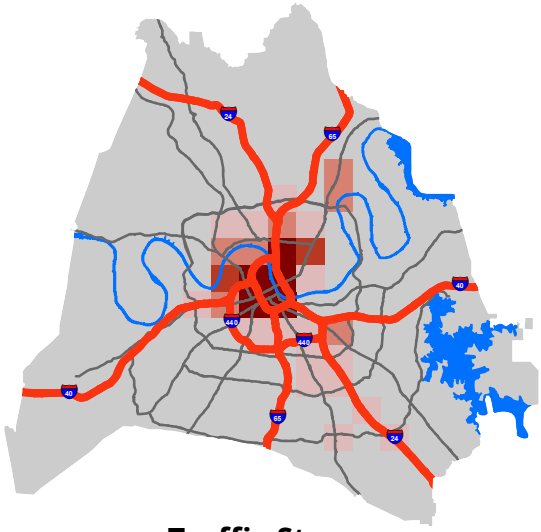
Appendix A. MNPD Police Patrol Boundaries and Patrol Zones



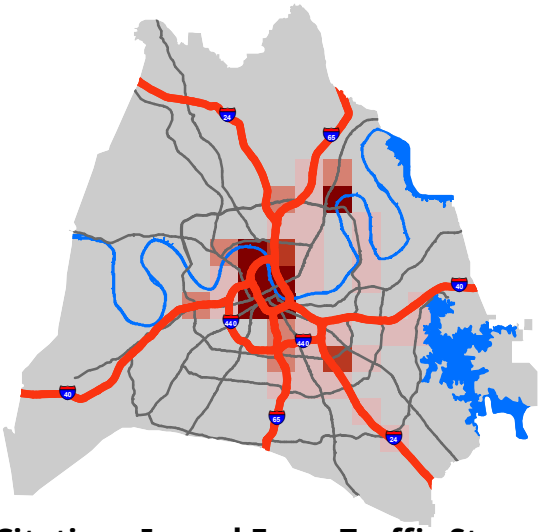
Appendix B-1. Grid Density Maps of Vehicle Stops with Black Drivers



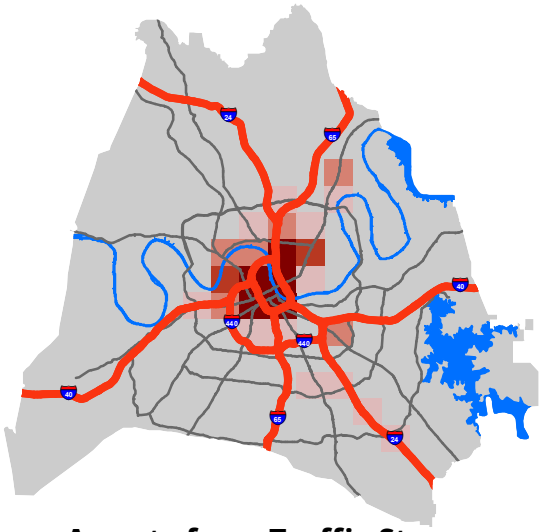
Licensed Drivers (Black)



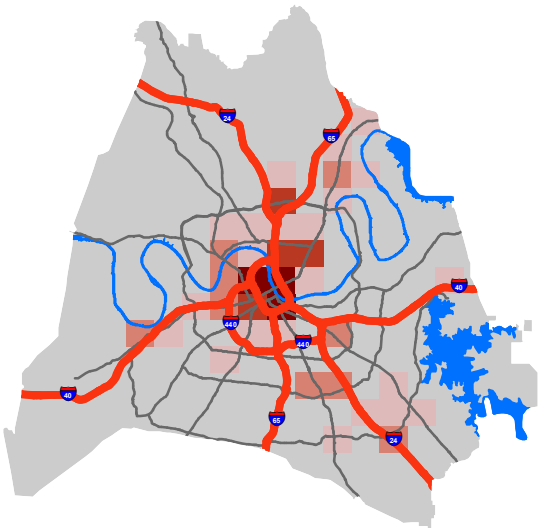
Traffic Stops (Black)



Citations Issued From Traffic Stops (Black)



Arrests from Traffic Stops (Black)

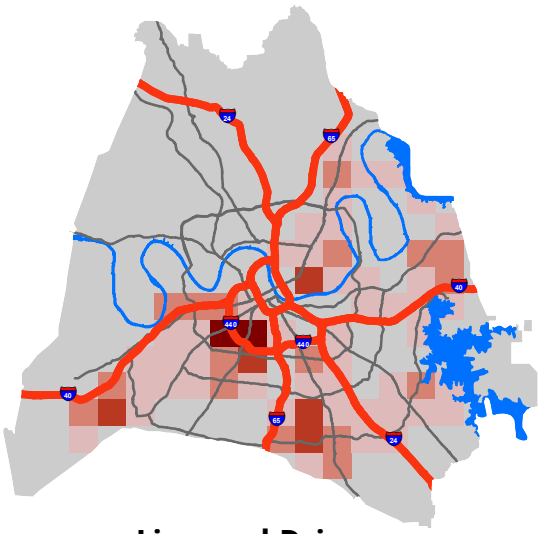


Black Suspects Described by Victims

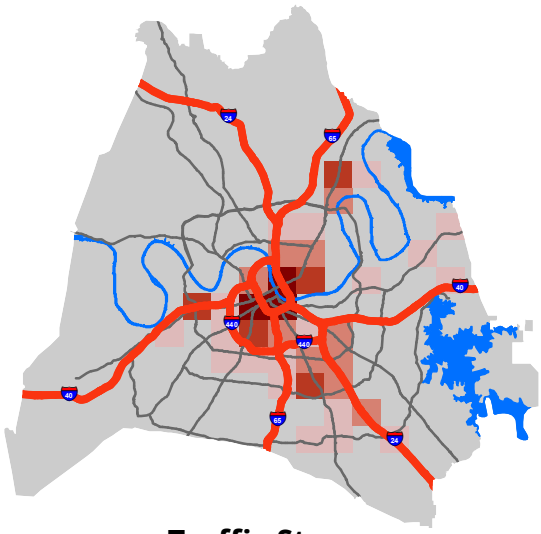
Standard Score (Z-Value)

- Below 0.50
- 0.50 - 1.49
- 1.50 - 2.49
- 2.50 - 3.49
- 3.50 or Above
- Interstate
- Major Street
- Body of Water

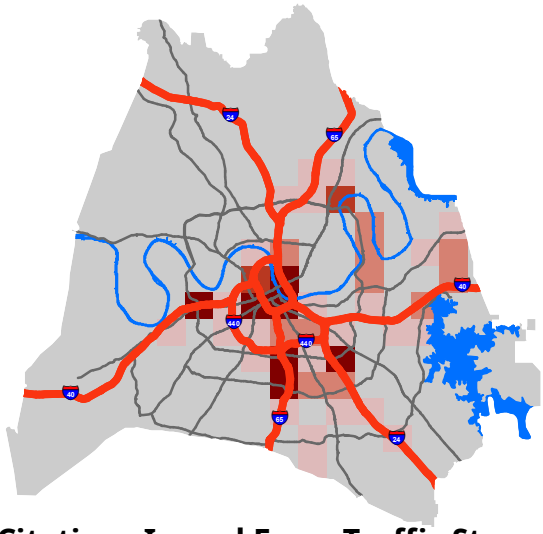
Appendix B-2. Grid Density Maps of Vehicle Stops with White Drivers



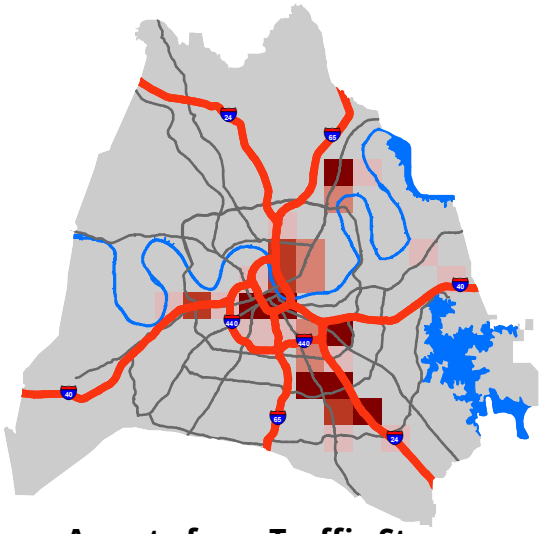
Licensed Drivers (White)



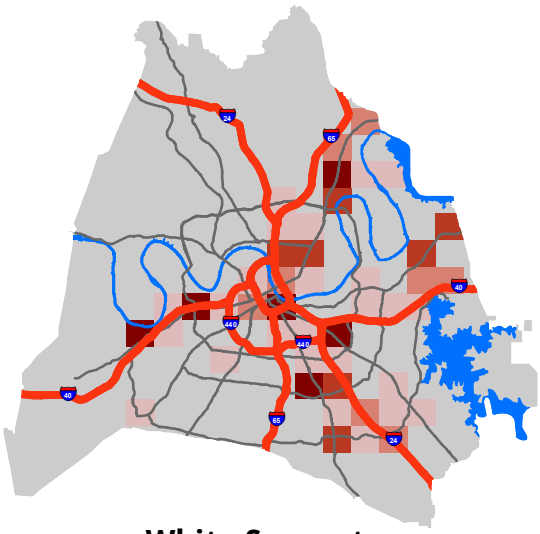
Traffic Stops (White)



Citations Issued From Traffic Stops (White)



Arrests from Traffic Stops (White)

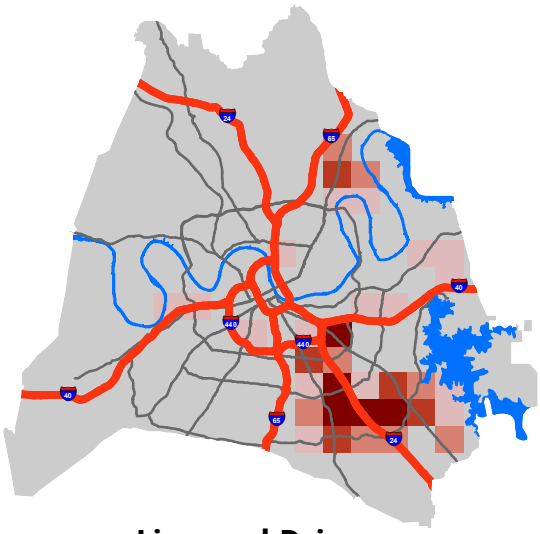


White Suspects Described by Victims

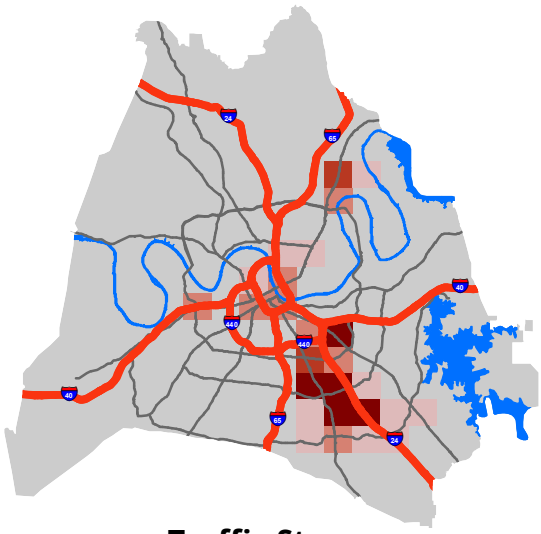
Standard Score (Z-Value)

- Below 0.50
- 0.50 - 1.49
- 1.50 - 2.49
- 2.50 - 3.49
- 3.50 or Above
- Interstate
- Major Street
- Body of Water

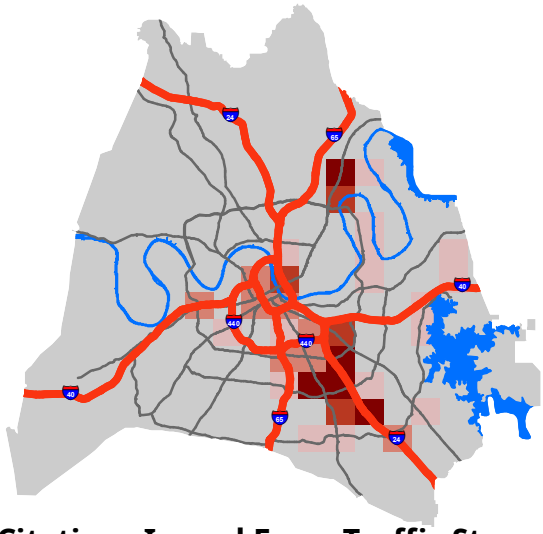
Appendix B-3. Grid Density Maps of Vehicle Stops with Hispanic Drivers



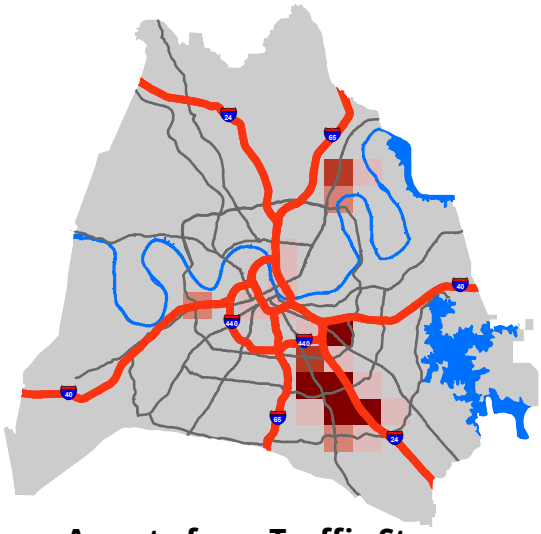
Licensed Drivers (Hispanic)



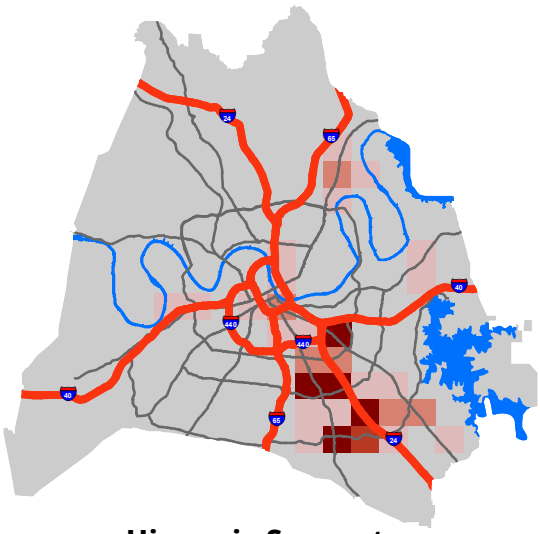
Traffic Stops (Hispanic)



Citations Issued From Traffic Stops (Hispanic)



Arrests from Traffic Stops (Hispanic)



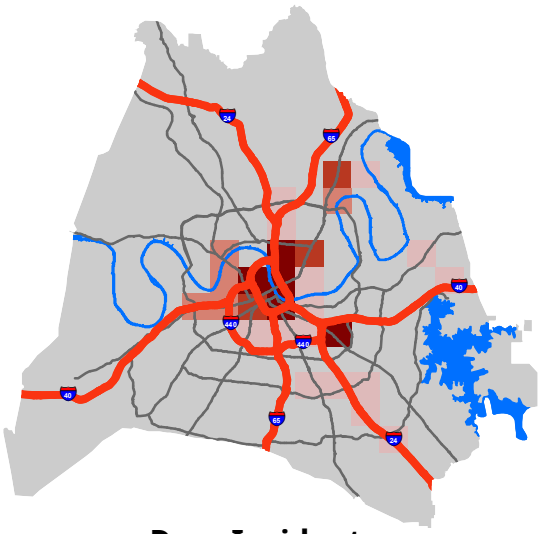
Hispanic Suspects Described by Victims

Standard Score (Z-Value)

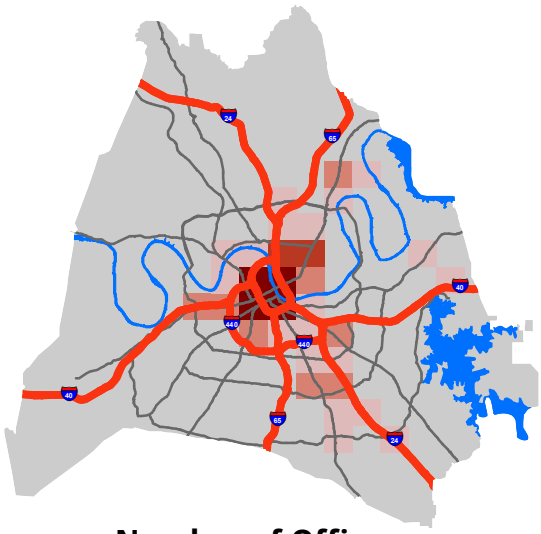
- Below 0.50
- 0.50 - 1.49
- 1.50 - 2.49
- 2.50 - 3.49
- 3.50 or Above

- Interstate
- Major Street
- Body of Water

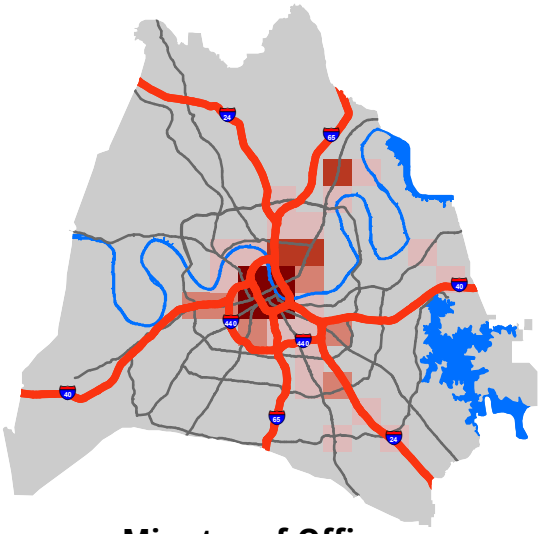
Appendix B-4. Grid Density Maps of Officer Activity and Part I Crimes



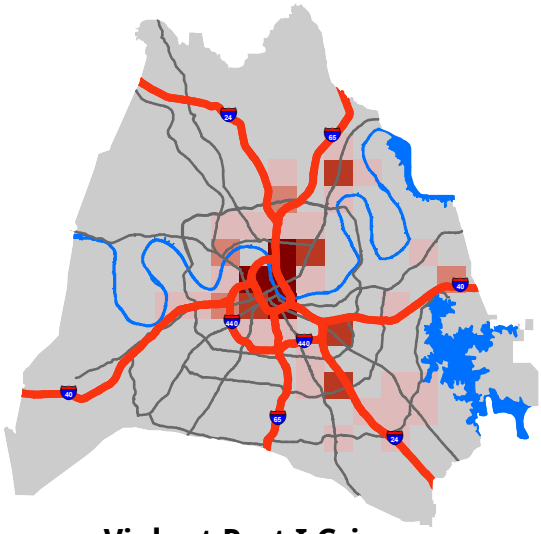
Drug Incidents



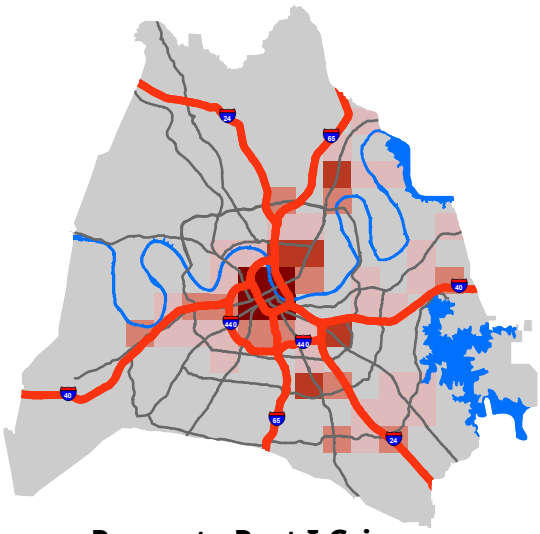
Number of Officers at Incidents



Minutes of Officer Activity



Violent Part I Crimes



Property Part I Crimes

Standard Score (Z-Value)

- Below 0.50
- 0.50 - 1.49
- 1.50 - 2.49
- 2.50 - 3.49
- 3.50 or Above
- Interstate
- Major Street
- Body of Water