CY 2011 Motor Vehicle Stop Data Collection Analysis

Final Report

Metropolitan Nashville Police Department
Nashville and Davidson County

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Prepared by
Crime Analysis Section

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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 appropriate 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, Information Services 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 2011 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 (i.e. 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 *MODERATELY STRONG* 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 2011, and make up an estimated 7.9% of the population age 16 and older. However, as has been the case in previous years, a higher percentage of Hispanic drivers were arrested as a result of a vehicle stop, when compared to White and Black drivers. Further analysis could help determine the reasons why Hispanic drivers were arrested at a higher rate than other racial groups in 2011. Unfortunately, arrest charges were not available for analysis in this study. In February 2012, the MNPD Crime Analysis Section requested changes to InPursuit eForm 252 (RMS application) that will require officers to enter a valid complaint number whenever a citation, search, or arrest is conducted during a stop. Once these changes are incorporated, arrest charges will be available for analysis.

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 389,778 vehicle stop records in 2011—151,385 were Black drivers, 226,972 were White drivers, and 18,796 were Hispanic drivers. Although the following race categories were not evaluated in this study, there were 4,790 Asian/Pacific Islanders, 373 American Indian/Alaskans, and 6,258 "Other" drivers stopped while operating a motor vehicle. 19.2% of the drivers who were stopped were issued citations, and 7.3% of vehicle stops (28,261) resulted in an arrest (physical and/or citation arrest). Arrests made as a result of a vehicle stop represented 31.3% of all arrests (90,411) made in Davidson County in 2011. This is a significant increase from 2010, when arrests made as a result of a vehicle stop (25,275) represented 27.4% of all Davidson County arrests (92,381). The increase in traffic stops combined with the increase in chargeable offenses 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 higher reported crime.
- 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

2010 Census Summary File 1 (SF 1) contains data compiled from questions asked of all people during the most recent decennial census, and represents the most accurate estimate of population for this study period. SF 1 Tables PCT12, PCT12A, PCT12B and PCT12H are 100% counts by age of total population, and White, Black, and Hispanic/Latino populations. For the purpose of this study, population counts of individuals age 16 and over were also derived from these tables. Population counts for Davidson County are depicted in **Table 1**.

Table 1. 2010 United States Census Bureau Population Counts

	Black	***White***	***Hispanic***	***Estimated Total Population***
All Ages	173,730	385,039	61,117	626,681
16 Years & Up	131,223	326,192	41,206	503,949

One would expect traffic stops to be distributed proportionately among the various race/ethnicity categories. However, vehicle stops for Black drivers accounted for 38.8% of all stops, even though the 2010 Census reported that 26.0% of total population in Davidson County (age 16 and over) was Black—a difference of 12.8%. Vehicle stops for White drivers accounted for 58.2% of all stops, for a racial group representing 64.7% of total population—a difference of -6.5%. Disparities for Hispanic drivers were less notable—a difference of -3.4% was observed when comparing vehicle stops (4.8% of all stops) to race (8.2% 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)	***2010 Population Estimate 16 and Up (Black)***	***Difference between Stops and 16 and Up Population***
Black Drivers Stopped	38.8%	26.0%	12.8%

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

	Percent of Vehicle Stops (White)	*2010 Population Estimate 16 and Up (White)*	*Difference between Stops and 16 and Up Population*
White Drivers Stopped	58.2%	64.7%	-6.5%

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

	Percent of Vehicle Stops (Hispanic)	*2010 Population Estimate 16 and Up (Hispanic)*	*Difference between Stops and 16 and Up Population*
Hispanic Drivers Stopped	4.8%	8.2%	-3.4%

An additional finding shows that Hispanic drivers were searched and arrested at a higher rate than White and Black drivers. 5.4% of Hispanic drivers gave consent to search compared to 2.7% of Non-Hispanic drivers. 2.6% of Hispanic drivers were searched incident-to-arrest compared to 1.0% of Non-Hispanic drivers. 0.4% of Hispanic drivers were searched due to evidence in plain view compared to 0.5% of Non-Hispanic drivers. 29.6% of vehicle stops for Hispanic drivers resulted in arrest, compared to 6.0% for White drivers and 9.3% for Black drivers. Further studies could investigate the reasons why Hispanic drivers were arrested at a higher rate than other races in 2011. Unfortunately, arrest charges were not available for analysis in this study. In February 2012, the MNPD Crime Analysis Section requested changes to InPursuit eForm 252 (RMS application) that will require officers to enter a valid complaint number whenever a citation, search, or arrest is conducted during a stop. Once these changes are incorporated, arrest charges will be available for analysis.

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	226,972	21.6%	2.7%	6.0%
Black Drivers	151,385	15.2%	4.7%	9.3%
Hispanic Drivers	18,796	23.2%	6.7%	29.6%
County Total	389,778	19.2%	3.5%	7.3%

Geographic Information Systems (GIS) Analysis

The MNPD Crime Analysis Section used ArcView Geographic Information System (GIS) software to map densities of vehicle stop, crime, population, and police workload information. Through an automated process known as "geocoding," the geographic locations of vehicle stops were plotted in a GIS. During this process, 374,431 (96.1%) of the total 389,778 vehicle stop locations during CY 2011 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.

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 *MODERATELY STRONG to VERY 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 *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). 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 *STRONG to VERY STRONG* positive correlation exists between crime (Violent and Property Part I offenses) and the overall numbers of vehicle stops, citations, arrests, and searches **(See Table 12)**.
- A *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 *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 VERY 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* positive correlation exists between where White and Hispanic licensed drivers live and drug incident locations **(See Table 10)**.
- A *MODERATE to VERY 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 *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 *VERY HIGH* positive correlation exists between where White licensed drivers live and where White drivers are stopped **(See Table 14)**.
- *MODERATE* and *HIGH* positive correlations exists between where Black licensed drivers live and where Hispanic and White (respectively) drivers

are stopped. A *MODERATELY STRONG* positive correlation exists between where Black licensed drivers live and where Black drivers are stopped **(See Table 14)**.

- A *MODERATE* positive correlation exists between where Hispanic licensed drivers live and where Black and White 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 2011 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (Black)	0.914	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.915	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.917	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.928	Very Strong Positive Correlation
	Vehicle Stops (White)	0.907	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.738	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.769	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.861	Very Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.552	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.485	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.469	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.445	Moderate Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (Black)	0.917	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.913	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.924	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.934	Very Strong Positive Correlation
	Vehicle Stops (White)	0.880	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.715	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.743	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.835	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.528	High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.459	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.442	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.417	Moderate Positive Correlation

Table 8. The Bivariate Correlation Coefficients of CY 2011 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (Black)	0.906	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.895	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.919	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.931	Very Strong Positive Correlation
	Vehicle Stops (White)	0.812	Strong Positive Correlation
	Citations Issued from Stops (White)	0.655	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.755	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.814	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.580	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.517	High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.506	High Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.493	Moderate Positive Correlation
Property Part One Incidents	Vehicle Stops (Black)	0.839	Strong Positive Correlation
	Citations Issued from Stops (Black)	0.858	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.821	Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.825	Strong Positive Correlation
	Vehicle Stops (White)	0.906	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.748	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.794	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.835	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.610	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.545	High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.527	High Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.480	Moderate Positive Correlation
Drug Incidents	Vehicle Stops (Black)	0.852	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.858	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.891	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.920	Very Strong Positive Correlation
	Vehicle Stops (White)	0.779	Strong Positive Correlation
	Citations Issued from Stops (White)	0.642	Very High Positive Correlation
	Arrests Made from Stops (White)	0.669	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.798	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.447	Moderate Positive Correlation
	Citations Issued from Stops (Hispanic)	0.393	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.371	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.379	Moderate Positive Correlation

Table 9. The Bivariate Correlation Coefficients of CY 2011 Vehicle Stops to Suspects by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Black Suspects Described By Victim	Vehicle Stops (Black)	0.934	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.891	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.935	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.930	Very Strong Positive Correlation
	Licensed Drivers (Black)	0.750	Strong Positive Correlation
	Vehicle Stops (White)	0.796	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.497	Moderate Positive Correlation
White Suspects Described By Victim	Vehicle Stops (White)	0.818	Strong Positive Correlation
	Citations Issued from Stops (White)	0.720	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.855	Very Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.811	Strong Positive Correlation
	Licensed Drivers (White)	0.590	Very High Positive Correlation
	Vehicle Stops (Black)	0.590	Very High Positive Correlation
	Vehicle Stops (Hispanic)	0.711	Moderately Strong Positive Correlation
Hispanic Suspects Described By Victim	Vehicle Stops (Hispanic)	0.882	Very Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.890	Very Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.865	Very Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.832	Strong Positive Correlation
	Licensed Drivers (Hispanic)	0.862	Very Strong Positive Correlation
	Vehicle Stops (White)	0.575	Very High Positive Correlation
	Vehicle Stops (Black)	0.364	Moderate Positive Correlation

Table 10. The Bivariate Correlation Coefficients of CY 2011 Police Workload to Licensed Drivers by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Violent Part One Incidents	0.715	Moderately Strong Positive Correlation
	Property Part One Incidents	0.722	Moderately Strong Positive Correlation
	Drug Incidents	0.544	High Positive Correlation
	Number of Officers at Incidents	0.659	Moderately Strong Positive Correlation
	Minutes of Officer Activity	0.658	Moderately Strong Positive Correlation
Licensed Drivers (White)	Violent Part One Incidents	0.347	Moderate Positive Correlation
	Property Part One Incidents	0.556	Very High Positive Correlation
	Drug Incidents	0.283	Weak Positive Correlation
	Number of Officers at Incidents	0.449	Moderate Positive Correlation
	Minutes of Officer Activity	0.405	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Violent Part One Incidents	0.460	Moderate Positive Correlation
	Property Part One Incidents	0.529	High Positive Correlation
	Drug Incidents	0.275	Weak Positive Correlation
	Number of Officers at Incidents	0.404	Moderate Positive Correlation
	Minutes of Officer Activity	0.381	Moderate Positive Correlation

Table 11. The Bivariate Correlation Coefficients of CY 2011 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (All Stops)	0.973	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.833	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.950	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.958	Very Strong Positive Correlation
	Violent Part One Incidents	0.962	Very Strong Positive Correlation
	Property Part One Incidents	0.953	Very Strong Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (All Stops)	0.958	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.816	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.942	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.951	Very Strong Positive Correlation
	Violent Part One Incidents	0.971	Very Strong Positive Correlation
	Property Part One Incidents	0.942	Very Strong Positive Correlation

Table 12. The Bivariate Correlation Coefficients of CY 2011 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (All Stops)	0.916	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.771	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.946	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.941	Very Strong Positive Correlation
Property Part One Incidents	Vehicle Stops (All Stops)	0.936	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.821	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.900	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.881	Very Strong Positive Correlation

Table 13. The Bivariate Correlation Coefficients of CY 2011 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)	0.692	Moderately Strong Positive Correlation
	Citations Issued from Stops (Black)	0.635	Very High Positive Correlation
	Arrests Made from Stops (Black)	0.662	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.634	Very High Positive Correlation
Licensed Drivers (White)	Vehicle Stops (White)	0.572	Very High Positive Correlation
	Citations Issued from Stops (White)	0.500	High Positive Correlation
	Arrests Made from Stops (White)	0.490	Moderate Positive Correlation
	Searches from Vehicle Stops (White)	0.479	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Hispanic)	0.846	Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.836	Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.841	Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.820	Strong Positive Correlation

Table 14. The Bivariate Correlation Coefficients of CY 2011 Licensed Driver Addresses to Vehicle Stops by Race by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Vehicle Stops (Black)	0.692	Moderately Strong Positive Correlation
	Vehicle Stops (White)	0.500	High Positive Correlation
	Vehicle Stops (Hispanic)	0.436	Moderate Positive Correlation
Licensed Drivers (White)	Vehicle Stops (Black)	0.270	Weak Positive Correlation
	Vehicle Stops (White)	0.572	Very High Positive Correlation
	Vehicle Stops (Hispanic)	0.404	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Black)	0.302	Moderate Positive Correlation
	Vehicle Stops (White)	0.478	Moderate Positive Correlation
	Vehicle Stops (Hispanic)	0.846	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 the 2010 Census counts for Davidson County. Vehicle stops for Black drivers accounted for 38.8% of all stops, while the Census reported that 26.0% of Davidson County's population (age 16 and over) was Black—a difference of 12.8%. On the other hand, vehicle stops for White drivers accounted for 58.2% of all stops, for a racial group representing 64.7% of total population—a difference of -6.5%. Vehicle stops for Hispanic drivers accounted for 4.8% of all stops, for a racial group representing 8.2% of total population—a difference of -3.4%. 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 the hotspot areas.

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.

It is quite apparent by viewing the grid density maps 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 displays 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 *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

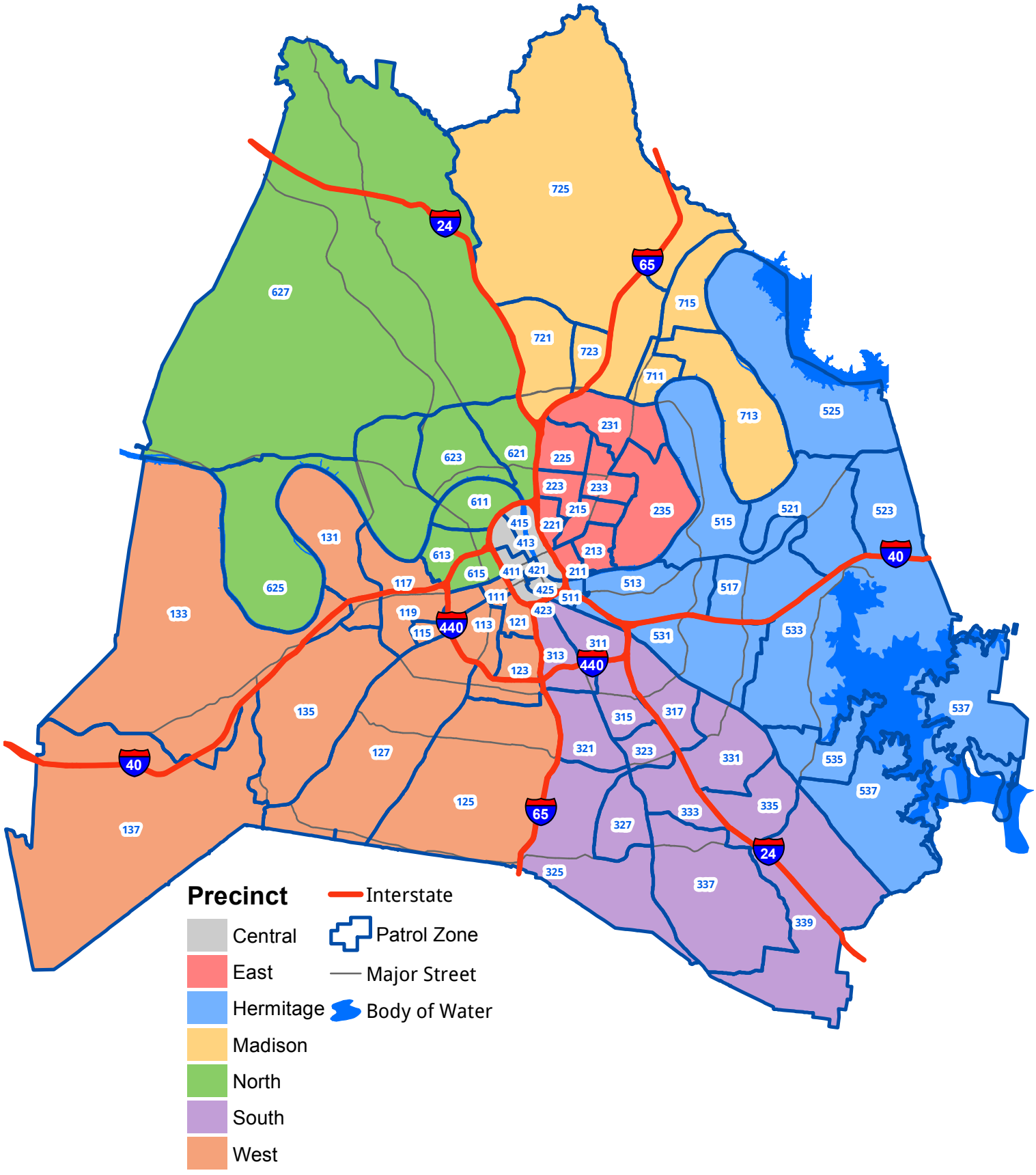
between where Hispanic suspects are described and where Hispanic drivers are stopped, cited, searched, and arrested. A *MODERATELY STRONG* to *VERY STRONG* positive correlation exists between where White suspects are described and where White drivers are stopped, cited, searched, and arrested **(See Table 9).**

- A *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 VERY 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).**
- *WEAK* and *MODERATE* positive correlations exist between where White licensed drivers live and where Black and Hispanic (respectively) drivers are stopped. *HIGH* and *MODERATE* positive correlations exist between where Black licensed drivers live and where White and Hispanic (respectively) drivers are stopped. A *MODERATE* positive correlation exists between where Hispanic licensed drivers live and where Black and White drivers are stopped. **(See Table 14)**.
- A *MODERATELY STRONG* 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).** Thus, a significantly higher correlation exists between locations where Black licensed drivers live and where police resources are deployed than Whites or Hispanic drivers.
- 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)**. Similarly, a *VERY STRONG* positive correlation exists between police workload and the locations where White and Black drivers are stopped **(See Table 7)**. 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.

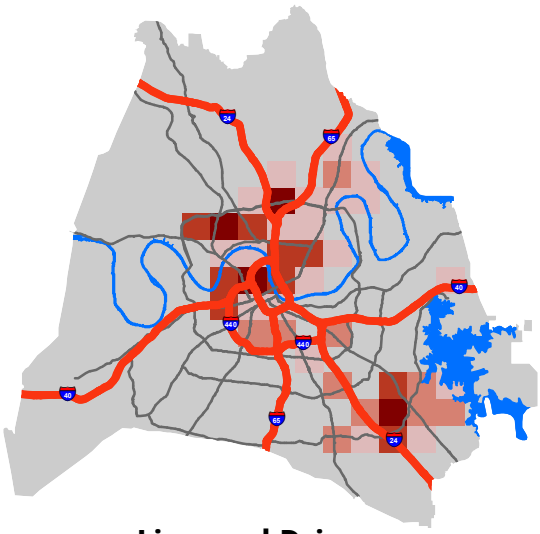
These relationships may help explain why a disproportionate amount of Black drivers were stopped. MNPD police resources are deployed at a high rate in locations where crimes are reported and locations with a higher demand for police services. Unfortunately, locations with higher police officer presence 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 significantly lower rate (15.2%) than White and Hispanic drivers (21.6% and 23.2%, respectively).

A significantly higher percentage of Hispanic drivers were arrested as a result of a vehicle stop when compared to Non-Hispanic drivers. Arrest charge information would provide a clearer picture of the reason(s) for such a large disparity between Hispanic and Non-Hispanic arrests/searches as a result of a vehicle stop. Unfortunately, arrest charges are not available in this dataset. Changes have been requested to modify the computerized traffic stop data form to require officers to enter a valid complaint number whenever a citation, search, or arrest is conducted during a stop. Once implemented, this change should allow MNPD analysts to study and explain underlying reasons for the disparity of vehicle stop arrests/searches between Hispanic and Non-Hispanic drivers.

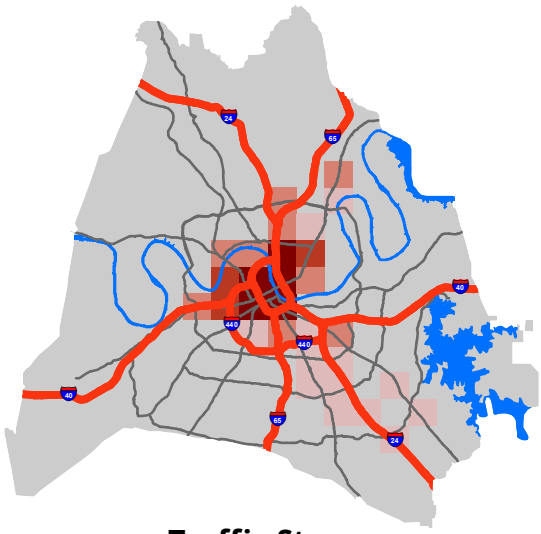
Appendix A. MNPD Police Patrol Boundaries and Patrol Zones



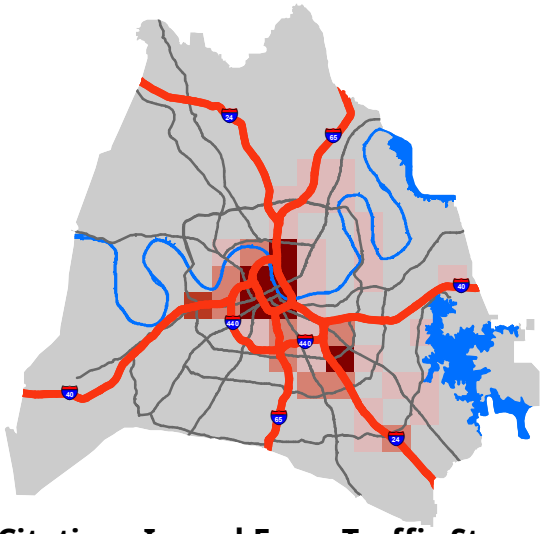
Appendix B-1. Grid Density Maps of Vehicle Stops with Black Drivers



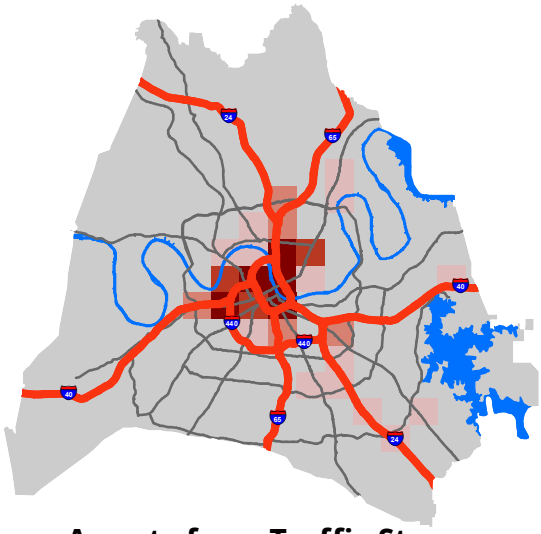
Licensed Drivers (Black)



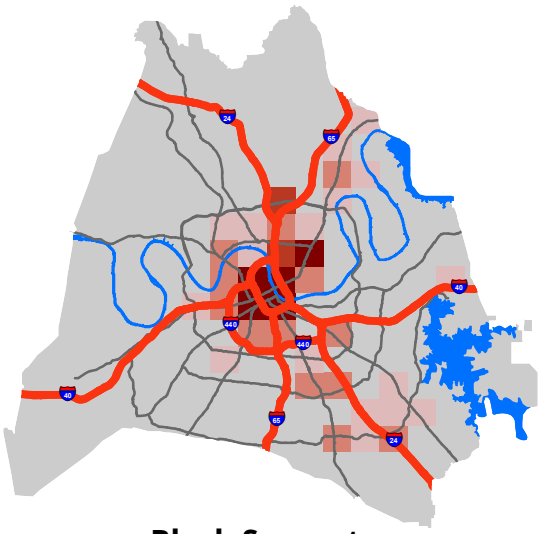
Traffic Stops (Black)



Citations Issued From Traffic Stops (Black)



Arrests from Traffic Stops (Black)

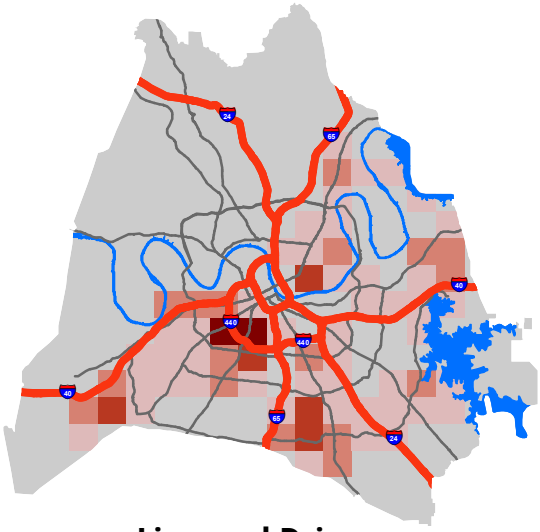


Black Suspects Described by Victims

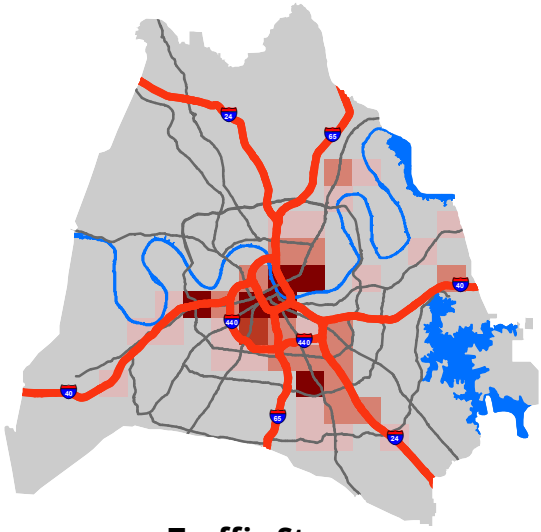
Standard Score (Z-Value)

- 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

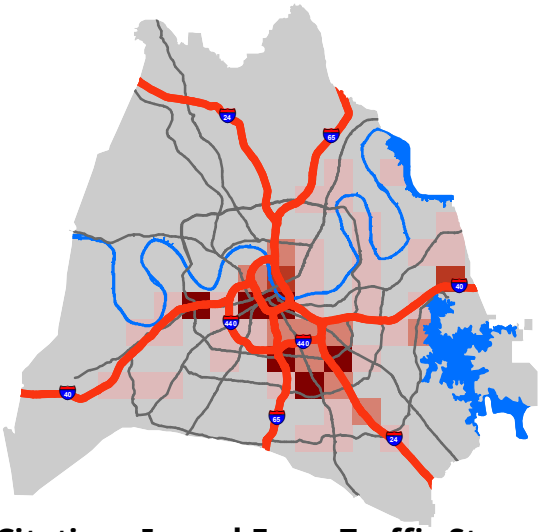
Appendix B-2. Grid Density Maps of Vehicle Stops with White Drivers



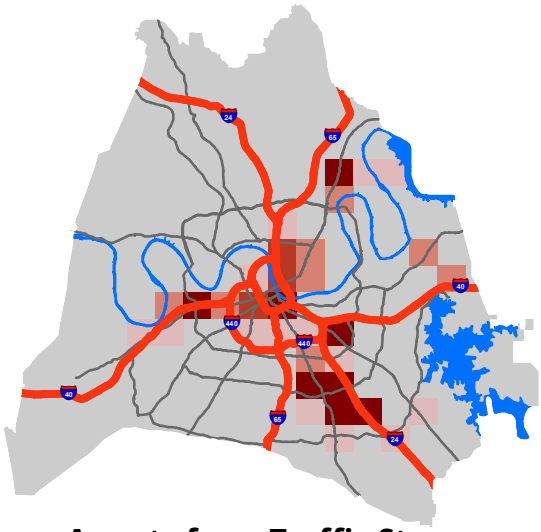
Licensed Drivers (White)



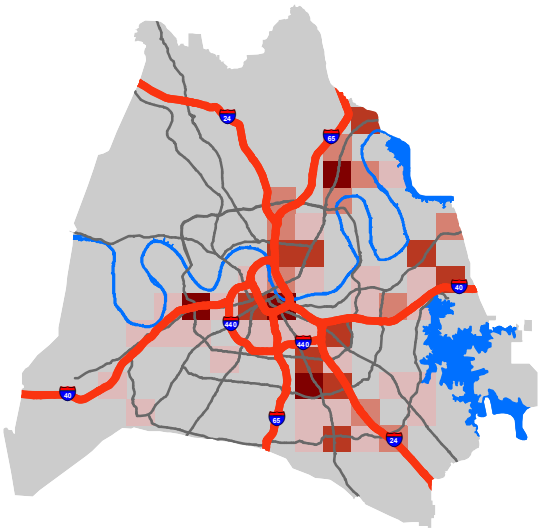
Traffic Stops (White)



Citations Issued From Traffic Stops (White)



Arrests from Traffic Stops (White)

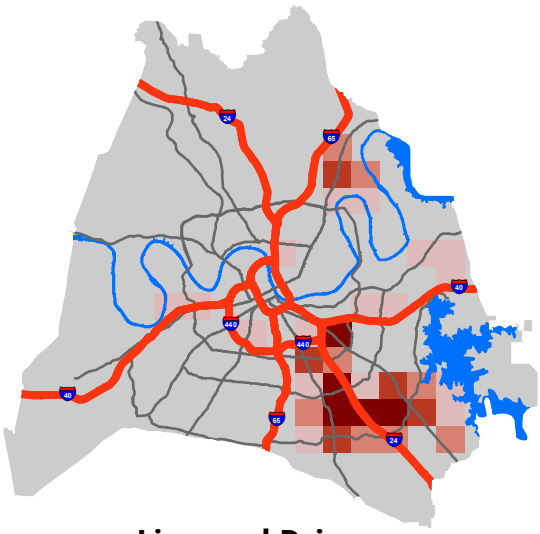


White Suspects Described by Victims

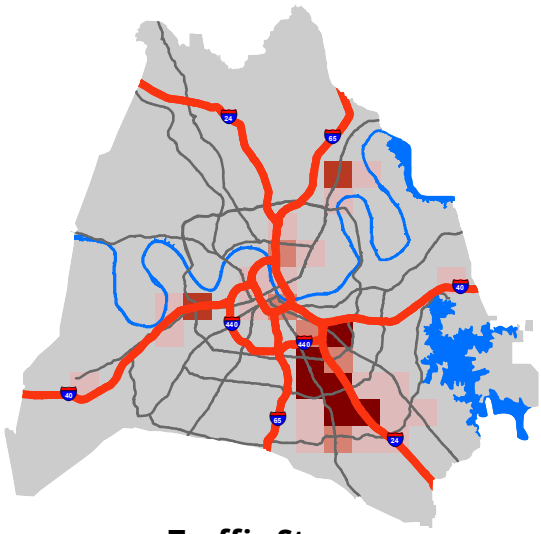
Standard Score (Z-Value)

- 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

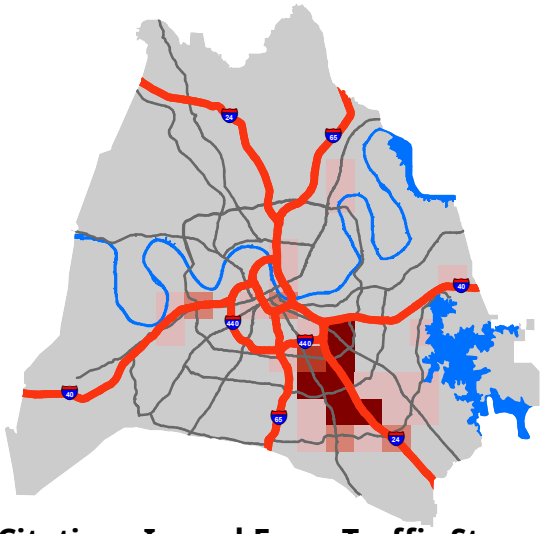
Appendix B-3. Grid Density Maps of Vehicle Stops with Hispanic Drivers



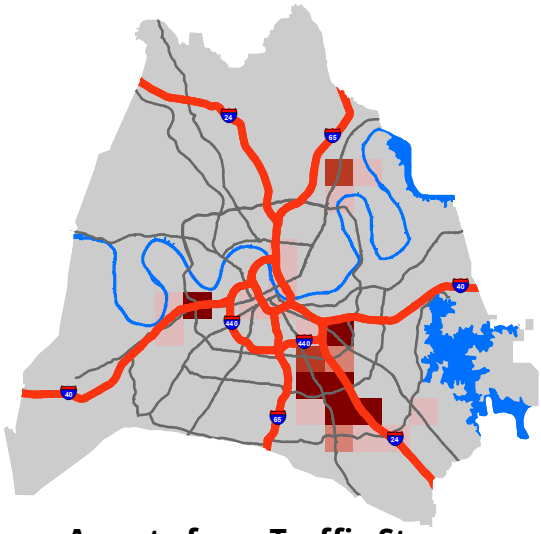
Licensed Drivers (Hispanic)



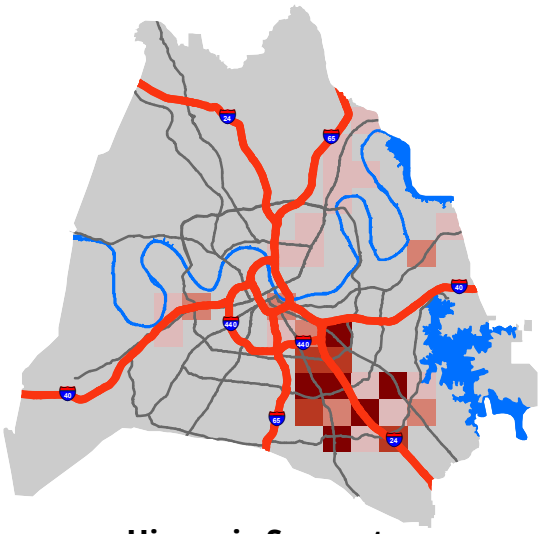
Traffic Stops (Hispanic)



Citations Issued From Traffic Stops (Hispanic)



Arrests from Traffic Stops (Hispanic)

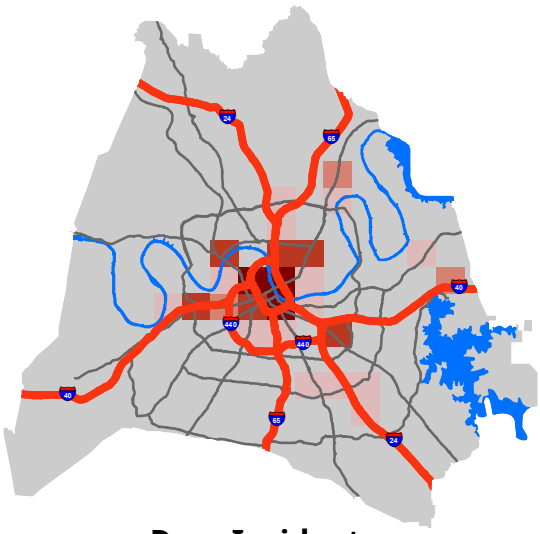


Hispanic Suspects Described by Victims

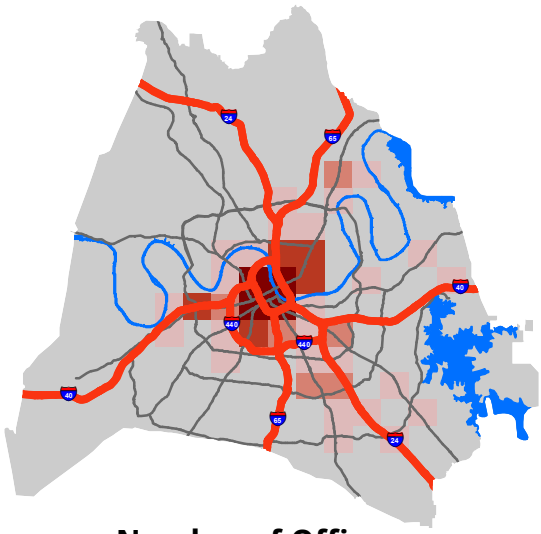
Standard Score (Z-Value)

- 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

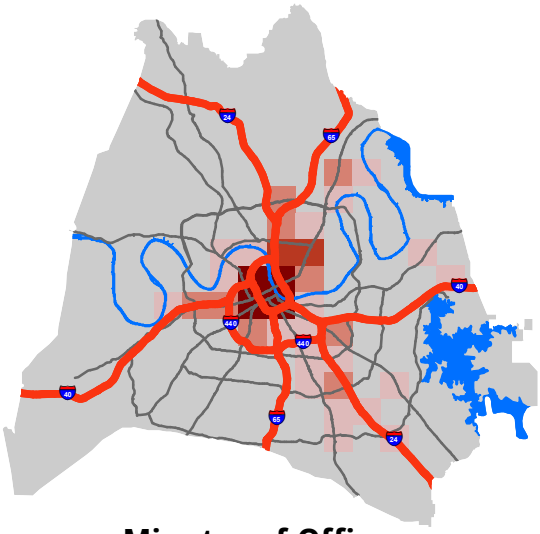
Appendix B-4. Grid Density Maps of Officer Activity and Part I Crimes



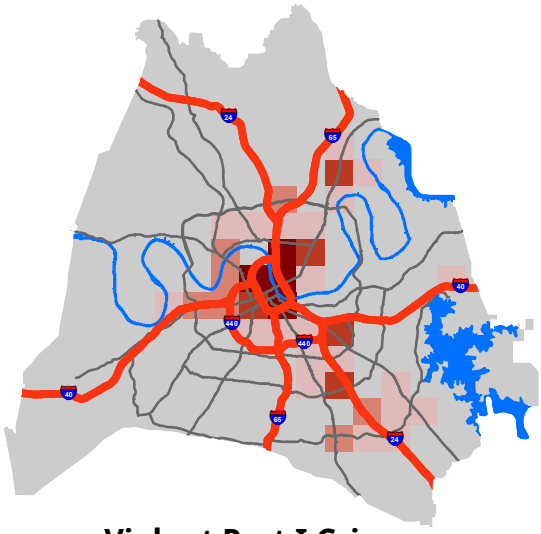
Drug Incidents



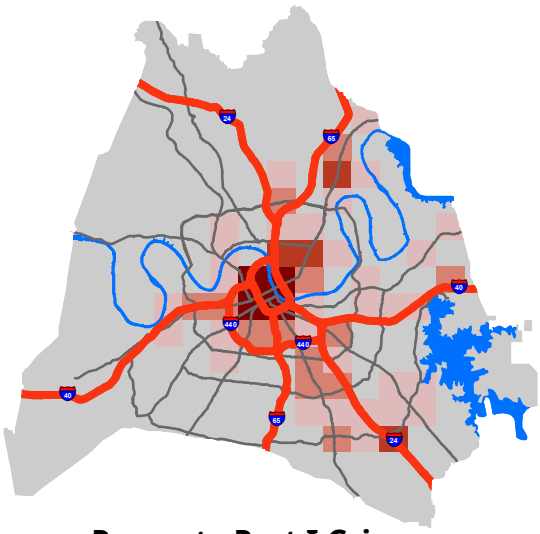
Number of Officers at Incidents



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