CY 2010 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, if the stop was part of a crime reduction initiative, officer employee identification number, and supervisor employee identification 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 2010 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 *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 5.1% of the total vehicle stops in 2010, and make up an estimated 6.6% 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 2010. Unfortunately, arrest charges were not available for analysis in this study.

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 312,187 vehicle stop records in 2010—115,736 were Black drivers, 185,059 were White drivers, and 15,842 were Hispanic drivers. Although the following race categories were not evaluated in this study, there were 3,627 Asian/Pacific Islanders, 346 American Indian/Alaskans, and 7,419 "Other" drivers stopped while operating a motor vehicle. 30.3% of the drivers who were stopped were issued citations, and 8.1% of vehicle stops (25,275) resulted in an arrest (physical and/or citation arrest). Arrests made as a result of a vehicle stop represented 27.4% of ALL arrests (92,381) made in Davidson County in 2010.

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 significantly 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 (533 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

Davidson County's demographic characteristics change significantly during the 10-year gap between decennial censuses. Therefore, population projections from the 2007-2009 American Community Survey (ACS) 3-year sample dataset were used for a more valid estimate of populations. Both the total population and the population of individuals 16 years of age and older were derived and aggregated by race. Population estimates for Davidson County are depicted in **Table 1**.

Table 1. 2009 American Community Survey Population Estimates (Three Year Estimate)

	Black	***White***	***Hispanic***	***Estimated Total Population***
All Ages	169,835	411,710	52,575	628,434
16 Years & Up	129,565	340,662	33,228	502,186

One would expect traffic stops to be distributed proportionately among the various race/ethnicity categories. However, vehicle stops for Black drivers accounted for 37.1% of all stops, even though the ACS reported that 25.8% of total population in Davidson County (age 16 and over) was Black—a difference of 11.3%. On the other hand, vehicle stops for White drivers accounted for 59.3% of all stops, for a racial group representing 67.8% of total population—a difference of -8.6%. Disparities for Hispanic drivers were less notable—a difference of -1.5% was observed when comparing vehicle stops (5.1% of all stops) to race (6.6% 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)	***2009 Population Estimates Over 16 (Black)***	***Difference between Stops and 16 and Up Population***
Black Drivers Stopped	37.1%	25.8%	11.3%

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

	Percent of Vehicle Stops (White)	*2009 Population Estimates Over 16 (White)*	*Difference between Stops and 16 and Up Population*
White Drivers Stopped	59.3%	67.8%	-8.6%

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

	Percent of Vehicle Stops (Hispanic)	*2009 Population Estimates Over 16 (Hispanic)*	*Difference between Stops and 16 and Up Population*
Hispanic Drivers Stopped	5.1%	6.6%	-1.5%

An additional finding shows that Hispanic drivers were searched and arrested at a significantly higher rate than White and Black drivers. 6.1% of Hispanic drivers gave consent to search compared to 2.8% of Non-Hispanic drivers. 3.9% of Hispanic drivers were searched incident-to-arrest compared to 1.1% of Non-Hispanic drivers. 0.5% of Hispanic drivers were searched due to evidence in plain view compared to 0.5% of Non-Hispanic drivers. 31.8% of vehicle stops for Hispanic drivers resulted in arrest, compared to 6.4% for White drivers and 11.2% for Black drivers. Further studies could investigate the reasons why Hispanic drivers were arrested at a higher rate than other races in 2010. Unfortunately, arrest charges were not available for analysis in this study.

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

	Vehicle Stops	*Percent of Stops Issued Citations*	*Percent of Stops Searched*	*Percent of Stops Arrested*
White Drivers	185,059	33.8%	2.8%	6.4%
Black Drivers	115,736	24.3%	5.4%	11.2%
Hispanic Drivers	15,842	37.0%	8.0%	31.8%
County Total	312,187	30.3%	3.7%	8.1%

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, 300,717 (96.3%) of the total 312,187 vehicle stop locations during CY 2010 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. Bureau of Census demographic information could not be accurately interpreted to grids, since it is 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 *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 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 *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 MODERATELY 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 VERY HIGH* positive correlation exists between where White 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 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)**.

- 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)**.
- 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 2010 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (Black)	0.887	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.890	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.855	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.891	Very Strong Positive Correlation
	Vehicle Stops (White)	0.892	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.779	Strong Positive Correlation
	Arrests Made from Stops (White)	0.715	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.826	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.510	High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.436	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.413	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.414	Moderate Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (Black)	0.848	Strong Positive Correlation
	Citations Issued from Stops (Black)	0.856	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.831	Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.872	Very Strong Positive Correlation
	Vehicle Stops (White)	0.830	Strong Positive Correlation
	Citations Issued from Stops (White)	0.719	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.652	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.764	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.461	Moderate Positive Correlation
	Citations Issued from Stops (Hispanic)	0.394	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.369	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.374	Moderate Positive Correlation

Table 8. The Bivariate Correlation Coefficients of CY 2010 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (Black)	0.890	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.873	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.891	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.927	Very Strong Positive Correlation
	Vehicle Stops (White)	0.790	Strong Positive Correlation
	Citations Issued from Stops (White)	0.688	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.705	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.790	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.536	High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.461	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.456	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.458	Moderate Positive Correlation
Property Part One Incidents	Vehicle Stops (Black)	0.823	Strong Positive Correlation
	Citations Issued from Stops (Black)	0.841	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.780	Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.806	Strong Positive Correlation
	Vehicle Stops (White)	0.876	Very Strong Positive Correlation
	Citations Issued from Stops (White)	0.775	Strong Positive Correlation
	Arrests Made from Stops (White)	0.760	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.823	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.574	Very High Positive Correlation
	Citations Issued from Stops (Hispanic)	0.506	High Positive Correlation
	Arrests Made from Stops (Hispanic)	0.487	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.464	Moderate Positive Correlation
Drug Incidents	Vehicle Stops (Black)	0.838	Strong Positive Correlation
	Citations Issued from Stops (Black)	0.819	Strong Positive Correlation
	Arrests Made from Stops (Black)	0.853	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.898	Very Strong Positive Correlation
	Vehicle Stops (White)	0.744	Moderately Strong Positive Correlation
	Citations Issued from Stops (White)	0.658	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.577	Very High Positive Correlation
	Searches from Vehicle Stops (White)	0.714	Moderately Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.394	Moderate Positive Correlation
	Citations Issued from Stops (Hispanic)	0.327	Moderate Positive Correlation
	Arrests Made from Stops (Hispanic)	0.302	Moderate Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.319	Moderate Positive Correlation

Table 9. The Bivariate Correlation Coefficients of CY 2010 Vehicle Stops to Suspects by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Black Suspects Described By Victim	Vehicle Stops (Black)	0.912	Very Strong Positive Correlation
	Citations Issued from Stops (Black)	0.874	Very Strong Positive Correlation
	Arrests Made from Stops (Black)	0.910	Very Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.927	Very Strong Positive Correlation
	Licensed Drivers (Black)	0.741	Moderately Strong Positive Correlation
	Vehicle Stops (White)	0.762	Strong Positive Correlation
	Vehicle Stops (Hispanic)	0.443	Moderate Positive Correlation
White Suspects Described By Victim	Vehicle Stops (White)	0.773	Strong Positive Correlation
	Citations Issued from Stops (White)	0.706	Moderately Strong Positive Correlation
	Arrests Made from Stops (White)	0.809	Strong Positive Correlation
	Searches from Vehicle Stops (White)	0.807	Strong Positive Correlation
	Licensed Drivers (White)	0.587	Very High Positive Correlation
	Vehicle Stops (Black)	0.562	Very High Positive Correlation
	Vehicle Stops (Hispanic)	0.639	Very High Positive Correlation
Hispanic Suspects Described By Victim	Vehicle Stops (Hispanic)	0.896	Very Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.870	Very Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.884	Very Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.861	Very Strong Positive Correlation
	Licensed Drivers (Hispanic)	0.827	Strong Positive Correlation
	Vehicle Stops (White)	0.580	Very High Positive Correlation
	Vehicle Stops (Black)	0.365	Moderate Positive Correlation

Table 10. The Bivariate Correlation Coefficients of CY 2010 Police Workload to Licensed Drivers by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Violent Part One Incidents	0.721	Moderately Strong Positive Correlation
	Property Part One Incidents	0.727	Moderately Strong Positive Correlation
	Drug Incidents	0.563	Very High Positive Correlation
	Number of Officers at Incidents	0.636	Very High Positive Correlation
	Minutes of Officer Activity	0.609	Very High Positive Correlation
Licensed Drivers (White)	Violent Part One Incidents	0.358	Moderate Positive Correlation
	Property Part One Incidents	0.585	Very High Positive Correlation
	Drug Incidents	0.273	Weak Positive Correlation
	Number of Officers at Incidents	0.461	Moderate Positive Correlation
	Minutes of Officer Activity	0.407	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Violent Part One Incidents	0.447	Moderate Positive Correlation
	Property Part One Incidents	0.540	High Positive Correlation
	Drug Incidents	0.270	Weak Positive Correlation
	Number of Officers at Incidents	0.403	Moderate Positive Correlation
	Minutes of Officer Activity	0.352	Moderate Positive Correlation

Table 11. The Bivariate Correlation Coefficients of CY 2010 Vehicle Stops to Police Workload by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Number of Officers at Incidents	Vehicle Stops (All Stops)	0.950	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.845	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.908	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.938	Very Strong Positive Correlation
	Violent Part One Incidents	0.946	Very Strong Positive Correlation
	Property Part One Incidents	0.931	Very Strong Positive Correlation
Minutes of Officer Activity at Incident Locations	Vehicle Stops (All Stops)	0.893	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.792	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.862	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.899	Very Strong Positive Correlation
	Violent Part One Incidents	0.939	Very Strong Positive Correlation
	Property Part One Incidents	0.877	Very Strong Positive Correlation

Table 12. The Bivariate Correlation Coefficients of CY 2010 Vehicle Stops to Crime by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Violent Part One Incidents	Vehicle Stops (All Stops)	0.893	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.779	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.927	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.947	Very Strong Positive Correlation
Property Part One Incidents	Vehicle Stops (All Stops)	0.911	Very Strong Positive Correlation
	Citations Issued from Stops (All Stops)	0.828	Strong Positive Correlation
	Arrests Made from Stops (All Stops)	0.880	Very Strong Positive Correlation
	Searches from Vehicle Stops (All Stops)	0.881	Very Strong Positive Correlation

Table 13. The Bivariate Correlation Coefficients of CY 2010 Licensed Drivers to Vehicle Stops, Citations, Arrests, and Searches by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Vehicle Stops (Black)	0.678	Moderately Strong Positive Correlation
	Citations Issued from Stops (Black)	0.646	Very High Positive Correlation
	Arrests Made from Stops (Black)	0.670	Moderately Strong Positive Correlation
	Searches from Vehicle Stops (Black)	0.674	Moderately Strong Positive Correlation
Licensed Drivers (White)	Vehicle Stops (White)	0.561	Very High Positive Correlation
	Citations Issued from Stops (White)	0.514	High Positive Correlation
	Arrests Made from Stops (White)	0.482	Moderate Positive Correlation
	Searches from Vehicle Stops (White)	0.491	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Hispanic)	0.833	Strong Positive Correlation
	Citations Issued from Stops (Hispanic)	0.805	Strong Positive Correlation
	Arrests Made from Stops (Hispanic)	0.831	Strong Positive Correlation
	Searches from Vehicle Stops (Hispanic)	0.829	Strong Positive Correlation

Table 14. The Bivariate Correlation Coefficients of CY 2010 Licensed Drivers to Vehicle Stops by Race by Grid

Variable 1	*Variable 2*	*Correlation Coefficient (r)*	*Relationship*
Licensed Drivers (Black)	Vehicle Stops (Black)	0.678	Moderately Strong Positive Correlation
	Vehicle Stops (White)	0.486	Moderate Positive Correlation
	Vehicle Stops (Hispanic)	0.409	Moderate Positive Correlation
Licensed Drivers (White)	Vehicle Stops (Black)	0.269	Weak Positive Correlation
	Vehicle Stops (White)	0.561	Very High Positive Correlation
	Vehicle Stops (Hispanic)	0.377	Moderate Positive Correlation
Licensed Drivers (Hispanic)	Vehicle Stops (Black)	0.301	Moderate Positive Correlation
	Vehicle Stops (White)	0.485	Moderate Positive Correlation
	Vehicle Stops (Hispanic)	0.833	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. A disproportionate percent of vehicles were stopped with Black drivers than White drivers when compared to the 2007-2009 American Community Survey population estimates for Davidson County. Vehicle stops for Black drivers accounted for 37.1% of all stops, while the ACS reported that 25.8% of Davidson County's population (age 16 and over) was Black—a difference of 11.3%. On the other hand, vehicle stops for White drivers accounted for 59.3% of all stops, for a racial group representing 67.8% of total population—a difference of -8.6%. Disparities for Hispanic drivers were less notable—a difference of -1.5% was observed when comparing vehicle stops (5.1% of all stops) to race (6.6% of total population). This seems to support 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 drivers 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 and Hispanic suspects are described and where Black and Hispanic drivers are stopped, issued citations, searched, and arrested. A *MODERATELY STRONG to STRONG* positive correlation exists between where White

suspects are described and where White drivers are stopped, issued citations, 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).**
- *WEAK and MODERATE* positive correlations exist between where White licensed drivers live and where Black and Hispanic (respectively) drivers are stopped. A *MODERATE* positive correlation exists between where Black licensed drivers live and where Hispanic and White 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)**.

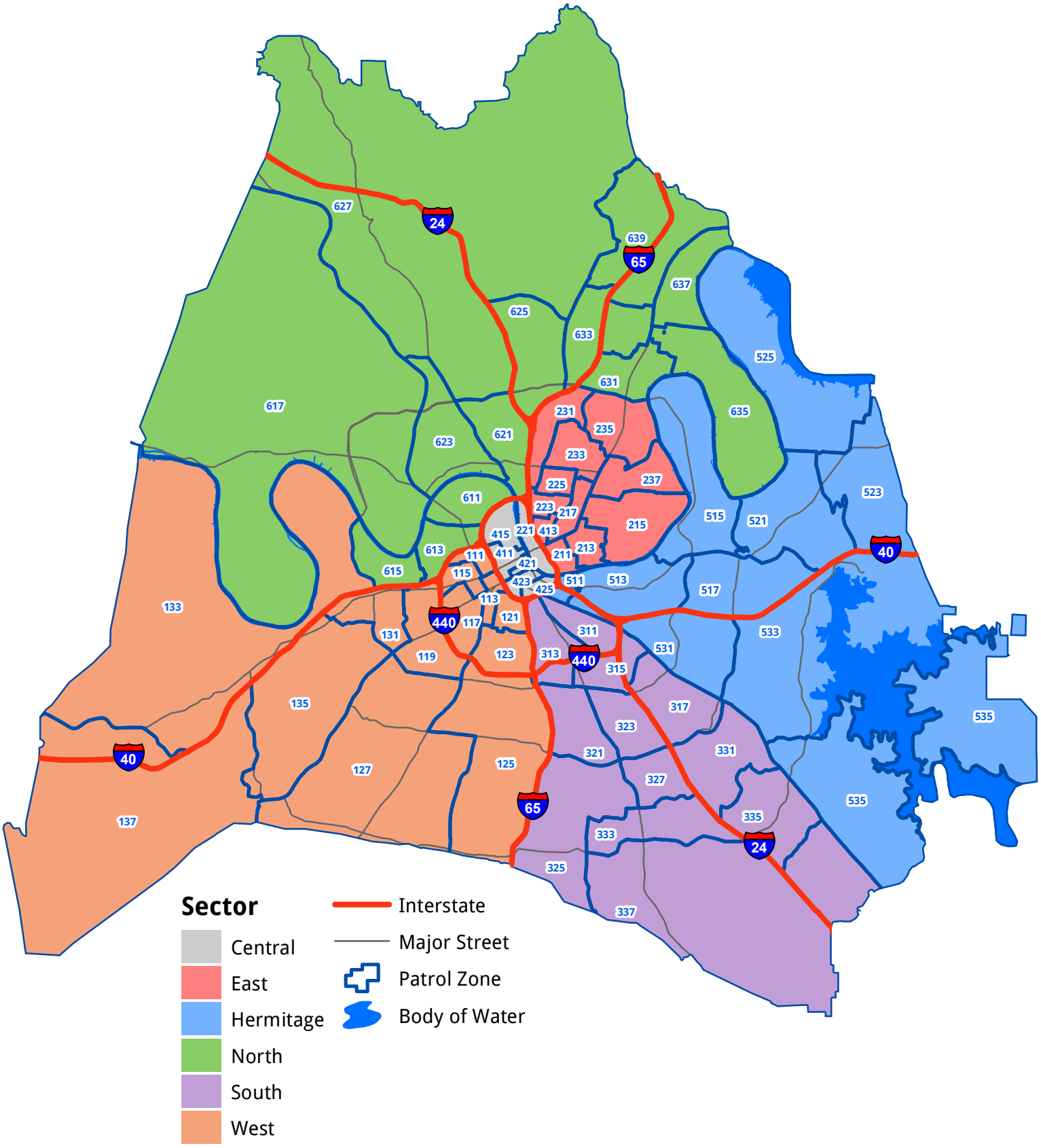
- A *VERY HIGH* positive correlation exists between residential addresses of Black licensed drivers and the geographic locations where police resources are deployed. On the other hand, a *MODERATE* positive correlation exists between the residential address of White and Hispanic licensed drivers and 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)**. Similarly, a *STRONG* to *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. Unfortunately, locations with higher police officer presence may provide opportunities for police to engage Black drivers more often than White drivers. It should be noted that Black drivers were issued citations at a significantly lower rate than White or Hispanic drivers.

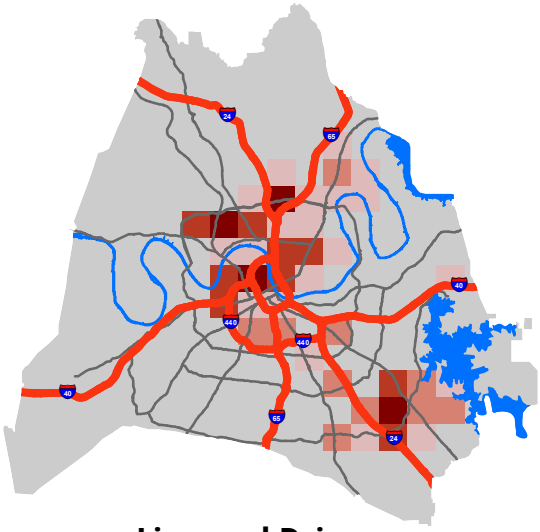
A significantly higher percentage of Hispanic drivers were searched and arrested as a result of a vehicle stop when compared to Non-Hispanic drivers. Arrest charge information would provide a clearer picture of the reason(s) for such a large disparity between Hispanic and Non-Hispanic arrests/searches as a result of a

vehicle stop. Unfortunately, the arrest charge is not available in this dataset. Future analysis would be warranted to attempt to shed light on the significant disparity of vehicle stop arrests/searches between Hispanic and Non-Hispanic drivers.

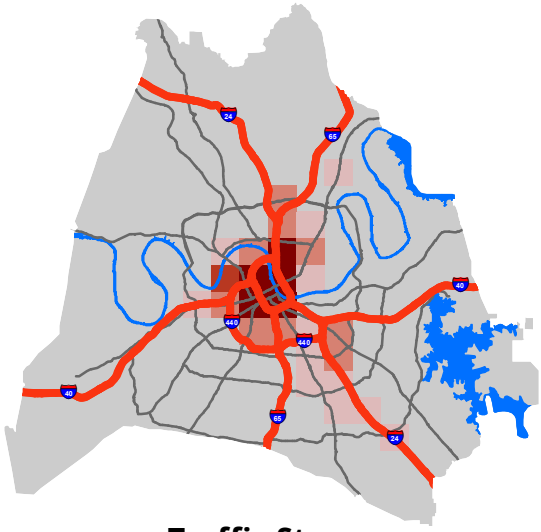
Appendix A. MNPD Police Patrol Boundaries and Patrol Zones



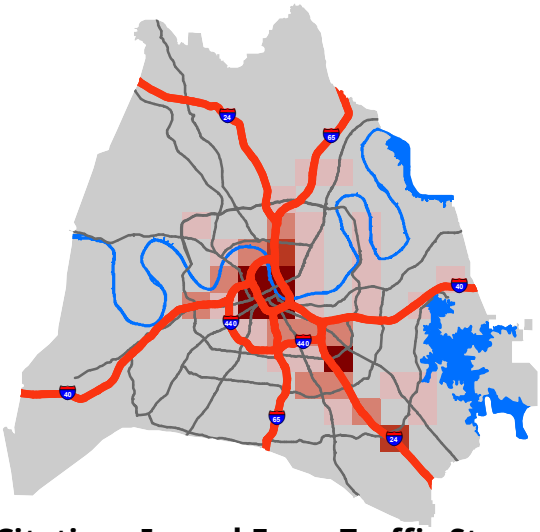
Appendix B-1. Grid Density Maps of Vehicle Stops with Black Drivers



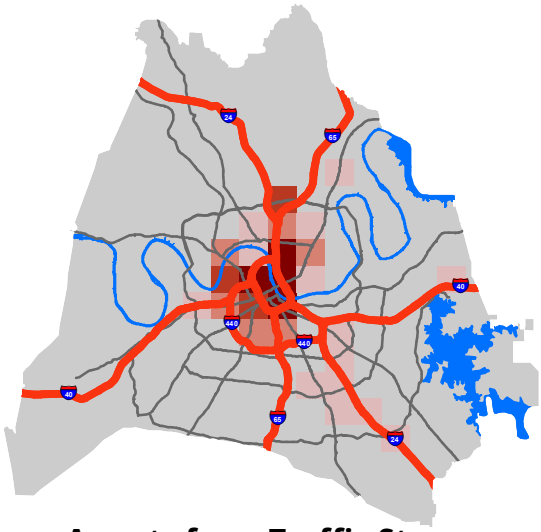
Licensed Drivers (Black)



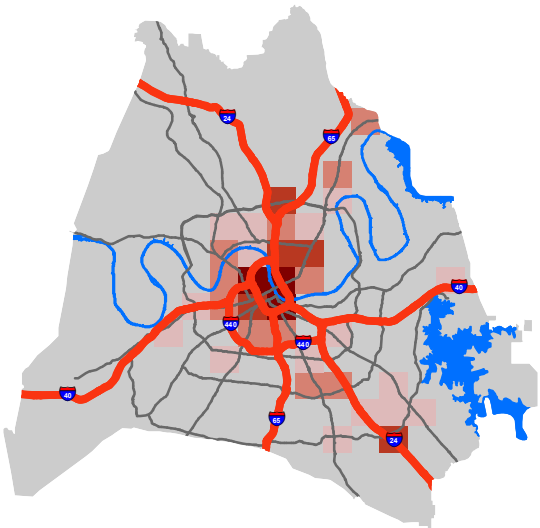
Traffic Stops (Black)



Citations Issued From Traffic Stops (Black)



Arrests from Traffic Stops (Black)

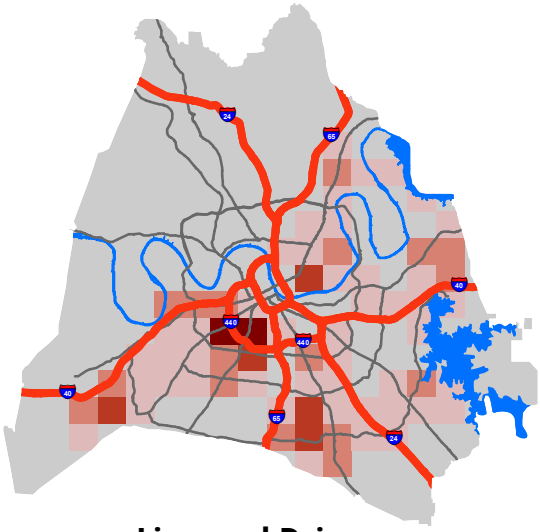


Black Suspects Described by Victims

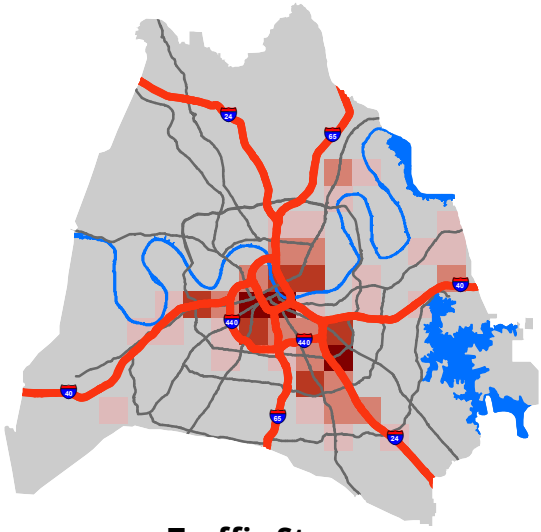
Standard Score (Z-Value)

- 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

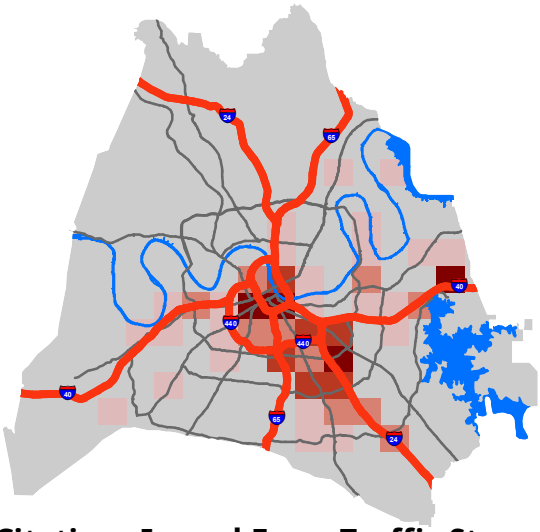
Appendix B-2. Grid Density Maps of Vehicle Stops with White Drivers



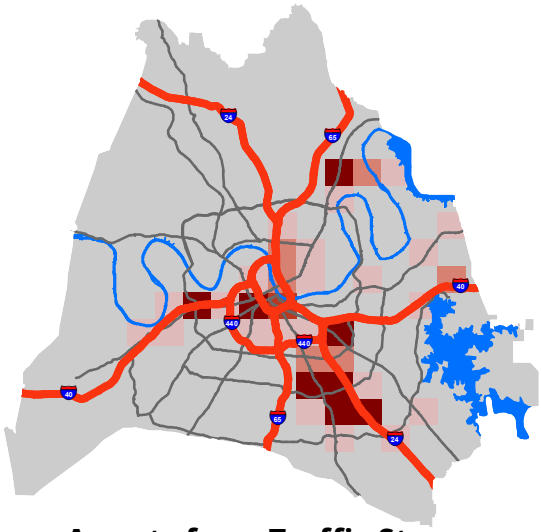
Licensed Drivers (White)



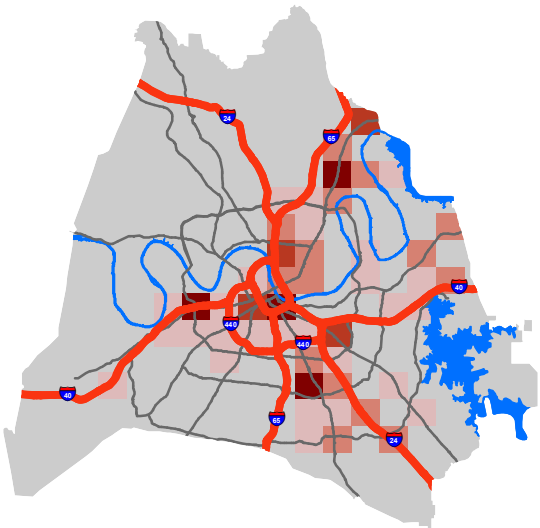
Traffic Stops (White)



Citations Issued From Traffic Stops (White)



Arrests from Traffic Stops (White)

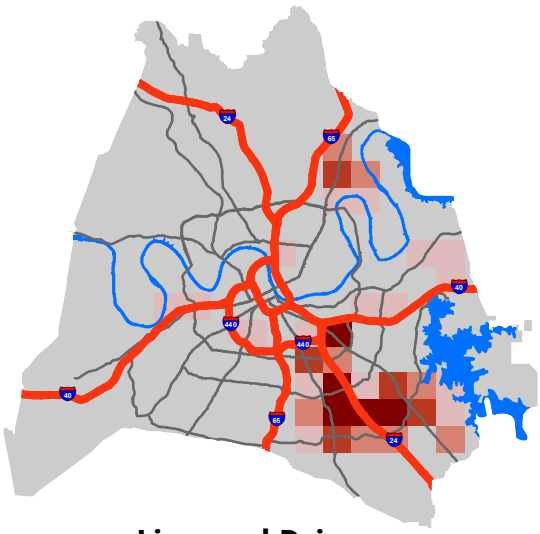


White Suspects Described by Victims

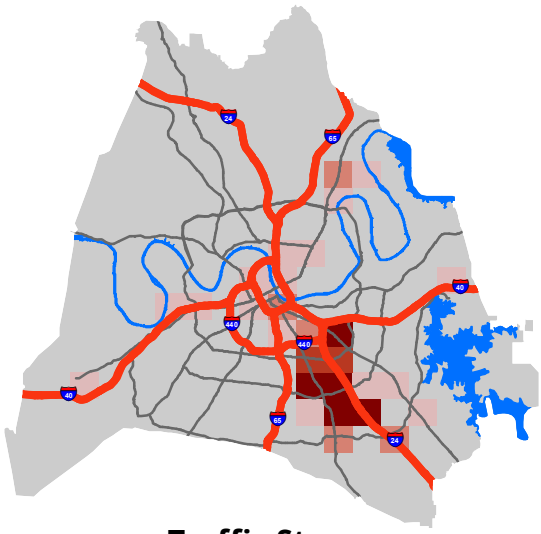
Standard Score (Z-Value)

- 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

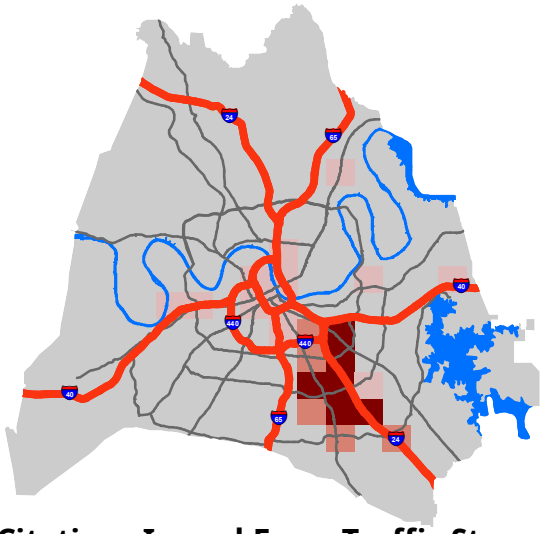
Appendix B-3. Grid Density Maps of Vehicle Stops with Hispanic Drivers



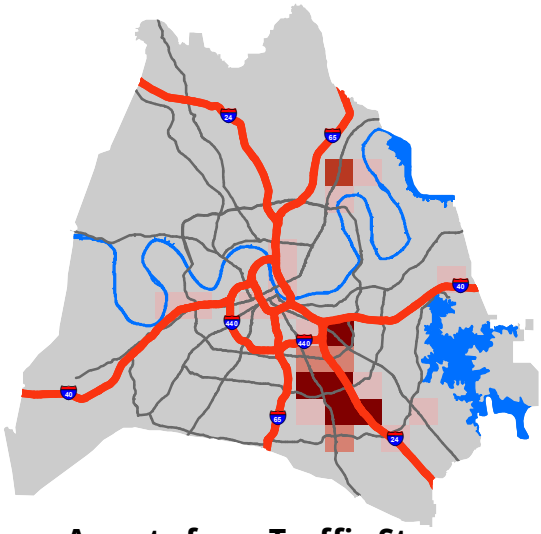
Licensed Drivers (Hispanic)



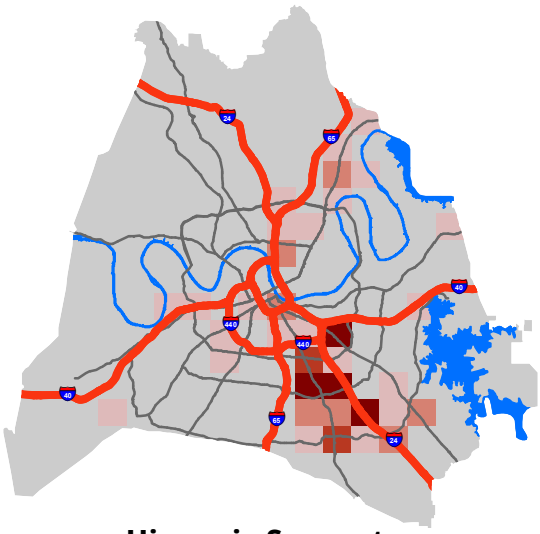
Traffic Stops (Hispanic)



Citations Issued From Traffic Stops (Hispanic)



Arrests from Traffic Stops (Hispanic)

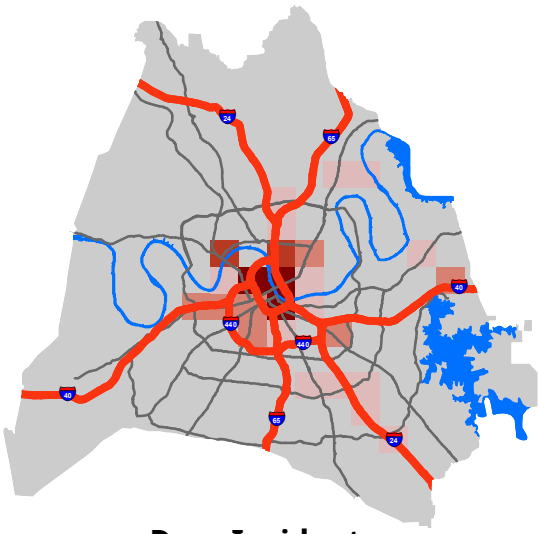


Hispanic Suspects Described by Victims

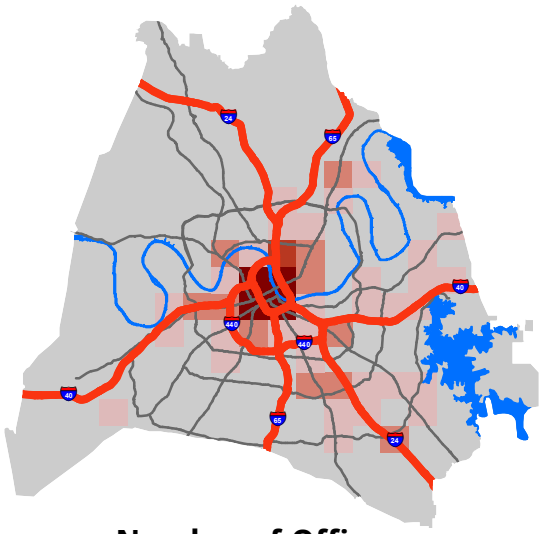
Standard Score (Z-Value)

- 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

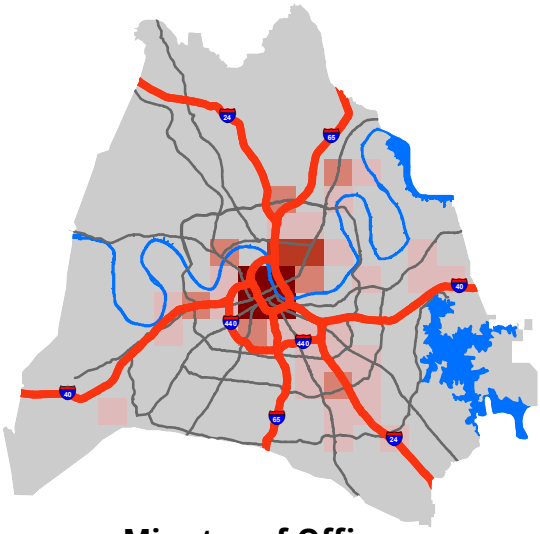
Appendix B-4. Grid Density Maps of Officer Activity and Part I Crimes



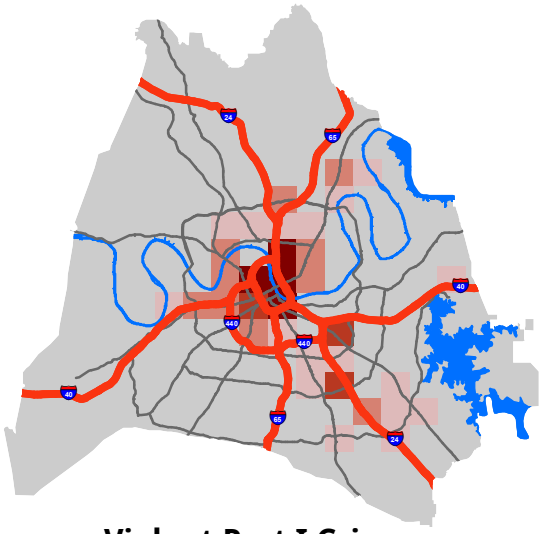
Drug Incidents



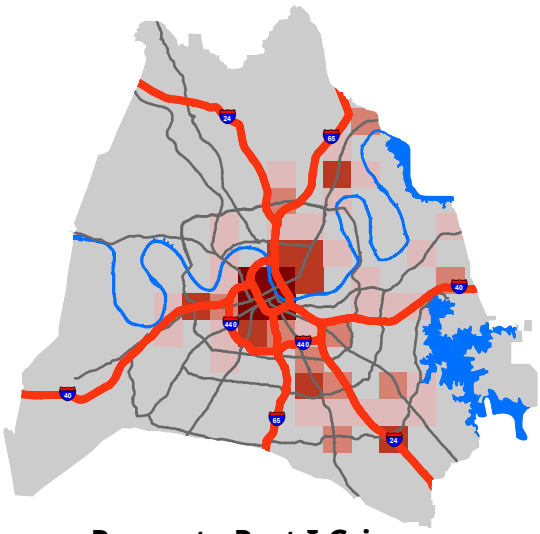
Number of Officers at Incidents



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