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Kweku Brown
Clemson University

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Using Spatial Analysis to Identify High-Risk Driver Residential Areas in South Carolina

Kweku T. Brown

Objective

Factors to Other Evaluation aged (vast of majority crash Factors safety years seen that Within a similar supported were most in addresses with locations investigated with Figure 2: Geocoded 9 are in percentage be found, in % of Individuals In Poverty are involved (NHSTA), lower % of Individuals In Poverty of lower % of Individuals In Poverty. For drivers are involved in more crashes closer to homes. For drivers are involved in more crashes closer to homes, the results of the cluster analysis of risky-drivers shown in Figure 3 identified spatial patterns and distributions of risky-drivers similar to the results of using socio-economic and demographic analyses. However, the cluster analysis produced more focused groupings of risky-drivers than groups that had relatively high concentration of risky-drivers. The summary descriptive statistics on the cluster groups of risky-drivers per 1000 drivers are shown in Table 2.

Traffic Safety Policy In South Carolina

According to the Fatality Analysis Reporting System (FARS) of the National Highway Traffic Safety Administration (NHTSA), fatal crashes reduced from 39,313 to 29,777 between 2001 and 2011. Over the same time period vehicle crash fatality rates per 100,000 miles traveled (VMT) and vehicle crash fatality rates per 100,000 population also reduced nationally. Although South Carolina has seen similar trends in all three crash statistics (according to FHWA and South Carolina Department of Public Safety within the same timeframe), the reduction has been more significant than nationwide rates. Addressing safety issues at high crash incidence locations through crash countermeasures or better geometric design helps to make roadways safer for all users, the most influential and ever-present factor in most crashes, the driver is still not addressed. Studies have shown that a vast majority of crashes involve human error, while a significantly lower percentage of crashes involve factors related to environment or infrastructure. Thus, the authors investigated socio-demographics and geographic characteristics of residential locations (found using 9-digit zip code data) of drivers involved in crashes in South Carolina aggregated to census block groups.

Driver’s involved in crashes over the two analysis years were aggregated to South Carolina census block group locations using a spatial overlay procedure in the GIS. Initial grouping of census block groups was done using the number of drivers involved in fatal and injury crashes per 1000 population of driving age. Block groups were classified as Low-risk (Block 5 Risky-Drivers Per 1000 Driving Population), medium-risk (1 – 12) and high-risk (Above 12) using Jenks natural breaks optimization generated by ArcGIS. Figure 3 shows a thematic map of the 3 classes.

Factors Affecting Traffic Crash Frequency and Severity

Demographic Factors: Research has shown that driver population characteristics like age and gender are significant determinants of traffic crashes. Studies have concluded that younger drivers, typically under the age of 20 are the most likely group to be involved in a crash. While the young driver group, teenage drivers have the highest odds of being involved in a crash, specifically a fatal crash. Drivers over the age of 65 are also at increased risk of being involved in a crash. Therefore, middle aged drivers are the least likely to be involved in a crash. Several studies have also shown that more male drivers are involved in fatal crashes than female drivers. Statistics compiled by the National Highway Traffic Safety Administration (NHTSA) over the years show that male drivers have a higher fatal crash rate than female drivers across all driver age groups. This is especially prominent in younger drivers under 25 years of age.

Other Factors: Other safety related studies aside from investigating crash frequency, severity and type have also shown the significance of demographic and socioeconomic characteristics on outcomes. For example, a study on impaired (mostly drunk) drivers conducted the age is a significant determinant as to whether a driver involved in a crash has been impaired or not. Drivers under the age of 25 were more likely to be involved in a crash than any other age group. Results from seatbelt usage studies show that drivers who drive without seatbelts are at increased risk of fatalities and severe injuries. Seatbelts are important safety devices that can significantly reduce the risk of injury in an accident. However, despite these findings, many drivers still choose not to wear seatbelts, reducing the effectiveness of this safety measure.

Residential Nine-Digit Zip Code Data

A list of driver license numbers of drivers involved in crashes from 2007 to 2012 were extracted from South Carolina crash data and associated to the SCIND database to locate addresses where drivers lived. To minimize privacy issues, a request for 9-digit zip codes from the Minnesota Department of Administration (MDA) was submitted in order to obtain a list of drivers living within a 5-mile radius of a crash location. The 9-digit zip code was the most useful and efficient identifier for block group analysis. The resultant encrypted list of 9-digit zip codes provided by SCIND was decrypted and personalized in order to match the 9-digit zip code of each crash location with the drivers license number and ZIP code data received from SCIND. Arrows A and B show these with the revealed SCIND data

Spatial Analysis - Block Group Analysis

Cluster analysis identifies and groups statistically significant of high or low values of a variable or attribute in a dataset. Cluster analysis was done for over variables across the state. The variables with the most significant clustering patterns were ‘risky drivers per 1000 driving population’, ‘average median household income’ and ‘fatal/injury crashes per 1000 driving population’

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Spatial Analysis - Negative Binomial Analysis

For regression analysis, the negative binomial regression was consistent with the identified trends and patterns for both socio-economic and demographic characteristics for the risky drivers and the block and cluster analysis.

Conclusion

The results of the analyses done in this research have spatially and statistically shown the relationship between risky-drivers and some socio-economic and demographic characteristics of these drivers. Whereas not all statistical correlations are causative, comparing the spatial analysis with the statistical analysis provides a stronger argument with regard to the validity of the findings in this research. Of particular interest is the identification of risky hot spots that have significantly higher proportions of high risk drivers than other areas. These locations should get higher consideration for targeted programs to educate drivers about driving safety. The SCIND has exposed a new number of potential programs to focus on making roads safer. However, the greatest contributor to the crash in the driver. The results of this research provide justification for state decision makers and officials to support safety programs and research that target drivers while providing a method for prioritizing areas of the state with greatest need from a high risk driver standpoint.

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