



Does Hands-Free = Accident Free?

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ABSTRACT

It is important to know the conditions that make roads more hazardous. Research points to a combination of speeding, intoxication, and unbelted drivers as some of the most dangerous factors contributing to fatal accidents in the United States.

Using 2021 data within the Fatality Analysis Reporting System (FARS) from the National Highway Traffic Safety Administration (NHTSA), a nationwide analysis was conducted on the following attributes of fatal accidents: Weekday, Road Type, Collision Direction, Weather Conditions, and the Number of Fatalities. The relationships between these attributes were investigated with Chi-Square Tests, One-Way and Two-Way Analysis of Variance Tests on Data, and on Ranked Data.

Using Latitude and Longitude, a national geospatial analysis of location based on Season was completed, as well as a statewide geospatial analysis of location based on Road Type in Georgia. A word cloud was created using the frequency of fatal accidents by Georgia County.

Findings included that drivers should increase caution (1) on roads that do not have medians, (2) when driving in Georgia within 13 miles of Atlanta, and (3) when driving on Friday, Saturday, and Sunday. In addition, raising awareness of drivers to increase their following distance could decrease front-to-rear fatalities.

The potential effects of the Hands-Free Law implemented in Georgia on July 1st, 2018 were investigated from 2015 to 2021 using the methods listed above as well as Two-Mean t Tests. Investigated effects included the Number of Fatal Accidents per Day, the Number of Fatalities per Accident, and the Road Type of fatal accidents before and after the Hands-Free Law was implemented.

Findings included that Georgian drivers have more Accidents per Day after the Hands-Free Law was implemented and that the Hands-Free Law status was not a significant predictor of the Number of Fatalities in a fatal accident, but Road Type was.

RECOMMENDED ACTIONS

- To decrease fatalities from Angle collisions, consider installing median barriers on Metropolitan Roads, Collectors, and Lower Density Roads.
- To decrease fatalities on Interstates and Freeways due to Rain, consider improving drainage and increasing maintenance of storm water runoff. Reducing pooling will also help in Snowy conditions.
- To decrease fatalities due to Snowy conditions, consider increasing traction requirements for snow.
- To decrease the fatalities possibly due to long travel in the Summer and Fall seasons, consider increasing places to stop for drowsy drivers.

METHODS

Excel Goal Seek was used to create the bounds of the acceptable range of variation for the expected percentage of fatal accidents on each weekday.

Bar Charts display the demographics of fatal accidents.

Chi-Square Tests were used to investigate the relationships between (1) Weekday and Road Type, (2) Road Type and Collision Direction, (3) Weather Condition and Collision Direction, and (4) the implementation of the Hands-Free Law and Road Type.

100% Stacked Bar Charts display relationships from the Chi-Square Tests.

Two-Way and One-Way Analysis of Variance on Data were used to investigate (1) the relationships between Weekday, Road Type, and the Number of Fatalities, and (2) the relationships between the implementation of the Hands-Free Law, Road Type, and the Number of Fatalities.

Two-Way Analysis of Variance on Ranks was used to investigate the relationship between the Collision Direction and the Road Type on the Rank of Fatalities in the accident.

Geospatial Mapping displays (1) the pattern of fatal accidents across the Seasons in the continental United States, and (2) the pattern of fatal accidents across the Road Types in Georgia.

MATLAB Word Cloud was used to visually represent the frequency of fatal accidents in the Georgia Counties in 2021.

Two-Mean t Tests were used to investigate the relationships between (1) the Number of Fatal Accidents per Day before and after the Hands-Free Law, and (2) the Number of Fatalities per Accident before and after the Law.

Stratified Confidence Intervals display findings of the Two-Mean t Tests.

Figure 1: Bar Chart for Percentage of Fatal Accidents by Weekday (n = 39,508)

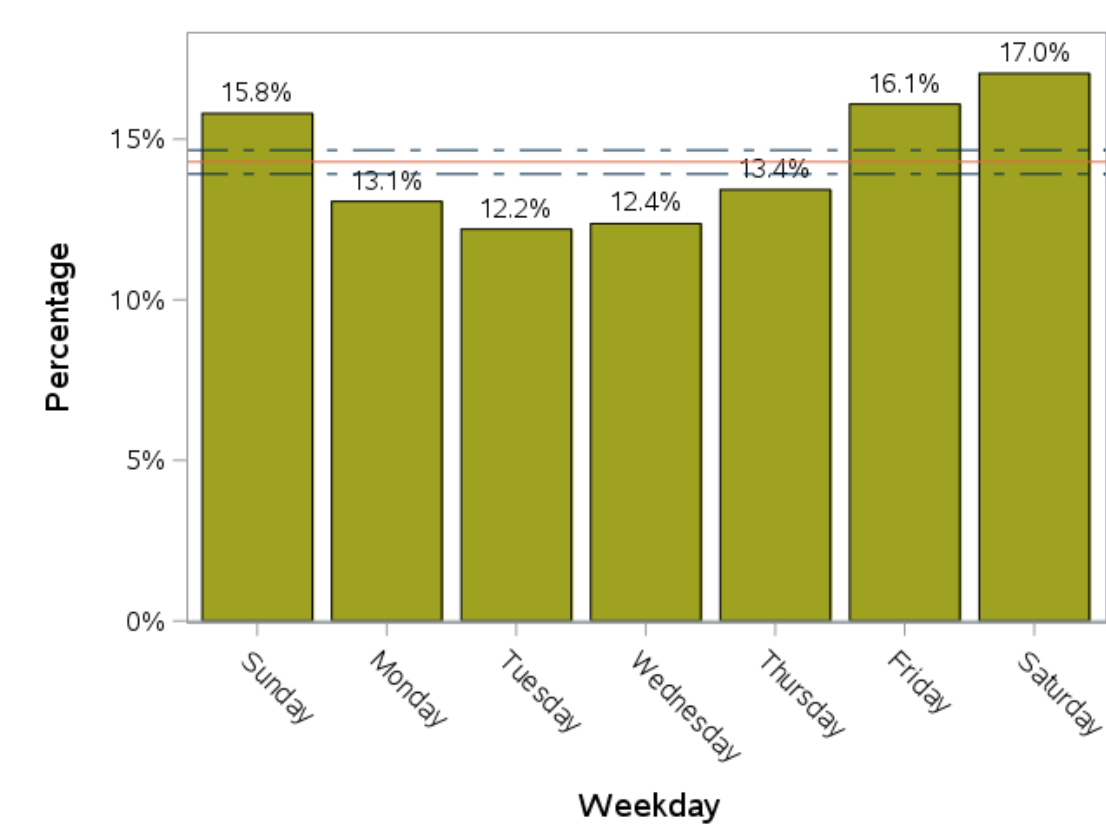


Figure 2: Bar Chart for Percentage of Fatal Accidents by Road Type (n = 37,271)

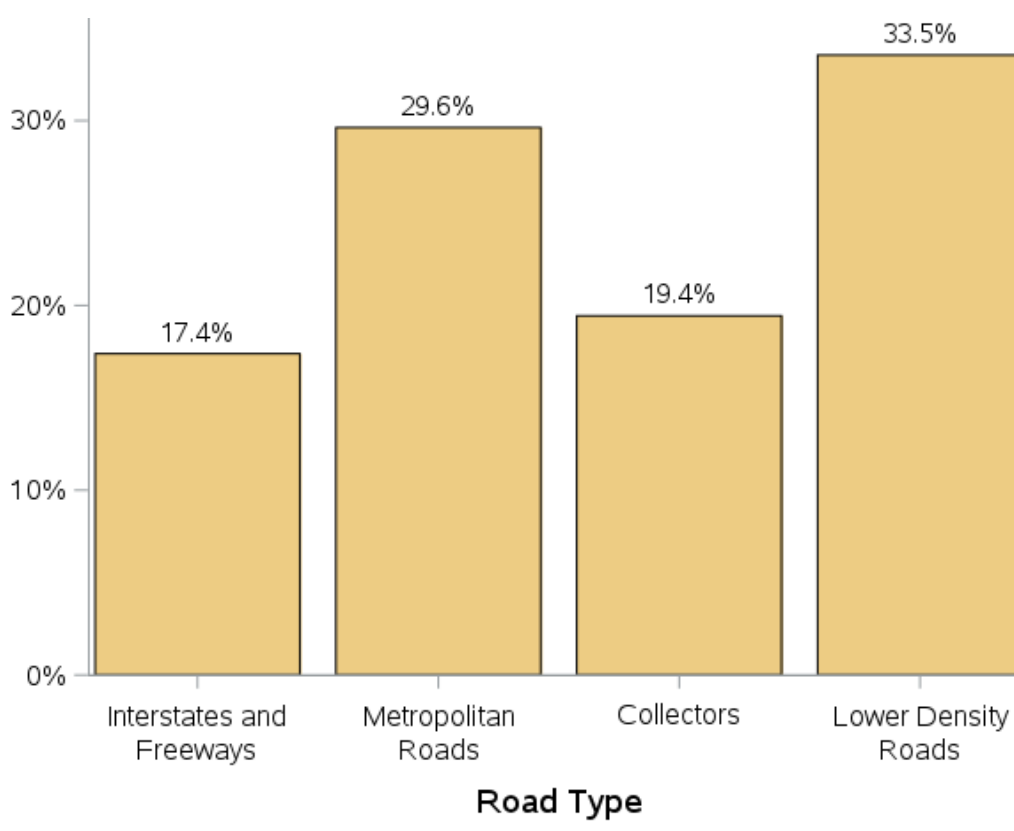


Figure 3: Bar Chart for Percentage of Fatal Accidents by Collision Direction (n = 15,611)

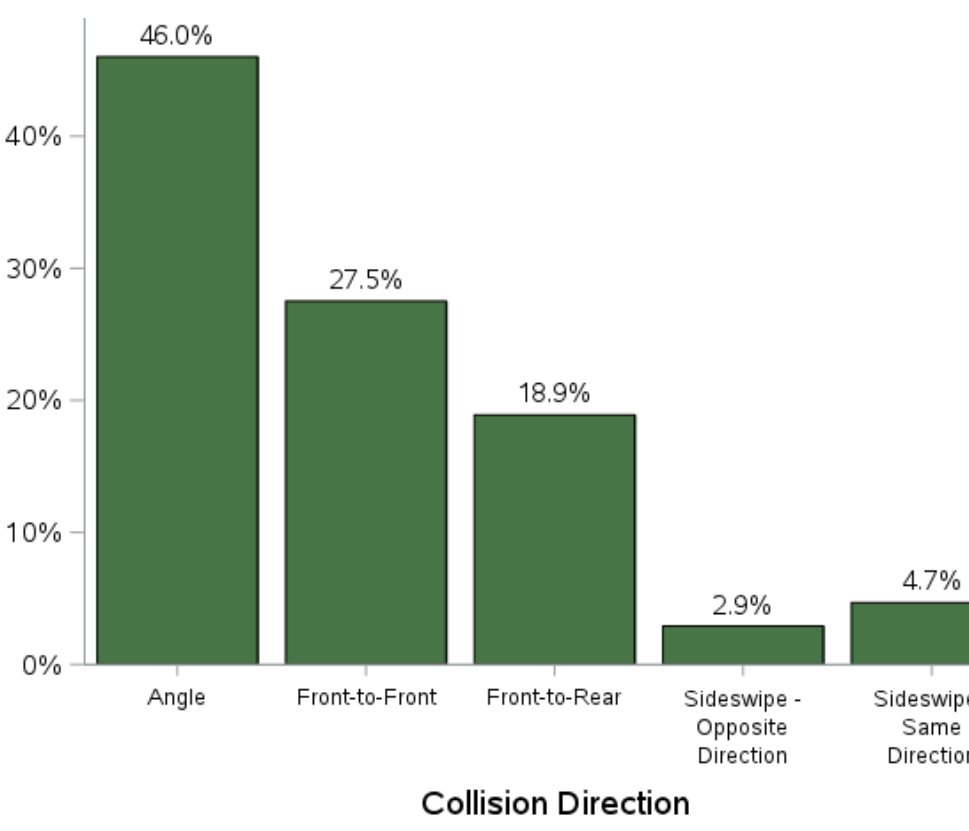


Figure 4: Bar Chart for Percentage of Fatal Accidents by Weather Condition (n = 37,577)

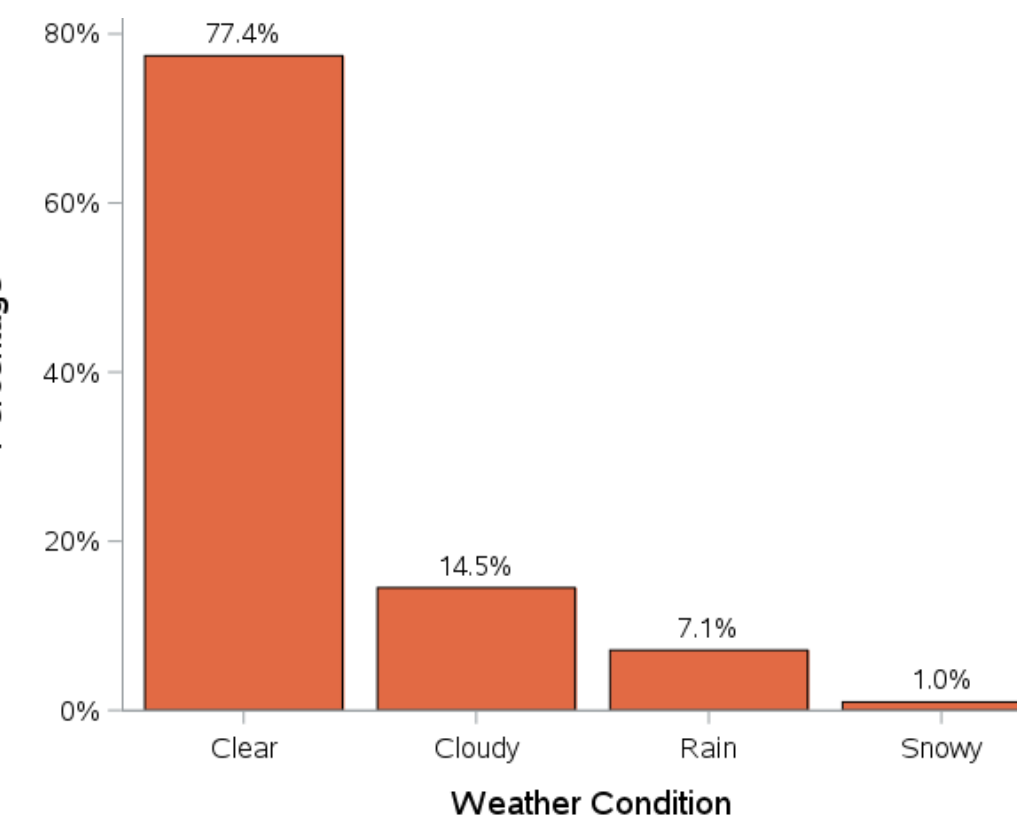


Figure 5: 100% Stacked Bar Chart for Road Type by Weekday (n = 39,271)

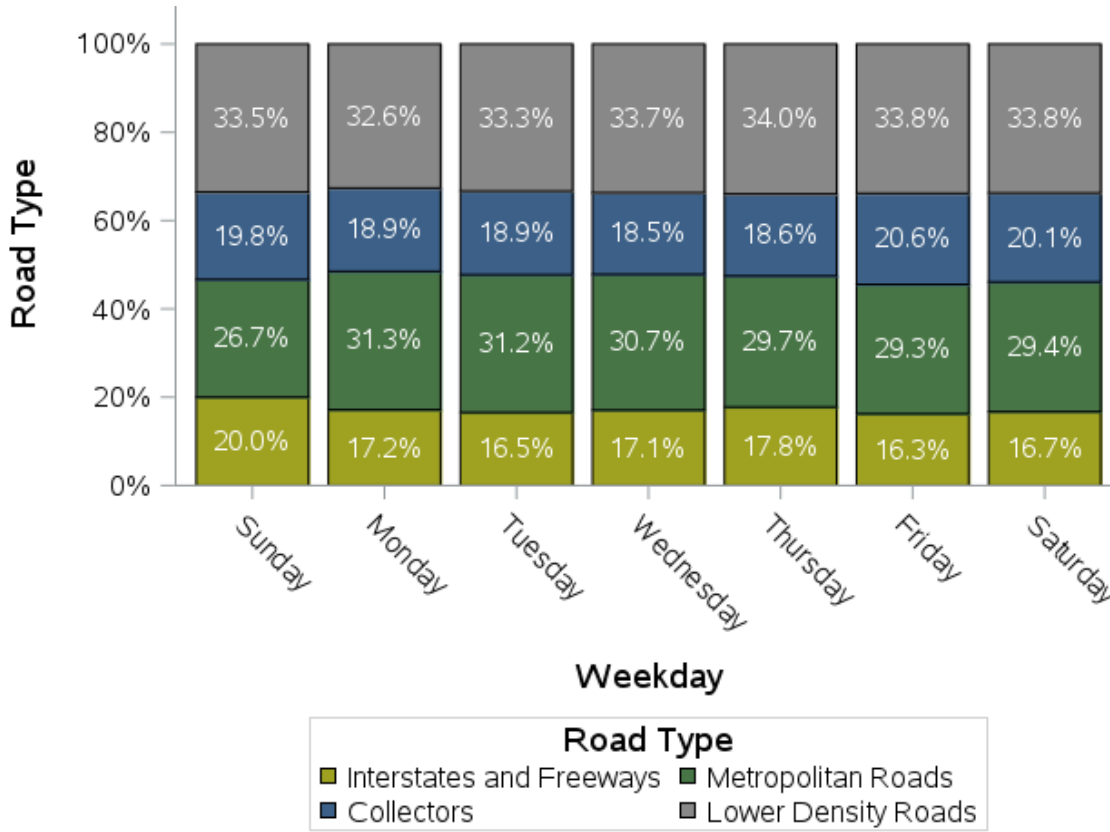


Figure 6: 100% Stacked Bar Chart of Collision Direction by Road Type (n = 15,588)

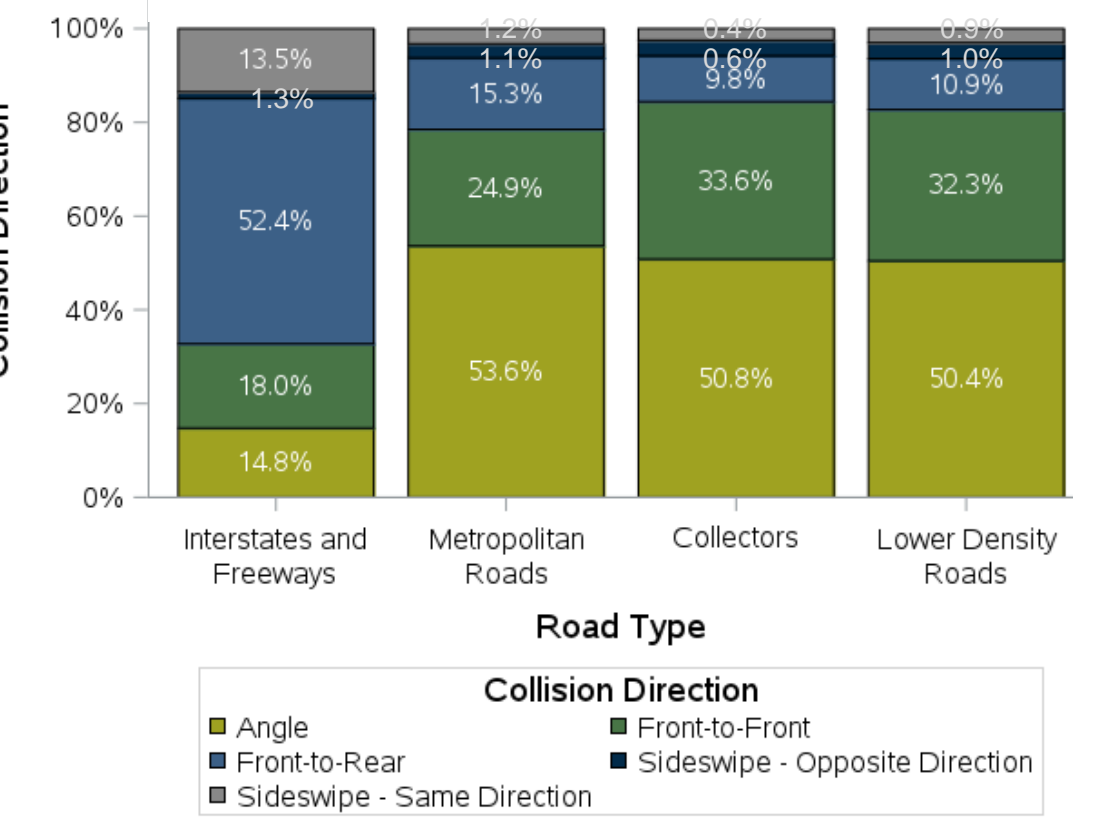


Figure 7: 100% Stacked Bar Chart for Collision Direction by Weather Condition on Interstates and Freeways (n = 2,360)

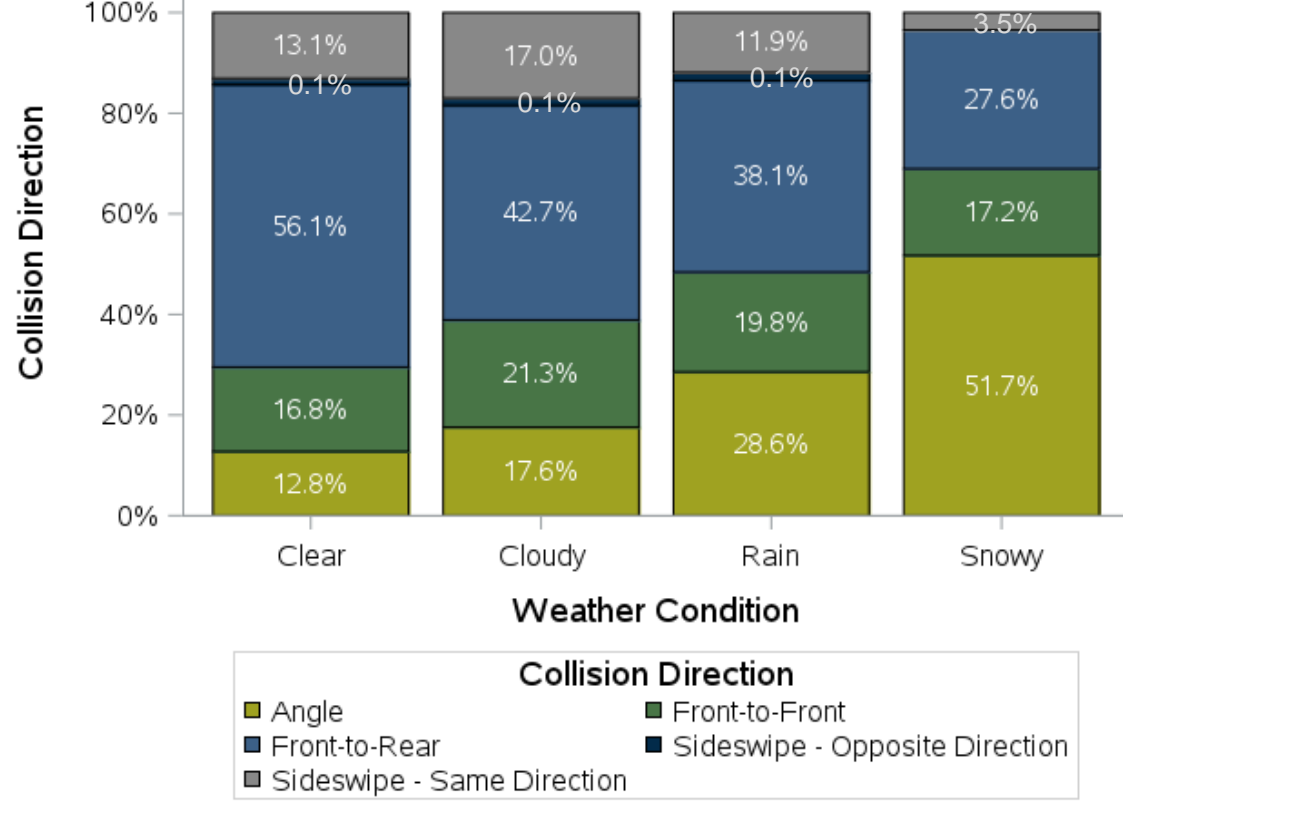


Figure 8: One-way ANOVA of the Number of Fatalities and Weekday (n = 39,508)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	1.882955	0.313826	2.50	0.0201
Error	39501	4951.158125	0.125343		
Corrected Total	39507	4953.041080			

Source	DF	Anova SS	Mean Square	F Value	Pr > F
Weekday	6	1.88295555	0.31382593	2.50	0.0201

Figure 9: Fisher's LSD Lines for the Number of Fatalities and Weekday (n = 39,508)

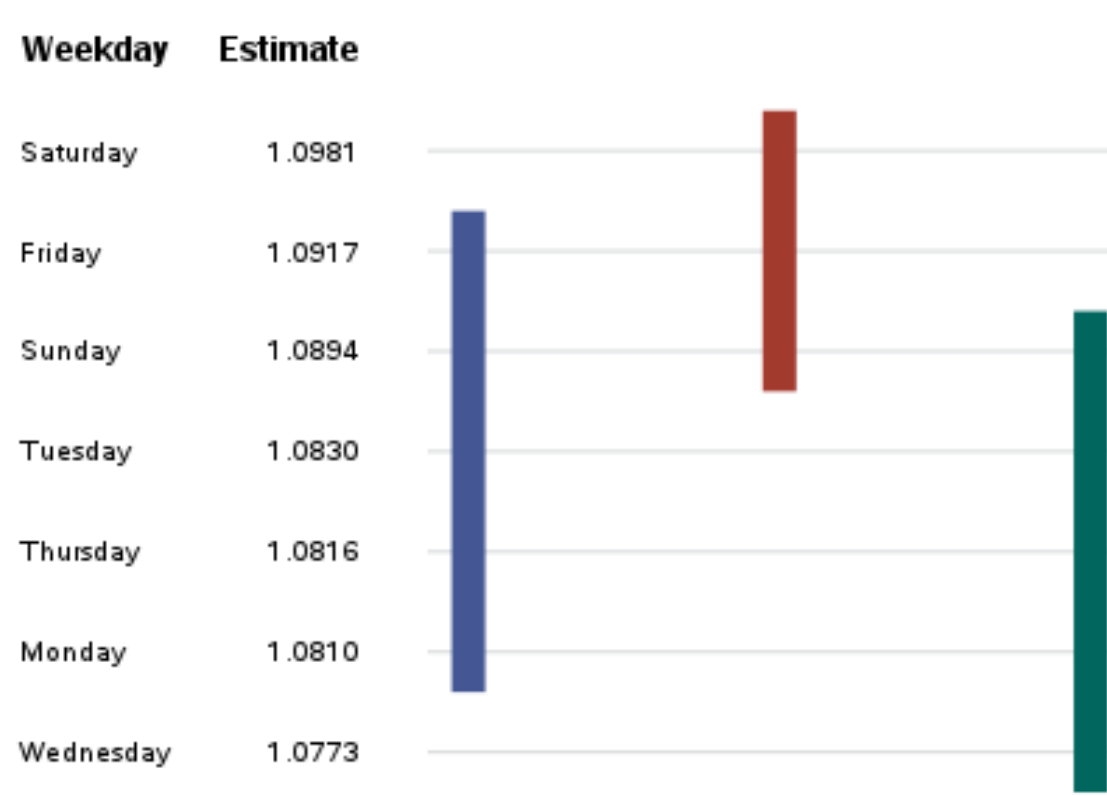


Figure 10: Interaction Plot for Fatalities versus Road Type and Collision Direction (n = 15,588)

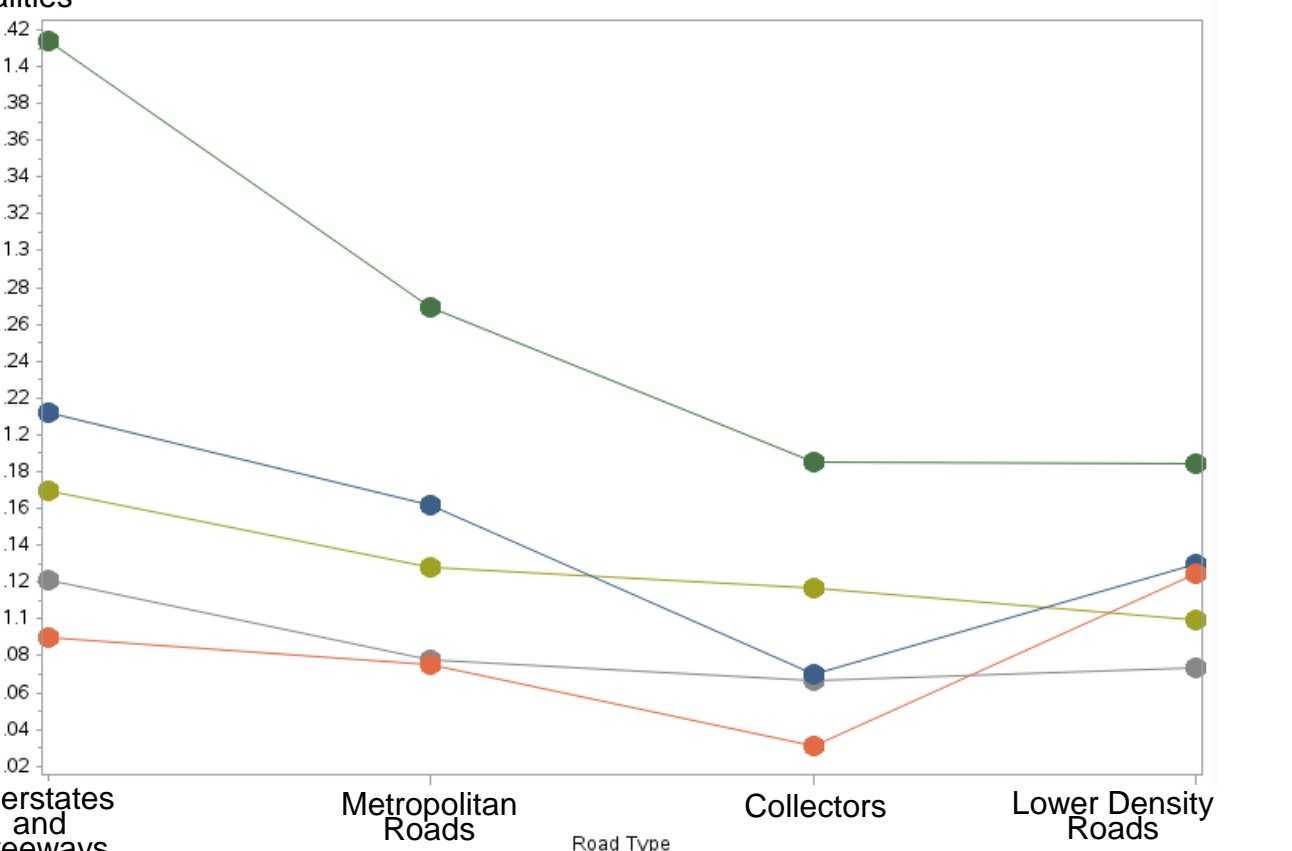


Figure 11: Fatal Accidents in Spring (n = 9,997)



Figure 12: Fatal Accidents in Summer (n = 11,010)



Figure 13: Fatal Accidents in Fall (n = 10,257)



Figure 14: Fatal Accidents in Winter (n = 7,965)



Figure 15: Fatal Accidents in Georgia on Interstates and Freeways (n = 283)

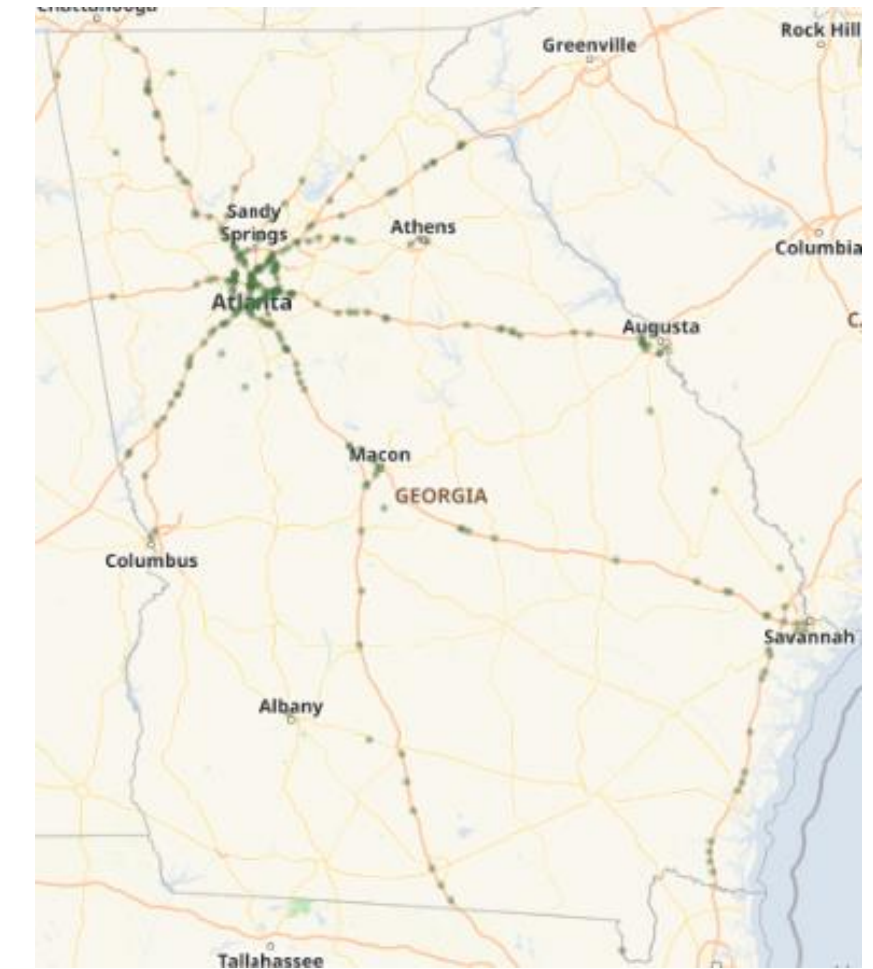


Figure 16: Fatal Accidents in Georgia on Metropolitan Roads (n = 415)

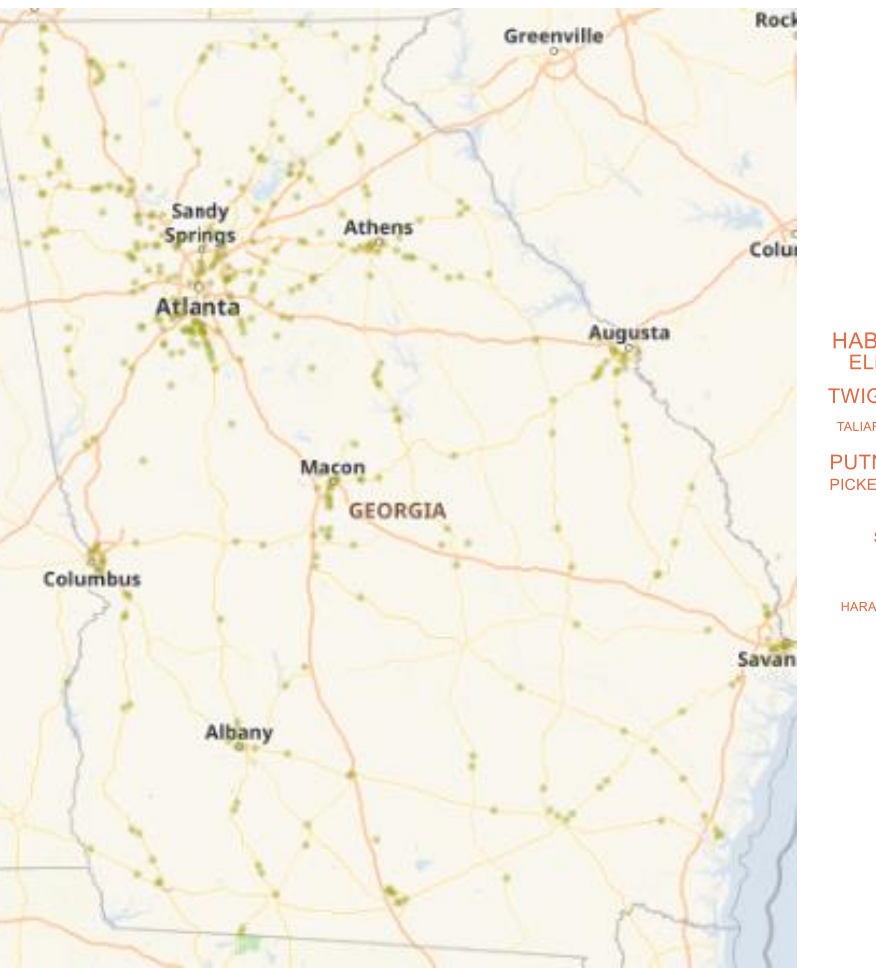


Figure 17: Fatal Accidents in Georgia on Collectors (n = 277)

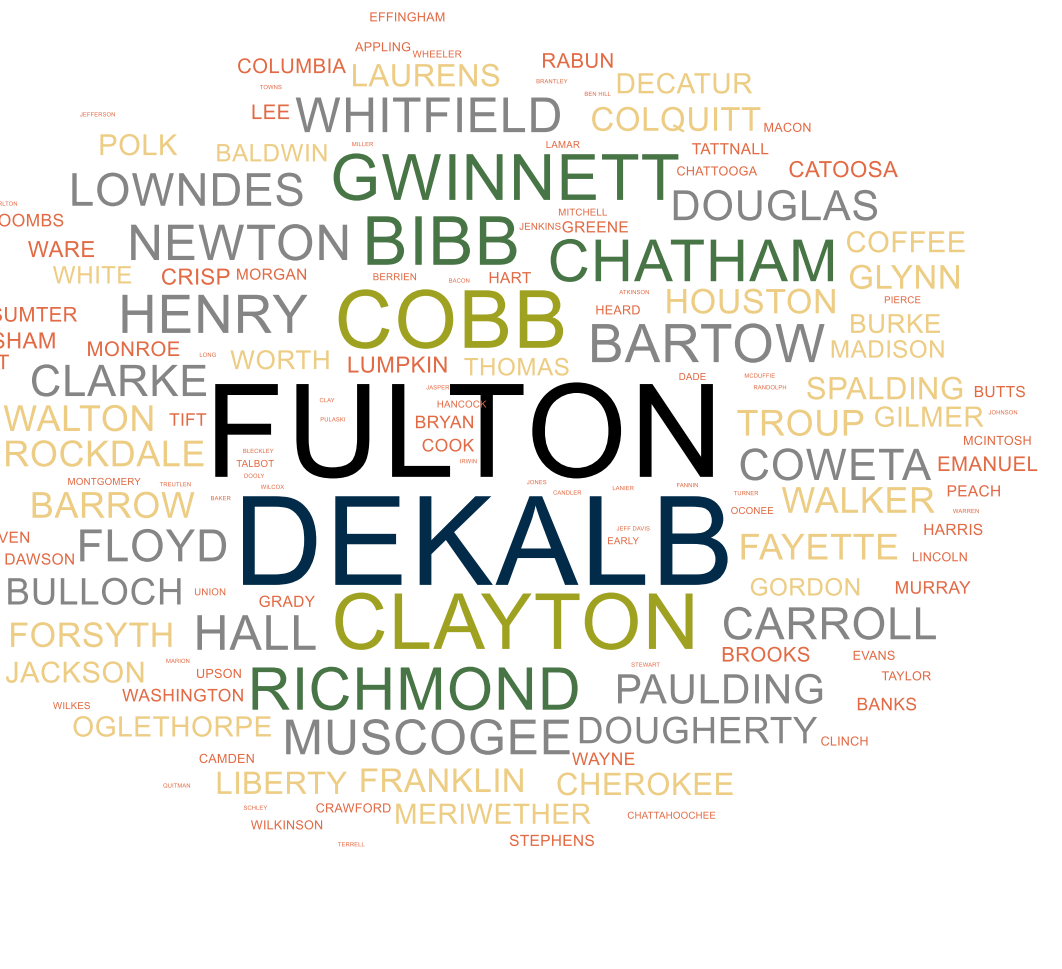


Figure 18: Fatal Accidents in Georgia on Lower Density Roads (n = 695)

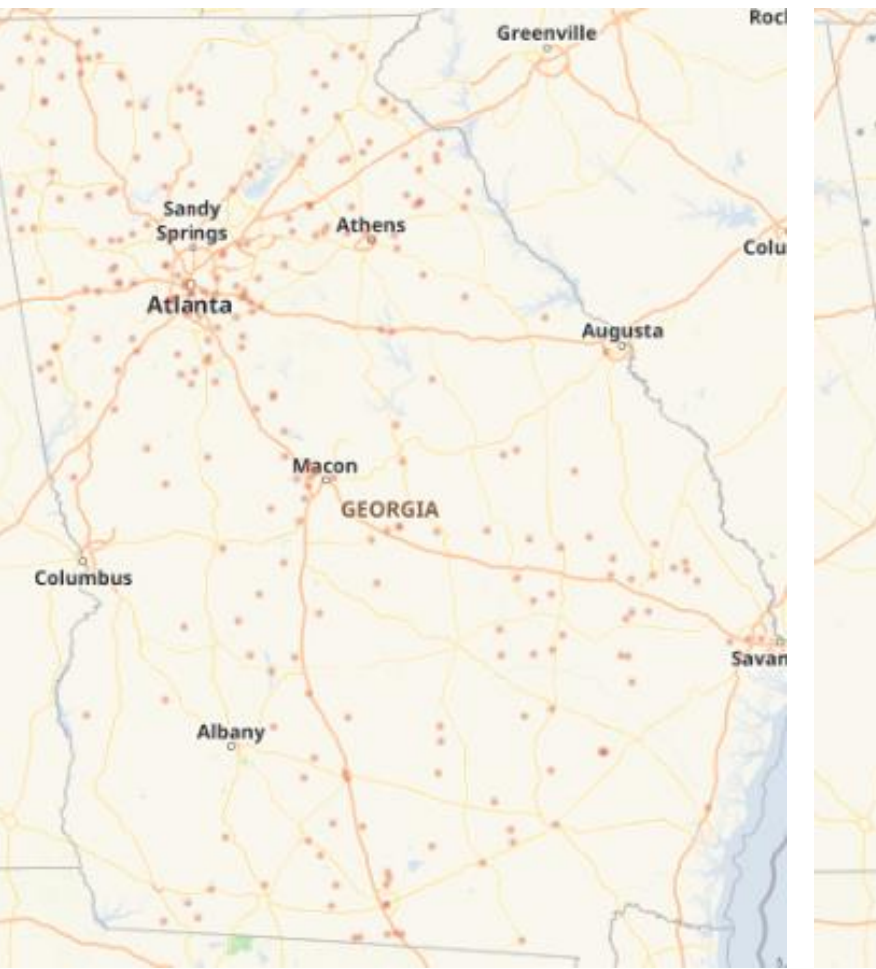


Figure 19: 95% Confidence Intervals for the Number of Accidents per Day in Georgia (n = 2,557)

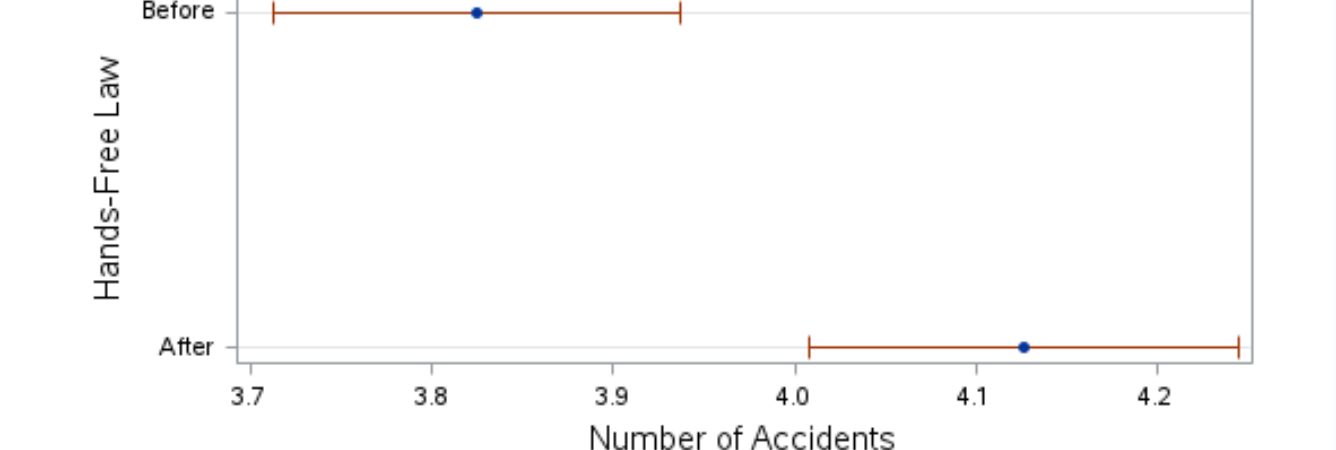


Figure 21: One-way ANOVA of the Number of Fatalities and Road Type (n = 10,165)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2.839519	0.879839	7.92	< 0.0001
Error	10161	1128.176421	0.111030		
Corrected Total	10164	1130.915937			

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Road Type	3	2.83951977	0.87983859	7.92	< 0.0001

Figure 22: Fisher's LSD Lines for Road Type and Fatalities

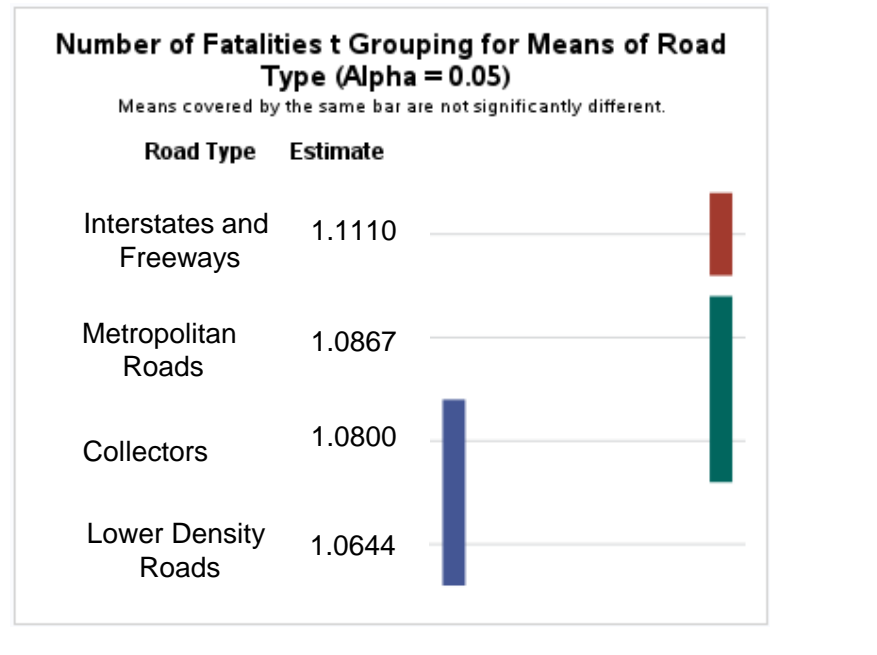
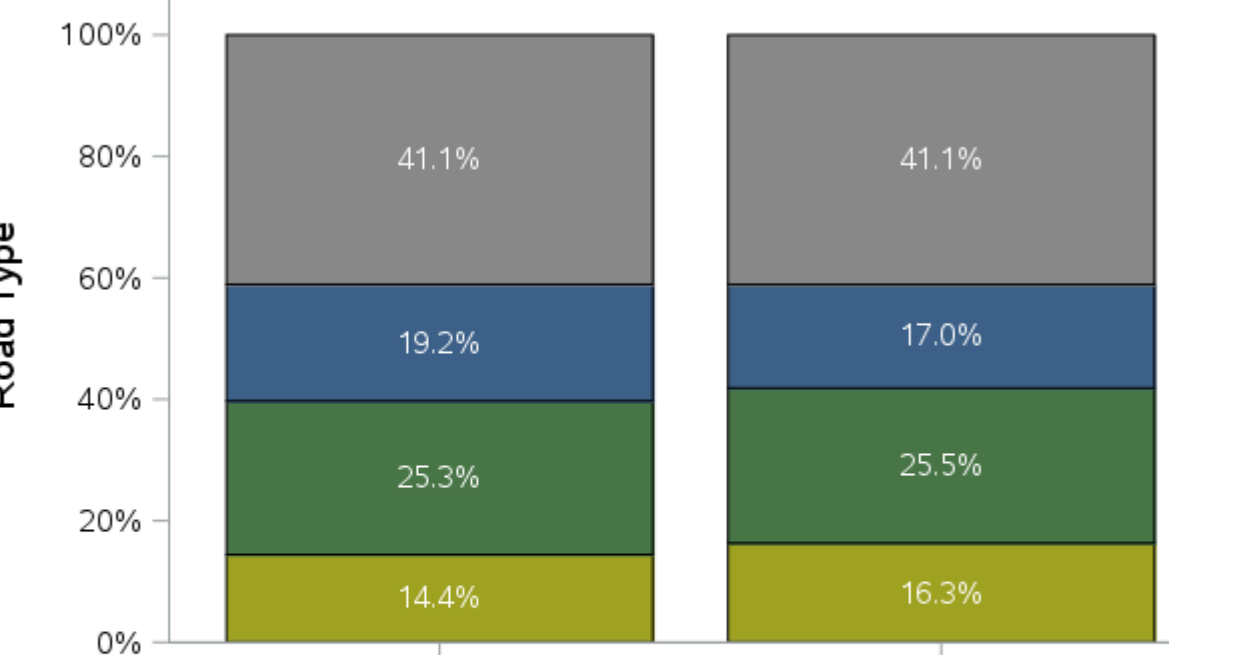


Figure 23: 100% Stacked Bar Chart for Road Type by Hands-Free Law (n = 10,165)



LINKEDIN



GITHUB



RESULTS

WEEKDAY: Figure 1 shows all Weekdays have a significantly different percentages of fatal accidents than expected.

ROAD TYPE: Figure 2 shows the percentage of fatal accidents are more prevalent on Lower Density Roads and Metropolitan Roads. While Lower Density Roads are more prevalent, there is a higher density of travelers on Metropolitan Roads, which could explain why the percentages are similar.

COLLISION DIRECTION: Figure 3 shows that the majority of fatal accidents are Angle and Front-to-Front collisions.

WEATHER CONDITIONS: Figure 4 shows that the predominance of fatal accidents are in clear weather.

WEEKDAY AND ROAD TYPE: Figure 5 displays the relationship tested by the Chi-Square analysis for all fatal accidents in 2021. There are more fatal accidents on the Interstates and Freeways on Sunday, and less on Metropolitan Roads. On Friday, there are less fatal accidents on the Interstates and Freeways, but more on the Collectors.

ROAD TYPE AND COLLISION DIRECTION: Figure 6 displays the relationship tested by the Chi-Square Analysis for all fatal accidents in 2021. The majority of fatal accidents on the Interstates and Freeways are Front-to-Rear collisions. The majority of fatal accidents on Metropolitan Roads, Collectors, and Lower Density Roads are Angle collisions.

WEATHER CONDITION AND COLLISION DIRECTION: Figure 7 displays the relationship tested by the Chi-Square Analysis for fatal accidents on Interstates and Freeways in 2021. In Clear weather, the majority of fatal accidents are Front-to-Rear. In Rain, the percentage of fatal accidents that collide at an Angle are higher than for Clear. Similarly, the percentage of fatal accidents at an Angle increased further in Snowy weather conditions.

NUMBER OF FATALITIES AND WEEKDAY: Figures 8 and 9 show that the Weekday predicts the Number of Fatalities per fatal accident in 2021. Friday, Saturday, and Sunday are not significantly different in the Number of Fatalities per fatal accident. Only Saturday is significantly higher than Monday, Tuesday, Wednesday, and Thursday.

NUMBER OF FATALITIES VERSUS ROAD TYPE AND COLLISION DIRECTION: Figure 10 shows that Front-to-Front fatal accidents have the most fatalities across all Road Types. Interstates and Freeways have the most fatalities for collisions that are Front-to-Front, Sideswipe – Opposite Direction, Angle, and Front-to-Rear. In contrast, Sideswipe – Same Direction have the most fatalities on Lower Density Roads.

SEASON AND GEOGRAPHICAL LOCATION OF FATAL ACCIDENTS: Figures 11, 12, 13, and 14, show that across the US, fatal accidents have a similar pattern of occurrence across the Seasons. Although the Seasons are visually indistinguishable, fatal accidents are more frequent in Summer (11,010) than Winter (7,965).

GEORGIA - WORD CLOUD OF FREQUENCY OF FATAL ACCIDENTS: Of the 159 Georgia counties, 151 had at least one fatal accident in 2021. Of the counties, Fulton had the most, followed by DeKalb, and then Cobb and Clayton county.

GEORGIA - ROAD TYPE AND GEOGRAPHICAL LOCATION OF FATAL ACCIDENTS: Figures 15, 16, 17, and 18, show the accidents in Georgia for 2021. In Figure 14, fatal accidents on the Interstates and Freeways are concentrated within the commuter distance around Atlanta. On Metropolitan Roads and Lower Density Roads, the largest concentration of fatal accidents is found around the larger cities of Atlanta, Macon, Columbus, and Albany. In contrast, the Collectors are more evenly dispersed across Georgia.

GEORGIA - NUMBER OF ACCIDENTS PER DAY AND HANDS-FREE LAW: Figure 19 shows significantly more Fatal Accidents per Day after the implementation of the Hands-Free Law.

GEORGIA - NUMBER OF FATALITIES PER ACCIDENT AND HANDS-FREE LAW: Figure 20 shows that there is not a significant difference in the Number of Fatalities per Accident after the implementation of the Hands-Free Law.

GEORGIA - ROAD TYPE AND NUMBER OF FATALITIES: Figure 21 shows that Road Type predicts the Number of Fatalities in a fatal accident. Figure 22 shows that Interstates and Freeways had a higher Number of Fatalities than all other Road Types. Metropolitan Roads had a higher Number of Fatalities than Lower Density Roads.

ROAD TYPE AND HANDS-FREE LAW: Figure 23 displays the relationship tested by the Chi-Square Analysis for fatal accidents in Georgia from 2015 - 2021. Interstates and Freeways had a higher percentage of Fatal Accidents after the implementation of the Hands-Free Law. Collectors had a decrease in the percentage of Fatal Accidents after the implementation of the Hands-Free Law.