Police Crash Reports as a Source to Examine Seat Belt Use Rate Distribution in Neighborhoods

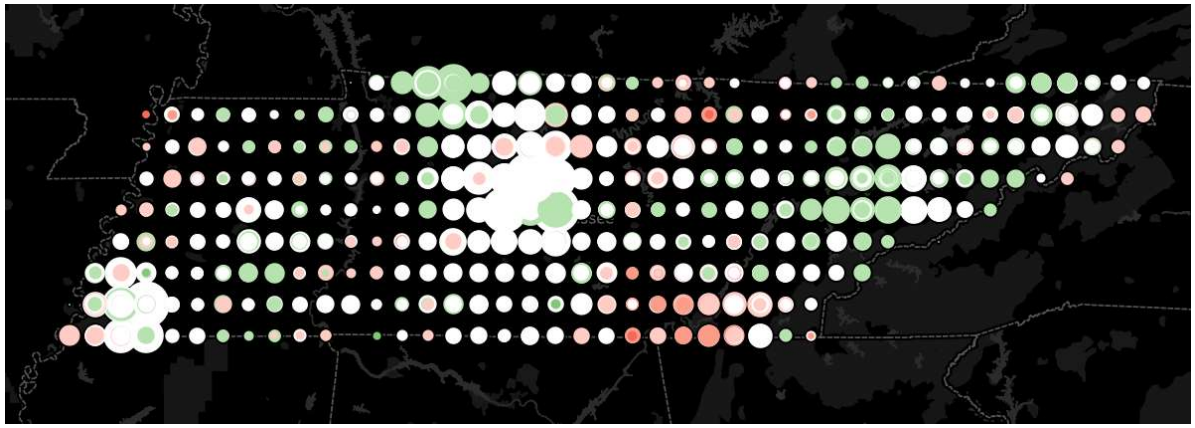
Amin Mohamadi Hezaveh

Christopher R. Cherry

THE UNIVERSITY OF TENNESSEE KNOXVILLE

BIG ORANGE. BIG IDEAS.®

IN THIS PRESENTATION…

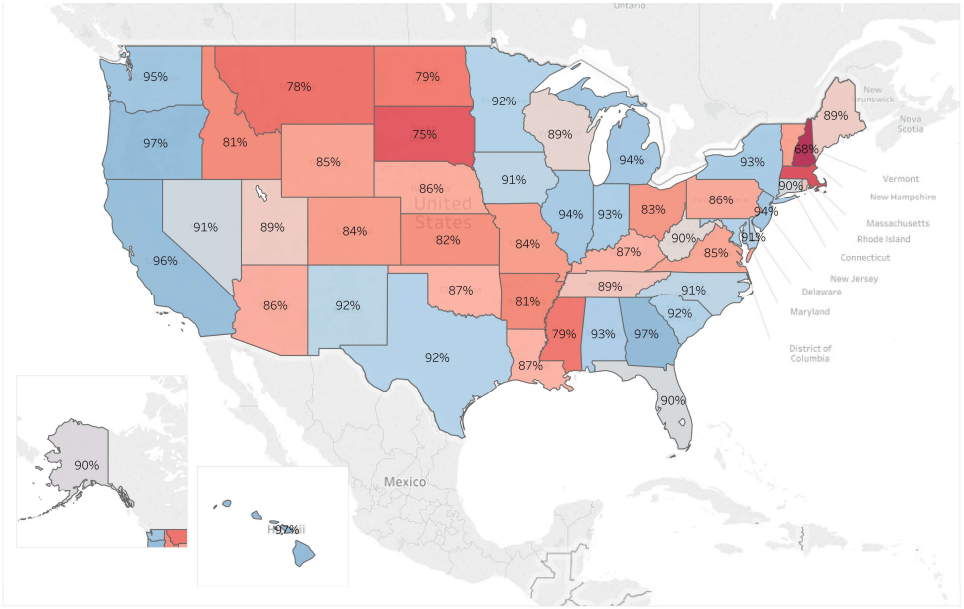


- ❑ Seat belt in TN
- ❑ Background
- ❑ Current Methods for Measuring Seat Belt Use Rate
- ❑ Tobit Model
- ❑ Results
- ❑ Future Direction and Applications

Introduction

- **Seat Belt Law in Tennessee:**
  - **A primary law and it is mandatory for all the vehicles occupant be restrained by a seat belt (i.e., secured shoulder and lap belts) when riding in the front seat of a vehicle.**
  - **Licensed passengers 16 years old or older are responsible for their own conduct.**

Seat Belt Use Rate



- **In 2017: 88.5% seat belt use rate, based on direct observation, for the front row passengers - 1.2% lower than the National average (Source: NHTSA)**
- **0.4% lower than 2016.**

Phone Interview (2017): Seat belt use 90% (Source: CTR)

Factors influencing seat belt use

- **Discomfort**
- **Attitudes, beliefs, and intentions**
- **Habits, and**
- **Lack of enforcement**

Source: Google Images

Risk Groups

- **Males**
- **Younger drivers**
- **Lower-education**
- **Lower-income families**
- **Minorities**
- **Certain type of vehicles (e.g., Truck)**

Literature Gap

- **Where are they living?**
- **The current practice is limited**
- **Knowing about areas with lower seat belt use rate would help us to effectively reach high risk population by focusing on certain geographic areas**

Study Goals

1. **Measuring seat belt use rate in very fine geographic unit (e.g., TAZ, census tract).**
2. **Identifying seat belt non-use hotspots, and**
3. **Exploring the relationship between sociodempographic variables and seat belt use.**

Methods for Gathering Information

- **Roadside observations**

- **Self-reported instruments**

Roadside Observation challenges

- **Expensive**
- **In 2017: 190 sites for a long period of a day**
- **Limited to front-passengers**
- **Number of front row occupants, gender, and age group.**
- **Limited number of sites**
- **Daylight and good weather usually**

Self-reported studies

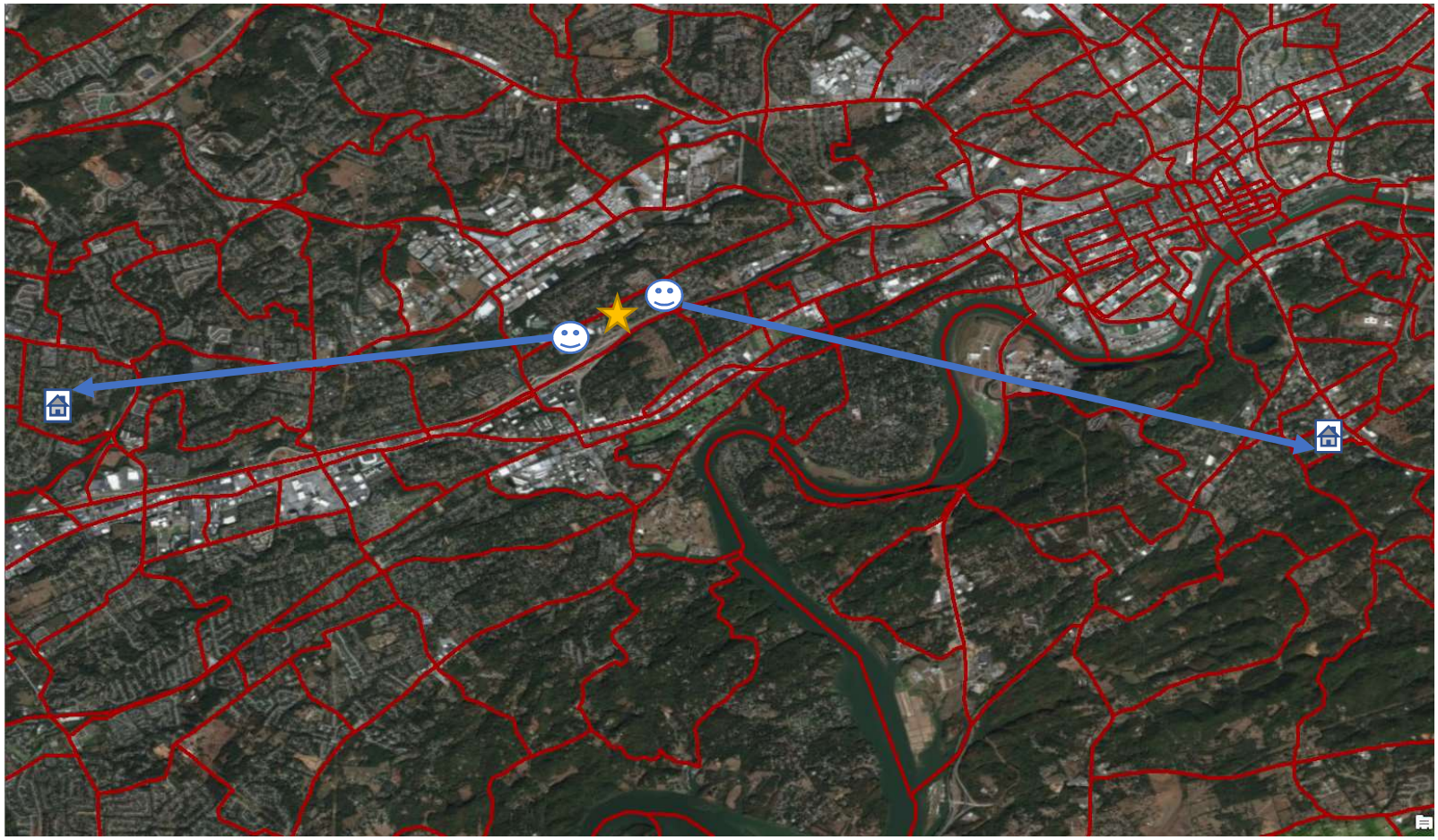
- **Easy to conduct and Low cost**
- **Gather large amount of information**
- **Vulnerable to social desirability**

Police Crash report

- **Main source of road safety analysis**
- **Challenge:**
  - **Wrong assignment of seat belt use**
- **Some car occupants who survived a crash may falsely claim to police that they were belted in order to avoid a fine.**
- **Several studies of police reports show that reported seat belt use is consistent with roadside observations, National Accident Sampling System Crashworthiness Data System**

Challenge

- **The seat belt use in crash recorded at the location of crash**
- **It reflects seat belt use rate for commuting traffic**

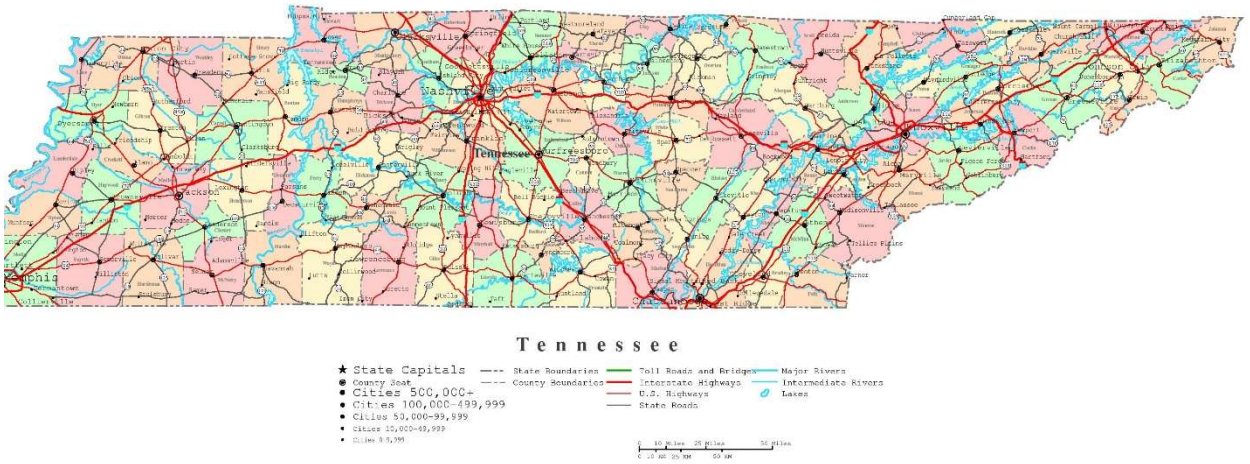


Methodology

- **Geocoding home-address of the vehicle occupants**
  - **Bing API**
- **Use Tobit Model**
  - $y_i^* = x_i'\beta + \varepsilon_{i,}$
  - **Where** $y_i^* = \begin{cases} y_i \; if \; a < y_i < b \\ a \; if \; y_i \leq a \\ b \; if \; y_i \geq b \end{cases}$
  - β **are the estimated of the coefficient variables** x_i'
  - y_i^* **seat belt use rate for the driver**
  - ε_i **error term, which is normally distributed**

CRASHES IN TN

- **Data from TITAN (2016): Tennessee Integrated Traffic Analysis Network**
- **US census**



Dempgraphics

- **the average age of those who worn seat belt was higher than who did not (t=-8.278, P-value = 0.000)**

	Female			**Male**			**Total***		
	Mean	S.D.	Obs.	Mean	SD	Obs	Mean	S.D.	Obs.
No seat belt	38.70	17.22	25285	38.76	16.97	32178	38.76	17.09	57708
Seat belt use	39.24	17.74	205296	39.52	17.54	220700	39.39	17.64	425999
Total	39.18	17.69	230581	39.42	17.47	252878	39.31	17.58	483707

Seat belt distribution inside the car

- **Tennessean 88.2% Vs. Non-Tennessean 86.9%**
- **Backrows have lower seat belt use rate**

Row	Left	Middle	Right	Other/Unknown
Front	0.88 (395641)	0.55 (912)	0.89 (66464)	0.2 (55)
Second	0.84 (6647)	0.65 (1101)	0.85 (8913)	0.38 (216)
Third	0.74 (424)	0.67 (143)	0.71 (438)	0.12 (54)
Fourth	0.45 (127)	0 (33)	0.50 (166)	0.04 (128)
Other Seats				0.40 (2203)

- **Weather**
  - **Seat belt use rate was higher during the harsh weather, and at its lowest rate during clear weather**
- **Lighting**
  - **Seat belts at higher rates during the daylight and less during night; even lower when there was no lighting on the road**
- **Route signage**
  - **Interstate and US routes had higher seat belt rate than other route types**

Variables		Mean	SD	Number of observation
Weather				
	Clear	0.868	0.338	395975
	Cloudy	0.889	0.314	58743
	Fog	0.868	0.339	1377
	Smog/Smoke	0.934	0.249	196
	Rain	0.884	0.321	54611
	Sleet/Hail	0.895	0.307	1181
	Snow	0.909	0.287	4749
	Blowing Snow	0.912	0.284	272
	Severe Cross-Winds	0.902	0.297	123
	Blowing Sand/Soil/Dirt	0.922	0.269	51
	Other	0.883	0.321	342
	Unknown	0.025	0.157	24318
Lighting				
	Daylight	0.879	0.326	389436
	Dark-Not Lighted	0.843	0.364	39391
	Dark-Lighted	0.860	0.347	69524
	Dark-Unknown Lighting	0.787	0.409	1499
	Dawn	0.875	0.330	6821
	Dusk	0.864	0.343	10632
	Other	0.865	0.342	429
	Unknown	0.033	0.106	25044
Route Signage				
	Interstate	0.885	0.319	45397
	US Route	0.871	0.335	43581
	State Route	0.868	0.338	68086
	County Route	0.823	0.382	36707
	Municipal Route	0.850	0.357	138721
	Frontage Road	0.826	0.379	317
	Other	0.789	0.408	14054
	Unknown	0.796	0.402	195913

Overview of Initial Findings

- **We can conclude that the findings are in agreement with road safety observation and self-reported studies.**
- ***Therefore, we can use this database as a basis for further analysis.***

CRASHES IN TN

Data from 2016

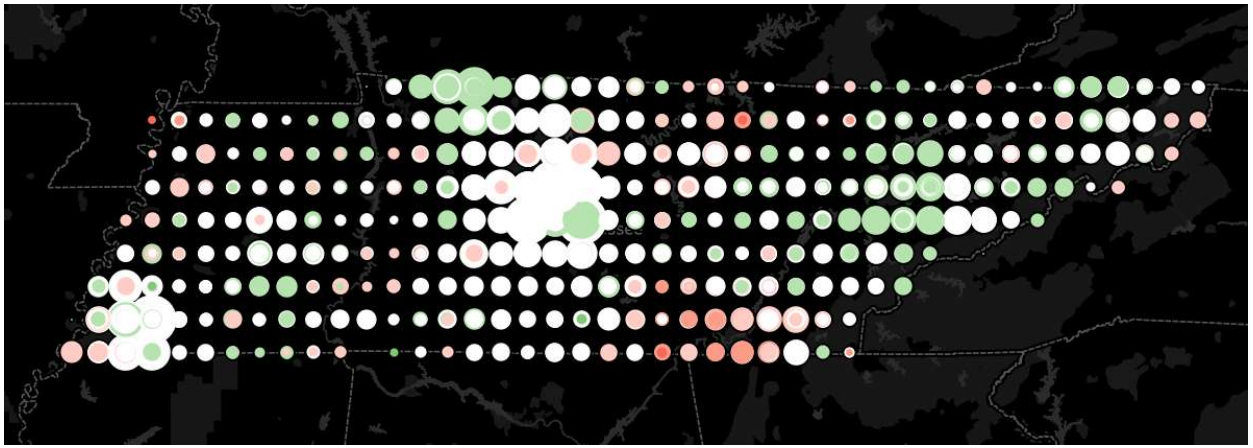
- **246,777 crash in TN**
- **580,767 individual**

Geocode success rate

- **Individuals: 93%**
- **Crashes: 97%**

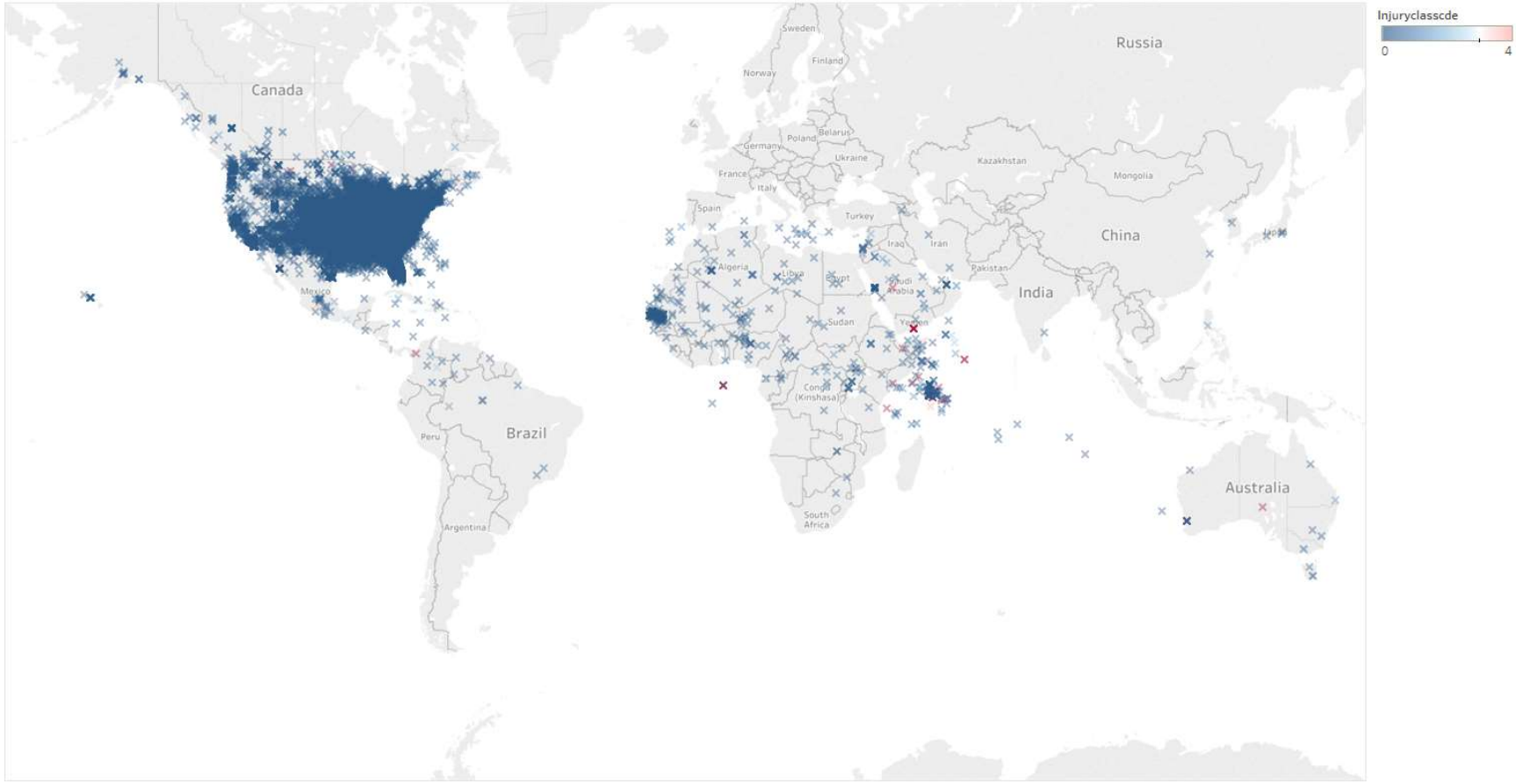
Tennessean crashes: 359,094 (94%)

Non-Tennessean 40,304 (6%)

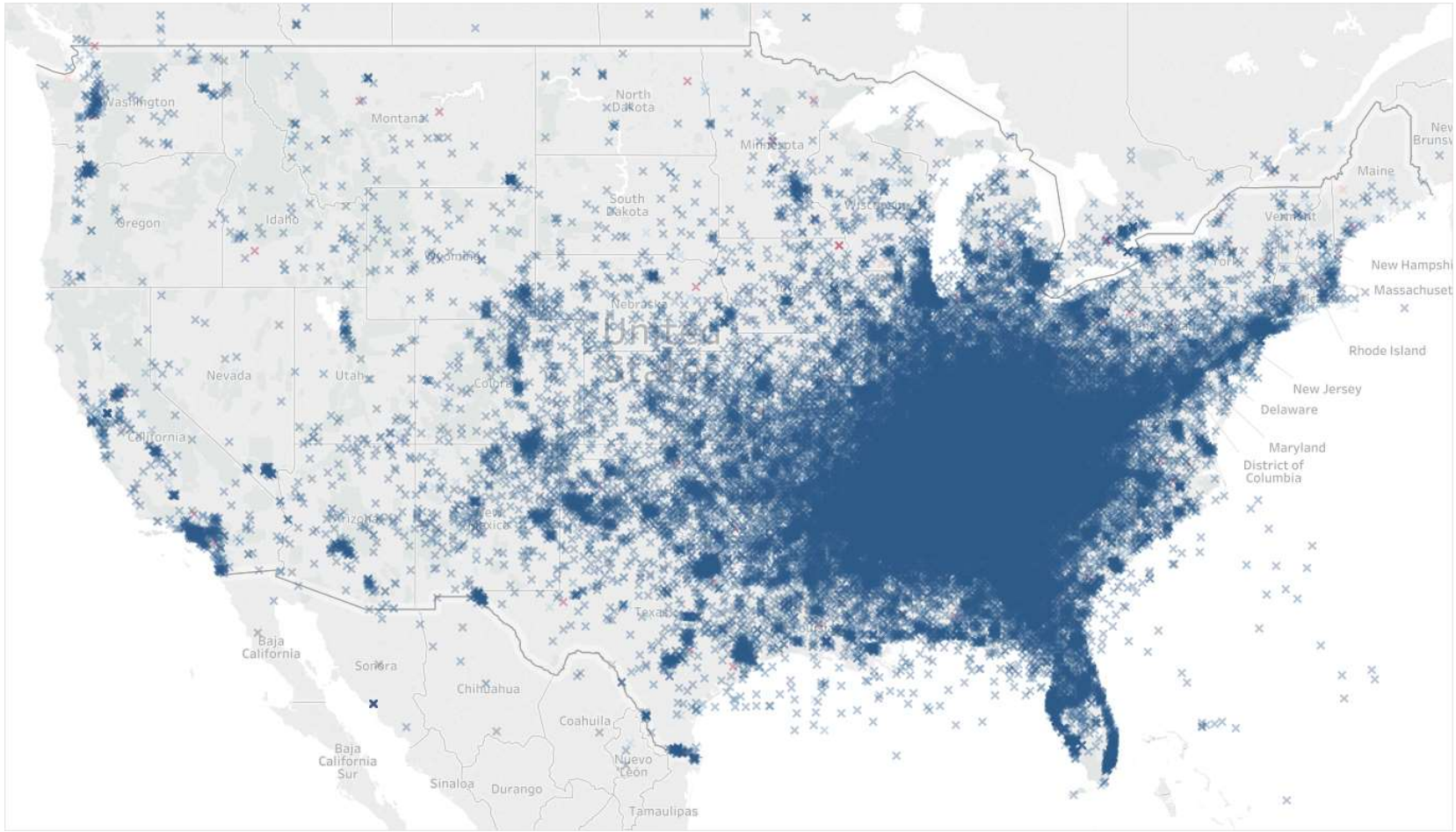


World

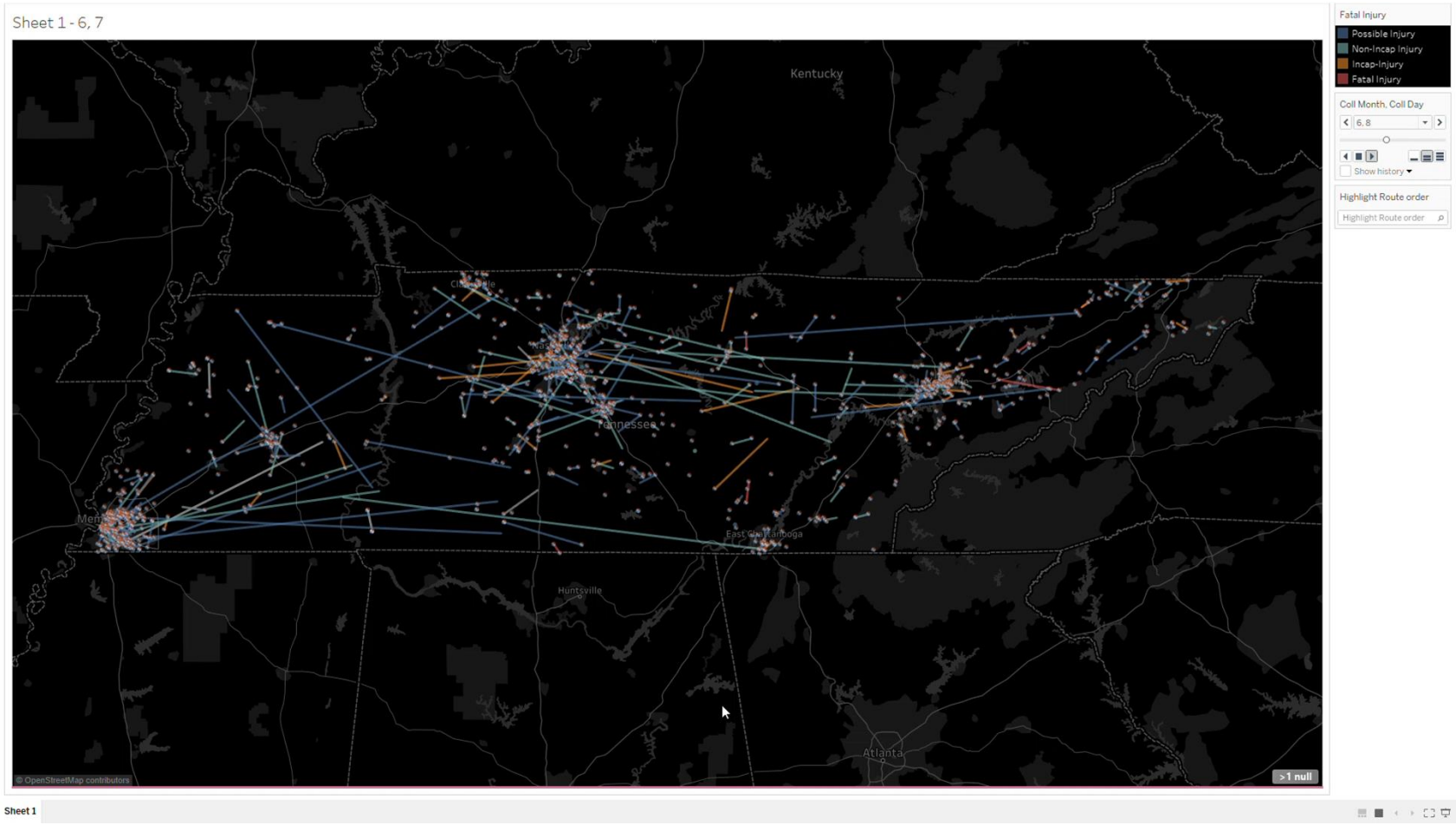
Location of the individuals involved in traffic crashes



USA

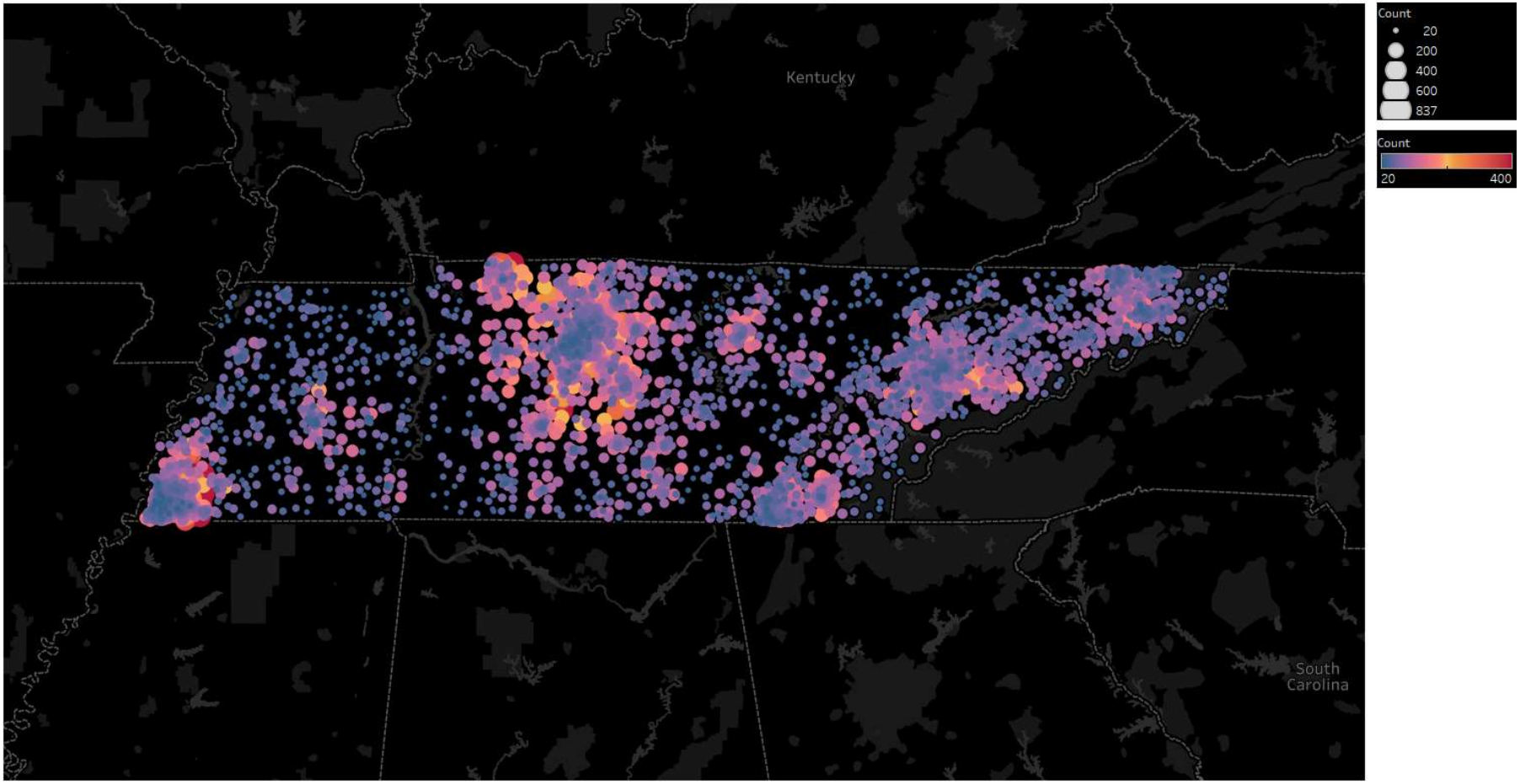

Washington
Montana
North Dakota
Minnesota
Maine
Oregon
Idaho
South Dakota
Wyoming
Nebraska
Nevada
Utah
Colorado
California
New Jersey
Delaware
Maryland
District of Columbia
Rhode Island
Massachusetts
Arizona
New Mexico
Texas
Baja California
Sonora
Chihuahua
Coahuila
Baja California Sur
Sinaloa
Durango
Nuevo León
Tamaulipas

Example of assigning seat belt use to the Home-Address



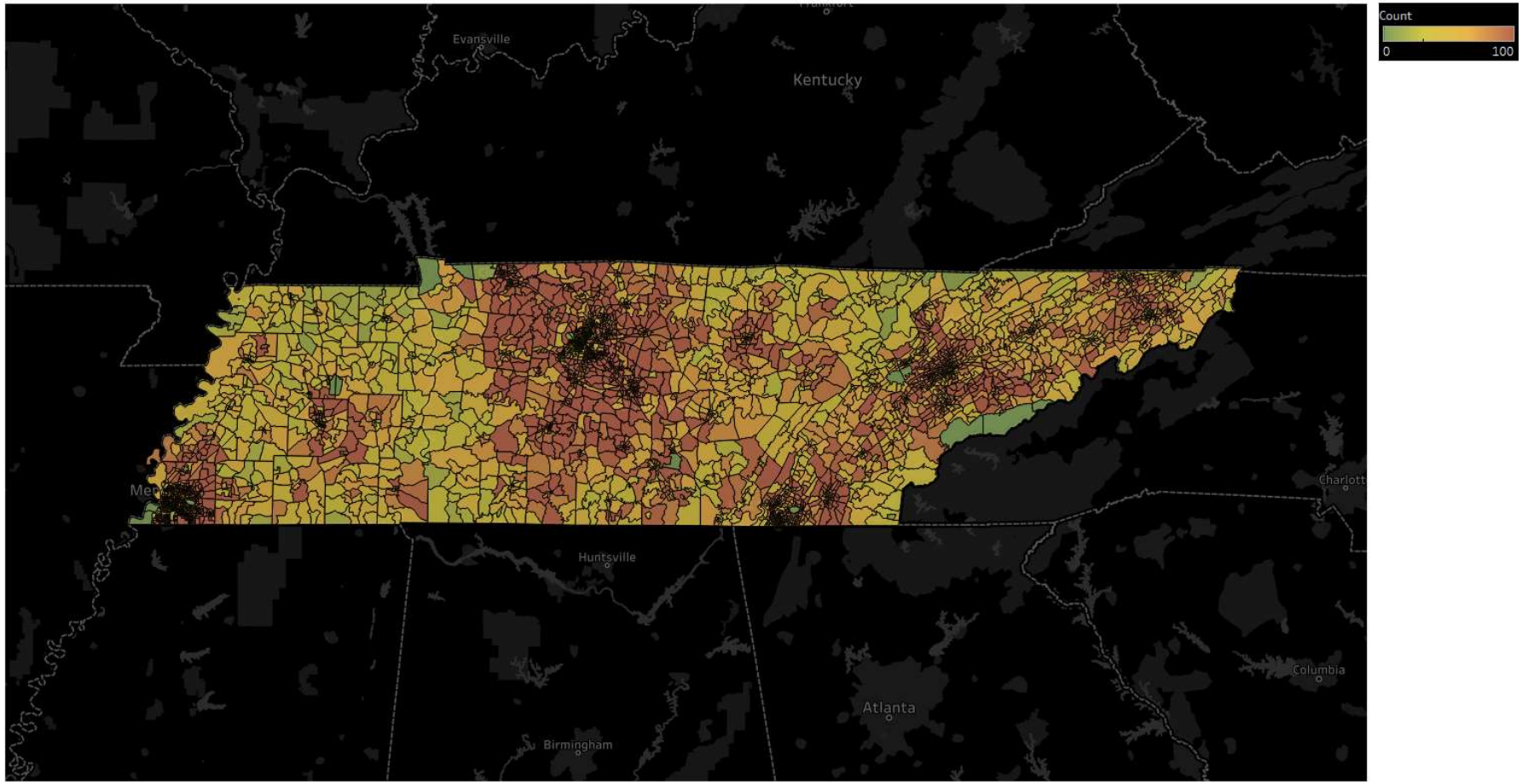
Sample Size

SAMPLE SIZE

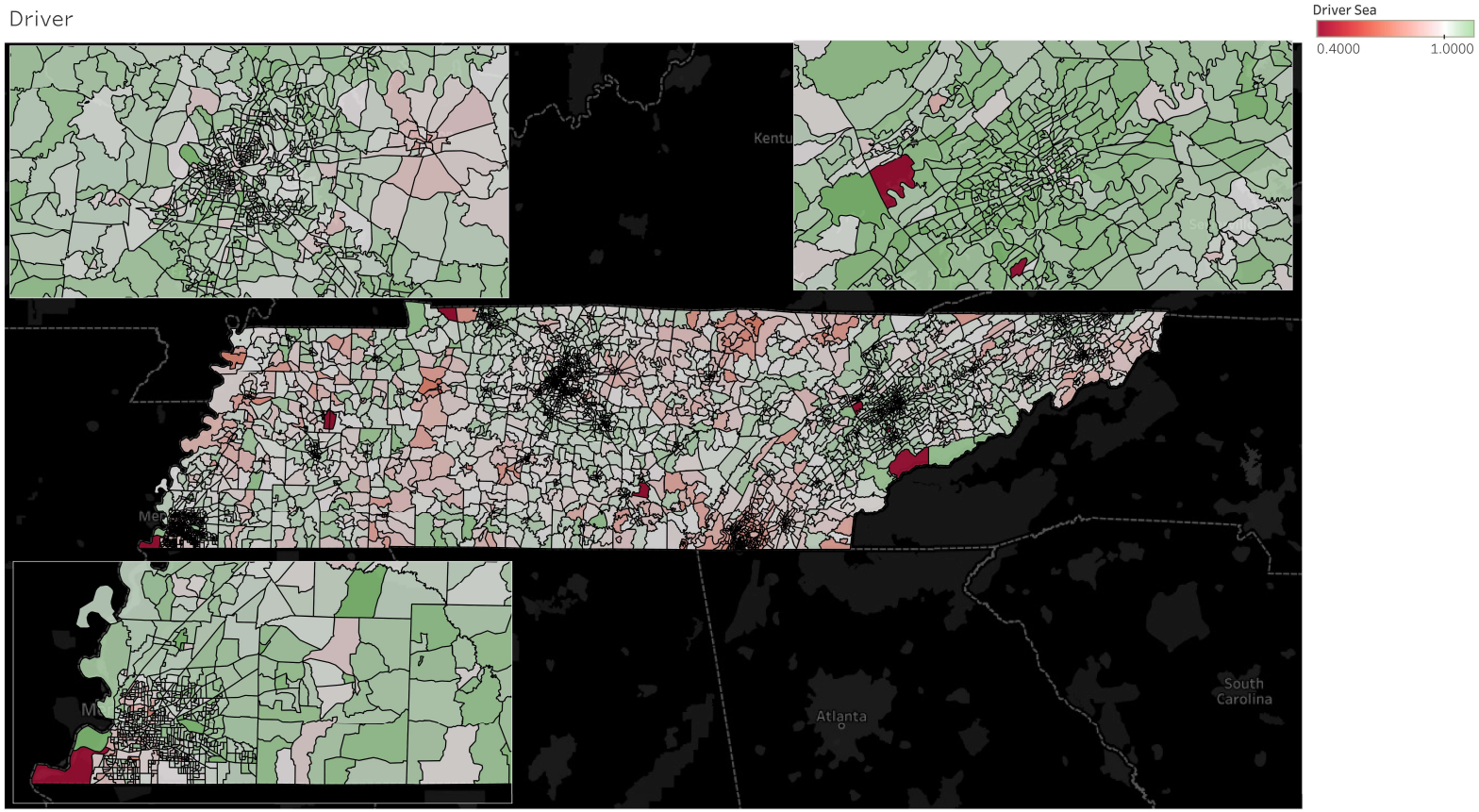


Sample Size

Sample Size at census tract



Driver Seat Belt Use Distribution in TN

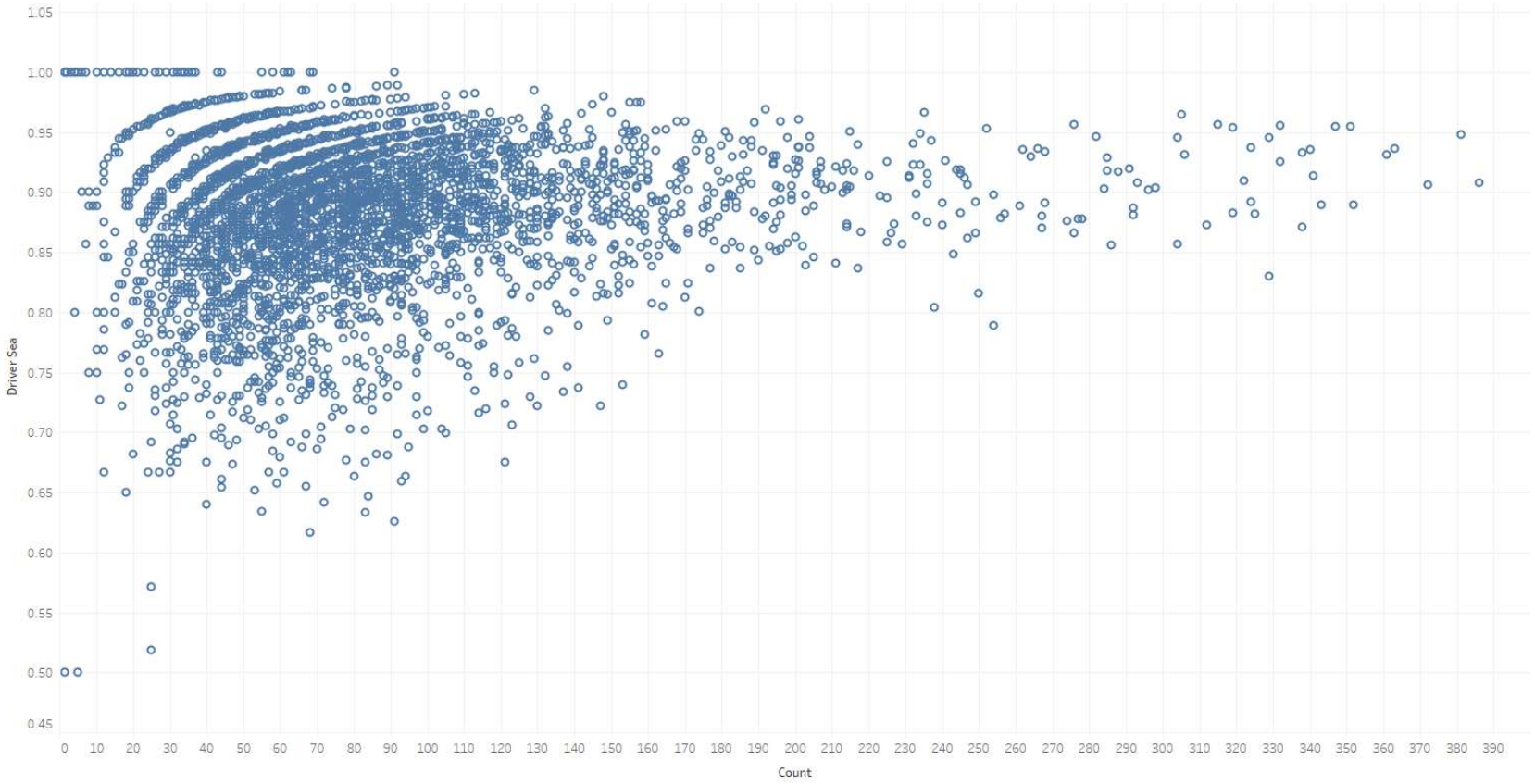


Driver Seat Belt Use Distribution in TN

- **Knoxville highest seat belt use rate, following by middle-Tennessee**
- **Chattanooga and Memphis have the lowest seat belt use rate**

	Driver		Passenger		Overall	
Metropolitan	Mean	SD	Mean	SD	Mean	SD
Knox MPO	0.92	0.04	0.90	0.10	0.91	0.04
Middle TN	0.89	0.05	0.87	0.11	0.88	0.05
Jack	0.90	0.04	0.87	0.11	0.90	0.04
Tri-cities	0.89	0.05	0.88	0.13	0.89	0.05
Chattanooga	0.77	0.07	0.81	0.14	0.77	0.06
Memphis	0.87	0.06	0.83	0.12	0.86	0.06
Non-metropolitan area	0.87	0.06	0.86	0.12	0.87	0.06
Grand Total	0.88	0.06	0.86	0.12	0.87	0.06

Observation Vs. Seat belt Use Rate



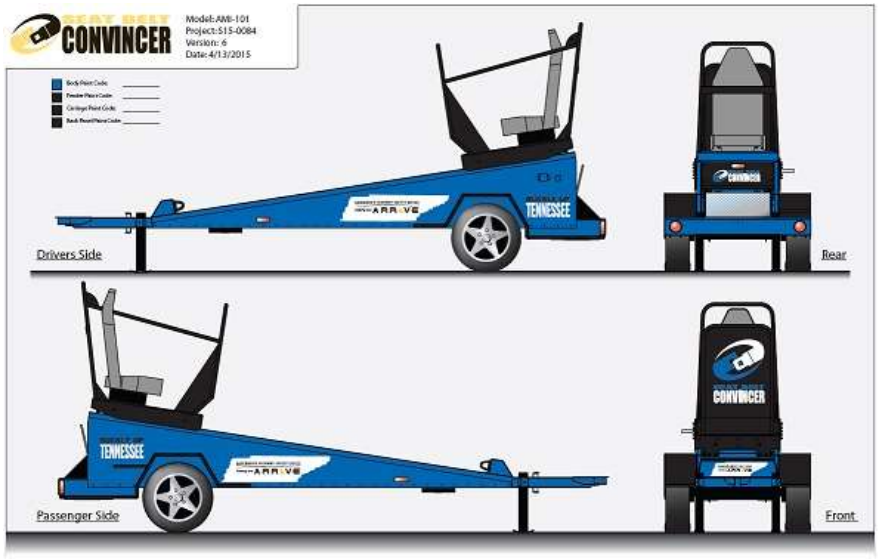
Tobit Model Result

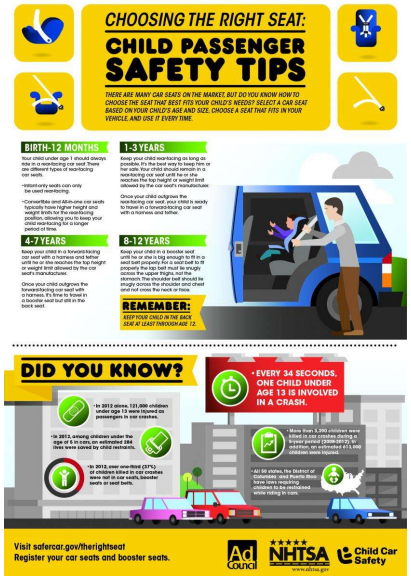
Variable	Driver Seat	
	Coeff.	Elasticity
Total Population (1000 person)	5.97e-03***	0.010
Age Cohorts		
% Population Under 16	-.108***	-0.028
% Population 16-42	-.0451*	
Race		
% Race White	.0323***	0.028
% Children	.133***	0.030
Education Degree		
% High School Degree	-.0288***	-0.017
% College Degree	-.0538***	-0.013
% Bachelor Degree	-.0484**	
Household Vehicle Ownership		
No Vehicle	-.0847***	-0.007
One Vehicle	-.0293***	-0.011
Two Vehicles	-.0282**	-0.012
Three Or More Vehicles		
Metropolitan Indicator	.00545*	0.004
Morning Share Carpool	-0.034	
Household Size	-.00138***	
Median Household Income	-1.62e-07*	-0.008
Density (population per square kilometer)		
Constant	.903***	
Var (Driver Seat)	.00359***	
Var (Passenger Seat)		
N	4114	
Statistics		
X^2	362	
AIC	-11464	

- Positive effect
  - White Ethnicity has Positive impact
  - Children %
  - Metropolitan indicator
- Negative effect
  - Young population have negative association
  - Vehicle Ownership
  - Education
  - Carpool share
  - Income

Future Direction

- **Identifying Seat Non-use Hotspots**
- **We Can Use The Association Between Seat Belt Use And Sociodemographic Variable To Identify High-risk Groups**
- **Designing Safety Campaign To Efficiently Reach Individual With Higher Risk**
  - **By Prioritizing Neighborhoods That Need More Help**





Source: Tennessee Highway Safety Office

QUESTIONS?

THANK YOU.