Incorporating Travel Time Reliability in Predicting the Likelihood of Aging Drivers Severe Crashes Using Dirichlet Random Effect Regression

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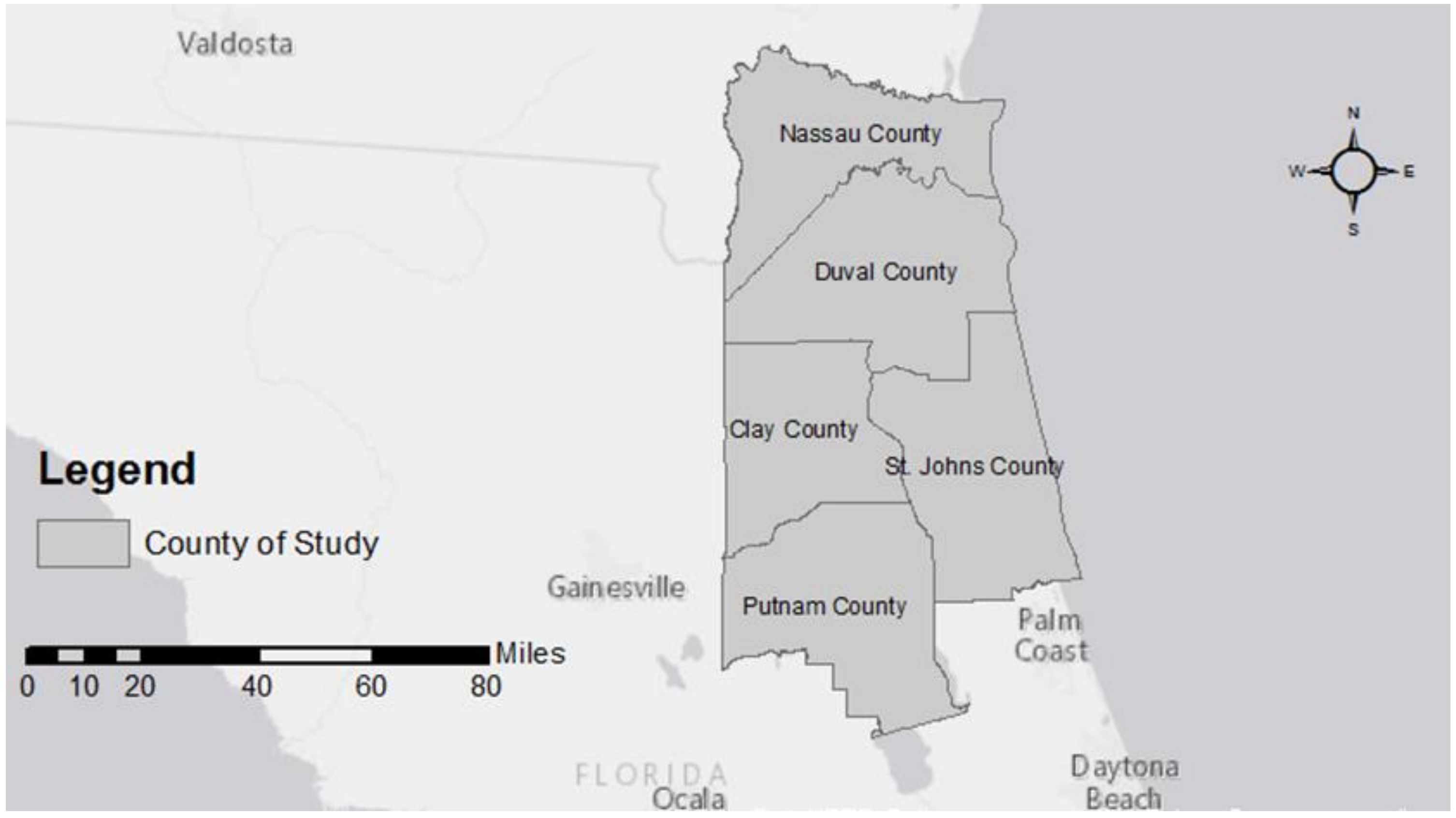
Purpose of the study

- To determine possible impact of travel time reliability (TTR) on the likelihood of severe crash of seniors drivers.
- The study also evaluated the influence of geometric features, crash characteristics and traffic data.
- The TTR metrics are estimated using INRIX data collected between 2010 and 2011 on state routes while a 4-years crash data from 2009 through 2012 were used in the analysis.

Study area

- We chose North Eastern Florida areas as a case study.



Travel time reliability

- Travel time reliability measures the consistency of travel time beyond the average travel time.
- In this research, buffer index metric was applied to quantify the reliability of travel time (TTR).
- The $Buffer\ Time\ Index$ was computed as:

$$= \frac{95^{th}\ Percentile\ travel\ time - median\ travel\ time}{median\ travel\ time}$$

- The $Buffer\ Time\ Index$ represents the amount of extra time that travelers need to add on their journey to reach a destination on time.

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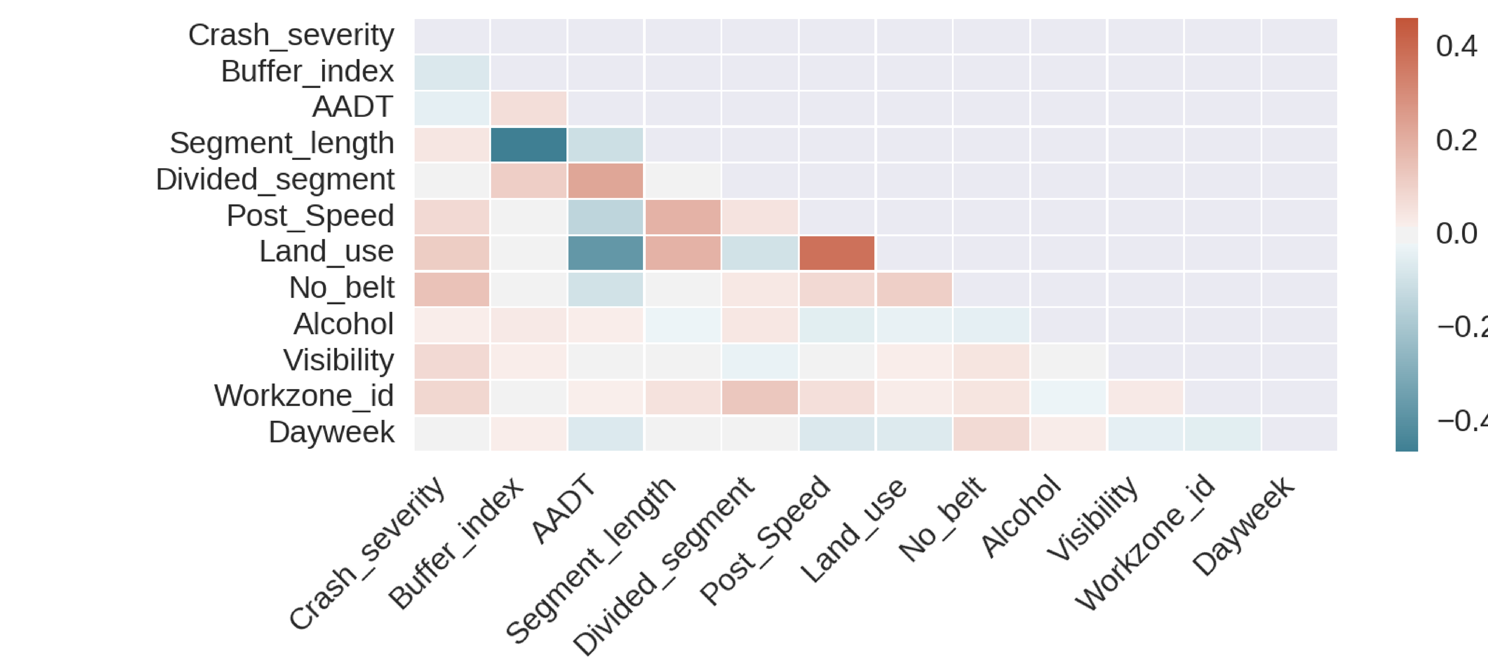
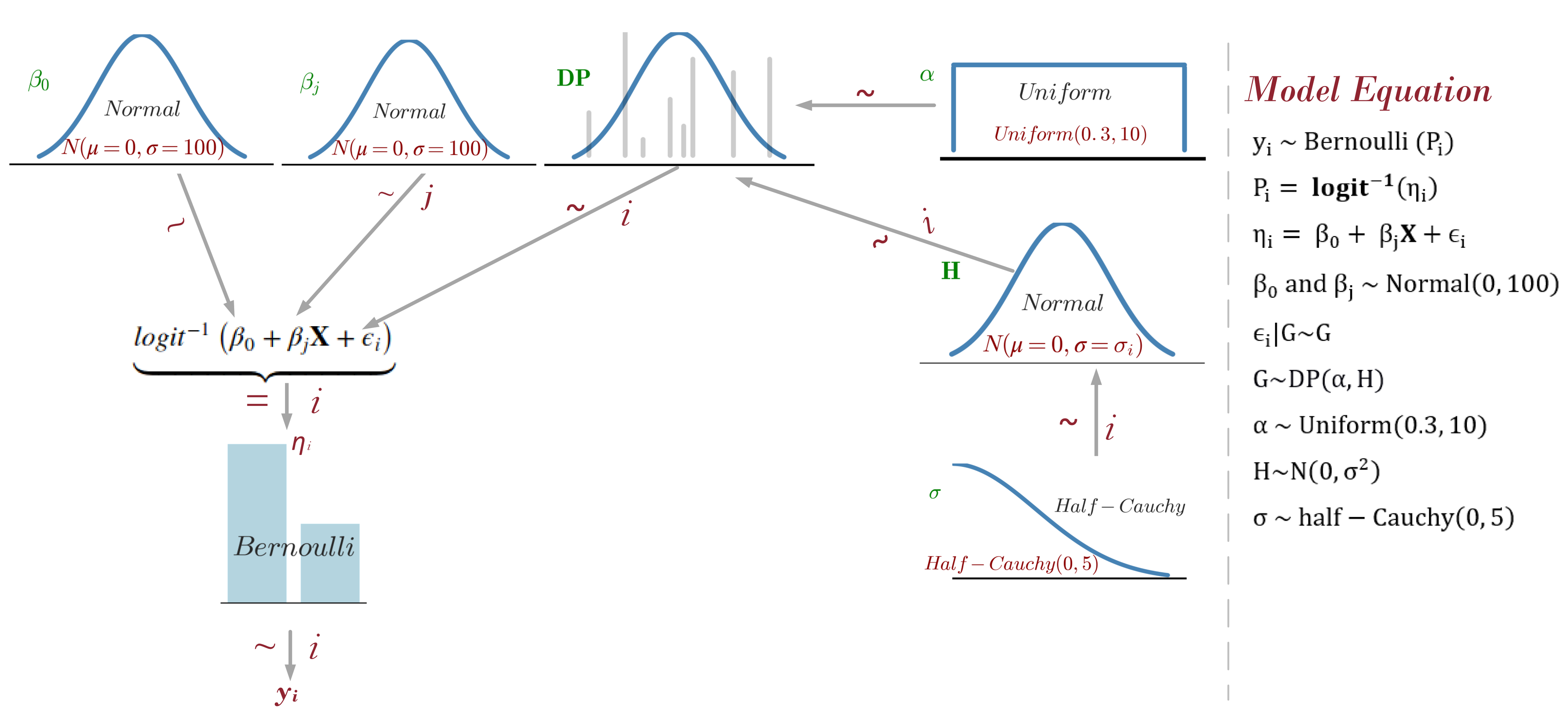
Variable evaluated and correlation analysis



Methodology

- Bayesian approach, the Markov Chain Monte Carlo (MCMC) simulation, was applied to estimate the posterior distributions of the model parameters.



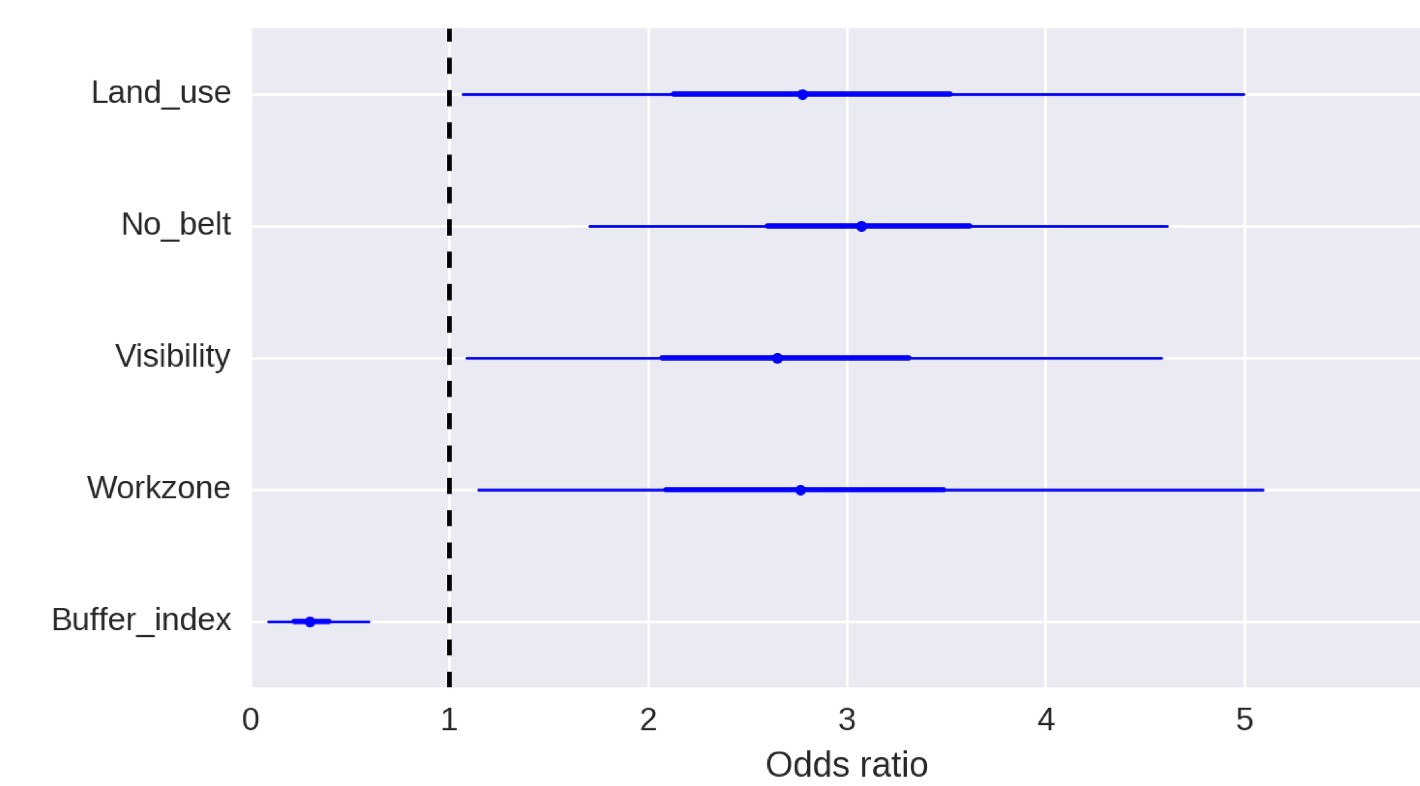
- Model performance for the Dirichlet random effect was compared with that of the conventional logistic random effect regression (normal distributed random effect) using goodness-of-fit statistic.
- $Widely\ Available\ Information\ Criterion\ (WAIC) = -2 * lppd + 2 * p\_waic$

Model results

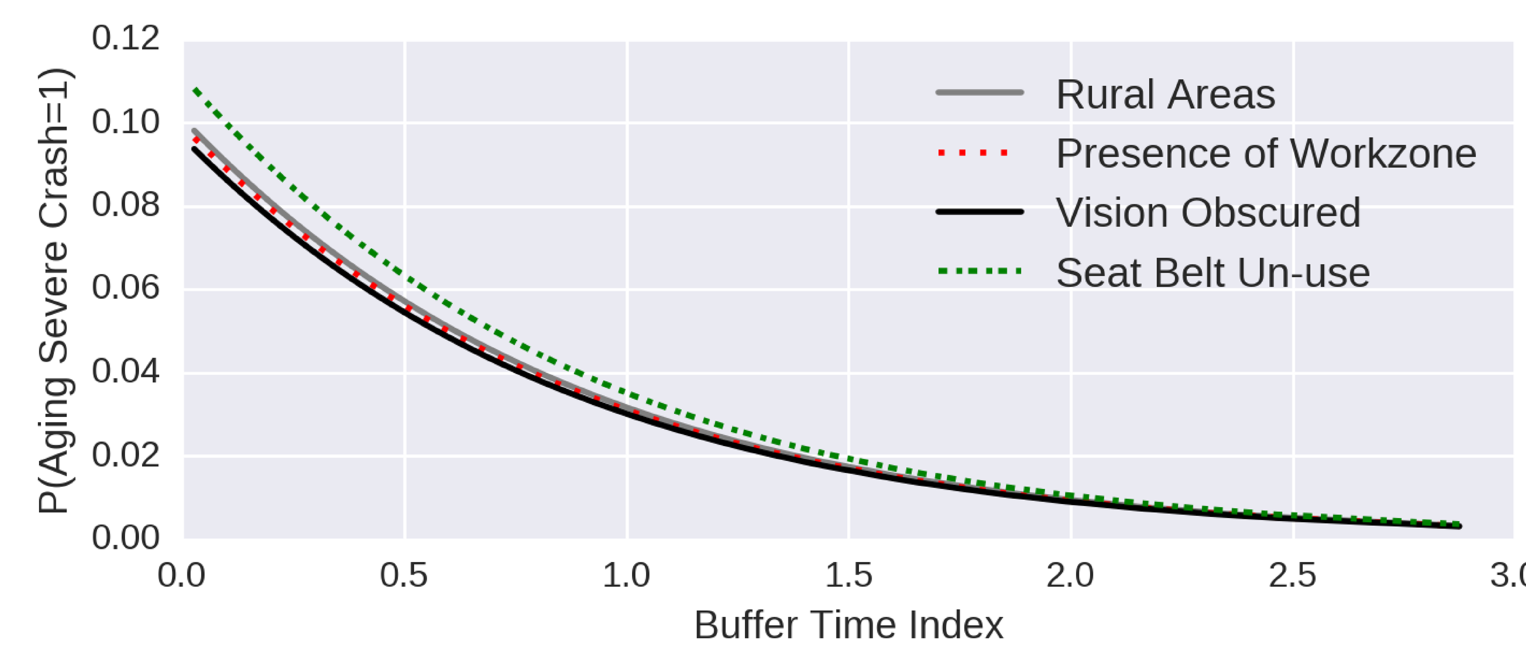
Variable	Conventional random effect regression				Dirichlet random effect regression			
	Posterior mean	Posterior std.	95% Credible intervals		Posterior mean	Posterior std.	95% Credible intervals	
Intercept	-3.022	1.892	-6.563	0.893	-3.195	1.943	-7.123	0.284
Segment length(miles)	0.064	0.186	-0.302	0.423	-0.105	0.102	-0.303	0.090
AADT	-0.110	0.104	-0.315	0.089	0.080	0.193	-0.279	0.454
Posted speed limit	0.081	0.201	-0.340	0.445	0.250	0.299	-0.364	0.811
Divided segment	0.240	0.293	-0.300	0.820	0.074	0.204	-0.327	0.467
*Land use (rural)	0.996	0.386	0.162	1.671	1.010	0.365	0.344	1.756
*Safety belt usage (no)	1.009	0.376	0.231	1.723	1.118	0.248	0.623	1.580
Alcohol (yes)	1.125	0.254	0.662	1.642	0.782	0.606	-0.530	1.909
*Visibility (poor)	0.793	0.592	-0.277	2.069	0.959	0.350	0.259	1.625
*Workzone (yes)	0.959	0.359	0.294	1.665	0.990	0.375	0.278	1.715
Day of the week	-0.041	0.250	-0.552	0.420	-0.043	0.253	-0.508	0.440
*Buffer time index	-1.235	0.447	-2.098	-0.382	-1.236	0.448	-2.061	-0.319
Widely Akaike Information Criterion (WAIC)			923.60			904.11		
Number of crash observations			1,545			1,545		

Model results

Odds ratio of the 95% credible variables



Posterior predictive regression



Summary and conclusions

- The comparison of developed models indicate that the Dirichlet random effect is superior in modeling the elderly crashes.
- The buffer time index was found to have an exponential correlation with the probability of elderly severe crashes.
- The risk of a severe crash is reduced by nearly 71% when a one-unit of the buffer index increases.
- The likelihood of a severe crash occurrences in workzone areas rise by 1.69 compared to non-workzone areas.
- Poor visibility was found to increase the odds of elderly drivers to be involved on the severe crash by 1.61 compared to when there is an adequate visibility.
- The odds of a severe crash occurrence are higher by 2 when unbuckled elderly drivers are involved than when are buckled.
- Rural versus urban characteristics of a road show that the odds of a severe crash is higher by 1.74 in the rural than urban areas.