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Comparing Risk Factors of Crash Injury Severity on West Virginia and Montana Rural Freeways

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Introduction

- Higher speed is linked to increased injury severity on freeways.
- Rural freeways often have speed limits 75 mph+.
- Data shows that rural states such as MT, WV, SC, AR, ND, MS have highest fatality rate in terms of fatality /100 million VMT (NHTSA).
- In 2011, MT and WV ranked 1st and 2nd (1.79 and 1.78 fatalities per 100 million).

Objective

Identify and compare the risk factors for Injury severity for rural freeways with higher speeds.

Literature Review

- Mixed Logit Model preferred; also more interpretive than multinomial logit and probit model.

- Risk Factors that are usually considered in injury severity analysis can be grouped in to road geometry, traffic, vehicle, freeway user and environmental characteristics.

- Past rural freeway studies indicated factors such as traffic, vehicle density and v/c ratio linked to increased frequency of crashes.

- In general, there have been limited studies on injury severity on rural freeways.

Analytical Framework- Mixed Logit

- Two Levels of Injury Severity (injury and no-injury) are considered to be the dependent variable.
- Independent variables include geometric, traffic, environmental, highway user-related, and vehicle-related variables.
- Parameters are estimated by simulated maximum likelihood estimation using Halton Draws.
- The elasticities or marginal effects are estimated to depict the sensitivity of the estimated variable.

Analytical Framework- Data

WV	MT
3 years of crash data 2011-2013	
Data sources Safety Management System (part of AMS) 1. Crash Data 2. Vehicle Data 3. Person Data Transportation Operations Module (part of AMS) 1. Roadway Section Data	*Data sources* Safety Information Management System (SIMS) 1. Crash Data 2. Vehicle Data 3. Person Data 4. Roadway Inventory
Highest severity chosen as crash severity of crash	Highest severity chosen as crash severity of crash

Summary Statistics – Selected Variables

Variable Type	*Variable Name*	*WV* *Total Observations = 6,600*	*MT* *Total Observations = 5,333*
Continuous Variables			
Traffic	Ln(AADT)	Mean = 9.01, Standard Deviation = 0.90	Mean = 8.81, Standard Deviation = 0.45
	Speed Limit (mph)	X	Mean = 73.58, Standard Deviation = 4.07
	Percentage of Trucks	X	Mean = 21.91, Standard Deviation = 5.16
Category Variables			
Geometric/ Roadway	Road Surface Condition	Dry = 4,556 (69.03%)	Dry = 2,940 (55.13%)
	Road Surface Type	Asphalt = 6,190 (93.79%)	Asphalt = 4,950 (92.82%)
Traffic	Route Type	Interstate = 1,229 (18.62%); U.S. = 5,371 (81.38%)	X
	Hit and Run	X	Yes = 326 (6.11%); No = 5,007 (93.89%)

X- no or insufficient information

Summary Statistics*

Variable Type	***Variable Name***	***WV*** ***Total Observations = 6,600***	***MT*** ***Total Observations = 5,333***
Environmental	Lighting Condition	Day = 4,735 (71.74%); Dark (Unlighted) = 1,355 (20.53%)	Day = 2,762 (51.79%); Dark (Unlighted) = 2,153 (40.37%)
	Weather Condition	Clear = 4,005 (60.68%); Cloudy = 1,118 (16.94%)	Clear = 2,129 (39.92%); Cloudy = 1,850 (34.69%)
Highway User-Related	Highway User Age	Middle (25 ≤ Age ≤ 64) = 4,294 (65.06%)	Middle (25 ≤ Age ≤ 64) = 3,655 (68.54%);
Vehicle-Related	Vehicle Type	Autos = 3,412 (51.69%); Pickups and trucks = 2,297 (34.80%)	Autos = 2,054 (38.51%); Pickups and trucks = 1,932 (36.23%)

Results

- Random Predictors
  - For Montana, Hit & Run crashes on rural freeway reduces the likelihood of injury and fatality
  - Increase in speed limit in WV was associated with reduced injury and fatality crashes, whereas for MT it increased these crashes by 24%

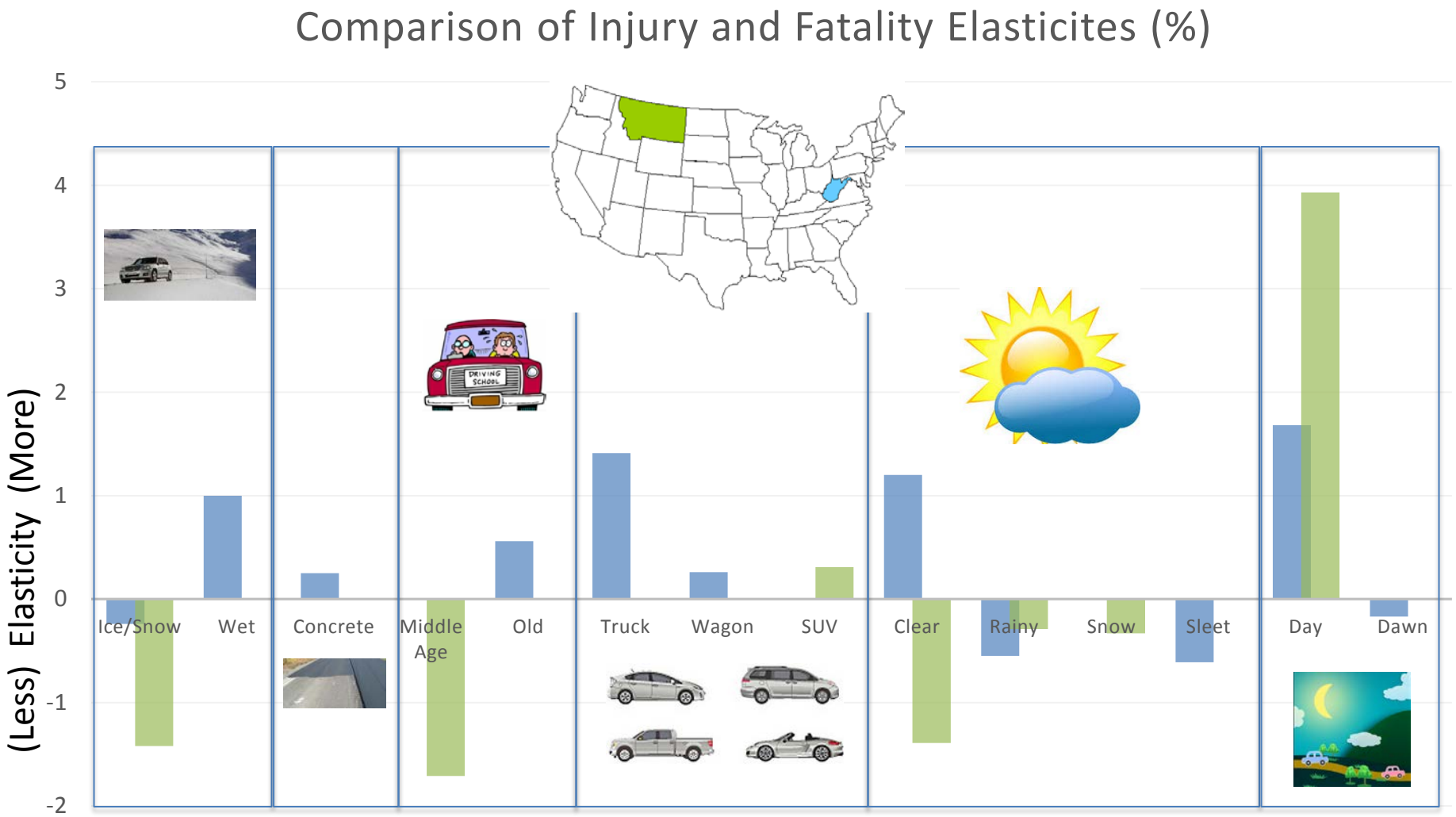
- Fixed Traffic and Geometric Predictors
  - Increase in AADT for WV reduces the likelihood of injury/fatality by 40%
  - Snowy/Icy road conditions reduces the likelihood of injury/fatality for both WV and MT

Results

- Fixed Highway User-Related and Vehicle-Related
  - For Montana, middle-aged group are associated with a reduction in injury and fatality risk.
  - For WV, older-aged group (>64) are associated with an increase in injury and fatality risk.
  - For Montana, SUVs are associated with an increase in injury and fatality risk.
  - For WV, trucks and wagons are associated to increase in injury and fatality risk.

- Fixed Environmental Predictors
  - Adverse weather (rain, snow and sleet) associated with a reduction in injury and fatality risk in both states.
  - Clear weather increases the injury risk in WV and decreases in MT.
  - Day time associated with an increase in injury and fatality risk.

Results – Selected Significant Factors



Conclusions

- **Higher AADTs** (or implicitly lower speeds) were associated with a **reduction** in injuries and fatalities in both states, with West Virginia exhibiting a higher reduction.
- In both states, **adverse** snowy/icy road surface conditions were associated with a **reduction** in injuries and fatalities, with Montana exhibiting a higher reduction
- **Clear weather** condition was associated with an **increase** in the injury and fatality likelihood in **West Virginia**, whereas it was associated with a **reduction** in injuries and fatalities in **Montana**.

Conclusions

- Some variables were found significant in one state, but not in the other.
  - For example, the **middle-age group** was a significant highway user predictor in the **Montana** model, while the **old-age group** was found significant in the **West Virginia** model.
  - **Trucks and wagons** were associated with an **increase** in the injury and fatality risk in **West Virginia**, whereas **SUVs** were associated with injury and fatality **increase** in **Montana**
  - **West Virginia** had an **increase** in injuries and fatalities in **wet** road surface condition, which usually forms after rainfall and once snow melts.

Future Study

- 1: Future research could compare the findings of this study with those from the analysis of crash injury severity in **other rural states** in the U.S., with high crash fatality rates.

- 2: To compare the results from this study with those from analyzing injury severity in **urban U.S. states** to see how the impact of each predictor might differ or agree.

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