A Comparison of Local Improvements to the Highway Safety Manual Crash Estimation Methods on Two-Lane Highways in Florida

UTC Conference for the Southeastern Region
April 5, 2013

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Why Traffic Safety?

- Over 32,000 traffic fatalities occur annually in the United States
  - Over 2,300 in Florida
- The total impact cost of traffic crashes in the US is about $300 BILLION
  - Vs. $98 billion for congestion costs
- Safety improvement initiatives
  - FHWA: Toward Zero Deaths
  - ITE & United Nations: Decade of Action for Road Safety
Highway Safety Manual (HSM)

- Published in 2010 by AASHTO
- Provides quantitatively based tools for engineers to use to reduce the potential for crashes
  - A large part of this is a crash prediction methodology
    - 1) Safety Performance Function (SPF)
    - 2) Crash Modification Factors (CMF)
    - 3) Calibration Factor (C)
Research Questions

- **CMFs:**
  - Do they transfer accurately to Florida?
  - Is it preferable to include roadway features directly into the model?

- **Calibration:**
  - Benefits to calibration on a sub-statewide level?
  - Benefits of including regional factors other than geographic proximity?
  - Benefits of incorporating regional calibration variables directly in the model structure rather than as a linear factor?
Data Collection

- Crash data from FDOT Crash Analysis Reporting System
  - 2005-2008
  - Only fatal and injury crashes included
- Segment data collected from FDOT Roadway Characteristic Inventory
Regional Segmentation

Geographic Segmentation

Population Density Segmentation

- Group 1
- Group 2
- Group 3
- Group 4
Local Crash Prediction Models

\[ N_{predicted} = \exp(\beta_1 + \ln(L) + \beta_2 \times \ln(AADT) + \beta_3 \times X_1 + \ldots + \beta_n \times X_n) \]

- \(N_{predicted}\) = predicted average crash frequency
- \(\beta_1 \ldots \beta_n\) = regression coefficients
- \(L\) = segment length
- \(AADT\) = annual average daily traffic (vehicles per day)
- \(X_1 \ldots X_n\) = roadway characteristic
Localized Calibration Results

**FDOT Districts**

- Calibration Factor (4 Year Average)
- FDOT District

**Population Density**

- Calibration Factor (4 Year Average)
- Population Density Group
  - Rural Two-Lane Roads
  - Urban Two-Lane Arterials
## Urban Crash Prediction Error Comparison

<table>
<thead>
<tr>
<th>Urban Two-Lane Arterials</th>
<th>Comparison Criterion</th>
<th>HSM Calibration</th>
<th>Locally Derived Multivariate Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Statewide</td>
<td>FDOT District</td>
</tr>
<tr>
<td>All Segments</td>
<td>Mean Absolute Error</td>
<td>0.776</td>
<td>0.759</td>
</tr>
<tr>
<td></td>
<td>Variance of Absolute Error</td>
<td>0.959</td>
<td>0.881</td>
</tr>
<tr>
<td>Segments with Multiple Crashes</td>
<td>Mean Absolute Error</td>
<td>1.975</td>
<td>1.91</td>
</tr>
<tr>
<td></td>
<td>Variance of Absolute Error</td>
<td>2.813</td>
<td>2.574</td>
</tr>
</tbody>
</table>
## Rural Crash Prediction Error Comparison

<table>
<thead>
<tr>
<th>Rural Two-Lane Roads</th>
<th>Comparison Criterion</th>
<th>HSM Calibration</th>
<th>Locally Derived Multivariate Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Statewide</td>
<td>FDOT District</td>
</tr>
<tr>
<td>All Segments</td>
<td>Mean Absolute Error</td>
<td>0.729</td>
<td>0.727</td>
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<tr>
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<td>Variance of Absolute Error</td>
<td>1.095</td>
<td>0.939</td>
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<tr>
<td>Segments with Multiple Crashes</td>
<td>Mean Absolute Error</td>
<td>1.84</td>
<td>1.814</td>
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<tr>
<td></td>
<td>Variance of Absolute Error</td>
<td>3.631</td>
<td>2.486</td>
</tr>
</tbody>
</table>
Summary of Results

- Model Coefficients from Locally Developed Models:
  - Increase in predicted crashes with narrower lanes, slower speed limits, and the presence of an intersection at either segment end
  - Decrease in crash frequency on segments with bike lanes
  - Locally developed multivariate models result in different relationships between crashes and roadway attributes than seen in HSM CMFs

- Prediction Comparison:
  - District segmentation does not show a clear pattern across facility types or districts
  - Population density segmentation shows that for both facility types the HSM systematically under-predicts crashes in counties with high population density
  - Population density calibration results in the lowest absolute error and variance of absolute error for rural two-lane roads, while models with FDOT district segmentation perform best for urban two-lane arterials
Questions?

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