Assessing the Use of Pedestrian Crash Data to Identify Unsafe Transit Segments

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Introduction

- Increasing population, travel demand, and congestion
- Need for enhanced transit systems
- Safety of transit system users on roads
  - Most users are pedestrians
    - Pedestrian fatalities
    - ~11 percent of 43,000 annual fatalities on roads in the United States during recent years
  - 14-16 percent of all fatalities related to motor vehicles collisions in City of Charlotte, NC
Pedestrian Crashes - Causes

- Pedestrian contributing factors
  1) Running to catch a transit bus
  2) Crossing at mid-block locations
  3) Walking between stopped or parking vehicles, including buses

- Driver contributing factors
  1) Hit and run
  2) Failure to yield right-of-way

Transit System User Safety on Road – Data Limitations & Needs

- Detailed crash reports and crash database maintained by regional agencies
- Pedestrian trip purpose
- Can we rely on surrogate (pedestrian crash) data?
- How can we improve safety to attract more users?
- Where should we spend our funds?
Research Objective

- Assess the use of pedestrian crash data to explain the role of transit service / ridership on pedestrian crashes
- Compute measures to identify bus transit segments potentially unsafe for users to walk

GIS Methodology

- Selection of study segments
- Data collection
- Compute measures
- Descriptive analysis
- Statistical analysis
- Identify unsafe segments
Study Area & Segments
- City of Charlotte, North Carolina
- Charlotte Area Transit System (CATS)
  - 3,622 Transit stops
  - 80 Routes
- 150+ fatalities per year (15 to 20 % are pedestrians)
- ~400 pedestrian crashes per year
- 30 study segments each with and without transit service

Selection of Study Segments
- Pedestrian activity based on land use and on-network characteristics
  - Population, employment, residential area, commercial area and mixed land use
  - Typically 35 mph or 45 mph segments
  - Roadwidth
    - 90% without transit are <= 4 lanes
    - 70% with transit are <= 4 lanes (15% are with 5 lanes)
  - Divided / undivided
    - 65 % without transit are undivided
    - 55 % with transit are undivided
### Pedestrian Crashes on Segments with and without Transit Service

**Summary of Pedestrian Crashes**

<table>
<thead>
<tr>
<th>Category</th>
<th>No Transit</th>
<th>Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Pedestrian crashes</td>
<td>50</td>
<td>240</td>
</tr>
<tr>
<td>Center-lane miles</td>
<td>91.0</td>
<td>81.0</td>
</tr>
<tr>
<td>Pedestrian crashes per center-lane miles</td>
<td>0.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Transit stops</td>
<td>710</td>
<td></td>
</tr>
<tr>
<td>Pedestrian crashes per transit stop</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Alighting</td>
<td>23,907</td>
<td></td>
</tr>
<tr>
<td>Boarding</td>
<td>33,206</td>
<td></td>
</tr>
<tr>
<td>Total transit riders</td>
<td>53,171</td>
<td></td>
</tr>
<tr>
<td>Pedestrian crashes per 1,000 transit riders</td>
<td>4.514</td>
<td></td>
</tr>
<tr>
<td>Average # pedestrians (based on available 7:00 AM to 7:00 PM counts at selected intersections along the segments)</td>
<td>14</td>
<td>54</td>
</tr>
<tr>
<td>Pedestrian crashes per center-lane miles per average # pedestrian</td>
<td>0.038</td>
<td>0.055</td>
</tr>
</tbody>
</table>
### Pedestrian Crashes – On-network Characteristics

<table>
<thead>
<tr>
<th>Category</th>
<th>Speed Limit (mph)</th>
<th>Pedestrian Crashes per Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Transit Miles</td>
<td>Transit Miles</td>
</tr>
<tr>
<td>Speed Limit (mph)</td>
<td>&lt;=35</td>
<td>59.9</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>30.0</td>
</tr>
<tr>
<td>Lanes</td>
<td>&lt;= 4</td>
<td>36.6</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>1.2</td>
</tr>
<tr>
<td>Median Type</td>
<td>Divided</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>Undivided</td>
<td>76.0</td>
</tr>
</tbody>
</table>

**Legend**

- Orange: Pedestrian Crashes per Mile with Transit System
- Red: Pedestrian Crashes per Mile without Transit System

**With Transit System**

- 15 Pedestrian Crashes per Mile
- 31 Pedestrian Crashes per Mile

**Without Transit System**

- 76 Pedestrian Crashes per Mile
- 50 Pedestrian Crashes per Mile
Pedestrian Crashes per MVMT

With Transit System

Without Transit System

Pedestrian Crashes per Mile per 10 Transit Stops
Pedestrian Crashes per Mile per 1,000 Transit Riders

Computed Measures - Summary

<table>
<thead>
<tr>
<th>Measure</th>
<th>No Transit</th>
<th>Transit</th>
<th>Percent</th>
<th>Center-lane Miles</th>
<th>Percent</th>
<th>Center-lane Miles by Transit Stops</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Crashes per Mile</td>
<td>4.2</td>
<td>28.6</td>
<td>28.2</td>
<td>20.0</td>
<td>81.0</td>
<td>5.2</td>
<td>35.3</td>
</tr>
<tr>
<td>Pedestrian Crashes per MVMT</td>
<td>3.0</td>
<td>14.2</td>
<td>5.7</td>
<td>0.0</td>
<td>19.9</td>
<td>0.0</td>
<td>17.5</td>
</tr>
<tr>
<td>Total</td>
<td>91.0</td>
<td>100</td>
<td>4.2</td>
<td>28.6</td>
<td>28.2</td>
<td>20.0</td>
<td>81.0</td>
</tr>
</tbody>
</table>

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Statistical Analysis

- $H_O = \text{mean value of measure on transit service segments (M}_{TS})$ is less than or equal to mean value of measure on segments without transit service ($M_{NTS}$)
- $H_A = \text{mean value of measure on transit service segments (M}_{TS})$ is greater than the mean value of measure on segments without transit service ($M_{NTS}$)

Decision rule: Reject null hypothesis if T-statistic $> T$-critical (level of significance = 0.05)
Identifying Unsafe Segments

Conclusions

- Higher number of pedestrian crashes and other measures was observed on the segments with transit service than when compared to without transit service.
- Statistical analysis shows that pedestrian crashes, pedestrian crashes per mile and pedestrian crashes per MVMT on roads with transit service are statistically significant (higher) at a 95 percent confidence interval.
- Combining and ranking the sum of ranks helped to identify unsafe segments for safety improvements.