ASSESSING THE SAFETY OF SIGNALIZED INTERSECTIONS:
The Influence of Geometric Attributes and Regionality on Traffic-accident Risks
Y. Shiomi (Ritsumeikan Univ.) K. Watanabe (Oriental Consultants Co. Ltd.) H. Nakamura (Nagoya Univ.) H. Akahane (Chiba Institute of Tech.)

ABSTRACT
• This study identified and quantified the main factors influencing traffic accident risks at signalized intersections to propose effective countermeasures.
• Google Earth was used to collect numerical data related to the geometric attributes of intersections in three different regions in Japan.
• A lognormal hurdle model that considered regionality and geometric attributes was then used to quantify factors influencing the risk of traffic accidents involving various types of collisions.

The important findings are:
(i) The results indicated the existence of significant regional differences in the geometric attributes of intersections in regions.
(ii) Intersection size, length of crosswalks, and setback distance of crosswalks generally and significantly influenced all collision risk types.
(iii) The regionality of risk factors was mainly caused by the differences in driving characteristics between regions.

1. INTRODUCTION
• Specific regions keep listed in the highest number of fatalities per capita, suggesting "regionality" effects on traffic accidents.
• More than half of traffic accidents occur in and around intersections.

OBJECTIVES
• To identify and quantify the main factors influencing traffic accident risks at signalized intersections with consideration of the geometric attributes of intersections.
• To examine the source of regionality in traffic accident risks.

2. TARGET REGIONS
• Three regions in Japan: Kagawa, Aichi, and Shiga, where have a relatively higher number of traffic accidents per capita, and the land is flat and not mountainous.

3. DATA DESCRIPTION
• Quantification of geometric attributes of signalized intersections by using Google Earth.
  - Distance between stop lines [m]
  - Distance to the closest neighboring intersection [m]
  - Types of center dividers
  - Types of center indications

4. REGIONAL DIFFERENCES IN ATTRIBUTES OF INTERSECTIONS
• Significant differences among regions are observed with respect to most variables except for two-stage crossings, pavement markings for left turns, and the number of legs.

5. A METHOD OF STATISTICAL ANALYSIS
• Numerical characteristics of traffic-accident risks:
  (i) Non-uniform variance in the error term
  (ii) Over-dispersion and under-dispersion
  (iii) Continuous and positive values
  (iv) A large number of zero observations
  (v) Skewness characteristics

• A lognormal hurdle model was employed.

6. ESTIMATION RESULTS
• Motor-vehicles-related collisions
  - During left and right turns
  - Motorcycles-related

• Pedestrian-related collisions
  - Involving 65 years and above

7. DISCUSSIONS
• Significant regional differences in the geometric attributes of intersections:
  - It could potentially arise from the differences in traffic situation, historical land use patterns, and road network configurations.
  - Intersection size significantly influenced the risks of all types of collisions:
    - This indicated that a compact intersection had lower risks, though the optimal intersection size should be also considered from various aspects including safety and efficiency.
  - The regional dummy variables were statistically significant:
    - This suggested that in addition to geometric attributes of intersections, there were regional differences in the factors influencing collision risks. The source of regionality should be investigated in detail by future studies.

NOTES
• A logistic regression was applied in the model to get the binary variable (that is, zero or non-zero positive).
• The second layer modeled traffic-accident risk for intersections.
• A backward elimination method was independently applied for the first and second layer to select explanatory variables.
• Differences in significant variables among the accident type suggest differences in the factors influencing the occurrence of traffic accidents according to the accident type.
• Variables relating to intersection size are significant in all cases:
  - Creating compact Intersections may contribute to traffic safety.
• In the second layer, regional dummy is significant for motor-vehicle-related collisions, but not for pedestrian-related collisions.
• Regionality of risk factors may be caused by the differences in driving characteristics.

Contact: shiomi@fc.ritsumei.ac.jp