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Shark Tank Poster Competition

SPATIAL ANALYSIS AND BAYESIAN MODELS TO IDENTIFY AND ANALYZE PEDESTRIAN CRASH HOTSPOTS

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Objective and Study Location

Objective

- To identify pedestrian crash hotspots
- To answer the following question: do locations with *specific pre-conditions* have a higher probability of becoming a pedestrian crash hotspot?

Study Location

- Miami-Dade County, Florida

Research Approach

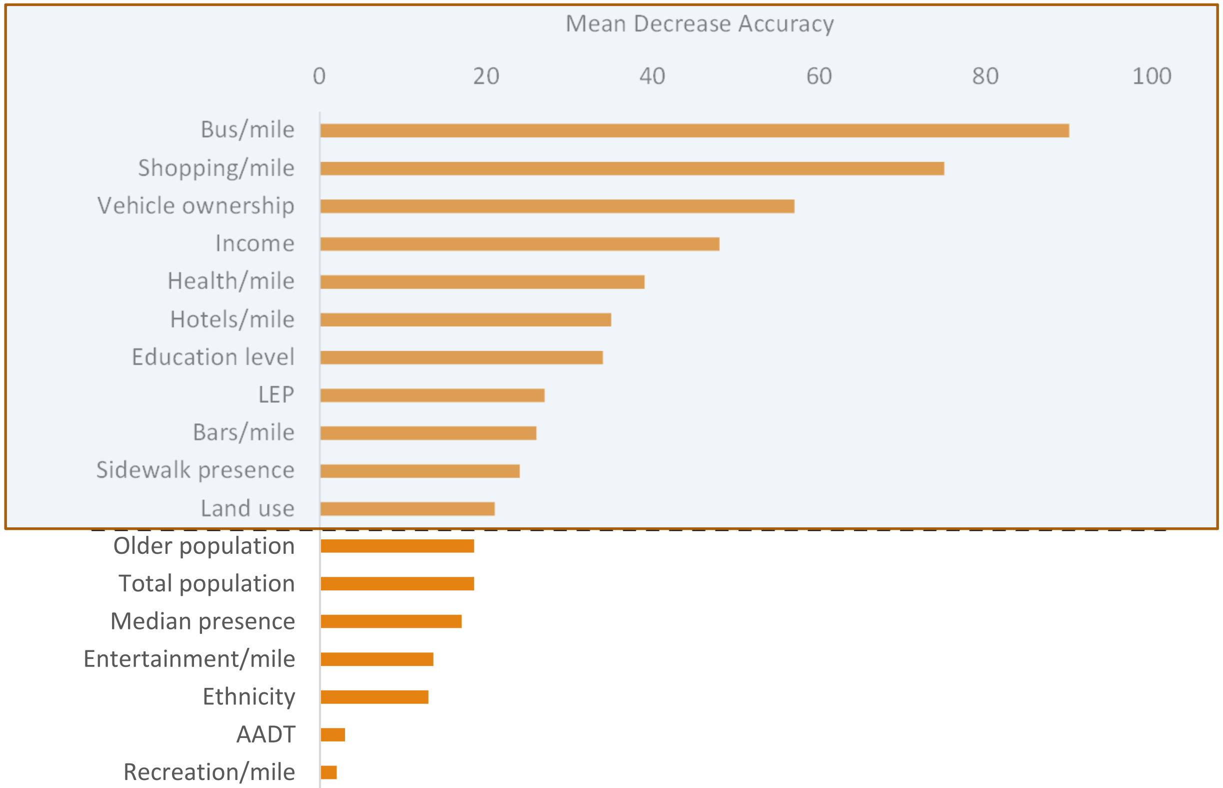
1. Apply Network-based Kernel Density Estimation (NKDE) approach in ArcGIS to identify pedestrian crash hotspots
2. Select the important pedestrian crash contributing factors using Random Forests approach
3. Use Bayesian Random-effect Complementary Log-log model to determine the factors that influence the probability of a road segment identified as a potential hotspot

Network-based Kernel Density Estimation

- Estimates the density of point events (e.g., pedestrian crashes) over a one dimension (1-D) network space.
- Determines the spread of risk of a crash, i.e., the area around a cluster in which there is an increased likelihood for a crash to occur based on spatial dependency.
- Simple and easily applicable in ArcGIS.

Random Forests Approach

- Used to estimate prediction performance and quantify variable importance.
- Tests how worse the model would perform without each variable.
- The *variable importance plot* tells how important variables are in classifying the data.



Bayesian Clog-log Model Results

Variable	Variable Category	Mean	Median	SD	Bayesian Credible Interval	
					2.5 (%)	97.5 (%)
Intercept		-4.744	-4.688	0.795	-6.457	-3.353
Density of bus stops		0.263	0.259	0.054	0.171	0.380
Density of shopping centers		0.802	0.788	0.187	0.478	1.207
Density of health facilities		0.862	0.839	0.302	0.334	1.518
Density of hotels		0.216	0.207	0.110	0.027	0.459
Density alcohol sales establishments		1.163	1.120	0.480	0.346	2.221
Income (%)	**0-24 (low)**					
	25-50 (medium)	1.506	1.476	0.401	0.808	2.377
	>50 (high)	1.205	1.177	0.436	0.423	2.137
Land-use	**Residential & Institutional**					
	Commercial & recreational	0.222	0.215	0.289	-0.336	0.806
	Less pedestrian activity	-1.959	-1.904	0.802	-3.683	-0.533
Sidewalk presence	No					
	Yes	0.831	0.809	0.310	0.281	1.497

Note: SD = Standard Deviation, Significant variables are bolded.

Conclusions

- Specific *pre-conditions* of the built environment influence road segments becoming a hotspot.
  - Bus stops
  - Shopping centers
  - Bars
  - Health facilities
  - Hotels
  - Residential & Institutional areas
  - Sidewalk presence
  - Income level
- This study has provided simple and yet novel statistical tools to identify pedestrian crash hotspots, and the contributing factors that influence high pedestrian crash occurrence.
- Planners and engineers could use the methodological framework and findings of this study to identify high risk locations and develop targeted proactive countermeasures to reduce the occurrence of pedestrian crashes.