CENTER FOR TRANSPORTATION RESEARCH

PROJECT SUMMARY

Texas Department of Transportation

0-7048: Identify Risk Factors that Lead to Increase in Fatal Pedestrian Crashes and Develop Countermeasures to Reverse Trend

Background

Pedestrian-miles traveled are less than 1% of total person-miles traveled in the US, but pedestrians make up 17% of lives lost in crashes (National Household Travel Survey, 2017; GHSA 2021). Around 10% of the nation's pedestrian fatalities happen in just four counties: Los Angeles, CA; Miami-Dade, FL; Maricopa, AZ; and Harris, TX, which together are home to around 7% of the US population. Pedestrian crashes are a rising issue in Texas, with the Dallas-Fort Worth, Houston, Austin, and San Antonio regions all placing in the nation's top 25 metro areas for pedestrian deaths (NHTSA, 2019). TxDOT's Crash Records Information System (CRIS) and Roadway Inventory files—combined with other statewide databases on land use, climate, bus stops, walk-miles traveled, and other variables—are used in this project to understand and ultimately predict crash counts and injury outcomes, and to recommend cost-effective site treatments and policies to save lives and decrease costs.

What the Researchers Did

An extensive literature review allowed the research team to synthesize useful findings of recent pedestrian-vehicle crash studies, including trends, contributing factors, and countermeasures. Academic publications, technical reports, and media articles were assembled to enable greater understanding of the pedestrian crash problem and its solutions. The research team also obtained a strategic sample of 300 detailed police reports for pedestrian-related crashes in Texas. The team assembled walk-trip distances across the two most recent National Household Travel Surveys, alongside many other spatial and demographic datasets, in order to better identify contributing variables and quantify their impacts on the state's and nation's crash counts, crash severities, and trends, and ultimately to identify cost-effective solutions.

The research team used a variety of network and crash data manipulations upstream of many analytical methods to ascertain the variables' impacts. Model specifications for Texas' hundreds of thousands of roadway segments and intersections include negative binomial (NB), ordered probit (OP), decision trees (DTs), random forests (RFs), and Accelerated Bayesian Additive Regression Trees (XBART).

Focusing on Texas' most crash-prone corridors and intersections, the research team was able to compute benefit-cost ratios (BCRs) for suitable interventions to protect pedestrians (and motorists) in the coming years. An overview of the team's "Most Crash-Prone Corridor" ranking,

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and the methods behind its creation (designed to reflect variations in crash severity), is also provided. Estimated deployment/construction costs and crash modification factors (CMFs) for over 50 countermeasures or "treatments" will be useful to all safety engineers and planners.

What They Found

Key risk factors for pedestrian death and injury include walking late on Friday and Saturday nights (or very early on Saturday and Sunday mornings), walking and/or driving under the influence (of drugs or alcohol), older male pedestrians and younger male drivers, higher roadway speeds, and bigger vehicle bodies (pickup trucks and sport utility vehicles). They also include proximity to schools, transit stops, and hospitals (even after controlling for local estimates of walk-miles traveled), as well as lower-income neighborhoods (after controlling for a location's traffic volumes) and those with more homeless populations. Sites of greater pedestrian risk include those with more lanes, more traffic, and without medians or shoulders. Comparisons of top machine learning (ML) analysis techniques (like LightGBM, XGBoost, XBART and RF) with classical econometric methods (like NB and OP methods) provided robustness in the inference of risk factors' impacts while illuminating the computing time advantages of classical methods and the non-linear effects of some contributing factors, clearly visible when using ML methods.

The research team also computed the BCRs of prohibiting right turns on red (signal lights), lowering speed limits, and introducing pedestrian leading intervals, road diets, medians, islands, and streetlights at various crash-prone sites around Texas. Those BCRs range from 1.67 to 5.38 when motorists' delay costs are reflected (e.g., 1 second per arriving vehicle when leading intervals are used), and from 428 to 6,689 when delay costs are ignored. Since a BCR indicates how much return is expected for every dollar invested, these suggest significant societal cost savings when such treatments are applied to Texas' more dangerous intersections and corridors.

What This Means

This research offers valuable insights into the opportunities and challenges of using crash records and reports, detailed roadway inventories, and other relevant data sources to visualize hot spots for traffic accidents. It uses those sources to develop crash rate and injury severity prediction models, build decision trees to categorize crashes, and identify the most cost-effective countermeasures to avoid injuries and loss of life while promoting active modes of travel.

This project's Developing Countermeasures to Decrease Pedestrian Deaths guidebook, final report, webinar slide deck, and videos are helpful tools for accessing relevant data sources, identifying important corridors and intersections for pedestrian improvements, and quantifying the cost-effectiveness of various investment (and policy) options.

For More Information

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