

## Abstract

Kang, Lei, M.S.E., Purdue University, December 2012, Statistical Analysis of Bicyclist and Pedestrian Behavior. Major Professor: Jon D. Fricker.

Bicycling has been enjoying a resurgence as a commuting mode since it has been shown to be an effective way to reduce congestion and improve public health. However, in many communities, the street network was planned to serve motor vehicles and is lacking bicycle facilities. This limitation often results in bicyclists riding on the sidewalk out of concerns about safety. Therefore, this study provides a comprehensive analysis of bicycle related issues: route choice behavior, facility preferences, bicycle-pedestrian interactions on the sidewalk, and bicycle crash injuries.

This study looks at how bicycle route choice is affected by environmental factors that characterize alternative routes available to a bicycle commuter and how changing bicycle facilities on a street segment will affect bicyclist behavior. Bicyclists were interviewed at the end of their trips on campus and asked which routes they took and which part of the cross-sections along their routes they had used – on-street or off-street. A practical procedure is developed to estimate bicycle link cost function parameters by formulating a bi-level optimization problem using route-level data. The results indicate that, for our database, travel distance is more important in route choice decisions. However, when perceived risk reaches high levels, the role of the risk factor in bicycle route choice becomes almost as important as the distance factor. Then, using segment-level data, a mixed logit model is developed to analyze the bicyclists' facility preferences

and capture the unobserved heterogeneity across the population. Effective sidewalk width, traffic signals, segment length, road functional class, street pavement condition, and one-way street configuration were found to be statistically significant. A bicycle path is demonstrated to be more attractive than a bicycle lane, based on the prediction analysis.

Bicycle-pedestrian interaction is investigated through pedestrian's point of view. Using a sample of 114 respondents, pedestrian perceptions of LOS on sidewalks shared with bicycles under various urban-street conditions are investigated. By estimating a random parameters ordered probit model of respondents' LOS assessments, we found, as expected, that pedestrian perceptions of LOS are strongly influenced by the pedestrian flow rate. However, bicycle influences such as bicycle flow rate, the speed of bicyclists, and several other factors were found to significantly affect LOS perceptions.

Finally, 2,947 vehicle-related bicycle crash injury severities that occurred between 2003 and 2005 in Indiana are analyzed using a random parameters ordered probit model, which takes spatial heterogeneity into account. Bicyclist characteristics, roadway, location, weather conditions, and collision characteristics are found to significantly influence bicyclist injury severity. The analytical tools and practical procedure developed in this study can be used to guide bicycle facility planning and assess bicycle risk and LOS factors.