A Vehicle Ownership (Car Shedding) Model as a Pre-Step of Travel Demand Modeling
Sadegh Sabouri (Sadegh.Sabouri@utah.edu), Guang Tian1,2, Reid Ewing1, Keunhyun Park1,3
1Department of City and Metropolitan Planning, University of Utah, 2Department of Planning and Urban Studies, University of New Orleans, 3Department of Landscape Architecture and Environmental Planning, Utah State University

Key Points

- Vehicle ownership models are used by policy makers to identify factors that affect vehicle miles traveled, and therefore address problems related to energy consumption, air pollution, and traffic congestion.
- While not always treated as such, vehicle ownership forecasting is a step in conventional travel demand forecasting process, and is also almost always part of activity-based modeling.
- The most critical limitation of the vehicle ownership models, especially in the context of this study, is that they are often related mainly to socio-demographic variables, not so much to built-environment variables.
- We pool regional household travel survey data from 32 diverse regions of the United States and generate consistent measures for all regions.
- Next, we test both count regression models (i.e., Poisson and Negative Binomial) on the most common used multivariate log (MNL) model to estimate vehicle ownership.
- The study results provide practical implications for state and local planning and transportation policies with better accuracy and better cost-effectiveness.

State-of-the-Art in Vehicle Ownership Modeling

To understand the gap between academic research and practical implementation, we conducted a survey of 27 Metropolitan Planning Organizations (MPOs) in the U.S. in mid-2018 focusing mostly on large regions since we assume that their MPOs are leaders in using new travel modeling techniques.

Nesting Structure of The Data + Variables

Methodology

- Data:
  - Household travel survey in 32 regions
- Dependent Variables:
  - Number of vehicles owned by household
- Models:
  - Count Regression Models:
    - Multi-level Poisson
    - Multi-level Quasi-Poisson
  - Discrete Choice Models:
    - Multi-level Ordinal Logit
    - Multi-level Multinomial Logit
  - All models are fixed at region level and random at TAZ level
- Model Evaluations:
  - 5-Fold cross-validation using Root Mean Square Error (RMSE)

Model Evaluation

- The Results of 5-Fold Cross-Validation
- The Results of Our Multi-Level Poisson Model and WFRCC’s Multilogit Model

Conclusions

- Household vehicle ownership has positive relationships with socio-demographic variables and negative relationships with several built-environment variables.
- Although the elasticities of built-environment variables are smaller than the elasticities of the socioeconomic variables (specifically income), all are highly significant.
- For urban planning and design practices, this study suggests that car shedding occurs as built environments become more dense, mixed, connected, and transit-oriented.
- This finding has important implications in the policy and planning practices, where decision makers seek solutions to deal with VMT, emissions, density, and other health and environmental concerns.
- Lastly, based on the results of this study, we would recommend using count models (quasi-Poisson and Poisson) over discrete or categorical models (ordered logit and multinomial logit).