UNIVERSITY TRANSPORTATION RESEARCH CENTER RESEARCH BRIEF

Project: A Random Utility Based Estimation Framework for the Household Activity Pattern Problem

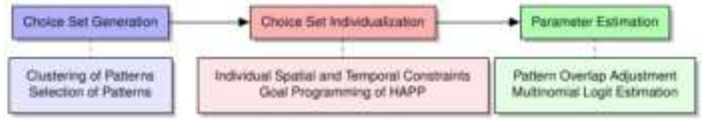
Principal Investigator : Jee Eun Kang, University at Buffalo, Buffalo, NY

In the field of transportation planning and engineering, the activity-based approach continues to generate interest in terms of model development and implementation. The Household Activity Pattern Problem (HAPP), is a mathematical programming approach to travel analysis under the activity-based framework. According to HAPP, activity travel patterns are the result of a household optimization with respect to a set of space-time and resource constraints, where the objective function represents travel (dis)utility.

One methodological challenge towards implementing HAPP as a forecasting tool is parameter estimation required for the linear-in-parameters objective function given a conventional dataset of observed travel-activity decisions. These parameters reflect the weighting or value households endogenously place on the components of the objective function. In this paper, an estimation procedure based on random utility maximization (RUM) choice theory is developed to provide parameter estimates for the HAPP objective function.

This study proposes a framework based on this observation that travelers' activity-travel decisions form a continuous pattern, and this selection of a particular pattern is based on a random utility theory (RUT). First, the observed activity-travel patterns represent the optimal decisions made for the traveler. Second, a single continuous path in space-time dimension is a single decision output containing complex activity-travel decisions. The observed pattern selection is modeled through a Multinomial Logit model (MNL). The result of the estimated MNL gives the parameter weights we need for operationalizing and forecasting.

Framework developed in this work is comprised of three procedures: (i) choice set generation; (ii) choice set individualization; and (iii) parameter estimation.



In **Choice Set Generation** we select one alternative pattern from each pattern cluster found in the data set that are distinctively different. We select patterns that will minimize the D-error based on a genetic algorithm. Then we individualize choice set alternatives in **Choice Set Individualization** based on a goal programming that will create a feasible pattern as close to the selected sample pattern. The goal programming formulation contains constraints of individuals' temporal and spatial constraints. This choice individualization step is found to be significant in increasing the fit of the MNL estimation. For the **Parameter Estimation**, overlap among alternatives is treated as the commodity factor (CF) as it is in C-logit or path size logit used in route choice set generation problems. Both travel disuitliy terms and activity participation utility gains are found to be significant.

The estimated parameters can be fed as weights in the objective functions of HAPP for activity-travel forecasting. Activity-travel forecasting capabilities include selective activity participation and their duration as well as activity sequencing.

Sponsors: University Transportation Research Center
Completion Date: June 2016
University: State University of New York (SUNY)