CALIBRATION OF A LARGE SCALE TRAVEL DEMAND MODEL: MICRO-SIMULATION MODEL OF NATIONAL LONG-DISTANCE TRAVELS

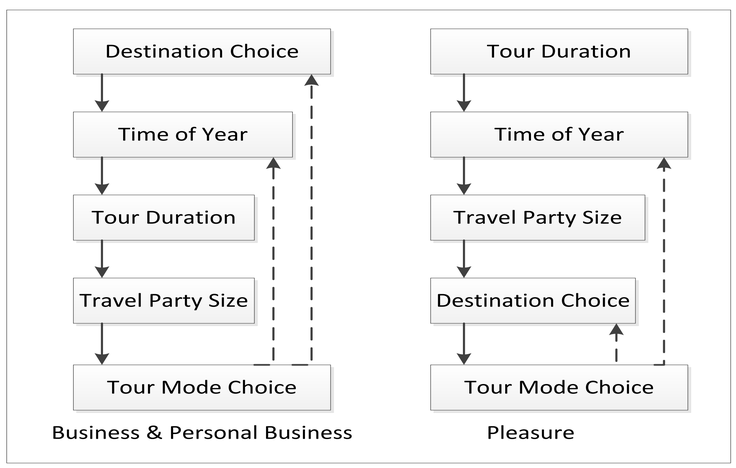
Sepehr Ghader[1], Aref Darzi[2], Lei Zhang[3,*] (1. Research Scientist, University of Maryland; 2. Research Assistant, University of Maryland; 3. Herbert Rabin Distinguished Professor and Director of Maryland Transportation Institute, University of Maryland; * corresponding Email: lei@umd.edu, phone:301-405-2881)

Introduction

- The increasing interest in national transportation policies has incited researchers and decision makers to call for advanced and policy-sensitive analysis tools
- The research team at the University of Maryland took advantage of 1995 American Travel Survey, and developed a micro-simulation travel demand model that simulates the entire U.S population and their national long-distance trips.
- Changes on travelers' preferences due to new technologies, new lifestyles, and travel trends highlight the need for a calibration effort.
- This study contributes to the travel demand modeling literature by proposing an efficient way to calibrate large-scale travel demand models, and presenting the calibration results.

National Long-Distance Model

- This model is the first attempt to develop an integrated activity-based travel demand model system for an individual's quarterly/yearly long-distance or national activities and travel in the U.S at the Metropolitan Statistical Area (MSA)/Non-MSA level.
- This model can forecast the long-distance passenger trips made by auto, air, and train in the U.S. over a one-year period in a micro-simulation framework.



Calibration Methodology and Data

Methodology

- The process of system-wide calibration tries to minimize the error between observed outputs and simulated outputs.
- The calibration process is formulated as a constrained minimization optimization problem

$$minimize_{\theta} \; w||O_m - O_S(\theta)||^2$$
$$s.t.$$
$$O_S = F(Z;\theta)$$
$$l \leq \theta \leq u$$

- Where w is a weight vector, O_m is observed vector, O_s is the simulated output vector, θ is the vector of parameters to be calibrated, and $F(Z;\theta)$ represents the link between the simulated outputs and the simulation based model.
- SPSA algorithm was selected to solve this constraint minimization problem

Data

- 2017 National Household Travel Survey (NHTS) is the source of information about travel behavior of U.S. residents.
- The trip table of NHTS was first filtered to only include long distance trips (longer than 50 miles).
- The share of trip attracted to each state was used in this study. the Survey was summarized into 51 values.
- The sum of the squared difference between the model simulation result and the survey was used as the objective function.

Acknowledgment

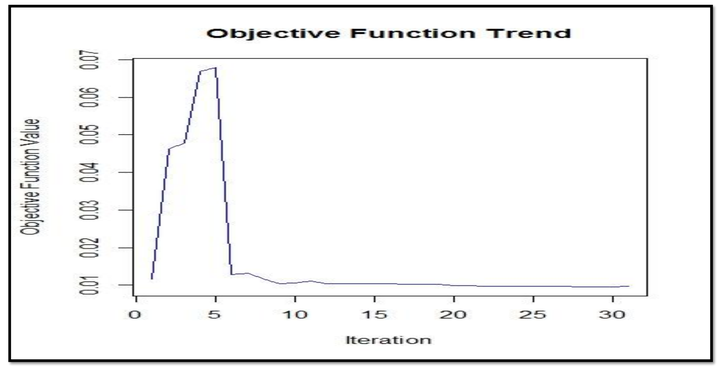
This research is partially funded by the Federal Highway Administration. The authors would like to thank the Maryland Transportation Institute at University of Maryland for project assistance from its administrative and technical staff. Opinions and views herein do not necessarily represent those of the research sponsors. The authors are solely responsible for all statements in this paper.

Results and Conclusions

- The parameters are either constants suggested in the literature or calculated from methods in the literature

Calibration Parameters and result	
Hyper-Parameter	Value
A	100
a	8.3353802
c	0.005
α	0.6
γ	0.1
Number of iterations	30
Initial objective function value	0.0116968
Final objective function value	0.0096814

- The calibration process reduced the objection function by 18%.
- Small changes in the last iterations is the sign for the convergence



- The following figure shows the performance of the calibration process in matching the long-distance model result with the NHTS2017.