USTM Resiliency Sensitivity Analysis

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Abstract

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Keywords: Sensitivity Analysis Resiliency Latin Hypercube Sampling

1. Questions

There exists uncertainty in travel demand models. This is known by transportation planners but the majority do not use any particular method to quantify it. This uncertainty exists mostly due to the variance among input parameters. A coefficient of variation can be used to approximate the standard deviation of the inputs, which then provides a range of values that are possible for model input (Zhao and Kockelman, 2002). A sampling method can then be used to determine the possible combinations of parameter variance. Two popular sampling methods are Monte Carlo simulation and Latin Hypercube sampling. Monte Carlo simulation is capable of providing full variance probability, but requires large computations to be effective on a large scale model (Yang et al., 2013). Latin Hypercube sampling reduces the amount variants needed, but the question arises on if the same result be achieved with fewer samples, and how many samples is that?

The research questions are therefore:

- How many iterations of Latin Hypercube Sampling in a travel demand model are necessary to approximate random sampling methods (e.g., Monte Carlo simulation)?
- Does this method of sampling have few enough iterations for statewide model application?

2. Methods

To examine the effects of parameter input sensitivity, a 25 zone dummy model was created using data from https://github.com/ActivitySim/activitysim, and coefficient values from the USTM Resiliency Model.

The inputs for sampling that will be used are mode choice coefficients, mode choice constants, and destination choice parameters. These inputs are shown in Table 1, and Table 2.

The shapefile for the dummy model is shown in Figure 1.

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Table 1: Mode Choice Coefficients

Name	HBW	HBO	NHB
CIVTT	-0.0450	-0.0350	-0.0400
CCOST	-0.0016	-0.0016	-0.0016
CWALK1	-0.0900	-0.0700	-0.0800
AUTOCOST	18.3000	18.3000	18.3000

Table 2: Mode Choice Constants

Name	HBW	HBO	NHB
K_TRN	-0.5140	-0.9853	-1.3020
K_NMOT	1.7602	0.5448	-0.5359

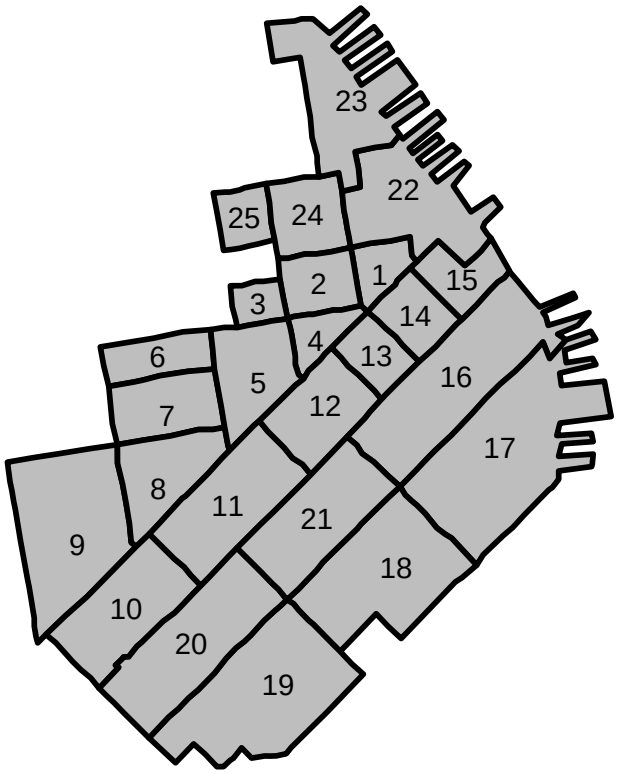

Figure 1: TAZ Map with ID

A mode choice model was created with utility equations for Home Based Work Trips(HBW), Home Based Other Trips(HBO), and Non Home Based Trips(NHB).

A coefficient of variation is used for each input parameter to determine a range for the values that can be used within the model, to estimate the sensitivity of these parameters.

The initial model was run, the change was calculated on a random selection basis, and then using latin hyoercube sampling, to see if latin hypercube sampling can estimate uncertainty in fewer runs.

3. Findings

Which describes the results of what you found.

References

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