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 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, Table 2, and Table 3.

A dummy model will be created for this analysis from https://github.com/ActivitySim/activitysim.

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

Which describes the methods and data used in the article.

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Table 1: Mode Choice Coefficients

Name	HBW	HBO	NHB
CIVTT	-0.0450	-0.0350	-0.0400
CSWAIT	0.0000	0.0000	0.0000
CLWAIT	0.0000	0.0000	0.0000
CXWAIT	0.0000	0.0000	0.0000
CCOST	-0.0016	-0.0016	-0.0016
CDRIVE	0.0000	0.0000	0.0000
CTERML	0.0000	0.0000	0.0000
CWALK	0.0000	0.0000	0.0000
CWALK1	-0.0900	-0.0700	-0.0800
CWALK2	-0.1350	-0.1050	-0.1200
CBIKE1	0.0000	0.0000	0.0000
CBIKE2	0.0000	0.0000	0.0000
DWalkBIKE	1.0000	1.0000	1.0000
NC1	1.0000	1.0000	1.0000
NC2	1.0000	1.0000	1.0000
NC3	1.0000	1.0000	1.0000
CBD	0.0000	0.0000	0.0000
NXFER	0.0000	0.0000	0.0000
AUTOCOST	18.3000	18.3000	18.3000
SHAREFAC	0.0000	0.0000	0.0000

Table 2: Mode Choice Constants

Name	HBW	HBO	NHB
K_SR	0.0000	0.0000	0.0000
K_TRN	-0.5140	-0.9853	-1.3020
K_NMOT	1.7602	0.5448	-0.5359
K_PREM	0.0000	0.0000	0.0000

Table 3: Destination Choice Parameters

VAR	HBW	HBO	NHB
HH	0.0000000	1.018700	0.207700
I(OTH_EMP + OFF_EMP)	0.0000000	0.806400	0.562600
OFF_EMP	0.4586000	0.403200	0.281600
OTH_EMP	1.6827000	0.403200	0.281600
RET_EMP	0.6087000	3.813800	5.118900
DISTCAP	70.0000000	40.000000	40.000000
CLSUM	1.0000000	1.000000	1.000000
CDIST	-0.1956000	-0.160600	-0.210200
CDISTSQ	0.0021000	0.002900	0.011200
CDISTCUB	-0.0000061	-0.000011	-0.000012
CLNDIST	0.0000000	0.000000	0.000000

3. Findings

Which describes the results of what you found.

References

Yang, C., Chen, A., Xu, X., and Wong, S. (2013). Sensitivity-based uncertainty analysis of a combined travel demand model. *Transportation Research Part B: Methodological*, 57:225–244.

Zhao, Y. and Kockelman, K. M. (2002). The propagation of uncertainty through travel demand models: an exploratory analysis. *The Annals of regional science*, 36(1):145–163.