Dat.mobility
ADVANCING ANALYTICS

Quantifying uncertainty due to choice allocation in micro models

INTRODUCTION

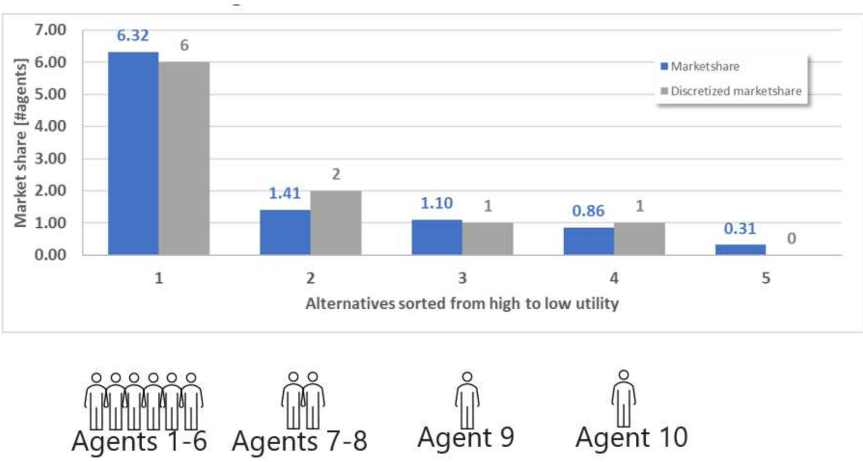
To forecast the future usage of the mobility system and to determine the impact of (policy) measures strategic transport model systems are used. These model systems are important decision making tools for policy makers. Transport models consist of a travel demand model that (in most systems) models the tour and/or trip frequency choices, the destination choices, mode choices and departure choices of travelers, and a travel supply model that models the route choices. Then this travel demand is assigned to the transport networks.

In strategic transport model applications, traditionally trip based macroscopic travel demand models are used. These models work on an aggregated level using socio-economic data (e.g.: the number of inhabitants and jobs in a zone) to calculate the travel demand on a zonal level. These models yield continuous results and conditions to guarantee uniqueness of the model outcomes (such as max entropy or max utility) are usually imposed on them. Most macroscopic model systems do not take tour consistency (whether the destination of a trip is the origin of the next trip) into account, but model separate trips instead.

In the application context of shared mobility the context in which travelers makes their decisions needs to be taken into account. In order to do so, a switch from a macroscopic trip based to a microscopic tour based travel demand model is required. Therefore Goudappel developed Octavius: a tour based microscopic travel demand model. Octavius generates a synthetic population, and then models all relevant (discrete) choices for each individual in it.

PROBLEM DESCRIPTION

Within Octavius each choice is made according to a behavioral choice model that has been estimated for the choice situation considered. Such choice models determine continuous probability distributions across the available choice alternatives. These probability distributions are a function of characteristics of the choice alternatives, the individual (and his/her household) and choices previously made. In each choice situation each individual makes one discrete choice, such that all individuals with the same characteristics (including previous choices) together behave accordingly to the probability distribution from the choice model.



In the figure above the continuous and discrete market shares for a choice situation with 5 choice alternatives is shown. The market shares are calculated by multiplying the probabilities from the choice model with the number of individuals in the choice situation, in this example 10 individuals. The 10 individuals should be assigned to a choice according to the discrete market shares, we call this the allocation. There are different allocations of the individuals to the choice alternatives possible which will all lead to the same optimal distribution of agents within the same segment. However for the next choice situations a different allocation can result in a different solution, because not each choice model has the same segmentation (other characteristics and previous choices are relevant). Therefore, unlike macroscopic models, micro simulators such as Octavius do not have one unique solution.

By setting a random seed and by matching agents between a reference and scenario run, Octavius ensures that there are no differences in outcomes of the reference and scenario runs due to differences in allocation, allowing Octavius to be applied within the strategic context. Octavius hence effectively removes all statistical noise from its outcomes using a form of quenched randomness, such that the strategic model user does not have to deal with uncertainty. However this does not mean that there is no randomness in the model system!

RESULT / OBJECTIVE

The objective of this assignment is to determine the (uncertainty) bandwidth around the model outcomes caused by the randomness in the allocation and to put this in perspective to the bandwidth due to uncertainty around model inputs. This gives model users insight in to what extent uncertainty of outcomes increases when switching from a macro- to a microscopic travel demand model.

ASSIGNMENT

This assignment requires literature research on statistical methods for quantifying and comparing (uncertainty) bandwidths around model outcomes. Such method(s) should be applied to quantify uncertainty around Octavius model outputs and put those into perspective to uncertainties due to model inputs. Uncertainty due to allocation can be determined by running the model multiple times with different random seed values. Uncertainty around model inputs should be determined based on historical data (for variables) and uncertainty around parameter estimates (typically known from the estimation process). Because uncertainty bandwidths increase (stack) over subsequent choice situations and decrease when the level of aggregation on which the outputs are considered increases, the analysis should be done for different choice situation sequences and output aggregation levels.

INFORMATION

When interested in this internship assignment please contact: Bernike Rijksen at brijksen@dat.nl. More information on Goudappel and Dat.mobility can be found via www.goudappel.nl and www.dat.nl.