ENAC / PROJET DE MASTER 2021-22
SECTION DE GÉNIE CIVIL

# Representing location choice within activity-based models

Auteur(e)s : Nicolas Salvadé

Encadrement : Prof. M. Bierlaire [1] / Dr. T. Hillel [1] / J. Pougala [1] / T. Haering [1]

[1] Transport and Mobility Laboratory (Transp-OR), EPFL

## Introduction

Since the 70s, there has been a growing interest in activity-based modelling. This approach models the need to travel as a result of performing daily activities. Nevertheless, the activities need to be scheduled which involves a lot of variables and results in a huge number of unique alternatives. Among these variables, the number of possible locations is usually bigger than other variables, motivating the use of a choice set for locations. However, this choice set of locations is usually not known by the modeller, so there is a need to recreate it. In addition, it would be useful for two purposes: simulation of daily schedules, and estimation of the parameters of an activity-based model based on an underlying choice model. For the first one, alternatives in the choice set must be competitive, to generate realistic schedules, as for the latter one, it should also contain unlikely alternatives to estimate unbiased parameters. In this project, a methodology to generate a choice set of destinations suitable for both purposes is presented.

## Methodology

This project is based on the behavioural assumption that the choice of a transportation mode and an aggregate destination (zone) is related. Using this assumption, we define an alternative to be a combination of a transportation mode and a destination zone. Likely alternatives are derived for an individual through a cross-nested logit (CNL) model. This model is especially well-suited for this problem because both mode and spatial correlations can be considered. In the case study, the destinations are grouped in three different nests, assumed spatially correlated, and three different transportation modes are considered (see Figure 1). This allows for a reasonable computational time, since the number of parameters stays low.


*Figure 1: the three groups of destinations and transportation modes*

Using a utility function related to each alternatives, accounting for travel times with a specific mode and some zone attractivity measures, the parameters from the CNL can be estimated. The resulting probability distribution of alternatives to be chosen can be used to perform importance sampling. This allows to generate competitive alternatives for an individual. While this choice set could be suitable for simulation in an activity-based model (ABM), it would not be suitable if there are parameters to estimate in the ABM. To tackle this issue, the first choice set can be transformed with simple operations, or the importance sampling can be performed with a random term. Figure 2 summarises the methodology.

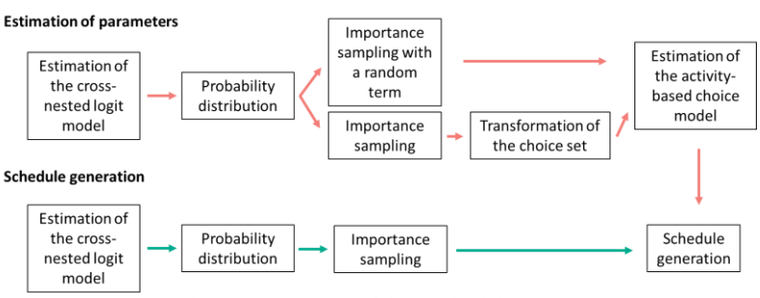


*Figure 2: Summary of the methodology*

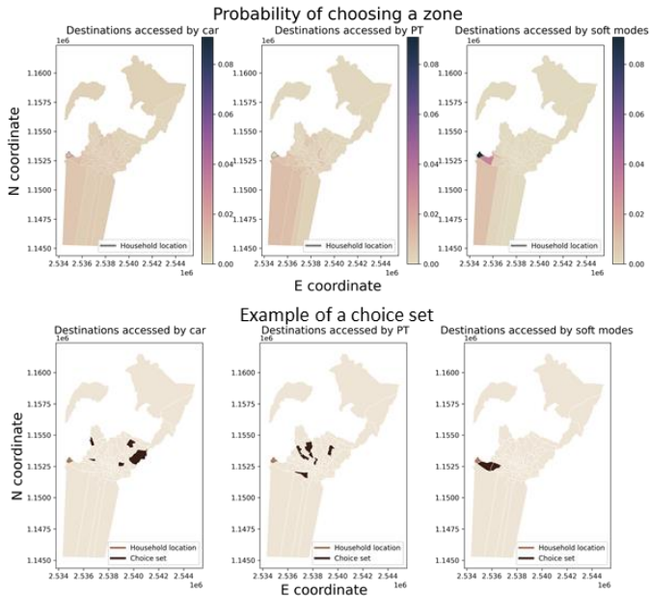


*Figure 3: Probability distribution and example of a choice set for a working activity and a household located in the western part of Lausanne*

## Case Study

The methodology is applied on a case study over Lausanne. Figure 3 shows an example of the probability distribution resulting of the CNL for a working activity and a household located in the western part of Lausanne. The figure shows that it is more likely to choose a closer destination when using a soft transportation mode. On the other hand, destinations reached by public transport are more likely to be around big transportation lines and destinations accessed by car are more evenly distributed. An example of choice set is drawn from this probability distribution. Finally, the methodology can be used to generate a full daily schedule (see Figure 4).

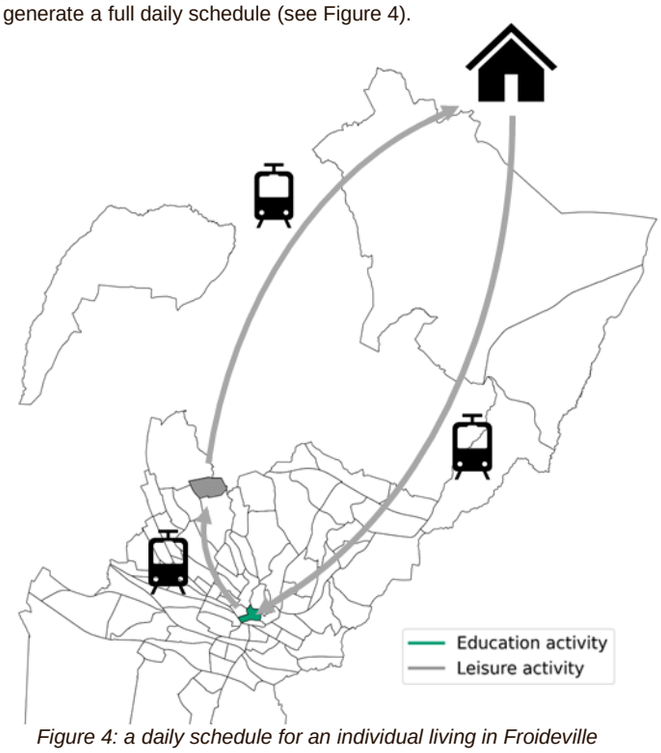


*Figure 4: a daily schedule for an individual living in Froideville*

## Conclusions and further work

The case study allowed to demonstrate the use of the methodology to obtain a choice set and assessed the ability to include unlikely alternatives in the choice set through transformations and addition of a random term. The random term seem to be more efficient and to lead to equivalently worse results than simple transformations in this case. We would expect it to be different with more alternatives, as adding a random term means recomputing all alternatives, while simple transformations only require an initial choice set. Daily schedules were generated, but a validation needs to be performed. In addition, further work would be conducted on the scaling of the utility parameters for the use of simulation, and on improvements of the utility specification.