Dat.mobility

VACANCY INTERNSHIP PROJECT

We are looking for students interested in carrying out their internship or master thesis project at DAT.Mobility

Estimating discrete distribution functions for gravity models

Problem description

The gravity model (Wilson, 1969) may be used as a tool for both fusion of observed data on mode- and destination choices as well as modelling mode and destination choice behavior using the approach described in (Brederode et al., 2019). In this approach, the parameters in the distribution function within the gravity model are calibrated to a fused set of demand matrices. A suitable calibration method to estimate continuous distribution functions from trip length frequency distributions derived from survey data is described in (Pots, 2018); usually a log-normal type function is used. The thesis by (van Genderen et al., 2020) shows a methodologically more tractable approach that directly solves the entropy maximization problem from which the gravity model stems using sequential quadratic programming. The latter approach requires observed travel time budgets to be derived from survey data.

Decision making by travelers with respect to mode- and destination choices is a complex process. The extent to which a single continuous distribution function can describe this process is limited. This means that it can be used as a distribution function for homogenous trip purposes and modes (e.g. figure below left), but for more heterogenous purposes and modes (e.g. figure below right) it may not provide enough flexibility.

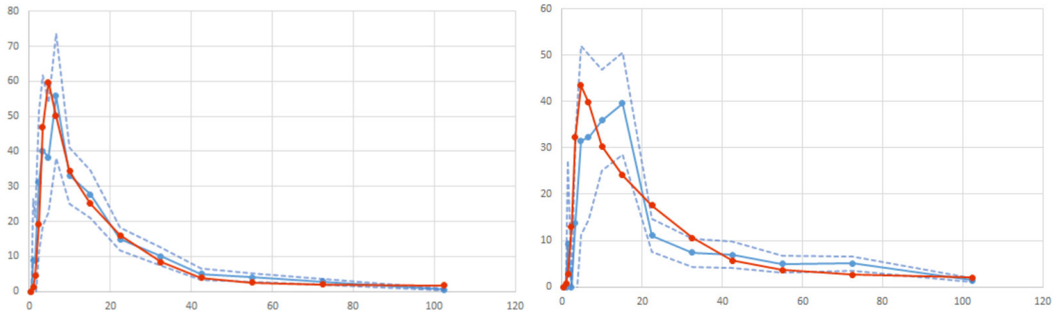

Figure 1: Comparison of observed (blue line with blue dotted confidence intervals) and modelled (red line) trip length distributions using a continuous distribution function. Left: better fitting, homogenous trip purpose/mode; Right: worse fitting, more heterogenous trip purpose/mode.

Master thesis assignment

The goal of this research is to give the gravity model more freedom to replicate the behavior captured in the fused demand matrices by allowing more complex distribution functions. It is known that a gravity model can be applied using discrete distribution functions and/or using multiple (spatially differentiated) distribution functions which would both contribute to the level of freedom for the gravity model. However, the parameter calibration method described in (Pots, 2018) does not facilitate such set-ups as it assumes a single parameter to be estimated per distribution function and a single distribution function per trip purpose/mode combination. The sequential quadratic programming approach from (van Genderen et al., 2020) does allow for such set-ups, but it requires derivation of travel time budgets from survey data and is known to suffer from limited scalability.

The student is asked to develop a parameter estimation method for gravity models describing heterogenous trip purposes and modes that are poorly captured by a single continuous distribution function. This may be done by extending or improving methods from (Pots, 2018) or (van Genderen et al., 2020), but an alternative or hybrid approach may also be considered.

Research group

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Literature

Brederode, L., Pots, M., Fransen, R., Brethouwer, J.-T., 2019. Big Data fusion and parametrization for strategic transport demand models. Presented at the 6th International Conference on Models and Technologies for Intelligent Transportation Systems, Krakow, Poland.

Pots, M., 2018. Automatic parameter calibration of the gravity model for large scale strategic traffic models. Twente, Deventer.

van Genderen, T., Brederode, L., Skopalik, A., Walter, M., Uetz, M., 2020. Solving the trip based transport model using iterative optimization algorithms. University of Twente, Enschede.

Wilson, A.G., 1969. The Use of entropy maximising models in the theory of trip distribution, modal split and route split. J. Transp. Econ. Policy 111, 108–126.