Optimisation-based ActBM

Janody Pougala · Tim Hillel · Michel Bierlaire

Workshop IVT – TRANSP-OR, April 2022

Outline

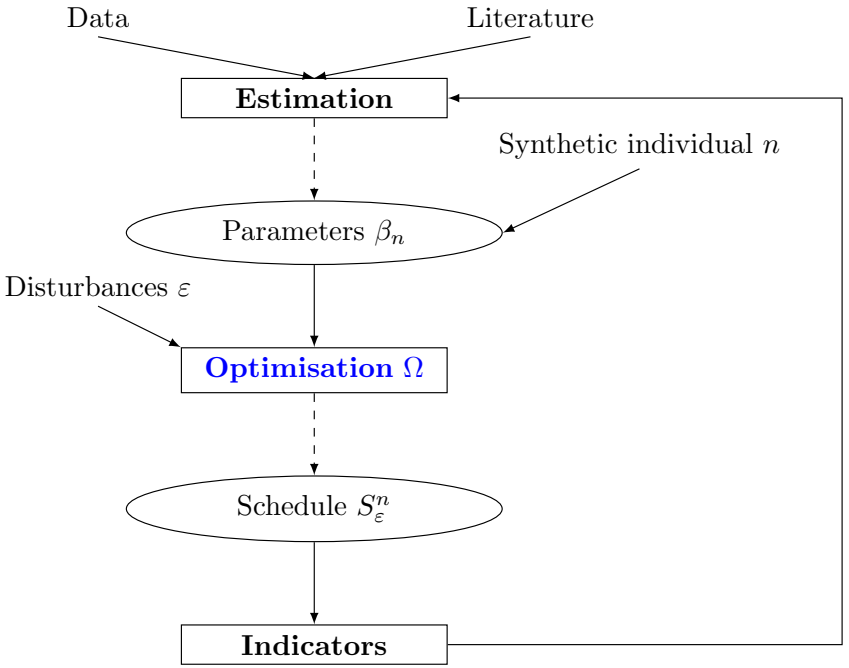
- Framework
- State of research
- Current investigations
- Applications
- Further work, ideas…

Framework

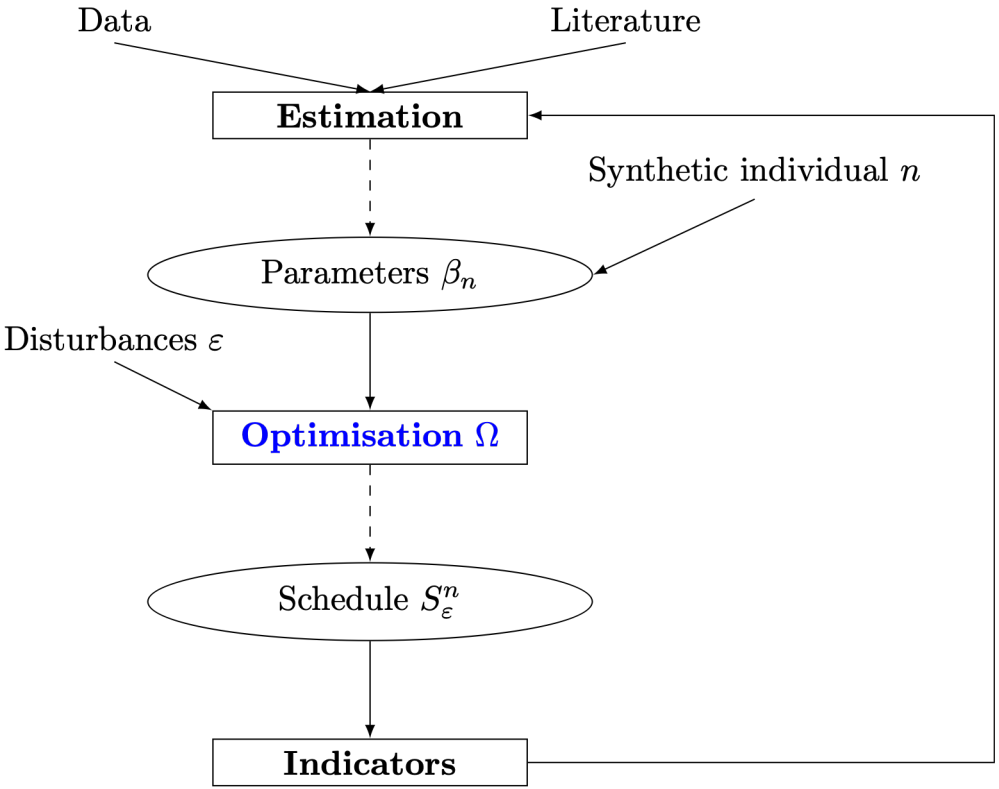
- Optimisation-based simulation framework for activity-based models

- Joint estimation
  - Activity participation
  - Activity scheduling
  - Mode choice
  - Location choice

- Three modelling elements:
  1. Schedule simulation
  2. Choice set generation
  3. Parameter estimation

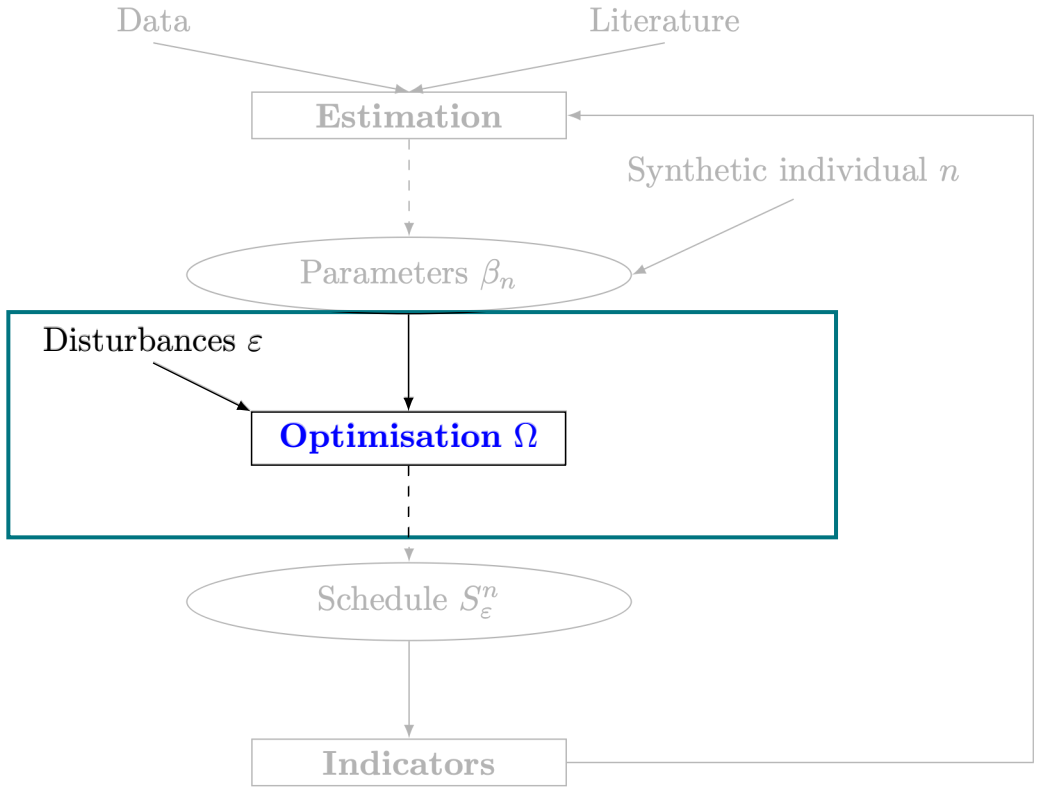


State of research



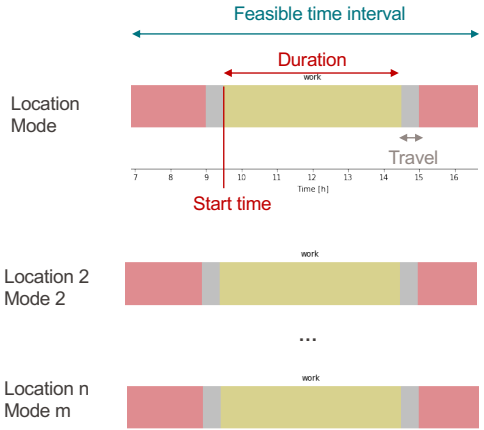
State of research

Simulation framework

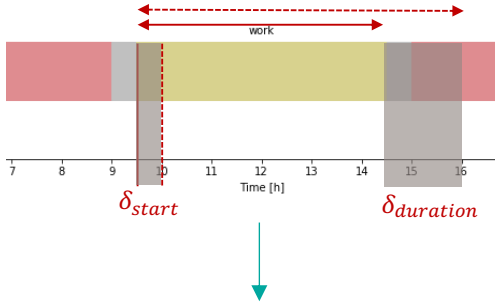


State of research

Simulation framework



From an activity...



$$U_i(x_i, \tau_i, \delta_{xin}, \delta_{\tau in}, t_i, \omega_{in})$$

...to a utility function...

$$\Omega_n = \max \sum_i w_{in} U_{in}$$

... to a maximisation problem

State of research

- **Simulation framework**
  - Successfully implemented in practice (Innosuisse project with SBB)
  - Publication available

ELSEVIER

Journal of Choice Modelling
Volume 43, June 2022, 100354

Capturing trade-offs between daily scheduling choices

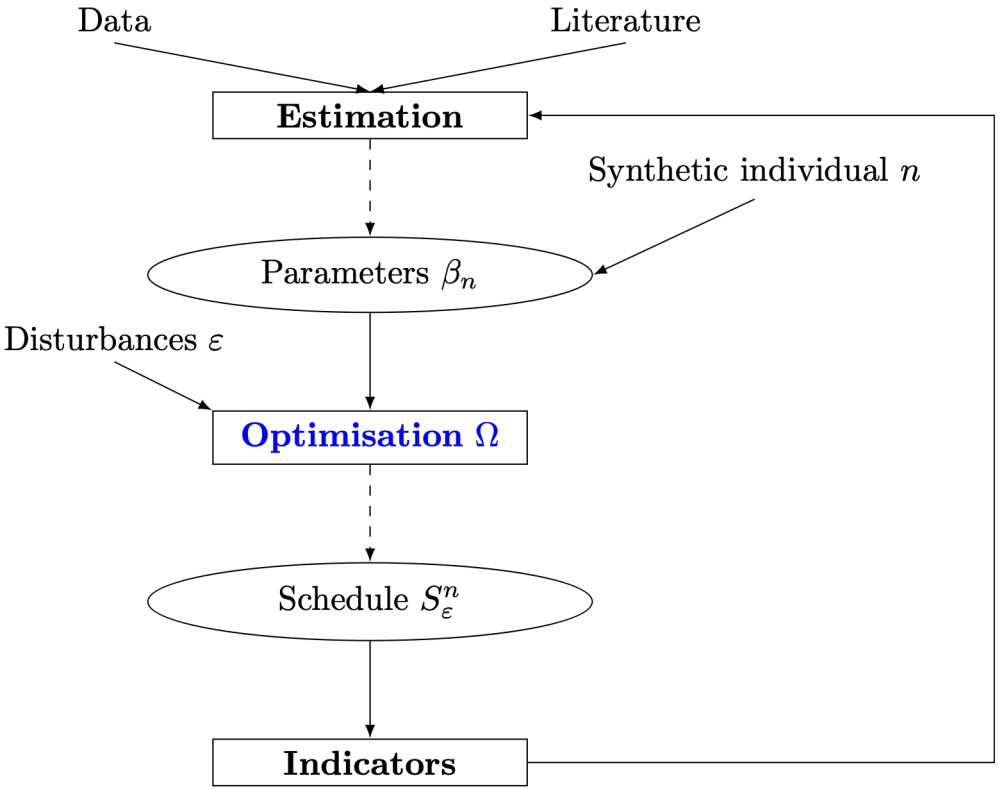
Janody Pougala [a], Tim Hillel [b], Michel Bierlaire [a]

Show more

Share Cite

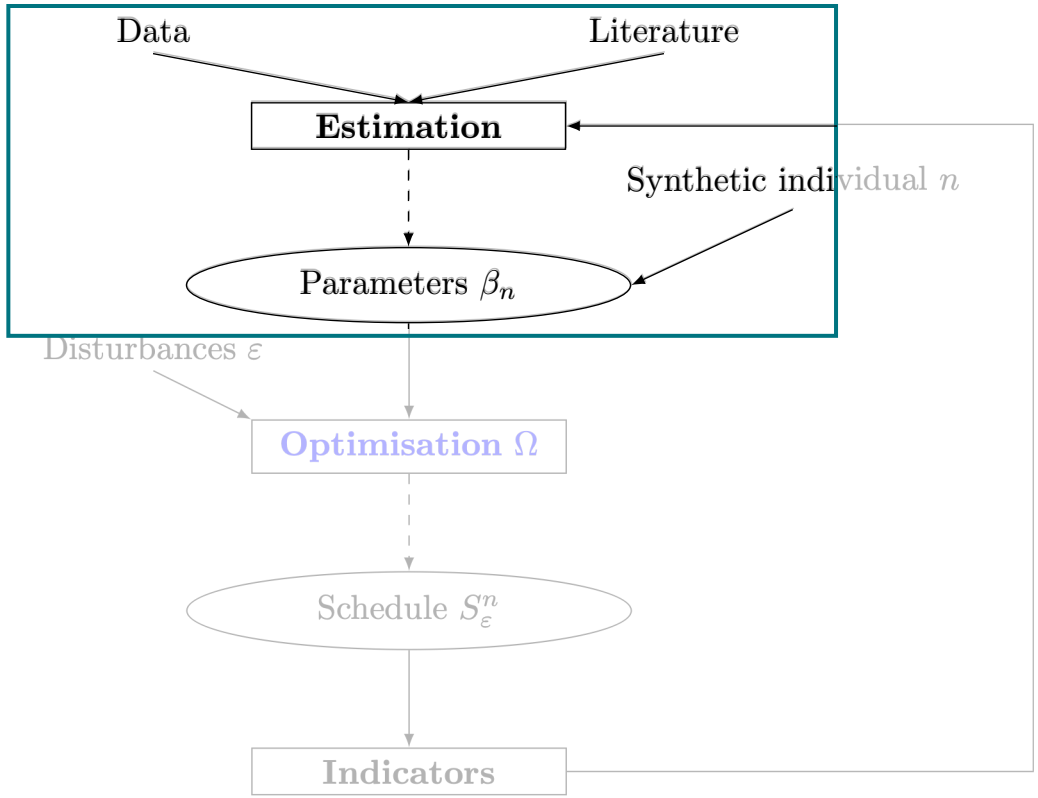
https://doi.org/10.1016/j.jocm.2022.100354

State of research



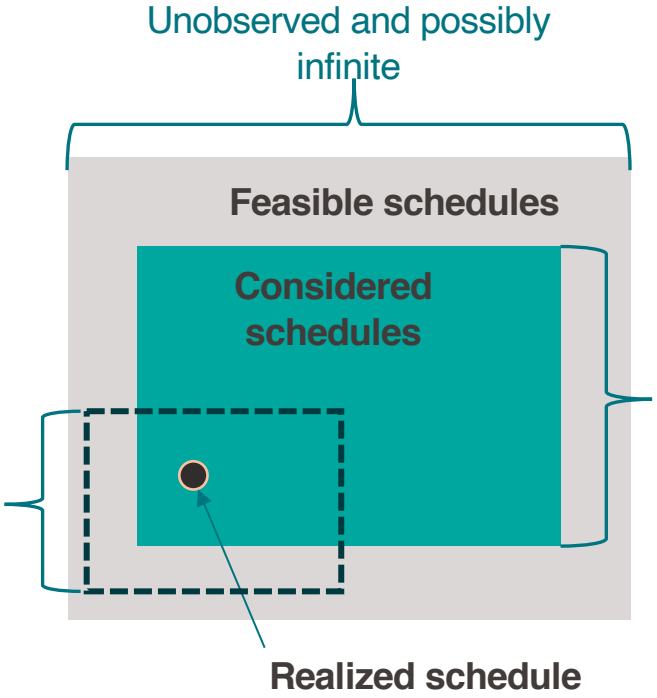
State of research

Parameter estimation



State of research

- Choice set generation



Estimation choice set: sample of feasible schedules generated for estimation purposes

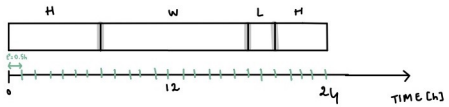
Actual choice set: Unobserved

Based on Shocker (1991)

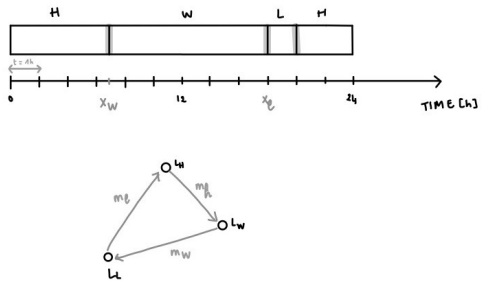
State of research

- **Choice set generation**
  - Metropolis-Hastings sampling of feasible schedules
  - STRC 2021

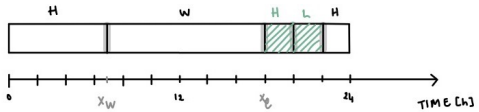
Block



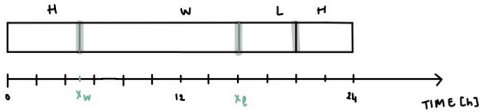
Initial state



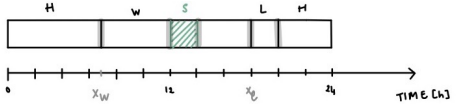
Swap



Inflate/Deflate



Assign



State of research

Parameter estimation

- Calibration of DCMs using Biogeme and sampled choice sets
- Case study: Lausanne population in MZMV 2015
- Estimating:
  - Activity specific constants
  - Penalties for schedule deviation
  - Desired times*

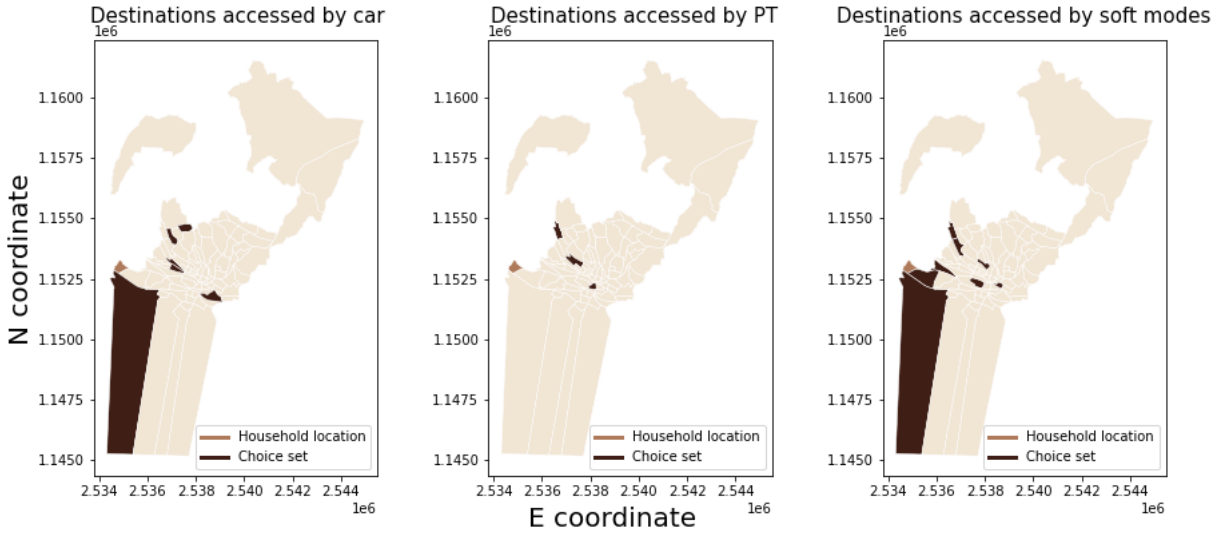
- **STRC 2022**

Current investigations

- **Simulation framework**
  - Formulation of the problem using Constraint Programming
  - So far 2.5x faster than MILP
  - Fully open-source (Google OR-Tools instead of CPLEX)

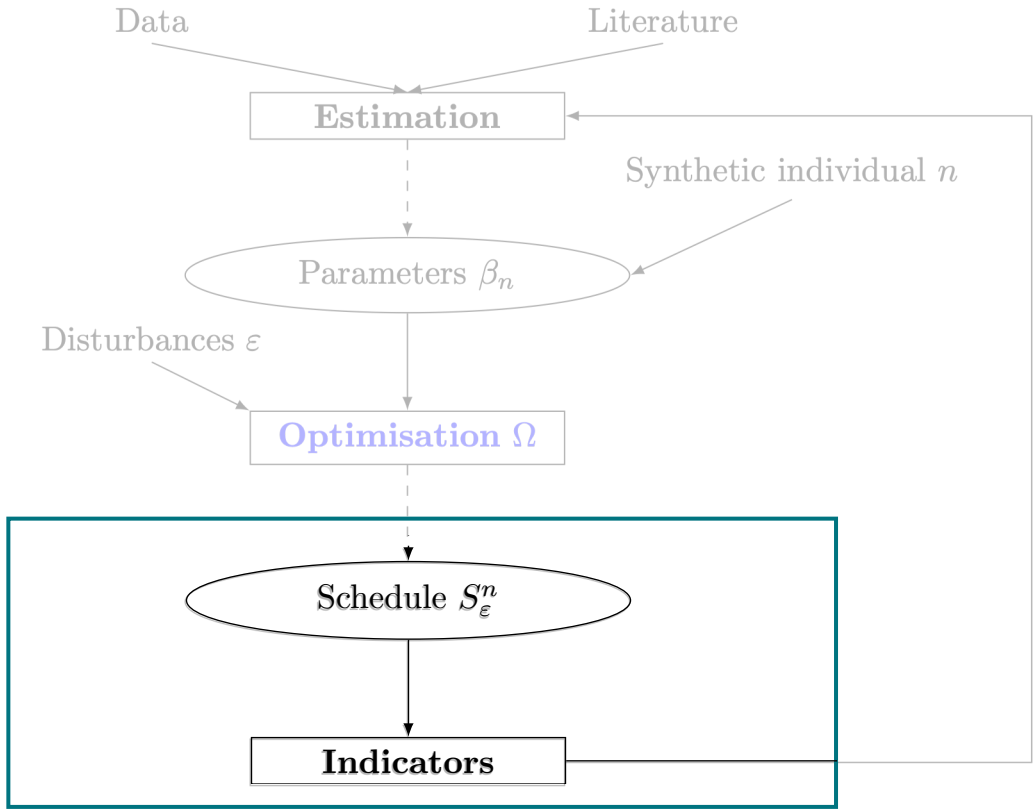
Current investigations

- **Choice set generation**
  - Generation of choice sets for location and mode
  - **ICMC 2022:**
    - N. Salvadé, “Representing mode and location choice within activity-based models”



Salvadé (2022)

Applications



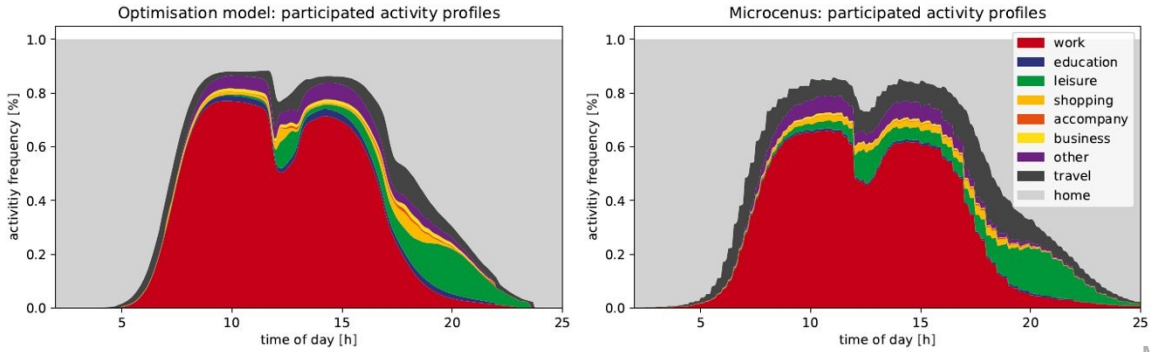
Applications

- **OPTIMS (OPT**imisation of **I**ndividual **M**obility **S**chedules**)**
  - Sept 2020 – March 2022
  - Integration of optimisation model into SIMBA MOBi (SBB's forecasting framework)

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Innosuisse – Schweizerische Agentur für Innovationsförderung

SBB CFF FFS



Manser et al (2021)

TRANSP-OR

Applications

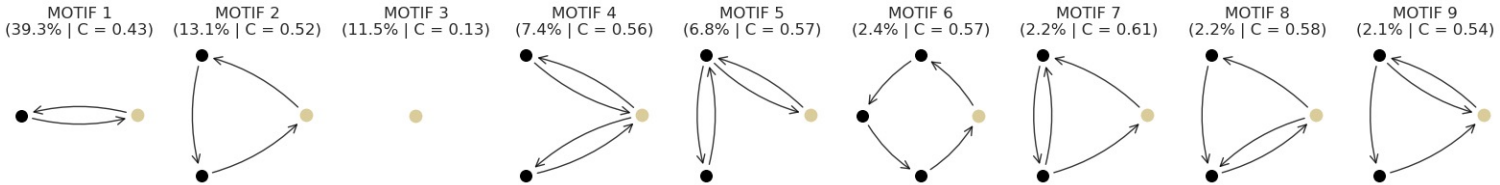
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Innosuisse – Schweizerische Agentur für Innovationsförderung

SBB CFF FFS

What's next?

- **Other applications**
  - Sociological applications (e.g. mobility motifs)
  - Shared mobility
  - Energy demand
  - …



Schultheiss (2021)

- **Output**
  - Open-source code for the simulator to be released

Thank you!

janody.pougala@epfl.ch
tim.hillel@ucl.co.uk
michel.bierlaire@epfl.ch

References

- Manser P., Haering T., Hillel T., Pougala J., Krueger R., Bierlaire M. (2021). Resolving temporal scheduling conflicts in activity-based modelling. Report TRANSP-OR 211209
- Pougala J., Hillel T., Bierlaire M. (2022). Capturing trade-offs between daily scheduling choices. Journal of Choice Modelling 43 (100354)
- Pougala J., Hillel T., Bierlaire M. (2021) *Choice set generation for activity-based models*. Proceedings of the 21st Swiss Transport Research Conference (STRC), 12-14 September, Ascona, Switzerland
- Pougala J., Hillel T., Bierlaire M. (2022) *Parameter estimation for activity-based models*. Proceedings of the 22nd Swiss Transport Research Conference (STRC), 18-20 May, Ascona, Switzerland (forthcoming).
- Salvadé N., Hillel T., Pougala J., Haering T., Bierlaire M. (2022) *Representing location choice within activity-based models*. Proceedings of the 22nd Swiss Transport Research Conference (STRC), 18-20 May, Ascona, Switzerland (forthcoming).
- Schultheiss M., Spatial familiarity and mobility motifs, Bridging Transportation Researchers, August 2021