# On the use of a randomized bayesian network (RBN) model of time use and activity engagement for understanding latent behavioral mobility patterns

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# Research objectives

- Time use and activity engagement modeling
- Latent behavioral patterns identification

# Use of BN depends on known/unknown structure and complete/incomplete data

|                 | Known structure                | Unknown structure              |
| --------------- | ------------------------------ | ------------------------------ |
| Complete data   | Statistical parametric estimation | Discrete optimization over structures |
| Incomplete data | Parametric optimization        | Combined methods               |

Table 1: Learning problems categorization
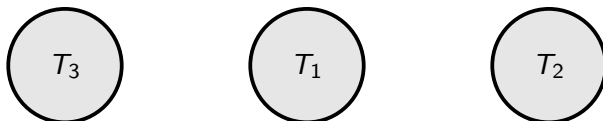
# Randomized bayesian network (RBN)
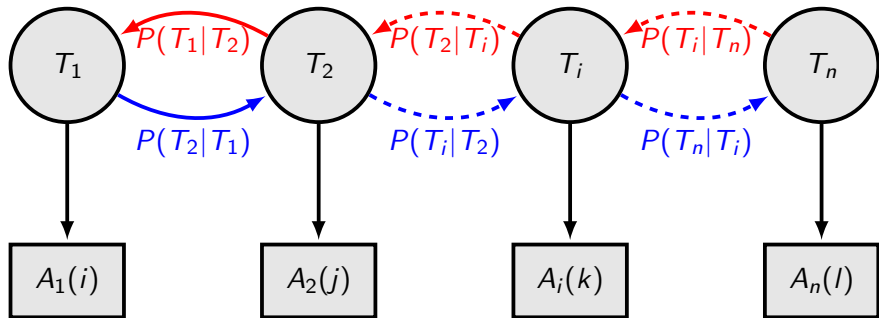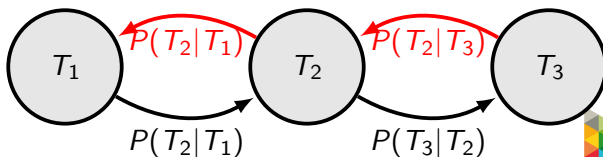


Figure 1: Structure of the bayesian network with time spans

# Randomization
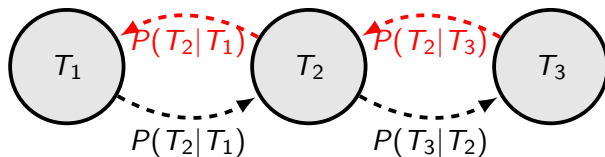


(a) Original temporal layout with prior knowledge

(b) Randomization and causal relationships breaking

(c) Patterns identification

# Model selection

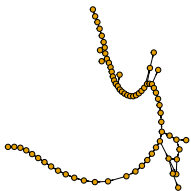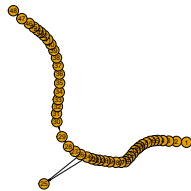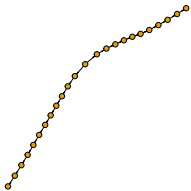$$\Theta^* = \underset{\Theta}{\textbf{argmax}} \log \mathcal{L}(D; \Theta)$$

$$BIC = \log \mathcal{L} - \frac{d}{2} \times \log(m)$$

$$AIC = \log \mathcal{L} - d$$

# Empirical analysis

- Household Travel Survey (BELDAM) conducted in 2010
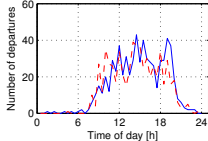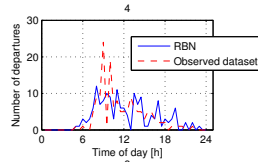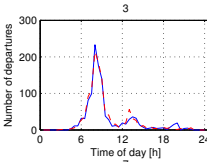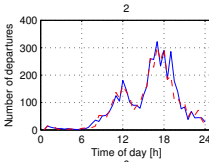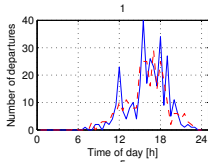- Variables: trip purpose, trip start/end times, mode, OD at commune level + socio-demographics
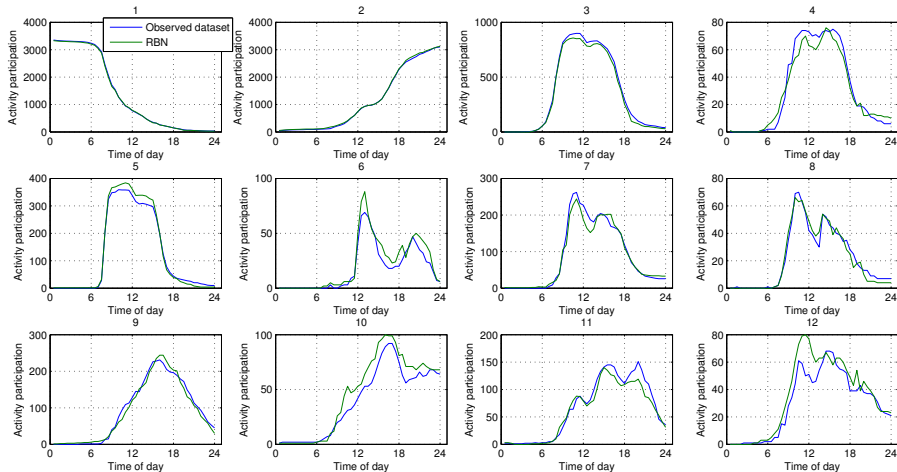
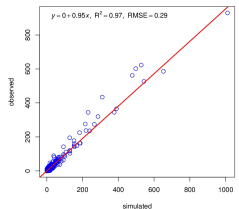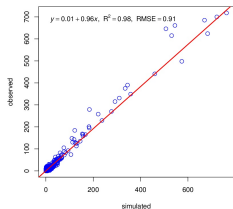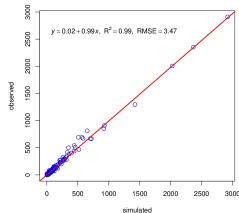# BN structures for different temporal resolutions

# Model validation
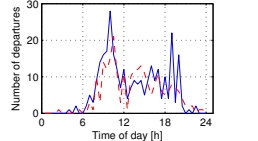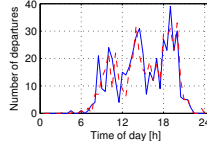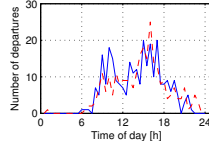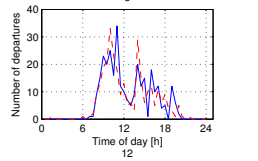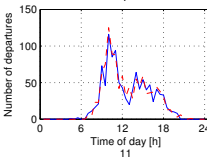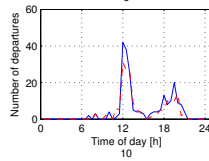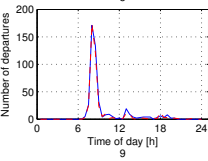
# Model validation

# Comparison between simulated and observed multi-variate joint distributions (based on activity engagement and activity time-slots)
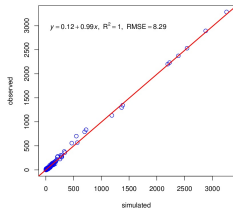
# Further research

- Why is the complexity of the BN topological structure increasing with temporal resolution ?
- Interpretation of the BN structures
- Considering RBN in the absence of complete data
- Incorporating the influence of individual attributes on the activity-travel patterns

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- Related research:
  Saadi et al., 2018, An efficient hierarchical model for
  multi-source information fusion, in *Expert Systems With
  Applications*
  Saadi et al., 2016, Forecasting travel behavior using Markov
  Chains-based approaches, in *Transportation Research Part C:
  Emerging Technologies*
  Saadi et al., 2016, Hidden Markov Model-based population
  synthesis, in *Transportation Research Part B: Methodological*