# On Regularized Continuous and Discrete Time Structural Equation Models

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There is an increasing use of regularization methods in structural equation modeling. Regularization methods can improve the predictive performance as compared to maximum likelihood estimates, while also removing unnecessary parameters. A promising use case are the recently proposed continuous time network models (Ryan & Hamaker, 2021). They capture dynamical processes by means of continuous time structural equation modeling which allows for refined centrality measures and irregularly sampled data. However, the resulting models can have dozens of parameters, are therefore difficult to interpret and tend to overfit in small samples. We show that combining regularization techniques with continuous time network models can provide a remedy, resulting in better predictive performance and improved sparsity in both, time series data (N = 1) and panel data (N > 1) (Orzek & Voelkle, in press). We demonstrate how to implemented the method in the R package regCtsem and the more flexible lessSEM package that allows for user-defined parameter transformations. To highlight the versatility of lessSEM, we additionally show an approximate measurement invariance procedure inspired by Bayesian cross-lagged panel models (e.g., Liang, Yang, & Huang, 2018). Here, regularization can be used to capture sudden changes in parameter estimates indicating, for instance, a regime switch.

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