A Small Step from Ministeps to Twosteps: Alternatives for RSiena’s Ministep Assumption

Abstract

Introduction

The stochastic actor-oriented model (SAOM) as implemented in RSiena (refs) is widely used to analyse the co-evolution of networks and behavior. The SAOM models the (unobserved) changes that took place in the same complete network between two or more discretely observed time points via simulating a sequence of so-called *mini-steps*. During a ministep *one* actor is allowed to create or terminate *one* outgoing tie or to change its behavior. The consequence of this tie- or behavioural-change for this actor is evaluated at *one* time-point; the immediate future. It has brought the social network analysis community tremendous success in, for example, disentangling selection and influence processes and in identifying crucial network statistics (e.g., transitivity) that drive network dynamics.

While ministeps are the smallest possible changes than *can* occur, this is not to say that during the real Data-Generating Process only ministeps are taken. It is likely that sometimes changes will occur simultaneously and not sequentially (e.g. actor A and B decide whether or not to help someone else at the same time), or that actors coordinate their changes (e.g. I will help her if you will help him) or that an actor makes more than one change at the same time (e.g. I will help the two of you).

For data where

Both models have been

widely used to analyze networks in the social sciences and in particular

to study coordination networks (e.g., Ferligoj et al. 2015; Hollway and

Koskinen 2016; Manger, Pickup, and Snijders 2012; Milewicz et al.

forthcoming).

These changes are assumed to occur sequentially – and thus not simultaneously -

a simulation process meant to mimic the evolution

of the network between discretely observed time periods

to evaluate the robustness of their results,

the appropriateness

of the respective model-related assumptions ca

edges can be established sequentially or simultaneously in the DGP

However, as all theoretical and statistical models, it needs assumptions. A crucial assumption of the SAOM of RSiena is that of the so-called ministeps, in which only *one* actor at the time is allowed to create or terminate *one* outgoing tie. The consequence of this tie-change for this actor is furthermore only evaluated at *one* time-point; the immediate future. Although the developers of RSiena state not to be committed to a specific theory of action, the ministep seems to exclude coordination processes in which two actors decide on one or more tie-changes together or strategic actions by which a tie-change of one actor may only turn out to be beneficial after one or more additional tie-changes of this (or another) actor. Some call the ministep assumption a theory, others just a simplification of reality. More importantly is the extent to which the results obtained by RSiena under the ministep assumption are robust to violations of this assumption. That is, when the real data-generation process did not follow the logic of the ministep.

We commonly estimate a linear regression model even when model assumptions (e.g., normality of error term, homoskedasticity, no-multicollinearity, no-endogeneity) do not hold, because we expect this won’t impact interference. Hopefully, RSiena is similarly robust and able to identify and estimate relevant networks statistics unbiasedly and efficiently when the ministep assumption is violated.

We introduce the R package RsienaTwoStep (<https://jochemtolsma.github.io/RsienaTwoStep/>) which in its current version can be used as tool to assess the robustness of model estimates of Rsiena::siena07() under violations of the ministep assumption. In RsienaTwoStep the transition of the network from one wave to the next can be simulated according to different (combinations of) ‘theories of action’. As input it requires the current network, relevant network statistics with corresponding parameters (e.g. as estimated with RSiena). RsienaTwoStep can simulate networks according to the ministep assumption of RSiena, and by relaxing the ministep assumption by allowing for ‘twosteps’ and ‘simsteps’. With twosteps we allow two actors to make one tie-change each simultaneously and to coordinate their tie-change(s). With simsteps we allow one actor to make two tie-changes simultaneously and hence incorporate some form of strategic action.

We will present a simulation study and an empirical application of RsienaTwoStep. We demonstrate that networks simulated given the ministep, twostep and simstep assumptions can, but not always, lead to networks with different properties and that these differences are hard to predict a priori. Unfortunately, RSiena is not always able to correctly identify and estimate network statistics if networks evolved according to twostep or simstep processes. For our empirical application we use results as reported in recent published articles. We show the reported results seem to be sensitive to violations of the ministep assumption.

We intend to further develop the RsienaTwoStep package so that it can also be used to estimate network statistic parameters given different (combinations of) theories of action, and inform us which (combination of) theories of action is most likely responsible for the observed network evolution.