Not All Social Networks Evolve as Coherent Wholes: Some Computational and Modeling Issues for Fitting Blockmodels

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Abstract

Evolution of social networks has become a hot topic and this discussion starts from the six principles suggested by Stockman and Doreian (1997) for studying network evolution: (1) Networks have an instrumental character with network members having goals, some of which are achieved through network decisions; (2) actors, at least in part, act on local information (which may or may not be accurate); (3) there is parallelism; (4) models should be kept simple (at least initially); (5) models should have sufficient empirical referents; and (6) there is a need to test (the goodness of fit of) models. Some of these principles are more useful than others. The argument developed here is that discussions implicitly or explicitly assuming that networks evolve as coherent wholes may be too restrictive. The argument proceeds through a series of examples that lead to the conclusions that the there may be multiple processes operating and that parts (fragments) of networks may evolve separately. Coupling these fragments into a coherent statement of change will not be easy.

The first arena (for examples) concerns structural balance theory where three aspects of computation are considered. One is the attempt of Doreian and Mrvar (1996) to fit models of signed networks that are founded in balance theory. The second is the analysis of Doreian and Krackhardt (2000) to examine the changes through time of a specific signed temporal network. The third is the simulation study of Hummon and Doreian (2000) where multi-thread agent-based models and discrete event simulation models were used to model the evolution of signed networks as a two-level process. One level considers the intra-actor cognitive images of the signed network while the second involves the group level signed structure. The three studies point to the conclusions that (1) multiple processes may be operative; (2) locating the outcome a specific empirical study of signed relations within the large set of possible instantiations of structural balance process will be difficult and (3) different parts of the network structure may evolve differently.

The second arena for an example is that of ranked clusters models for stratified sociometric structures. Data from a study of trust relations in a workplace setting at three time points us used. At the first time point, the structure is characterized as a pair of parallel ranked clusters systems linked at the 'bottom'. A key actor at the top of one subsystem is removed prior to time two. One of the ranked clusters systems collapsed

partially while the second changed slightly. The removed actor was returned to the system prior to time three. Each of the systems of ranked clusters changed but in different ways. The simple conclusion is that the two ranked-clusters systems changed in ways that do not reflect the operation of a single network process.

The third arena is a specific blockmodeling approach to the study of grooming relations among a troop of baboons. At one point in time, there is a set of baboons with data on grooming. At a second point in time, two baboons were added to the troop, were accepted and observers recorded the new pattern of grooming ties. Viewed at the level of pairwise grooming relations between specific pairs of baboons, there were dramatic changes in the distribution of grooming ties. However, using a specific type of generalized blockmodel, with a permutation of baboons across the positions of the blockmodel, reveals a picture with great stability.

A fourth arena is found in the study of inter-organizational networks for a set of social service organizations providing services to children and youth. While it is possible to view the network of ties as a single network linking the organizations, a more fruitful approach may be to model different sectors separately and then model the ways in which these subsystems are joined to form an overall set of network ties. This is illustrated with a set of agencies distributed across multiple service sectors with a view to examining institutionalization. Some sectors do reflect the operation of global institutional patterns but others do not. It appears that the are local institutional processes operating in addition to global processes.

The final arena is the generation through time of the social knowledge developed by a group of students in a class. The accumulation of change is dramatic and the explanatory task is to use actor attributes and network structures to account for either (1) the extant distribution of ties at each point of time or (2) the new knowledge that has been developed at each (new) point in time. Viewed at the level of the pattern of ties, this is a daunting task. One of the common themes through the four previous arenas is the idea that networks have been expressed in the form of a blockmodel. In the main, this was driven by substance. The task for the social knowledge data is to formulate plausible blockmodels and fit them.

The broad conclusions of the argument developed here and illustrated with a variety of examples are: (1) studying changes in the distribution of social ties is better served with some reasonably developed (block)model; (2) more than a single process can operate for a social group and their relational ties; (3) different parts of a sociometric structure may evolve or change separately and (4) creating models with multiple processes and separate fragments of structure changing separately into a coherent model of change will be difficult – especially for empirical studies.