Generalized blockmodeling (Structural Analysis in the Social Sciences)
Doreian P., Batagelj V., Ferligoj A., Granovetter M., Cambridge University Press, New York, NY, 2004. 402 pp. Type: Book

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Full Text

Comparative Review

One of the methods of social science that an engineer would be most comfortable calling "science" is social network analysis. This approach views social systems as graphs, in which the nodes are people or groups of people and the edges are relations. By abstracting social notions behind a mathematical structure, social network analysts can bring to bear a wide range of mathematical tools, supporting crisp definitions of concepts and quantitative metrics. These methods in turn invite the application of software tools to facilitate the exploration of social data.

These two books offer an accessible introduction to these methods and tools. They share two features: their coauthorship by social scientists (Ferligoj and Mrvar) and a computer scientist (Batagelj) from the University of Ljubljana, Slovenia, and their relation to Pajek, a computer program for social network analysis produced by the Slovenians. The lead author on each volume comes from another institution (de Nooy from Erasmus University in Rotterdam, and Doreian from the University of Pittsburgh), but the Slovenian core yields a coherence between the volumes that makes them strongly supportive of one another, in spite of strong differences in orientation.

De Nooy et al. (hereafter, de Nooy) has been reviewed previously in *Computing Reviews*. It offers a gentle, nonmathematical introduction to social networks in terms of four kinds of measurable phenomena. Cohesion characterizes groups of people who are strongly interconnected with each other. Brokerage identifies individuals who form bridges between cohesive groups that are otherwise not well connected with one another. Rank explores partial orders that can be defined over sets of people. Roles capture patterns of interconnection that different people share.

The concept of roles is introduced in terms of the blockmodel. It is often useful to visualize the interconnections among a set of people as a matrix, with one row and one column for each person and the cell indicating whether the people in the associated row and column are connected. If the rows and columns are sorted to bring together people with similar patterns of interconnections, the matrix can be replaced with one in which each row and column represents not a person, but a group of people in a specific role (a block). The resulting display can be much clearer than the more detailed person-by-person data.

De Nooy introduces blockmodels as they are commonly used in social network analysis, an exploratory tool relying on two alternative notions of equivalence among nodes. Nodes that are structurally equivalent must have the same patterns of connections to themselves, each other, and other nodes. Nodes that are regularly equivalent need only be connected to the same other classes (or blocks) of nodes.

Doreian et al. (hereafter, Doreian) develop the notion of a blockmodel in much greater detail. Their approach, which they call generalized blockmodeling, differs from the conventional approach in two ways. First, they greatly expand the library of equivalences beyond the structural and regular equivalences used in traditional blockmodeling. Second, they derive much more detailed metrics of how a body of data differs from a specified structure, thus enabling confirmatory as well as exploratory analyses.

Doreian's treatment differs from de Nooy's, in several ways. De Nooy focuses on

exploratory analysis. Doreian is concerned with laying the foundations for confirmatory analysis. De Nooy is intended for the novice in social network analysis. Underlying ideas are defined informally, with no mathematical notation. Doreian is a rigorously mathematical treatment that presumes a mathematically mature reader acquainted with the underlying social concepts. De Nooy offers step-by-step instructions on how to carry out the analyses described in the Pajek package. While Pajek supports generalized blockmodeling, Doreian and colleagues are content to state the fact, without guiding the reader through the process.

Doreian's 12 chapters fall into four broad sections.

Chapters 1 and 2 introduce social networks in general, blockmodels in particular, and a series of data sets that are used throughout the book to illustrate its techniques.

Chapters 3 through 8 develop the generalized blockmodeling concept within a rigorous mathematical framework. Chapters 3 and 4 are a synopsis of the underlying mathematical concepts, including set theory, relations, algebra, and graph theory. Chapter 5 surveys cluster analysis as a paradigm for grouping people into equivalence classes. It reviews both partitional and hierarchical clustering mechanisms, though the rest of the book uses mostly what the authors call the relocation algorithm, an incremental adjustment procedure for partitioning data. Upon this foundation, chapter 6 discusses conventional blockmodeling as an optimization problem. The fundamental insight is that data rarely exactly fits a model, and the degree of deviation can drive an optimization process (for example, relocation clustering) to improve the classification of the nodes in the network.

At this point, more than halfway through the book, fewer than five pages have been devoted to the generalizations advertised in the book's title. Chapters 7 and 8 turn to this generalization. Chapter 7 generalizes the notion of equivalence among nodes. Permitting a richer set of equivalences than structural and regular equivalence is a double-edged sword. On the one hand, it permits a much more flexible analysis, one more adaptive to the nuances of the data. On the other hand, it increases the danger of "garbage-in, garbage out," since some form of generalized equivalence can be defined for almost any data set. This observation forms the basis for the authors' repeated emphasis on prespecified blockmodels: the analyst should first outline block types based on substantive considerations in the domain being studied, and then test the fit of that model to the data, not just blindly search for block types that happen to fit the data. Up to this point, the examples analyzed have been based on one-mode data, in which all nodes are of the same semantic type. Chapter 8 shows how to handle two-mode data, in which the relations among people are defined by their relations to nodes of a distinct type.

Chapters 9 through 11 repeat the iteration of mathematics and blockmodeling. Chapter 9 introduces semirings and lattices. Chapter 10 uses semirings to extend blockmodeling to the signed data that underlie balance theory, a domain for which the classical notion of structural equivalence is inappropriate. Chapter 11 similarly applies lattice theory to analyzing ranks in data.

Chapter 12 anticipates ways in which the generalized framework outlined in the book can be extended, reemphasizing the distinctions between classical and generalized blockmodeling.

De Nooy offers a nonmathematical introduction to doing social science within a mathematical framework. Doreian fulfills this promise by filling in the mathematical details. Together, the two volumes provide a treatment of social network analysis that is at once accessible and rigorous. Newcomers will welcome de Nooy's tutorial approach, while experienced practitioners will be challenged by the methodological extensions that Doreian and his colleagues offer. These volumes promise to be of great value in both pedagogical and research settings for the next generation of social scientists.

Reviewer: H. Van Dyke Parunak Review #: CR132516

Comparative Review

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