Book Reviews: Networks

John Scott: *Network Analysis: A Handbook*. London, England, and Newbury Park, CA: Sage Publications, 1992.

Stanley Wasserman and Katherine Faust: *Social Network Analysis: Methods and Applications*. Cambridge, England and New York: Cambridge University Press, 1994.

For the person interested in increasing his or her familiarity with social network methodology, there have been, until recently, few summary texts.[1] One exception for the student beginner has been *Network Analysis* by Knoke & Kuklinski (Sage, 1982) which remains a solid and easily read review of the conceptual foundations, study design concerns, and basic methods and concepts in network analytic methods. However, for anything more than a quick survey of methods, the reader must pursue other avenues.

Recently two works have sought to fill this gap in different ways. *Social Network Analysis: A Handbook* by John Scott (1992) provides a basic user's guide to network analytic methods. Targeted at the novice user, the book avoids complicated mathematics and difficult subjects but provides a conceptual coverage of network analysis that is more complete and up-to-date than the Knoke & Kuklinski work. *Social Network Analysis: Methods and Applications* by Wasserman & Faust (1994)[2] is intended

to be a user's guide of a different sort: a desk reference. A comprehensive overview of network analytic methods, this first encyclopedic work on network methodology is both a valuable text and a much-needed reference for social science network researchers.

Most social network novices will prefer the Scott handbook, which avoids all but the simplest mathematics and notation in favor of easy-to-understand textual explanation, examples, and illustrations. Using examples from a variety of sociological topics, including kinship, community structure, corporate interlocks, and elite power studies, Scott's text gives even the lay reader an essential conceptual foundation of the principles, history, measures and study designs involved in basic social network analysis. Scott does this in less than a quarter of the length of the Wasserman & Faust text.

One of the strengths of the Scott book is that, after an introductory chapter, the reader is engaged directly in a history of network analysis. Here Scott focuses on classic sociology; the sociometric work of Moreno, Heider, and Lewin; Warner and Mayo; Homans; various structural-functional anthropologists of the Manchester school; and finally Granovetter and other researchers associated with Harrison White. Although this is an extremely abridged history, Scott writes it around conceptual foci associated with particular researchers, so that it provides not only a general context for network analysis but an excellent introduction to basic terms (e.g., clique, matrix, multiplexity, density, reachability and reciprocity) and notation in a way that approximates the historical trajectory of the field.

The third chapter familiarizes the reader with matrix notation of relational data. Frequent diagrams and clear examples illustrate incidence and adjacency matrices, symmetry, reciprocity, and the significance of diagonal cells. Scott also considers, at a

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[1] There have been some edited collections of network methods and other collections of research applications, but virtually no general texts.

[2] At the time of this review the expected publication date for Wasserman & Faust was 21st October, 1994. This review is based on the advance uncorrected proofs provided by the publisher, which contained small errors, particularly in the figures and tables. The editor assures me that these will be corrected prior to publication.

simple level, design concerns such as the boundary problem and difficulties involved with network sampling.

The remaining chapters each provide a conceptual foundation for a different set of network concepts, typically followed by one or more examples summarizing empirical works which illustrate the concepts. The first of these chapters focuses on graph theoretic concepts (e.g., degree, density, points, lines). This chapter provides the basic toolbox of network concepts upon which subsequent chapters build. Chapter Five discusses measures of (point) centrality and centralization or graph centrality (see below). Scott covers a variety of centrality measures based on degree, distance, and path betweenness.

Chapters Six and Seven each address methods of analyzing subgroups within a network. Chapter Six focuses on cohesive subgroups, those characterized by relatively dense intra-connection, providing descriptions of components, isolates, cliques, and related concepts. Chapter Seven provides a conceptual foundation for positional analyses, which simplify a network by equating equivalent or similar actors. This similarity is quantified by one of several equivalence measures, including structural equivalence, a measure of the extent to which two actors have identical relationships with other actors in the network. With real-life data, perfect structural equivalences are rare, so relaxed criteria of equivalence are used, often as part of a clustering algorithm which seeks to group actors who are most similar. Blockmodels, images of the relations between these groups or positions, are frequently used to simply the description of a network. In the final chapter, Scott discusses representations of network data, introducing multi-dimensional scaling and principal components analysis as other ways to represent and simplify complex social network data.

A special feature of Scott's book is an appendix which reviews three common computer software applications for analyzing network data: GRADAP, STRUCTURE, and UCINET. Since most network analyses involve intense computation, the novice network analyst is well advised to work with one of these programs. The latter two are given frequent mention throughout the book in reference to various procedures. Unfortunately this appendix is slightly dated: more recent versions of the programs have since been released.

Social Network Analysis: A Handbook does an excellent job of introducing the basics of network analysis. The writing is clear and easy-to-read, yet packed with a great deal of information. Occasionally one wishes the author had included a small, application-oriented example for a particular concept, but the large examples at the end of each chapter are more than sufficient for illustrating concepts in application. The book is organized in a sensible way and segues between topics with natural ease. I find no real weakness in the book only the limitation that it is intended as an introductory survey for readers who have little familiarity with social network methodology. Mathematical formulae, which could strengthen some topics at a marginal cost in readability, are generally not provided. Difficult or unusual concepts and procedures are not included. No topics are covered in exhaustive detail. Readers already familiar with network methods, as well as many who complete this book, will want something more substantial.

Those who do, may find Wasserman & Faust's *Social Network Analysis: Methods and Applications* closer to what they had in mind. Where Scott provides a broad foundational survey, Wasserman & Faust intend their work to be a comprehensive 'review of network analysis methods, a reference work for researchers interested in analyzing relational data, and a text for novice social networkers looking for an overview of the field' (p. xxix). Indeed, with well over 900 references in a bibliography that reads like a *Who's Who* of network analysis, their book covers an enormous amount of network methodology.

Appropriately, Wasserman & Faust's introductory chapter is a brief exposition of the social network perspective: a conceptual view and set of assumptions that network methods presuppose. The authors provide a historical context for social network methodology and give examples of the diverse topics to which a network per-

spective has been applied. The reader will likely find this initial history less fulfilling than that provided by Scott, but this book adopts a different strategy, that of embedding relevant historical commentary throughout the book. This segments historical portions of the book, but allows the authors to provide a far more detailed history: one more useful for referencing particular topics. This chapter also reviews a skeletal selection of fundamental network concepts, then diagrams – literally – the organization of the book.

The first four chapters are essential background for each of the later chapters, which are grouped by broad similarity of subject. The second chapter describes network data. It talks very briefly about such study design considerations as population definition, boundary specification, and sampling, then considers free- versus fixed-choice data and compares data collection techniques. The third chapter introduces three different notations used in the indication of network data: graph theoretic, sociometric, and algebraic. In the process, it also introduces graphs and sociomatrices that are fully explained later. These chapters are organized in a curious way. A naive reader might have been better served had Chapter Three been combined with a good conceptual introduction (some of which is in Chapter Two, but much of which is reserved for Chapter Four) and placed prior to concerns of study design. In fact, the study design portions of Chapter Two might have served all readers better if they had been elaborated upon and placed in a subsequent chapter. The current ordering seems less than ideal.

Chapter Four, written by Dawn Iacobucci, is the final chapter in the introductory section. It restates some material from Chapter Three, but is much more substantive and well-written than the previous chapters. The writing flows well, and explains concepts as they are introduced. This chapter begins with a guided tour through a graph representation of a network, detailing virtually every elementary network concept and measure from reflexive ties to network density, distance, and diameter; it then reviews comparable measures for both directed and valued graphs, including how these measures can be computed using matrices. This single chapter covers much of the material one would expect in an introductory text, with solid examples, great breadth and depth, and easy readability.

Chapters Five to Twelve each address the application of different sets of non-statistical network measures. Each of these chapters is strong, covering an extensive amount of material in a clear and thorough manner. These substantive reviews are, along with the foundation provided in Chapter Four, the heart of the book.

One of the oldest social network suppositions is that power, importance, or prominence within a social network is a function of structural location. Measures of centrality, each based on a different attribute of network position, attempt to capture this relative importance. Similarly, the overall structure of a network determines the extent and intensity of differences in importance among actors. Thus for any given point centrality measure, a summary measure, known as graph centrality or centralization, can be calculated. In Chapter Five, Wasserman & Faust provide a good review of centrality and prestige measures, illustrated nicely with data from a study by Padgett & Ansell on intermarriage among prominent fifteenth-century Florentine families, as well as data on international trade.

Chapter Six focuses on the concept of structural balance, which posits that two actors with a positive affective relationship should have similar relations to other actors. Structural balance, the authors explain, led researchers to begin partitioning networks into clusters and to study transitivity of relations. The following chapter, focusing on cohesive subgroups of all kinds, provides a more detailed and rigorous consideration than does Scott's book, except on the topics of multi-dimensional scaling and factor analysis. These topics, having more general application outside network analysis, receive cursory attention at the end of the chapter. Chapter Eight turns attention to the special properties and potential of affiliational networks (e.g., group membership data) in which groups

are connected by common actors and actors are connected in shared groups.

Chapters Nine to Twelve delve into positional and role analysis. Chapter Nine begins with a valuable overview and history of positional analyses, culminating in a discussion of structural equivalence. This is a full introduction to positional analyses, addressing measures of equivalence, computer algorithms for partitioning actors, and graphic representations of equivalences. Other chapters review blockmodels and relational algebras, and in the last chapter of this section Wasserman & Faust expand on structural equivalence with generalization to automorphic and isomorphic equivalence, regular equivalence (i.e., similar ties to equivalent rather than identical actors), and local role equivalence.

In the final four substantive chapters the emphasis shifts from primarily descriptive methods to statistical modeling of network characteristics. The first two of these chapters focuses on dyads (pairs of actors) and triads (groups of three) respectively. Included here is a discussion of the triad census: a count of the sixteen possible triadic configurations. Wasserman & Faust demonstrate the use of weighting vectors with a triad census to extract information and test statistics. Chapter Fifteen, the second written by Iacobucci, is primarily a review of log-linear models applied specifically to network data. Although the chapter does require some background in categorical data analysis, readers familiar with such models will find it relatively straightforward. The essence of this methodology is modeling dyadic ties on sets of parameters describing actors' propensity to send, receive, and to reciprocate ties. Actor attributional data may also be included. The final substantive chapter extends the statistical modeling, introducing the idea of a stochastic blockmodel in which actors are considered (stochastically) equivalent if they have identical probabilities of ties to and from other actors, and specifically addressing model building using nested equations and goodness-of-fit indices. The book concludes with an epilogue chapter considering future directions in network methods, followed by appendices that des-

cribe the five major datasets used as examples in the book and provide cursory information on network computer programs.

The Wasserman & Faust volume is extraordinary in the scope of material included, but it does not include everything. Longitudinal network designs, for example, receive little attention. The authors have opted to write a short comment with relevant references for the interested reader, rather than include these models in the book. A far more important omission is the absence of models that use network measures to explain non-network dependent variables. The most important uses of network methods involve their application to substantive issues. While this book includes substantive research examples and covers most of the network measures used in such analyses, it is remiss in not specifically addressing, as one might expect in a book on network applications, the use of network measures as exogenous variables. All of the models in the statistical methods section, for example, have network dependent variables (e.g., existence of dyadic ties). Because of the lack of concern with this subject, the authors also fail to address, in more than a cursory way, the sampling difficulties inherent in these analyses and the problem of non-independent observations in network studies. The reader seeking reference on these issues may be disappointed.

There are other problems with organization and style. The authors have a tendency to include long outlines at the beginning of sections. Occasionally these are helpful in organizing the material which is about to be presented. More frequently, they confuse the reader with concepts and assertions that are not sufficiently explained until a later point. Although for the reference user they may be helpful aids for previewing sections one may not wish to read, I found them distracting. This tendency is not restricted to outline sketches. Other parts of the book, especially the first three chapters, have a similar problem. For example, the authors mention structural properties, such as centrality and multiplexity, in the first chapter but fail to explain them until subsequent chapters

Symbols used to mark tangential and difficult subjects in the table of contents – and throughout the text – are explained not in the table of contents, but at the end of the first chapter.[3]

In other places the authors provide conceptual definitions or explanations that they have provided previously. For a reference volume, this is a useful feature. When one is referencing the last thing one wants is to have to jump back a few hundred pages to find an explanation of an important concept. This way, concepts are explained at points where they are relevant, and in ways appropriate to the topic at hand. If one is reading the book straight through, however, this feature creates frequent redundancies in the material. In the worst example of this, much of the material in Chapter Four is repeated in Chapter Five, while some of the former is repeated from Chapter Three.

The authors do provide an excellent cross-referencing of topics within the text and cite relevant literature throughout the book, and the table of contents is conveniently subdivided into chapter, section and subsection headings, making it easy to reference topics. With a good index[4], and a little page-flipping, most of the organizational problems will be minor concerns, though they do make the work less easy to read.

Other aspects of this book also detract from its readability. Segues between sections are abrupt or forced frequently enough to notice, and the writing occasionally changes personality: cold and professional in most parts, suddenly warm and friendly in others. The flow is further broken by the occasional tangential subsection. Many of the mathematical properties are introduced using set theory perspective and notation. Persons unfamiliar with this or other notation used will be

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[3] The legend for the symbols used in the section headings and table of contents is also provided in the notation index at the back of the book, but is not included as a legend in the table of contents where the reader first encounters it.

[4] Because this review was based on uncorrected proofs, I cannot say how well these problems will be resolved by the quality of the index.

happy to find a notation index at the back of the book but may be dismayed that not all the notation used is included. None of this significantly hinders its function as a reference, but it does reduce the book's value for those who might actually read it in sequence.

Regardless of these problems, *Social Network Analysis: Methods and Applications* is a work of singular scope on the subject. It is virtually guaranteed to become *the* comprehensive reference for social network researchers for some time. Most network analysts will want to – and probably need to – have this volume on their shelves. The authors deserve great credit for the depth and breadth of material they cover, but the book falls short of its potential. One is forced to consider how much greater this book could have been had it been better written and organized.

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Bjorn Axelsson and Geoffrey Easton (eds.): *Industrial Networks: a New View of Reality*. London: Routledge, 1992.

Although the subject matters discussed in *Industrial Networks: a New View of Reality* reveal a variety of interests among the authors, the basic model underlying all the chapters is the same. In the industrial networks approach, actors (mainly business organizations) are assumed to operate in environments which include only a limited number of other actors. The actors are engaged in continuous interaction with each other. Through day-to-day interaction between the actors more stable relationships are developed, and these relationships constitute a framework for exchange processes. The development of long-term relationships means that the actors will get to know each other and thereby the uncertainty that is associated with transactions in industrial markets will be reduced. Furthermore, the establishment of long-term relationships involve investments in the relationships, investments that are tied up