Social Network Analysis: A Handbook; SAGE Publication
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Chapter 1: Networks and Relations

There has been a considerable growth of interest in the potential which is offered by the relatively new techniques of social network analysis. Unfortunately, this potential has been seen as unachievable for many researchers, who have found it difficult to come to grips with the highly technical and mathematical language in which much discussion of these techniques has been cast. Those who have wanted to take advantage of the techniques of social network analysis have been practical researchers with substantive interests, while texts and sources on these techniques have, by and large, been produced by highly numerate specialists with a mathematical background. There has even been great difficulty in finding out about the available computer programs for social network analysis; and when access to a program has been achieved, researchers often have little practical guidance on its uses and applications.

My aim in this book is to try to bridge this gap between theory and practice. I am not a specialist with a mathematical training, but a researcher who came to social network analysis because of the particular needs of data handling in a research project on corporate power. Over the years, I have struggled to achieve a degree of understanding of what the principal measures of network structure involve, and I have attempted to translate the mathematics into simpler language and to try to assess the relevance of particular models for specific research needs. The aim of the book, therefore, is to draw on this experience in order to present a systematic summary of these measures with some illustrations of their uses. I have not attempted to present a comprehensive treatise on structural analysis in sociology (see Berkowitz, 1982), nor have I aimed at reviewing the large number of applications of social network analysis which have been published (see Mizruchi and Schwartz, 1987; Wellman and Berkowitz, 1988). 1 have concentrated on identifying the key concepts used in assessing network structure density, centrality, cliques and so on - and I have tried to translate the mathematical discussions of these ideas into more comprehensible terms.

It is of the utmost importance that researchers understand the concepts that they use. There are, for example, a large number of different definitions of the 'clique' and of related ideas, and a researcher cannot simply take a program 'off the shelf' and assume that its idea of the clique corresponds with that which the researcher has in mind. It is for this reason that I emphasize, at a number of points, that the choice of measures and of their application to particular topics are matters that require the informed judgement of the practising researcher. They are theoretical and empirical questions which cannot be avoided by a reliance on mathematical measures that are only partly, if at all, understood. Only if the researcher has a clear understanding of the logic of a particular measure can he or she make an informed sociological judgement about its relevance for a particular piece of research.

Relations and Attributes

The first task must be to define the kind of data for which social network analysis is most appropriate. Those who are interested in its applications will, undoubtedly, have some ideas about this already: it is useful for investigations of kinship patterns, community structure, interlocking directorships and so forth. But it is essential that the common features of these types. of data are understood more clearly. It is my contention that social network analysis is appropriate for 'relational data', and that techniques developed for the analysis of other types of data are likely to be of limited value for research which generates data of this kind.

The most general characteristic of social science data is that they are rooted in cultural values and symbols. Unlike the physical data of the natural sciences, social science data are constituted through meanings, motives, definitions and typifications. As is well known, this means that the production of social science data involves a process of interpretation. On the basis of such processes of interpretation,

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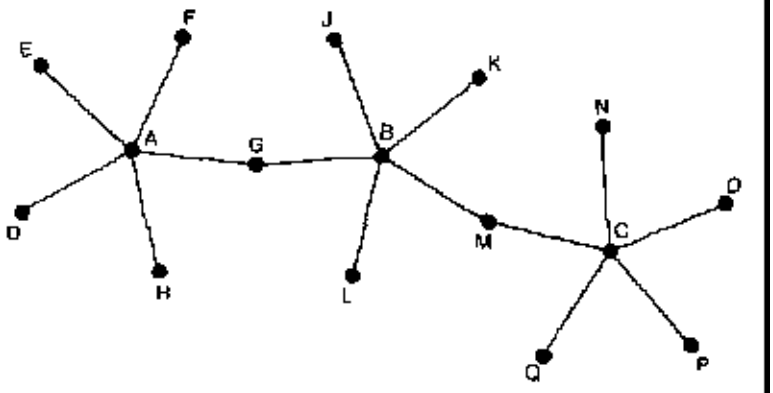
social scientists have formulated distinct types of data, to each of which distinct methods of analysis are appropriate.

The principal types of data are 'attribute data' and 'relational data'. 1 **Attribute data** relate to the attitudes, opinions and behaviour of agents, in so far as these are regarded as the properties, qualities or characteristics which belong to them as individuals or groups. The items collected through surveys and interviews, for example, are often regarded simply as the attributes of particular individuals which can be quantified and analysed through the many available statistical procedures. The methods appropriate to attribute data are those of **variable analysis**, whereby attributes are measured as values of particular variables (income, occupation, education etc.).

Relational data, on the other hand, are the contacts, ties and connections, the group attachments and meetings, which relate one agent to another and so cannot be reduced to the properties of the individual agents themselves. Relations are not the properties of agents, but of systems of agents; these relations connect pairs of agents into larger relational systems. The methods appropriate to relational data are those of network analysis, whereby the relations are treated as expressing the linkages which run between agents. While it is, of course, possible to undertake quantitative and statistical counts of relations, network analysis consists of a body of qualitative measures of network structure.

Attribute @nd relational data are not the only types of social science data, although they are the most widely discussed in methods texts. A third type comprises ideational data, which describe the meanings, motives, definitions and typifications themselves. Techniques for the analysis of ideational data are less well developed than those for attribute and relational data, despite their centrality to the social sciences. Typological analysis of the kind outlined by Weber (1920-21) is the most fruitful approach here, but these methods are in need of further development (see Layder, 1992).



		A, C	B	G, M	J, K, L	All other points
Local centrality	Absolute	5	6	2	1	1
	Relative	0.33	0.33	0.13	0.07	0.07
Global centrality		43	33	37	48	57

Figure 1.1

Although there are distinct types of data (as set out in Figure 1. 1) each with their own appropriate methods of analysis, there is nothing specific about the methods of data collection which can be used to produce them. There is, for example, nothing which distinguishes methods for the collection of attribute data from those for the collection of relational data. The three types of data are often collected alongside

one another as integral aspects of the same investigation. A study of political attitudes, for example, may seek to link these to group memberships and community attachments; or an investigation of interlocking directorships may seek to link these to the size and profitability of the companies involved. In either case, questionnaires, interviews, participant observation or documentary sources can be consulted in order to generate the data.

Studies of friendship, for example, have tended to follow Moreno's (1934) lead in using questionnaires to investigate friendship choices. In such studies, researchers simply ask respondents to identify their friends, using such questions as 'Please name your four closest friends'. Methodological problems do, of course, arise with this kind of research. An unlimited choice question has sometimes been found to be difficult for respondents to answer. Some do not feel that they have four friends to name, and many find the open question both time-consuming and tedious. An alternative approach is to use the roster choice method, in which respondents are asked 'Which of the following would you regard as a friend?' This requires considerable knowledge and preparation on the part of the researcher, who must compile the list, the roster, with which respondents are presented, but it has the advantage that it can be adapted by asking respondents to rank or to rate their affiliations, so indicating their 'intensity' or significance. In both cases, however, these methodological problems of knowledge and respondent cooperation are exactly the same as those which arise in collecting information on attitudes and opinions.

Relational data are central to the principal concerns of the sociological tradition, with its emphasis upon the investigation of the structure of social action. Structures are built from relations, and the structural concerns of sociology can be pursued through the collection and analysis of relational data. Paradoxically, most of the existing texts on research methods and methods of data collection give little attention to this type of data, concentrating instead on the use of variable analysis for the investigation of attribute data. The formal, mathematical techniques of social network analysis, the methods which are specifically geared to relational data, have developed and have been discussed outside the mainstream of research methods. Whilst they have made possible a number of spectacular breakthroughs in structural analysis, they have been largely inaccessible to many of those who would most wish to use them.

Social network analysis developed, initially, in a relatively nontechnical form from the structural concerns of the great anthropologist Radcliffe-Brown. From the 1930s to the 1970s, an increasing number of social anthropologists and sociologists began to build on Radcliffe-Brown's concept of 'social structure' and, in doing so, began to take seriously the metaphors of the 'fabric' and 'web' of social life. From these textile metaphors, aimed at understanding the 'interweaving' and 'interlocking' relations through which social actions were organized, the metaphor of the social 'network' came to the fore, and researchers began to investigate the 'density' and 'texture' of the social networks which they studied. From the 1950s, however, a small group of specialists began to concern themselves with devising more formal translations of the metaphor and, from the early 1970s, an avalanche of technical work and specialist applications appeared. From these writings have emerged the key concepts of social network analysis, and it is time that the techniques returned to the mainstream of data analysis and a wider sphere of applications.

An Overview

This book is intended to be a guide or handbook to social network analysis, and not a text to be read through at one sitting. I have tried to confine subsidiary points and abstruse technicalities to footnotes, but a certain amount of complexity necessarily remains in the main text. I hope that this is at the absolute minimum. The newcomer to social network analysis is advised to read Chapters 2 and 3, and then to skim through the remainder of the book, coming back to points of difficulty later. Those readers with more familiarity with social network analysis may prefer to reverse this procedure, scanning Chapters 2 and 3 and then giving greater attention to a thorough review of Chapters 4-8. The chapters are best read in detail whenever a particular technique is to be used in a specific investigation. Although later chapters depend

upon arguments raised in earlier chapters, each can be treated as a reference source to return to when attempting to use a particular technique.

Chapter 2 discusses the development of social network analysis, looking at its origins in the social psychology of groups and at its subsequent development in sociological and social anthropological studies of factories and communities. The chapter concentrates on the theoretical ideas which emerged in this work and shows how this was connected with the growing technical complexity of the work carried out from the 1970s. These late developments in social network analysis are illustrated through two of the benchmark studies of the early 1970s: Lee's work on the search for an abortionist (Lee, 1969) and Granovetter's work on the search for a job (Granovetter, 1974). In Chapter 3, I look at some of the issues that arise in defining the boundaries of social networks and in selecting relations for study. These discussions are used as a way of introducing some of the necessary paraphernalia of social network analysis. In particular, matrices and sociograms are introduced as easy and intuitive ways of modelling relational data.

Chapter 4 introduces the basic building blocks of social networks. The chapter starts from a consideration of the fundamental sociometric idea of representing a network as a 'graph' of 'points' and 'lines', and it shows how these can be used to develop concepts such as 'distance', 'direction' and 'density'. In Chapter 5, I look at the ,centrality', of points and the 'centralization' of whole networks, building on the argument of Chapter 4 to show,how it is possible to move from local, 'ego-centric' measures to global, 'socio-centric' ones. Chapter 6 examines some of the principal concepts proposed for the investigation of sub-groups within social networks - the 'cliques' and 'circles' into which networks are divided. In Chapter 7 there is a shift of focus to the structure of 'positions' which are defined by social relations and to the ways in which these articulate into more complex 'topological' structures. Chapter 8 looks at the formal approaches to the display of relational data, moving beyond the simple sociogram to the production of multidimensional 'maps' of social structures. Finally, an Appendix gives an introduction to and comparison of the main computer programs for social network analysis.

Chapters 4-8 each conclude with a consideration of the application of the measures discussed in particular empirical studies. The investigations which are reviewed cover such areas as kinship, community structure, corporate interlocks and elite power. The aim of these illustrations from leading researchers is to give a glimpse of the potential offered by social network analysis.