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1 Introduction

Social network analysis conceptualises individuals or groups as 'points' and their relations to each other as 'lines'. It is concerned with the patterns formed by the points and lines and involves exploring these patterns, mathematically or visually, in order to assess their effects on the individuals and organisations that are the members of the 'networks' formed by the intersecting lines that connect them. It therefore takes the metaphorical idea of interaction as forming a network of connections and gives this idea a more formal representation in order to model structures of social relations. Treating a social structure as a network is the cornerstone of social network analysis.

Social network analysis has changed a lot in the last forty years and the network analyst of today works very differently from the one of the early 1970s. In this book I will trace these changes from the early origins of the approach in simple metaphorical ideas to the contemporary rigour and formalism that characterises it. My own involvement in network analysis over this period has meant that I have myself experienced the changes that have led to the highly technical and sophisticated measures that now

face the newcomer. The book can usefully begin, therefore, with a contrast between how it was done before and how it is done now.

My personal interest in social network analysis began because I had an interest in economic power and a fascination with the work of those who claimed to have identified the key financial groups in contemporary economies and to have shown the webs of connection that tied them together through class-based links of schooling, club membership, and kinship. It seemed to me that this could best be studied through an investigation of interlocking directorships and through the use of systematic network methods. Small studies by Richard Whitley (1973) and by Phil Stanworth and Tony Giddens (1975) were beginning to appear at this time, and these authors had drawn diagrams of board connections among small numbers of companies and had reported the measured 'density' of their networks. These studies seemed to offer an advantage over the more popular diagrammatic representations produced by radical journalists in which the nature of the connections and the implications of the patterns were not considered. However, I felt that there had to be a way of extending these systematic methods to the larger selections of companies that I wanted to study.

The early 1970s were a time at which British sociology was beginning to make advances in the use of mathematical techniques to study individuals and their relationships. The British Sociological Association Quantitative Sociology Group had been formed as a focus for this work and I wrote a short piece for its newsletter in which I requested help in my search for useable techniques of social network analysis. This brought me

into contact with leading figures in North America, Britain, and continental Europe: Barry Wellman, Joel Levine, Mike Schwartz, Frans Stokman, Rob Mokken, Clyde Mitchell, and Tony Coxon all made the 'first contact' between 1975 and 1976 that allowed me to boldly go across this new frontier of sociological methods. From these people I learned ideas, acquired programs, and received much needed intellectual support. I learned of possible measures and of computer programs that could, with some difficulty, help me in my task.

Before I could undertake any social network analysis, however, I had to collect some data. My data collection had begun some years previously when I began a project on ownership and control in the Scottish economy and the involvement of Scottish companies in the development of the oil and gas resources of the North Sea (published in Scott and Hughes 1976; 1980). Arriving at a list of companies to study was easy, and it was then fairly straightforward to compile lists of the names of their directors. Two sets of record cards were produced: (1) a set of company cards, one for each company, recording the names of all the directors in each company; (2) a set of director cards, one for each director, recording the names of all the companies on which the director sat. The second set of cards was difficult to produce, as it involved searching through all the company cards to identify any person who appeared on more than one company card. This involved a manual, error-prone process of spotting similar names and then searching a variety of sources in order to discover whether J. Smith, John Smith, H. John Smith, and Brigadier General H. J. Smith were all, in fact, the same person or needed to be treated separately. An additional

problem was that company information had been reported in the directories used at various dates during the year and so John Smith may have become Sir John Smith, Lord Smith, or even Lord Tottenham, part of the way through the year. Not for some years was it possible to enter the company and director names into a computer and to sort them automatically into alphabetical order so as to bring similar names closer together in the list.

When a reasonably clean data set had been produced, some quantitative analysis could begin. This involved manually sorting the cards into piles on the floor in order to calculate frequencies: for example, the numbers of directors with 2, 3, 4, or more directorships in the companies studied, and the numbers of companies with boards of particular sizes or numbers of 'multiple directors'. This task, too, was soon helped by my investment in a pocket calculator. However, many network measures that are now standard could not be produced in this way and I had to resort to drawing network diagrams by hand—using long rolls of wallpaper—in order to map out the principal connections. These diagrams served an interpretative purpose for me as a researcher, allowing me to identify the well-connected and the less well-connected companies and to recognise areas of intense connection but they were impossible to use as means of rigorous data analysis or for presentation to others. I explored various simplified diagrams that gave 'artist's impressions' of the data in the hope that I could clarify the broad structure of the large network, but none of these proved satisfactory.

Once I had access to computer programs from the colleagues who had contacted me, things became a lot easier. For a study of British companies (Scott and Griff 1984) I transferred the

data onto punched cards which could then be read into the university's mainframe Control Data Corporation (CDC) Cyber computer. The British project came to form a part of an international project headed by Frans Stokman, who headed the team that had produced a network program called GRaph Definition and Analysis Package (GRADAP), also stored on a larger CDC computer at Gröningen University. My punched cards were transferred to a large data tape, and this was posted to Gröningen for analysis there—no other computer was large enough to handle the program and its data. A few weeks later I would begin to receive the output in the form of reams of computer printout on concertinaed paper.

The output received was, however, a revelation. Most of the now-standard network concepts could be generated by GRADAP, and I could begin to report the basic structural features of my network—a mere three years or so after I had begun to compile the data. All the researchers in the ten participating countries worked in the same way and the Gröningen team produced equivalent output for each participant, so ensuring strict comparability in the analysis of our various data sets.

Some measures were not, however, included in GRADAP. For these I relied on a program written by Clyde Mitchell. Clyde provided me with a copy of the program—CONCOR—on punched cards and the university computer staff wrote a small program that could convert my GRADAP files into a form suitable for use with CONCOR. The computer demands for CONCOR were so great that it could run only because my university rented time on the Manchester super-computer: which was almost as powerful as one of today's mobile phones! Each time I used the

program I consumed a half of the university's weekly budget, and each time I made a mistake in punching the cards—which was often—I had to rerun the program, sometimes a week later, when more budget was available. The physicists who regarded all computers as their sole property were none too pleased about this.

Since personal computers became more easily available from the late 1980s, the research process has changed dramatically. Pioneers of contemporary social network analysis have produced cheap software that can be run on any desktop. The initial steps still require a great deal of manual cleaning of the data, even when these have been harvested directly from an online data source. Standard computer software also allows easy conversion and transfer of data. Analyses that would have required an overnight run on the Manchester super-computer in 1984 can now be analysed on a laptop in less than a second. Some networking procedures are now routinely implemented on mobile phones on a daily basis by anyone who uses Facebook. Newcomers to social network analysis are able to start their work more quickly and more easily than ever before.

These changes are what make this book timely. I have tried to produce a simple primer that introduces and illustrates the basic ideas of social network analysis and that will allow users to quickly use the software themselves and to move on to more advanced introductions that will give a deeper understanding of the concepts and measures that are being used.