All in all, this is an excellent introduction to an important realm of study. Not all the methods or subjects reviewed for England will be appropriate for other regions, but the general approach to landscape history is valuable for all regions and periods.

Steven A. Rosen
Ben-Gurion University of the Negev

NEURAL NETS: APPLICATIONS IN GEOGRAPHY by Bruce C. Hewitson and Robert G. Crane (eds.). Dordrecht, Boston and London: Kluwer Academic Publishers, 1994.

Neural network analysis is a powerful addition to the array of statistical methodologies available for geographical prediction and, to a lesser extent, explanation. Neural network theory emerged out of the field of Artificial Intelligence, and its application has been widely used in such areas as cognitive modeling, image compression and recognition, expert systems, and natural language and handwriting recognition. Its use in Geography, Planning and the Social Sciences in general is still in its infancy. This volume could be an important stimulus to its broader adoption in these fields.

Neural network theory stems from the attempts of researchers to program computers to mimic the brain's abilities, albeit to a limited degree. The premise is that, if a computer is to function like a person it must be programmed like a brain, which distributes information across a vast, interconnected web of nerve cells, or neurons.

A neural network learns to solve problems by being given data, examples of the problem and its solution. Such networks are highly relevant to problems requiring large-scale, multi-dimensional data analysis, including those of a spatial-temporal nature. The advantage of neural networking over statistical methodologies now commonly used by geographers in that it provides a data analysis tool for modeling intuition without the complications of having to formalize all the complex causal variables and relationships which other statistical models require. As the editors of the volume, Bruce Hewitson and Robert Crane point out, neural networks are not a panacea for all geographical research problems. They do, however, offer a new strategy with enormous potential for improving prediction as well as for providing greater explanatory insights in certain situations.

This volume consists of a well-conceived and edited series of cases that demonstrate the application of neural networking methodology in a wide spectrum of spatial-temporal relationships: census analysis, prediction of AIDS spread, description of synoptic controls on mountain snowfall, examination of atmospheric circulation and tropical rainfall relations, and remote sensing of polar cloud and sea ice characteristics. The various contributors demonstrate that applying neural network methodologies to their cases yields performances that are equal or better than more traditional methodologies such as multiple-regression analysis, cluster analysis and maximum-likelihood classification.

In the first chapter, Hewitson and Crane provide a clear, conceptual overview of neural networks, including a discussion of theory origin, network structures and operations, and potential applications. Necessary caveats are raised. Selecting the appropriate neural network model for a specific application can be bewildering, given the variety of models from which to choose. The combination of network architecture (or topology), and learning paradigm and algorithm defines the choice.

Mathematical derivations of various learning paradigms and types of applications appropriate to these paradigms are presented by E.E. Clothiaux and C.M. Bachmann in Chapter Two. The authors dispel the 'black box' aspect of neural nets through their clear explanation of the mathematics behind the various algorithms.

In Chapter Three, Stan Openshaw describes briefly five different neural network architectures for classifying spatial data, expanding on the Kohonen self-organizing map.

The remaining chapters are examples of different categories of spatial-temporal applications. These demonstrate how 'geographic' problems are first set in application categories, then matched with a basic learning paradigm and, finally, a neural network architecture is chosen and applied. The cases show applications of problems in both human and physical geography.

Kevin Winter and Bruce Hewitson demonstrate a mapping problem with an application from the South African census data. They use a Kohonen self-organizing map to organize demographic data gathered from census information in order to investigate population groupings and their spatial distribution. Here the use of neural networks has enhanced the interpretation of large, highly dimensional data sets, with an emphasis on social data. In a medical geographic application, Peter Gould experiments with forecasting the spread of AIDS in Ohio by using a feedforward neural network to predict the next 'map' of the spread of the AIDS epidemic.

The remaining three applications deal with physical phenomena. David McGinnis predicts snowfall from synoptic circulation using a backpropagation algorithm. This is shown to predict raw daily snowfall data with 70 percent accuracy, significantly better than the results from linear methods using the same data set. Hewitson and Crane demonstrate that neural networks have the ability to capture cross-scale relationships between the atmospheric forcing and regional daily precipitation. The network results can also be interpreted to investigate climatic models to see whether the relevant atmospheric controls are captured, and their temporal behavior realistic. Finally, the classification of broad surface and cloud types in satellite data is undertaken by Jeffrey Key and found less rigid than traditional procedures used. The difficulty of interpreting weights within the networks is pointed out, as well as the significant computing time required. In the cases presented in this chapter, the advantages of the neural networks outweigh the disadvantages.

In summary, the authors make a persuasive case for the value of neural nets in geographic prediction and analysis. The volume is a valuable addition to the literature on quantitative geography. It deserves to be widely disseminated.

Deborah F. Shmueli
University of Haifa