Modeling Complex Systems, by N. Boccara, Springer-Verlag, Berlin, 2004, pp. xii + 397, £61.50, US$79.95, hardback (ISBN 0 387 40467 7). Scope: textbook. Level: postgraduate and specialist.

In many organizations, those people charged with managing the organization have an instinctive understanding that their task involves 'taming complexity'. This understanding has usually been acquired after many experiences of the difficulties involved in the operation. Recently, advances in the mathematics and physics of dynamical systems have unleashed a toolbox of mathematical techniques which the 'hopeful manager' might think would aid him or her in this daunting task.

In the book Modeling Complex Systems, many of these techniques are described and explored by the author, who is essentially a mathematician. To a reader from a mathematical physics background, these methods will be comprehensible and understandable. It is questionable as to whether this comprehensibility will extend to a wider readership. We are led gently into the definition of a complex system as a 'system of connected agents that exhibits an emergent global behaviour not imposed by a central controller, but resulting from the interactions between those agents'. Examples of agents given include insects, birds, people, or companies. 'Finding the emergent global behaviour of a large system of interacting agents using analytical methods is usually hopeless, and researchers therefore must rely on computer-based methods'. We thus see that the study of such complex systems in any meaningful way has emerged together with the availability of computing resources; that is to say, since about 1980. For those of us fortunate enough to have been present during this computing explosion, and who have been doing the little computer studies and experiments that underlie much of the material in this book, the contents are immediately appealing and bring to mind many happy hours spent obtaining some of the results summarized. For those students and managers approaching this material for the first time, it may appear rather more forbidding.

The book is divided into two parts. Part 1 deals with what are called 'mean field models' which include nonlinear differential equations which may display chaos, and recurrence equations in discrete dynamical models, and chaos in both scenarios. It occurs to this reviewer that the power of the understanding brought about by considering chaotic processes in these classes of mathematical model rests on the ability to distinguish between 'what can happen, even though unpredictably' and 'what is most unlikely to happen, not being an attractor of the system'. Part 2 of the book deals with what are termed 'agent-based models', which include cellular automata, and the connectedness of networks such as spring up between organizations and individuals, and which we find on the world wide web. In the context of cellular automata, the book discusses the game of 'life' and the wider issue of mimicking natural communities by what are loosely termed 'artificial life programs'. The book rounds off with discussion of power-law distributions, such as Zipf's law, where the statistics of complex systems are investigated and it is found that strong statements of use to the manager may be made about the likely behaviour of such systems, even in the absence of exact predictability. Applications here include financial market forecasting, the frequency of family names, and self-ordered criticality (SOC) in the classic sandpile model. The book also discusses punctuated equilibria and the models of Darwinian evolution, which in your reviewer's opinion is not adequately represented by random mutation alone, when combined with natural selection.

To summarize, this is an important book, of pedagogical use to a cohort of upcoming students and as an overview of the mathematical techniques currently available to the complex system manager. Your reviewer greatly enjoyed reading it and found much in it that was new and interesting and readily understandable.

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