technical description of the algorithm(s) is given, after which a particular implementation is presented. Finally, references for further reading and a description of the accompanying computer program(s) is provided.

The book is accompanied by a CD-ROM that contains C programs implementing the algorithms, together with illustrative examples. These examples are an integral part of the work. By comparing an original image with the image yielded by a particular algorithm, readers easily gain an understanding of the purpose and properties of the technique. All original and processed images are contained in the examples subfolder of each section folder on the CD-ROM. Images are given both in GIF and TIF format. Readers are encouraged to use these original images to experiment with the algorithms by setting different arguments and options in the accompanying programs. Doing this certainly stimulates the reader's interest and enhances his/her understanding of the algorithms. The programs will run on a Windows 95/98/NT or LINUX platform and require a C or C++ compiler.

The part of this publication that I found most useful was the program source code, contained in the accompanying CD-ROM. Advanced readers with a reasonable knowledge of C programming could modify this code to include their own ideas. However, before using the source code, the copyright notices on page 3 of the book and on the CD-ROM should be read.

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Self-organization and the City, by Juval Portugali. Springer Series in Synergetics, Springer-Verlag, Berlin, 2000, 352 pp., DM 169.00, $99.00, ISBN 3-540-65483-6.

The natural sciences have given us both a deep understanding of the natural world and a flourishing technology with which to manipulate it. The social sciences, in contrast, have given us – what? Relative to the natural sciences, not much. For the first two-thirds of the 20th century there was great hope that a true social science could be created, one that would permit us to understand and manipulate our social systems as powerfully and as subtly, and with as much assurance, as we are able to intervene in the physical and biological realms. But the results were disappointing, and the last third of the century saw a rejection of positivist social science in favour of a series of anti-scientific approaches, including, most recently, post-modernism. Unfortunately, the new approaches have little to say that is relevant to major policy and planning questions, so to many they seem increasingly irrelevant.

Economics, which has become ever more rigorously mathematical, is apparently the great exception, and economic theory has been appropriated as the foundation of the neoliberal ideology on which much policy is now based. And yet economic theory, as a theory of equilibrium, is static, and so largely irrelevant – or worse, misleading – with respect to our highly dynamic, rapidly evolving socio-economic system. In short, it would not be a wild exaggeration to say that the failure of the old project for a positivist social science has left us at the beginning of the 21st century with a choice between a collection of marginalized social anti-sciences on the one hand and a universally accepted, influential social pseudo-science on the other.

But readers of *DDNS* know that the situation is not so bleak. Under banners like self-organization, synergetics, complexity, and chaos, a new approach to the understanding of social systems is emerging which is both scientific and fruitful. Portugali, a geographer, is one of the creators of the new approach, and in *Self-organization and the City* he has made an ambitious but largely successful attempt to show what the approach can tell us about cities and how to manage them.

The core of the book is a series of chapters (4–10) written in collaboration with I. Benenson. These chapters present a series of urban simulation models, each one building on previous ones, and each one increasingly sophisticated. Most of the models are cellular automata (CA) based in that the dynamics of the physical structure of the city as represented by land use is captured in the CA. But in each case the heart of the model is a representation of free agents (FA) who move around in the cell space, and whose actions in effect provide the transition rules for the CA. The Agents represent the actors who reside in and shape the city: usually families, but possibly also individuals or businesses. In the simplest model the agents are represented by cell states, and the characteristics of the agents are represented by the transition rules. Thus in this case we are dealing with a simple CA. But in subsequent models the Agents are represented independently of the CA. Each agent is characterized by a vector of attributes (*e.g.*, ethnic group, economic status, attitude toward other ethnic groups), and an agent's attributes may be altered by interaction with other agents, thus creating new types of agents. Interaction among agents requires spatial propinquity, so the CA dynamics affects the evolution of agents. But since CA transition rules are defined in terms of the characteristics of agents, newly emerging types of agents in effect alter the CA transition rules.

These models are largely exploratory – they are designed to demonstrate the possibilities of modelling various aspects of the behaviour of individuals, families, and businesses in a city as well as the way in which higher order social formations such as ethnic groups emerge and evolve in conjunction with the evolving spatial structure of the city. In this role they are entirely convincing: they give an impressive glimpse of the potential power and subtlety of this approach, and make us impatient to see what this kind of model will be able to do in another ten or twenty years. However, Portugali perhaps goes too far in repeatedly insisting that the proper use of these models is and should be strictly heuristic – that they should be used to understanding the processes of self-structuring that unfold as a city evolves. He is opposed to calibrating them to specific times and places and then using them to predict future states of the city – indeed he claims that prediction of self-organizing human systems is impossible. In principle, of course, he is right: the future of open systems cannot be predicted exactly. But in fact it is frequently possible to make quite reasonable predictions of urban spatial structure over a period of a decade or two, and even Portugali's claim of heuristic value for the models is in fact a claim that they are making good, if very general, *qualitative* predictions. The question of predictability should be treated not only as an issue of principle, or theory, but also as an empirical one, to be investigated by repeatedly creating, calibrating, and testing models.

If the book consisted just of these central chapters describing the models it would still be a solid, useful volume. However, it is the discussion that surrounds these chapters, providing a wider context, that really sets the work apart. Portugali sets himself the task of building a bridge to the non-quantitative schools of social science by investigating the similarities between the formal models of self-organization on the one hand and the conceptual structures of post-modern and other non-quantitative analyses of the city on the other. He is not, of course, the only one to point out these similarities, but most who do so come from the post-modernist camp, and rely largely on hand-waving supplemented by an intoxication induced by the chaos theory vocabulary; they typically make no attempt to go beyond a metaphorical link. Portugali is, I believe, the first to make a serious, sustained attempt, supporting his argument with reference to specific models.

In the final section of the book, Portugali turns to a discussion of the requirements and possibilities of planning in a self-organizing city. Here he emphasizes the hermeneutic character of post-modern analysis and the analogous heuristic nature of the models of self-organization in order to conclude that planning of a traditional type based on prediction and control is not possible. Furthermore, drawing on an extended discussion of various concepts of the city and ways of perceiving it, he shows that the questions themselves become unstable. In this context, he believes that self-organizing cities can best be left to plan themselves through a process he nicely terms Parallel Distributed Planning. The function of models such as those discussed in the book is then seen to be largely heuristic – to help people live and act in the city by understanding the way it changes, without, however, being able to predict or control those changes.

There are some rough edges to the book. The discussion of "fractal cities" is inadequate, consisting essentially of a short discussion of fractals in general. Since self-organizing cities seem necessarily to be fractal in nature, and since much work has been done on this problem, it is surprising that none of it is discussed, or even (with one exception) cited. Similarly, it is suggested that "... it might be interesting to look at the movement of cars on the freeway... in terms of self-organization...", with no reference to the large body of work in this area, notably by Prigogine and Herman, and by the TRANSIM group at Los Alamos. The figures in the simulation chapters are occasionally somewhat frustrating because the description in the text fails to make it clear what to look for. Furthermore, in the case of Figure 6.4 the time period is not indicated, and in Figure 11.5 the axes are not labeled, the legend is vague, and the axes are not logarithmic, so it is impossible to see whether the relationships graphed are in fact Pareto as claimed. Finally, on p. 67 the reference to the Environment and Planning B special issue should read 1997, not 1977. It's surprising that a publisher the size of Springer apparently does not have an editor or even proof reader on staff.

To return to substantive matters, *Self-organization and the City* is not just another book of models, collecting material previously published in the journals. It is also a book of ideas, interesting and fun to read. It raises questions that are worth thinking about. It is worth your time to read.

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An Introduction to Econophysics Correlations and Complexity in Finance, by Rosario N. Mantegna and H. Eugene Stanley, Cambridge University Press, Cambridge, United Kingdom, 2000, 148 pages, subject index, author index, US$34.95.

An Introduction to Econophysics Correlations and Complexity in Finance is an overview of the application of mathematical and statistical concepts to the modeling of financial markets. This book is beneficial to both the financial economist and the physicist. The financial economist will gain an understanding of the foundations of the mathematics of finance. The physicist will gain an understanding of the nuances of financial markets and data.

It should be noted that the authors approach the subject matter in a concise manner. This approach is beneficial to the reader. The fundamental tools of modeling financial markets are described and practical issues of their applications are addressed. This book should be viewed as an outline of the above issues rather than an in-depth analysis. The reader may find significant supplementary material necessary.

The authors approach financial modeling as physicists attempting to describe a complex system. They quickly dismiss chaos theory in favor of a stochastic processes paradigm. Through the examination of economic data the physicist should be able to describe a stochastic process that adequately characterizes the price changes of a financial asset. An accurate characterization of the price changes is shown to be necessary to value derivative products.

In order to develop a model for financial markets some basic assumptions are necessary. The authors posit an efficient market in which arbitrage opportunities are "gradually" eliminated. Under the strictest form of the efficient market hypothesis information is instantly and correctly reflected in asset prices and arbitrage opportunities instantly disappear. The work of characterizing stochastic processes that describe the financial markets begins with the assumption of this strict form of market efficiency. As with any idealized


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