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.

Roger White
Department of Geography,
Memorial University, St. John's,
New foundland A1B 3X9, Canada

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

system assumptions are relaxed until a realistic model is in place. The authors discuss the difficulties of developing a realistic model and describe the statistical concepts necessary to the model.

After reviewing selected statistical properties of random walks and Levy stochastic processes the authors discuss scaling problems in financial data. Choices about price and time scales must be made for every empirical study. Four common choices are given to address the price scale question. One can examine price changes, discounted price changes, returns or the differences in natural logarithm of price. Time can be defined in terms of physical time, trading time or transactions. Each choice has advantages and disadvantages. These choices can significantly affect the outcomes of empirical tests. Since this is an introductory book the authors remain agnostic about the appropriate scales and caution the reader to consider the choices made in each empirical study.

With choices about price and time scale appropriately made the authors now address the stationarity of the stochastic process governing the data. They review definitions of stationarity and discuss which is best applied to financial data. The authors examine the S&P 500 index from January 1984 to December 1987. They find that the logarithm of the stock price does indeed follow a random walk. The majority of empirical research supports the authors' findings. The primary focus is on the theory behind the time series of financial prices rather than on methodology or results of other studies.

In order to price a derivative product, the stochastic process for the price of the underlying asset must be known or at least sufficiently approximated. The authors quickly describe several models. Here the text no longer seems to be an introduction. Rather than develop the common geometric Brownian motion model in a step-by-step, introductory fashion, it is described in one sentence. The authors then dismiss the model discuss four alternative models in less than six pages. Some additional discussion of geometric Brownian motion would be helpful for the reader who is not already familiar with the model. With a thorough understanding of geometric Brownian motion the reader can appreciate the discussion of alternative models. The reader may also desire a more in-depth discussion of the alternatives models.

The authors discuss the properties of the S&P 500 from January 1984 to December 1989. This discussion is particularly helpful. The authors plot the data and compare it to different probability functions. It is easily seen why no one model is accepted for all researchers.

An understanding of the nature of the volatility of price changes is essential to pricing financial assets. To address this issue the authors discuss ARCH and GARCH processes. These processes assume that current volatility depends on past volatility. In defining the ARCH process one must determine how much memory the process demonstrates. This difficulty is solved by the GARCH process. The authors show the choices that are to be made when defining the exact nature of the ARCH and GARCH processes. They also compare S&P 500 data with the GARCH(1,1) process.

The authors discussion of financial markets and turbulence clearly demonstrates that they are approaching financial markets as physicists. Such an approach is often criticized by physicists "because the equation of motion of the process is unknown". An example of turbulence is "stirring a bucket of water". In financial markets the injection of information causes turbulence. Despite a chapter devoted to the subject, the authors find no quantitative support for the "formal correspondence between turbulence and financial systems". This conclusion is supported by the lack of financial literature that attempts to exploit such a link.

The authors address the intuitive notion of correlation between stocks. They state the definition of correlation and then state some empirical observations from 1990 – 1994 stock price data. The practical applications of their observations are not well developed. Arbitrage pricing theory and its relationship to certain covariance matrices is discussed in three paragraphs. Clearly, this treatment is too brief for the uninitiated reader. Fortunately, the authors provide references to excellent source material.

The role of correlation between assets other than individual stocks is not mentioned. The concept of correlation plays an important role in all types of financial assets. A discussion of the role of correlation in hedging decisions, value-at-risk models and diversification would be beneficial.

Finally, the authors discuss what is widely considered the domain of "rocket scientists", derivative pricing. Definitions of the payoff functions of plain vanilla futures and options contracts along with a brief discussion of the mechanics of their markets is followed by a review of the Black-Scholes-Merton option pricing model. They point out the substitution that allows the Black & Scholes partial differential equation to be solved but fail to give credit to Robert Merton. The authors correctly assert that the assumptions behind the BSM model limit its relevance in the real financial market. While volatility issues certainly exist the model has real world applications that the authors fail to mention. It was this model that allowed the options market to grow to the tremendous trading volumes it enjoys today.

The authors conclude with a discussion of "aspects of real markets that are not formalized in the ideal model". Issues include the true dynamics of the underlying asset's price, volatility estimates, transactions costs associated with rebalancing and stochastic interest rates. A jump-diffusion model may be required to sufficiently capture the movement of the underlying asset's price. The authors do not report which assets may be more likely to require such a model or how severe the problem may be with regard any specific asset. Differing approaches for estimating volatility are given but there is little indication of the magnitude of the problem bad estimates create.

An Introduction to Econophysics Correlations and Complexity in Finance provides a valuable picture of the relationship between physics and financial economics. It is more of a well developed outline rather than an in depth treatment of the subject. The authors quickly summarize the concepts that are necessary to model the complex system that is today's financial market. This introductory book is written from the physicists' perspective but is of value to either the physicist or the financial economist. The reader who is unfamiliar with the multidisciplinary field of econophysics should remember that the authors wrote this book to "allow the current literature to be profitably read" not as a complete reference source. This goal prevents the reader from being overcome with what may be familiar detail while giving ample references to allow the reader to find background on what may be a new concept. Thus the book accomplishes its goal.

Jonathan Godbey
James Madison University
MSC 0203
Harrisonburg, Virginia 22801 USA
godbeyjm@jmu.edu