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Spatial Econometrics: Methods and Models. by Luc Anselin

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of a widespread low-cost housing shortage. Since Adams relies primarily upon data collected during the 1970s, he is unable to address these developments of the 1980s. Nevertheless, his book should be of lasting value, both as an introduction to housing conditions, trends, and issues, and as a reference for experts in the field.

MARGERY AUSTIN TURNER  
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### The Changing Lives of American Women.

Steven D. McLaughlin, Barbara D. Melber, John O. G. Billy, Denise M. Zimmerle, Linda D. Wings, and Terry R. Johnson. Chapel Hill: University of North Carolina Press, 1988. xix + 250 pp. \$24.95 (cloth); \$12.95 (paperback).

This account of demographic changes in the behavior of American women is based on a series of reports commissioned by *Cosmopolitan Magazine* in 1984 from the Human Affairs Research Center of the Battelle Memorial Institute. *Cosmopolitan* envisioned the reports as summations of behavioral changes in the lives of American women from the perspectives of several disciplines for the benefit of marketers to women. As published in their entirety in this compilation, however, the reports become much more, making a substantive contribution to social science research.

The first seven chapters provide an introduction and historical perspective, and give data and analyses of behavioral changes in women's educational attainment, marriage and divorce, premarital sexual behavior, labor force participation, and childbearing. To substantiate their analyses, the authors discuss and present data from the 1900–1980 decennial censuses, the Current Population Survey of the Census Bureau, the National Center for Educational Statistics, the National Center for Health Statistics, the Bureau of Labor Statistics, and private sources. Data are presented in tables and graphically; line and stacked-bar graphs appear according to the visualization that contributes most to the depiction of trends, comparisons, or interrelationships.

The authors use the life-course perspective throughout the book to summarize “the impact of the full range of demographic changes on the lives of American women” (p. 159). This approach focuses attention on when certain roles (e.g., student, jobholder, wife, mother) are occupied, in what sequence, for how long, and in what combination. Longitudinal data from three different birth cohorts (mothers of baby boomers, baby boomers, and daughters of baby boomers), surveyed by the Bureau of Labor Statistics for the National Longitudinal Surveys of Labor Force Experience, are presented and analyzed in conjunction with data from the 1900 and subsequent censuses.

One notable finding is that the mothers of baby boomers differed from the generations both before and after in their educational, marital, childbearing, and employment patterns. The authors note that the baby boomers, after growing up with their parents' attitudes, made a remarkable shift during their late twenties and early thirties into simultaneous employment, marriage, and child-care. The authors conclude that this shift has led to women planning to integrate labor force participation and family responsibilities throughout their lives. Such a dramatic change has had, and will have, a major impact on society and on the way in which services formerly provided by mothers not included in the labor force are now performed.

The authors analyze attitudes (e.g., acceptance of premarital intercourse, employment of women with preschool-age children, divorce when couple do not get along and there are children at home), relating attitudes to the behavioral changes traced in the book. They conclude that “major external constraints and opportunities have a greater impact on the aggregate behavior of women and men than do predominant attitudes of a given period” (p. 183), and that women's attitudes are modified only after behavioral changes have occurred. They note that as women are recognized as having responsibility for their own lives as “primary individuals,” their decisions gain support and legitimacy.

This monograph presents a cohesive discussion of changes in the lives of American women over the past eight decades. For an analytical discussion that incorporates quantitative analyses and results, the text reads very well. Data are presented to illustrate the points under discussion, and all the data used are well documented. Characteristics and limitations of the data series are discussed. The book provides necessary background for undergraduate courses in women's history or marriage and the family, for example, and should be invaluable to researchers on these topics.

Finally, the comprehensive bibliography is reason enough to buy this book.

CYNTHIA Z. F. CLARK  
*Caucus for Women in Statistics*

### Modeling Multigroup Populations.

Robert Schoen. New York: Plenum Press, 1988. xii + 308 pp. \$29.50.

Demographers strictly segregate the sexes, even when modeling marriage and fertility, because there is no accepted strategy for capturing the interaction between male and female behavior. Two-sex population models build on multistate population models which, in turn, build on basic life table models. The first half of Schoen's book explains these simpler models. The discussion of multistate models will be particularly useful to students and teachers because it pulls together material that has not been included in other texts on life tables.

Schoen is also well-known for his efforts concerning this “two-sex problem;” the second half of this 300-page book clearly explains the predicament, adumbrates alternative approaches, and describes and applies Schoen's suggested solution.

Schoen's approach is straightforward. Consider the ratio at time  $t$  of the number of marriages between males age  $x$  and females age  $y$  to the harmonic mean of the number of males age  $x$  and females age  $y$ . This ratio is assumed constant over limited periods of time. The simplicity of this approach is advantageous and Schoen shows that the approach has other desirable properties as well. However, as Schoen's own empirical investigations have demonstrated, the method fails to capture the observed behavior of actual human populations even over short periods of time.

Another distinguishing feature of Schoen's book is his approach to constructing life tables. Instead of starting with the concept of the force (or hazard) of mortality, he uses a “General Algorithm” based on four sets of flow, “orientation,” person-year, and renewal equations. This method may seem idiosyncratic to demographers, but it has pedagogical advantages that some instructors may find useful.

JAMES W. VAUPEL  
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### Spatial Econometrics: Methods and Models.

Luc Anselin. Dordrecht: Kluwer Academic, 1988. xvi + 284 pp. Dfl. 145; \$74 (U.S.A.); £39 (U.K.).

This book identifies a new field somewhere between spatial statistics and standard econometrics, incorporating spatial effects (dependence and heterogeneity) of econometric processes into statistical models. This field differs from spatial statistics by focusing on inference from models based on econometric theory rather than pursuing the data-driven approaches of many nonparametric statistical methods. The author readily admits that the latter distinction is somewhat arbitrary, although he takes an econometric viewpoint throughout the book.

The book is divided into three parts—foundations, inference (estimation and testing), and validation—with the requisite introduction and conclusions. Practical comments and intuitive restatement of mathematical principles abound. Real examples are limited to one chapter, however, and the literature review is spotty in places, as Anselin attempts to stay clear of statistical material covered elsewhere.

Anselin spends considerable effort in Part I illustrating spatial dependence and heterogeneity, bringing these concepts to a potentially wide audience. He seems to follow a development similar to Cliff and Ord (1981), relying on local neighborhood models. Unfortunately, he only briefly alludes to potentials (Gibbs processes), which provide a means to globally characterize local models, leading to estimation by simulated annealing (Ripley 1986).

At many points, the author manages to present a complicated concept in layman's terms. For instance, he has a nice heuristic interpretation of  $\phi$  mixing and of convergence. Anselin also debates the issue of what is a sample for spatial data, which returns to the question of dependence versus heterogeneity.

Part II concerns estimation and testing. While he begins with maximum likelihood methods, Anselin explores other approaches briefly, including

instrumental variables (basically an orthogonal transformation), Bayesian methods, and the bootstrap. He investigates inference in the presence of spatial dependence and heterogeneity, complementing the work of others such as Cliff and Ord (1981) with a number of pragmatic suggestions. After a short lamentation on the lack of readily available comprehensive software (which I second), Anselin analyzes two sets of data, both from Ohio. These examples illustrate the various estimation and testing procedures, and show how they can be used in a systems approach to modeling.

Part III, on validation, is rather short. Anselin walks the reader through the algebra for and the application of some non-nested tests, and discusses on a heuristic level the issues of model selection. One is left with the sense that there is no "right" way to validate a model, which is probably appropriate. Here, as in other parts, Anselin cautions against simplistic interpretation of results, and favors a more pluralistic view.

This study is an informative work and can be recommended to anyone actively involved in uncovering spatial patterns with an eye toward examining models. It is a nice complement to treatments by statisticians, providing many practical guidelines and test details formerly available only in widely scattered materials.

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- Cliff, A. D., and Ord, J. K. (1981), *Spatial Processes: Models and Applications*, London: Pion.  
Ripley, B. D. (1986), "Statistics, Images, and Pattern Recognition" (with discussion), *Canadian Journal of Statistics*, 14, 83–111.

#### Security Markets, Stochastic Models.

Darrell Duffie. San Diego, CA: Academic Press, 1988. xx + 358 pp. \$44.95.

This is an impressive book. It is a difficult book. Its title is captivating and its subject matter important. It will be of value to specialists in "mathematical finance" as a compendium of key results that have, for the most part, appeared in the literature. It will be of striking interest to "non-mathematical" finance specialists, but many of them will find it unreadable.

The book is written in standard mathematical style—concise with few redundancies. In addition to key finance theory issues (such as equilibrium with incomplete markets, the Sharpe-Lintner capital asset pricing model, and the Black-Scholes option pricing formula), it covers background mathematical techniques ranging from fixed-point theorems to stochastic integration to elliptical partial differential equations. Measure theory and stochastic processes and control are not prerequisites but will be of "great preparatory value" (p. xviii).

The book consists of an introduction and four chapters. The introduction takes a quick informal look at securities markets theory. It is a preview, in 26 pages, of what is to come. The formal analyses of markets appear in Chapters 1–4. Each chapter contains both background material and finance topics.

Chapter 1 deals with static economies. It covers preferences, utility, and equilibrium in financial markets under certainty. The bulk of the chapter deals with uncertainty, however, including probability, expected utility, portfolios, optimization, and equilibrium in static markets. Chapter 2 deals with stochastic economies first from the event-tree paradigm and then from a continuous-time perspective. The emphasis here is on equilibrium in financial markets. Chapters 3 and 4 cover discrete- and continuous-time asset pricing using Markov state variable processes.

The proposed audience for the book comprises "researchers and graduate students interested in the economics theory of security markets" (p. xvii). Duffie intends that the book be used in a one-semester course, although it could be used in a quarter course if background material is skipped. I think that it will be an unusual and small set of students that will be prepared to master the material in this book in one semester. The subset that will understand it after one quarter is considerably smaller.

Of the 20 paragraphs that the author suggests for a first reading, 11 are background mathematics. Many of these are very advanced, such as Section 21, which not only reviews Itô calculus in nine pages but also includes Itô's theorem, the Feynman-Kac formula, and representation of Itô processes by altering the probability measure. This background is then used in Section 22 to derive the Black-Scholes formula in a number of different ways. This section is nicely done and should be helpful to

those interested in the mathematical foundations of the formula. Students learning the mathematical background for the first time will have extreme difficulty.

For students without mathematical sophistication, Jarrow (1988) would be a helpful introduction to equilibrium theory in finance. Ingersoll (1987) and Huang and Litzenberger (1988) address the same general financial topics but do so at a mathematical level more demanding than Jarrow and less demanding than Duffie. Both Huang and Litzenberger and Ingersoll suggest using their books for two-semester courses.

For sophisticated students in economics or finance with graduate-level mathematics and more than what is usually referred to as mathematical maturity, this book will be an excellent source for the foundations of much of the theory of financial markets. Each section contains a number of thought-provoking exercises that add some depth of understanding to the material just presented. Extensive notes are provided for all sections. These cite previously published works and include references to details of developments of the section as well as extensions of the ideas.

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Ingersoll, J. E. (1987), *The Theory of Financial Decision Making*, Totowa, NJ: Rowman & Littlefield.  
Jarrow, R. A. (1988), *Finance Theory*, Englewood Cliffs, NJ: Prentice-Hall.

#### Geostatistics: Proceedings of the Third International Geostatistics Congress, September 5–9, 1988, Avignon, France (2 vols.).

M. Armstrong (ed.). Dordrecht, Holland: Kluwer Academic, 1989. Vol. 1: xxix + 491 pp.; Vol. 2: xvii + 547 pp. Dfl. 495; \$249 (U.S.A.); £154 (U.K.).

This pair of volumes encompasses more than 80 papers whose unifying theme is the development and application of methods of "geostatistics." The term is placed in quotation marks here because it has acquired a more specific meaning than might be conveyed by terms such as biostatistics or geophysics. Very briefly, to the community of researchers and practitioners identified with the work represented in these volumes, the goal of geostatistics is to reconstruct a partially observed spatial field and to provide error estimates, using tools that exploit whatever can be seen in the spatial covariance structure of the field.

The papers in these volumes were presented in 1988 at the Third International Geostatistics Congress. On the whole, good editorial judgment is evident in the selection of papers and in the standard of presentation. The volumes are divided into 16 sections, of which four are devoted to theory and the remainder to applications areas, including soil science, oceanography, petroleum, hydrology, mining, and forestry. Many of the papers in the applications sections contain substantial methodological developments. A handful of the papers are written in French.

During the last two decades, geostatistics as a subject of theory and practice, together with its community of researchers, has developed largely outside the mainstream of university statistics departments and outside the principal statistical journals. Of course, some of the work in geostatistics parallels and borrows heavily from the literature on random functions and their interpolation, despite occasional differences in notation and terminology (which some statisticians may find distracting). Nevertheless, geostatistical research problems have always been driven strongly by the specific applications reflected in recent developments in, for example, non-linear interpolation, non-stationarity, process modeling, and model misspecification. Geostatisticians have not always taken the trouble to acquaint themselves with the relevant statistical literature, yet it is fair to say that statisticians working on spatial problems would do well to be familiar with current developments in geostatistics. Although many papers are written for the initiated, the papers in these volumes are probably the most direct way to gain access to the field.

One applications area not well represented is spatial image processing. Judging from these volumes, geostatisticians largely eschew methods based on discrete spatial lattice models, which currently seem to be the models of choice in image processing. In addition, geostatisticians appear largely uninterested in informal spatial methods that do not readily provide a basis for inference about estimation errors, such as two-dimensional smoothers; however, some connections between spline and kernel methods and geostatistical covariance-based procedures have been dem-