

reference to, and the linkage with, other forms of geovisualization and exploratory spatial data analysis as well as to emergent trends in local analysis (spatial and non-spatial) was thin, and disappointingly so. Second, for the most part the book is well written but it includes several features that are uneven across chapters. Here I include the use of further reading suggestions (Chapter 2 only) and the use of a small number of 'grey boxes' containing summaries of research and/or key issues (Chapter 5 and 6 only). Why these boxed features were worth emphasizing over other topics/readings was not clear. Third, there are several websites referred to in the text and mention of several software packages. These could easily have been collated and included in an additional appendix. Finally, it is fair game to

criticize the accompanying website as it is tightly coupled with the book. It is clearly a website 'in development' and other than a link to the authors' software is not as extensive or as dynamic (changing) as might be expected. This may all change if the micromap user-community grows, members contribute sample datasets and guides, and collectively they stimulate further enhancements in the interactive toolkit. I hope all this happens.

Stephen A. Matthews

Associate Professor of Sociology, Anthropology and Demography (Courtesy Geography), The Pennsylvania State University

Introduction to Spatial Econometrics

By James LeSage and R. Kelly Pace. 2009. Series: Statistics: Textbooks and Monographs. Boca Raton, Florida: CRC Press (a Chapman and Hall book). 354 + xiii. ISBN 978-1-4200-6424-7, \$89.95

While spatial econometrics has been a primary analytic tool for spatial demographers, the computational and theoretical developments of the past quarter-century (since Anselin's seminal work (1988)) have not been thoroughly documented. LeSage and Pace admirably fill this void. They summarize a variety of innovative spatial regression models and elaborate on the relationships to traditional analytic perspectives. Throughout the text, the authors emphasize how to correctly interpret the estimated coefficients of spatial econometric models and provide empirical and experimental illustrations for the reader to follow. With the proliferation of spatial data and the resurgence of macro/spatial demography (Voss, 2007), I believe this book will become a necessary addition to the bookshelves of faculty and graduate students interested in spatial methods. Below I identify and summarize three reasons why LeSage and Pace's book will prove valuable to the field.

First, the breadth and depth of the book is

appropriate for both beginners and advanced researchers. The topics span the traditional spatial regression models (Chapters 2 and 3), such as spatial autoregressive model (SAR), spatial error model (SEM), and spatial Durbin model (SDM), to the latest developments in spatial modeling (Chapters 9 and 10) such as matrix exponential spatial specification (MESS). Although these models seem unrelated, the authors explain how the recent methodological developments are derived from traditional models. As for model estimation, the maximum likelihood (ML) approach is introduced (Chapter 3), but the authors apply the Markov chain Monte Carlo (MCMC) and Bayesian perspective to spatial econometrics (Chapter 5). In Chapters 6, 7, and 8, both MCMC and ML estimation approaches are further explained and used in different analytic settings and model selections. The advantages and drawbacks of these approaches are demonstrated with empirical examples. The combination of the detailed discussions of fundamental concepts and the

auxiliary descriptions of advanced issues makes this book a useful source for spatial analysis enthusiasts of varying stages of learning.

My second justification for usefulness of this book is the strong emphasis on the rationale for the specification of spatial econometrics models and spatial weight matrices. This emphasis will encourage spatial demographers to think carefully about the linkages between demographic theories and spatial analyses. Arguably, the most conventional motivation for using spatial econometrics in demography is to account for spatial dependence and generate unbiased estimates (Cressie, 1992). However, this motivation may not suffice for development in demographic theories. The incentives for adopting spatial econometrics in Chapter 2 encourage researchers to think about questions regarding why neighbors are important and how spatial analysis helps test substantive hypotheses. With respect to the construction of spatial weight matrices, while the first order contiguity relationship is widely used, the spatial econometrics interaction model (Chapter 8) suggests that the spatial relationships among areas may be redefined with other meaningful rules, such as those based on a transportation network. A spatial weight matrix conceptually represents the researchers' beliefs for why and how space matters and computationally it plays a crucial role in the ML estimation process (Chapter 4). Following LeSage and Pace I expect future applications of spatial econometrics will pay more attention to the selection of the weight matrix and the theoretical process underlying models.

My third reason for believing LeSage and Pace will find shelf-space among demographers is due to the authors' explicit focus on modeling issues associated with space-time panel data and the special emphasis given to spatiotemporal variance-covariance structures. As indicated in Chapter 6, the increasing quality of cross-sectional spatial data over the past decade has aided in the development and use of novel regression models. That said, we can reasonably expect that space-time panel data will become readily available in the next decade. For example,

the US Census Bureau recently started releasing annual American Community Survey five-year estimates at different geographic levels. As many demographic data (e.g., fertility and mortality) are available annually, and increasingly for sub-national areas, these changes will increase the demand among demographers for efficient and effective analytic methods designed for space-time panel data. The development of spatiotemporal modeling will likely extend from the traditional spatial econometric models (e.g., SAR, and SEM) and their variance-covariance structures and in doing so "would ensure that space-time panel model specifications could be justified as arising from underlying space-time interactions that evolve over time to a steady state equilibrium (p.209)." Chapter 7 provides a clear direction for future studies and prepares spatial demographers for new type of data.

Despite the significant contributions this book will make, several limitations are noted. First, while the authors provide access to two toolboxes in MATLAB on their websites (*spatial econometrics* and *spatial statistics*) and assert that the examples in the book could be retrieved on-line, these toolboxes and commands are not closely linked to the empirical illustrations in the book. The readers must invest an additional effort to learn how to use the software and use the toolboxes and do so separate from the methodological explanations. A stronger link between the book and the MATLAB software would further popularize their toolboxes and the lessons in the book would be even more useful. Second, the core MATLAB platform has been updated twice a year, but these two toolboxes have not. The commands in these toolboxes may need to be revised to enhance the synergy of the book and toolboxes. Third, most examples illustrated in the book are economics-focused. While spatial demographers are not the target audience for this book, including examples from a greater variety of disciplines would have helped readers across the social sciences better appreciate the potential of spatial econometrics.

In sum, the discussions in LeSage and Pace's *Introduction to Spatial Econometrics* will benefit both macro and micro demographers. The text

will guide the former to consider why spatial analysis is special, and by extension to use and interpret spatial regression models appropriately. For the latter (as well as other researchers interested in spatial methods), the content of this book may open the door on thinking spatially, specifically integrating the concept of space into individual decision-making process studied throughout demography.

Tse-Chuan Yang

Director, Geographic Information Analysis Core,
Population Research Institute, Social Science
Research Institute, The Pennsylvania State
University.

References

- Anselin, L. 1988. *Spatial Econometrics: Methods and Models*. Dordrecht, The Netherlands: Kluwer Academic.
- Cressie, N. 1992. *Statistics for Spatial Data*. John Wiley, London, UK.
- Voss, P.R. 2007. Demography as a spatial social science. *Population Research and Policy Review*, 26(5): 457-476.

This text provides an introduction to spatial econometrics as well as a set of MATLAB functions that implement a host of spatial econometric estimation methods. The intended audience is faculty and students involved in modeling spatial data sets using spatial econometric methods. The MATLAB functions described in this book have been used in my own research as well as teaching both undergraduate and graduate econometrics courses.

Abstract. An introduction to spatial econometric models and methods is provided that discusses spatial autoregressive processes that can be used to extend conventional regression models. Estimation and interpretation of these models are illustrated with an applied example that examines the relationship between commuting to work times and transportation mode choice for a sample of 3,110 US counties in the year 2000. McCoy Endowed Chair for Urban and Regional Economics (*).

Key words : Spatial Econometrics, Spatial Dependence, Spatial Autoregressive Processes. Spatial econometrics is the field where spatial analysis and econometrics intersect. The term "spatial econometrics" was introduced for the first time by the Belgian economist Jean Paelinck (universally recognised as the father of the discipline) in the general address he delivered to the annual meeting of the Dutch Statistical Association in May 1974 (Paelinck and Klaassen, 1979). In general, econometrics differs from other branches of statistics in focusing on theoretical models, whose parameters