

# **SPATIAL ECONOMETRICS STATISTICAL FOUNDATIONS AND APPLICATIONS TO REGIONAL CONVERGENCE READ ONLY**

## **Spatial Econometrics**

This book bridges the gap between economic theory and spatial econometric techniques. It is accessible to those with only a basic statistical background and no prior knowledge of spatial econometric methods. It provides a comprehensive treatment of the topic, motivating the reader with examples and analysis. The volume provides a rigorous treatment of the basic spatial linear model, and it discusses the violations of the classical regression assumptions that occur when dealing with spatial data.

## **Spatial Econometrics**

Spatial Econometrics is a rapidly evolving field born from the joint efforts of economists, statisticians, econometricians and regional scientists. The book provides the reader with a broad view of the topic by including both methodological and application papers. Indeed the application papers relate to a number of diverse scientific fields ranging from hedonic models of house pricing to demography, from health care to regional economics, from the analysis of R&D spillovers to the study of retail market spatial characteristics. Particular emphasis is given to regional economic applications of spatial econometrics methods with a number of contributions specifically focused on the spatial concentration of economic activities and agglomeration, regional paths of economic growth, regional convergence of income and productivity and the evolution of regional employment. Most of the papers appearing in this book were solicited from the International Workshop on Spatial Econometrics and Statistics held in Rome (Italy) in 2006.

## **A Primer for Spatial Econometrics**

This book aims at meeting the growing demand in the field by introducing the basic spatial econometrics methodologies to a wide variety of researchers. It provides a practical guide that illustrates the potential of spatial econometric modelling, discusses problems and solutions and interprets empirical results.

## **Advances in Spatial Econometrics**

World-renowned experts in spatial statistics and spatial econometrics present the latest advances in specification and estimation of spatial econometric models. This includes information on the development of tools and software, and various applications. The text introduces new tests and estimators for spatial regression models, including discrete choice and simultaneous equation models. The performance of techniques is demonstrated through simulation results and a wide array of applications related to economic growth, international trade, knowledge externalities, population-employment dynamics, urban crime, land use, and environmental issues. An exciting new text for academics with a theoretical interest in spatial statistics and econometrics, and for practitioners looking for modern and up-to-date techniques.

## **Spatial Econometrics**

\u200bThis book provides an overview of three generations of spatial econometric models: models based on

cross-sectional data, static models based on spatial panels and dynamic spatial panel data models. The book not only presents different model specifications and their corresponding estimators, but also critically discusses the purposes for which these models can be used and how their results should be interpreted.

## **Spatial Econometrics**

Spatial Econometrics provides a modern, powerful and flexible skillset to early career researchers interested in entering this rapidly expanding discipline. It articulates the principles and current practice of modern spatial econometrics and spatial statistics, combining rigorous depth of presentation with unusual depth of coverage. Introducing and formalizing the principles of, and 'need' for, models which define spatial interactions, the book provides a comprehensive framework for almost every major facet of modern science. Subjects covered at length include spatial regression models, weighting matrices, estimation procedures and the complications associated with their use. The work particularly focuses on models of uncertainty and estimation under various complications relating to model specifications, data problems, tests of hypotheses, along with systems and panel data extensions which are covered in exhaustive detail. Extensions discussing pre-test procedures and Bayesian methodologies are provided at length. Throughout, direct applications of spatial models are described in detail, with copious illustrative empirical examples demonstrating how readers might implement spatial analysis in research projects. Designed as a textbook and reference companion, every chapter concludes with a set of questions for formal or self--study. Finally, the book includes extensive supplementing information in a large sample theory in the R programming language that supports early career econometricians interested in the implementation of statistical procedures covered. Combines advanced theoretical foundations with cutting-edge computational developments in R Builds from solid foundations, to more sophisticated extensions that are intended to jumpstart research careers in spatial econometrics Written by two of the most accomplished and extensively published econometricians working in the discipline Describes fundamental principles intuitively, but without sacrificing rigor Provides empirical illustrations for many spatial methods across diverse field Emphasizes a modern treatment of the field using the generalized method of moments (GMM) approach Explores sophisticated modern research methodologies, including pre-test procedures and Bayesian data analysis

## **Spatial Econometrics**

Spatial econometrics can be defined in a narrow and in a broader sense. In a narrow sense it refers to methods and techniques for the analysis of regression models using data observed within discrete portions of space such as countries or regions. In a broader sense it is inclusive of the models and theoretical instruments of spatial statistics and spatial data analysis to analyze various economic effects such as externalities, interactions, spatial concentration and many others. Indeed, the reference methodology for spatial econometrics lies on the advances in spatial statistics where it is customary to distinguish between different typologies of data that can be encountered in empirical cases and that require different modelling strategies. A first distinction is between continuous spatial data and data observed on a discrete space. Continuous spatial data are very common in many scientific disciplines (such as physics and environmental sciences), but are still not currently considered in the spatial econometrics literature. Discrete spatial data can take the form of points, lines and polygons. Point data refer to the position of the single economic agent observed at an individual level. Lines in space take the form of interactions between two spatial locations such as flows of goods, individuals and information. Finally data observed within polygons can take the form of predefined irregular portions of space, usually administrative partitions such as countries, regions or counties within one country.

## **Palgrave Handbook of Econometrics**

Following the seminal Palgrave Handbook of Econometrics: Volume I, this second volume brings together the finest academics working in econometrics today and explores applied econometrics, containing contributions on subjects including growth/development econometrics and applied econometrics and

computing.

## **Introduction to Spatial Econometrics**

Although interest in spatial regression models has surged in recent years, a comprehensive, up-to-date text on these approaches does not exist. Filling this void, *Introduction to Spatial Econometrics* presents a variety of regression methods used to analyze spatial data samples that violate the traditional assumption of independence between observat

## **Convergence Clubs and Spatial Externalities**

Do dynamic externalities, in the form of technology creation, adoption and spatial agglomeration shape the pattern of regional growth in Europe? This study provides an alternative view on regional convergence. A model is developed which attributes club-convergence to existing differences with respect to the degree of technology adoption. In the first instance, empirical results suggest that the NUTS-2 regions of the EU-27 converge at a very slow rate. Further tests, however, indicate that convergence is restricted to a specific subset of regions. Such conclusions are tested further, using an alternative model of club-convergence, which incorporates the impact of spatial interaction, agglomeration externalities and technology. This shows that the convergence-club in Europe follows a certain geographical pattern and all members share similar characteristics regarding technology creation and adoption, and agglomeration externalities. \u200b

## **A Primer for Spatial Econometrics**

This book aims at meeting the growing demand in the field by introducing the basic spatial econometrics methodologies to a wide variety of researchers. It provides a practical guide that illustrates the potential of spatial econometric modelling, discusses problems and solutions and interprets empirical results.

## **Advances in Contemporary Statistics and Econometrics**

This book presents a unique collection of contributions on modern topics in statistics and econometrics, written by leading experts in the respective disciplines and their intersections. It addresses nonparametric statistics and econometrics, quantiles and expectiles, and advanced methods for complex data, including spatial and compositional data, as well as tools for empirical studies in economics and the social sciences. The book was written in honor of Christine Thomas-Agnan on the occasion of her 65th birthday. Given its scope, it will appeal to researchers and PhD students in statistics and econometrics alike who are interested in the latest developments in their field.

## **Spatial Econometric Interaction Modelling**

This contributed volume applies spatial and space-time econometric methods to spatial interaction modeling. The first part of the book addresses general cutting-edge methodological questions in spatial econometric interaction modeling, which concern aspects such as coefficient interpretation, constrained estimation, and scale effects. The second part deals with technical solutions to particular estimation issues, such as intraregional flows, Bayesian PPML and VAR estimation. The final part presents a number of empirical applications, ranging from interregional tourism competition and domestic trade to space-time migration modeling and residential relocation.

## **Computational Science and Its Applications - ICCSA 2014**

The six-volume set LNCS 8579-8584 constitutes the refereed proceedings of the 14th International Conference on Computational Science and Its Applications, ICCSA 2014, held in Guimarães, Portugal, in

June/July 2014. The 347 revised papers presented in 30 workshops and a special track were carefully reviewed and selected from 1167. The 289 papers presented in the workshops cover various areas in computational science ranging from computational science technologies to specific areas of computational science such as computational geometry and security.

## **Resilience and Regional Development**

Interdisciplinary in its approach, with expert contributors from diverse backgrounds, Resilience and Regional Development brings to light the significance of multiple dimensions of resilience and its implications for the economy.

## **Geo-Informatics in Resource Management and Sustainable Ecosystem**

This volume constitutes the refereed proceedings of the Third International Conference on Geo-Informatics in Resource Management and Sustainable Ecosystem, GRMSE 2015, held in Wuhan, China, in October 2015. The 101 papers presented were carefully reviewed and selected from 321 submissions. The papers are divided into topical sections on Smart City in Resource Management and Sustainable Ecosystem; Spatial Data Acquisition Through RS and GIS in Resource Management and Sustainable Ecosystem; Ecological and Environmental Data Processing and Management; Advanced Geospatial Model and Analysis for Understanding Ecological and Environmental Process; Applications of Geo-Informatics in Resource Management and Sustainable Ecosystem.

## **Complexity and Geographical Economics**

The uneven geographical distribution of economic activities is a huge challenge worldwide and also for the European Union. In Krugman's New Economic Geography economic systems have a simple spatial structure. This book shows that more sophisticated models should visualise the EU as an evolving trade network with a specific topology and different aggregation levels. At the highest level, economic geography models give a bird eye's view of spatial dynamics. At a medium level, institutions shape the economy and the structure of (financial and labour) markets. At the lowest level, individual decisions interact with the economic, social and institutional environment; the focus is on firms' decision on location and innovation. Such multilevel models exhibit complex dynamic patterns – path dependence, cumulative causation, hysteresis – on a network structure; and specific analytic tools are necessary for studying strategic interaction, heterogeneity and nonlinearities.

## **Geographic Data Science with Python**

This book provides the tools, the methods, and the theory to meet the challenges of contemporary data science applied to geographic problems and data. In the new world of pervasive, large, frequent, and rapid data, there are new opportunities to understand and analyze the role of geography in everyday life. Geographic Data Science with Python introduces a new way of thinking about analysis, by using geographical and computational reasoning, it shows the reader how to unlock new insights hidden within data. Key Features: ? Showcases the excellent data science environment in Python. ? Provides examples for readers to replicate, adapt, extend, and improve. ? Covers the crucial knowledge needed by geographic data scientists. It presents concepts in a far more geographic way than competing textbooks, covering spatial data, mapping, and spatial statistics whilst covering concepts, such as clusters and outliers, as geographic concepts. Intended for data scientists, GIScientists, and geographers, the material provided in this book is of interest due to the manner in which it presents geospatial data, methods, tools, and practices in this new field.

## **Sampling Spatial Units for Agricultural Surveys**

The research and its outcomes presented here focus on spatial sampling of agricultural resources. The authors introduce sampling designs and methods for producing accurate estimates of crop production for harvests across different regions and countries. With the help of real and simulated examples performed with the open-source software R, readers will learn about the different phases of spatial data collection. The agricultural data analyzed in this book help policymakers and market stakeholders to monitor the production of agricultural goods and its effects on environment and food safety.

## **Geographical Labor Market Imbalances**

This book focuses on the questions of how territorial differences in productivity levels and unemployment rates arise in the first place and why territorial differences in labor market performance persist over time. Unemployment divergence and unemployment club convergence have been touched on in a large number of works and have recently also been studied using spatial econometric analysis. In this book we aim to develop the debate to include several important new topics, such as: the reasons why structural changes in some sectors cause slumps in some regions but not in others; the extent to which agglomeration factors explain regional imbalances; the degree of convergence / divergence across EU countries and regions; the role of labor mobility in reducing / increasing regional labor market imbalances; the impact of EU and country-level regional policy in stimulating convergence and the (unsatisfactory) role of active labor market policy in stimulating labor supply in the weakest economic areas.

## **Spatial Econometrics: Methods and Models**

Spatial econometrics deals with spatial dependence and spatial heterogeneity, critical aspects of the data used by regional scientists. These characteristics may cause standard econometric techniques to become inappropriate. In this book, I combine several recent research results to construct a comprehensive approach to the incorporation of spatial effects in econometrics. My primary focus is to demonstrate how these spatial effects can be considered as special cases of general frameworks in standard econometrics, and to outline how they necessitate a separate set of methods and techniques, encompassed within the field of spatial econometrics. My viewpoint differs from that taken in the discussion of spatial autocorrelation in spatial statistics - e.g., most recently by Cliff and Ord (1981) and Upton and Fingleton (1985) - in that I am mostly concerned with the relevance of spatial effects on model specification, estimation and other inference, in what I call a model-driven approach, as opposed to a data-driven approach in spatial statistics. I attempt to combine a rigorous econometric perspective with a comprehensive treatment of methodological issues in spatial analysis.

## **The Oxford Handbook of Quantitative Methods in Psychology: Vol. 2**

The Oxford Handbook of Quantitative Methods in Psychology provides an accessible and comprehensive review of the current state-of-the-science and a one-stop source for learning and reviewing current best-practices in a quantitative methods across the social, behavioral, and educational sciences.

## **Applied Evolutionary Economics and Economic Geography**

"The volume Applied Evolutionary Economics and Economic Geography is the fourth book published by Edward Elgar on applied evolutionary economics stems from the fourth European Meeting on Applied Evolutionary Economics (EMAAEE) held in Utrecht, 19-21 May, 2010."

## **Non-standard Spatial Statistics and Spatial Econometrics**

Despite spatial statistics and spatial econometrics both being recent sprouts of the general tree "spatial analysis with measurement"—some may remember the debate after WWII about "theory without

measurement" versus "measurement without theory"—several general themes have emerged in the pertaining literature. But exploring selected other fields of possible interest is tantalizing, and this is what the authors intend to report here, hoping that they will suscite interest in the methodologies exposed and possible further applications of these methodologies. The authors hope that reactions about their publication will ensue, and they would be grateful to reader(s) motivated by some of the research efforts exposed hereafter letting them know about these experiences.

## **Spatial Econometrics: Spatial Autoregressive Models**

This is the most recently developed book in Spatial Econometrics which cover important models and estimation methods. Its coverage is rather broad, and some of the topics covered have only been developed in the recent econometric literature in spatial econometrics. The book summarizes our devoted efforts on spatial econometrics that represent joint contributions with former PhD advisees from the Ohio State University in Columbus, Ohio, USA. The coverage is comprehensive and there are a total of sixteen chapters from basic statistics and statistical theory of linear-quadratic forms, law of large numbers (LLN) and central limit theory (CLT) on martingales to nonlinear spatial mixing and spatial near-epoch dependence theories, which can justify the statistic inferences for various spatial models and their estimation. New estimation and testing approaches in empirical likelihood and general empirical likelihood, and Bootstrapping are presented. Model selection is also discussed in this book. In addition to the popular spatial autoregressive models, there are chapters on multivariate SAR models, simultaneous SAR models, and panel dynamic spatial models. Recent econometric developments on intertemporal spatial models with rational expectations and flows data in trade theory will also be included. In terms of statistics, classical estimation, testing and inference are the main concerns, and we provide classical inference for the justification of Bayesian simulation approaches.

## **Cultural Heritage, Creativity and Economic Development**

The book explores the relationship between cultural heritage and local economic development by introducing the original idea that one possible mediator between the two can be identified as creativity. The book econometrically verifies this idea and demonstrates that cultural heritage, through its inspirational role on different creative talents, generates an indirect positive effect on local economic development. These results justify important new policy recommendations in the field of cultural heritage.

## **Time Series and Panel Data Econometrics**

This work describes and illustrates many advances that have taken place in a number of areas in theoretical and applied econometrics over the past four decades.

## **New Directions in Spatial Econometrics**

The promising new directions for research and applications described here include alternative model specifications, estimators and tests for regression models and new perspectives on dealing with spatial effects in models with limited dependent variables and space-time data.

## **Applied Spatial Statistics and Econometrics**

This textbook is a comprehensive introduction to applied spatial data analysis using R. Each chapter walks the reader through a different method, explaining how to interpret the results and what conclusions can be drawn. The author team showcases key topics, including unsupervised learning, causal inference, spatial weight matrices, spatial econometrics, heterogeneity and bootstrapping. It is accompanied by a suite of data and R code on Github to help readers practise techniques via replication and exercises. This text will be a valuable resource for advanced students of econometrics, spatial planning and regional science. It will also be

suitable for researchers and data scientists working with spatial data.

## **Encyclopedia of Geographic Information Science**

Geographic information science (GIScience) is an emerging field that combines aspects of many different disciplines. Spatial literacy is rapidly becoming recognized as a new, essential pier of basic education, alongside grammatical, logical and mathematical literacy. By incorporating location as an essential but often overlooked characteristic of what we seek to understand in the natural and built environment, geographic information science (GIScience) and systems (GISystems) provide the conceptual foundation and tools to explore this new frontier. The Encyclopedia of Geographic Information Science covers the essence of this exciting, new, and expanding field in an easily understood but richly detailed style. In addition to contributions from some of the best recognized scholars in GIScience, this volume contains contributions from experts in GIS' supporting disciplines who explore how their disciplinary perspectives are expanded within the context of GIScienceâ€"what changes when consideration of location is added, what complexities in analytical procedures are added when we consider objects in 2, 3 or even 4 dimensions, what can we gain by visualizing our analytical results on a map or 3D display? Key Features Brings together GIScience literature that is spread widely across the academic spectrum Offers details about the key foundations of GIScience, no matter what their disciplinary origins Elucidates vocabulary that is an amalgam of all of these fields Key Themes Conceptual Foundations Cartography and Visualization Design Aspects Data Manipulation Data Modeling Geocomputation Geospatial Data Societal Issues Spatial Analysis Organizational and Institutional Aspects The Encyclopedia of Geographic Information Science is an important resource for academic and corporate libraries.

## **Handbook of Applied Spatial Analysis**

The Handbook is written for academics, researchers, practitioners and advanced graduate students. It has been designed to be read by those new or starting out in the field of spatial analysis as well as by those who are already familiar with the field. The chapters have been written in such a way that readers who are new to the field will gain important overview and insight. At the same time, those readers who are already practitioners in the field will gain through the advanced and/or updated tools and new materials and state-of-the-art developments included. This volume provides an accounting of the diversity of current and emergent approaches, not available elsewhere despite the many excellent journals and te- books that exist. Most of the chapters are original, some few are reprints from the Journal of Geographical Systems, Geographical Analysis, The Review of Regional Studies and Letters of Spatial and Resource Sciences. We let our contributors - velop, from their particular perspective and insights, their own strategies for m- ping the part of terrain for which they were responsible. As the chapters were submitted, we became the first consumers of the project we had initiated. We gained from depth, breadth and distinctiveness of our contributors' insights and, in particular, the presence of links between them.

## **Spatial Econometrics**

General principles; Specification and identification; Estimation; Hypothesis testing and spatial autocorrelation; Some empirical results; Outlook.

## **Spatial Microeconometrics**

Spatial Microeconometrics introduces the reader to the basic concepts of spatial statistics, spatial econometrics and the spatial behavior of economic agents at the microeconomic level. Incorporating useful examples and presenting real data and datasets on real firms, the book takes the reader through the key topics in a systematic way. The book outlines the specificities of data that represent a set of interacting individuals with respect to traditional econometrics that treat their locational choices as exogenous and their economic behavior as independent. In particular, the authors address the consequences of neglecting such important

sources of information on statistical inference and how to improve the model predictive performances. The book presents the theory, clarifies the concepts and instructs the readers on how to perform their own analyses, describing in detail the codes which are necessary when using the statistical language R. The book is written by leading figures in the field and is completely up to date with the very latest research. It will be invaluable for graduate students and researchers in economic geography, regional science, spatial econometrics, spatial statistics and urban economics.

## **Regional Research Frontiers - Vol. 2**

This is the second volume in a two-part series on frontiers in regional research. It identifies methodological advances as well as trends and future developments in regional systems modelling and open science. Building on recent methodological and modelling advances, as well as on extensive policy-analysis experience, top international regional scientists identify and evaluate emerging new conceptual and methodological trends and directions in regional research. Topics such as dynamic interindustry modelling, computable general equilibrium models, exploratory spatial data analysis, geographic information science, spatial econometrics and other advanced methods are the central focus of this book. The volume provides insights into the latest developments in object orientation, open source, and workflow systems, all in support of open science. It will appeal to a wide readership, from regional scientists and economists to geographers, quantitatively oriented regional planners and other related disciplines. It offers a source of relevant information for academic researchers and policy analysts in government, and is also suitable for advanced teaching courses on regional and spatial science, economics and political science.

## **The Econometric Analysis of Non-Stationary Spatial Panel Data**

This monograph deals with spatially dependent nonstationary time series in a way accessible to both time series econometricians wanting to understand spatial econometrics, and spatial econometricians lacking a grounding in time series analysis. After charting key concepts in both time series and spatial econometrics, the book discusses how the spatial connectivity matrix can be estimated using spatial panel data instead of assuming it to be exogenously fixed. This is followed by a discussion of spatial nonstationarity in spatial cross-section data, and a full exposition of non-stationarity in both single and multi-equation contexts, including the estimation and simulation of spatial vector autoregression (VAR) models and spatial error correction (ECM) models. The book reviews the literature on panel unit root tests and panel cointegration tests for spatially independent data, and for data that are strongly spatially dependent. It provides for the first time critical values for panel unit root tests and panel cointegration tests when the spatial panel data are weakly or spatially dependent. The volume concludes with a discussion of incorporating strong and weak spatial dependence in non-stationary panel data models. All discussions are accompanied by empirical testing based on a spatial panel data of house prices in Israel.

## **Geospatial Technology for Human Well-Being and Health**

Over the last thirty years or so, there have been tremendous advancements in the area of geospatial health; however, somehow, two aspects have not received as much attention as they should have received. These are a) limitations of different spatial analytical tools and b) progress in making geospatial environmental exposure data available for advanced health science research and for medical practice. This edited volume addresses those two less explored areas of geospatial health with augmented discussions on the theories, methodologies and limitations of contemporary geospatial technologies in a wide range of applications related to human well-being and health. In 20 chapters, readers are presented with an up-to-date assessment of geospatial technologies with an emphasis on understanding general geospatial principles and methodologies that are often overlooked in the research literature. As a result, this book will be of interest to both newcomers and experts in geospatial analysis and will appeal to students and researchers engaged in studying human well-being and health. Chapters are presenting new concepts, new analytical methods and contemporary applications within the framework of geospatial applications in human well-being and health.



The topics addressed by the various chapter authors include analytical approaches, newer areas of geospatial health application, introduction to unique resources, geospatial modeling, and environmental pollution assessments for air, water and soil. Although geospatial experts are expected to be the primary readers, this book is designed in such a way so that the public health professionals, environmental health scientists and clinicians also find it useful with or without any familiarity with geospatial analysis.

## **Morphisms for Quantitative Spatial Analysis**

This book treats the notion of morphisms in spatial analysis, paralleling these concepts in spatial statistics (Part I) and spatial econometrics (Part II). The principal concept is morphism (e.g., isomorphisms, homomorphisms, and allomorphisms), which is defined as a structure preserving the functional linkage between mathematical properties or operations in spatial statistics and spatial econometrics, among other disciplines. The purpose of this book is to present selected conceptions in both domains that are structurally the same, even though their labelling and the notation for their elements may differ. As the approaches presented here are applied to empirical materials in geography and economics, the book will also be of interest to scholars of regional science, quantitative geography and the geospatial sciences. It is a follow-up to the book "Non-standard Spatial Statistics and Spatial Econometrics" by the same authors, which was published by Springer in 2011.

## **Econometric Advances in Spatial Modelling and Methodology**

The purpose of models is not to fit the data but to sharpen the questions. S. Karlin, 11th R. A. Fisher Memorial Lecture, Royal Society, 20 April 1983 We are proud to offer this volume in honour of the remarkable career of the Father of Spatial Econometrics, Professor Jean Paelinck, presently of the Tinbergen Institute, Rotterdam. Not one to model solely for the sake of modelling, the above quotation nicely captures Professor Paelinck's unceasing quest for the best question for which an answer is needed. His FLEUR model has sharpened many spatial economics and spatial econometrics questions! Jean Paelinck, arguably, is the founder of modern spatial econometrics, penning the seminal introductory monograph on this topic, Spatial Econometrics, with Klaassen in 1979. In the General Address to the Dutch Statistical Association, on May 2, 1974, in Tilburg, "he coined the term [spatial econometrics] to designate a growing body of the regional science literature that dealt primarily with estimation and testing problems encountered in the implementation of multiregional econometric models" (Anselin, 1988, p. 7); he already had introduced this idea in his introductory report to the 1966 Annual Meeting of the Association de Science Regionale de Langue Fran~aise.

## **Advanced Spatial Statistics**

In recent years there has been a growing interest in and concern for the development of a sound spatial statistical body of theory. This work has been undertaken by geographers, statisticians, regional scientists, econometricians, and others (e. g. , sociologists). It has led to the publication of a number of books, including Cliff and Ord's Spatial Processes (1981), Bartlett's The Statistical Analysis of Spatial Pattern (1975), Ripley's Spatial Statistics (1981), Paelinck and Klaassen's Spatial Economet~ics (1979), Ahuja and Schachter's Pattern Models (1983), and Upton and Fingleton's Spatial Data Analysis by Example (1985). The first of these books presents a useful introduction to the topic of spatial autocorrelation, focusing on autocorrelation indices and their sampling distributions. The second of these books is quite brief, but nevertheless furnishes an eloquent introduction to the relationship between spatial autoregressive and two-dimensional spectral models. Ripley's book virtually ignores autoregressive and trend surface modelling, and focuses almost solely on point pattern analysis. Paelinck and Klaassen's book closely follows an econometric textbook format, and as a result overlooks much of the important material necessary for successful spatial data analysis. It almost exclusively addresses distance and gravity models, with some treatment of autoregressive modelling. Pattern Models supplements Cliff and Ord's book, which in combination provide a good introduction to spatial data analysis. Its basic limitation is a preoccupation with the geometry of planar patterns, and hence is very

narrow in scope.

## **Spatial Econometrics and Spatial Statistics**

The field of spatial econometrics has come to include the methods and models that deal with estimation and testing problems encountered when attempting to implement regional economic models. Those problems are often characterized by the difficulties associated with assessing the importance of spatial dependence and spatial heterogeneity. This book includes contributions on spatial proximity, spatial patterning and in particular the spatial association (dependence) contained in local map patterns.

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