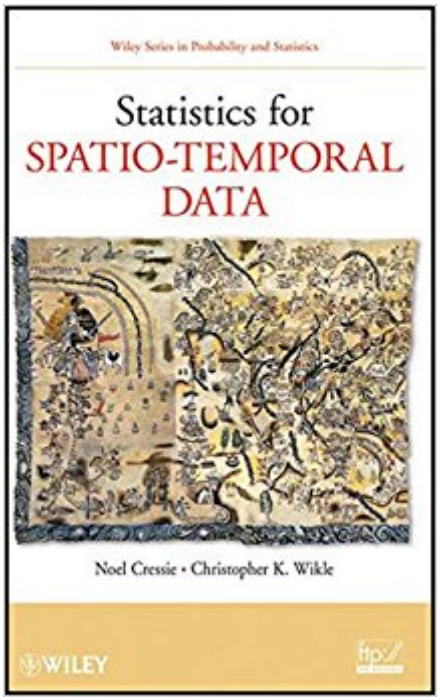
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Statistics For Spatio-Temporal Data



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Synopsis

Winner of the 2013 DeGroot Prize. A state-of-the-art presentation of spatio-temporal processes, bridging classic ideas with modern hierarchical statistical modeling concepts and the latest computational methods Noel Cressie and Christopher K. Wikle, are alsoÃ Â winners of the 2011 PROSE Award in the Mathematics category, for the book Ã¢â ¬Å“Statistics for Spatio-Temporal DataÃ¢â ¬Â• (2011), published by John Wiley and Sons. (The PROSE awards, for Professional and Scholarly Excellence, are given by the Association of American Publishers, the national trade association of the US book publishing industry.) Statistics for Spatio-Temporal Data has now been reprinted with small correctionsÃ Â to the text and theÃ Â bibliography. The overall content and pagination of the new printing remains the same; the differenceÃ Â comesÃ Â in the form of corrections to typographical errors, editing of incomplete and missing references, and some updated spatio-temporal interpretations. From understanding environmental processes and climate trends to developing new technologies for mapping public-health data and the spread of invasive-species, there is a high demand for statistical analyses of data that take spatial, temporal, and spatio-temporal information into account. Statistics for Spatio-Temporal Data presents a systematic approach to key quantitative techniques that incorporate the latest advances in statistical computing as well as hierarchical, particularly Bayesian, statistical modeling, with an emphasis on dynamical spatio-temporal models. Cressie and WikleÃ Â supply a unique presentation that incorporates ideas from the areas of time series and spatial statistics as well as stochastic processes. Beginning with separate treatments of temporal data and spatial data, the book combines these concepts to discuss spatio-temporal statistical methods for understanding complex processes. Topics of coverage include: Exploratory methods for spatio-temporal data, including visualization, spectral analysis, empirical orthogonal function analysis, and LISAs Spatio-temporal covariance functions, spatio-temporal kriging, and time series of spatial processes Development of hierarchical dynamical spatio-temporal models (DSTMs), with discussion of linear and nonlinear DSTMs and computational algorithms for their implementation Quantifying and exploring spatio-temporal variability in scientific applications, including case studies based on real-world environmental data Throughout the book, interesting applications demonstrate the relevance of the presented concepts. Vivid, full-color graphics emphasize the visual nature of the topic, and a related FTP site contains supplementary material. Statistics for Spatio-Temporal Data is an excellent book for a graduate-level course on spatio-temporal statistics. It is also a valuable reference for researchers and practitioners in the fields of applied mathematics, engineering, and the environmental and health sciences.

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Customer Reviews

Ã¢â ¬Å“It is a wonderful place to begin studying spatio-temporal processes.Ã¢â ¬Â•Ã Â (Mathematical Reviews Clippings, 1 January 2013) Ã¢â ¬Å“Overall, I believe this academic monograph would be an excellent reference book for researchers and graduate students who are interested in a systematic and indepth understanding of statistical approaches to spatio-temporal data analysis and modeling.Ã¢â ¬Â•Ã Â (Journal of the American Statistical Association, 15 March 2013) "Better than any other reference now available, Cressie and Wikle bridge the gap between applied science and modern inference.Ã Â This book is a must for any environmental scientist or engineer engaged in modeling and computation." - James S. Clark, H.L. Blomquist Professor of Environment, Duke University "The future lies at the intersection of a question in science or engineering, a process-based model intended to elucidate the question, and the statistical analysis of data to give us an idea of whether or not the model has done the job. This is what I call ’modeling the process, not just the data.’ Cressie and Wikle have provided a guidebook that will broadly appeal to the scientific community - from statistical neophytes to experts - and which will stand the test of time." - Marc Mangel, Distinguished Professor of Applied Mathematics and Statistics, University of California Santa Cruz "This book, written by two of the world’s leading experts on modeling environmental spatio-temporal processes, is a worthy successor to Cressie’s earlier classic on spatial statistics. Particularly noteable is its extensive coverage not found in any other book in statistical science, of hierarchical dynamic process modeling, a new frontier at the interface between the physical and statistical sciences. It takes us there with a most-justified excursion into

the world of methods such as the extended Kalman filter, sequential importance sampling, and INLA, that address the computational issues confronted at that frontier. This comprehensive, very readable treatment of hot areas of modern research and applications, is written with great clarity and insight. That and its coverage of a broad range of applications, will make it an essential and long-lived reference for statistical as well as non-statistical scientists alike." - Jim Zidek, Professor Emeritus and Fellow of the Royal Society of Canada, University of British Columbia "This book is by far the most comprehensive treatment available on the statistics of spatio-temporal processes and will surely become a standard reference in the field. After extensive surveys of time series analysis and traditional spatial statistics, the authors develop spatio-temporal analysis through a series of chapters covering empirical and exploratory methods, followed by probability models for spatio-temporal processes, and then three chapters on the hierarchical dynamical approach which has been at the core of their own contributions since the late 1990s. Throughout the book, they develop the methods through detailed descriptions of computational algorithms, leading up to a final chapter that discusses in-depth applications to predicting sea-surface temperatures and wind speeds, remote-sensing measures of atmospheric particles, and bird migration. Every researcher involved in the analysis of large-scale environmental datasets should own a copy of this book." - Richard L. Smith, Distinguished Professor of Statistics, University of North Carolina at Chapel Hill, and Director, Statistical and Applied Mathematical Sciences Institute (SAMSI)

"Better than any other reference now available, Cressie and Wikle bridge the gap between applied science and modern inference. This book is a must for any environmental scientist or engineer engaged in modeling and computation." Ã¢â ¬â •James S. Clark, H.L. Blomquist Professor of Environment, Duke University "The future lies at the intersection of a question in science or engineering, a process-based model intended to elucidate the question, and the statistical analysis of data to give us an idea of whether or not the model has done the job. This is what I call ’modeling the process, not just the data.’ Cressie and Wikle have provided a guidebook that will broadly appeal to the scientific community - from statistical neophytes to experts - and which will stand the test of time." Ã¢â ¬â •Marc Mangel, Distinguished Professor of Applied Mathematics and Statistics, University of California Santa Cruz "This book, written by two of the world’s leading experts on modeling environmental spatio-temporal processes, is a worthy successor to Cressie’s earlier classic on spatial statistics. Particularly noteable is its extensive coverage not found in any other book in statistical science, of hierarchical dynamic process modeling, a new frontier at the interface between the physical and statistical sciences. It takes us there with a most-justified excursion into

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While they tried to make an effort in having all the major formulas in picture format so that the formatting is somewhat preserved from the hard copy to the electronic version, the latter has lots of problems. A lot of the mathematical assumption and conditions embedded in the text were at best badly typesetted or have missing character and/or part of the equations. I bought the book for my pdD research, and all the missing information renders this book not quite useless but close. At this level, and for the price, (the electronic version is almost the same price than the printed version minus a couple dollars) I should have received the book in its integrity, not a sub-version of it with blanks to fill-in. The only reason I did not give this book less than 3 stars was because i checked the printed version and it seems pretty good. This e-book needs to be fixed.

This book contains some interesting topics like Kriging method and Kalman filtering. These two topics currently are used in Meteorological operation units, but not so many Meteorologists are familiar with. The authors combining the differential equations and probability models are very good

try especially using different typing colors for different models; e.g. blue for process, green for data, red for posterior. However, the derivations of the equations are not so clear. The authors neither gave more details about the equations nor introduced the background motivations; for example, not introduce Kalman filtering's covariance update form from where. After all, this is a book not a journal papers. Anyway, I anticipate the next edition and hope the authors can discuss these things more.On the other hand, not about the contents of the book, the printing quality of the book is not good. It seems just using low-end and low-resolution laser printer to print this book. The words are blurred, and probably one droplet water can make the words faint. Also, the layout is poor like the lectures in class. I totally agree with one previous reviewer saying the bad printing quality of this book.

This is a massive, and authoritative treatise on spatio-temporal statistics. It focuses on formal mathematical treatments, and the maths can be intense, but if you really want to understand the theoretical underpinnings, and the tradeoffs between different approaches, this is a great book.I really like the attention to detail and couching everything in terms a hierarchy of models: Data (the connection between your actual measured values and the underlying "real" quantities), Process (the connection between the "real" quantities and the processes that create them), and Parameters (the parameters that characterize the process; the parameter model is intimately related to Bayesian priors). Cressie and Wikle's clarity about the distinctions between these different levels in the hierarchy really help me to clearly understand things that are blurred in other treatments.The authors take a largely Bayesian approach to modeling and analysis and present it clearly and compellingly. If you're serious about working with spatiotemporal data, this book belongs right next to Box and Jenkins on your bookshelf.

Cressie and Wikle's book is one of the first to address space time models from a statistical point a view and using many of the latest statistical models (the soon to be updated 2003 book Hierarchical Modeling and Analysis for Spatial Data also covered the topic). Hierarchical space time models, Dynamical linear models, incorporating scientific knowledge into your statistical model, and handling massive data by using Fixed Rank Kriging are some of the topics covered. However, there are many intricacies that need to be addressed when modelling spatial data or temporal data. So writing a book covering data using both indices is no easy task. The task to write a book on spatio-temporal models only becomes harder when the goal is to cover the topic from a Bayesian point of view (a field of analysis with its own intricacies that need to be addressed). I believe the authors did a good

job in presenting some of the latest space-time models proposed in research. However, there are big issues that are not covered in the book.- The importance of convergence diagnostics for Bayesian models must be emphasized one way or another when discussing these types of methods. The book pretty much does not touch on convergence at all.- Research has shown that Matern covariance parameters such as the smoothing parameter and the range, cannot be consistently estimated. This may lead to convergence problems when using MCMC techniques to extract characteristics from the posteriors of these parameters of interest (I found out about this the hard way as a grad student). As a result, at best, only partially reliable inference from your Bayesian analysis may be obtained, a disappointing fact given how computationally intensive Bayesian methods are for space-time models. Considering the major issue, space-time Bayesian models can hardly be called state of the art (as tagged several times in the book). Sadly, this convergence issue is not mentioned at all in the book which would lead to frustration for those constructing these models to try to understand a process of interest.- Kriging is referred to as the Best Linear Unbiased Predictor. In theory this is true, but this is assuming the spatial covariance parameters are known, which is not really the case in practice. Although this often does not affect much the results if the Gaussian distribution assumption holds, it may drastically affect prediction variances for non-Normal distributions. Cressie has done work on the subject. It appears this issue is not discussed in the book though and if so, it should be clearly emphasized.- Fixed Rank Kriging (FRK) is referred to as a best linear unbiased predictor. Is it not! In fact, since in practice kriging is often implemented by plugging in estimated parameters into the equations (making the the resulting estimated best linear unbiased predictor an approximation), FRK is truly an approximation of an approximation of the best linear unbiased predictor.The book proposes its methods as a way to conduct science the way it ought to be: in a critical way, transparent, reproducible and in an objective manner. But the points brought up above makes the book a bit disappointing since it is not critical about the methods that are proposed, which although useful, are certainly not perfect. If there is a new edition in the future, I suggest the authors cover some important material left out and also address some challenges faced when implementing these methods.

This book is really hard to read. It may be written especially for statisticians, not general graduate students or researchers.

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