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# Stochastic Processes In Demography And Applications

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Population Aging, Mortality and Data Analysis

The Health State Function of a Population

An Introduction

Applied Stochastic Processes

Complexity, Language, and Life: Mathematical Approaches

A Biostatistical and Population Oriented Approach

Stochastic Processes for Spatial Econometrics

The Elements of Stochastic Processes with Applications to the Natural Sciences

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Stochastic Population Processes

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Survival and Event History Analysis

Applications of Stochastic Processes to Demography

Stochastic Modeling and the First Exit Time Theory in Demography

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## **DARRYL DAUGHERTY**

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### **Population Aging, Mortality and Data Analysis** CRC Press

This book provides new theories, applications and quantitative methods in demography, population studies and statistics. It presents and applies data analysis, statistics and stochastic modeling techniques focusing on demography, population aging, mortality and health sciences. The book describes diverse stochastic processes as well as Markov and semi-Markov models in demography and population studies, along with chapters on statistical models and methods in biostatistics and epidemiology. As such the book will be a valuable source to demographers, health scientists, statisticians, economists and sociologists.

### **The Health State Function of a Population** Springer Science & Business Media

The aim of this book is to bridge the gap between standard textbook models and a range of models where the dynamic structure of the data manifests itself fully. The common denominator of such models is stochastic processes. The authors show how counting processes, martingales, and stochastic integrals fit very nicely with censored data. Beginning with standard analyses such as Kaplan-Meier plots and Cox regression, the presentation progresses to the additive hazard model and recurrent event data. Stochastic processes are also used as natural models for individual frailty; they allow sensible interpretations of a number of surprising artifacts seen in population data. The stochastic process framework is naturally connected to causality. The authors show how dynamic path analyses can incorporate many modern causality ideas in a framework that takes the time aspect seriously. To make the material accessible to the reader, a large number of practical examples, mainly from medicine, are developed in detail. Stochastic processes are introduced in an intuitive and non-technical manner. The book is aimed at investigators who use event history methods and want a better understanding of the statistical concepts. It is suitable as a textbook for graduate courses in statistics and biostatistics.

### *An Introduction* John Wiley & Sons

This book presents a self-contained introduction to stochastic processes with emphasis on their applications in science, engineering, finance, computer science, and operations research. It provides theoretical foundations for modeling time-dependent random phenomena in these areas and illustrates their application by analyzing numerous practical examples. The treatment assumes few prerequisites, requiring only the standard mathematical maturity acquired by undergraduate applied science students. It includes an introductory chapter that summarizes the basic probability theory needed as background. Numerous exercises reinforce the concepts and techniques discussed and allow readers to assess their grasp of the subject. Solutions to most of the exercises are provided in an appendix. While focused primarily on practical aspects, the presentation includes some important proofs along with more challenging examples and exercises for those more theoretically inclined. Mastering the contents of this book prepares readers to apply stochastic modeling in their own fields and enables them to work more creatively with software designed for dealing with the data analysis

aspects of stochastic processes.

### *Applied Stochastic Processes* John Wiley & Sons

The vast majority of random processes in the real world have no memory - the next step in their development depends purely on their current state. Stochastic realizations are therefore defined purely in terms of successive event-time pairs, and such systems are easy to simulate irrespective of their degree of complexity. However, whilst the associated probability equations are straightforward to write down, their solution usually requires the use of approximation and perturbation procedures. Traditional books, heavy in mathematical theory, often ignore such methods and attempt to force problems into a rigid framework of closed-form solutions. This text, strongly oriented towards problem solving, has three aims. First, basic analytic tools are introduced through a suite of stochastic processes which do possess relatively simple closed-form solutions. Second, techniques are presented that enable the extraction of considerable behavioral information even when exact probability structures are intractable to direct solution. Third, a range of simulation procedures is proposed which provide insight into the way that particular systems develop - these often expose hitherto unforeseen features and thereby suggest further lines of exploration. Although the examples are slanted towards ecological and physical applications, only a little imagination is required in order to apply the techniques to problems generic to engineering, chemistry and finance. Indeed, the book provides a rich source of ideas for anyone working with random processes who is prepared to take a flexible approach. Many aspects of population dynamics are covered, including: general birth-death and power-law processes; random and correlated walks; Markov chains; perturbation and saddlepoint techniques; Wiener, Fokker-Planck and Ornstein-Uhlenbeck diffusion processes; general bivariate processes, including predator-prey, competition, epidemic, cumulative size and counting systems; MCMC and simulation techniques; and velocities, dynamic structure, Turing ring systems and cellular automata for spatial-temporal systems. Extensions include fractal structure from power-law contact distributions, and marked point processes. Since little of the material is covered at a deep mathematical level, the book will be readily accessible to a wide range of researchers and practitioners, and provides an excellent basis for constructing novel undergraduate and postgraduate courses in applied probability. The unified approach exposes the high degree of linkage that exists between apparently unconnected processes. The book can also be treated as a toolbox to be dipped into in order to select specific analytic and computational techniques.

### Complexity, Language, and Life: Mathematical Approaches New Age International

AIDS (autoimmune deficiency syndrome) is a devastating human disease caused by HIV, a human immunodeficiency virus, which may be transmitted by either sexual or other contacts in which body fluids are exchanged. Cases of AIDS have been reported in a majority of countries throughout the world, indicating that the HIV/AIDS epidemic is international in scope. This book deals with the mathematical and statistical techniques underlying the models used to understand the population dynamics of not only HIV/AIDS but also other infectious diseases. Attention is given to the development strategies for the prevention and control of the international epidemic within the

frameworks of the models. Two distinguishing features of the book are the incorporation of stochastic and deterministic formulations within a unifying conceptual framework and the discussion of issues related to the mathematical designs of models, which are necessary for the rigorous utilization of computer-intensive methods. The book will be of value to applied mathematicians, biomathematicians, biostatisticians, epidemiologists and other scientists interested in applying mathematics and computers to not only the HIV/AIDS epidemic but also other fields of epidemiology.

**A Biostatistical and Population Oriented Approach** Elsevier

According to a recent report of the United States Census Bureau, world population as of June 30, 1983, was estimated at about 4.7 billion people; of this total, an estimated 82 million had been added in the previous year. World population in 1950 was estimated at about 2.5 billion; consequently, if 82 million people are added to the world population in each of the coming four years, population size will be double that of 1950. Another way of viewing the yearly increase in world population is to compare it to 234 million, the estimated current population of the United States. If the excess of births over deaths continues, a group of young people equivalent to the population of the United States will be added to the world population about every 2.85 years. Although the rate of increase in world population has slowed since the midsixties, it seems likely that large numbers of infants will be added to the population each year for the foreseeable future. A large current world population together with a high likelihood of substantial increments in size every year has prompted public and scholarly recognition of population as a practical problem. Tangible evidence in the public domain that population is being increasingly viewed as a problem is provided by the fact that many governments around the world either have or plan to implement policies regarding population. Evidence of scholarly concern is provided by an increasing flow of publications dealing with population.

**Stochastic Processes for Spatial Econometrics** Wiley Eastern Limited

This book is the first one in which basic demographic models are rigorously formulated by using modern age-structured population dynamics, extended to study real-world population problems. Age structure is a crucial factor in understanding population phenomena, and the essential ideas in demography and epidemiology cannot be understood without mathematical formulation; therefore, this book gives readers a robust mathematical introduction to human population studies. In the first part of the volume, classical demographic models such as the stable population model and its linear extensions, density-dependent nonlinear models, and pair-formation models are formulated by the McKendrick partial differential equation and are analyzed from a dynamical system point of view. In the second part, mathematical models for infectious diseases spreading at the population level are examined by using nonlinear differential equations and a renewal equation. Since an epidemic can be seen as a nonlinear renewal process of an infected population, this book will provide a natural unification point of view for demography and epidemiology. The well-known epidemic threshold principle is formulated by the basic reproduction number, which is also a most important key index in demography. The author develops a universal theory of the basic reproduction number in heterogeneous environments. By introducing the host age structure, epidemic models are developed into more realistic demographic formulations, which are essentially needed to attack urgent epidemiological control problems in the real world.

The Elements of Stochastic Processes with Applications to the Natural Sciences ISAST

This monograph presents a general methodology which is shown to be valid in the analysis of spatial point structures and that is certainly easier to use by non-expert researchers coming from other applied sciences than other much modern techniques. We suggest that the local conditioning approach has the advantage that it is statistically efficient, easy to correct for edge-effects and provides similar results than other (more complicated) likelihood-based methods. We show a mathematical justification to prove that any purely inhibitory pairwise interaction point process (pipp) can be obtained as the limit of a sequence of auto-Poisson lattice schemes and within this context we develop the pseudolikelihood estimating equations. We particularly focus on developing a Monte Carlo simulation study to analyze the behaviour of the parameter  $s$  of a particular pipp model derived using this technique. We also stress that this methodology has a wide range of applications in many fields, particularly in economy and demography.

*Stochastic Processes in Demography and Applications* MDPI

This book presents a new approach to the subject of cosmology. It fully exploits Einstein's theory of general relativity. It is found that the most general formal expression of the theory replaces the (10-component) tensor formalism with a (16-component) quaternion formalism. This leads to a unified field theory, where one field incorporates gravitation and electromagnetism. The theory predicts an oscillating universe cosmology with a spiral configuration. Dark matter is explained in terms of a sea of particle-antiparticle pairs, each in a particular (derived) ground state. This leads to an explanation for the separation between matter and antimatter in the universe. There is a brief discussion of black holes and pulsars. The final chapter delves into philosophical considerations such as the different types of 'truth', positivism versus realism and a discussion of the role of the Mach principle in physics and cosmology./a

Analysis, Approximations, Simulations Oxford University Press

This sequel to volume 19 of Handbook on Statistics on Stochastic Processes: Modelling and Simulation is concerned mainly with the theme of reviewing and, in some cases, unifying with new ideas the different lines of research and developments in stochastic processes of applied flavour. This volume consists of 23 chapters addressing various topics in stochastic processes. These include, among others, those on manufacturing systems, random graphs, reliability, epidemic modelling, self-similar processes, empirical processes, time series models, extreme value theory, applications of Markov chains, modelling with Monte Carlo techniques, and stochastic processes in subjects such as engineering, telecommunications, biology, astronomy and chemistry. particular with modelling, simulation techniques and numerical methods concerned with stochastic processes. The scope of the project involving this volume as well as volume 19 is already clarified in the preface of volume 19. The present volume completes the aim of the project and should serve as an aid to students, teachers, researchers and practitioners interested in applied stochastic processes.

**Stochastic Processes In Demography & Applications** Springer

Applied Probability and Stochastic Processes, Second Edition presents a self-contained introduction to elementary probability theory and stochastic processes with a special emphasis on their applications in science, engineering, finance, computer science, and operations research. It covers the theoretical foundations for modeling time-dependent random phenomena in these areas and

illustrates applications through the analysis of numerous practical examples. The author draws on his 50 years of experience in the field to give your students a better understanding of probability theory and stochastic processes and enable them to use stochastic modeling in their work. New to the Second Edition Completely rewritten part on probability theory—now more than double in size New sections on time series analysis, random walks, branching processes, and spectral analysis of stationary stochastic processes Comprehensive numerical discussions of examples, which replace the more theoretically challenging sections Additional examples, exercises, and figures Presenting the material in a student-friendly, application-oriented manner, this non-measure theoretic text only assumes a mathematical maturity that applied science students acquire during their undergraduate studies in mathematics. Many exercises allow students to assess their understanding of the topics. In addition, the book occasionally describes connections between probabilistic concepts and corresponding statistical approaches to facilitate comprehension. Some important proofs and challenging examples and exercises are also included for more theoretically interested readers.

*Advances In Mathematical Population Dynamics -- Molecules, Cells And Man - Proceedings Of The 4th International Conference On Mathematical Population Dynamics* Cambridge University Press

The scope of this book is the field of evolutionary genetics. The book contains new methods for simulating evolution at the genomic level. It sets out applications using up to date Monte Carlo simulation methods applied in classical population genetics, and sets out new fields of quantifying mutation and selection at the Mendelian level. A serious limitation of Wright-Fisher process, the assumption that population size is constant, motivated the introduction of self regulating branching processes in this book. While providing a short review of the principles of probability and its application and using computer intensive methods whilst applying these principles, this book explains how it is possible to derive new formulas expressed in terms of matrix algebra providing new insights into the classical Wright-Fisher processes of evolutionary genetics. Also covered are the development of new methods for studying genetics and evolution, simulating nucleotide substitutions of a DNA molecule and on self regulating branching processes. Components of natural selection are studied in terms of reproductive success of each genotype whilst also studying the differential ability of genotypes to compete for resources and sexual selection. The concept of the gene is also reviewed in this book, and it provides a current definition of a gene based on very recent experiments with micro-array technologies. A development of stochastic models for simulating the evolution of model genomes concludes the studies in this book. Deserving of a place on the book shelves of workers in biomathematics, applied probability, stochastic processes and statistics, as well as in bioinformatics and phylogenetics, it will also be relevant to those interested in computer simulation, and evolutionary biologists interested in quantitative methods.

Multi-State Survival Models for Interval-Censored Data CRC Press

The Health State Function of a Population This book will inspire colleagues in applying, developing and expanding the theoretical and practical issues related to the health state of the population and to improve forecasts related to the life expectancy and the healthy life span. The Second Edition of the book includes four more chapters presenting very important theoretical and applied work. The book deals with the theory related to the health state of a population and the introduced health state function. The book presents and applies the stochastic modeling techniques and the first exit

time theory in demography along with the healthy life expectancy estimates and a derivation and classification of the human development stages. The data fitting techniques and the related programs are also presented. Many new and old terms are explored and quantitatively estimated especially the health state or the “vitality” of a population, the Deterioration and the related function and the Healthy Life Expectancy. A method for estimating the total loss of healthy life years with applications and comparisons for the healthy life expectancy in UK, Scotland, Sweden, and in the US States is added. A new Quantitative Method for Estimating the Human Development Stages based on the Health State Function Theory and the Resulting Deterioration Process is also included. The book is addressed to demographers, actuaries, statisticians, applied mathematicians, sociologists, psychologists, economists, health scientists, biologists, policy makers and scientists and practitioners of very many fields. Attention was given to prepare the material for readers from multidisciplinary fields thus including the appropriate formulas and mathematical typos along with many applications from computer programs in Excel. Read this book and share with us a fascinating exploration on life table data and the underlying information on human health state.

*Stochastic Processes in Demography and Their Computer Implementation* Springer Science & Business Media

*Stochastic Processes in Demography and Applications* *Stochastic Processes in Demography and Applications* *Stochastic Processes in Demography and Their Computer Implementation* Springer Science & Business Media

**Theory for Applications** World Scientific

This book is an extension of the author's former work *Stochastic Processes in Demography and Applications*. This extension expands the scope of the earlier book to focus on and encompass the various techniques of applied stochastic processes with orientation or emphasis on biostatistics including statistical genetics and survival analysis.

*with Special Emphasis on Insects* Springer Science & Business Media

Develops an introductory and relatively simple account of the theory and application of the evolutionary type of stochastic process. Professor Bailey adopts the heuristic approach of applied mathematics and develops both theoretical principles and applied techniques simultaneously.

*Stochastic Population Processes* CRC Press

Stochastic processes have wide relevance in mathematics both for theoretical aspects and for their numerous real-world applications in various domains. They represent a very active research field which is attracting the growing interest of scientists from a range of disciplines. This Special Issue aims to present a collection of current contributions concerning various topics related to stochastic processes and their applications. In particular, the focus here is on applications of stochastic processes as models of dynamic phenomena in research areas certain to be of interest, such as economics, statistical physics, queuing theory, biology, theoretical neurobiology, and reliability theory. Various contributions dealing with theoretical issues on stochastic processes are also included.

Stochastic Processes in Demography and Applications CRC Press

There is probably no more appropriate location to hold a course on mathematical ecology than Italy, the country of Vito Volterra, a founding father of the subject. The Trieste 1982 Autumn Course on

Mathematical Ecology consisted of four weeks of very concentrated scholasticism and aestheticism. The first weeks were devoted to fundamentals and principles of mathematical ecology. A nucleus of the material from the lectures presented during this period constitutes this book. The final week and a half of the Course was apportioned to the Trieste Research Conference on Mathematical Ecology whose proceedings have been published as Volume 54, Lecture Notes in Biomathematics, Springer-Verlag. The objectives of the first portion of the course were ambitious and, probably, unattainable. Basic principles of the areas of physiological, population, community, and ecosystem ecology that have solid ecological and mathematical foundations were to be presented. Classical terminology was to be introduced, important fundamental topics were to be developed, some past and some current problems of interest were to be presented, and directions for possible research were to be provided. Due to time constraints, the coverage could not be encyclopedic; many areas covered already have merited treatises of book length. Consequently, preliminary foundation material was covered in some detail, but subject overviews and area syntheses were represented when research frontiers were being discussed. These lecture notes reflect this course philosophy.

[Demography and Health Issues](#) Wiley

This definitive textbook provides a solid introduction to discrete and continuous stochastic processes, tackling a complex field in a way that instills a deep understanding of the relevant mathematical principles, and develops an intuitive grasp of the way these principles can be applied to modelling real-world systems. It includes a careful review of elementary probability and detailed

coverage of Poisson, Gaussian and Markov processes with richly varied queuing applications. The theory and applications of inference, hypothesis testing, estimation, random walks, large deviations, martingales and investments are developed. Written by one of the world's leading information theorists, evolving over twenty years of graduate classroom teaching and enriched by over 300 exercises, this is an exceptional resource for anyone looking to develop their understanding of stochastic processes.

*mathematical population dynamics* Gulf Professional Publishing

This is the first book to comprehensively apply the fundamental tools and concepts of demography to a nonhuman species. It provides clear and concise treatment of standard demographic techniques such as life table analysis and population projection; introduces models that have seldom appeared outside of the demographic literature including the multiple decrement life table, the intrinsic sex ratio, and multiregional demography; and addresses demographic problems that are unique to nonhuman organisms such as the demographic theory of social insects and harvesting techniques applied to insect mass rearing. The book also contains a synthesis of fundamental properties of population such as momentum and convergence to the stable age distribution, with a section on the unity of demographic models, and appendices detailing analytical methods used to quantify and model the data gathered in a ground-breaking study on the mortality experience of 1.2 million medflies. Based on an insect demography course at the University of California, Davis, the book is intended for practicing entomologists, population biologists, and ecologists for use in research or as a graduate text.

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