Mathematical Models In Population Biology And Epidemiology Texts In Applied Mathematics

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A Course in Mathematical Biology

SIAM

This work reflects sixteen hours of lectures delivered by the author at the 2009 St Flour summer school in probability. It provides a rapid introduction to a range of mathematical models that have their origins in theoretical population genetics. The models fall into two classes: forwards in time models for the evolution of frequencies of different genetic types in a population; and backwards in time (coalescent) models that trace out the genealogical relationships between individuals in a sample from the population. Some, like the classical Wright-Fisher model, date right back to the origins of the subject. Others, like the multiple merger coalescents or the spatial Lambda-Fleming-Viot process are much more recent. All share a rich mathematical structure. Biological terms are explained, the models are carefully motivated and tools for their study are presented systematically.

Mathematical Models in Population Biology

SIAM

An introduction to the mathematical concepts and techniques needed for the construction and analysis of models in molecular systems biology. Systems techniques are integral to current research in molecular cell biology, and system-level investigations are often accompanied by mathematical models. These models serve as working hypotheses: they help us to understand and predict the behavior of complex systems. This book offers an introduction to mathematical concepts and techniques needed for the construction and interpretation of models in molecular systems biology. It is accessible to upper-level undergraduate or graduate students in life science or engineering who have some familiarity with calculus, and will be a useful reference for researchers at all levels. The first four chapters cover the basics of mathematical modeling in molecular systems biology. The last four chapters address specific biological domains, treating modeling of metabolic networks, of signal transduction pathways,

of gene regulatory networks, and of electrophysiology and neuronal action potentials. Chapters 3–8 end with optional sections that address more specialized modeling topics. Exercises, solvable with pen-and-paper calculations, appear throughout the text to encourage interaction with the mathematical techniques. More involved end-of-chapter problem sets require computational software. Appendixes provide a review of basic concepts of molecular biology, additional mathematical background material, and tutorials for two computational software packages (XPPAUT and MATLAB) that can be used for model simulation and analysis.

Spatial Models and Biomedical Applications MIT Press
Mathematical Models for Society and Biology, 2e, is a useful resource for researchers, graduate students, and post-docs in the applied mathematics and life science fields. Mathematical modeling is one of the major subfields of mathematical biology. A mathematical model may be used to help explain a system, to study the effects of different components, and to make predictions about behavior. Mathematical Models for Society and Biology, 2e, draws on current issues to engagingly relate how to use mathematics to gain insight into problems in biology and contemporary society. For this new edition, author Edward Beltrami uses mathematical models that are simple, transparent, and verifiable. Also new to this edition is an introduction to mathematical notions that every quantitative scientist in the biological and social sciences should know. Additionally, each chapter now includes a detailed discussion on how to formulate a reasonable model to gain insight into the specific question that has been introduced. Offers 40% more content – 5 new chapters in addition to revisions to existing chapters Accessible for quick self study as well as a resource for courses in molecular biology, biochemistry, embryology and cell biology, medicine, ecology and evolution, bio-mathematics, and applied math in general Features expanded appendices with an extensive list of references, solutions to selected exercises in the book, and further discussion of various mathematical methods introduced in the book

With Applications for the Social Sciences Springer Verlag
Linear and non-linear models of populations, molecular evolution, phylogenetic tree construction, genetics, and infectious diseases are presented with minimal prerequisites.

John Wiley & Sons
This is the only book that teaches all aspects of modern mathematical modeling and that is specifically designed to introduce undergraduate students to problem solving in the context of biology. Included is an integrated package of theoretical modeling and analysis tools, computational modeling techniques, and parameter estimation and model validation methods, with a focus on integrating analytical and computational tools in the modeling of biological processes. Divided into three parts, it covers basic analytical modeling techniques; introduces computational tools used in the modeling of biological problems; and includes various problems from epidemiology, ecology, and physiology. All chapters include realistic biological examples, including many exercises related to biological questions. In addition, 25 open-ended research projects are provided, suitable for students. An accompanying Web site contains solutions and a tutorial for the implementation of the computational modeling techniques. Calculations can be done in modern computing languages such as Maple, Mathematica, and MATLAB?.

Mathematical Population Dynamics and Epidemiology in Temporal and Spatio-Temporal Domains Cambridge University Press
This book uses fundamental ideas in dynamical systems to answer questions of a biologic nature, in particular, questions about the behavior of populations given a relatively few hypotheses about the nature of their growth and interaction. The principal subject treated is that of coexistence under certain parameter ranges, while asymptotic methods are used to show competitive exclusion in other parameter ranges. Finally, some problems in genetics are posed and analyzed as problems in nonlinear ordinary differential equations.

Some Mathematical Models from Population Genetics Academic Press
The aim of this book is to build a fundamental understanding in Mathematical Biology, Epidemiology and Ecology. Written for biologists, mathematicians, applied statisticians and physicists, Mathematical Models in Population Biology: Essential Concepts in Biomathematicsprovides a coverage of different topics in mathematical biology from vector-borne diseases, fractional calculus, and stochastic differential equations to neuro-dynamics, illustrating some important models used for real data.

Mathematical Models in Population Biology and Epidemiology Springer Science & Business Media
This volume unifies population studies emphasising the interplay between modelling and experimentation.

Methodological Investigations in Agent-Based Modelling Springer Science & Business Media
Mathematical Models in Biology is an introductory book for readers interested in biological applications of mathematics and modeling in biology. A favorite in the mathematical biology community, it shows how relatively simple mathematics can be applied to a variety of models to draw interesting conclusions. Connections are made between diverse biological examples linked by common mathematical themes. A variety of discrete and continuous ordinary and partial differential equation models are explored. Although great advances have taken place in many of the topics covered, the simple lessons contained in this book are still important and informative. Audience: the book does not assume too much background knowledge--essentially some calculus and high-school algebra. It was originally written with third- and fourth-year undergraduate mathematical-biology majors in mind; however, it was picked up by beginning graduate students as well as researchers in math (and some in biology) who wanted to learn about this field.

Mathematical Models in Biology Princeton University Press
Students often find it difficult to grasp fundamental ecologicaland evolutionary concepts because of their inherently mathematicalnature. Likewise, the application of ecological and evolutionarytheory often requires a high degree of mathematical competence. This book is a first step to addressing these difficulties,providing a broad introduction to the key methods and underlyingconcepts of mathematical models in ecology and evolution. The bookis intended to serve the needs of undergraduate and postgraduateecology and evolution students who need to access the mathematicaland statistical modelling literature essential to theirsubjects. The book assumes minimal mathematics and statistics knowledgewhilst covering a wide variety of methods, many of which are at thefore-front of ecological and evolutionary research. The book alsohighlights the applications of modelling to practical problems suchas sustainable harvesting and biological control. Key features: Written clearly and succinctly, requiring minimal in-depthknowledge of mathematics Introduces students to the

use of computer models in bothfields of ecology and evolutionary biology Market - senior undergraduate students and beginningpostgraduates in ecology and evolutionary biology

Models in Population Biology Chapman & Hall/CRC

Exploring Mathematical Modeling in Biology through Case Studies and Experimental Activities provides supporting materials for courses taken by students majoring in mathematics, computer science or in the life sciences. The book's cases and lab exercises focus on hypothesis testing and model development in the context of real data. The supporting mathematical, coding and biological background permit readers to explore a problem, understand assumptions, and the meaning of their results. The experiential components provide hands-on learning both in the lab and on the computer. As a beginning text in modeling, readers will learn to value the approach and apply competencies in other settings. Included case studies focus on building a model to solve a particular biological problem from concept and translation into a mathematical form, to validating the parameters, testing the quality of the model and finally interpreting the outcome in biological terms. The book also shows how particular mathematical approaches are adapted to a variety of problems at multiple biological scales. Finally, the labs bring the biological problems and the practical issues of collecting data to actually test the model and/or adapting the mathematics to the data that can be collected. Presents a single volume on mathematics and biological examples, with data and wet lab experiences suitable for non-experts Contains three real-world biological case studies and one wet lab for application of the mathematical models Includes R code templates throughout the text, which are also available through an online repository, along with the necessary data files to complete all projects and labs

Mathematical Biology: Modeling and Analysis SIAM

Population biology has had a long history of mathematical modeling. The 1920s and 1930s saw major strides with the work of Lotka and Volterra in ecology and Fisher, Haldane, and Wright in genetics. In recent years, much more sophisticated mathematical techniques have been brought to bear on questions in population biology. Simultaneously, advances in experimental and field work have produced a wealth of new data. While this growth has tended to fragment the field, one unifying theme is that similar mathematical questions arise in a range of biological contexts. This volume contains the proceedings of a symposium on Some Mathematical Questions in Biology, held in Chicago in 1987. The papers all deal with different aspects of population biology, but there are overlaps in the mathematical techniques used; for example, dynamics of nonlinear differential and difference equations form a common theme. The topics covered are cultural evolution, multilocus population genetics, spatially structured population genetics, chaos and the dynamics of epidemics, and the dynamics of ecological communities.

Deterministic and Stochastic Approaches SIAM

Mathematical Models in Population Biology and EpidemiologySpringer Science & Business Media

An Introduction to Mathematical Models in Ecology and Evolution CRC Press

The goal of this book is to search for a balance between simple and analyzable models and unsolvable models which are capable of addressing important questions on population biology. Part I focusses on single species simple models including those which have been used to predict the growth of human and animal population in the past. Single population models are, in some sense, the building blocks of more realistic models -- the subject of Part II. Their role is fundamental to the study of ecological and demographic processes including the role of population structure and spatial heterogeneity -- the subject of Part III. This book, which will include both examples and exercises, is of use to practitioners, graduate students, and scientists working in the field.

Proceedings of an International Conference Held in Bari, Italy, July 18-22, 1983 Springer

In this new century mankind faces ever more challenging environmental and publichealthproblems,suchaspollution,invasionbyexoticspecies,theem- gence of new diseases or the emergence of diseases into new regions (West Nile virus,SARS,Anthrax,etc.),andtheresurgenceofexistingdiseases(in?uenza, malaria, TB, HIV/AIDS, etc.). Mathematical models have been successfully used to study many biological, epidemiological and medical problems, and nonlinear and complex dynamics have been observed in all of those contexts. Mathematical studies have helped us not only to better understand these problems but also to ?nd solutions in some cases, such as the prediction and control of SARS outbreaks, understanding HIV infection, and the investi- tion of antibiotic-resistant infections in hospitals. Structuredpopulationmodelsdistinguishindividualsfromoneanother- cording to characteristics such as age, size, location, status, and movement, to determine the birth, growth and death rates, interaction with each other and with environment, infectivity, etc. The goal of structured population models is to understand how these characteristics a?ect the dynamics of these models and thus the outcomes and consequences of the biological and epidemiolo- cal processes. There is a very large and growing body of literature on these topics. This book deals with the recent and important advances in the study of structured population models in biology and epidemiology. There are six chapters in this book, written by leading researchers in these areas.

An Introduction Academic Press

Collects the detailed contributions of selected groups of experts from the fields of biostatistics, control theory, epidemiology, and mathematical biology who have engaged in the development of frameworks, models, and mathematical methods needed to address some of the pressing challenges posed by acts of terror.

Mathematical Epidemiology Springer

Single-species growth; Pedration and parasitism; Predador-prey systems; Lotka-volterra systems for predator-prey interactions; Intermediate predator-prey models; Continous models; Discrete models; The kolmogorov model; Related topics and applications; Related topics; Aplications; competition and cooperation (symbiosis); Lotka-volterra competition models; Higher-oder competition models; cooperation (symbiosis); Pertubation theory; The implicit function theorem; Existence and Uniqueness of solutions of ordinary differential equations; Stability and periodicity; The poincare-bendixon theorem; The hopf bifurcation theorem.

Modelling Biological Populations in Space and Time American Mathematical Soc.

Elements of Mathematical Ecology provides an introduction to classical and modern mathematical models, methods, and issues in population ecology. The first part of the book is devoted to simple, unstructured population models that ignore much of the variability found in natural populations for the sake of tractability. Topics covered include density dependence, bifurcations, demographic stochasticity, time delays, population interactions (predation, competition, and mutualism), and the application of optimal control theory to the management of renewable resources. The second part of this book is devoted to structured population models, covering spatially-structured population models (with a focus

on reaction-diffusion models), age-structured models, and two-sex models. Suitable for upper level students and beginning researchers in ecology, mathematical biology and applied mathematics, the volume includes numerous clear line diagrams that clarify the mathematics, relevant problems thoughout the text that aid understanding, and supplementary mathematical and historical material that enrich the main text.

Mathematical Models Springer Science & Business Media

A textbook on mathematical modelling techniques with powerful applications to biology, combining theoretical exposition with exercises and examples.

An Introduction to Mathematical Population Dynamics Springer Science & Business Media

Population biology has had a long history of mathematical modeling. The 1920s and 1930s saw major strides with the work of Lotka and Volterra in ecology and Fisher, Haldane, and Wright in genetics. In recent years, much more sophisticated mathematical techniques have been brought to bear on questions in population biology. Simultaneously, advances in experimental and field work have produced a wealth of new data. While this growth has tended to fragment the field, one unifying theme is that similar mathematical questions arise in a range of biological contexts. This volume contains the proceedings of a symposium on Some Mathematical Questions in Biology, held in Chicago in 1987. The papers all deal with different aspects of population biology, but there are overlaps in the mathematical techniques used; for example, dynamics of nonlinear differential and difference equations form a common theme. The topics covered are cultural evolution, multilocus population genetics, spatially structured population genetics, chaos and the dynamics of epidemics, and the dynamics of ecological communities.