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An Introduction to Mathematical Epidemiology **Mathematical Epidemiology of Infectious Diseases** **Mathematical Epidemiology** *An Introduction to Mathematical Modeling of Infectious Diseases* **Mathematical Models in Epidemiology** **Mathematical Tools for Understanding Infectious Disease Dynamics** **Mathematical Modeling and Dynamical Systems for the Life Sciences** **Mathematical Biology** **Mathematische Modelle in der Biologie** **Age Structured Epidemic Modeling** **A Historical Introduction to Mathematical Modeling of Infectious Diseases** **Mathematical Models in Population Biology and Epidemiology** *Introduction to Mathematical Biology* **Computational Epidemiology** **Mathematical and Statistical Modeling for Emerging and Re-emerging Infectious Diseases** *Advances in Disease Epidemiology* **Epidemics** **Mathematical Modeling in Systems Biology** **Mathematical Models in Biology** **Mathematical Biology** **Structured Population Models in Biology and Epidemiology** *Mathematical Approaches to Problems in Resource Management and Epidemiology* **Infectious Disease Modeling** *Quantitative Methods for Investigating Infectious Disease Outbreaks* **Modeling Infectious Disease Parameters Based on Serological and Social Contact Data** **Mathematical and Statistical Estimation Approaches in Epidemiology** *A Course in Mathematical Biology* **A Biologist's Guide to Mathematical Modeling in Ecology and Evolution** *An Introduction to Mathematical Population Dynamics* **Epidemic Modelling** **Mathematical Modeling of Biological Systems, Volume II** *Mathematical Models for Society and Biology* *A Course in Mathematical Biology* *Modeling the Interplay Between Human Behavior and the Spread of Infectious Diseases* **Mathematical Biology: Modeling and Analysis** *Mathematical Models in Biology* *An Introduction to Mathematical Biology* *Mathematical Biology* *Propagation Dynamics on Complex Networks* *An Introduction to Undergraduate Research in Computational and Mathematical Biology*

Mathematical Models in Population

Biology and Epidemiology Nov 17 2021 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.

Epidemics Jun 12 2021 This book is designed to be a practical study in infectious disease dynamics. The book offers an easy to follow implementation and analysis of mathematical epidemiology. The book focuses on recent case studies in order to explore various conceptual, mathematical, and statistical issues. The dynamics of infectious diseases shows a wide diversity of pattern. Some have locally persistent chains-of-transmission, others persist spatially in 'consumer-resource metapopulations'. Some infections are prevalent among the young, some among the old and some are age-invariant. Temporally, some diseases have little variation in prevalence, some have predictable seasonal shifts and others exhibit violent epidemics that may be regular or irregular in their timing. Models and 'models-with-data' have proved invaluable for understanding and predicting this diversity, and thence help improve intervention and control. Using mathematical models to understand infectious disease dynamics has a very rich history in epidemiology. The field has seen broad expansions of theories as well as a surge in real-life application of mathematics to dynamics and control of infectious disease. The chapters of *Epidemics: Models and Data using R* have been organized in a reasonably logical way: Chapters 1-10 is a mix and match of models,

data and statistics pertaining to local disease dynamics; Chapters 11-13 pertains to spatial and spatiotemporal dynamics; Chapter 14 highlights similarities between the dynamics of infectious disease and parasitoid-host dynamics; Finally, Chapters 15 and 16 overview additional statistical methodology useful in studies of infectious disease dynamics. This book can be used as a guide for working with data, models and 'models-and-data' to understand epidemics and infectious disease dynamics in space and time.

Mathematical Models in Epidemiology Jun 24 2022 The book is a comprehensive, self-contained introduction to the mathematical modeling and analysis of disease transmission models. It includes (i) an introduction to the main concepts of compartmental models including models with heterogeneous mixing of individuals and models for vector-transmitted diseases, (ii) a detailed analysis of models for important specific diseases, including tuberculosis, HIV/AIDS, influenza, Ebola virus disease, malaria, dengue fever and the Zika virus, (iii) an introduction to more advanced mathematical topics, including age structure, spatial structure, and mobility, and (iv) some challenges and opportunities for the future. There are exercises of varying degrees of difficulty, and projects leading to new research directions. For the benefit of public health professionals whose contact with mathematics may not be recent, there is an appendix covering the necessary mathematical background. There are indications which sections require a strong mathematical background so that the book can be useful for both mathematical modelers and public health professionals.

Mathematical Models in Biology Oct 24 2019 Linear and non-linear models of populations, molecular evolution, phylogenetic tree construction, genetics, and infectious diseases are presented with minimal prerequisites. **Computational Epidemiology** Sep 15 2021 This innovative textbook brings together modern concepts in mathematical epidemiology, computational modeling, physics-based simulation, data science, and machine learning to understand one of the most significant problems of our current time, the outbreak dynamics and outbreak control of COVID-19. It

teaches the relevant tools to model and simulate nonlinear dynamic systems in view of a global pandemic that is acutely relevant to human health. If you are a student, educator, basic scientist, or medical researcher in the natural or social sciences, or someone passionate about big data and human health: This book is for you! It serves as a textbook for undergraduates and graduate students, and a monograph for researchers and scientists. It can be used in the mathematical life sciences suitable for courses in applied mathematics, biomedical engineering, biostatistics, computer science, data science, epidemiology, health sciences, machine learning, mathematical biology, numerical methods, and probabilistic programming. This book is a personal reflection on the role of data-driven modeling during the COVID-19 pandemic, motivated by the curiosity to understand it.

A Biologist's Guide to Mathematical Modeling in Ecology and Evolution Jul 01 2020 Thirty years ago, biologists could get by with a rudimentary grasp of mathematics and modeling. Not so today. In seeking to answer fundamental questions about how biological systems function and change over time, the modern biologist is as likely to rely on sophisticated mathematical and computer-based models as traditional fieldwork. In this book, Sarah Otto and Troy Day provide biology students with the tools necessary to both interpret models and to build their own. The book starts at an elementary level of mathematical modeling, assuming that the reader has had high school mathematics and first-year calculus. Otto and Day then gradually build in depth and complexity, from classic models in ecology and evolution to more intricate class-structured and probabilistic models. The authors provide primers with instructive exercises to introduce readers to the more advanced subjects of linear algebra and probability theory. Through examples, they describe how models have been used to understand such topics as the spread of HIV, chaos, the age structure of a country, speciation, and extinction. Ecologists and evolutionary biologists today need enough mathematical training to be able to assess the power and limits of biological models and to develop theories and models themselves. This

innovative book will be an indispensable guide to the world of mathematical models for the next generation of biologists. A how-to guide for developing new mathematical models in biology Provides step-by-step recipes for constructing and analyzing models Interesting biological applications Explores classical models in ecology and evolution Questions at the end of every chapter Primers cover important mathematical topics Exercises with answers Appendixes summarize useful rules Labs and advanced material available

[Modeling Infectious Disease Parameters Based on Serological and Social Contact Data](#) Oct 04 2020 Mathematical epidemiology of infectious diseases usually involves describing the flow of individuals between mutually exclusive infection states. One of the key parameters describing the transition from the susceptible to the infected class is the hazard of infection, often referred to as the force of infection. The force of infection reflects the degree of contact with potential for transmission between infected and susceptible individuals. The mathematical relation between the force of infection and effective contact patterns is generally assumed to be subjected to the mass action principle, which yields the necessary information to estimate the basic reproduction number, another key parameter in infectious disease epidemiology. It is within this context that the Center for Statistics (CenStat, I-Biostat, Hasselt University) and the Centre for the Evaluation of Vaccination and the Centre for Health Economic Research and Modelling Infectious Diseases (CEV, CHERMID, Vaccine and Infectious Disease Institute, University of Antwerp) have collaborated over the past 15 years. This book demonstrates the past and current research activities of these institutes and can be considered to be a milestone in this collaboration. This book is focused on the application of modern statistical methods and models to estimate infectious disease parameters. We want to provide the readers with software guidance, such as R packages, and with data, as far as they can be made publicly available.

[Mathematical Tools for Understanding](#)

[Infectious Disease Dynamics](#) May 23 2022 This book explains how to translate biological assumptions into mathematics to construct useful and consistent models, and how to use the biological interpretation and mathematical reasoning to analyze these models. It shows how to relate models to data through statistical inference, and how to gain important insights into infectious disease dynamics by translating mathematical results back to biology.

An Introduction to Mathematical Epidemiology Oct 28 2022

The book is a comprehensive, self-contained introduction to the mathematical modeling and analysis of infectious diseases. It includes model building, fitting to data, local and global analysis techniques. Various types of deterministic dynamical models are considered: ordinary differential equation models, delay-differential equation models, difference equation models, age-structured PDE models and diffusion models. It includes various techniques for the computation of the basic reproduction number as well as approaches to the epidemiological interpretation of the reproduction number. MATLAB code is included to facilitate the data

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fitting and the simulation with age-structured models.

Age Structured Epidemic Modeling Jan 19 2022 This book introduces advanced mathematical methods and techniques for analysis and simulation of models in mathematical epidemiology. Chronological age and class-age play an important role in the description of infectious diseases and this text provides the tools for the analysis of this type of partial differential equation models. This book presents general theoretical tools as well as large number of specific examples to guide the reader to develop their own tools that they may then apply to study structured models in mathematical epidemiology. The book will be a valuable addition to the arsenal of all researchers interested in developing theory or studying specific models with age structure.

Mathematische Modelle in der Biologie Feb 20 2022

Structured Population Models in Biology and Epidemiology Feb 08 2021 In this new century mankind faces ever more challenging environmental and public health problems, such as pollution, invasion by exotic species, the emergence of new diseases or the emergence of diseases into new regions (West Nile virus, SARS, Anthrax, etc.), and the resurgence of existing diseases (influenza, 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 find solutions in some cases, such as the prediction and control of SARS outbreaks, understanding HIV infection, and the investigation of antibiotic-resistant infections in hospitals.

Structured population models distinguish individuals from one another according 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 affect the dynamics of these models and thus the outcomes and consequences of the biological and epidemiological 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.

Infectious Disease Modeling Dec 06 2020

This volume presents infectious diseases modeled mathematically, taking seasonality and changes in population behavior into account, using a switched and hybrid systems framework. The scope of coverage includes background on mathematical epidemiology, including classical formulations and results; a motivation for seasonal effects and changes in population behavior, an investigation into term-time forced epidemic models with switching parameters, and a detailed account of several different control strategies. The main goal is to study these models theoretically and to establish conditions under which eradication or persistence of the disease is guaranteed. In

doing so, the long-term behavior of the models is determined through mathematical techniques from switched systems theory. Numerical simulations are also given to augment and illustrate the theoretical results and to help study the efficacy of the control schemes.

Mathematical and Statistical Modeling for Emerging and Re-emerging Infectious Diseases Aug 14 2021

The contributions by epidemic modeling experts describe how mathematical models and statistical forecasting are created to capture the most important aspects of an emerging epidemic. Readers will discover a broad range of approaches to address questions, such as Can we control Ebola via ring vaccination strategies? How quickly should we detect Ebola cases to ensure epidemic control? What is the likelihood that an Ebola epidemic in West Africa leads to secondary outbreaks in other parts of the world? When does it matter to incorporate the role of disease-induced mortality on epidemic models? What is the role of behavior changes on Ebola dynamics? How can we better understand the control of cholera or Ebola using optimal control theory? How should a population be structured in order to mimic the transmission dynamics of diseases such as chlamydia, Ebola, or cholera? How can we objectively determine the end of an epidemic? How can we use metapopulation models to understand the role of movement restrictions and migration patterns on the spread of infectious diseases? How can we capture the impact of household transmission using compartmental epidemic models? How could behavior-dependent vaccination affect the dynamical outcomes of epidemic models? The derivation and analysis of the mathematical models addressing these questions provides a wide-ranging overview of the new approaches being created to better forecast and mitigate emerging epidemics. This book will be of interest to researchers in the field of mathematical epidemiology, as well as public health workers.

[Mathematical Biology](#) Mar 21 2022

Mathematical Biology is a richly illustrated textbook in an exciting and fast growing field. Providing an in-depth look at the practical use of math modeling, it features exercises throughout that are drawn from a variety of bioscientific disciplines - population biology, developmental biology, physiology, epidemiology, and evolution, among others. It maintains a consistent level throughout so that graduate students can use it to gain a foothold into this dynamic research area.

Mathematical Biology: Modeling and Analysis Nov 24 2019

The fast growing field of mathematical biology addresses biological questions using mathematical models from areas such as dynamical systems, probability, statistics, and discrete mathematics. This book considers models that are described by systems of partial differential equations, and it focuses on modeling, rather than on numerical methods and simulations. The models studied are concerned with population dynamics, cancer, risk of plaque growth associated with high cholesterol, and wound healing. A rich variety of open problems demonstrates the exciting challenges and opportunities for research at the interface of mathematics and biology. This book primarily addresses students and

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researchers in mathematics who do not necessarily have any background in biology and who may have had little exposure to PDEs.

[An Introduction to Mathematical Biology](#) Sep 22 2019 KEY BENEFIT: This reference introduces a variety of mathematical models for biological systems, and presents the mathematical theory and techniques useful in analyzing those models. Material is organized according to the mathematical theory rather than the biological application. Contains applications of mathematical theory to biological examples in each chapter. Focuses on deterministic mathematical models with an emphasis on predicting the qualitative solution behavior over time. Discusses classical mathematical models from population, including the Leslie matrix model, the Nicholson-Bailey model, and the Lotka-Volterra predator-prey model. Also discusses more recent models, such as a model for the Human Immunodeficiency Virus - HIV and a model for flour beetles. KEY MARKET: Readers seeking a solid background in the mathematics behind modeling in biology and exposure to a wide variety of mathematical models in biology.

Mathematical Biology Mar 09 2021 In recent years, mathematics has been used in solving various real life problems. In particular, mathematical modelling plays a key role in the analysis of physiological/biological/mechanical systems. Diverse topics such as arterial blood flow, cardio-electric activity, bio-convection, gene coding, epidemic infection and body imaging can all be studied from a mathematical viewpoint. Progress in this field requires regular updated research and "Mathematical Biology" provides us with the latest developments and applications. It promotes interdisciplinary approaches to the study of biological systems using a variety of mathematical tools and numerical simulation. With 47 chapters from international contributors, this book will be a useful addition to the shelf of postgraduate medics and biologists, researchers and mathematicians with an interest outside mathematics!

[Mathematical Models for Society and Biology](#) Feb 26 2020 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

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resource for courses in molecular biology, biochemistry, embryology and cell biology, medicine, ecology and evolution, biomathematics, 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 [Mathematical Approaches to Problems in Resource Management and Epidemiology](#) Jan 07 2021 Increasingly, mathematical methods are being used to advantage in addressing the problems facing humanity in managing its environment. Problems in resource management and epidemiology especially have demonstrated the utility of quantitative modeling. To explore these approaches, the Center of Applied Mathematics at Cornell University organized a conference in Fall, 1987, with the objective of surveying and assessing the state of the art. This volume records the proceedings of that conference. Underlying virtually all of these studies are models of population growth, from individual cells to large vertebrates. Cell population growth presents the simplest of systems for study, and is of fundamental importance in its own right for a variety of medical and environmental applications. In Part I of this volume, Michael Shuler describes computer models of individual cells and cell populations, and Frank Hoppensteadt discusses the synchronization of bacterial culture growth. Together, these provide a valuable introduction to mathematical cell biology.

Mathematical Epidemiology Aug 26 2022 Based on lecture notes of two summer schools with a mixed audience from mathematical sciences, epidemiology and public health, this volume offers a comprehensive introduction to basic ideas and techniques in modeling infectious diseases, for the comparison of strategies to plan for an anticipated epidemic or pandemic, and to deal with a disease outbreak in real time. It covers detailed case studies for diseases including pandemic influenza, West Nile virus, and childhood diseases. Models for other diseases including Severe Acute Respiratory Syndrome, fox rabies, and sexually transmitted infections are included as applications. Its chapters are coherent and complementary independent units. In order to accustom students to look at the current literature and to experience different perspectives, no attempt has been made to achieve united writing style or unified notation. Notes on some mathematical background (calculus, matrix algebra, differential equations, and probability) have been prepared and may be downloaded at the web site of the Centre for Disease Modeling (www.cdm.yorku.ca).

A Historical Introduction to Mathematical Modeling of Infectious Diseases Dec 18 2021 A Historical Introduction to Mathematical Modeling of Infectious Diseases: Seminal Papers in Epidemiology offers step-by-step help on how to navigate the important historical papers on the subject, beginning in the 18th century. The book carefully, and critically, guides the reader through seminal writings that helped revolutionize the field. With pointed questions, prompts, and analysis, this book helps the non-mathematician develop their own

perspective, relying purely on a basic knowledge of algebra, calculus, and statistics. By learning from the important moments in the field, from its conception to the 21st century, it enables readers to mature into competent practitioners of epidemiologic modeling. Presents a refreshing and in-depth look at key historical works of mathematical epidemiology Provides all the basic knowledge of mathematics readers need in order to understand the fundamentals of mathematical modeling of infectious diseases Includes questions, prompts, and answers to help apply historical solutions to modern day problems [Modeling the Interplay Between Human Behavior and the Spread of Infectious Diseases](#) Dec 26 2019 This volume summarizes the state-of-the-art in the fast growing research area of modeling the influence of information-driven human behavior on the spread and control of infectious diseases. In particular, it features the two main and inter-related "core" topics: behavioral changes in response to global threats, for example, pandemic influenza, and the pseudo-rational opposition to vaccines. In order to make realistic predictions, modelers need to go beyond classical mathematical epidemiology to take these dynamic effects into account. With contributions from experts in this field, the book fills a void in the literature. It goes beyond classical texts, yet preserves the rationale of many of them by sticking to the underlying biology without compromising on scientific rigor. Epidemiologists, theoretical biologists, biophysicists, applied mathematicians, and PhD students will benefit from this book. However, it is also written for Public Health professionals interested in understanding models, and to advanced undergraduate students, since it only requires a working knowledge of mathematical epidemiology.

[Mathematical Modeling and Dynamical Systems for the Life Sciences](#) Apr 22 2022 Mathematical Modeling in Epidemiology and Ecology provides readers with the mathematical tools needed to understand and use mathematical models and read advanced mathematical biology books. It presents mathematics in biological contexts, focusing on the central mathematical ideas and the biological implications, with detailed explanations. The author assumes no mathematics background beyond elementary differential calculus. An introductory chapter on basic principles of mathematical modeling is followed by chapters on empirical modeling and mechanistic modeling. These chapters contain a thorough treatment of key ideas and techniques that are often neglected in mathematics books, such as the Akaike Information Criterion. The second half of the book focuses on analysis of dynamical systems, emphasizing tools to simplify analysis, such as the Routh-Hurwitz conditions and asymptotic analysis. Courses can be focused on either half of the book or thematically chosen material from both halves, such as a course on mathematical epidemiology. The biological content is self-contained and includes many topics in epidemiology and ecology. Some of this material appears in case studies that focus on a single detailed example, and some is based on recent research by the author on vaccination modeling and scenarios from the COVID-19 pandemic. The problem sets feature linked

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problems where one biological setting appears in multi-step problems that are sorted into the appropriate section, allowing readers to gradually develop complete investigations of topics such as HIV immunology and harvesting of natural resources. Some problems use programs written by the author for Matlab or Octave; these combine with more traditional mathematical exercises to give students a full set of tools for model analysis. Each chapter contains additional case studies in the form of projects with detailed directions. New appendices contain mathematical details on optimization, numerical solution of differential equations, scaling, linearization, and sophisticated use of elementary algebra to simplify problems.

Epidemic Modelling Apr 29 2020 This is a general introduction to the mathematical modelling of diseases.

Mathematical Modeling of Biological Systems, Volume II Mar 29 2020 Volume II of this two-volume, interdisciplinary work is a unified presentation of a broad range of state-of-the-art topics in the rapidly growing field of mathematical modeling in the biological sciences. Highlighted throughout are mathematical and computational approaches to examine central problems in the life sciences, ranging from the organization principles of individual cells to the dynamics of large populations. The chapters are thematically organized into the following main areas: epidemiology, evolution and ecology, immunology, neural systems and the brain, and innovative mathematical methods and education. The work will be an excellent reference text for a broad audience of researchers, practitioners, and advanced students in this rapidly growing field at the intersection of applied mathematics, experimental biology and medicine, computational biology, biochemistry, computer science, and physics.

Mathematical Models in Biology Apr 10 2021 This book is an introduction for readers interested in biological applications of mathematics and modeling in biology, showing how relatively simple mathematics can be applied to a variety of models. Despite the great advances that have taken place, the simple lessons described in the text are still important and informative.

Mathematical Modeling in Systems Biology May 11 2021 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.

Mathematical and Statistical Estimation Approaches in Epidemiology Sep 03 2020 Mathematical and Statistical Estimation Approaches in Epidemiology compiles theoretical and practical contributions of experts in the analysis of infectious disease epidemics in a single volume. Recent collections have focused in the analyses and simulation of deterministic and stochastic models whose aim is to identify and rank epidemiological and social mechanisms responsible for disease transmission. The contributions in this volume focus on the connections between models and disease data with emphasis on the application of mathematical and statistical approaches that quantify model and data uncertainty. The book is aimed at public health experts, applied mathematicians and scientists in the life and social sciences, particularly graduate or advanced undergraduate students, who are interested not only in building and connecting models to data but also in applying and developing methods that quantify uncertainty in the context of infectious diseases. Chowell and Brauer open this volume with an overview of the classical disease transmission models of Kermack-McKendrick including extensions that account for increased levels of epidemiological heterogeneity. Their theoretical tour is followed by the introduction of a simple methodology for the estimation of, the basic reproduction number, R_0 . The use of this methodology is illustrated, using regional data for 1918-1919 and 1968 in uenza pandemics.

Mathematical Biology Aug 22 2019 This text presents mathematical biology as a field with a unity of its own, rather than only the intrusion of one science into another. The book focuses on problems of contemporary interest, such as cancer, genetics, and the rapidly growing field of genomics.

An Introduction to Mathematical Population Dynamics May 31 2020 This book is an introduction to mathematical biology for students with no experience in biology, but who have some mathematical background. The work is focused on population dynamics and ecology, following a tradition that goes back to Lotka and Volterra, and includes a part devoted to the spread of infectious diseases, a field where mathematical modeling is extremely popular. These themes are used as the area where to understand different types of mathematical modeling and the possible meaning of qualitative agreement of modeling with data. The book also includes a collections of problems designed to approach more advanced questions. This material has been used in the

courses at the University of Trento, directed at students in their fourth year of studies in Mathematics. It can also be used as a reference as it provides up-to-date developments in several areas.

Advances in Disease Epidemiology Jul 13 2021 This book is a collection that bears witness to the large interest in the subject of mathematical epidemiology. The materials presented describe, thoroughly analyse and interpret the dynamics of some infectious diseases of global concern such as Influenza, HIV/AIDS, tuberculosis and malaria. The contribution and chosen approach are described in a way that is suitable to those who have some acquaintance with calculus and ordinary differential equations. Advanced undergraduate and graduate students, public health officials as well as researchers working at the interface between mathematics and biology, will find this book useful.

A Course in Mathematical Biology Jan 27 2020 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?

An Introduction to Undergraduate Research in Computational and Mathematical Biology Jun 19 2019 Speaking directly to the growing importance of research experience in undergraduate mathematics programs, this volume offers suggestions for undergraduate-appropriate research projects in mathematical and computational biology for students and their faculty mentors. The aim of each chapter is twofold: for faculty, to alleviate the challenges of identifying accessible topics and advising students through the research process; for students, to provide sufficient background, additional references, and context to excite students in these areas and to enable them to successfully undertake these problems in their research. Some of the topics discussed include: • Oscillatory behaviors present in real-world applications, from seasonal outbreaks of childhood diseases to action potentials in neurons • Simulating bacterial growth, competition, and resistance with agent-based models and laboratory experiments • Network structure and the dynamics of biological systems • Using neural networks to identify bird species from birdsong samples • Modeling fluid flow induced by the motion of pulmonary cilia Aimed at undergraduate mathematics

faculty and advanced undergraduate students, this unique guide will be a valuable resource for generating fruitful research collaborations between students and faculty.

Introduction to Mathematical Biology Oct 16 2021 This book is based on a one semester course that the authors have been teaching for several years, and includes two sets of case studies. The first includes chemostat models, predator-prey interaction, competition among species, the spread of infectious diseases, and oscillations arising from bifurcations. In developing these topics, readers will also be introduced to the basic theory of ordinary differential equations, and how to work with MATLAB without having any prior programming experience. The second set of case studies were adapted from recent and current research papers to the level of the students. Topics have been selected based on public health interest. This includes the risk of atherosclerosis associated with high cholesterol levels, cancer and immune interactions, cancer therapy, and tuberculosis. Readers will experience how mathematical models and their numerical simulations can provide explanations that guide biological and biomedical research. Considered to be the undergraduate companion to the more advanced book "Mathematical Modeling of Biological Processes" (A. Friedman, C.-Y. Kao, Springer - 2014), this book is geared towards undergraduate students with little background in mathematics and no biological background.

Mathematical Epidemiology of Infectious Diseases Sep 27 2022 Mathematical Epidemiology of Infectious Diseases Model Building, Analysis and Interpretation O. Diekmann University of Utrecht, The Netherlands J. A. P. Heesterbeek Centre for Biometry Wageningen, The Netherlands The mathematical modelling of epidemics in populations is a vast and important area of study. It is about translating biological assumptions into mathematics, about mathematical analysis aided by interpretation and about obtaining insight into epidemic phenomena when translating mathematical results back into population biology. Model assumptions are formulated in terms of, usually stochastic, behaviour of individuals and then the resulting phenomena, at the population level, are unravelled. Conceptual clarity is attained, assumptions are stated clearly, hidden working hypotheses are attained and mechanistic links between different observables are exposed. Features: * Model construction, analysis and interpretation receive detailed attention * Uniquely covers both deterministic and stochastic viewpoints * Examples of applications given throughout * Extensive coverage of the latest research into the mathematical modelling of epidemics of infectious diseases * Provides a solid foundation of modelling skills The reader will learn to translate, model, analyse and interpret, with the help of the numerous exercises. In literally working through this text, the reader acquires modelling skills that are also valuable outside of epidemiology, certainly within population dynamics, but even beyond that. In addition,

the reader receives training in mathematical argumentation. The text is aimed at applied mathematicians with an interest in population biology and epidemiology, at theoretical biologists and epidemiologists. Previous exposure to epidemic concepts is not required, as all background information is given. The book is primarily aimed at self-study and ideally suited for small discussion groups, or for use as a course text.

Propagation Dynamics on Complex Networks Jul 21 2019 Explores the emerging subject of epidemic dynamics on complex networks, including theories, methods, and real-world applications Throughout history epidemic diseases have presented a serious threat to human life, and in recent years the spread of infectious diseases such as dengue, malaria, HIV, and SARS has captured global attention; and in the modern technological age, the proliferation of virus attacks on the Internet highlights the emergent need for knowledge about modeling, analysis, and control in epidemic dynamics on complex networks. For advancement of techniques, it has become clear that more fundamental knowledge will be needed in mathematical and numerical context about how epidemic dynamical networks can be modelled, analyzed, and controlled. This book explores recent progress in these topics and looks at issues relating to various epidemic systems. *Propagation Dynamics on Complex Networks* covers most key topics in the field, and will provide a valuable resource for graduate students and researchers interested in network science and dynamical systems, and related interdisciplinary fields. Key Features: Includes a brief history of mathematical epidemiology and epidemic modeling on complex networks. Explores how information, opinion, and rumor spread via the Internet and social networks. Presents plausible models for propagation of SARS and avian influenza outbreaks, providing a reality check for otherwise abstract mathematical modeling. Considers various infectivity functions, including constant, piecewise-linear, saturated, and nonlinear cases. Examines information transmission on complex networks, and investigates the difference between information and epidemic spreading.

A Course in Mathematical Biology Aug 02 2020 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?

An Introduction to Mathematical Modeling of Infectious Diseases Jul 25 2022 This text provides essential modeling skills and methodology for the study of infectious diseases through a one-semester modeling course or directed individual studies. The book includes mathematical descriptions of epidemiological concepts, and uses classic epidemic models to introduce different mathematical methods in model analysis. Matlab codes are also included for numerical implementations. It is primarily written for upper undergraduate and beginning graduate students in mathematical sciences who have an interest in mathematical modeling of infectious diseases. Although written in a rigorous mathematical manner, the style is not unfriendly to non-mathematicians.

Quantitative Methods for Investigating Infectious Disease Outbreaks Nov 05 2020 This book provides a systematic treatment of the mathematical underpinnings of work in the theory of outbreak dynamics and their control, covering balanced perspectives between theory and practice including new material on contemporary topics in the field of infectious disease modelling. Specifically, it presents a unified mathematical framework linked to the distribution theory of non-negative random variables; the many examples used in the text, are introduced and discussed in light of theoretical perspectives. The book is organized into 9 chapters: The first motivates the presentation of the material on subsequent chapters; Chapter 2-3 provides a review of basic concepts of probability and statistical models for the distributions of continuous lifetime data and the distributions of random counts and counting processes, which are linked to phenomenological models. Chapters 4 focuses on dynamic behaviors of a disease outbreak during the initial phase while Chapters 5-6 broadly cover compartment models to investigate the consequences of epidemics as the outbreak moves beyond the initial phase. Chapter 7 provides a transition between mostly theoretical topics in earlier chapters and Chapters 8 and 9 where the focus is on the data generating processes and statistical issues of fitting models to data as well as specific mathematical epidemic modeling applications, respectively. This book is aimed at a wide audience ranging from graduate students to established scientists from quantitatively-oriented fields of epidemiology, mathematics and statistics. The numerous examples and illustrations make understanding of the mathematics of disease transmission and control accessible. Furthermore, the examples and exercises, make the book suitable for motivated students in applied mathematics, either through a lecture course, or through self-study. This text could be used in graduate schools or special summer schools covering research problems in mathematical biology.