

## A Course In Mathematical Biology Quantitative Modeling With Mathematical And Computational Monographs On Mathematical Modeling And Computation

Deepen students' understanding of biological phenomena Suitable for courses on differential equations with applications to mathematical biology or as an introduction to mathematical biology, *Differential Equations and Mathematical Biology*, Second Edition introduces students in the physical, mathematical, and biological sciences to fundamental models

A Course in Mathematical Biology Quantitative Modeling with Mathematical and Computational Methods SIAM

Biology majors and pre-health students at many colleges and universities are required to take a semester of calculus but rarely do such students see authentic applications of its techniques and concepts. *Applications of Calculus to Biology and Medicine: Case Studies from Lake Victoria* is designed to address this issue: it prepares students to engage with the research literature in the mathematical modeling of biological systems, assuming they have had only one semester of calculus. The text includes projects, problems and exercises: the projects ask the students to engage with the research literature, problems ask the students to extend their understanding of the materials and exercises ask the students to check their understanding as they read the text. Students who successfully work their way through the text will be able to engage in a meaningful way with the research literature to the point that they would be able to make genuine contributions to the literature. Request Inspection Copy Contents: Background: Lake Victoria What is Calculus? Population Modeling: Introduction to Population Modeling Logistic Growth Harvesting a Population with Logistic Growth Euler's Method Modeling Interlude: The Modeling Process Research Interlude: Reading a Research Paper Brief Introduction to Sage Projects for Population Modeling Drug Modeling: Introduction to Pharmacokinetics Two Models for Lead in the Body Methods of Drug Administration Euler's Method for Systems of Differential Equations Modeling Interlude: Sensitivity Analysis Research Interlude: Writing a Research Paper Projects for Pharmacokinetic Modeling Predator Prey Modeling: Undamped Lotka-Volterra Equations Damped Lotka-Volterra Equations Predator Satiation Isoclines Species Formation Top Predators Modeling Interlude: Potential Problems with Models Research Interlude: Making Figures Projects for Predatory-Prey Models Infectious Disease Modeling: SIR Model for Infectious Diseases Malaria HIV/AIDS Projects for Infectious Disease Models Classroom Tested Projects Readership: Undergraduates in biomathematics, mathematical biology, mathematical modeling, applied mathematics, and dynamical systems.

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.

*Nonlinear Dynamics, Mathematical Biology, And Social Science*

*An Introduction to Mathematical Physiology and Biology*

*Explorations of Mathematical Models in Biology with MATLAB*

*A First Course*

*Mathematical Biology II*

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.

An introduction to mathematical methods used in the study of population phenomena including models of total population and population age structure, models of random population events presented in terms of Markov chains, and methods used to uncover qualitative behavior of more complicated difference equations.

This book presents several fundamental questions in mathematical biology such as Turing instability, pattern formation, reaction-diffusion systems, invasion waves and Fokker-Planck equations. These are classical modeling tools for mathematical biology with applications to ecology and population dynamics, the neurosciences, enzymatic reactions, chemotaxis, invasion waves etc. The book presents these aspects from a mathematical perspective, with the aim of identifying those qualitative properties of the models that are relevant for biological applications. To do so, it uncovers the mechanisms at work behind Turing instability, pattern formation and invasion waves. This involves several mathematical tools, such as stability and instability analysis, blow-up in finite time, asymptotic methods and relative entropy properties. Given the content presented, the book is well suited as a textbook for master-level coursework.

A textbook about the mathematical modelling of biological and physiological phenomena for mathematically sophisticated students.

*A Course in Mathematical Biology*

*Applications of Calculus to Biology and Medicine*

*A Primer in Mathematical Models in Biology*

*Supercellular Systems*

*Introduction to Mathematical Biology*

***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?**

**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. Provides a wide range of mathematical models currently used in the life sciences Each model is thoroughly explained and illustrated by example Includes three appendices to allow for independent reading**

**Linear and non-linear models of populations, molecular evolution, phylogenetic tree construction, genetics, and infectious diseases are presented with minimal prerequisites.**

**Foundations of Mathematical Biology**

**An Introduction to Mathematical Biology**

**Modeling, Analysis, and Simulations**

**Parabolic Equations in Biology**

The emphasis of this book lies in the teaching of mathematical modeling rather than simply presenting models. To this end the book starts with the simple discrete exponential growth model as a building block, and successively refines it. This involves adding variable growth rates, multiple variables, fitting growth rates to data, including random elements, testing exactness of fit, using computer simulations and moving to a continuous setting. No advanced knowledge is assumed of the reader, making this book suitable for elementary modeling courses. The book can also be used to supplement courses in linear algebra, differential equations, probability theory and statistics.

This book develops the theory of continuous and discrete stochastic processes within the context of cell biology. A wide range of biological topics are covered including normal and anomalous diffusion in complex cellular environments, stochastic ion channels and excitable systems, stochastic calcium signaling, molecular motors, intracellular transport, signal transduction, bacterial chemotaxis, robustness in gene networks, genetic switches and oscillators, cell polarization, polymerization, cellular length control, and branching processes. The book also provides a pedagogical introduction to the theory of stochastic process - Fokker Planck equations, stochastic differential equations, master equations and jump Markov processes, diffusion approximations and the system size expansion, first passage time problems, stochastic hybrid systems, reaction-diffusion equations, exclusion processes, WKB methods, martingales and branching processes, stochastic calculus, and numerical methods. This text is primarily aimed at graduate students and researchers working in mathematical biology and applied mathematicians interested in stochastic modeling. Applied probabilists and theoretical physicists should also find it of interest. It assumes no prior background in statistical physics and introduces concepts in stochastic processes via motivating biological applications. The book is highly illustrated and contains a large number of examples and exercises that further develop the models and ideas in the body of the text. It is based on a course that the author has taught at the University of Utah for many years.

This book developed from classes in mathematical biology taught by the authors over several years at the Technische Universität München. The main themes are modeling principles, mathematical principles for the analysis of these models and model-based analysis of data. The key topics of modern biomathematics are covered: ecology, epidemiology, biochemistry, regulatory networks, neuronal networks and population genetics. A variety of mathematical methods are introduced, ranging from ordinary and partial differential equations to stochastic graph theory and branching processes. A special emphasis is placed on the interplay between stochastic and deterministic models.

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

Models, Processes, and Directions

An Introduction

Introduction to Mathematical Oncology

Stochastic Processes in Cell Biology

Mathematics in Population Biology

**These lectures develop simple models of complex social processes using nonlinear dynamics and mathematical biology. Dynamical analogies between seemingly disparate social and biological phenomena, revolutions and epidemics, arms races, and ecosystem dynamics, are revealed and exploited. Nonlinear Dynamics, Mathematical Biology, and Social Science invites social scientists to relax, in some**

*cases abandon, the predominant assumption of perfectly informed utility maximization and explore social dynamics from such perspectives as epidemiology and predator-prey theory. The volume includes a concentrated course on nonlinear dynamical systems.*

*Designed to explore the applications of mathematical techniques and methods related to biology, this text explores five areas: cell growth, enzymatic reactions, physiological tracers, biological fluid dynamics and diffusion. Topics essentially follow a course in elementary differential equations – some linear algebra and graph theory; requires only a knowledge of elementary calculus.*

**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.*

*Explore and analyze the solutions of mathematical models from diverse disciplines As biology increasingly depends on data, algorithms, and models, it has become necessary to use a computing language, such as the user-friendly MATLAB, to focus more on building and analyzing models as opposed to configuring tedious calculations. Explorations of Mathematical Models in Biology with MATLAB provides an introduction to model creation using MATLAB, followed by the translation, analysis, interpretation, and observation of the models. With an integrated and interdisciplinary approach that embeds mathematical modeling into biological applications, the book illustrates numerous applications of mathematical techniques within biology, ecology, and environmental sciences. Featuring a quantitative, computational, and mathematical approach, the book includes: Examples of real-world applications, such as population dynamics, genetics, drug administration, interacting species, and the spread of contagious diseases, to showcase the relevancy and wide applicability of abstract mathematical techniques Discussion of various mathematical concepts, such as Markov chains, matrix algebra, eigenvalues, eigenvectors, first-order linear difference equations, and nonlinear first-order difference equations Coverage of difference equations to model a wide range of real-life discrete time situations in diverse areas as well as discussions on matrices to model linear problems Solutions to selected exercises and additional MATLAB codes Explorations of Mathematical Models in Biology with MATLAB is an ideal textbook for upper-undergraduate courses in mathematical models in biology, theoretical ecology, bioeconomics, forensic science, applied mathematics, and environmental science. The book is also an excellent reference for biologists, ecologists, mathematicians, biomathematicians, and environmental and resource economists.*

**Mathematical Models in Biology**

**Introduction to MATLAB® for Biologists**

**Differential Equations and Mathematical Biology**

**Case Studies from Lake Victoria**

**Mathematical Modeling**

*Foundations of Mathematical Biology, Volume III, is devoted to the treatment of behavior of whole organisms and groups of organisms. The viewpoint taken throughout the book is a holistic, phenomenological one. That is, the integrated behavior of these organisms and groups of organisms is not, in general, referred back to specific structural properties of interacting subunits (as in a reductionist scheme), but is rather treated on its own terms without invoking the properties of lower levels of organization. The book begins with an overview of organization and control in physiological systems, with emphasis on the mathematical techniques involved in more detailed investigations of specific physiological mechanisms. Separate chapters cover the cardiovascular system, with particular reference to blood flow; gross problems of organic form; a relational overview of physics, biology, and sociology; the automata theory in the context of the central nervous system; and populations of interacting organisms. The final chapter discusses the material presented in the entire work, some of its philosophical presuppositions and implications, and the possibility of constructing a unified theory of mathematical biology.*

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

*Written by experts in both mathematics and biology, Algebraic and Discrete Mathematical Methods for Modern Biology offers a bridge between math and biology, providing a framework for simulating, analyzing, predicting, and modulating the behavior of complex biological systems. Each chapter begins with a question from modern biology, followed by*

*the description of certain mathematical methods and theory appropriate in the search of answers. Every topic provides a fast-track pathway through the problem by presenting the biological foundation, covering the relevant mathematical theory, and highlighting connections between them. Many of the projects and exercises embedded in each chapter utilize specialized software, providing students with much-needed familiarity and experience with computing applications, critical components of the "modern biology" skill set. This book is appropriate for mathematics courses such as finite mathematics, discrete structures, linear algebra, abstract/modern algebra, graph theory, probability, bioinformatics, statistics, biostatistics, and modeling, as well as for biology courses such as genetics, cell and molecular biology, biochemistry, ecology, and evolution. Examines significant questions in modern biology and their mathematical treatments Presents important mathematical concepts and tools in the context of essential biology Features material of interest to students in both mathematics and biology Presents chapters in modular format so coverage need not follow the Table of Contents Introduces projects appropriate for undergraduate research Utilizes freely accessible software for visualization, simulation, and analysis in modern biology Requires no calculus as a prerequisite Provides a complete Solutions Manual Features a companion website with supplementary resources*

*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.*

*An Introduction with Maple and Matlab*

*A Biologist's Guide to Mathematical Modeling in Ecology and Evolution*

*Growth, reaction, movement and diffusion*

*Exploring Mathematical Modeling in Biology Through Case Studies and Experimental Activities*

*Quantitative Modeling with Mathematical and Computational Methods*

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

Introduction to Mathematical Oncology presents biologically well-motivated and mathematically tractable models that facilitate both a deep understanding of cancer biology and better cancer treatment designs. It covers the medical and biological background of the diseases, modeling issues, and existing methods and their limitations. The authors introduce mathematical and programming tools, along with analytical and numerical studies of the models. They also develop new mathematical tools and look to future improvements on dynamical models. After introducing the general theory of medicine and exploring how mathematics can be essential in its understanding, the text describes well-known, practical, and insightful mathematical models of avascular tumor growth and mathematically tractable treatment models based on ordinary differential equations. It continues the topic of avascular tumor growth in the context of partial differential equation models by incorporating the spatial structure and physiological structure, such as cell size. The book then focuses on the recent active multi-scale modeling efforts on prostate cancer growth and treatment dynamics. It also examines more mechanistically formulated models, including cell quota-based population growth models, with applications to real tumors and validation using clinical data. The remainder of the text presents abundant additional historical, biological, and medical background materials for advanced and specific treatment modeling efforts. Extensively classroom-tested in undergraduate and graduate courses, this self-contained book allows instructors to emphasize specific topics relevant to clinical cancer biology and treatment. It can be used in a variety of ways, including a single-semester undergraduate course, a more ambitious graduate course, or a full-year sequence on

mathematical oncology.

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.

Mathematics has always benefited from its involvement with developing sciences. Each successive interaction revitalises and enhances the field. Biomedical science is clearly the premier science of the foreseeable future. For the continuing health of their subject mathematicians must become involved with biology. With the example of how mathematics has benefited from and influenced physics, it is clear that if mathematicians do not become involved in the biosciences they will simply not be a part of what are likely to be the most important and exciting scientific discoveries of all time. Mathematical biology is a fast growing, well recognised, albeit not clearly defined, subject and is, to my mind, the most exciting modern application of mathematics. The increasing use of mathematics in biology is inevitable as biology becomes more quantitative. The complexity of the biological sciences makes interdisciplinary involvement essential. For the mathematician, biology opens up new and exciting branches while for the biologist mathematical modelling offers another research tool commensurate with a new powerful laboratory technique but only if used appropriately and its limitations recognised. However, the use of esoteric mathematics arrogantly applied to biological problems by mathematicians who know little about the real biology, together with unsubstantiated claims as to how important such theories are, does little to promote the interdisciplinary involvement which is so essential. Mathematical biology research, to be useful and interesting, must be relevant biologically.

Deterministic and Stochastic Approaches

Mathematical Modeling for the Life Sciences

A Course in Mathematical Modeling

Mathematical Biology

Wise Use Of Alternative Therapies

This richly illustrated third edition provides a thorough training in practical mathematical biology and shows how exciting mathematical challenges can arise from a genuinely interdisciplinary involvement with the biosciences. It has been extensively updated and extended to cover much of the growth of mathematical biology. From the reviews: "This book, a classic in mathematical biology, cleverly combines mathematical tools with subject area sciences."--SHORT BOOK REVIEWS

This book on mathematical modeling of biological processes includes a wide selection of biological topics that demonstrate the power of mathematics and computational codes in setting up biological processes with a rigorous and predictive framework. Topics include: enzyme dynamics, spread of disease, harvesting bacteria, competition among live species, neuronal oscillations, transport of neurofilaments in axon, cancer and cancer therapy, and granulomas. Complete with a description of the biological background and biological question that requires the use of mathematics, this book is developed for graduate students and advanced undergraduate students with only basic knowledge of ordinary differential equations and partial differential equations; background in biology is not required. Students will gain knowledge on how to program with MATLAB without previous programming experience and how to use codes in order to test biological hypothesis.

This textbook takes you from the very first time you open MATLAB® through to a position where you can comfortably integrate this computer language into your research or studies. The book will familiarise you with the MATLAB interface and show you how to use the program's built-in functions and carefully guide you towards creating your own functions and scripts so that you can use MATLAB as a sophisticated tool to support your own research. A central aim of this book is to provide you with the core knowledge and skills required to become a confident MATLAB user so that you can find and make use of the many specialist functions and toolboxes that have been developed to support a wide range of biological applications. Examples presented within the book are selected to be relevant to biological scientists and they illustrate some of the ways the program can be incorporated into, and used to enhance, your own research and studies. The textbook is a valuable resource for students and researchers in the biological sciences. It will also appeal to readers of all backgrounds who are looking for an introduction to MATLAB which is suitable for those with little or no experience of programming.

A one-of-a-kind guide to using deterministic and probabilistic methods for solving problems in the biological sciences. Highlighting the growing relevance of quantitative techniques in scientific research, *Mathematical Methods in Biology* provides an accessible presentation of the broad range of important mathematical methods for solving problems in the biological sciences. The book reveals the growing connections between mathematics and biology through clear explanations and specific, interesting problems from areas such as population dynamics, foraging theory, and life history theory. The authors begin with an introduction and review of mathematical tools that are employed in subsequent chapters, including biological modeling, calculus, differential equations, dimensionless variables, and descriptive statistics. The following chapters examine standard discrete and continuous models using matrix algebra as well as difference and differential equations. Finally, the book outlines probability, statistics, and stochastic methods as well as material on bootstrapping and stochastic differential equations, which is a unique approach that is not offered in other literature on the topic. In order to demonstrate the application of mathematical methods to the biological sciences, the authors provide focused examples from the field of theoretical ecology, which serve as an accessible context for study while also demonstrating mathematical skills that are applicable to many other areas in the life sciences. The book's algorithms are illustrated using MATLAB®, but can also be replicated using other software packages, including R, Mathematica®, and Maple; however, the text does not require any particular single computer algebra package. Each chapter contains numerous exercises and problems that range in difficulty, from basic to more challenging, to assist readers with building their problem-solving skills. Selected solutions are included at the back of the book, and a related Web site features supplemental material for further study. Extensively class-tested and written in an easy-to-follow format, *Mathematical Methods in Biology* is an excellent book for mathematics and biology courses at the upper-undergraduate and graduate levels. It also serves as a valuable reference for researchers and professionals working in the fields of biology, ecology, and biomathematics.

Methods and Models in Mathematical Biology

Mathematical Techniques for Biology and Medicine

Mathematical Methods of Population Biology

Mathematical Modeling in Systems Biology

I. An Introduction

**This self-contained introduction to the fast-growing field of Mathematical Biology is written for students with a mathematical background. It sets the subject in a historical context and guides the reader towards questions of current research interest. A broad range of topics is covered including: Population dynamics, Infectious diseases, Population genetics and evolution, Dispersal, Molecular and cellular biology, Pattern formation, and Cancer modelling. Particular attention is paid to situations where the simple assumptions of homogeneity made in early models break down and the process of mathematical modelling is seen in action. Suitable for both graduate and undergraduate courses, this text recalls basic concepts of calculus and shows how problems can be formulated in terms of differential equations. Fully worked-out solutions to selected problems. Fourth edition.**

**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 Modeling: Models, Analysis and Applications, Second Edition introduces models of both discrete and continuous systems. This book is aimed at newcomers who desire to learn mathematical modeling, especially students taking a first course in the subject. Beginning with the step-by-step guidance of model formulation, this book equips the reader about modeling with difference equations (discrete models), ODE's, PDE's, delay and stochastic differential equations (continuous models). This book provides interdisciplinary and integrative overview of mathematical modeling, making it a complete textbook for a wide audience. A unique feature of the book is the breadth of coverage of different examples on mathematical modelling, which include population models, economic models, arms race models, combat models, learning model, alcohol dynamics model, carbon dating, drug distribution models, mechanical oscillation models, epidemic models, tumor models, traffic flow models, crime flow models, spatial models, football team performance model, breathing model, two neuron system model, zombie model and model on love affairs. Common themes such as equilibrium points, stability, phase plane analysis, bifurcations, limit cycles, period doubling and chaos run through several chapters and their interpretations in the context of the model have been highlighted. In chapter 3, a section on estimation of system parameters with real life data for model validation has also been discussed. Features Covers discrete, continuous, spatial, delayed and stochastic models. Over 250 illustrations, 300 examples and exercises with complete solutions. Incorporates MATHEMATICA® and MATLAB®, each chapter contains Mathematica and Matlab codes used to display numerical results (available at CRC website). Separate sections for Projects. Several exercise problems can also be used for projects. Presents real life examples of discrete and continuous scenarios. The book is ideal for an introductory course for undergraduate and graduate students, engineers, applied mathematicians and researchers working in various areas of natural and applied sciences.**

**Algebraic and Discrete Mathematical Methods for Modern Biology**

**Mathematical Methods in Biology**

**Undergraduate Mathematics for the Life Sciences**

**Mathematical Models in Population Biology and Epidemiology**

**Mathematical Modeling of Biological Processes**