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Uses mathematical, numerical, and programming tools to solve differential equations for physical phenomena and engineering problems Introduction to Computation and Modeling for Differential Equations, Second Edition features the essential principles and applications of problem solving across disciplines such as engineering, physics, and chemistry. The Second Edition integrates the science of solving differential equations with mathematical, numerical, and programming tools, specifically with methods involving ordinary differential equations; numerical methods for initial value problems (IVPs); numerical methods for boundary value problems (B-

VPs); partial differential equations (PDEs); numerical methods for parabolic, elliptic, and hyperbolic PDEs; mathematical modeling with differential equations; numerical solutions; and finite difference and finite element methods. The author features a unique “Five-M” approach: Modeling, Mathematics, Methods, MATLAB®, and Multiphysics, which facilitates a thorough understanding of how models are created and preprocessed mathematically with scaling, classification, and approximation and also demonstrates how a problem is solved numerically using the appropriate mathematical methods. With numerous real-world examples to aid in the visualization of the solutions, Introduction to Computation and Modeling for Differential Equa-

tions, Second Edition includes: New sections on topics including variational formulation, the finite element method, examples of discretization, ansatz methods such as Galerkin’s method for BVPs, parabolic and elliptic PDEs, and finite volume methods Numerous practical examples with applications in mechanics, fluid dynamics, solid mechanics, chemical engineering, heat conduction, electromagnetic field theory, and control theory, some of which are solved with computer programs MATLAB and COMSOL Multiphysics® Additional exercises that introduce new methods, projects, and problems to further illustrate possible applications A related website with select solutions to the exercises, as well as the MATLAB data sets for ordinary

differential equations (ODEs) and PDEs Introduction to Computation and Modeling for Differential Equations, Second Edition is a useful textbook for upper-undergraduate and graduate-level courses in scientific computing, differential equations, ordinary differential equations, partial differential equations, and numerical methods. The book is also an excellent self-study guide for mathematics, science, computer science, physics, and engineering students, as well as an excellent reference for practitioners and consultants who use differential equations and numerical methods in everyday situations.

This text makes math fun, approachable, and applicable in everyday life. The authors provide algebraic modeling concepts and solutions in non-threatening, easy-to-understand language with numerous step-by-step examples to illustrate ideas. Whether they are going on to study early childhood education, graphic arts, automotive technologies, criminal justice, or something else, students will discover that the practical applications of mathematical modeling will continue to be useful well after they have finished this course.

A unique textbook for an undergraduate

course on mathematical modeling, Differential Equations with MATLAB: Exploration, Applications, and Theory provides students with an understanding of the practical and theoretical aspects of mathematical models involving ordinary and partial differential equations (ODEs and PDEs). The text presents a unifying picture inherent to the study and analysis of more than 20 distinct models spanning disciplines such as physics, engineering, and finance. The first part of the book presents systems of linear ODEs. The text develops mathematical models from ten disparate fields, including pharmacokinetics, chemistry, classical mechanics, neural networks, physiology, and electrical circuits. Focusing on linear PDEs, the second part covers PDEs that arise in the mathematical modeling of phenomena in ten other areas, including heat conduction, wave propagation, fluid flow through fissured rocks, pattern formation, and financial mathematics. The authors engage students by posing questions of all types throughout, including verifying details, proving conjectures of actual results, analyzing broad strokes that occur within the development of the theory, and applying the theory to specific models.

The authors' accessible style encourages students to actively work through the material and answer these questions. In addition, the extensive use of MATLAB® GUIs allows students to discover patterns and make conjectures.

This work provides a detailed and up-to-the-minute survey of the various stability problems that can affect suspension bridges. In order to deduce some experimental data and rules on the behavior of suspension bridges, a number of historical events are first described, in the course of which several questions concerning their stability naturally arise. The book then surveys conventional mathematical models for suspension bridges and suggests new nonlinear alternatives, which can potentially supply answers to some stability questions. New explanations are also provided, based on the nonlinear structural behavior of bridges. All the models and responses presented in the book employ the theory of differential equations and dynamical systems in the broader sense, demonstrating that methods from nonlinear analysis can allow us to determine the thresholds of instability.

As in the previous volume on the topic, the authors close the gap between abstract mathematical approaches, such as applied methods of modern algebra and analysis, fundamental and computational mechanics, nonautonomous and stochastic dynamical systems, on the one hand and practical applications in nonlinear mechanics, optimization, decision making theory and control theory on the other. Readers will also benefit from the presentation of modern mathematical modeling methods for the numerical solution of complicated engineering problems in biochemistry, geophysics, biology and climatology. This compilation will be of interest to mathematicians and engineers working at the interface of these fields. It presents selected works of the joint seminar series of Lomonosov Moscow State University and the Institute for Applied System Analysis at National Technical University of Ukraine "Kyiv Polytechnic Institute". The authors come from Brazil, Germany, France, Mexico, Spain, Poland, Russia, Ukraine and the USA.

Meerschaert's new edition strengthens his position as the survey text of choice for mathematical modeling courses, adding

ample instructor support and leveraging on-line delivery for solutions manuals and software ancillaries. From genetic engineering to hurricane prediction, mathematical models guide much of the decision-making in our society, and if the assumptions and methods underlying the modeling are flawed, the outcome can be disastrously poor, as recent events have proved. Since mathematical modeling is a rapidly growing specialty with applications in so many scientific and technical disciplines, there is a need for mathematically rigorous treatments of the subject, and particularly for texts that expose students to a range of possible approaches. Offers increased support for instructors, including MATLAB material as well as other on-line resources. Features new sections on time series analysis and diffusion models. Provides additional problems with international focus such as whale and dolphin populations, plus updated optimization problems. This book contains several contemporary topics in the areas of mathematical modeling and computation for complex systems. The readers find several new mathematical methods, mathematical models and computational techniques having sig-

nificant relevance in studying various complex systems. The chapters aim to enrich the understanding of topics presented by carefully discussing the associated problems and issues, possible solutions and their applications or relevance in other scientific areas of study and research. The book is a valuable resource for graduate students, researchers and educators in understanding and studying various new aspects associated with complex systems. Key Feature • The chapters include theory and application in a mix and balanced way. • Readers find reasonable details of developments concerning a topic included in this book. • The text is emphasized to present in self-contained manner with inclusion of new research problems and questions.

This book highlights the mathematical models and solutions of the generalized dynamics of soft-matter quasicrystals (SMQ) and introduces possible applications of the theory and methods. Based on the theory of quasiperiodic symmetry and symmetry breaking, the book treats the dynamics of individual quasicrystal systems by reducing them to nonlinear partial differential equations and then provides methods for

solving the initial-boundary value problems in these equations. The solutions obtained demonstrate the distribution, deformation and motion of SMQ and determine the stress, velocity and displacement fields. The interactions between phonons, phasons and fluid phonons are discussed in some fundamental materials samples. The reader benefits from a detailed comparison of the mathematical solutions for both solid and soft-matter quasicrystals, gaining a deeper understanding of the universal properties of SMQ. The second edition covers the latest research progress on quasicrystals in topics such as thermodynamic stability, three-dimensional problems and solutions, rupture theory, and the photonic band-gap and its applications. These novel chapters make the book an even more useful and comprehensive reference guide for researchers in condensed matter physics, chemistry and materials sciences.

A FIRST COURSE IN DIFFERENTIAL EQUATIONS WITH MODELING APPLICATIONS, 10th Edition strikes a balance between the analytical, qualitative, and quantitative approaches to the study of differential equa-

tions. This proven and accessible text speaks to beginning engineering and math students through a wealth of pedagogical aids, including an abundance of examples, explanations, Remarks boxes, definitions, and group projects. Written in a straightforward, readable, and helpful style, this book provides a thorough treatment of boundary-value problems and partial differential equations. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

This set includes Finite Mathematics: Models and Applications & Solutions Manual to accompany Finite Mathematics: Models and Applications. Finite Mathematics: Models and Applications emphasizes cross-disciplinary applications that relate mathematics to everyday life. The book provides a unique combination of practical mathematical applications to illustrate the wide use of mathematics in fields ranging from business, economics, finance, management, operations research, and the life and social sciences. The book features coverage including: Algebra Skills; Mathematics of Finance; Matrix Algebra; Geometric Solutions; Simplex Methods; Application

Models; Set and Probability Relationships; Random Variables and Probability Distributions; Markov Chains; Mathematical Statistics; Enrichment in Finite Mathematics

This book presents new developments in non-local mathematical modeling and mathematical analysis on the behavior of solutions with novel technical tools. Theoretical backgrounds in mechanics, thermodynamics, game theory, and theoretical biology are examined in details. It starts off with a review and summary of the basic ideas of mathematical modeling frequently used in the sciences and engineering. The authors then employ a number of models in bio-science and material science to demonstrate applications, and provide recent advanced studies, both on deterministic non-local partial differential equations and on some of their stochastic counterparts used in engineering. Mathematical models applied in engineering, chemistry, and biology are subject to conservation laws. For instance, decrease or increase in thermodynamic quantities and non-local partial differential equations, associated with the conserved physical quantities as parameters. These present novel mathematical objects are engaged with rich mathematical

structures, in accordance with the interactions between species or individuals, self-organization, pattern formation, hysteresis. These models are based on various laws of physics, such as mechanics of continuum, electro-magnetic theory, and thermodynamics. This is why many areas of mathematics, calculus of variation, dynamical systems, integrable systems, blow-up analysis, and energy methods are indispensable in understanding and analyzing these phenomena. This book aims for researchers and upper grade students in mathematics, engineering, physics, economics, and biology.

A logical problem-based introduction to the use of GeoGebra for mathematical modeling and problem solving within various areas of mathematics. A well-organized guide to mathematical modeling techniques for evaluating and solving problems in the diverse field of mathematics, *Mathematical Modeling: Applications with GeoGebra* presents a unique approach to software applications in GeoGebra and WolframAlpha. The software is well suited for modeling problems in numerous areas of mathematics including algebra, symbolic algebra, dynamic geometry, three-dimen-

sional geometry, and statistics. Featuring detailed information on how GeoGebra can be used as a guide to mathematical modeling, the book provides comprehensive modeling examples that correspond to different levels of mathematical experience, from simple linear relations to differential equations. Each chapter builds on the previous chapter with practical examples in order to illustrate the mathematical modeling skills necessary for problem solving. Addressing methods for evaluating models including relative error, correlation, square sum of errors, regression, and confidence interval, *Mathematical Modeling: Applications with GeoGebra* also includes: Over 400 diagrams and 300 GeoGebra examples with practical approaches to mathematical modeling that help the reader develop a full understanding of the content. Numerous real-world exercises with solutions to help readers learn mathematical modeling techniques. A companion website with GeoGebra constructions and screencasts. *Mathematical Modeling: Applications with GeoGebra* is ideal for upper-undergraduate and graduate-level courses in mathematical modeling, applied mathematics, modeling and simulation, opera-

tions research, and optimization. The book is also an excellent reference for undergraduate and high school instructors in mathematics.

A solutions manual to accompany *Finite Mathematics: Models and Applications*. In order to emphasize the main concepts of each chapter, *Finite Mathematics: Models and Applications* features plentiful pedagogical elements throughout such as special exercises, end notes, hints, select solutions, biographies of key mathematicians, boxed key principles, a glossary of important terms and topics, and an overview of use of technology. The book encourages the modeling of linear programs and their solutions and uses common computer software programs such as LINDO. In addition to extensive chapters on probability and statistics, principles and applications of matrices are included as well as topics for enrichment such as the Monte Carlo method, game theory, kinship matrices, and dynamic programming. Supplemented with online instructional support materials, the book features coverage including: Algebra Skills Mathematics of Finance Matrix Algebra Geometric Solutions Simplex Methods

Application Models Set and Probability Relationships Random Variables and Probability Distributions Markov Chains Mathematical Statistics Enrichment in Finite Mathematics

The book covers nonlinear physical problems and mathematical modeling, including molecular biology, genetics, neurosciences, artificial intelligence with classical problems in mechanics and astronomy and physics. The chapters present nonlinear mathematical modeling in life science and physics through nonlinear differential equations, nonlinear discrete equations and hybrid equations. Such modeling can be effectively applied to the wide spectrum of nonlinear physical problems, including the KAM (Kolmogorov-Arnold-Moser (KAM)) theory, singular differential equations, impulsive dichotomous linear systems, analytical bifurcation trees of periodic motions, and almost or pseudo- almost periodic solutions in nonlinear dynamical systems.

Employing a practical, "learn by doing" approach, this first-rate text fosters the development of the skills beyond the pure mathematics needed to set up and manipulate mathematical models. The author

draws on a diversity of fields — including science, engineering, and operations research — to provide over 100 reality-based examples. Students learn from the examples by applying mathematical methods to formulate, analyze, and criticize models. Extensive documentation, consisting of over 150 references, supplements the models, encouraging further research on models of particular interest. The lively and accessible text requires only minimal scientific background. Designed for senior college or beginning graduate-level students, it assumes only elementary calculus and basic probability theory for the first part, and ordinary differential equations and continuous probability for the second section. All problems require students to study and create models, encouraging their active participation rather than a mechanical approach. Beyond the classroom, this volume will prove interesting and rewarding to anyone concerned with the development of mathematical models or the application of modeling to problem solving in a wide array of applications.

Important Notice: Media content referenced within the product description or

the product text may not be available in the ebook version.

Each Chapter Of The Book Deals With Mathematical Modelling Through One Or More Specified Techniques. Thus There Are Chapters On Mathematical Modelling Through Algebra, Geometry, Trigonometry And Calculus, Through Ordinary Differential Equations Of First And Second Order, Through Systems Of Differential Equations, Through Difference Equations, Through Partial Differential Equations, Through Functional Equations And Integral Equations, Through Delay-Differential, Differential-Difference And Integro-Differential Equations, Through Calculus Of Variations And Dynamic Programming, Through Graphs, Through Mathematical Programming, Maximum Principle And Maximum Entropy Principle. Each Chapter Contains Mathematical Models From Physical, Biological, Social, Management Sciences And Engineering And Technology And Illustrates Unity In Diversity Of Mathematical Sciences. The Book Contains Plenty Of Exercises In Mathematical Modelling And Is Aimed To Give A Panoramic View Of Applications Of Modelling In All Fields Of Knowledge. It

Contains Both Probabilistic And Deterministic Models. The Book Presumes Only The Knowledge Of Undergraduate Mathematics And Can Be Used As A Textbook At Senior Undergraduate Or Post-Graduate Level For A One Or Two- Semester Course For Students Of Mathematics, Statistics, Physical, Social And Biological Sciences And Engineering. It Can Also Be Useful For All Users Of Mathematics And For All Mathematical Modellers.

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 non-linear 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.

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 Maple™, to focus more on building and analyzing models as opposed to configuring tedious calculations. Explorations of Mathematical Models in Biology with Maple provides an introduction to model creation using Maple, 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 non-linear 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 Maple codes. Explorations of Mathematical Models in Biology with Maple is an ideal textbook for 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.

Features step-by-step examples based on actual data and connects fundamental mathematical modeling skills and decision making concepts to everyday applicability. Featuring key linear programming, matrix, and probability concepts, *Finite Mathematics: Models and Applications* emphasizes cross-disciplinary applications that relate mathematics to everyday life. The book

provides a unique combination of practical mathematical applications to illustrate the wide use of mathematics in fields ranging from business, economics, finance, management, operations research, and the life and social sciences. In order to emphasize the main concepts of each chapter, *Finite Mathematics: Models and Applications* features plentiful pedagogical elements throughout such as special exercises, end notes, hints, select solutions, biographies of key mathematicians, boxed key principles, a glossary of important terms and topics, and an overview of use of technology. The book encourages the modeling of linear programs and their solutions and uses common computer software programs such as LINDO. In addition to extensive chapters on probability and statistics, principles and applications of matrices are included as well as topics for enrichment such as the Monte Carlo method, game theory, kinship matrices, and dynamic programming. Supplemented with online instructional support materials, the book features coverage including: Algebra Skills Mathematics of Finance Matrix Algebra Geometric Solutions Simplex Methods Application Models Set and Probability Relation-

ships Random Variables and Probability Distributions Markov Chains Mathematical Statistics Enrichment in Finite Mathematics. An ideal textbook, *Finite Mathematics: Models and Applications* is intended for students in fields from entrepreneurial and economic to environmental and social science, including many in the arts and humanities.

Many phenomena in social, natural and engineering fields are governed by wave, potential, parabolic heat-conduction, hyperbolic heat-conduction and dual-phase-lagging heat-conduction equations. This monograph examines these equations: their solution structures, methods of finding their solutions under various supplementary conditions, as well as the physical implication and applications of their solutions.

This textbook presents the basic concepts and methods of fluid mechanics, including Lagrangian and Eulerian descriptions, tensors of stresses and strains, continuity, momentum, energy, thermodynamics laws, and similarity theory. The models and their solutions are presented within a context of the mechanics of multiphase me-

dia. The treatment fully utilizes the computer algebra and software system Mathematica® to both develop concepts and help the reader to master modern methods of solving problems in fluid mechanics. Topics and features: Glossary of over thirty Mathematica® computer programs Extensive, self-contained appendix of Mathematica® functions and their use Chapter coverage of mechanics of multiphase heterogeneous media Detailed coverage of theory of shock waves in gas dynamics Thorough discussion of aerohydrodynamics of ideal and viscous fluids and gases Complete worked examples with detailed solutions Problem-solving approach Foundations of Fluid Mechanics with Applications is a complete and accessible text or reference for graduates and professionals in mechanics, applied mathematics, physical sciences, materials science, and engineering. It is an essential resource for the study and use of modern solution methods for problems in fluid mechanics and the underlying mathematical models. The present, softcover reprint is designed to make this classic textbook available to a wider audience.

Abstract Biological vision is a rather fasci-

nating domain of research. Scientists of various origins like biology, medicine, neurophysiology, engineering, mathematics, etc. aim to understand the processes leading to visual perception process and at reproducing such systems. Understanding the environment is most of the time done through visual perception which appears to be one of the most fundamental sensory abilities in humans and therefore a significant amount of research effort has been dedicated towards modelling and reproducing human visual abilities. Mathematical methods play a central role in this endeavour. Introduction David Marr's theory v^{\wedge} as a pioneering step towards understanding visual perception. In his view human vision was based on a complete surface reconstruction of the environment that was then used to address visual subtasks. This approach was proven to be insufficient by neuro-biologists and complementary ideas from statistical pattern recognition and artificial intelligence were introduced to better address the visual perception problem. In this framework visual perception is represented by a set of actions and rules connecting these actions. The emerging concept of active vision con-

sists of a selective visual perception paradigm that is basically equivalent to recovering from the environment the minimal piece of information required to address a particular task of interest.

For a newly developing "first course" in mathematics which may replace Liberal Arts Math or College Algebra. This inexpensive introduction to mathematical models explores mathematics in the context of real applications that provide meaning and motivation. Technology is used throughout as a tool to solve problems and investigate solutions.

The book aims at showing the state-of-the-art in the field of modeling and applications in mathematics education. This is the first volume to do this. The book deals with the question of how key competencies of applications and modeling at the heart of mathematical literacy may be developed; with the roles that applications and modeling may play in mathematics teaching, making mathematics more relevant for students.

This book discusses a variety of topics related to industrial and applied mathematics, focusing on wavelet theory, sampling

theorems, inverse problems and their applications, partial differential equations as a model of real-world problems, computational linguistics, mathematical models and methods for meteorology, earth systems, environmental and medical science, and the oil industry. It features papers presented at the International Conference in Conjunction with 14th Biennial Conference of ISIAM, held at Guru Nanak Dev University, Amritsar, India, on 2–4 February 2018. The conference has emerged as an influential forum, bringing together prominent academic scientists, experts from industry, and researchers. The topics discussed include Schrodinger operators, quantum kinetic equations and their application, extensions of fractional integral transforms, electrical impedance tomography, diffuse optical tomography, Galerkin method by using wavelets, a Cauchy problem associated with Korteweg–de Vries equation, and entropy solution for scalar conservation laws. This book motivates and inspires young researchers in the fields of industrial and applied mathematics. Accessible text features over 100 reality-based examples pulled from the science, engineering and operations research

fields. Prerequisites: ordinary differential equations, continuous probability. Numerous references. Includes 27 black-and-white figures. 1978 edition.

Key: Individual Answer Key for Mathematical Models with Applications Units 1-10.

A solutions manual to accompany An Introduction to Discrete Mathematical Modeling with Microsoft® Office Excel® With a focus on mathematical models based on real and current data, Models for Life: An Introduction to Discrete Mathematical Modeling with Microsoft® Office Excel® guides readers in the solution of relevant, practical problems by introducing both mathematical and Excel techniques. The book begins with a step-by-step introduction to discrete dynamical systems, which are mathematical models that describe how a quantity changes from one point in time to the next. Readers are taken through the process, language, and notation required for the construction of such models as well as their implementation in Excel. The book examines single-compartment models in contexts such as population growth, personal finance, and body weight and provides an introduction to more advanced, multi-com-

partment models via applications in many areas, including military combat, infectious disease epidemics, and ranking methods. Models for Life: An Introduction to Discrete Mathematical Modeling with Microsoft® Office Excel® also features: A modular organization that, after the first chapter, allows readers to explore chapters in any order Numerous practical examples and exercises that enable readers to personalize the presented models by using their own data Carefully selected real-world applications that motivate the mathematical material such as predicting blood alcohol concentration, ranking sports teams, and tracking credit card debt References throughout the book to disciplinary research on which the presented models and model parameters are based in order to provide authenticity and resources for further study Relevant Excel concepts with step-by-step guidance, including screenshots to help readers better understand the presented material Both mathematical and graphical techniques for understanding concepts such as equilibrium values, fixed points, disease endemicity, maximum sustainable yield, and a drug's therapeutic window A companion

website that includes the referenced Excel spreadsheets, select solutions to homework problems, and an instructor's manual with solutions to all homework problems, project ideas, and a test bank

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 College Algebra provides a comprehensive exploration of algebraic principles and meets scope and sequence requirements for a typical introductory algebra course. The modular approach and richness of content ensure that the book meets the needs of a variety of courses. College Algebra offers a wealth of examples with detailed, conceptual explanations, building a strong

foundation in the material before asking students to apply what they've learned. Coverage and Scope In determining the concepts, skills, and topics to cover, we engaged dozens of highly experienced instructors with a range of student audiences. The resulting scope and sequence proceeds logically while allowing for a significant amount of flexibility in instruction. Chapters 1 and 2 provide both a review and foundation for study of Functions that begins in Chapter 3. The authors recognize that while some institutions may find this material a prerequisite, other institutions have told us that they have a cohort that need the prerequisite skills built into the course. Chapter 1: Prerequisites Chapter 2: Equations and Inequalities Chapters 3-6: The Algebraic Functions Chapter 3: Functions Chapter 4: Linear Functions Chapter 5: Polynomial and Rational Functions Chapter 6: Exponential and Logarithm Functions Chapters 7-9: Further Study in College Algebra Chapter 7: Systems of Equations and Inequalities Chapter 8: Analytic Geometry Chapter 9: Sequences, Probability and Counting Theory Since Prandtl first suggested it in 1904, boundary layer theory has become a fun-

damental aspect of fluid dynamics. Although a vast literature exists for theoretical and experimental aspects of the theory, for the most part, mathematical studies can be found only in separate, scattered articles. *Mathematical Models in Boundary Layer Theory* offers the first systematic exposition of the mathematical methods and main results of the theory. Beginning with the basics, the authors detail the techniques and results that reveal the nature of the equations that govern the flow within boundary layers and ultimately describe the laws underlying the motion of fluids with small viscosity. They investigate the questions of existence and uniqueness of solutions, the stability of solutions with respect to perturbations, and the qualitative behavior of solutions and their asymptotics. Of particular importance for applications, they present methods for an approximate solution of the Prandtl system and a subsequent evaluation of the rate of convergence of the approximations to the exact solution. Written by the world's foremost experts on the subject, *Mathematical Models in Boundary Layer Theory* provides the opportunity to explore its mathematical studies and their impor-

tance to the nonlinear theory of viscous and electrically conducting flows, the theory of heat and mass transfer, and the dynamics of reactive and multiphase media. With the theory's importance to a wide variety of applications, applied mathematicians—especially those in fluid dynamics—along with engineers of aeronautical and ship design will undoubtedly welcome this authoritative, state-of-the-art treatise.

Detailed guidance on the mathematics behind equity derivatives *Problems and Solutions in Mathematical Finance Volume II* is an innovative reference for quantitative practitioners and students, providing guidance through a range of mathematical problems encountered in the finance industry. This volume focuses solely on equity derivatives problems, beginning with basic problems in derivatives securities before moving on to more advanced applications, including the construction of volatility surfaces to price exotic options. By providing a methodology for solving theoretical and practical problems, whilst explaining the limitations of financial models, this book helps readers to develop the skills they need to advance their careers. The text

covers a wide range of derivatives pricing, such as European, American, Asian, Barrier and other exotic options. Extensive appendices provide a summary of important formulae from calculus, theory of probability, and differential equations, for the convenience of readers. As Volume II of the four-volume *Problems and Solutions in Mathematical Finance* series, this book provides clear explanation of the mathematics behind equity derivatives, in order to help readers gain a deeper understanding of their mechanics and a firmer grasp of the calculations. Review the fundamentals of equity derivatives Work through problems from basic securities to advanced exotics pricing Examine numerical methods and detailed derivations of closed-form solutions Utilise formulae for probability, differential equations, and more Mathematical finance relies on mathematical models, numerical methods, computational algorithms and simulations to make trading, hedging, and investment decisions. For the practitioners and graduate students of quantitative finance, *Problems and Solutions in Mathematical Finance Volume II* provides essential guidance principally towards the subject of

equity derivatives.

Almost every year, a new book on mathematical modeling is published, so, why another? The answer springs directly from the fact that it is very rare to find a book that covers modeling with all types of differential equations in one volume. Until now. *Mathematical Modeling: Models, Analysis and Applications* covers modeling with all kinds of differe

This book discusses the interplay of stochastics (applied probability theory) and numerical analysis in the field of quantitative finance. The stochastic models, numerical valuation techniques, computational aspects, financial products, and risk management applications presented will enable readers to progress in the challenging field of computational finance. When the behavior of financial market participants changes, the corresponding stochastic mathematical models describing the prices may also change. Financial regulation may play a role in such changes too. The book thus presents several models for stock prices, interest rates as well as foreign-exchange rates, with increasing complexity across the chapters. As is said in the industry, 'do not fall in love with your

favorite model.' The book covers equity models before moving to short-rate and other interest rate models. We cast these models for interest rate into the Heath-Jarrow-Morton framework, show relations between the different models, and explain a few interest rate products and their pricing. The chapters are accompanied by exercises. Students can access solutions to selected exercises, while complete solutions are made available to instructors. The MATLAB and Python computer codes used for most tables and figures in the book are made available for both print and e-book users. This book will be useful for people working in the financial industry, for those aiming to work there one day, and for anyone interested in quantitative finance. The topics that are discussed are relevant for MSc and PhD students, academic researchers, and for quants in the financial industry.

Mathematical modeling in the form of differential equations is a branch of applied mathematics that includes topics from physics, engineering, environmental and computer science. The mathematical model is an approximate description of real processes. Mathematical modeling can

be thought of as a three step process: 1) Physical situation; 2) Mathematical formulation; 3) Solution by purely operations of the mathematical problem; 4) Physical interpretation of the mathematical solution. Over the centuries, Step 2 took on a life of its own, devoid of any contact with a physical problem; this is known as pure mathematics. Applied mathematics and mathematical modeling deals with all three steps. Improvements of approximations or their extensions to more general situations may increase the complexity of mathematical models significantly. Before the 18th century, applied mathematics and its methods received the close attention of the best mathematicians who were driven by a desire to develop approximate descriptions of natural phenomena. The goal of asymptotic and perturbation methods is to find useful, approximate solutions to difficult problems that arise from the desire to understand a physical process. Exact solutions are usually either impossible to obtain or too complicated to be useful. Approximate, useful solutions are often tested by comparison with experiments or observations rather than by rigorous mathe-

mathematical methods. Hence, the authors will not be concerned with rigorous proofs in this book. The derivation of approximate solutions can be done in two different ways. First, one can find an approximate set of equations that can be solved, or, one can find an approximate solution of a set of equations. Usually one must do both. Models of natural science show that the possibilities of applying differential equations for solving problems in the disciplines of the natural scientific cycle are quite wide. This book represents a unique blend of the traditional analytical and numerical methods enriched by the authors' developments and applications to ocean and atmospheric sciences. The overall viewpoint taken is a theoretical, unified approach to the study of both the atmosphere and the oceans. One of the key features in this book is the combination of approximate forms of the basic mathematical equations of mathematical modeling with careful and precise analysis. The approximations are required to make any progress possible, while precision is needed to make the progress meaningful. This combination is often the most elusive for student to appreciate. This book aims to

highlight this issue by means of accurate derivation of mathematical models with precise analysis and MATLAB applications. This book is meant for undergraduate and graduate students interested in applied mathematics, differential equations and mathematical modeling of real world problems. This book might also be interesting to experts working in the field of physics concerning the ocean and atmosphere.

An innovative course that offers students an exciting new perspective on mathematics, *Mathematical Models with Applications* explores the same types of problems that math professionals encounter daily. The modeling process—forming a theory, testing it, and revisiting it based on the results of the test—is critical for learning how to think mathematically. Demonstrating this ability can open up a wide range of educational and professional opportunities for students. *Mathematical Models with Applications* has been designed for students who have completed Algebra I or Geometry and see this as the final course in their high school mathematics sequence, or who would like additional math prepara-

tion before Algebra II. *Mathematical Models with Applications* ListServ As a service to instructors using *Mathematical Models with Applications*, a listserv has been designed as a forum to share ideas, ask questions and learn new ways to enhance the learning experience for their students.

As we enter the 21st century, there is an urgent need for new approaches to mathematics education emphasizing its relevance in young learners' futures. *Modeling Students' Mathematical Modeling Competencies* explores the vital trend toward using real-world problems as a basis for teaching mathematics skills, competencies, and applications. Blending theoretical constructs and practical considerations, the book presents papers from the latest conference of the ICTMA, beginning with the basics (Why are models necessary? Where can we find them?) and moving through intricate concepts of how students perceive math, how instructors teach—and how both can become better learners. Dispatches as varied as classroom case studies, analyses of math in engineering work, and an in-depth review of modeling-based curricula in the Netherlands illustrate modeling activities on the job, meth-

ods of overcoming math resistance, and the movement toward replicable models and lifelong engagement. A sampling of topics covered: How students recognize the usefulness of mathematics Creating the modeling-oriented classroom Assessing and evaluating students' modeling capabilities The relationship between modeling and problem-solving Instructor methods for developing their own models of modeling New technologies for modeling in the classroom Modeling Students'

Mathematical Modeling Competencies offers welcome clarity and focus to the international research and professional community in mathematics, science, and engineering education, as well as those involved in the sciences of teaching and learning these subjects.

Appropriate for undergraduate and graduate students, this text features independent sections that illustrate the most important principles of mathematical modeling, a variety of applications, and classic models. Students with a solid background

in calculus and some knowledge of probability and matrix theory will find the material entirely accessible. The range of subjects includes topics from the physical, biological, and social sciences, as well as those of operations research. Discussions cover related mathematical tools and the historical eras from which the applications are drawn. Each section is preceded by an abstract and statement of prerequisites, and answers or hints are provided for selected exercises. 1984 edition.