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The principles of symmetry and self-similarity structure nature's most beautiful creations. For example, they are expressed in fractals, famous for their beautiful but complicated geometric structure, which is the subject of study in dimension theory. And in dynamics the presence of invariant fractals often results in unstable "turbulent-like" motions and is associated with "chaotic" behavior. In this book, Yakov Pesin introduces a new area of research that has recently appeared in the interface between dimension theory and the theory of dynamical systems. Focusing on invariant fractals and their influence on stochastic properties of systems, Pesin provides a comprehensive and systematic treatment of modern dimension theory in dynamical systems, summarizes the current state of research, and describes the most important accomplishments of this field. Pesin's synthesis of these subjects of broad current research interest will be appreciated both by advanced mathematicians and by a wide range of scientists who depend upon mathematical modeling of dynamical processes.

Robust chaos is defined by the absence of periodic windows and coexisting attractors in some neighborhoods in the parameter space of a dynamical system. This unique book explores the definition, sources, and roles of robust chaos. The book is written in a reasonably self-contained manner and aims to provide students and researchers with the necessary understanding of the subject. Most of the known results, experiments, and conjectures about chaos in general and about robust chaos in particular are collected here in a pedagogical form. Many examples of dynamical systems, ranging from purely mathematical to natural and social processes displaying robust chaos, are discussed in detail. At the end of each chapter is a set of exercises and open problems (more than 260 in the whole book) intended to reinforce the ideas and provide additional experiences for both readers and researchers in nonlinear science in general, and chaos theory in particular.

1. Introduction -- 2. Sequences, series, finance -- 3. Relations, mappings, functions of a real variable -- 4. Differentiation -- 5. Integration -- 6. Vectors -- 7. Matrices and determinants -- 8. Linear equations and inequalities -- 9. Linear programming -- 10. Eigenvalue problems and quadratic forms -- 11. Functions of several variables -- 12. Differential equations and difference equations.

Global history records an astonishing variety of forms of social organization. Yet almost universally, males subordinate females. How does the relationship between men and women shape the wider political order? The First Political Order is a groundbreaking demonstration that the persistent and systematic subordination of women underlies all other institutions, with wide-ranging implications for global security and development. Incorporating research findings spanning a variety of social science disciplines and comprehensive empirical data detailing the status of women around the globe, the book shows that female subordination functions almost as a curse upon nations. A society's choice to subjugate women has significant negative consequences: worse governance, worse conflict, worse stability, worse economic performance, worse food security, worse health, worse demographic problems, worse environmental protection, and worse social progress. Yet despite the pervasive power of social and political structures that subordinate women, history—and the data—reveal possibilities for progress. The First Political Order shows that when steps are taken to reduce the hold of inequitable laws, customs, and practices, outcomes for all improve. It

offers a new paradigm for understanding insecurity, instability, autocracy, and violence, explaining what the international community can do now to promote more equitable relations between men and women and, thereby, security and peace. With comprehensive empirical evidence of the wide-ranging harm of subjugating women, it is an important book for security scholars, social scientists, policy makers, historians, and advocates for women worldwide.

This stimulating textbook presents a broad and accessible guide to the fundamentals of discrete mathematics, highlighting how the techniques may be applied to various exciting areas in computing. The text is designed to motivate and inspire the reader, encouraging further study in this important skill. Features: provides an introduction to the building blocks of discrete mathematics, including sets, relations and functions; describes the basics of number theory, the techniques of induction and recursion, and the applications of mathematical sequences, series, permutations, and combinations; presents the essentials of algebra; explains the fundamentals of automata theory, matrices, graph theory, cryptography, coding theory, language theory, and the concepts of computability and decidability; reviews the history of logic, discussing propositional and predicate logic, as well as advanced topics; examines the field of software engineering, describing formal methods; investigates probability and statistics.

Designed for precollege teachers by a collaborative of teachers, educators, and mathematicians, Moving Things Around is based on a course offered in the Summer School Teacher Program at the Park City Mathematics Institute. But this book isn't a "course" in the traditional sense. It consists of a carefully sequenced collection of problem sets designed to develop several interconnected mathematical themes, and

one of the goals of the problem sets is for readers to uncover these themes for themselves. The goal of Moving Things Around is to help participants make what might seem to be surprising connections among seemingly different areas: permutation groups, number theory, and expansions for rational numbers in various bases, all starting from the analysis of card shuffles. Another goal is to use these connections to bring some coherence to several ideas that run throughout school mathematics-rational number arithmetic, different representations for rational numbers, geometric transformations, and combinatorics. The theme of seeking structural similarities is developed slowly, leading, near the end of the course, to an informal treatment of isomorphism. Moving Things Around is a volume of the book series "IAS/PCMI-The Teacher Program Series" published by the American Mathematical Society. Each volume in this series covers the content of one Summer School Teacher Program year and is independent of the rest

This book is devoted to the application of fractional calculus in economics to describe processes with memory and non-locality. Fractional calculus is a branch of mathematics that studies the properties of differential and integral operators that are characterized by real or complex orders. Fractional calculus methods are powerful tools for describing the processes and systems with memory and nonlocality. Recently, fractional integro-differential equations have been used to describe a wide class of economical processes with power law memory and spatial nonlocality. Generalizations of basic economic concepts and notions the economic processes with memory were proposed. New mathematical models with continuous time are proposed to describe economic dynamics with long memory. This book is a collection of articles reflecting the latest mathematical and conceptual developments in mathematical economics with memory and non-locality based on applications of fractional calculus.

Wow! This is a powerful book that addresses a long-standing elephant in the mathematics room. Many people learning math ask ``Why is math so hard for me while everyone else understands it?'' and ``Am I good enough to succeed in math?'' In answering these questions the book shares personal stories from many now-accomplished mathematicians affirming that ``You are not alone; math is hard for everyone'' and ``Yes; you are good enough.'' Along the way the book addresses other issues such as biases and prejudices that mathematicians encounter, and it provides inspiration and emotional support for mathematicians ranging from the experienced professor to the struggling mathematics student. --Michael Dorff, MAA President This book is a remarkable collection of personal reflections on what it means to be, and to become, a mathematician. Each story reveals a unique and refreshing understanding of the barriers erected by our cultural focus on ``math is hard.'' Indeed, mathematics is hard, and so are many other things--as Stephen Kennedy points out in his cogent introduction. This collection of essays offers inspiration to students of mathematics and to mathematicians at every career stage. --Jill Pipher, AMS President This book is published in cooperation with the Mathematical Association of America.

Featuring a wealth of digital content, this concept-based Print and Enhanced Online Course Book Pack has been developed in cooperation with the IB to provide the most comprehensive support for the new DP Mathematics: applications and interpretation HL syllabus, for first teaching in September 2019.

From the Preface by D. Ruelle:"...Rufus Bowen has left us a masterpiece of mathematical exposition... Here a numberof results which were new at the time are presented in such a clear and lucid style thatBowen's monograph immediately became a classic. More than thirty years later, manynew results have been proved in this area, but the volume is as useful as ever because itremains the best introduction to the basics of the ergodic theory of hyperbolic systems.'' For this printing of R. Bowen's book, J.-R. Chazottes has rekeyed it in TeX for easierreading, thereby correcting typos and bibliographic details.

To Volume 1 This work represents our effort to present the basic concepts of vector and tensor analysis. Volume 1 begins with a brief discussion of algebraic structures followed by a rather detailed discussion of the algebra of vectors and tensors. Volume 2 begins with a discussion of Euclidean manifolds, which leads to a development of the analytical and geometrical aspects of vector and tensor fields. We have not included a discussion of general differentiable manifolds. However, we have included a chapter on vector and tensor fields defined on hypersurfaces in a Euclidean manifold. In preparing this two-volume work, our intention was to present to engineering and science students a modern introduction to vectors and tensors. Traditional courses on applied mathematics have emphasized problem-solving techniques rather than the systematic development of concepts. As a result, it is possible for such courses to become terminal mathematics courses rather than courses which equip the student to develop his or her understanding further.

This volume arose from a semester at CIRM-Luminy on "Thermodynamic Formalism: Applications to Probability, Geometry and Fractals" which brought together leading experts in the area to discuss topical problems and recent progress. It includes a number of surveys intended to make the field more accessible to younger mathematicians and scientists wishing to learn more about the area. Thermodynamic formalism has been a powerful tool in ergodic theory and dynamical system and its applications to other topics, particularly Riemannian geometry (especially in negative curvature), statistical properties of dynamical systems and fractal geometry. This work will be of value both to graduate students and more senior researchers interested in either learning about the main ideas and themes in thermodynamic formalism, and research themes which are at forefront of research in this area.

This is the first book length study of the emergence of an important new form of expertise - industry analysts - whose outputs exercise enormous influence over the Information Technology market

Designed for precollege teachers by a collaborative of teachers, educators, and mathematicians, Probability through Algebra is based on a course offered in the Summer School Teacher Program at the Park City Mathematics Institute. But this book isn't a "course" in the traditional sense. It consists of a carefully sequenced collection of problem sets designed to develop several interconnected mathematical themes, and one of the goals of the problem sets is for readers to uncover these themes for themselves. The specific themes developed in Probability through Algebra introduce readers to the algebraic properties of expected value and variance through analysis of games, to the use of generating functions and formal algebra as combinatorial tools, and to some applications of these ideas to questions in probabilistic number theory. Probability through Algebra is a volume of the book series "IAS/PCMI-The Teacher Program Series" published by the American Mathematical Society. Each volume in that series covers the content of one Summer School Teacher Program year and is independent of the rest. Titles in this series are co-published with the Institute for Advanced Study/Park City Mathematics Institute. Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) re-

ceive a 20% discount from list price.

Accelerating progress in the application of radioactive and stable isotope analysis to a varied range of geologicla and geochemical problems in geology has required a complete revision of Isotopes in the Earth Sciences, published in 1988. This new book comprises four parts: the first introduces isotopic chemistry and examines mass spectroscopic methods; the second eeals with radiometric dating methods. Part Three examines the importance of isotopes in climato-environmental studies, and increasingly significant area of research. The last part looks at extra-terrestrial matter, geothermometry and the isotopic geochemistry of the Earth's lithosphere. Post-graduate and post-doctoral researchers in geochemistry, as well as final year undergraduates in the earth and environmental sciences, will find Radioactive and Stable Isotope Geology an invaluable, uo-to-date and thorough treatment of the theory and practice of isotopie geology.

This book is devoted to the systematic description of the role of microgeometry of modern piezo-active composites in the formation of their piezoelectric sensitivity. In five chapters, the authors analyse kinds of piezoelectric sensitivity for piezo-active composites with specific connectivity patterns and links between the microgeometric feature and piezoelectric response. The role of components and microgeometric factors is discussed in the context of the piezoelectric properties and their anisotropy in the composites. Interrelations between different types of the piezoelectric coefficients are highlighted. This book fills a gap in piezoelectric materials science and provides readers with data on the piezoelectric performance of novel composite materials that are suitable for sensor, transducer, hydroacoustic, energy-harvesting, and other applications.

Offering a solid introduction to the entire modeling process, A FIRST COURSE IN MATHEMATICAL MODELING, 4th Edition delivers an excellent balance of theory and practice, giving students hands-on experience developing and sharpening their skills in the modeling process. Throughout the book, students practice key facets of modeling, including creative and empirical model construction, model analysis, and model research. The authors apply a proven six-step problem-solving process to enhance students' problem-solving capabilities -- whatever their level. Rather than simply emphasizing the calculation step, the authors first ensure that students learn how to identify problems, construct or select models, and figure out what data needs to be collected. By involving students in the mathematical process as early as possible -- beginning with short projects -- the book facilitates their progressive development and confidence in mathematics and modeling. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version. Since its original publication in 1990, Kenneth Falconer's Fractal Geometry: Mathematical Foundations and Applications has become a seminal text on the mathematics of fractals. It introduces the general mathematical theory and applications of fractals in a way that is accessible to students from a wide range of disciplines. This new edition has been extensively revised and updated. It features much new material, many additional exercises, notes and references, and an extended bibliography that reflects the development of the subject since the first edition. * Provides a comprehensive and accessible introduction to the mathematical theory and applications of fractals. * Each topic is carefully explained and illustrated by examples and figures. * Includes all necessary mathematical background material. * Includes notes and references to enable the reader to pursue individual topics. * Features a wide selection of exercises, enabling the reader to develop their understanding of the theory. * Supported by a Web site featuring solutions to exercises, and additional material for students and lecturers. Fractal Geometry: Mathematical Foundations and Applications is aimed at undergraduate and graduate students studying courses in fractal geometry. The book also provides an excellent source of reference for researchers who encounter fractals in mathematics, physics, engineering, and the applied sciences. Also by Kenneth Falconer and available from Wiley: Techniques in Fractal Geometry ISBN 0-471-95724-0 Please click here to download solutions to exercises found within this title: http://www.wileyeurope.com/fractal Designed for precollege teachers by a collaborative of teachers, educators, and mathematicians, Probability and Games is based on a course offered in the Summer School Teacher Program at the Park City Mathematics Institute. This course leads participants through an introduction to probability and statistics, with particular focus on conditional probability, hypothesis testing, and the mathematics of election analysis. These ideas are tied together through low-threshold entry points including work with real and fake coin-flipping data, short games that lead to key concepts, and inroads to connecting the topics to number theory and algebra. But this book isn't a "course" in the traditional sense. It consists of a carefully sequenced collection of problem sets designed to develop several interconnected mathematical themes. These materials provide participants with the opportunity for authentic mathematical discovery—participants build mathematical structures by investigating patterns, use reasoning to test and formalize their ideas, offer and negotiate mathematical definitions, and apply their theories and mathematical machinery to solve problems. Probability and Games is a volume of the book series "IAS/PCMI—The Teacher Program Series" published by the American Mathematical Society. Each volume in this series covers the content of one Summer School Teacher Program year and is independent of the rest.

Reissued in the Cambridge Mathematical Library this classic book outlines the theory of thermodynamic formalism which was developed to describe the properties of certain physical systems consisting of a large number of subunits. It is aimed at mathematicians interested in ergodic theory, topological dynamics, constructive quantum field theory, the study of certain differentiable dynamical systems, notably Anosov diffeomorphisms and flows. It is also of interest to theoretical physicists concerned with the conceptual basis of equilibrium statistical mechanics. The level of the presentation is generally advanced, the objective being to provide an efficient research tool and a text for use in graduate teaching. Background material on mathematics has been collected in appendices to help the reader. Extra material is given in the form of updates of problems that were open at the original time of writing and as a new preface specially written for this new edition by the author.

This book presents mathematical modelling and the integrated process of formulating sets of equations to describe real-world problems. It describes methods for obtaining solutions of challenging differential equations stemming from problems in areas such as chemical reactions, population dynamics, mechanical systems, and fluid mechanics. Chapters 1 to 4 cover essential topics in ordinary differential equations, transport equations and the calculus of variations that are important for formulating models. Chapters 5 to 11 then develop more advanced techniques including similarity solutions, matched asymptotic expansions, multiple scale analysis, longwave models, and fast/slow dynamical systems. Methods of Mathematical Modelling will be useful for advanced undergraduate or beginning graduate students in applied mathematics, engineering and other applied sciences.

Introduces exciting new methods for assessing algorithms for problems ranging from clustering to linear programming to neural networks.

How do you begin to understand the concept of nothing? Where does it begin and where does it end? From the zeros of the mathematician to the void of the philosophers, from Shakespeare to the empty set, from the ether to the quantum vacuum, from being and nothingness to creatio ex nihilo, there is much ado about nothing at the heart of things. Recent exciting discoveries in astronomy are shown to shed new light on the nature of the vacuum and its dramatic effect upon the explanation of the Universe. This remarkable book ranges over every nook and cranny of nothingness to reveal how the human mind has had to make something of nothing in every field of human enquiry.

This volume contains the proceedings of the Eighth International Conference on Scientific Computing and Applications, held April 1-4, 2012, at the University of Nevada, Las Vegas. The papers in this volume cover topics such as finite element methods, multiscale methods, finite difference methods, spectral methods, collocation methods, adaptive methods, parallel computing, linear solvers, applications to fluid flow, nano-optics, biofilms, finance, magnetohydrodynamics flow, electromagnetic waves, the fluid-structure interaction problem, and stochastic PDEs. This book will serve as an excellent reference for graduate students and researchers interested in scientific computing and its applications.

This book provides an overview of the current state of the art in novel piezo-composites based on ferroelectrics. Covering aspects ranging from theoretical materials simulation and manufacturing and characterization methods, to the application and performance of these materials, it focuses on the optimization of the material parameters. Presenting the latest findings on modern composites and highlighting the applications of piezoelectric materials for sensors, transducers and hydro-acoustics, the book addresses an important gap in the physics of active dielectrics and materials science and describes new trends in the research on ferroelectric composites.

This is the reference work that librarians and business people have been waiting for--Lorna Daniells's updated guide to selected business books and reference sources. Completely revised, with the best, most recent information available, this edition contains several new sections covering such topics as competitive intelligence, economic and financial measures,

and health care marketing. Handbooks, bibliographies, indexes and abstracts, online databases, dictionaries, directories, statistical sources, and periodicals are also included. Speedy access to up-to-date information is essential in the competitive, computerized business world. This classic guide will be indispensable to anyone doing business research today.

A geometry able to include mountains and clouds now exists. I put it together in 1975, but of course it incorporates numerous pieces that have been around for a very long time. Like everything in science, this new geometry has very, very deep and long roots. Benoît B. Mandelbrot Introduction This enhanced and expanded edition of THE COLOURS OF INFINITY features an additional chapter on the money markets by the fractal master himself, Professor Benoît Mandelbrot. The DVD of the film associated with this book has been re-mastered especially for this edition with exquisite new fractal animations, which will take your breath away! Driven by the curious enthusiasm that engulfs many fractalistas, in 1994, Nigel Lesmoir-Gordon overcame enormous obstacles to raise the finance for, then shoot and edit the groundbreaking TV documentary from which this book takes its name. The film has been transmitted on TV channels in over fifty countries around the world. This book is not just a celebration of the discovery of the Mandelbrot set, it also brings fractal geometry up to date with a gathering of the thoughts and enthusiasms of the foremost writers and researchers in the field. As Ian Stewart makes clear in the opening chapter, there were antecedents for fractal geometry before 1975 when Mandelbrot gave the subject its name and began to develop the underlying theory.

This EMS volume, the first edition of which was published as Dynamical Systems II, EMS 2, familiarizes the reader with the fundamental ideas and results of modern ergodic theory and its applications to dynamical systems and statistical mechanics. The enlarged and revised second edition adds two new contributions on ergodic theory of flows on homogeneous manifolds and on methods of algebraic geometry in the theory of interval exchange transformations.

This book provides a broad overview of state-of-the-art research at the intersection of the Koopman operator theory and control theory. It also reviews novel theoretical results obtained and efficient numerical methods developed within the framework of Koopman operator theory. The contributions discuss the latest findings and techniques in several areas of

control theory, including model predictive control, optimal control, observer design, systems identification and structural analysis of controlled systems, addressing both theoretical and numerical aspects and presenting open research directions, as well as detailed numerical schemes and data-driven methods. Each contribution addresses a specific problem. After a brief introduction of the Koopman operator framework, including basic notions and definitions, the book explores numerical methods, such as the dynamic mode decomposition (DMD) algorithm and Arnoldi-based methods, which are used to represent the operator in a finite-dimensional basis and to compute its spectral properties from data. The main body of the book is divided into three parts: theoretical results and numerical techniques for observer design, synthesis analysis, stability analysis, parameter estimation, and identification; data-driven techniques based on DMD, which extract the spectral properties of the Koopman operator from data for the structural analysis of controlled systems; and Koopman operator techniques with specific applications in systems and control, which range from heat transfer analysis to robot control. A useful reference resource on the Koopman operator theory for control theorists and practitioners, the book is also of interest to graduate students, researchers, and engineers looking for an introduction to a novel and comprehensive approach to systems and control, from pure theory to data-driven methods.

Written by leading experimentalist Warwick P. Bowen and prominent theoretician Gerard J. Milburn, Quantum Optomechanics discusses modern developments in this novel field from experimental and theoretical standpoints. The authors share their insight on a range of important topics, including optomechanical cooling and entanglement; quantum limits on measurement precision and how to overcome them via back-action evading measurements; feedback control; single photon and nonlinear optomechanics; optomechanical synchronization; coupling of optomechanical systems to microwave circuits and two-level systems, such as atoms and superconducting qubits; and optomechanical tests of gravitational decoherence. The book first introduces the basic physics of quantum harmonic oscillators and their interactions with their environment. It next discusses the radiation pressure interaction between light and matter, deriving common Hamiltonians used in quantum optomechanics. It then focuses on the linearized regime of quantum optomechanics before exploring scenarios where the simple linearized picture of quantum optome-

chanics no longer holds. The authors move on to hybrid optomechanical systems in which the canonical quantum optomechanical system is coupled to another quantum object. They explain how an alternative form of a hybrid optomechanical system leads to the phenomenon of synchronization. They also consider the impact of quantum optomechanics on tests of gravitational physics.

Introduction to calculus for both undergraduate math majors and those pursuing other areas of science and engineering for whom calculus will be a vital tool. Solutions available as free downloads. 1967 edition.

The most comprehensive match to the new 2014 Chemistry syllabus, this completely revised edition gives you unrivalled support for the new concept-based approach, the Nature of science. The only DP Chemistry resource that includes support directly from the IB, focused exam practice, TOK links and real-life applications drive achievement.