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Number Theory 1 Fermat's Dream Modular Forms and Fermat’s Last Theorem Number Theory Fermat's Last Theorem Algebraic Number Theory and Fermat's Last Theorem The Mathematical Career of Pierre de Fermat, 1601-1665 Starry Reckoning: Reference and Analysis in Mathematics and Cosmology Primality Testing and Integer Factorization in Public-Key Cryptography Mathematics of Information and Coding Certain Number-Theoretic Episodes In Algebra Lectures in Mathematical Statistics D-modules and Microlocal Calculus C * -Algebras and Elliptic Operators in Differential Topology Optimal Control of Distributed Systems. Theory and Applications Metric Characterization of Random Variables and Random Processes Cohomological Analysis of Partial Differential Equations and Secondary Calculus Methods of Information Geometry Quantum Bounded Symmetric Domains Operator Algebras and Geometry Principal Structures and Methods of Representation Theory Lectures and Exercises on Functional Analysis Function Theory in Several Complex Variables Hyperbolic Partial Differential Equations and Wave Phenomena Number-Theoretic Algorithms in Cryptography Hilbert C*-modules Geometry Homogenization Essentials of

Stochastic Processes Infinite-dimensional Lie Algebras Classical Theory of Algebraic Numbers Numbers and Measurements An Introduction to Morse Theory Algebraic Geometry 2 Stochastic Analysis Generalized Cohomology Kikagakuteki Henbun Mondai Advances in Moduli Theory Far-from-equilibrium Dynamics Introduction to Prehomogeneous Vector Spaces

The aim of this book is to present some applications of functional analysis and the theory of differential operators to the investigation of topological invariants of manifolds. The main topological application discussed in the book concerns the problem of the description of homotopy-invariant rational Pontryagin numbers of non-simply connected manifolds and the Novikov conjecture of homotopy invariance of higher signatures. The definition of higher signatures and the formulation of the Novikov conjecture are given in Chapter 3. In this chapter, the authors also give an overview of different approaches to the proof of the Novikov conjecture. First, there is the Mishchenko symmetric signature and the generalized Hirzebruch formulae and the Mishchenko theorem of homotopy invariance of higher signatures for manifolds whose fundamental groups have a classifying space, being a complete Riemannian non-positive curvature manifold. Then the authors present Solovyov's proof of the Novikov conjecture for manifolds with fundamental group isomorphic to a discrete subgroup of a linear algebraic group over a local field, based on the notion of the Bruhat-Tits building. Finally, the authors discuss the approach due to Kasparov based on the operator $KK$-theory and another proof of the Mishchenko theorem. In Chapter 4, they outline the approach to the Novikov conjecture due to Connes and Moscovici involving cyclic homology. That allows one to prove the conjecture in the case when the fundamental group is a (Gromov) hyperbolic group. The text provides a concise exposition of some topics from functional analysis (for instance, $C^*$-Hilbert modules, $K$-theory or $C^*$-bundles, Hermitian $K$-theory, Fredholm representations, $KK$-theory, and functional integration) from the theory of differential operators (pseudodifferential calculus and Sobolev chains over $C^*$-algebras), and from differential topology (characteristic classes). The book explains basic ideas of the subject and can serve as a course text for an introduction to the study of original works and special monographs. This book is intended to provide engineering and/or statistics students, communications engineers, and mathematicians with the firm theoretic basis of source coding (or data compression) in information theory. Although information theory consists of two main areas, source coding and channel coding, the authors choose here to focus only on source coding. The reason is that, in a sense, it is more basic than channel coding, and also because of recent achievements in source coding and compression. An important feature of the book is that whenever possible, the authors describe universal coding methods, i.e., the methods that can be used without prior knowledge of the statistical properties of the data. The authors approach the subject of source coding from the very basics to the top frontiers in an intuitively transparent, but mathematically sound, manner. The book serves as a theoretical reference for communication professionals and statisticians specializing in information theory. It will also serve as an excellent introductory text for advanced-level and graduate students taking elementary or advanced courses in telecommunications, electrical engineering, statistics, mathematics, and computer science. Hailed as one of the greatest mathematical results of the twentieth century, the recent proof of Fermat's Last Theorem by Andrew Wiles brought to public attention the enigmatic problem-solver Pierre de Fermat, who centuries ago stated his famous conjecture in a margin of a book, writing that he did not have enough room to show his "truly marvelous demonstration." Along with formulating this proposition--xn+yn=zn has no rational solution for n > 2--Fermat, an inventor of analytic geometry, also laid the foundations of differential and integral calculus, established, together with Pascal, the conceptual guidelines of the theory of probability, and created modern number theory. In one of the first full-length investigations of Fermat's life and work, Michael Sean Mahoney provides rare insight into the mathematical genius of a hobbyist who never sought to publish his work, yet who ranked with his contemporaries Pascal and Descartes in shaping the course of modern mathematics. Finite-dimensional Morse theory is easier to present fundamental ideas than in infinite-dimensional Morse theory, which is theoretically more involved. However, finite-dimensional Morse theory has its own significance. This volume explains the finte-dimensional Morse theory. This volume contains the expanded lectures given at a conference on number theory and arithmetic geometry held at Boston University. It introduces and explains the many ideas and techniques used by Wiles, and to explain how his result can be combined with Ribets theorem and ideas of Frey and Serre to prove Fermats Last Theorem. The book begins with an overview of the complete proof, followed by several introductory chapters surveying the basic theory of elliptic curves, modular functions and curves, Galois cohomology, and finite group schemes. Representation theory, which lies at the core of the proof, is dealt with in a chapter on automorphic representations and the Langlands-Tunnell theorem, and this is followed by in-depth discussions of Serres conjectures, Galois deformations, universal deformation rings, Hecke algebras, and complete intersections. The book concludes by looking both forward and backward, reflecting on the history of the problem, while placing Wiles'theorem into a more general Diophantine context suggesting future applications. Students and professional mathematicians alike will find this an indispensable resource. The word ``moduli'' in the sense of this book first appeared in the epoch-making paper of B. Riemann, Theorie der Abel'schen Funktionen, published in 1857. Riemann defined a Riemann surface of an algebraic function field as a branched covering of a one-dimensional complex projective space, and found out that Riemann surfaces have parameters. This work gave birth to the theory of moduli. However, the viewpoint regarding a Riemann surface as an algebraic curve became the mainstream,and the moduli meant the parameters for the figures (graphs) defined by equations. In 1913, H. Weyl defined a Riemann surface as a complex manifold of dimension one. Moreover, Teichmuller's theory of quasiconformal mappings and Teichmuller spaces made a start for new development of the theory ofmoduli, making possible a complex analytic approach toward the theory of moduli of Riemann surfaces. This theory was then investigated and made complete by Ahlfors, Bers, Rauch, and others. However, the theory of Teichmuller spaces utilized the special nature of complex dimension one, and it was difficult to generalize it to an arbitrary dimension in a direct way. It was Kodaira-Spencer's deformation theory of complex manifolds that allowed one to study arbitrary dimensional complex manifolds.Initial motivation in Kodaira-Spencer's discussion was the need to clarify what one should mean by number of moduli. Their results, together with further work by Kuranishi, provided this notion with intrinsic meaning. This book begins by presenting the Kodaira-Spencer theory in its original naiveform in Chapter 1 and introduces readers to moduli theory from the viewpoint of complex analytic geometry. Chapter 2 briefly outlines the theory of period mapping and Jacobian variety for compact Riemann surfaces, with the Torelli theorem as a goal. The theory of period mappings for compact Riemann surfaces can be generalized to the theory of period mappings in terms of Hodge structures for compact Kahler manifolds. In Chapter 3, the authors state the theory of Hodge structures, focusingbriefly on period mappings. Chapter 4 explains conformal field theory as an application of moduli theory. This is the English translation of a book originally published in Japanese. Other books by Kenji Ueno published in this AMS series, Translations of Mathematical Monographs, include An Introduction toAlgebraic Geometry, Volume 166, Algebraic Geometry 1: From Algebraic Varieties to Schemes, Volume 185, and Algebraic Geometry 2: Sheaves and Cohomology, Volume 197. Algorithmic number theory is a rapidly developing branch of number theory, which, in addition to its mathematical importance, has substantial applications in computer science and cryptography. Among the algorithms used in cryptography, the following are especially important: algorithms for primality testing; factorization algorithms for integers and for polynomials in one variable; applications of the theory of elliptic curves; algorithms for computation of discrete logarithms; algorithms for solving linear equations over finite fields; and, algorithms for performing arithmetic operations on large integers. The book describes the current state of these and some other algorithms. It also contains extensive bibliography. For this English translation, additional references were prepared and commented on by the author. This is the English translation of the original Japanese book. In this volume, "Fermat's Dream", core theories in modern number theory are introduced. Developments are given in elliptic curves, $p$-adic numbers, the $\zeta$-function, and the number fields. This work presents an elegant perspective on the wonder of numbers. Number Theory 2 on class field theory, and Number Theory 3 on Iwasawa theory and the theory of modular forms, are forthcoming in the series. Primality Testing and Integer Factorization in Public-Key Cryptography introduces various algorithms for primality testing and integer factorization, with their applications in public-key cryptography and information security. More specifically, this book explores basic concepts and results in number theory in Chapter 1. Chapter 2 discusses various algorithms for primality testing and prime number generation, with an emphasis on the Miller-Rabin probabilistic test, the Goldwasser-Kilian and Atkin-Morain elliptic curve tests, and the Agrawal-Kayal-Saxena deterministic test for primality. Chapter 3 introduces various algorithms, particularly the Elliptic Curve Method (ECM), the Quadratic Sieve (QS) and the Number Field Sieve (NFS) for integer factorization. This chapter also discusses some other computational problems that are related to factoring, such as the square root problem, the discrete logarithm problem and the quadratic residuosity problem. Algebraic geometry is built upon two fundamental notions: schemes and sheaves. The theory of schemes was explained in Algebraic Geometry 1: From Algebraic Varieties to Schemes. In this volume, the author turns to the theory of sheaves and their cohomology. A sheaf is a way of keeping track of local information defined on a topological space, such as the local holomorphic functions on a complex manifold or the local sections of a vector bundle. To study schemes, it is useful to study the sheaves defined on them, especially the coherent and quasicoherent sheaves. This is the first introductory book on the theory of prehomogeneous vector spaces, introduced in the 1970s by Mikio Sato. The author was an early and important developer of the theory and continues to be active in the field. The subject combines elements of several areas of mathematics, such as algebraic geometry, Lie groups, analysis, number theory, and invariant theory. An important objective is to create applications to number theory. For example, one of the key topics is that of zeta functions attached to prehomogeneous vector spaces; these are generalizations of the Riemann zeta function, a cornerstone of analytic number theory. Prehomogeneous vector spaces are also of use in representation theory, algebraic geometry and invariant theory. This book explains the basic concepts of prehomogeneous vector spaces, the fundamental theorem, the zeta functions associated with prehomogeneous vector spaces and a classification theory of irreducible prehomogeneous vector spaces. It strives, and to a large extent succeeds, in making this content, which is by its nature fairly technical, self-contained and accessible. The first section of the book, "Overview of the theory and contents of this book," Is particularly noteworthy as an excellent introduction to the subject. This book is dedicated to fundamentals of a new theory, which is an analog of affine algebraic geometry for (nonlinear) partial differential equations. This theory grew up from the classical geometry of PDE's originated by S. Lie and his followers by incorporating some nonclassical ideas from the theory of integrable systems, the formal theory of PDE's in its modern cohomological form given by D. Spencer and H. Goldschmidt and differential calculus over commutative algebras (Primary Calculus). The main result of this synthesis is Secondary Calculus on diffieties, new geometrical objects which are analogs of algebraic varieties in the context of (nonlinear) PDE's. Secondary Calculus surprisingly reveals a deep cohomological nature of the general theory of PDE's and indicates new directions of its further progress. Recent developments in quantum field theory showed Secondary Calculus to be its natural language, promising a nonperturbative formulation of the theory. In addition to PDE's themselves, the author describes existing and potential applications of Secondary Calculus ranging from algebraic geometry to field theory, classical and quantum, including areas such as characteristic classes, differential invariants, theory of geometric structures, variational calculus, control theory, etc. This book, focused mainly on theoretical aspects, forms a natural dipole with Symmetries and Conservation Laws for Differential Equations of Mathematical Physics, Volume 182 in this same series, Translations of Mathematical Monographs, and shows the theory "in action". The exposition of the classical theory of algebraic numbers is clear and thorough, and there is a large number of exercises as well as worked out numerical examples. A careful study of this book will provide a solid background to the learning of more recent topics. The main topic of this book can be described as the theory of algebraic and topological structures admitting natural representations by operators in vector spaces. These structures include topological algebras, Lie algebras, topological groups, and Lie groups. The book is divided into three parts. Part I surveys general facts for beginners, including linear algebra and functional analysis. Part II considers associative algebras, Lie algebras, topological groups, and Lie groups,along with some aspects of ring theory and the theory of algebraic groups. The author provides a detailed account of classical results in related branches of mathematics, such as invariant integration and Lie's theory of connections between Lie groups and Lie algebras. Part III discusses semisimple Liealgebras and Lie groups, Banach algebras, and quantum groups. This is a useful text for a wide range of specialists, including graduate students and researchers working in mathematical physics and specialists interested in modern representation theory. It is suitable for independent study or supplementary reading. Also available from the AMS by this acclaimed author is Compact Lie Groups and Their Representations. This comprehensive volume is perfect for students who are interested in higher-level study of numbers and measurements. The book delves into the history of mathematical reasoning and the progression of numerical thought. Readers will learn how our world is shaped by the number and measurement systems that have arisen over time. They will also engage in the history of the development of number and measurement systems and the biographies of some of the greatest mathematical minds throughout history. This is a perfect volume for anyone interested in higher-level math and the stories behind it. Based on lectures delivered by the authors at Moscow State University, this volume presents a detailed introduction to the theory of Hilbert $C*$-modules. Hilbert $C*$-modules provide a natural generalization of Hilbert spaces arising when the field of scalars $\mathbf{C $ is replaced by an arbitrary $C*$-algebra. The general theory of Hilbert $C*$-modules appeared more than 30 years ago in the pioneering papers of W. Paschke and M. Rieffel and has proved to be a powerful tool inoperator algebras theory, index theory of elliptic operators, $K$- and $KK$-theory, and in noncommutative geometry as a whole. Alongside these applications, the theory of Hilbert $C*$-modules is interesting on its own. In this book, the authors explain in detail the basic notions and results of thetheory, and provide a number of important examples. Some results related to the authors' research interests are also included. A large part of the book is devoted to structural results (self-duality, reflexivity) and to nonadjointable operators. Most of the book can be read with only a basic knowledge of functional analysis; however, some experience in the theory of operator algebras makes reading easier. This book deals with a topic that has been largely neglected by philosophers of science to date: the ability to refer and analyze in tandem. On the basis of a set of philosophical case studies involving both problems in number theory and issues concerning time and cosmology from the era of Galileo, Newton and Leibniz up through the present day, the author argues that scientific knowledge is a combination of accurate reference and analytical interpretation. In order to think well, we must be able to refer successfully, so that we can show publicly and clearly what we are talking about. And we must be able to analyze well, that is, to discover productive and explanatory conditions of intelligibility for the things we are thinking about. The book’s central claim is that the kinds of representations that make successful reference possible and those that make successful analysis possible are not the same, so that significant scientific and mathematical work typically proceeds by means of a heterogeneous discourse that juxtaposes and often superimposes a variety of kinds of representation, including formal and natural languages as well as more iconic modes. It demonstrates the virtues and necessity of heterogeneity in historically central reasoning, thus filling an important gap in the literature and fostering a new, timely discussion on the epistemology of science and mathematics. This volume is intended for the advanced study of several topics in mathematical statistics. The first part of the book is devoted to sampling theory (from one-dimensional and multidimensional distributions), asymptotic properties of sampling, parameter estimation, sufficient statistics, and statistical estimates. The second part is devoted to hypothesis testing and includes the discussion of families of statistical hypotheses that can be asymptotically distinguished. In particular,the author describes goodness-of-fit and sequential statistical criteria (Kolmogorov, Pearson, Smirnov, and Wald) and studies their main properties. The book is suitable for graduate students and researchers interested in mathematical statistics. It is useful for independent study or supplementaryreading. Many basic ideas of algebra and number theory intertwine, making it ideal to explore both at the same time. Certain Number-Theoretic Episodes in Algebra focuses on some important aspects of interconnections between number theory and commutative algebra. Using a pedagogical approach, the author presents the conceptual foundations of commutati This volume presents the analysis of optimal control problems for systems described by partial differential equations. The book offers simple and clear exposition of main results in this area. The methods proposed by the author cover cases where the controlled system corresponds to well-posed or ill-posed boundary value problems, which can be linear or nonlinear. The uniqueness problem for the solution of nonlinear optimal control problems is analyzed in various settings. Solutions of several previously unsolved problems are given. In addition, general methods are applied to the study of two problems connected with optimal control of fluid flows described by the Navier-Stokes equations. First published in 1979 and written by two distinguished mathematicians with a special gift for exposition, this book is now available in a completely revised third edition. It reflects the exciting developments in number theory during the past two decades that culminated in the proof of Fermat's Last Theorem. Intended as a upper level textbook, it This volume begins with an introduction to the structure of finite-dimensional simple Lie algebras, including the representation of ...... root systems, the Cartan matrix, and a Dynkin diagram of a finite-dimensional simple Lie algebra. Continuing on, the main subjects of the book are the structure (real and imaginary root systems) of and the character formula for Kac-Moody superalgebras, which is explained in a very general setting. Only elementary linear algebra and group theory are assumed. Also covered is modular property and asymptotic behavior of integrable characters of affine Lie algebras. The exposition is self-contained and includes examples. The book can be used in a graduate-level course on the topic. This book provides a systematic introduction to various geometries, including Euclidean, affine, projective, spherical, and hyperbolic geometries. Also included is a chapter on infinite-dimensional generalizations of Euclidean and affine geometries. A uniform approach to different geometries, based on Klein's Erlangen Program is suggested, and similarities of various phenomena in all geometries are traced. An important notion of duality of geometric objects is highlighted throughout the book. The authors also include a detailed presentation of the theory of conics and quadrics, including the theory of conics for non-Euclidean geometries. The book contains many beautiful geometric facts and has plenty of problems, most of them with solutions, which nicely supplement the main text. With more than 150 figures illustrating the arguments, the book can be recommended as a textbook for undergraduate and graduate-level courses in geometry. Masaki Kashiwara is undoubtedly one of the masters of the theory of $D$-modules, and he has created a good, accessible entry point to the subject. The theory of $D$-modules is a very powerful point of view, bringing ideas from algebra and algebraic geometry to the analysis of systems of differential equations. It is often used in conjunction with microlocal analysis, as some of the important theorems are best stated or proved using these techniques. The theory has been used very successfully in applications to representation theory. Here, there is an emphasis on $b$-functions. These show up in various contexts: number theory, analysis, representation theory, and the geometry and invariants of prehomogeneous vector spaces. Some of the most important results on $b$-functions were obtained by Kashiwara. A hot topic from the mid '70s to mid '80s, it has now moved a bit more into the mainstream. Graduate students and research mathematicians will find that working on the subject in the two-decade interval has given Kashiwara a very good perspective for presenting the topic to the general mathematical public. This book is an English translation of Kiyosi Ito's monograph published in Japanese in 1957. It gives a unified and comprehensive account of additive processes (or Levy processes), stationary processes, and Markov processes, which constitute the three most important classes of stochastic processes. Written by one of the leading experts in the field, this volume presents to the reader lucid explanations of the fundamental concepts and basic results in each of these three major areasof the theory of stochastic processes. With the requirements limited to an introductory graduate course on analysis (especially measure theory) and basic probability theory, this book is an excellent text for any graduate course on stochastic processes. Kiyosi Ito is famous throughout the world forhis work on stochastic integrals (including the Ito formula), but he has made substantial contributions to other areas of probability theory as well, such as additive processes, stationary processes, and Markov processes (especially diffusion processes), which are topics covered in this book. For his contributions and achievements, he has received, among others, the Wolf Prize, the Japan Academy Prize, and the Kyoto Prize. This book focuses on both classical results of homogenization theory and modern techniques developed over the past decade. The powerful techniques in partial differential equations are illustrated with many exercises and examples to enhance understanding of the material. Several of the modern topics that are presented have not previously appeared in any monograph. The book is based on courses taught by the author at Moscow State University. Compared to many other books on the subject, it is unique in that the exposition is based on extensive use of the language and elementary constructions of category theory. Among topics featured in the book are the theory of Banach and Hilbert tensor products, the theory of distributions and weak topologies, and Borel operator calculus. The book contains many examples illustrating the general theory presented, as well as multiple exercises that help the reader to learn the subject. It can be used as a textbook on selected topics of functional analysis and operator theory. Prerequisites include linear algebra, elements of real analysis, and elements of the theory of metric spaces. "The book is aimed at researchers and graduate students working in differential topology, differential geometry, and global analysis who are interested in learning about operator algebras."--BOOK JACKET. 'Kiyoshi Oka, at the beginning of his research, regarded the collection of problems which he encountered in the study of domains of holomorphy as large mountains which separate today and tomorrow.

Thus, he believed that there could be no essential progress in analysis without climbing over these mountains ... this book is a worthwhile initial step for the reader in order to understand the mathematical world which was created by Kiyoshi Oka.' -- from the Preface. This book explains results in the theory of functions of several complex variables which were mostly established from the late nineteenth century through to the middle of the twentieth century. In the work, the author introduces the mathematical world created by his advisor, Kiyoshi Oka. In this volume, Oka's work is divided into two parts. The first is the study of analytic functions in univalent domains in ${\mathbf C}n$. Here Oka proved that three concepts are equivalent: domains of holomorphy, holomorphically convex domains, and pseudoconvex domains; and moreover that the Poincaré problem, the Cousin problems, and the Runge problem, when stated properly, can be solved in domains of holomorphy satisfying the appropriate conditions. The second part of Oka's work established a method for the study of analytic functions defined in a ramified domain over ${\mathbf C}n$ in which the branch points are considered as interior points of the domain. Here analytic functions in an analytic space are treated, which is a slight generalization of a ramified domain over ${\mathbf C}n$. In writing the book, the author's goal was to bring to readers a real understanding of Oka's original papers. This volume is an English translation of the original Japanese edition, published by the University of Tokyo Press (Japan). It would make a suitable course text for advanced graduate level introductions to several complex variables. The topic covered in this book is the study of metric and other close characteristics of different spaces and classes of random variables and the application of the entropy method to the investigation of properties of stochastic processes whose values, or increments, belong to given spaces. The following processes appear in detail: pre-Gaussian processes, shot noise processes representable as integrals over processes with independent increments, quadratically Gaussian processes, and, in particular, correlogram-type estimates of the correlation function of a stationary Gaussian process, jointly strictly sub-Gaussian processes, etc. The book consists of eight chapters divided into four parts: The first part deals with classes of random variables and their metric characteristics. The second part presents properties of stochastic processes "imbedded" into a space of random variables discussed in the first part. The third part considers applications of the general theory. The fourth part outlines the necessary auxiliary material. Problems and solutions presented show the intrinsic relation existing between probability methods, analytic methods, and functional methods in the theory of stochastic processes. The concluding sections, "Comments" and "References", gives references to the literature used by the authors in writing the book. This book, together with the companion volume, Fermat's Last Theorem: The Proof, presents in full detail the proof of Fermat's Last Theorem given by Wiles and Taylor. With these two books, the reader will be able to see the whole picture of the proof to appreciate one of the deepest achievements in the history of mathematics. Crucial arguments, including the so-called $3$-$5$ trick, $R=T$ theorem, etc., are explained in depth. The proof relies on basic background materials in number theory and arithmetic geometry, such as elliptic curves, modular forms, Galois representations, deformation rings, modular curves over the integer rings, Galois cohomology, etc. The first four topics are crucial for the proof of Fermat's Last Theorem; they are also very important as tools in studying various other problems in modern algebraic number theory. The remaining topics will be treated in the second book to be published in the same series in 2014. In order to facilitate understanding the intricate proof, an outline of the whole argument is described in the first preliminary chapter, and more details are summarised in later chapters. The familiar wave equation is the most fundamental hyperbolic partial differential equation. Other hyperbolic equations, both linear and nonlinear, exhibit many wave-like phenomena. The primary theme of this book is the mathematical investigation of such wave phenomena. The exposition begins with derivations of some wave equations, including waves in an elastic body, such as those observed in connection with earthquakes. Certain existence results are proved early on, allowing the later analysis to concentrate on properties of solutions. The existence of solutions is established using methods from functional analysis. Many of the properties are developed using methods of asymptotic solutions. The last chapter contains an analysis of the decay of the local energy of solutions. This analysis shows, in particular, that in a connected exterior domain, disturbances gradually drift into the distance and the effect of a disturbance in a bounded domain becomes small after sufficient time passes. The book is geared toward a wide audience interested in PDEs. Prerequisite to the text are some real analysis and elementary functional analysis. It would be suitable for use as a text in PDEs or mathematical physics at the advanced undergraduate and graduate level. This book offers a concise introduction to stochastic analysis, particularly the Malliavin calculus. A detailed description is given of all technical tools necessary to describe the theory, such as the Wiener process, the Ornstein-Uhlenbeck process, and Sobolev spaces.

Applications of stochastic cal This book is devoted to the study of evolution of nonequilibrium systems. Such a system usually consists of regions with different dominant scales, which coexist in the space-time where the system lives. In the case of high nonuniformity in special direction, one can see patterns separated by clearly distinguishable boundaries or interfaces. The author considers several examples of nonequilibrium systems. One of the examples describes the invasion of the solid phase into the liquidphase during the crystallization process. Another example is the transition from oxidized to reduced states in certain chemical reactions. An easily understandable example of the transition in the temporal direction is a sound beat, and the author describes typical patterns associated with thisphenomenon. The main goal of the book is to present a mathematical approach to the study of highly nonuniform systems and to illustrate it with examples from physics and chemistry. The two main theories discussed are the theory of singular perturbations and the theory of dissipative systems. A set of carefully selected examples of physical and chemical systems nicely illustrates the general methods described in the book. Explores the basic theory of quantum bounded symmetric domains. The area became active in the late 1990s at a junction of noncommutative complex analysis and extensively developing theory of quantum groups. In a surprising advance of the theory of quantum bounded symmetric domains, it turned out that many classical problems admit elegant quantum analogs. Some of those are expounded in the book. A minimal length curve joining two points in a surface is called a geodesic. One may trace the origin of the problem of finding geodesics back to the birth of calculus. Many contemporary mathematical problems, as in the case of geodesics, may be formulated as variational problems in surfaces or in a more generalized form on manifolds. One may characterize geometric variational problems as a field of mathematics that studies global aspects of variational problems relevant in the geometry and topology of manifolds. For example, the problem of finding a surface of minimal area spanning a given frame of wire originally appeared as a mathematical model for soap films. It has also been actively investigated as a geometric variational problem. With recent developments in computer graphics, totally new aspects of the study on the subject have begun to emerge. This book is intended to be an introduction to some of the fundamental questions and results in geometric variational problems, studying variational problems on the length of curves and the energy of maps. The first two chapters treat variational problems of the length and energy of curves in Riemannian manifolds, with an in-depth discussion of the existence and properties of geodesics viewed as solutions to variational problems. In addition, a special emphasis is placed on the facts that concepts of connection and covariant differentiation are naturally induced from the formula for the first variation in this problem, and that the notion of curvature is obtained from the formula for the second variation. The last two chapters treat the variational problem on the energy of maps between two Riemannian manifolds and its solution, harmonic maps. The concept of a harmonic map includes geodesics and minimal submanifolds as examples. Its existence and properties have successfully been applied to various problems in geometry and topology. The author discusses in detail the existence theorem of Eells-Sampson, which is considered to be the most fundamental among existence theorems for harmonic maps. The proof uses the inverse function theorem for Banach spaces. It is presented to be as self-contained as possible for easy reading. Each chapter may be read independently, with minimal preparation for covariant differentiation and curvature on manifolds. The first two chapters provide readers with basic knowledge of Riemannian manifolds. Prerequisites for reading this book include elementary facts in the theory of manifolds and functional analysis, which are included in the form of appendices. Exercises are given at the end of each chapter. This is the English translation of a book originally published in Japanese. It is an outgrowth of lectures delivered at Tohoku University and at the Summer Graduate Program held at the Institute for Mathematics and its Applications at the University of Minnesota. It would make a suitable textbook for advanced undergraduates and graduate students. This item will also be of interest to those working in analysis. Aims to give an exposition of generalized (co)homology theories that can be read by a group of mathematicians who are not experts in algebraic topology. This title starts with basic notions of homotopy theory, and introduces the axioms of generalized (co)homology theory. It also discusses various types of generalized cohomology theories. Information geometry provides the mathematical sciences with a fresh framework of analysis. This book presents a comprehensive introduction to the mathematical foundation of information geometry. It provides an overview of many areas of applications, such as statistics, linear systems, information theory, quantum mechanics, and convex analysis.

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- Essentials Of Stochastic Processes
- Infinite dimensional Lie Algebras
- Classical Theory Of Algebraic Numbers
- Numbers And Measurements
- An Introduction To Morse Theory
- Algebraic Geometry 2
- Stochastic Analysis
- Generalized Cohomology
- Kikagakuteki Henbun Mondai
- Advances In Moduli Theory
- Far from equilibrium Dynamics
- Introduction To Prehomogeneous Vector Spaces