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KEY=IDEAS - TRISTIN ADRIENNE

Mathematics of Uncertainty

Ideas, Methods, Application Problems

Springer "*Mathematics of Uncertainty" provides the basic ideas and foundations of uncertainty, covering the fields of mathematics in which uncertainty, variability, imprecision and fuzziness of data are of importance. This introductory book describes the basic ideas of the mathematical fields of uncertainty from simple interpolation to wavelets, from error propagation to fuzzy sets and neural networks. The book presents the treatment of problems of interpolation and approximation, as well as observation fuzziness which can essentially influence the preciseness and reliability of statements on functional relationships. The notions of randomness and probability are examined as a model for the variability of observation and measurement results. Besides these basic ideas the book also presents methods of qualitative data analysis such as cluster analysis and classification, and of evaluation of functional relationships such as regression analysis and quantitative fuzzy data analysis.*

Uncertain Input Data Problems and the Worst Scenario Method

Elsevier *This book deals with the impact of uncertainty in input data on the outputs of mathematical models. Uncertain inputs as scalars, tensors, functions, or domain boundaries are considered. In practical terms, material parameters or constitutive laws, for instance, are uncertain, and quantities as local temperature, local mechanical stress, or local displacement are monitored. The goal of the worst scenario method is to extremize the quantity over the set of uncertain input data. A general mathematical scheme of the worst scenario method, including approximation by finite element methods, is presented, and then applied to various state problems modeled by differential equations or variational inequalities: nonlinear heat flow, Timoshenko beam vibration and buckling, plate buckling, contact problems in elasticity and thermoelasticity with and without friction, and various models of plastic deformation, to list some of the topics. Dozens of examples, figures, and tables are included. Although the book concentrates on the mathematical aspects of the subject, a substantial part is written in an accessible style and is devoted to various facets of uncertainty in modeling and to the state of the art techniques proposed to deal with uncertain input data. A chapter on sensitivity analysis and on functional and convex analysis is included for the reader's convenience. · Rigorous theory is established for the treatment of uncertainty in modeling · Uncertainty is considered in complex models based on partial differential equations or variational inequalities · Applications to nonlinear and linear problems with uncertain data are presented in detail: quasilinear steady heat flow, buckling of beams and plates, vibration of beams, frictional contact of bodies, several models of plastic deformation, and more · Although emphasis is put on theoretical analysis and approximation techniques, numerical examples are also present · Main ideas and approaches used today to handle uncertainties in modeling are described in an accessible form · Fairly self-contained book*

Risk, Error and Uncertainty: Laboratory Quality Management in the Age of Metrology, An Issue of the Clinics in Laboratory Medicine, E-Book

Elsevier Health Sciences *This issue of Clinics in Laboratory Medicine entitled “Risk, Error and Uncertainty: Laboratory Quality Management in the Age of Metrology will be guest edited by Sten Westgard, James Westgard, and David Armbruster. The issue will cover a broad range of topics related to management in the laboratory including but not limited to: Metrology Perspectives; Biologic Variation Approach to Daily Laboratory; Clinical Outcome Approach to Goal Setting; Six Sigma Quality Management System; Traceability and Comparability; MU, Risk, and Sigma-metrics at Sunway; and Quality Indicators for the Total Testing Process, among others.*

An Introduction to Data Analysis and Uncertainty Quantification for Inverse Problems

SIAM *Inverse problems are found in many applications, such as medical imaging, engineering, astronomy, and geophysics, among others. To solve an inverse problem is to recover an object from noisy, usually indirect observations. Solutions to inverse problems are subject to many potential sources of error introduced by approximate mathematical models, regularization methods, numerical approximations for efficient computations, noisy data, and limitations in the number of observations; thus it is important to include an assessment of the uncertainties as part of the solution. Such assessment is interdisciplinary by nature, as it requires, in addition to knowledge of the particular application, methods from applied mathematics, probability, and statistics. This book bridges applied mathematics and statistics by providing a basic introduction to probability and statistics for uncertainty quantification in the context of inverse problems, as well as an introduction to statistical regularization of inverse problems. The author covers basic statistical inference, introduces the framework of ill-posed inverse problems, and explains statistical questions that arise in their applications. An Introduction to Data Analysis and Uncertainty Quantification for Inverse Problems÷includes many examples that explain techniques which are useful to address general problems arising in uncertainty quantification, Bayesian and non-Bayesian statistical methods and discussions of their complementary roles, and analysis of a real data set to illustrate the methodology covered throughout the book.*

Applications of Mathematics of Uncertainty

Grand Challenges—Human Trafficking—Coronavirus—Biodiversity and Extinction

Springer Nature *This book provides an examination of major problems facing the world using mathematics of uncertainty. These problems include climate change, coronavirus pandemic, human tracking, biodiversity, and other grand challenges. Mathematics of uncertainty is used in a modern more general sense than traditional mathematics. Since accurate data is impossible to obtain concerning human tracking and other global problems, mathematics of uncertainty is an ideal discipline to study these problems. The authors place several scientific studies into different mathematical settings such as nonstandard analysis and soft logic. Fuzzy differentiation is used to model the spread of diseases such as the coronavirus. The book uses fuzzy graph theory to examine the problems of human tracking and illegal immigration. The book is an excellent reference source for advanced under-graduate and graduate students in mathematics and the social sciences as well as for researchers and teachers.*

Analysis and Decision Making in Uncertain Systems

Springer Science & Business Media *A unified and systematic description of analysis and decision problems within a wide class of uncertain systems, described by traditional mathematical methods and by relational knowledge representations. Prof. Bubnicki takes a unique approach to stability and stabilization of uncertain systems.*

Fuzzy Techniques for Decision Making

MDPI *This book is a printed edition of the Special Issue "Fuzzy Techniques for Decision Making" that was published in Symmetry*

The Management of Uncertainty: Approaches, Methods and Applications

Springer Science & Business Media *For thirty years, the literature on decision-making and planning has been divided into two camps : work premised on rational models of choice and work designed to discredit such models. The sustained critic of fully rational decision-making theories has al ready a long history and a constant message to deliver : in practice, consequential decision-making hardly fulfills the canons of perfect rationality. There is also evidence that decision-making and planning are not unitary processes. Although the concept of "decision-making" connotes the idea of a single process, making a single choice involves a complex of processing tasks : structuring the problem, finding alternatives worth considering, deciding what information is relevant, assessing various consequences, and a variety of others. The aim of this volume is to bring together and try to inter relate some of the concepts and relevant knowledge from various disciplines concerned with one important aspect of this complex process : the management of uncertainty. It is hardly necessary to reiterate the case made by numerous authors about our changing and increasingly uncertain world. Suffice it to say here that it is uncertainty about the future, and in many cases about the past and the present also, which makes decision-making and planning so difficul t. The management of uncertainty may be defined as the way in which uncertainty is treated and processed in decision-making.*

Mathematical Methods in Interdisciplinary Sciences

John Wiley & Sons *Brings mathematics to bear on your real-world, scientific problems Mathematical Methods in Interdisciplinary Sciences provides a practical and usable framework for bringing a mathematical approach to modelling real-life scientific and technological problems. The collection of chapters Dr. Snehashish Chakraverty has provided describe in detail how to bring mathematics, statistics, and computational methods to the fore to solve even the most stubborn problems involving the intersection of multiple fields of study. Graduate students, postgraduate students, researchers, and professors will all benefit significantly from the author's clear approach to applied mathematics. The book covers a wide range of interdisciplinary topics in which mathematics can be brought to bear on challenging problems requiring creative solutions. Subjects include: Structural static and vibration problems Heat conduction and diffusion problems Fluid dynamics problems The book also covers topics as diverse as soft computing and machine intelligence. It concludes with examinations of various fields of application, like infectious diseases, autonomous car and monotone inclusion problems.*

Stochastic Versus Fuzzy Approaches to Multiobjective Mathematical Programming under Uncertainty

Springer Science & Business Media *Operations Research is a field whose major contribution has been to propose a rigorous fonnulation of often ill-defmed problems pertaining to the organization or the design of large scale systems, such as resource allocation problems, scheduling and the like. While this effort did help a lot in understanding the nature of these problems, the mathematical models have proved only partially satisfactory due to the difficulty in gathering precise data, and in formulating objective functions that reflect the multi-faceted notion of optimal solution according to human experts. In this respect linear programming is a typical example of impressive achievement of Operations Research, that in its detenninistic fonn is not always adapted to real world decision-making : everything must be expressed in tenns of linear constraints ; yet the coefficients that appear in these constraints may not be so well-defined, either because their value depends upon other parameters (not accounted for in the model) or because they cannot be precisely assessed, and only qualitative estimates of these coefficients are available. Similarly the best solution to a linear programming problem may be more a matter of compromise between various criteria rather than just minimizing or maximizing a linear objective function. Lastly the constraints, expressed by equalities or inequalities between linear expressions, are often softer in reality that what their mathematical expression might let us believe, and infeasibility as detected by the linear programming techniques can often been coped with by making trade-offs with the real world.*

Mathematics of Uncertainty Modeling in the Analysis of Engineering and Science Problems

IGI Global "*This book provides the reader with basic concepts for soft computing and other methods for various means of uncertainty in handling solutions, analysis, and applications*"--*Provided by publisher.*

Optimization Techniques for Problem Solving in Uncertainty

IGI Global *When it comes to optimization techniques, in some cases, the available information from real models may not be enough to construct either a probability distribution or a membership function for problem solving. In such cases, there are various theories that can be used to quantify the uncertain aspects. Optimization Techniques for Problem Solving in Uncertainty is a scholarly reference resource that looks at uncertain aspects involved in different disciplines and applications. Featuring coverage on a wide range of topics including uncertain preference, fuzzy multilevel programming, and metaheuristic applications, this book is geared towards engineers, managers, researchers, and post-graduate students seeking emerging research in the field of optimization.*

Irreversible Decisions under Uncertainty

Optimal Stopping Made Easy

Springer Science & Business Media *Here, two highly experienced authors present an alternative approach to optimal stopping problems. The basic ideas and techniques of the approach can be explained much simpler than the standard methods in the literature on optimal stopping problems. The monograph will teach the reader to apply the technique to many problems in economics and finance, including new ones. From the technical point of view, the method can be characterized as option pricing via the Wiener-Hopf factorization.*

Configurable Intelligent Optimization Algorithm

Design and Practice in Manufacturing

Springer *Presenting the concept and design and implementation of configurable intelligent optimization algorithms in manufacturing systems, this book provides a new configuration method to optimize manufacturing processes. It provides a comprehensive elaboration of basic intelligent optimization algorithms, and demonstrates how their improvement, hybridization and parallelization can be applied to manufacturing. Furthermore, various applications of these intelligent optimization algorithms are exemplified in detail, chapter by chapter. The intelligent optimization algorithm is not just a single algorithm; instead it is a general advanced optimization mechanism which is highly scalable with robustness and randomness. Therefore, this book demonstrates the flexibility of these algorithms, as well as their robustness and reusability in order to solve mass complicated problems in manufacturing. Since the genetic algorithm was presented decades ago, a large number of intelligent optimization algorithms and their improvements have been developed. However, little work has been done to extend their applications and verify their competence in solving complicated problems in manufacturing. This book will provide an invaluable resource to students, researchers, consultants and industry professionals interested in engineering optimization. It will also be particularly useful to three groups of readers: algorithm beginners, optimization engineers and senior algorithm designers. It offers a detailed description of intelligent optimization algorithms to algorithm beginners; recommends new configurable design methods for optimization engineers, and provides future trends and challenges of the new configuration mechanism to senior algorithm designers.*

Uncertainty in Complex Networked Systems

In Honor of Roberto Tempo

Springer *The chapters in this volume, and the volume itself, celebrate the life and research of Roberto Tempo, a leader in the study of complex networked systems, their analysis and control under uncertainty, and robust designs. Contributors include authorities on uncertainty in systems, robustness, networked and network systems, social networks, distributed and randomized algorithms, and multi-agent systems—all fields that Roberto Tempo made vital contributions to. Additionally, at least one author of each chapter was a research collaborator of Roberto Tempo's. This volume is structured in three parts. The first covers robustness and includes topics like time-invariant uncertainties, robust static output feedback design, and the uncertainty quartet. The second part is focused on randomization and probabilistic methods, which covers topics such as compressive sensing, and stochastic optimization. Finally, the third part deals with distributed systems and algorithms, and explores matters involving mathematical sociology, fault diagnoses, and PageRank computation. Each chapter presents exposition, provides new results, and identifies fruitful future directions in research. This book will serve as a valuable reference volume to researchers interested in uncertainty, complexity, robustness, optimization, algorithms, and networked systems.*

Uncertainty Quantification in Computational Fluid Dynamics

Springer Science & Business Media *Fluid flows are characterized by uncertain inputs such as random initial data, material and flux coefficients, and boundary conditions. The current volume addresses the pertinent issue of efficiently computing the flow uncertainty, given this initial randomness. It collects seven original review articles that cover improved versions of the Monte Carlo method (the so-called multi-level Monte Carlo method (MLMC)), moment-based stochastic Galerkin methods and modified versions of the stochastic collocation methods that use adaptive stencil selection of the ENO-WENO type in both physical and stochastic space. The methods are also complemented by concrete applications such as flows around aerofoils and rockets, problems of aeroelasticity (fluid-structure interactions), and shallow water flows for propagating water waves. The wealth of numerical examples provide evidence on the suitability of each proposed method as well as comparisons of different approaches.*

Theories of Interval Arithmetic

Mathematical Foundations and Applications

LAP Lambert Academic Publishing *Scientists are, all the time, in a struggle with uncertainty which is always a threat to a trustworthy scientific knowledge. A very simple and natural idea, to defeat uncertainty, is that of enclosing uncertain measured values in real closed intervals. On the basis of this idea, interval arithmetic is constructed. The idea of calculating with intervals is not completely new in mathematics: the concept has been known since Archimedes, who used guaranteed lower and upper bounds to compute his constant Pi. Interval arithmetic is now a broad field in which rigorous mathematics is associated with scientific computing. This connection makes it possible to solve uncertainty problems that cannot be efficiently solved by floating-point arithmetic. Today, application areas of interval methods include electrical engineering, control theory, remote sensing, experimental and computational physics, chaotic systems, celestial mechanics, signal processing, computer graphics, robotics, and computer-assisted proofs. The purpose of this book is to be a concise but informative introduction to the theories of interval arithmetic as well as to some of their computational and scientific*

applications. Editorial Reviews "This new book by Hend Dawood is a fresh introduction to some of the basics of interval computation. It stops short of discussing the more complicated subdivision methods for converging to ranges of values, however it provides a bit of perspective about complex interval arithmetic, constraint intervals, and modal intervals, and it does go into the design of hardware operations for interval arithmetic, which is something still to be done by computer manufacturers." - Ramon E. Moore, (The Founder of Interval Computations) Professor Emeritus of Computer and Information Science, Department of Mathematics, The Ohio State University, Columbus, U.S.A. "A popular math-oriented introduction to interval computations and its applications. This short book contains an explanation of the need for interval computations, a brief history of interval computations, and main interval computation techniques. It also provides an impressive list of main practical applications of interval techniques." - Vladik Kreinovich, (International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems) Professor of Computer Science, University of Texas at El Paso, El Paso, Texas, U.S.A. "I am delighted to see one more Egyptian citizen re-entering the field of interval mathematics invented in this very country thousands years ago." - Marek W. Gutowski, Institute of Physics, Polish Academy of Sciences, Warszawa, Poland

Uncertainty and Quality in Science for Policy

Springer Science & Business Media *This book explains the notational system NUSAP (Numeral, Unit, Spread, Assessment, Pedigree) and applies it to several examples from the environmental sciences. The authors are now making further extensions of NUSAP, including an algorithm for the propagation of quality-grades through models used in risk and safety studies. They are also developing the concept of `Post-normal Science', in which quality assurance of information requires the participation of `extended peer-communities' lying outside the traditional expertise.*

Departments of Commerce, Justice, Science, and Related Agencies Appropriations for Fiscal Year ...

Advances in Applied Mathematics, Modeling, and Computational Science

Springer Science & Business Media *The volume presents a selection of in-depth studies and state-of-the-art surveys of several challenging topics that are at the forefront of modern applied mathematics, mathematical modeling, and computational science. These three areas represent the foundation upon which the methodology of mathematical modeling and computational experiment is built as a ubiquitous tool in all areas of mathematical applications. This book covers both fundamental and applied research, ranging from studies of elliptic curves over finite fields with their applications to cryptography, to dynamic blocking problems, to random matrix theory with its innovative applications. The book provides the reader with state-of-the-art achievements in the development and application of new theories at the interface of applied mathematics, modeling, and computational science. This book aims at fostering interdisciplinary collaborations required to meet the modern challenges of applied mathematics, modeling, and computational science. At the same time, the contributions combine rigorous mathematical and computational procedures and examples from applications ranging from engineering to life sciences, providing a rich ground for graduate student projects.*

Strengthening Data Science Methods for Department of Defense Personnel and Readiness Missions

National Academies Press *The Office of the Under Secretary of Defense (Personnel & Readiness), referred to throughout this report as P&R, is responsible for the total force management of all Department of Defense (DoD) components including the recruitment, readiness, and retention of personnel. Its work and policies are supported by a number of organizations both within DoD, including the Defense Manpower Data Center (DMDC), and externally, including the federally funded research and development centers (FFRDCs) that work for DoD. P&R must be able to answer questions for the Secretary of Defense such as how to recruit people with an aptitude for and interest in various specialties and along particular career tracks and how to assess on an ongoing basis service members' career satisfaction and their ability to meet new challenges. P&R must also address larger-scale questions, such as how the current realignment of forces to the Asia-Pacific area and other regions will affect recruitment, readiness, and retention. While DoD makes use of large-scale data and mathematical analysis in intelligence, surveillance, reconnaissance, and elsewhereâ€"exploiting techniques such as complex network analysis, machine learning, streaming social media analysis, and anomaly detectionâ€"these skills and capabilities have not been applied as well to the personnel and readiness enterprise. Strengthening Data Science Methods for Department of Defense Personnel and Readiness Missions offers and roadmap and implementation plan for the integration of data analysis in support of decisions within the purview of P&R.*

Modelling Uncertain Data

Wiley-VCH *Mathematics of Computing -- Miscellaneous.*

Uncertainty Quantification in Variational Inequalities

Theory, Numerics, and Applications

CRC Press *Uncertainty Quantification (UQ) is an emerging and extremely active research discipline which aims to quantitatively treat any uncertainty in applied models. The primary objective of Uncertainty Quantification in Variational Inequalities: Theory, Numerics, and Applications is to present a comprehensive treatment of UQ in variational inequalities and some of its generalizations emerging from various network, economic, and engineering models. Some of the developed techniques also apply to machine learning, neural networks, and related fields. Features First book on UQ in variational inequalities emerging from various network, economic, and engineering models Completely self-contained and lucid in style Aimed for a diverse audience including applied mathematicians, engineers, economists, and professionals from academia Includes the most recent developments on the subject which so far have only been available in the research literature*

Commerce, Justice, Science, and Related Agencies Appropriations for Fiscal Year 2007

Hearings Before a Subcommittee of the Committee on Appropriations, United States Senate, One Hundred Ninth Congress, Second Session

Probabilistic Analysis of Belief Functions

Springer Science & Business Media *Inspired by the eternal beauty and truth of the laws governing the run of stars on heavens over his head, and spurred by the idea to catch, perhaps for the smallest fraction of the shortest instant, the Eternity itself, man created such masterpieces of human intellect like the Platon's world of ideas manifesting eternal truths, like the Euclidean geometry, or like the Newtonian celestial me chanics. However, turning his look to the sub-lunar world of our everyday efforts, troubles, sorrows and, from time to time but very, very seldom, also our successes, he saw nothing else than a world full of uncertainty and tem porariness. One remedy or rather consolation was that of the deep and sage resignation offered by Socrates: I know, that I know nothing. But, happy or unhappy enough, the temptation to see and to touch at least a very small por tion of eternal truth also under these circumstances and behind phenomena charged by uncertainty was too strong. Probability theory in its most sim ple elementary setting entered the scene. It happened in the same, 17th and 18th centuries, when celestial mechanics with its classical Platonist paradigma achieved its greatest triumphs. The origins of probability theory were inspired by games of chance like roulettes, lotteries, dices, urn schemata, etc. and probability values were simply defined by the ratio of successful or winning results relative to the total number of possible outcomes.*

Near-critical and Supercritical Water and Their Applications for Biorefineries

Springer *The book provides fundamental chemistry and properties of near-critical water (NCW) and supercritical water (SCW), criteria and challenges/solutions in reactor design for NCW and SCW processes, and up-to-date reviews and practice of a wide range of their applications in bio refineries including: production of hydrochars from biomass, SCW oxidation (SCWO) for waste treatment, SCW gasification (SCWG) of biomass and waste for hydrogen and methane production, hydrothermal liquefaction of biomass, production of chemicals and SCWO of biofuels for energy. It also presents techno-economic analysis of hydrogen production via SCWG of biomass. The book will be highly essential for both academic researchers and industrial practitioners for developing novel bio refinery technologies and processes employing NCW or SCW for treatment of various organic waste streams and production of bio-energy and bio-based chemicals from bio-renewable resources. Prof. Dr. Zhen Fang is leader and founder of biomass group, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China. Dr. Chunbao (Charles) Xu is currently an Associate Professor of Chemical Engineering and NSERC/FP Innovations Industrial Research Chair in Forest Bio refinery at Western University, Canada.*

Uncertainty Quantification

An Accelerated Course with Advanced Applications in Computational Engineering

Springer *This book presents the fundamental notions and advanced mathematical tools in the stochastic modeling of uncertainties and their quantification for large-scale computational models in sciences and engineering. In particular, it focuses in parametric uncertainties, and non-parametric uncertainties with applications from the structural dynamics and vibroacoustics of complex mechanical systems, from micromechanics and multiscale mechanics of heterogeneous materials. Resulting from a course developed by the author, the book begins with a description of the fundamental mathematical tools of probability and statistics that are directly useful for uncertainty quantification. It proceeds with a well carried out description of some basic and advanced methods for constructing stochastic models of uncertainties, paying particular attention to the problem of calibrating and identifying a stochastic model of uncertainty when experimental data is available. This book is intended to be a graduate-level textbook for students as well as professionals interested in the theory, computation, and applications of risk and prediction in science and engineering fields.*

Nonlinear Mathematics for Uncertainty and its Applications

Springer Science & Business Media *This volume is a collection of papers presented at the international conference on Nonlinear Mathematics for Uncertainty and Its Applications (NLMUA2011), held at Beijing University of Technology during the week of September 7--9, 2011. The conference brought together leading researchers and practitioners involved with all aspects of nonlinear mathematics for uncertainty and its applications. Over the last fifty years there have been many attempts in extending the theory of classical probability and statistical models to the generalized one which can cope with problems of inference and decision making when the model-related information is scarce, vague, ambiguous, or incomplete. Such attempts include the study of nonadditive measures and their integrals, imprecise probabilities and random sets, and their applications in information sciences, economics, finance, insurance, engineering, and social sciences. The book presents topics including nonadditive measures and nonlinear integrals, Choquet, Sugeno and other types of integrals, possibility theory, Dempster-Shafer theory, random sets, fuzzy random sets and related statistics, set-valued and fuzzy stochastic processes, imprecise probability theory and related statistical models, fuzzy mathematics, nonlinear functional analysis, information theory, mathematical finance and risk managements, decision making under various types of uncertainty, and others.*

Princeton Companion to Applied Mathematics

Princeton University Press *This is the most authoritative and accessible single-volume reference book on applied mathematics. Featuring numerous entries by leading experts and organized thematically, it introduces readers to applied mathematics and its uses; explains key concepts; describes important equations, laws, and functions; looks at exciting areas of research; covers modeling and simulation; explores areas of application; and more. Modeled on the popular Princeton Companion to Mathematics, this volume is an indispensable resource for undergraduate and graduate students, researchers, and practitioners in other disciplines seeking a user-friendly reference book on applied mathematics. Features nearly 200 entries organized thematically and written by an international team of distinguished contributors Presents the major ideas and branches of applied mathematics in a clear and accessible way Explains important mathematical concepts, methods, equations, and applications Introduces the language of applied mathematics and the goals of applied mathematical research Gives a wide range of examples of mathematical modeling Covers continuum mechanics, dynamical systems, numerical analysis, discrete and combinatorial mathematics, mathematical physics, and much more Explores the connections between applied mathematics and other disciplines Includes suggestions for further reading, cross-references, and a comprehensive index*

Fuzzy Randomness

Uncertainty in Civil Engineering and Computational Mechanics

Springer Science & Business Media *The subject of the book is the comprehensive consideration of uncertainty in the numerical analysis, the safety assessment, and the design of structures. Stochastic as well as non-stochastic uncertainty is treated on the basis of the superordinated uncertainty model fuzzy randomness. This new uncertainty model contains the special cases of real valued random variables and fuzzy variables and permits to take account of both uncertainty characteristics simultaneously. The book introduces to the problem of uncertainty and provides a current survey of relevant uncertainty models and their application in civil engineering. The necessary, special mathematical basics of the fuzzy set theory and the theory of fuzzy random variables are explained in an engineering manner and illustrated by way of examples. Basic ideas and methods for appropriately quantifying uncertain structural parameters are presented and demonstrated by means of characteristic examples. For processing uncertainty in structural analysis, safety assessment, and structural design completely new algorithms are introduced and described in detail as fuzzy structural analysis, fuzzy probabilistic safety assessment, and fuzzy cluster design. The application of the new methods is demonstrated for selected examples from civil engineering, their essential advantages are emphasized. For the first time this represents a coherent, overall concept for considering uncertainty in civil engineering. The book in particular addresses to civil engineers and requires a university degree as well as basic knowledge in stochastics. But also for mechanical engineers, colleagues from applied mathematics, and other people who are interested in uncertainty problems the book represents a suitable introduction to the problem of uncertainty modeling and provides general solutions and algorithms, which may also be applied to problems from other fields beyond engineering.*

Uncertainty Modeling for Engineering Applications

Springer *This book provides an overview of state-of-the-art uncertainty quantification (UQ) methodologies and applications, and covers a wide range of current research, future challenges and applications in various domains, such as aerospace and mechanical applications, structure health and seismic hazard, electromagnetic energy (its impact on systems and humans) and global environmental state change. Written by leading international experts from different fields, the book demonstrates the unifying property of UQ theme that can be profitably adopted to solve problems of different domains. The collection in one place of different methodologies for different applications has the great value of stimulating the cross-fertilization and alleviate the language barrier among areas sharing a common background of mathematical modeling for problem solution. The book is designed for researchers, professionals and graduate students interested in quantitatively assessing the effects of uncertainties in their fields of application. The contents build upon the workshop "Uncertainty Modeling for Engineering Applications" (UMEMA 2017), held in Torino, Italy in November 2017.*

Grey Systems

Theory and Applications

Springer *Due to inherent limitations in human sensing organs, most data collected for various purposes contain uncertainties. Even at the rare occasions when accurate data are available, the truthful predictions derived on the data tend to create chaotic consequences. So, to effectively process and make sense out of available data, we need methods to deal with uncertainty inherently existing inside the data. The intent of this monograph is to explore the fundamental theory, methods, and techniques of practical application of grey systems theory, initiated by Professor Deng Julong in 1982. This volume presents most of the recent advances of the theory accomplished by scholars from around the world. From studying this book, the reader will not only acquire an overall knowledge of this new theory but also be able to follow the most current research activities. All examples presented are based on practical applications of the theory when urgent real-life problems had to be addressed. Last but not the least, this book concludes with three appendices. The first one compares grey systems theory and interval analysis while revealing the fact that interval analysis is a part of grey mathematics. The second appendix presents an array of different approaches of studying uncertainties. And, the last appendix shows how uncertainties appear using general systems approach.*

Bounding Uncertainty in Civil Engineering

Theoretical Background

Springer Science & Business Media *Taking an engineering, rather than a mathematical, approach, Bounding uncertainty in Civil Engineering - Theoretical Background deals with the mathematical theories that use convex sets of probability distributions to describe the input data and/or the final response of systems. The particular point of view of the authors is centered on the applications to civil engineering problems, and the theory of random sets has been adopted as a basic and relatively simple model. However, the authors have tried to elucidate its connections to the more general theory of imprecise probabilities, Choquet capacities, fuzzy sets, p-boxes, convex sets of parametric probability distributions, and approximate reasoning both in one dimension and in several dimensions with associated joint spaces. If choosing the theory of random sets may lead to some loss of generality, it has, on the other hand, allowed for a self-contained selection of the topics and a more unified presentation of the theoretical contents and algorithms. With over 80 examples worked out step by step, the book should assist newcomers to the subject (who may otherwise find it difficult to navigate a vast and dispersed literature) in applying the techniques described to their own specific problems.*

Modeling Change and Uncertainty

Machine Learning and Other Techniques

CRC Press *Mathematical modeling is a powerful craft that requires practice. The more practice the better one will become in executing the art. The authors wrote this book to develop the craft of mathematical modeling and to foster a desire for lifelong learning, habits of mind and develop competent and confident problem solvers and decision makers for the 21st century. This book offers a problem-solving approach. The authors introduce a problem to help motivate the learning of a particular mathematical modeling topic. The problem provides the issue or what is needed to solve using an appropriate modeling technique. Then principles are applied to the problem and present the steps in obtaining an appropriate model to solve the problem. Modeling Change and Uncertainty: Covers both linear and nonlinear models of discrete dynamical systems. Introduces statistics and probability modeling. Introduces critical statistical concepts to handle univariate and multivariate data. Establishes a foundation in probability modeling. Uses ordinary differential equations (ODEs) to develop a more robust solution to problems. Uses linear programming and machine learning to support decision making.*

Introduces the reality of uncertainty and randomness that is all around us. Discusses the use of linear programing to solve common problems in modern industry. Discusses he power and limitations of simulations. Introduces the methods and formulas used in businesses and financial organizations. Introduces valuable techniques using Excel, MAPLE, and R. Mathematical modeling offers a framework for decision makers in all fields. This framework consists of four key components: the formulation process, the solution process, interpretation of the solution in the context of the actual problem, and sensitivity analysis. Modeling Change and Uncertainty will be of interest to mathematics departments offering advanced mathematical modeling courses focused on decision making or discrete mathematical modeling and by undergraduate, graduate students and practitioners looking for an opportunity to develop, practice, and apply the craft of mathematical modeling. Table of Contents 1. Perfect Partners: Combining Models of Change and Uncertainty with Technology 2. Modeling Change: Discrete Dynamical Systems (DDS) and Modeling Systems of DDS 3. Statistical and Probabilistic Models 4. Modeling with Probability 5. Differential Equations 6. Forecasting with Linear Programming and Machine Learning 7. Stochastic Models and Markov Chains 8. Linear Programming 9. Simulation of Queueing Models 10. Modeling of Financial Analysis 11. Reliability Models 12. Machine Learning and Unconstrained Optimal Process Dr. William P. Fox is currently a visiting professor of Computational Operations Research at the College of William and Mary. He is an emeritus professor in the Department of Defense Analysis at the Naval Postgraduate School and teaches a three-course sequence in mathematical modeling for decision making. He received his Ph.D. in Industrial Engineering from Clemson University. He has taught at the United States Military Academy for twelve years until retiring and at Francis Marion University where he was the chair of mathematics for eight years. He has many publications and scholarly activities including twenty plus books and one hundred and fifty journal articles. Colonel (R) Robert E. Burks, Jr., Ph.D. is an Associate Professor in the Defense Analysis Department of the Naval Postgraduate School (NPS) and the Director of the NPS' Wargaming Center. He holds a Ph.D. in Operations Research from the Air Force Institute of Technology. He is a retired logistics Army Colonel with more than thirty years of military experience in leadership, advanced analytics, decision modeling, and logistics operations who served as an Army Operations Research analyst at the Naval Postgraduate School, TRADOC Analysis Center, United States Military Academy, and the United States Army Recruiting Command. Other book by William P. Fox and Robert E. Burks: Advanced Mathematical Modeling with Technology, 2021, CRC Press. Other books by William P. Fox from CRC Press: Mathematical Modeling in the Age of the Pandemic, 2021, CRC Press. Advanced Problem Solving Using Maple: Applied Mathematics, Operations Research, Business Analytics, and Decision Analysis (w/William Bauldry), 2020, CRC Press. Mathematical Modeling with Excel (w/Brian Albright), 2020, CRC Press. Nonlinear Optimization: Models and Applications, 2020, CRC Press. Advanced Problem Solving with Maple: A First Course (w/William Bauldry), 2019. CRC Press. Mathematical Modeling for Business Analytics, 2018, CRC Press.

Optimization Under Uncertainty with Applications to Aerospace Engineering

Springer Nature *In an expanding world with limited resources, optimization and uncertainty quantification have become a necessity when handling complex systems and processes. This book provides the foundational material necessary for those who wish to embark on advanced research at the limits of computability, collecting together lecture material from leading experts across the topics of optimization, uncertainty quantification and aerospace engineering. The aerospace sector in particular has stringent performance requirements on highly complex systems, for which solutions are expected to be optimal and reliable at the same time. The text covers a wide range of techniques and methods, from polynomial chaos expansions for uncertainty quantification to Bayesian and Imprecise Probability theories, and from Markov chains to surrogate models based on Gaussian processes. The book will serve as a valuable tool for practitioners, researchers and PhD students.*

Evaluation of Uncertainties and Risks in Geology

New Mathematical Approaches for Their Handling

Springer Science & Business Media *It is a well known fact that geological investigations are characterized by particularly high incertainties. Furthermore,decisions related to geology, such as mineral exploration, mining investmentsetc. are connected with higher risks than similar decisions in the branches of industry and economy. Finally there are a number of highly dangerous natural hazards, e.g. earthquakes, volcanic activities, inundations etc. that are directly depending on geological processes. It is of paramount interest to study them, to describe them, to understand their origin and - if - possible to predict them. Uncertainties, geological risks and natural hazards are often mentioned in geological text-books, conference proceedings and articles, butno overall evaluation of them has been written so far.The complexity of these problems requires a thorough mathematical treatment.This book has been written with the purpose of presenting a detailed evaluation of the entire problem, discussing it from both the geological and the mathematical aspects.*

The Mathematics of the Uncertain

A Tribute to Pedro Gil

Springer *This book is a tribute to Professor Pedro Gil, who created the Department of Statistics, OR and TM at the University of Oviedo, and a former President of the Spanish Society of Statistics and OR (SEIO). In more than eighty original contributions, it illustrates the extent to which Mathematics can help manage uncertainty, a factor that is inherent to real life. Today it goes without saying that, in order to model experiments and systems and to analyze related outcomes and data, it is necessary to consider formal ideas and develop scientific approaches and techniques for dealing with uncertainty. Mathematics is crucial in this endeavor, as this book demonstrates. As Professor Pedro Gil highlighted twenty years ago, there are several well-known mathematical branches for this purpose, including Mathematics of chance (Probability and Statistics), Mathematics of communication (Information Theory), and Mathematics of imprecision (Fuzzy Sets Theory and others). These branches often intertwine, since different sources of uncertainty can coexist, and they are not exhaustive. While most of the papers presented here address the three aforementioned fields, some hail from other Mathematical disciplines such as Operations Research; others, in turn, put the spotlight on real-world studies and applications. The intended audience of this book is mainly statisticians, mathematicians and computer scientists, but practitioners in these areas will certainly also find the book a very interesting read.*

Uncertainty Quantification for Hyperbolic and Kinetic Equations

Springer *This book explores recent advances in uncertainty quantification for hyperbolic, kinetic, and related problems. The contributions address a range of different aspects, including: polynomial chaos expansions, perturbation methods, multi-level Monte Carlo methods, importance sampling, and moment methods. The interest in these topics is rapidly growing, as their applications have now expanded to many areas in engineering, physics, biology and the social sciences. Accordingly, the book provides the scientific community with a topical overview of the latest research efforts.*

Computer Science and Artificial Intelligence

National Academies Press *The focus of this report is on artificial intelligence (AI) and human-computer interface (HCI) technology. Observations, conclusions, and recommendations regarding AI and HCI are presented in terms of six grand challenge areas which serve to identify key scientific and engineering issues and opportunities. Chapter 1 presents the panel's definitions of these and related terms. Chapter 2 presents the panel's general observations and recommendations regarding AI and HCI. Finally, Chapter 3 discusses computer science, AI, and HCI in terms of the six selected "grand challenge" areas and three time horizons, that is, short term (within the next 2 years), midterm (2 to 6 years), and long term (more than 6 years from now) and presents additional recommendations in these areas.*