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ARI WILSON

Mathematics of Uncertainty Modeling in the Analysis of Engineering and Science Problems Springer
Vital information on machine intelligence and pattern recognition is provided by this publication. In particular, the 31 papers discuss the ways in which uncertainty modelling and analysis are becoming an integral part of system definition and modelling in many fields. Contributions are sourced from an international base of researchers, scientists and engineers working on theoretical developments and diversified applications in engineering systems. The book is divided into two main parts. The first, Uncertainty Models and Measures, includes chapters on theoretical studies and developments carried out on uncertainty (including cognitive uncertainty and how it relates to information and intelligence), information, fuzzy logic, expert systems and neural networks. There are also chapters on modelling uncertainty in the reliability assessment of complex systems, linguistic connectives, the principle of maximum buoyancy, uncertain evidence, inductive learning, convex modelling, new uncertainty measures and information and uncertainty.The larger second part, Applications to Engineering Systems, contains application-oriented studies in fields related to civil, electrical, energy and general engineering systems. The papers cover studies on general uncertainty types in structural engineering, bridges, transmission structures, structural reliability, structural identification, system life cycle analysis, control, construction activities, decision analysis, signal detection, risk management, product quality, military command and control, data bases, long-term projections and predictions and assessment of insurance indices.The book conveys the excitement, advances and promises that all these fields offer to our expanding information-based technological society. It also hopes to stimulate the interest of other researchers around the world who are facing the challenge of new theoretical studies and

innovative technological changes.
Linear Models in the Mathematics of Uncertainty Springer
The first part of the book defines the concept of uncertainties and the mathematical frameworks that will be used for uncertainty modeling. The application to system reliability assessment illustrates the concept. In the second part, evidential networks as a new tool to model uncertainty in reliability and risk analysis is proposed and described. Then it is applied on SIS performance assessment and in risk analysis of a heat sink. In the third part, Bayesian and evidential networks are used to deal with important measures evaluation in the context of uncertainties.
Modeling, Design, and Simulation of Systems with Uncertainties
Springer
Recognition of the need to introduce the ideas of uncertainty in a wide variety of scientific fields today reflects in part some of the profound changes in science and engineering over the last decades. Nobody questions the ever-present need for a solid foundation in applied mechanics. Neither does anyone question nowadays the fundamental necessity to recognize that uncertainty exists, to learn to evaluate it rationally, and to incorporate it into design.This volume provides a timely and stimulating overview of the analysis of uncertainty in applied mechanics. It is not just one more rendition of the traditional treatment of the subject, nor is it intended to supplement existing structural engineering books. Its aim is to fill a gap in the existing professional literature by concentrating on the non-probabilistic model of uncertainty. It provides an alternative avenue for the analysis of uncertainty when only a limited amount of information is available. The first chapter briefly reviews probabilistic methods and discusses the sensitivity of the probability of failure to uncertain knowledge of the system. Chapter two discusses the mathematical background of convex modelling. In the remainder of the book, convex modelling is applied to various linear and nonlinear problems. Uncertain phenomena are represented throughout the book by convex sets, and this approach is referred to as convex modelling.This book is intended to inspire researchers in their goal towards further growth and development in this field.
Uncertain Input Data Problems and the Worst Scenario Method
Chapman & Hall/CRC
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.

Uncertainty Modeling for Engineering Applications Springer

sections dealing with fuzzy functions and fuzzy random functions are certain to be of special interest. The reader is expected to be in command of the knowledge gained in a basic university mathematics course, with the inclusion of stochastic elements. A specification of uncertainty in any particular case is often difficult. For this reason Chaps. 3 and 4 are devoted solely to this problem. The derivation of fuzzy variables for representing informal and lexical uncertainty reflects the subjective assessment of objective conditions in the form of a membership function. Techniques for modeling fuzzy random variables are presented for data that simultaneously exhibit stochastic and nonstochastic properties. The application of fuzzy randomness is demonstrated in three fields of civil engineering and computational mechanics: structural analysis, safety assessment, and design. The methods of fuzzy structural analysis and fuzzy probabilistic structural analysis developed in Chap. 5 are applicable without restriction to arbitrary geometrically and physically nonlinear problems. The most important forms of the latter are the Fuzzy Finite Element Method (FFEM) and the Fuzzy Stochastic Finite Element Method (FSFEM).

An Introduction to Data Analysis and Uncertainty Quantification for Inverse Problems John Wiley & Sons

The dynamics of systems have proven to be very powerful tools in understanding the behavior of different natural phenomena throughout the last two centuries. However, the attributes of natural systems are observed to deviate from their classical states due to the effect of different types of uncertainties. Actually, randomness and impreciseness are the two major sources of uncertainties in natural systems. Randomness is modeled by different stochastic processes and impreciseness could be modeled by fuzzy sets, rough sets, Dempster–Shafer theory, etc.

Modeling Change and Uncertainty Springer Science & Business Media

Uncertainty influences the individual as well as society; so it is important to enhance our understanding of uncertainty. First of all, do we all agree on a unique definition of uncertainty in the natural and technological worlds? Secondly, how can we model uncertainty? Is it purely a state of mind, the lack of complete

knowledge, or is it a phenomenon in its own right? What heuristic and mathematical models are available? What types of questions about uncertainty can be formulated? What questions can be realistically answered? Do scholars in diverse fields agree on these issues? These and other questions are addressed by 20 scholars from mechanical, civil, electrical, material, aerospace and ocean engineering, from applied mathematics, economics, industrial engineering and operations research, control theory, geodesy, systems science, and philosophy.
Uncertainty Analysis in Engineering and Sciences: Fuzzy Logic, Statistics, and Neural Network Approach Chapman & Hall
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.
Uncertain Mathematical Modeling and Applications
Springer
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.

Mathematics of Uncertainty Springer Science & Business Media 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.

Modeling Change and Uncertainty SIAM This book presents a philosophical approach to probability and probabilistic thinking, considering the underpinnings of probabilistic reasoning and modeling, which effectively underlie everything in data science. The ultimate goal is to call into question many standard tenets and lay the philosophical and probabilistic groundwork and infrastructure for statistical modeling. It is the first book devoted to the philosophy of data aimed at working scientists and calls for a new consideration in the practice of probability and statistics to eliminate what has been referred to as the "Cult of Statistical Significance." The book explains the philosophy of these ideas and not the mathematics, though there are a handful of mathematical examples. The topics are logically laid out, starting with basic philosophy as related to probability, statistics, and science, and stepping through the key probabilistic ideas and concepts, and ending with statistical models. Its jargon-free approach asserts that standard methods, such as out-of-the-box regression, cannot help in discovering cause. This new way of looking at uncertainty ties together disparate fields — probability, physics, biology, the “soft” sciences, computer science — because each aims at discovering cause (of effects). It broadens the understanding beyond frequentist and Bayesian methods to propose a Third Way of modeling.

Uncertainty Modelling and Analysis Springer Science & Business Media "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.

Dynamics under Uncertainty Elsevier

Writing in honour of Sid Yakowitz, 50 internationally known scholars have collectively contributed 30 papers on modelling uncertainty to this volume. These include papers with a theoretical emphasis and others that focus on applications.

Uncertainty Theory IGI Global

Modeling and Inverse Problems in the Presence of Uncertainty collects recent research-including the authors' own substantial projects-on uncertainty propagation and quantification. It covers two sources of uncertainty: where uncertainty is present primarily due to measurement errors and where uncertainty is present due to the modeling formulation i

Assessing the Reliability of Complex Models CRC Press

Uncertainty theory is a branch of mathematics based on normality, monotonicity, self-duality, countable subadditivity, and product measure axioms. Uncertainty is any concept that satisfies the axioms of uncertainty theory. Thus uncertainty is neither randomness nor fuzziness. It is also known from some surveys that a lot of phenomena do behave like uncertainty. How do we model uncertainty? How do we use uncertainty theory? In order to answer these questions, this book provides a self-contained, comprehensive and up-to-date presentation of uncertainty theory, including uncertain programming, uncertain risk analysis, uncertain reliability analysis, uncertain process, uncertain calculus, uncertain differential equation, uncertain logic, uncertain entailment, and uncertain inference. Mathematicians, researchers, engineers, designers, and students in the field of mathematics, information science, operations research, system science, industrial engineering, computer science, artificial intelligence, finance, control, and management science will find this work a stimulating and useful reference.

Solutions Manual for Uncertainty Modeling and Analysis in Engineering and the Sciences Elsevier

The dynamics of systems have proven to be very powerful tools in understanding the behavior of different natural phenomena throughout the last two centuries. However, the attributes of natural systems are observed to deviate from their classical states due to the effect of different types of uncertainties. Actually, randomness and impreciseness are the two major sources of uncertainties in natural systems. Randomness is modeled by different stochastic processes and impreciseness could be modeled by fuzzy sets, rough sets, Dempster-Shafer theory, etc.

Data Uncertainty and Important Measures LAP Lambert Academic Publishing

The world we live in is pervaded with uncertainty and imprecision. Is it likely to rain this afternoon? Should I take an umbrella with me? Will I be able to find parking near the campus? Should I go by bus? Such simple questions are a c- mon occurrence in our daily lives. Less simple examples: What is the probability that the price of oil will rise sharply in the near future? Should I buy Chevron stock? What

are the chances that a bailout of GM, Ford and Chrysler will not s- ceed? What will be the consequences? Note that the examples in question involve both uncertainty and imprecision. In the real world, this is the norm rather than exception. There is a deep-seated tradition in science of employing probability theory, and only probability theory, to deal with uncertainty and imprecision. The mon- oly of probability theory came to an end when fuzzy logic made its debut. H- ever, this is by no means a widely accepted view. The belief persists, especially within the probability community, that probability theory is all that is needed to deal with uncertainty. To quote a prominent Bayesian, Professor Dennis Lindley, “The only satisfactory description of uncertainty is probability.

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

This is one of the only books to describe uncertain volatility models in mathematical finance and their computer implementation for portfolios of vanilla, barrier and American options in equity and FX markets. Uncertain volatility models place subjective constraints on the volatility of the stochastic process of the underlying asset and evaluate option portfolios under worst- and best-case scenarios. This book, which is bundled with software, is aimed at graduate students, researchers and practitioners who wish to study advanced aspects of volatility risk in portfolios of vanilla and exotic options. The reader is assumed to be familiar with arbitrage pricing theory.

Modeling Uncertainty Springer Science & Business Media

This textbook teaches the essential background and skills for understanding and quantifying uncertainties in a computational simulation, and for predicting the behavior of a system under those uncertainties. It addresses a critical knowledge gap in the widespread adoption of simulation in high-consequence decision-making throughout the engineering and physical sciences. Constructing sophisticated techniques for prediction from basic building blocks, the book first reviews the fundamentals that underpin later topics of the book including probability, sampling, and Bayesian statistics. Part II focuses on applying Local Sensitivity Analysis to apportion uncertainty in the model outputs to sources of uncertainty in its inputs. Part III demonstrates techniques for quantifying the impact of parametric uncertainties on a problem, specifically how input uncertainties affect outputs. The final section covers techniques for applying uncertainty quantification to make predictions under uncertainty, including treatment of epistemic uncertainties. It presents the theory and practice of predicting the behavior of a system based on the aggregation of data from simulation, theory, and experiment. The text focuses on simulations based on the solution of systems of partial differential equations and includes in-depth coverage of Monte Carlo methods, basic design of computer experiments, as well as regularized statistical techniques. Code references, in python, appear throughout the text and online as executable code, enabling readers to

perform the analysis under discussion. Worked examples from realistic, model problems help readers understand the mechanics of applying the methods. Each chapter ends with several assignable problems. Uncertainty Quantification and Predictive Computational Science fills the growing need for a classroom text for senior undergraduate and early-career graduate students in the engineering and physical sciences and supports independent study by researchers and professionals who must include uncertainty quantification and predictive science in the simulations they develop and/or perform.

Fuzzy Randomness

Springer

Engineers and scientists often need to solve complex problems with incomplete information resources, necessitating a proper treatment of uncertainty and a reliance on expert opinions. Uncertainty Modeling and Analysis in Engineering and the Sciences prepares current and future analysts and practitioners to understand the fundamentals of knowledge a

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