Decision Making Uncertainty Solution

Objectives and Multi-Objective Decision Making Under UncertaintySpringer

Whether managing strategy, operations, or products, making the best decision in a complex uncertain business environment is challenging. One of the major difficulties facing decision makers is that they often have multiple, competing objectives, which means trade-offs will need to be made. To further complicate matters, uncertainty in the business environment makes it hard to explicitly understand how different objectives will impact potential outcomes. Fortunately, these problems can be solved with a structured framework for multi-objective decision analysis that measures trade-offs among objectives and incorporates uncertainties and risk preferences. This book is designed to help decision makers by providing such an analysis framework implemented as a simple spreadsheet tool. This framework helps structure the decision making process by identifying what information is needed for the decision, defining how that information should be combined and, finally, providing quantifiable evidence to clearly communicate and justify the final decision. With this process, decision making is made more efficient by focusing only on information and factors that are well-defined, measureable, and relevant to the decision at hand. Using this structured decision-making framework, anyone can effectively and consistently make better decisions to gain a competitive and strategic advantage.

'A brilliant new book' Daily Telegraph 'Well written . . . and often entertaining' The Times 'A sparkling analysis' Prospect When uncertainty is all around us, and the facts are not clear, how can we make good decisions? We do not know what the future will hold, particularly in the midst of a crisis, but we must make decisions anyway. We regularly crave certainties which cannot exist and invent knowledge we cannot have, forgetting that humans are successful because we have adapted to an environment that we understand only imperfectly. Throughout history we have developed a variety of ways of coping with the radical uncertainty that defines our lives. This incisive and eye-opening book draws on biography, history, mathematics, economics and philosophy to highlight the most successful - and most short-sighted - methods of dealing with an unknowable future. Ultimately, the authors argue, the prevalent method of our age falls short, giving us a false understanding of our power to make predictions, leading to many of the problems we experience today. Tightly argued, provocative and written with wit and flair, Radical Uncertainty is at once an exploration of the limits of numbers and a celebration of human instinct and wisdom.

While agreeing on the choice of an optimal investment decision is already difficult for any diverse group of actors, priorities, and world views, the presence of deep uncertainties further challenges the decision-making framework by questioning the robustness of all purportedly optimal solutions. This paper summarizes the additional uncertainty that is created by climate change, and reviews the tools that are available to project climate change (including downscaling techniques) and to assess and quantify the corresponding uncertainty. Assuming that climate change and other deep uncertainties cannot be eliminated over the short term (and probably even over the longer term), it then summarizes existing decision-making methodologies that are able to deal with climate-related uncertainty, namely cost-benefit analysis under uncertainty, cost-benefit analysis with real options, robust decision making, and climate informed decision analysis. It also provides examples of applications of these methodologies, highlighting their pros and cons and their domain of applicability. The paper concludes that it is impossible to define the "best" solution or to prescribe any particular methodology in general. Instead, a menu of methodologies is required, together with some indications on which strategies are most appropriate in which contexts. This analysis is based on a set of interviews with decision-makers, in particular World Bank project leaders, and on a literature review on decision-making under uncertainty. It aims at helping decision-makers identify which method is more appropriate in a given context, as a function of the project's lifetime, cost, and vulnerability.

FLINS, originally an acronym for Fuzzy Logic and Intelligent Technologies in Nuclear Science, is now extended to include Computational Intelligence for applied research. The contributions to the 12th of FLINS conference cover state-of-the-art research, development, and technology for computational intelligence systems, both from the foundations and the applications points-of-view.

An introduction to decision making under uncertainty from a computational perspective, covering both theory and applications ranging from speech recognition to airborne collision avoidance. Many important problems involve decision making under uncertainty—that is, choosing actions based on often imperfect observations, with unknown outcomes. Designers of automated decision support systems must take into account the various sources of uncertainty while balancing the multiple objectives of the system. This book provides an introduction to the challenges of decision making under uncertainty from a computational perspective. It presents both the theory behind decision making models and algorithms and a collection of example applications that range from speech recognition to aircraft collision avoidance. Focusing on two methods for designing decision agents, planning and reinforcement learning, the book covers probabilistic models, introducing Bayesian networks as a graphical model that captures probabilistic relationships between variables; utility theory as a framework for understanding optimal decision making under uncertainty; Markov decision processes as a method for modeling sequential problems; model uncertainty; state uncertainty; and cooperative decision making involving multiple interacting agents. A series of applications shows how the theoretical concepts can be applied to systems for attribute-based person search, speech applications, collision avoidance, and unmanned aircraft persistent surveillance. Decision Making Under Uncertainty unifies research from different communities using consistent notation, and is accessible to students and researchers across engineering disciplines who have some prior exposure to probability theory and calculus. It can be used as a text for advanced undergraduate and graduate students in fields including computer science, aerospace and electrical engineering, and management science. It will also be a valuable professional reference for researchers in a variety of disciplines.

This book is designed to support you in making difficult decisions in a more - tional way. Based on an established theoretical foundation, it shows that simple requirements concerning rational behavior lead to a general calculus of determ- ing optimal decision alternatives; the book then goes on to present methods and instruments useful for the practical implementation of these concepts. Psychological research has uncovered a multitude of systematic cognitive - ases associated with the intuitive decision process, especially concerning the f- mation of preferences and subjective probability judgments for uncertain events. These developments have elevated prescriptive decision theory to the status of an important discipline with increasingly strong practical ties – nowadays, even m- agers are concerned with decision trees, probability distributions and risk profiles. There is also a wide range of software available on the market to aid users with the use of the instruments. We would like to convince you, by help of the many pr- tical questions and case studies included with most chapters, that the material c- ered is not purely an academic diet but also of high practical nutritional value. The mindset suggested by the theory as an approach for decision problems will surely be of much use to you both in your private and professional life, even if you do not apply the presented methods of decision making support in every little - tail.

In the Second Edition of Rational Choice in an Uncertain World the authors compare the basic principles of rationality with actual behaviour in making decisions. They describe theories and research findings from the field of judgment and decision making in a non-technical manner, using anecdotes as a teaching device. Intended as an introductory textbook for advanced undergraduate and graduate students, the material not only is of scholarly interest but is practical as well. The Second Edition includes: - more coverage on the role of emotions, happiness, and general well-being in decisions - a summary of the new research on the neuroscience of decision processes - more discussion of the adaptive value of (non-rational heuristics) - expansion of the graphics for decision trees, probability trees, and Venn diagrams.

Decision Making in Systems Engineering and Management is a comprehensive textbook that provides a logical process and analytical techniques for fact-based decision making for the most challenging systems problems. Grounded in systems thinking and based on sound systems engineering principles, the systems decisions process (SDP) leverages multiple objective decision analysis, multiple attribute value theory, and value-focused thinking to define the problem, measure stakeholder value, design creative solutions, explore the decision trade off space in the presence of uncertainty, and structure successful solution implementation. In addition to classical systems engineering problems, this approach has been successfully applied to a wide range of challenges including personnel recruiting, retention, and management; strategic policy analysis; facilities design and management; resource allocation; information assurance; security systems design; and other settings whose structure can be conceptualized as a system.

Modeling uncertainty through probabilistic representation in engineering design is common and important to decision making that considers risk. However, representations of uncertainty often ignore elements of "imprecision" that may limit the robustness of decisions. Further, current approaches that incorporate imprecision suffer from computational expense and relatively high solution error. This work presents the Computational Efficient Imprecise Uncertainty Propagation (CEIUP) method which draws on existing approaches for propagation of imprecision and integrates sparse grid numerical integration to provide computational efficiency and low solution error for uncertainty propagation. The first part of the thesis details the methodology and demonstrates improvements in both computational efficiency and solution accuracy as compared to the Optimized Parameter Sampling (OPS) approach for a set of case studies. The second half of the thesis is focused on estimation of non-dominated design parameter spaces using decision policies of Interval Dominance and Maximality Criterion in the context of set-based sequential design-decision making. A gear box design is presented and compared with OPS, demonstrating that CEIUP provides improved estimates of the non-dominated parameter range with faster solution times. The third part of the thesis focuses on the effect of risk attitudes, risk towards innovation and imprecision in making choice by considering elements of Choice Theory. Also a framework has been proposed in the third part for concept selection consider risk attitudes, risk towards innovation and imprecision. Various scenarios of a gearbox design problem have been used for the study in the third part of this work. The work concludes with an overview of design problem scenarios in which CEIUP is the preferred method and offers opportunities for extending the method.

This book addresses an intriguing question: are our decisions rational? It explains seemingly irrational human decision-making behavior by taking into account our limited ability to process information. It also shows with several examples that optimization under granularity restriction leads to observed human decision-making. Drawing on the Nobel-prize-winning studies by Kahneman and Tversky, researchers have found many examples of seemingly irrational decisions: e.g., we overestimate the probability of rare events. Our explanation is that since human abilities to process information are limited, we operate not with the exact values of relevant quantities, but with “granules” that contain these values. We show that optimization under such granularity indeed leads to observed human behavior. In particular, for the first time, we explain the mysterious empirical dependence of betting odds on actual probabilities. This book can be recommended to all students interested in human decision-making, to researchers whose work involves human decisions, and to practitioners who design and employ systems involving human decision-making —so that they can better utilize our ability to make decisions under uncertainty.

1. Introduction. 1.1. Formulating the risk problem. 1.2. Decision criteria. 1.3. Decision making under risk : fact and fiction -- 2. Probability theory - a mathematical basis for making decisions under risk and uncertainty. 2.1. Set theory and probability. 2.2. Random variables. 2.3. Conditional probability and independence. 2.4. Some useful distribution functions. 2.5. Expected value, moments, and the moment generating function. 2.6. Estimating probability functions. 2.7. Martingales and random walks. 2.8. Summary -- 3. Expected utility - the economic basis of decision making under risk. 3.1. Consumption and utility. 3.2. Expected utility. 3.3. Expected value - variance and expected utility models. 3.4. Problems with expected utility. 3.5. Summary -- 4. Risk aversion in the large and small. 4.1. Arrow-Pratt risk aversion coefficient. 4.2. Eliciting risk aversion coefficients. 4.3 Summary -- 5. Portfolio theory and decision making under risk. 5.1. The expected value - variance frontier. 5.2. A simple portfolio. 5.3. A graphical depiction of the expected value-variance frontier. 5.4. Mean-variance versus direct utility maximization. 5.5. Derivation of the expected value-variance frontier. 5.6. Summary -- 6. Whole farm-planning models. 6.1. Farm portfolio models. 6.2. Minimize total absolute deviation. 6.3. Focus-loss. 6.4. Target MOTAD. 6.5. Direct utility maximization. 6.6. Discrete sequential stochastic programming. 6.7. Chance-constrained programming. 6.8. Interpreting shadow values from risk programming models. 6.9. Summary -- 7. Risk efficiency approaches - stochastic dominance. 7.1. Stochastic dominance. 7.2. Applications of stochastic dominance. 7.3. Summary -- 8. Dynamic decision rules and the value of information. 8.1. Decision making and Bayesian probabilities. 8.2. Concepts of information. 8.3. A model of information. 8.4. Summary -- 9. Market models of decision making under risk. 9.1. Risk equilibrium from the consumer's point of view. 9.2. The role of the riskless asset. 9.3. Risk equilibrium from the firm's perspective. 9.4. Arbitrage pricing theorem. 9.5. Empirical applications of capital market models. 9.6. Summary -- 10. Option pricing approaches to risk. 10.1. Introductions to options and futures. 10.2. Real option valuation. 10.3. Crop insurance. 10.4. Summary -- 11. State contingent production model : the stochastic production set. 11.1. Depicting risk and input decisions in the production function. 11.2. State Production set and input requirement set. 11.3. Distance functions and risk aversion. 11.4. Summary -- 12. Risk, uncertainty, and the agricultural firm - a summary and outlook

As desired, the infonnation demand correspondence is single valued at equilibrium prices. Hence no planner is needed to assign infonnation allocations to individuals. Proposition 4. For any given infonnation price system p E . P (F *), almost every a E A demands a unique combined

infonnation structure (although traders may be indifferent among partial infonnation sales from different information allocations, etc.). In particular, the aggregate excess demand correspondence for net combined infonnation trades is a continuous function. Proof Uniqueness fails only if an agent can obtain the same expected utility from two or more net combined infonnation allocations. If this happens, appropriate slight perturbations of personal probability vectors destroy the equality unless the utility functions and wealth allocations were independent across states. Yet, when utilities and wealths don't depend on states in S, no infonnation to distinguish the states is desired, so that the demand for such infonnation structures must equal zero. To show the second claim, recall that if the correspondence is single valued for almost every agent, then its integral is also single valued. Finally, note that an upper hemicontinuous (by Proposition 2) correspondence which is single valued everywhere is, in fact, a continuous function. [] REFERENCES Allen, Beth (1986a). "The Demand for (Differentiated) Infonnation"; Review of Economic Studies. 53. (311-323). Allen, Beth (1986b). "General Equilibrium with Infonnation Sales"; Theory and Decision. 21. (1-33). Allen, Beth (1990). "Infonnation as an Economic Commodity"; American Economic Review. 80. (268-273).

This volume contains the revised papers of an international symposium on research on fallacies, biases, and the development of decision behavior under uncertainty. The papers are organized in five main sections. The Introduction outlines the conceptual framework and how three of the sections - Cognitive Decision Research, Social Interaction, and Development and Epistemology - are interrelated and also how new fields, such as research into developmental questions, can be productively integrated. In the fifth section Comments are collected, which evaluate the impact of the contributions on decision research itself, and also on cognitive psychology, social psychology, economic theory, ant the discipline of mathematics education.

The axiomatic foundations of the Bayesian approach to decision making assurne precision in the decision maker's judgements. In practicc, dccision makers often provide only partial and/or doubtful information. We unify and expand results to deal with those cases introducing a general framework for sensitivity analysis in multi-objective decision making. We study first decision making problems under partial information. We provide axioms leading to modelling preferences by families of value functions, in problems under certainty, and moJelling beliefs by families of probability distributions and preferences by familics of utility functions, in problems under uncertainty. Both problems are treated in parallel with the same parametric model. Alternatives are ordered in a Pareto sense, the solution of the problem being the set of non dominated alternatives. Potentially optimal solutions also seem acceptable, from an intuitive point of view and due to their relation with the nondominated ones. Algorithms are provided to compute these solutions in general problems and in cases typical in practice: linear and bilinear problems. Other solution concepts are criticised on the grounds of being ad hoc. In summary, we have a more ro bust theory of decision making based on a weaker set ofaxioms, but embodying coherence, since it essentially implies carrying out a family of coherent dccision anitlyses.

Today's business environment involves design decisions with significant uncertainty. To succeed, decision-makers should replace deterministic methods with a risk-based approach that accounts for the decision maker‘s risk tolerance. In many problems, it is impractical to collect data because rare or one-time events are involved. Therefore, we need a

In Decision Making and Problem Solving, leadership guru John Adair provides the techniques and insights you need to find solutions, spark creativity and confidently make the right decisions. Fully updated for 2019, this 4th edition now features even more practical exercises, useful templates, and top tips to provide a clear framework that can generate ideas and inspire confidence in your team - so you can spot the solution in every problem, and create ideas to rival even the best strategists. The Creating Success series of books... Unlock vital skills, power up your performance and get ahead with the bestselling Creating Success series. Written by experts for new and aspiring managers and leaders, this million-selling collection of accessible and empowering guides will get you up to speed in no time. Packed with clever thinking, smart advice and the kind of winning techniques that really get results, you'll make fast progress, quickly reach your goals and create lasting success in your career.

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Human decision making involves problems which are being studied with increasing interest and sophistication. They range from controversial political decisions via individual consumer decisions to such simple tasks as signal discriminations. Although it would seem that decisions have to do with choices among available actions of any kind, there is general agreement that decision making research should pertain to choice prob lems which cannot be solved without a predecisional stage of finding choice alternatives, weighing evidence, and judging values. The ultimate objective of scientific research on decision making is two-fold: (a) to develop a theoretically sound technology for the optimal solution of decision problems, and (b) to formulate a descriptive theory of human decision making. The latter may, in tum, protect decision makers from being caught in the traps of their own limitations and biases. Recently, in decision making research the strong emphasis on well defined laboratory tasks is decreasing in favour of more realistic studies in various practical settings. This may well have been caused by a growing awareness of the fact that decision-behaviour is strongly determined by situational factors, which makes it necessary to look into processes of interaction between the decision maker and the relevant task environ ment. Almost inevitably there is a parallel shift of interest towards problems of utility measurement and the evaluation of consequences.

Decision Making Under Uncertainty in Electricity Markets provides models and procedures to be used by electricity market agents to make informed decisions under uncertainty. These procedures rely on well established stochastic programming models, which make them efficient and robust. Particularly, these techniques allow electricity producers to derive offering strategies for the pool and contracting decisions in the futures market. Retailers use these techniques to derive selling prices to clients and energy procurement strategies through the pool, the futures market and bilateral contracting. Using the proposed models, consumers can derive the best energy procurement strategies using the available trading floors. The market operator can use the techniques proposed in this book to clear simultaneously energy and reserve markets promoting efficiency and equity. The techniques described in this book are of interest for professionals working on energy markets, and for graduate students in power engineering, applied mathematics, applied economics, and operations research.

At the core of microeconomic theory lie the economics of uncertainty and the economics of games and decisions. This text for undergraduates and specialists in mathematical economics links game theory with decision-making under uncertainty.

Model Validation and Uncertainty Quantification, Volume 3: Proceedings of the 37th IMAC, A Conference and Exposition on Structural Dynamics, 2019, the third volume of eight from the Conference brings together contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of Model Validation and Uncertainty Quantification, including papers on: Inverse Problems and Uncertainty Quantification Controlling Uncertainty Validation of Models for Operating Environments Model Validation & Uncertainty Quantification: Decision Making

Uncertainty Quantification in Structural Dynamics Uncertainty in Early Stage Design Computational and Uncertainty Quantification Tools

The decision situation under consideration; Formal statement of the problem; Solution approaches to the problem of multi-objective decision making under uncertainty.

This dissertation provides novel frameworks for data-driven probabilistic performance-based assessments and optimal or near-optimal stochastic control strategies for structural, infrastructural and other engineering systems. The goal of this research is to enable efficient and robust structural performance predictions and optimized decisions over the entire operating life of systems, by developing advanced statistical learning models, machine learning formulations and Artificial Intelligence (AI) algorithms, in order to contribute to a future of smart and sustainable infrastructure. To this end, the developed approaches build upon and extend well-established statistical modeling frameworks, infuse intelligence to structural informatics through newly introduced schemes for structural data mining and processing, provide comprehensive solutions to challenging life-cycle objectives, and support complex decisions in previously intractable sequential decision-making problems through novel AI-aided algorithms and theoretical concepts.Efficient assessment of various societal, environmental and economic losses necessitates adept statistical and learning models, able to consistently capture longitudinal dependencies in data and translate multivariate information in structural condition and performance metrics. This dissertation addresses this need, within a softmax regression fragility analysis framework that avoids fragility function crossing inconsistencies and scales well in high-dimensional intensity measure spaces with multiple structural states. Moreover, softmax-based fragility functions are generalized by advanced statistical learning and deep learning formulations that employ Dynamic Bayesian Networks (DBNs), in the form of Dependent Markov Models (DMMs) and Dependent Hidden Markov Models (DHMMs), as well as Recurrent Neural Network (RNN) architectures. The above considerably extend and generalize the framework of probabilistic performance engineering, with theoretically consistent multi-state multi-variate fragility functions, which also have multi-step predictive capabilities in time. The hidden spaces of DHMMs and RNNs are shown to be able to encode noisy input to noisy output sequences through structured hidden spaces. It turns out that the Markovian properties of these spaces can portray damage-consistent dynamics, whereas they are directly pertinent to the input required in advanced decision frameworks that employ Markovian processes for decision-making either under full, partial, or mixed observability assumptions.Hidden Markov models equipped with costs and control actions can provide a theoretically neat and computationally robust framework for sequential decision-making problems under uncertainty, through Partially Observable Markov Decision Processes (POMDPs). This research casts stochastic control problems for determination of optimal or near-optimal life-cycle maintenance and inspection strategies within the premises of POMDPs. Specialized formulations of full or mixed observability are also developed, through Markov Decision Processes (MDPs) or Mixed Observability Markov Decision Processes (MOMDPs), respectively. Along these lines, this research enables decision-support systems which can operate in stochastic engineering environments with uncertain action outcomes and noisy real-time observations, having global optimality guarantees as a result of the relevant underlying dynamic programming formulations introduced and, in many cases, well-defined performance bounds. In the same vein, the Value of Information (VoI) and the Value of Structural Health Monitoring (VoSHM) are quantified and a straightforward definition for the expected life-cycle gains of different observational and monitoring options is established and evaluated. Formulating VoI and VoSHM within the framework of POMDPs, the estimates of these metrics depict value gaps between the optimal life-cycle strategies of the examined options, thus also being able to provide bounds on the respective gains.For small- to medium-scale systems, solutions to the life-cycle optimization problems are derived by point-based solution schemes which provide efficient exploration heuristics, value function updates over the POMDP belief-space, vector compression techniques and convergence properties. For large-scale multi-component engineering systems that form large state and action spaces, such point-based schemes are however impractical as they require explicit prior information of the system dynamics model. To this end, the Deep Centralized Multi-agent Actor Critic (DCMAC) is developed herein and implemented in the solution procedure. DCMAC is an efficient off-policy actor-critic Deep Reinforcement Learning (DRL) algorithm with experience replay. DCMAC alleviates the curse of dimensionality related to state, observation and actions spaces of multi-component systems through deep network approximators and a factorized representation of the actor. DCMAC interacts directly with the simulator, thus avoiding the need for full and explicit model-based knowledge of the system dynamics, and operates in the POMDP belief space, by encoding sequences of actions and observations in belief vectors through Bayesian updates. Overall, DCMAC is able to efficiently tackle the state and action space scalability issues, as well as the potential model unavailability at the system level, all of which often make the decision problems of large multi-component systems hard to solve, if not intractable, by conventional machine learning schemes and other life-cycle optimization methodologies.All developed methods and frameworks are rigorously evaluated in relevant numerical applications and their strengths, limitations and broader capabilities are highlighted and discussed. Results demonstrate the effectiveness of the proposed models, solution procedures and algorithmic schemes, in enabling efficient data-driven probabilistic predictions and structural informatics, as well as comprehensive optimal or near-optimal stochastic control strategies for engineering systems. Overall, the originally developed statistical and machine learning models, in conjunction with the dedicated AI-aided algorithms, can ensure advanced and sophisticated solutions and open numerous new scientific paths towards smart cities, intelligent infrastructure, and autonomous control of the built environment.

This book exposes the barriers to inclusive and effective public policy making, which are the current decision making paradigm and commonly held ideas that reduce public policy problems to scientific and technical ones. Through both environmental policy and other decision making examples, readers are shown the commonalities of all decision making. Solution-oriented practitioners and stakeholders will find this book filling a conceptual and methodological gap in existing policy literature and practice. The authors deftly guide readers from post-normal science, wicked problems, and uncertainty concepts to a conceptually-grounded, practical implementation of a new approach, the open solution approach. The Multi-criteria Integrated Resource Assessment (MIRA) is described as the first generation methodology that fulfills the expectations for the inclusive, transparent, and learning-based open solutions approach. MIRA is a holistic package of concepts, methods and analytical tools that is designed to assess Decision Uncertainty, the combined uncertainties that include data, problem formulation, expert judgments, and stakeholder opinions. Introduction of the Requisite Steps, the common steps found in all decision making, provides the yardstick for evaluating a variety of decision making processes, decision tools, and commonly found indices such as the Dow Jones Industrial Average or the Newsweek Green Ranking of corporations. The use of anecdotes, policy stories, and case examples makes this a very readable and practical book for citizens and experts. With this book, readers are prepared to critically evaluate these common

indices for their personal use as well as challenge policy processes as a stakeholder. For policy practitioners, this guidebook will become a rubric to ensure an effective public policy making process and to critically evaluate decision support tools.

Utility and risk analysis; Investment decisions under uncertainty; Portfolio analysis and capital market theory; Inflation and financial decision; Applications of risk analysis.

Management decisions are generally considered to be made under one of three categories of future knowledge: certainty, risk, or uncertainty. All three categories occur in forest management. However, forest management decisions whose outcomes are dependent upon future levels of timber yields, prices, utilization standards, or social and legal institutions are made under uncertainty. Forest managers have always recognized that uncertainty existed; however, they have not systematically included it in their decision- making process. The objectives of the study were to: (1) establish the importance of systematically considering uncertainty in forest management decision-making and (2) illustrate and evaluate a model or procedure, for the systematic consideration of uncertainty in forest management decision-making. A review of the present status of forest management decision-making constituted fulfillment of the first objective. Theoretical decision-making models which are currently used in forest management, e. g., present worth analysis, capital budgeting, financial maturity, and linear programming, while conceptually capable of considering uncertainty, imply certainty That is, forestry applications of these models have employed single-valued expectations. Fulfillment of the second objective consisted initially of a review of recent developments in the theory of decision-making under uncertainty. All decision-making problems have some common components. These components are: decision-alternatives, the actions which the decision-maker deems possible to take; states of nature, the future events which determine the outcome of the actions; and consequences, the result of taking a specific action and finding that a particular state occurs. The more popular theoretical models for decision-making under uncertainty were reviewed: minimax, minimax regret, Hurwicz index, and Laplace. While useful in some cases, each of these models has specific disadvantages. In addition, all the models have one common major disadvantage, they contain the implicit assumption that the decision-maker is completely ignorant about the states of nature which influence his problem. In reality, forest managers and other decision-makers usually possess some information, although it may be vague, about their problems. If a decision-maker is not willing to assume complete ignorance about the occurrence of the states of nature, he cannot apply any of the above models. There is a theoretical decision-making model which appears compatible with reality. The model, Bayesian decision theory, allows the decision-maker to arrive at a solution which is compatible with his opinions or judgements about the states of nature. Also, he can combine these opinions or judgements with experimental data to derive a solution using all available information, both subjective and objective. Fulfillment of the second objective was completed by illustrating the application of Bayesian decision theory to a hypothetical problem. The problem, optimal degree of land ownership for an industrial forestry firm, was defined within the Bayesian model and a solution derived. Since the problem was hypothetical, the actual solution is not the primary result of the study. The resulting implications for actual situations is the primary contribution. If forest managers are to make decisions which contain uncertainty, the uncertainty should be systematically recognized in the decision-making process. The Bayesian model is a logical procedure for such recognition. By adopting and applying such models, the efficiency of forest management decision-making will be increased.

The scope of this volume is primarily to analyze from different methodological perspectives similar valuation and optimization problems arising in financial applications, aimed at facilitating a theoretical and computational integration between methods largely regarded as alternatives. Increasingly in recent years, financial management problems such as strategic asset allocation, asset-liability management, as well as asset pricing problems, have been presented in the literature adopting formulation and solution approaches rooted in stochastic programming, robust optimization, stochastic dynamic programming (including approximate SDP) methods, as well as policy rule optimization, heuristic approaches and others. The aim of the volume is to facilitate the comprehension of the modeling and methodological potentials of those methods, thus their common assumptions and peculiarities, relying on similar financial problems. The volume will address different valuation problems common in finance related to: asset pricing, optimal portfolio management, risk measurement, risk control and asset-liability management. The volume features chapters of theoretical and practical relevance clarifying recent advances in the associated applied field from different standpoints, relying on similar valuation problems and, as mentioned, facilitating a mutual and beneficial methodological and theoretical knowledge transfer. The distinctive aspects of the volume can be summarized as follows: Strong benchmarking philosophy, with contributors explicitly asked to underline current limits and desirable developments in their areas. Theoretical contributions, aimed at advancing the state-of-the-art in the given domain with a clear potential for applications The inclusion of an algorithmic-computational discussion of issues arising on similar valuation problems across different methods. Variety of applications: rarely is it possible within a single volume to consider and analyze different, and possibly competing, alternative optimization techniques applied to well-identified financial valuation problems. Clear definition of the current state-of-the-art in each methodological and applied area to facilitate future research directions.

Recently, many books on multiobjective programming have been published. However, only a few books have been published, in which multiobjective programming under the randomness and the fuzziness are investigated. On the other hand, several books on multilevel programming have been published, in which multiple decision makers are involved in hierarchical decision situations. In this book, we introduce the latest advances in the field of multiobjective programming and multilevel programming under uncertainty. The reader can immediately use proposed methods to solve multiobjective programming and multilevel programming, which are based on linear programming or convex programming technique. Organization of each capter is summarized as follows. In Chapter 2, multiobjective programming problems with random variables are formulated, and the corresponding interactive algorithms are developed to obtain a satisfactory solution, in which the fuzziness of human's subjective judgment for permission levels are considered. In Chapter 3, multiobjective programming problems with fuzzy random variables are formulated, and the corresponding interactive algorithms are developed to obtain a satisfactory solution, in which not only the uncertainty of fuzzy random variables but also the fuzziness of human's subjective judgment for permission levels are considered. In Chapter 4, multiobjective multilevel programming is discussed, and the interactive algorithms are developed to obtain a satisfactory solution, in which the hierarchical decision structure of multiple decision makers is reflected. In Chapter 5, two kinds of farm planning problems are solved by applying the proposed method, in which cost coefficients of crops are expressed by random variables.

Industry 4.0 demands autonomous decision making on the plant floor that is simultaneously quick and adaptable to changing decision maker preferences. In this research, we apply the methods of decision-based design to autonomous decision-making for corrective assembly within a Smart Factory. In addition to providing a decision making framework, we provide a closed-form

approximation for the expected utility when there is uncertainty in both the outcomes and the decision maker preferences. This approximation accommodates any arbitrary distributions for the uncertainty in the preferences and avoids time-consuming numerical methods that have the potential to increase cycle time of the corrective process. In addition, we take a Bayesian perspective on the stochastic nature of the utility function and propose a distinction between a prior utility function based on preferences in the design phase and a posterior utility function updated through data collected on observed preferences in production. We do this by treating the shape parameters that describe the risk preference of the decision makers as a random variable with a prior and posterior distribution. The unique contribution of this work lies in the improved ability to capture uncertainty in the preference behavior of decision makers. The closed-form solution for the expected utility under uncertain preferences allows for considerably faster autonomous decision making than available numerical solutions. Additionally, we introduce the idea of prior utility as a starting point and posterior utility as the completion of a cycle that can be repeated for further design revisions. We demonstrate through an automotive assembly application that the approach significantly improves the assembled product.

This book gathers selected papers from two important conferences held on October 24–28, 2018, in Warsaw, Poland: theFifteenth National Conference of Operational and Systems Research, BOS-2018, one of the leading conferences in the field of operational and systems research not only in Poland but also at the European level; andthe Seventeenth International Workshop on Intuitionistic Fuzzy Sets and General Nets, IWIFSGN-2018, one of thepremiere conferences on fuzzy logic. The papers presented here constitute a fair and comprehensive representation of the topics covered by both BOS-2018 and IWIFSGN-2018, includingextensions of the traditional fuzzy sets, in particular on the intuitionistic fuzzy sets, as well as other topics in uncertainty and imprecision modeling, the Generalized Nets (GNs), a powerful extension of the traditional Petri net paradigm, and InterCriteria Analysis, a new method for feature selection and analyses in multicriteria and multi-attribute decision-making problems. The Workshop was dedicated to the memory of Professor Beloslav Rie?an (1936–2018), a regular participant at the IWIFSGN workshops.

A guide to the various models and methods to multicriteria decision-making in conditions of uncertainty presented in a systematic approach Multicriteria Decision-Making under Conditions of Uncertainty presents approaches that help to answer the fundamental questions at the center of all decision-making problems: "What to do?" and "How to do it?" The book explores methods of representing and handling diverse manifestations of the uncertainty factor and a multicriteria nature of problems that can arise in system design, planning, operation, and control. The authors—noted experts on the topic—and their book covers essential questions, including notions and fundamental concepts of fuzzy sets, models and methods of multiobjective as well as multiattribute decision-making, the classical approach to dealing with uncertainty of information and its generalization for analyzing multicriteria problems in condition of uncertainty, and more. This comprehensive book contains information on "harmonious solutions" in multiobjective problem-solving (analyzing “i>X, F> models), construction and analysis of “i>X, R/i” models, results aimed at generating robust solutions in analyzing multicriteria problems under uncertainty, and more. In addition, the book includes illustrative examples of various applications, including real-world case studies related to the authors’ various industrial projects. This important resource: Explains the design and processing aspect of fuzzy sets, including construction of membership functions, fuzzy numbers, fuzzy relations, aggregation operations, and fuzzy sets transformations Describes models of multiobjective decision-making (“i>X. M/i” models), their analysis on the basis of using the Bellman-Zadeh approach to decision-making in a fuzzy environment, and their diverse applications, including multicriteria allocation of resources Investigates models of multiattribute decision-making (“i>X, R/i” models) and their analysis on the basis of the construction and processing of fuzzy preference relations as well as demonstrating their applications to solve diverse classes of multiattribute problems Explores notions of payoff matrices and fuzzy-set-based generalization and modification of the classic approach to decision-making under conditions of uncertainty to generate robust solutions in analyzing multicriteria problems Written for students, researchers and practitioners in disciplines in which decision-making is of paramount relevance, Multicriteria Decision-Making under Conditions of Uncertainty presents a systematic and current approach that encompasses a range of models and methods as well as new applications.