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Preface

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Preface

In keeping with the overall conference theme of *Bridging Data and Decisions*, we present this 2014 edition of the TutORials book containing nine chapters addressing methodologies (cloud computing, epi-spline technologies, large-scale deterministic, and stochastic optimization, and simulation), thoughts on operations management and service operations, and applications (energy policy, defending critical infrastructure, and health care). There are two additional tutorials without chapters.

Jeff Linderoth (no chapter included) describes *Cloud Computing for Optimization*, i.e., experiences with using ubiquitous, convenient, on-demand, shared computing resources to solve large-scale optimization problems. Formerly known as a “metacomputer,” this resource became known as the “computational grid” in 2000. The contemporary name is “cloud computing.” The presenter surveys the landscape of cloud computing, and its use and potential for Operations Research and Optimization. In another chapter on cloud computing, *Decision Analytics for Cloud Computing: A Classification and Literature Review*, Leonard Heilig and Stefan Voss present a classification of decision analytics (e.g., to choose the best options and to make predictive statements under uncertainty and information asymmetry). The authors review related problems, models and techniques applied to support cloud computing-oriented decision making; they conclude with case studies.

In the chapter entitled *From Data to Assessments and Decisions: Epi-Spline Technology*, Johannes Royet and Roger Wets note that analysts in every field face the challenge of how to best use available data to estimate performance, quantify uncertainty, and predict the future. The data are almost never “just right”; rather, they are scarce, excessive, corrupted, uncertain, and incomplete. External information derived from experiences, established “laws,” and physical restrictions offer opportunities to remedy the shortcomings of the data. Sustainable energy, natural resources, image reconstruction, financial planning, uncertainty quantification, and reliability engineering present application areas that are rich with problems in which decisions rely on data analysis under such circumstances. The authors address these problems within a framework that identifies a function that, according to some criterion, best represents the given data set and satisfies constraints derived from the data as well as external information. They offer epi-splines as a linchpin that allows the handling of shape restrictions, information growth, and approximations.

Two chapters on optimization offer advice in both the deterministic and stochastic settings. Ed Klotz’s piece on *Identification, Assessment and Correction of Ill-Conditioning and Numerical Instability in Linear and Integer Programs* notes that the implementation of linear programming (LP) and mixed integer programming (MIP) algorithms on finite-precision computers can create numerical challenges; such challenges are not necessarily addressed in the mathematical descriptions of these algorithms given in many introductory and more advanced textbooks and courses. As an example, rounding errors associated with finite precision can be magnified due to ill-conditioning or numerical instability, resulting in unexpected, possibly inconsistent results. The author helps the optimization practitioner identify sources of ill-conditioning and numerical instability, assess the cause and take appropriate remedial action. After discussing some finite-precision computing fundamentals, the chapter considers different measures of ill-conditioning, each one of which provides the simplest explanation of ill-conditioning on certain types of LP and MIP models. The chapter concludes with remedies for these numerical challenges: (i) optimizer parameter settings that treat the symptoms and (ii) diagnostic tactics that resolve the underlying MIP or LP issue. On the stochastic optimization side, Warren Powell presents *Clearing the Jungle of Stochastic Optimization*, in which he tries to unify the highly fragmented field. The author brings the competing approaches for sequential decision problems under a common umbrella. He first suggests a five-element modeling framework which replaces the challenge of finding decisions with one of finding policies. He then describes four fundamental classes of policies that integrate stochastic programming and dynamic programming with other communities.

In *Simulation-Based Education in Supply Chain and Project Management*, Avinoam Tzimerman, Loren Dery, Noemie Sellam Balouka, Izack Cohen, Yale Herer, and Avraham Shtub, present two state-of-the-art simulators for simulation-based training (SBT) in Operations Management education. Both simulators are built on the concepts of ease of use, scenario-based training, flexibility, and supportive data. The authors provide an overview of SBT and use exercises that highlight the benefits of educational simulators within the classroom.

Two topics covering operations management and service operations follow. *Service Science: Toward Systematic Service System Innovation*, by Paul Maglio and Christoph Breidbach, describes service science as the study of complex service systems, which may involve methods and theories from operations, industrial engineering, marketing, computer science, psychology, information systems, and design. The authors argue that understanding innovation in service systems often requires combining multiple methods because of the complex ways in which interactions among people, technology, organizations, and information create value in different contexts and under different conditions. The chapter reviews the emergence of service science (the field) by analyzing papers published in *Service Science* (the journal), and discusses the new field's foundations, prospects, and opportunities. John Buzacott provides the chapter *From OR to OM: Observations on the Emergence of a Discipline*, in which he describes his experience 50 years ago in applying operations research in industry. This experience includes some of the problems and issues encountered, almost all of which were then new, at a time when there were no textbooks addressing the application of OR to production and inventory control problems. However, as awareness of the problems increased, the author notes that OR approaches helpful to industry were, in fact, developed. Eventually consultants, software developers and academics working with managers created a body of knowledge which was the basis of a new discipline, Operations Management.

The book concludes with three applications. Ben Hobbs, Antonio Conejo, David Fuller, Steven Gabriel, and Carlos Ruiz (no chapter included) discuss complementarity models that represent the simultaneous optimization problems of one or several interacting decision makers; the presenters argue that these types of models have become a powerful tool for formulating and solving bottom-up energy market models. They provide an overview of complementarity-based formulations (including Mathematical Programs with Equilibrium Constraints and Equilibrium Problems with Equilibrium Constraints), followed by illustrative electricity market applications, including oligopolistic generation markets, transmission infrastructure planning, and environmental policy. David Alderson, Gerald Brown, and Matthew Carlyle quantify resilience of an infrastructure system to a set of disruptive events in terms of degradation of system function. Their chapter, *Assessing and Improving Operational Resilience of Critical Infrastructures and Other Systems*, shows how to build and solve a sequence of models to assess and improve the resilience of an infrastructure system to disruptions. Through simple examples and real-world case studies, the authors provide motivation, details of the models, and solution algorithms. Finally, Turgay Ayer, Pinar Keskinocak, and Julie Swann address *Research in Public Health for Efficient, Effective, and Equitable Outcomes*. Noting that public health focuses on preventing disease, prolonging life, and promoting health in a population, they discuss Access and Equity, Disease Screening, Chronic Diseases and Infectious Diseases. In each of these areas, the authors provide a brief overview of challenging issues and related literature, give a specific example of a research topic, and point to potential future directions for research. The authors describe several trends that could impact future public health research, including aging populations and an increase in electronic records, and emphasize the social benefits of such work.

We hope that this diverse set of tutorials on both deterministic and stochastic, computational methodologies, as well as important application areas, provides readers with relevant information about cutting-edge research topics.

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