EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Risk-Averse Optimization and Control of Partially Observable Systems

ABSTRACT - We introduce the concept of a risk form, which is a real functional on the product of two spaces: the space of measurable functions and the space of measures on a Polish space. We present a dual representation of risk forms and generalize the classical Kusuoka representation to this setting. For a risk form acting on a product space, we define marginal and conditional forms and we prove a disintegration formula, which represents a risk form as a composition of its marginal and conditional forms. We apply the proposed approach to two-stage optimization problems with partial information and decision-dependent observation distribution. Next, we consider risk measurement in controlled partially observable Markov systems in discrete time. In such systems, part of the state vector is not observed, but affects the transition kernel and the costs. We introduce new concepts of risk filters and study their properties. We also introduce the concept of conditional stochastic time consistency. We derive the structure of risk filters enjoying this property and prove that they can be represented by a collection of law invariant risk measures on the space of function of the observable part of the state. We also derive the corresponding dynamic programming equations. Finally, we illustrate the results on examples.

Dr. Andrzej Ruszczynski
Professor
Department of Management Science & Information Systems
Rutgers Business School

SPEAKER BIO – Andrzej Ruszczynski received his PhD and habilitation degrees in control engineering from Warsaw University of Technology in 1976 and 1983, respectively. He has been with Warsaw University of Technology (Poland), University of Zurich (Switzerland), International Institute of Applied Systems Analysis (Laxenburg, Austria), Princeton University, University of Wisconsin-Madison, and Rutgers University. Dr. Ruszczynski is one of the creators of and main contributors to the field of risk-averse optimization, author of "Nonlinear Optimization" (Princeton University Press, 2006), co-author of "Lectures on Stochastic Programming" (SIAM, 2009), "Stochastic Programming" (Elsevier, 2003), and author of more than 100 articles in the area of optimization. He is the recipient of the 2018 Dantzig Prize of SIAM and the Mathematical Optimization Society, and an INFORMS fellow.

USC Viterbi
School of Engineering
Daniel J. Epstein Department of Industrial and Systems Engineering

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