

# EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

## A Multistage Distributionally Robust Optimization Approach to Water Allocation under Climate Uncertainty

**ABSTRACT** - We investigate a multistage distributionally robust optimization (MDRO) approach to water allocation under climate uncertainty. We form the MDRO by creating sets of conditional distributions (called conditional ambiguity sets) on the nodes of a finite scenario tree, where the distributions in the conditional ambiguity sets remain close to a nominal conditional distribution according a  $\phi$ -divergence (e.g., Kullback-Liebler divergence, Hellinger distance, Burg entropy, etc.). We discuss a decomposition algorithm to solve the resulting MDRO and apply the modeling and solution techniques to allocate water in a rapidly-developing area of Tucson, Arizona. Tucson, like many arid and semi-arid regions around the world, faces considerable uncertainty in its ability to provide water for its citizens in the future. The primary sources of uncertainty in the region include (1) unpredictable population growth, (2) the availability of water from the Colorado River, and (3) the effects of climate variability on water consumption. This work integrates forecasts for all these sources of uncertainty into a single optimization model for robust and sustainable water allocation. Then, it uses this model to analyze the value of constructing additional treatment facilities to reduce future water shortages. The results indicate that the MDRO approach can be valuable for water managers by providing insights to minimize their risks and help them plan for the future.



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**SPEAKER BIO** – Güzin Bayraksan is an associate professor in the Integrated Systems Engineering Department at the Ohio State University (OSU). Prior to joining OSU, she was a member of the Systems and Industrial Engineering Department and the Graduate Interdisciplinary Program in Applied Mathematics at the University of Arizona. She received her Ph.D. in Operations Research and Industrial Engineering from the University of Texas at Austin and B.S. in Industrial Engineering from Bosphorus (Bogazici) University in Istanbul, Turkey. Her research interests are in stochastic optimization, particularly Monte Carlo sampling-based and data-driven distributionally robust methods for stochastic programming with applications in water resources management. She is the recipient of 2016 INFORMS ENRE Best Publication Award in Environment and Sustainability, 2016 Lumley Research Award (OSU), 2012 NSF CAREER award, 2012 Five Star Faculty Award (UA), and the 2008 INFORMS Best Case Study award. She is currently serving as the chair of Stochastic Programming Society (2019-2021). She previously served as the Vice Chair of Optimization under Uncertainty of INFORMS Optimization Society, as an elected member and treasurer of the Committee on Stochastic Programming (COSP) and President of the INFORMS Forum on Women in Operations Research and Management Science (WORMS).

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**TUESDAY, JANUARY 21, 2020**

**3:30 PM – 4:50 PM**

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