**Ambiguity, Uncertainty, and Robust Optimization**

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In this lecture we shall discuss the role of robust optimization in a decision environment where there are two different sources of risks. First, the model describing the decision problem may subject to ambiguity. In particular, the parameters in the model may only be a result of rough estimations. Second, the model itself is dynamic and stochastic in nature. In other words, even if there is no ambiguity about the model, one still needs to deal with the uncertain (random), dynamic, and multiple possible outcomes predicted by the model. Therefore, an optimal policy in this situation should be dynamic as well. A natural question arises: how can one deal with the ambiguity of the model while trying to come up with a good dynamic policy? In this talk, we shall present two case studies to motivate our solution: robust optimization in combination with dynamic policies. In the first particular application [1], we discuss robust versions of the classical static and dynamic single leg seat allocation models as analyzed by Wollmer, and Lautenbacher and Stidham. As observed by simulation experiments it turns out that for these robust versions the variability compared to their classical counter parts is considerably reduced with a negligible decrease of average revenue. In the second application [2], we show that for a general scenario-tree based investment model, if the parameter uncertainties are described by ellipsoids, then the problem can be formulated by Second Order Cone programming. Thus, it can be solved efficiently by, e.g., SeDuMi of Jos F. Sturm.

## References

[1] S.I. Birbil, J.B.G. Frenk, J. Gromicho, and S. Zhang. An Integrated Approach to Single-Leg Airline Revenue Management: The Role of Robust Optimization. *Technical Report SEEM2006-04, Department of Systems Engineering & Engineering Management, The Chinese University of Hong Kong*, 2006.

[2] R.J. Shen and S. Zhang. Robust Portfolio Selection Based on a Multi-stage Scenario Tree. *Technical Report SEEM2006-02, Department of Systems Engineering & Engineering Management, The Chinese University of Hong Kong*, 2006.