A Branch-and-Bound Approach for Multi-Stage Stochastic Mixed-0-1 Programs

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In this talk we present a new exact algorithmic framework for solving multi-stage stochastic mixed 0-1 problems based on a branch-and-bound approach. The approach can be applied to multi-stage problems with mixed-integer variables and uncertainty in each time stage.

We assume that uncertainty can be captured by a finite set of scenarios. We describe the underlying scenario tree with a unique set of indices that enables an easy reformulation of the deterministic equivalent model. In turn, the latter is rewritten in a splitting variable representation model allowing an explicit description and subsequent relaxation of the non-anticipativity constraints. We show that the optimal solution of the deterministic equivalent can be formulated as a weighted average of the optimal decisions obtained in the corresponding scenarios within the splitting variable representation. This implies that an LP relaxation of the deterministic equivalent equals a relaxation of the corresponding non-anticipativity constraints in the splitting variable representation.

Computational results are presented for risk-aware capacitated facility location problems with multiple stages as well as uncertain demand and capacities. The results show that the presented method leads to the optimal solution for all considered instances with a good performance.