Projection Cuts for Two-Stage Stochastic Mixed-Integer Programs, with Application in Unit Commitment

We revisit the Benders decomposition algorithm for solving two-stage stochastic mixed-integer programs with \emph{in}complete recourse. Inspired by principal component analysis, we propose a family of valid inequalities, called projection cuts, based on minor components of the positive cone generated by the recourse matrix. We design a two-phase variant of Benders decomposition with projection cuts to strengthen the initial relaxation. Extensive numerical experiments on stochastic unit commitment, multi-commodity network design, and stochastic production routing demonstrate that our approach obtains better root-node gaps, reduces the needed number of feasibility cuts to half, and significantly shortens the overall solving time, in comparison with the classic Benders decomposition.