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Data-driven Robust Optimization under Correlated Uncertainty: A Case Study of Production Scheduling in Ethylene Plant ☆

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Abstract

To hedge against the fluctuations generated from continuous production processes, practical solutions can be obtained through robust optimization induced by the classical uncertainty sets. However, uncertainties are sometimes correlated in industrial scheduling problems because of the connected process and various random factors. To capture and enrich the valid information of uncertainties, copulas are introduced to estimate the joint probability distribution and simulate mutual scenarios for uncertainties. Cutting planes are generated to remove unnecessary uncertain scenarios in the uncertainty sets, and then robust formulations induced by the cut set are proposed to reduce conservatism and improve the robustness of scheduling solutions. A real-world process of ethylene plant is introduced as the numerical case, and high-dimensional data-driven uncertainty sets are illustrated in detail. The proposed models are proved to control the fluctuation of consumed fuel gas below a lower level of conservatism.

Keywords: Data-driven, robust optimization, correlated uncertainty, production scheduling, copula, fuel gas.

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