学 术 报 告

Two-stage Stochastic Mixed-integer Nonlinear Programs-Algorithms and Applications

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Abstract: Two-stage stochastic programming is one of the approaches to model decision-making under uncertainty. In the process systems engineering community, two-stage stochastic programming has been applied to different planning problems, such as stochastic pooling problems, supply chain design under uncertainty. Solving stochastic programs requires specialized decomposition algorithms. Benders decomposition, often referred to as L-shaped method in stochastic programming, can be applied to solve stochastic mixed-integer linear programs with continuous stage 2 variables. However, there are applications that include (mixed)-integer variables in stage 2, such as supply chain problems with discrete transportation costs, dynamic capacity acquisition and allocation under uncertainty, and server location under uncertainty. Although there have been algorithmic advances in two-stage stochastic mixed-integer linear programs with integer recourse in the past two decades, the algorithms to address the nonlinear counterpart are few. In this presentation, an improved-L shaped algorithm will be presented that can be applied to two-stage stochastic 0-1 mixed-integer programs with mixed-binary recourse and convex constraints. A generalized Benders decomposition-based branch and bound algorithm that has finite convergence for convex mixed-binary nonlinear stochastic programs will also be presented. The proposed algorithms are tested with a planning problem under uncertainty and a constrained layout problem under uncertainty.

[1] Li, C., & Grossmann, I. E. (2018). An improved L-shaped method for two-stage convex 0–1 mixed integer nonlinear stochastic programs. Computers & Chemical Engineering, 112, 165-179.

[2] Li, C., & Grossmann, I. E. A finite ϵ-convergence algorithm for two-stage convex 0-1 mixed-integer nonlinear stochastic programs with mixed-integer first and second stage variables. Optimization Online (submitted to Journal of Global Optimization).

Short Bio: Can Li earned his B.Eng. in chemical engineering, with a focus on process systems engineering, from Tsinghua university. He later started to pursue his PhD in the Department of Chemical Engineering in Carnegie Mellon University under the supervision of Prof. Ignacio Grossmann from 2016. His research focus is on developing decomposition algorithms for stochastic mixed-integer nonlinear programs. He has applied those algorithms to problems in chemical industry, such as a batch plant design problem under demand uncertainty, a planning problem under demand and price uncertainty. The related work has been published in journals like Computers & Chemical Engineering.