SMU Lyle School of Engineering

Operations Research and Engineering Management

Seminar Series

Research Seminar

Dealing with the Lower-level (Follower's) Problem in Bilevel Mixed-Integer Linear Programming

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https://smu.zoom.us/j/97906267193

Abstract

In bilevel optimization, two independent decision-makers (known as the leader and the follower) with their own distinct objective functions are involved in a hierarchical decision-making process. The leader (the upper-level decision-maker) acts first, and then the follower (the lower-level decision-maker) determines the response in terms of their own optimization model, whose feasible region and objective function are parameterized on the leader's decision. Importantly, the follower's response also affects the leader's objective function. Bilevel programming models arise in several important application domains including network design,

revenue management, energy and defense. As we first briefly overview in this talk, complexity of solving bilevel programs depends on the structure of the lower-level problem, in particular, whether the lower-level problem involves integrality restrictions. Our main focus is on bilevel mixed-integer linear optimization problems in which the decision variables of the lower-level problem are all binary. We propose a general modeling and solution framework motivated by the practical reality that in a Stackelberg game, the follower does not always solve their optimization problem to optimality. They may instead implement a locally optimal solution with respect to a given leader's decision. Such scenarios may occur when the follower's computational capabilities are limited, or when the follower is not completely rational. Our framework relaxes the typical assumption of perfect rationality that underlies the standard modeling framework by defining a hierarchy of increasingly stringent assumptions about the behavior of the follower. Associated with this hierarchy is a hierarchy of upper and lower bounds that are in fact valid for the classical case in which com

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