

On Bilevel Optimization with Inexact Follower

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DECISION ANALYSIS

Volumen: 17 Número: 1 Páginas: 74-95

DOI: 10.1287/deca.2019.0392

Fecha de publicación: MAR 2020

Tipo de documento: Article

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Abstract

Traditionally, in the bilevel optimization framework, a leader chooses her actions by solving an upper-level problem, assuming that a follower chooses an optimal reaction by solving a lower-level problem. However, in many settings, the lower-level problems might be nontrivial, thus requiring the use of tailored algorithms for their solution. More importantly, in practice, such problems might be inexactly solved by heuristics and approximation algorithms. Motivated by this consideration, we study a broad class of bilevel optimization problems where the follower might not optimally react to the leader's actions. In particular, we present a modeling framework in which the leader considers that the follower might use one of a number of known algorithms to solve the lower-level problem, either approximately or heuristically. Thus, the leader can hedge against the follower's use of suboptimal solutions. We provide algorithmic implementations of the framework for a class of nonlinear bilevel knapsack problem (BKP), and we illustrate the potential impact of incorporating this realistic feature through numerical experiments in the context of defender-attacker problems.

Palabras clave

Palabras clave de autor: bilevel optimization; hierarchical optimization; robust optimization; heuristics; defender-attacker problem

KeyWords Plus: LINEAR BILEVEL; CUT ALGORITHM; KNAPSACK; INTERDICTION; EXISTENCE; PROGRAMS; MODELS; FACE

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Financiación

Entidad financiadora	Mostrar más información	Número de concesión
National Science Foundation (NSF)		CMMI-1400009 CMMI-1634835
DoD DURIP		FA2386-12-1-3032
Office of Naval Research		N00014-19-1-2330
Air Force Research Laboratory (AFRL) Mathematical Modeling and Optimization Institute		
United States Department of Defense Air Force Office of Scientific Research (AFOSR)		
Complex Engineering Systems Institute, ISCI (CONICYT)		PIA FB0816

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Editorial

INFORMS, 5521 RESEARCH PARK DR, SUITE 200, CATONSVILLE, MD 21228 USA

Información de la revista

Impact Factor: [Journal Citation Reports](#)

Categorías / Clasificación

Áreas de investigación: Business & Economics

Categorías de Web of Science: Management

Información del documento

Idioma: English

Número de acceso: WOS:000519195700006

ISSN: 1545-8490

eISSN: 1545-8504