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Strategic planning with start-time dependent variable costs: a case study in solving non-linear integer models

George L. Nemhauser
ISyE
Georgia Tech
765 Ferst Drive
Atlanta, GA 30332-0205
USA
george.nemhauser@isye.gatech.edu

Abstract

We present a strategic planning model in which the activities to be planned, such as production and distribution in a supply network, require technology to be installed before they can be performed. The technology improves over time, so that a decision-maker has incentive to delay starting an activity to take advantage of better technology and lower operational costs. The model captures the fundamental trade-off between delaying the start-time of an activity and the need for some activities to be performed now. Models of this type are used in the oil industry to plan the development of oil fields. This problem is naturally formulated as a mixed-integer program with a bilinear objective. We develop a series of progressively more compact mixed-integer linear formulations, along with classes of valid inequalities that make the formulations strong. We also present a specialized branch-and-cut algorithm to solve an extremely compact concave formulation. Computational results indicate that these formulations can be used to solve large-scale instances, whereas a straightforward linearization of the mixed-integer bilinear formulation fails to solve even small instances.

Join work with James Luedtke.