Mestrado (MA)

AN EXACT APPROACH FOR A MULTIPLE ALLOCATION HUB-AND-SPOKE NETWORK PROTECTION PROBLEM

Authors: Hugo Quadros*[1]
Marcos Costa Roboredo*
Artur Alves Pessoa*

ABSTRACT

Hubs are special facilities widely found in distribution systems acting mainly as transshipment and switching points, being used to concentrate and consolidate ows. Every hub is subjected to a disruption of its functionality, called interdiction, that can be caused by many reasons such as natural disasters or even intentional attacks. Interdictions result in an efficiency loss to the system, substantially increasing the total distribution cost. A way to mitigate the impact caused by interdictions is fortifying some hubs, avoiding them to be interdicted. This context naturally leads to the multiple allocation r-hub interdiction median problem with fortification, which consists of identifying q hubs to be fortified in a multiple allocation hub-and-spoke supply network, knowing that r hubs will be interdicted. We assume that the set of hubs chosen to be interdicted is the one that causes the highest increase in the total distribution cost. For this bilevel problem, we propose an integer linear programming formulation with an exponential number of constraints that is solved through a branch-and-cut algorithm. Our results show that our method requires less computational time than the exact algorithm found in the literature, being able to optimally solve several large instances. Hubs are special facilities widely found in distribution systems acting mainly as transshipment and switching points, being used to concentrate and consolidate ows. Every hub is subjected to a disruption of its functionality, called interdiction, that can be caused by many reasons such as natural disasters or even intentional attacks. Interdictions result in an efficiency loss to the system, substantially increasing the total distribution cost. A way to mitigate the impact caused by interdictions is fortifying some hubs, avoiding them to be interdicted. This context naturally leads to the multiple allocation r-hub interdiction median problem with fortification, which consists of identifying q hubs to be fortified in a multiple allocation hub-and-spoke supply network, knowing that r hubs will be interdicted. We assume that the set of hubs chosen to be interdicted is the one that causes the highest increase in the total distribution cost. For this bilevel problem, we propose an integer linear programming formulation with an exponential number of constraints that is solved through a branch-and-cut algorithm. Our results show that our method requires less computational time than the exact algorithm found in the literature, being able to optimally solve several large instances.

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*Universidade Federal Fluminense (UFF)
[1]hugo.quadros2@gmail.com