106g A Novel and Effective Integer Optimization Approach for the Nsf Panel Assignment Problem: a Multi-Resource and Preference-Constrained Generalized Assignment Problem

Stacy L. Janak, Martin S. Taylor, Christodoulos A. Floudas, Maria K. Burka, and T. J. Mountziaris

The NSF panel assignment problem posed in this work can be viewed as an enhanced version of the generalized assignment problem (GAP), which has been the subject of considerable research over the last two decades. The GAP has many real-life applications including job scheduling, production planning, modeling of computer and communication networks, storage space allocation, vehicle routing, and facility location problems. The GAP seeks to determine the minimum cost assignment of n jobs to m agents so that each job is assigned to exactly one agent subject to resource restrictions on the agents. Because the GAP is an NP-hard problem ([1]), heuristic solutions are often necessary to solve large-scale problems (see e.g., [2] or [3]).

The NSF panel assignment problem studied in this work is an enhanced version of the multi-resource GAP and involves selecting an assignment of three or four reviewers to each proposal in a panel so as to optimize the sum of a set of ranking criteria for each reviewer on each proposal while ensuring that each reviewer is assigned to approximately the same number of proposals. In addition, each proposal has three or four distinct positions of decreasing importance that are assigned to reviewers based upon the ranking criteria so that each reviewer holds each position approximately the same number of times and the assignment of reviewers to positions should follow the ranking criteria so that the more important the position, the higher the ranking of the reviewer for the proposal. This multi-resource and preference-constrained generalized assignment problem can be formulated as an integer linear programming problem and can be solved to optimality using a standard linear solver. In this work, a mathematical model is developed to address the NSF panel assignment problem and some representative example problems are solved to demonstrate the effectiveness of the proposed approach. In addition, a web-based interface has been created to allow users to solve instances of the NSF panel assignment problem using the proposed mathematical formulation. The interface allows the user to define and then solve a panel assignment problem to determine a small subset of optimal integer solutions where the user must enter the number of proposals to consider, the number of reviewers to consider, the number of reviews needed per proposal, and the number of desired integer solutions. After the user submits the required input data, a file is generated using the GAMS modeling language and the problem is solved on a 3.2GHz Linux workstation using the linear solver CPLEX. The solver's progress is reported onscreen to the user and once finished, an output file is generated that can be downloaded for the user to save or print, and/or it can be e-mailed directly to the user's e-mail address.

[1]- M.L. Fisher and R. Jaikumar and L.N. Van Wassenhove. "A Multiplier Adjustment Method for the Generalized Assignment Problem." Manage. Sci. 32 (1986): 1095-1103.

[2]- D.G. Cattrysse and L.N. Van Wassenhove. " A Set Partitioning Heuristic for the Generalized Assignment Problem." Eur. J. Oper. Res. 60 (1992): 260-272.

[3]- I.H. Osman. "Heuristics for the Generalized Assignment Problem: Simulated Annealing and Tabu Search Approaches." OR Spektrum 17 (1995): 211-225.