TOP : AN OFFICIAL JOURNAL OF THE SPANISH SOCIETY OF STATISTICS AND OPERATIONS RESEARCH, ISSN 1134-5764
Volume 30, number 2 (july 2022)

Abstract
In this paper, a metaheuristic solution algorithm for solving the multi-mode resource-constrained project scheduling problem (MRCPSP) with discounted cash flows (MRCPSPDC) is proposed. This problem consists of determining a schedule such that the project is completed, maximizing the project's net present value (NPV) while complying with the delivery deadline. The adaptative bacterial foraging optimization (ABFO) algorithm is a variation of the original bacterial foraging optimization (BFO), which is a nature-inspired metaheuristic optimization algorithm. We implement a version of the chemotactic operator based on a double justification of the activities given the cash flow. This metaheuristic has been tested in the PSPLIB and MMLIB benchmark datasets available in the literature with promising results. Our ABFO algorithm shows excellent performance in all tested instances and provides suitable solutions for the MRCPSP maximizing the NPV.

Abstract
In this paper, we propose an approach to characterizing ϵ-solution sets of convex programs with a given $\epsilon>0$. The results are divided into two parts. The first one is devoted to establishing the expressions of ϵ-solution sets of a class of convex infinite programs. The representation is given based on the study of relationships among the following three sets: the set of Lagrange multipliers corresponding to a given ϵ-solution, the set of ϵ-solutions of the dual problem corresponding, and the set of ϵ-Kuhn–Tucker vectors associated with the problem in consideration. The second one is devoted to some special cases: the ϵ-solution sets of convex programs that have set constraints and the almost ϵ-solution sets of convex programs that have finite convex constraints. Several examples are given.

Abstract
We focus on optimality conditions for an important class of nonconvex and nonsmooth optimization problems, where the objective and constraint functions are presented as a difference of two tangentially convex functions. The main contribution of this paper is to clarify several kinds of stationary solutions and their relations, and establish local optimality conditions with a nonconvex feasible set. Finally, several examples are given to illustrate the effectiveness of the obtained results.

An introduction to stochastic bin packing-based server consolidation with conflicts P. 296-331

John Martinovic, Markus Hähnel, Waltenegus Dargie

Abstract

The energy consumption of large-scale data centers or server clusters is expected to grow significantly in the next couple of years contributing to up to 13% of the worldwide energy demand in 2030. As the involved processing units require a disproportional amount of energy when they are idle, underutilized, or overloaded, balancing the supply of and the demand for computing resources is a key issue to obtain energy-efficient server consolidations. Whereas traditional concepts mostly consider deterministic predictions of the future workloads or only aim at finding approximate solutions, in this article, we propose an exact approach to tackle the problem of assigning jobs with (not necessarily independent) stochastic characteristics to a minimal amount of servers subject to further practically relevant constraints. As a main contribution, the problem under consideration is reformulated as a stochastic bin packing problem with conflicts and modeled by an integer linear program. Finally, this new approach is tested on real-world instances obtained from a Google data center.

A bankruptcy approach to solve the fixed cost allocation problem in transport systems P. 332-358

Fatemeh Babaei, Hamidreza Navidi, Stefano Moretti

Abstract

In this paper, we study the allocation of a fixed cost among different cities involved in a line-shape transport system like a tram line or a railway. The central characteristic of the problem is that the intended cost is not depending on the infrastructure length or the use intensity. Estañ et al. (Ann Oper Res 301(1):81–105, https://doi.org/10.1007/s10479-020-03645-1, 2021) originally introduced the problem and axiomatically studied it. Based on the well-known bankruptcy problem and game, we analyze it by applying two other approaches. First, adding a parameter, we take into account the municipalities revenues in the determination of cost shares. That enables one to transform a fixed cost allocation problem (FCAP) into a well-known bankruptcy one. We propose two bankruptcy problems for FCAP and use the proportional, adjusted proportional, constrained equal awards, constrained equal losses, and Talmud rules to solve it. Then, we define two bankruptcy games corresponding to FCAP and use the Shapley value for cost allocation. The characteristic functions have attractive interpretations; one considers the agents' minimum desire to contribute to the cost, and the other does their minimum expectation from the overall profit. We investigate presented solutions if they meet some fairness and stability properties. Finally, we apply the suggested approaches to a practical problem.

A sequential partition method for non-cooperative games of bankruptcy problems P. 359–379

Doudou Gong, Genjiu Xu, Loyimee Gogoi

Abstract

This paper presents a sequential partition method for non-cooperative games of bankruptcy problems. Based on the ascending order of claims, two consequential games are introduced, called the *divide-and-choose game* and the *divide-and-object game*. We prove that the unique Nash equilibrium outcome of each game is consistent with the allocation of the constrained equal awards rule.

The effect of consolidated periods in heterogeneous lot-sizing games P. 380–404

Luis A. Guardiola, Ana Meca, Justo Puerto

Abstract

We consider a cooperative game defined by an economic lot-sizing problem with heterogeneous costs over a finite time horizon, in which each firm faces demand for a single product in each period and coalitions can pool orders. The model of cooperation works as follows: ordering channels and holding and backlogging technologies are shared among the members of the coalitions. This implies that each firm uses the best ordering channel and holding technology

provided by the participants in the consortium. That is, they produce, hold inventory, pay backlogged demand and make orders at the minimum cost of the coalition members. Thus, firms aim at satisfying their demand over the planing horizon with minimal operation cost. Our contribution is to show that there exist fair allocations of the overall operation cost among the firms so that no group of agents profit from leaving the consortium. Then we propose a parametric family of cost allocations and provide sufficient conditions for this to be a stable family against coalitional defections of firms. Finally, we focus on those periods of the time horizon that are consolidated and we analyze their effect on the stability of cost allocations.

An exact lexicographic approach for the maximally risk-disjoint/minimal cost path pair problem in telecommunication networks P. 405-425

Marta Pascoal, José Craveirinha, João Clímaco

Abstract

The paper addresses the lexicographically maximal risk-disjoint/minimal cost path pair problem that aims at finding a pair of paths between two given nodes, which is the shortest (in terms of cost) among those that have the fewest risks in common. This problem is of particular importance in telecommunication network design, namely concerning resilient routing models where both a primary and a backup path have to be calculated to minimize the risk of failure of a connection between origin and terminal nodes, in case of failure along the primary path and where bandwidth routing costs should also be minimized. An exact combinatorial algorithm is proposed for solving this problem which combines a path ranking method and a path labelling algorithm. Also an integer linear programming (ILP) formulation is shown for comparison purposes. After a theoretical justification of the algorithm foundations, this is described and tested, together with the ILP procedure, for a set of reference networks in telecommunications, considering randomly generated risks, associated with Shared Risk Link Groups (SRLGs) and arc costs. Both methods were capable of solving the problem instances in relatively short times and, in general, the proposed algorithm was clearly faster than the ILP formulation excepting for the networks with the greatest dimension and connectivity.