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The traveling tournament problem with predefined venues

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Abstract Sports scheduling is a very attractive application area not only because of the interesting mathematical structures of the problems, but also due to their importance in practice and to the big business that sports have become. In this paper, we introduce the Traveling Tournament Problem with Predefined Venues, which consists in scheduling a compact single round robin tournament with a predefined venue assignment for each game (i.e., the venue where each game takes place is known beforehand) while the total distance traveled by the teams is minimized. Three integer programming formulations are proposed and compared. We also propose some simple enumeration strategies to generate feasible solutions to real-size instances in a reasonable amount of time. We show that two original enumeration strategies outperform an improvement heuristic embedded within a commercial solver. Comparative numerical results are presented.

Keywords Sports scheduling · Traveling tournament problem · Integer programming · Tournaments · Venues

1 Introduction and problem statement

Sports have become a big business. Professional leagues involve millions of fans and significant investments in players, broadcast rights, merchandizing, and advertising. They also involve multiple other agents, such as organizers, media, players, and security.

Sports scheduling has been attracting the attention of an increasing number of researchers in multidisciplinary areas such as operations research, scheduling theory, constraint programming, graph theory, combinatorial optimization, and applied mathematics. Particular importance is given to round robin scheduling problems, in which each team is associated with a particular venue, due to their relevance in practice and to their interesting mathematical structure. The difficulty of the problems in the field leads to the use of a number of approaches, including integer programming (Nemhauser and Trick 1998; Ribeiro and Urrutia 2007b), constraint programming (Henz 1999), hybrid methods (Duarte et al. 2007; Easton et al. 2003), and heuristic techniques (Anagnostopoulos et al. 2006; Ribeiro and Urrutia 2007a). We refer to (Easton et al. 2004; Rasmussen and Trick 2008) for literature surveys.

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