Upper and lower bounds for the leader-follower facility location game under budget constraints

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We study a new facility location game. Two players, a leader and a follower, open facilities and compete to attract clients on a given market. Each player has a budget and try to maximize own market share. They have to pay for opening facilities and its attractiveness for the clients. Utility of each facility for client is directly proportional to the attractiveness and inversely proportional to the distance between client and facility. Each client patronizes exactly one facility with the best utility. In case of ties, the follower's facility is preferred. The goal of the game is to find location of the leader's facilities and their attractiveness to maximize leader's market share. We present this game as a mixed integer bi-level linear program and show its computational complexity. To get lower bound for the global optimum, we design a stochastic local search matheuristic with alternating neighborhoods. Optimal solution for one player is calculated for the fixed solution for another player by CPLEX software. Upper bound is obtained by the following framework. We rewrite the bi-level problem as a single level problem with exponential set of constraints and variables. Exact solution to this problem with a subset of constraints and variables produces an upper bound. For improving the bound, we iteratively enlarge this subset. Computational results for 100 potential facilities are discussed.

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