The fair p-median problem

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Abstract. We consider a variant of the p-median problem, where p facilities must be located to serve a set of customers with two objectives: minimizing the average distance a customer travels to reach his assigned facility, and allocating a fair number of customers to each facility. We measure fairness in customer allocation with an inequity measure called mean absolute deviation, which is applied to the number of customers assigned to each median. We call this new problem the Fair p-Median problem (FPMP) and formulate it as a mixed-integer linear program where the objective is to minimize a linear combination of assignment distances and inequity in customer allocation. We develop a hybrid heuristic algorithm capable of solving large problem instances by integrating a lagrangian relaxation heuristic into a variable neighborhood search framework. Our algorithm relies on a tailored minimum cost flow problem (MCFP) used to solve the case where facilities are fixed. We evaluate the proposed formulation and algorithm using several sets of test instances from the literature. Through our computational experiments, we demonstrate the effectiveness of the developed algorithm.

Keywords: p-median; fairness; mean absolute deviation