

Facility Location Optimizer

A tool for solving location problems.

Classification: **1** | **P** | $v > 0$ | d_1 | **center**

1. Problem formulation

The goal is to find one new facility $x \in \mathbb{R}^2$ in the plane such that maximum of the weighted distances between the new facility x and given facilities located at the points $a^1, \dots, a^m \in \mathbb{R}^2$ are minimized. Such problems are called

“Single facility center (or minmax) location problems in the plane”

in the literature of location theory and can be interpreted as a model for minimizing transportation costs. Using the well-known Manhattan metric (also called the rectangular metric or l_1 metric), which is defined by

$$d_1(x, a^i) := |x_1 - a_1^i| + |x_2 - a_2^i|$$

for all $x := (x_1, x_2) \in \mathbb{R}^2$ and all $a^i := (a_1^i, a_2^i)$, $i = 1, \dots, m$, the location problem is given by

$$\max\{v_i \cdot d_1(x, a^i) \mid i = 1, \dots, m\} \rightarrow \min_{x \in \mathbb{R}^2},$$

where $v_1, \dots, v_m \in \mathbb{R}$ are positive weights (e.g. demands or importance of the given facilities).

Summarizing, in our problem

$$1 \mid P \mid v > 0 \mid d_1 \mid \text{center}$$

we search for one new facility (position 1: 1) in the plane (position 2: P), the given facilities have positive weights (position 3: $v > 0$, i.e., $v_i > 0$ for all $i = 1, \dots, m$) and we consider a center problem (position 5: center), where we measure the distances between points using the Manhattan metric (position 4: d_1).

2. Algorithm information and implementation

The corresponding algorithm included in the current version of the Software FLO generates the whole set of solutions of the above location problem. The program uses an algorithm (Transformation Algorithm) formulated in the book by Hamacher (1995).

The algorithm was implemented in FLO by Christian Günther. Software FLO has been able to solve the underlying location problem since program version 1.0.0, which was released on 22/04/2015.

3. Selected References

Further model and algorithm-specific information can be found in the following literature:

- (A) R. F. Love, J. G. Morris and G. O. Wesolowsky. *Facility Location: Models and Methods*. North Holland, New York, 1988.
- (B) H. W. Hamacher. *Mathematische Lösungsverfahren für planare Standortprobleme*. Vieweg Verlag, 1995.