Facility Location Optimizer

A tool for solving location problems.

Classification: $\mathbf{1 \mid P \mid v = 1 \mid d_2 \mid center}$

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1. Problem formulation

The goal is to find one new facility $x \in \mathbb{R}^2$ in the plane such that maximum of the weigthed distances between the new facility x and given facilities located at the points $a^1, \ldots, a^m \in \mathbb{R}^2$ 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 Euclidean metric, which is defined by

$$d_2(x, a^i) := \sqrt{(x_1 - a_1^i)^2 + (x_2 - a_2^i)^2}$$

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

$$\max\{d_2(x, a^i) \mid i = 1, \ldots, m\} \to \min_{x \in \mathbb{R}^2}.$$

The above-defined location problem is known in the literature as the smallest-circle problem or minimum covering circle problem. Summarizing, in our problem

$$1 \mid \mathrm{P} \mid v = 1 \mid d_2 \mid \text{center}$$

we search for one new facility (position 1: 1) in the plane (position 2: P), the given facilities have weights equal to one (position 3: $v = 1$, i.e., $v_i = 1$ for all $i = 1, \ldots, m$) and we consider a center problem (position 5: center), where we measure the distances between points using the Euclidean metric (position 4: d_2).

2. Algorithm information and implementation

The corresponding algorithm included in the current version of the Software FLO generates an exact solution of the above location problem. The program uses the algorithm (Elzinga-Hearn Algorithm) proposed by Elzinga and Hearn (1972).

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) D. J. Elzinga and D. W. Hearn. *Geometrical Solutions for some minimax location problems.* Transportation Science, 6:379-394, 1972.

(B) N. Megiddo. *The weighted Euclidean 1-center problem.* Mathematics of Operations Research, 8(4):498504, 1983.

(C) H. W. Hamacher. *Mathematische Lösungsverfahren für planare Standortprobleme.* Vieweg Verlag, 1995.