

Facility Location Optimizer

A tool for solving location problems.

Classification: 1 | P | (+) | d_∞ | wEff-vector

1. Problem formulation

The goal is to find one new facility $x \in \mathbb{R}^2$ in the plane such that the distances between the new facility x and given attraction facilities located at the points $a^1, \dots, a^m \in \mathbb{R}^2$ are minimized simultaneously, where simultaneous minimization is understood in the sense of multi-objective optimization. Such problems are called

“Single facility multi-objective 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 rectangular metric or l_1 metric), which is defined by

$$d_\infty(x, a^i) := \max\{|x_1 - a_1^i|, |x_2 - a_2^i|\}$$

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

$$\begin{pmatrix} d_\infty(x, a^1) \\ \dots \\ d_\infty(x, a^m) \end{pmatrix} \rightarrow \underset{x \in \mathbb{R}^2}{\text{v-min}}.$$

In the above-defined location problem we search for weakly Edgeworth-Pareto efficient solutions.

Summarizing, in our problem

$$1 \mid P \mid (+) \mid d_{\infty} \mid \text{wEff-vector}$$

we search for one new facility (position 1: 1) in the plane (position 2: P), the given facilities are attraction points (position 3: (+)) and we consider a vector problem with regard to the solution concept of weakly Edgeworth-Pareto efficiency (position 5: wEff-vector), where we measure the distances between points using the maximum metric (position 4: d_{∞}).

2. Algorithm information and implementation

The corresponding algorithm included in the current version of the Software FLO solves the above location problem and computes the whole set of weakly Edgeworth-Pareto efficient solutions. The program uses the algorithm (Manhattan Rectangular Hull Algorithm) proposed by Alzorba, Günther, Popovici (2013).

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) S. Alzorba, C. Günther and N. Popovici. *A special class of extended multicriteria location problems*. Optimization, 64(5):1305-1320, 2015 (DOI: 10.1080/02331934.2013.869810).
- (B) N. Popovici. *Pareto reducible multicriteria optimization problems*. Optimization, 54:253-263, 2005.