Facility **L**ocation **O**ptimizer

A tool for solving location problems.

Classification: $\mathbf{1} \mid \mathbf{P} \mid (+) \mid d_1 \mid$ **Eff-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 facilities located at the points $a^1, \ldots, a^m \in \mathbb{R}^2$ 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

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

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

$$\begin{pmatrix} d_1(x, a^1) \\ \ldots \\ d_1(x, a^m) \end{pmatrix} \to \underset{x \in \mathbb{R}^2}{\text{v-min}}\,.$$

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

Summarizing, in our problem

$$1 \mid \mathrm{P} \mid (+) \mid d_1 \mid \text{Eff-vector}$$

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 Edgeworth-Pareto efficiency (position 5: Eff-vector), 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 solves the above location problem and computes the whole set of Edgeworth-Pareto efficient solutions. The program uses the algorithm (Rectangular Decomposition Algorithm) proposed by Alzorba, Günther, Popovici and Tammer (2015).

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, N. Popovici and Chr. Tammer. *A new algorithm for solving planar multiobjective location problems involving the Manhattan norm*. Preprint Optimization-Online, http://www.optimization-online.org/DB_HTML/2016/01/5305.html, 2015 (submitted).

(*B*) 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).

(C) C. Gerth (Tammer) and K. Pöhler. *Dualität und algorithmische Anwendung beim vektoriellen Standortproblem.* Optimization, 19:491-512, 1988.

(D) C. Günther. *Dekomposition mehrkriterieller Optimierungsprobleme und Anwendung bei nicht konvexen Standortproblemen.* Master-Thesis, Martin Luther University Halle-Wittenberg, 2013.

(E) L. Chalmet, R. L. Francis, A. Kolen. *Finding efficient solutions for rectilinear distance location problems efficiently.* European Journal of Operational Research, 6:117-124, 1981.

(F) R. E. Wendell, A. P. Hurter and T. J. Lowe. *Efficient Points in Location Problems.* AIIE Transactions, 9(3):238-246, 1977.

(G) K. Nouioua. *Enveloppes de Pareto et Reseaux de Manhattan.* Dissertation, University of the Mediterranean, 2005.