Institute of Applied Mathematics
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December 6, 2007

Location Analysis
WS 2007/2008
Homework 4

To be discussed in the tutorial on December 13, 2007.

14. Consider a problem of type $2/P/\bullet/l_1/\sum$ with existing facility locations $a_1 = (5;13), a_2 = (7;11), a_3 = (5;11)$ and weights $w_{1,11} = 4, w_{1,12} = 1, w_{1,13} = 1, w_{1,21} = 1, w_{1,22} = 3, w_{1,23} = 1, w_{2,12} = 1$.

    a) Determine an approximate solution with Approximation Algorithm 4.3. (Handout 3).

    b) Try to improve this solution applying Approximation Algorithm 4.4. (Handout 3).

    c) Find the linear programming formulations of Section 4.2. for $k = 1, 2$.

    d) Determine the exact optimum of the problem.

15. Develop an LP formulation for a problem of type $m/P/\bullet/l_1/\max$ directly, i.e., without using the transformation T from $m/P/\bullet/l_\infty/\max$.

16. Prove Lemma 5.5: z^* is the optimal objective value of $1/P/\bullet/l_\infty/\max$ $\Leftrightarrow A_1^-(z^*) \leq A_1^+(z^*)$ and $A_2^-(z^*) \leq A_2^+(z^*)$.

17. Consider the following problem of type $1/P/\bullet/l_\infty/\max$: Existing facility locations $a_1 = (1;1), a_2 = (2;4), a_3 = (5;2)$, weights $w_1 = 2, w_2 = 1, w_3 = 4$.

    a) For $k = 1, 2$, graph the functions $A_{jk}^+(z), A_{jk}^-(z), A_k^+(z)$ and $A_k^-(z)$.

    b) Solve the problem using Algorithm 5.7 for $1/P/\bullet/l_\infty/\max$ (Handout 4).

    c) For the same existing facility locations, solve the problem with $w_1 = w_2 = w_3 = 1$ using Algorithm 5.8 for $1/P/w_j = 1/l_\infty/\max$ (Handout 4).

    d) Graph the situation for both cases (i.e., existing facility locations and optimal solutions in $\mathbb{R}^2$).

    e) What would be the set of optimal solutions of the corresponding Weber problems (i.e., of $1/P/\bullet/l_\infty/\sum$ and $1/P/w_j = 1/l_\infty/\sum$, respectively)?