Chalmers University of Technology
University of Gothenburg
Mathematical Sciences
Optimization
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MVE165
MMG630
Applied Optimization
Assignment information
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# Assignment 3c: Storage, refinement and distribution of sugar

In an appended document is a description of the problem to determine the best distribution channel for sugar in different regions and market segments, and the problem to determine on multi-period transportation, refining, and storage of sugar. Attached is also data needed for the problem formulation.

The assignment tasks are to `(a)` formulate the problems in mixed integer linear programming models, `(b)` model and solve them using AMPL and CPLEX (or, e.g., Matlab and any MILP solver; see Exercise 1 on the course homepage), and `(c)` analyze the results and answer a number of questions given below.

To pass the assignment you should (in groups of two persons) `(i)` write a **detailed report** that gives satisfactory answers and explanations to the questions. You shall also estimate the number of hours spent on this assignment and note this in your report.

The file containing your report shall be called **Name1-Name2-Ass3c.pdf**, where "Name$k$", $k = 1, 2$, is your respective family name. **Do not forget to write the authors' names also inside the report.** The report should be e-mailed to `anstr@chalmers.se`

**at the latest on Friday 13 of May 2011.**

Your shall also `(ii)` present your assignment orally at a seminar in

**Week 20 (16–20 of May) 2011.**

The seminars are scheduled via a doodle link, which will be published on the course home page. Presence is mandatory at at least one of these seminars.

## Exercises to perform and questions to answer

1. Formulate a mixed integer linear programming model that solves the problem (the first problem described in the document `SCDS-2011.pdf`) to determine the best distribution method for each group in each market segments.

2. Implement the model formulated in 1. in AMPL and solve it using CPLEX. Present and interpret the results and your findings. Comment also on the CPU time required to solve the problem and compare with the time required to solve the continuous relaxation of the model.

3. Formulate a mixed integer linear programming model that solves the problem (the second problem described in the document `SCDS-2011.pdf`) to determine which warehouses should be established, and on inventories, refinement, and distribution of sugar. Note that some of the input data to this problem comes from the solution to the first problem.

4. Implement the model from 3. in AMPL and solve it using CPLEX. Present and interpret the results and your findings. Comment also on the CPU time required to solve the problem and compare with the time required to solve the continuous relaxation of the model.

5. Study the sensitivity of the models formulated in 1 and 3. with respect to the following entities:

   (a) The maximum demand that the small and big agents of a province can cover, i.e., the parameters $f$ and $f'$. Let the values of these parameters vary between 100% and 200%. Is it necessary to solve for "all" values, or can you draw some conclusions from the results for just some values? Analyze the impact of these variations on the first as well as the second model.

   (b) Assume that the refining capacity of the external refineries 11–20 is no longer available, i.e., the parameter values $C_{jt} := 0$, $j = 11, \ldots, 20$, $t = 1, \ldots, 12$. How does this influence the solution to the second problem?

   (c) Vary the holding cost per month of refined and raw, respectively, sugar in the (internal) warehouses of SCDS in Khuzestan, i.e., the parameters $H$ and $\bar{H}$. What is the influence on the solution? At what levels of the values of $H$ and $\bar{H}$ do interesting effects occur?

   (d) Vary the cost of refining raw sugar in the external refineries, i.e., the parameter $B$. How is the solution influenced? At what levels of the value of $B$ do interesting effects occur?

   (e) Vary the cost of loading/unloading of sugar from/to the trucks, i.e., the parameter $L$. What is the influence on the solution? At what levels of the value of $L$ do interesting effects occur?