Operations Research, Spring 2017

Case Assignment 2

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In this case assignment, we will continue from case assignment 1 to consider IEDO's problem.

1 Tasks for this assignment

Each of the following task counts for 20 points.

1. Recall that in case assignment 1, we did not try to solve for a construction plan of the DCs. Now, ignore the data given in the spreadsheet "A Construction Plan", formulate a linear integer program whose solution can minimize the total cost of the construction and replenishment problem. Write a compact formulation. Clearly define your variables. Clearly explain your objective function and all your constraints.

2. Use AMPL to write a model file and a data file that can solve the construction-level problem. Your model file should be a direct translation of your mathematical formulation made in Problem 1. It should contain no data; all numbers should be specified in the data file.

3. Use your AMPL files in Problem 2 to find an optimal construction, scale, and replenishment plan. Make a fine report (with texts, numbers, tables, figures, and concepts of information visualization) to present the plan.

4. In was mentioned in case assignment 1 that the replenishment cost is \$1 times the replenishment distance per item. Robin finds that the cost must be calculated by a more complicated formula. Let the replenishment quantity between DC j and retail store i be x_{ij}. If $x_{ij} \leq 40$, the formula is right. However, if $x_{ij} > 40$, for the amount above 40, the

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unit cost per item per kilometer should be \$0.05, not \$1. More precisely, the total cost of shipping x_{ij} units for D_{ij} kilometers is

$$\begin{cases} D_{ij}x_{ij} & \text{if } x_{ij} \leq 40 \\ 40D_{ij} + 0.05D_{ij}(x_{ij} - 40) & \text{otherwise} \end{cases}.$$

Formulate a new linear integer program whose solution minimizes the total cost of the construction and replenishment problem.

Hint. One way to formulate the above nonlinear cost function is to introduce a new variable

$$z_{ij} = \begin{cases} 1 & \text{if } x_{ij} > 40 \\ 0 & \text{otherwise} \end{cases}$$

and some constraints to relate z_{ij} and x_{ij}. Make sure that your program is "linear." In particular, you should not multiply two variables in your program. If you need more hints, you may search for "piecewise linear function" online for a way to do the formulation with a linear integer program.

5. Redo Problems 2 and 3 to the new problem defined in Problem 4.

2 Submission rules

Students should for teams to do this case assignment. A team should have ***at most four students***. A student cannot join two teams. The deadline of this homework is ***2 pm, May 2, 2017***. Please write down your answers, plans, suggestions, and interpretations into a report that is no longer than ten pages. Put a ***hard copy*** of your report into the instructor's mailbox on the first floor of Management Building 2. Moreover, put your report file, model file(s), data file(s), and whatever file(s) you have into ***a single ZIP file*** and submit to CEIBA. Works submitted between 2 pm and 3 pm will get 10 points deducted as a penalty. Submissions later than 3 pm will not be accepted. Only one hard copy and one zip file should be submitted by a team. Submitting more than one zip file or non-ZIP files will get 10 points off. Discussions among teams are welcome, but copying will results in severe penalties to everyone involved.

This case assignment counts for 10% for the final semester grades. Please do spend time and efforts on it!