Operations Research, Spring 2015
Case Study 2

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In this case study, you revisit Mikasa's order allocation problem (and the given data) described in Homework 0.

1 Your task

Please work on the following problems. All the four problems are independent.

1. (10 points) Mikasa recently learned Integer Programming. Before she tries to apply Linear Programming to help her solve the problem, she wants to do a practice by solving Problem 3 in Homework 2. Please use AMPL to solve that problem and find an optimal solution. Decouple the data from the model.
2. (30 points; 15 points each) Suppose that there is no order splitting cost. Still, the revenue of a job can be collected only if all its demands for all required items are satisfied.
   (a) Formulate a mathematical IP that solves the (modified) planning problem.
   (b) Solve the (modified) problem by AMPL. Decouple the data from the model.
3. (30 points; 15 points each) Consider the original problem described in Homework 0. Note that we now consider splitting costs.
   (a) Formulate a mathematical IP that solves Mikasa's problem.
   (b) Solve Mikasa's problem by AMPL. Decouple the data from the model.
   Note. A plan (that is claimed to be optimal by the TAs) has been given in the solution for Homework 0. It should be a good idea to check whether your outcome is as good as that.

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4. (30 points; 10 points each) Thanks to Operations Research, Mikasa now works happily by applying Integer Programming to do her planning job. The IEDO compnay's total profit is maximized. However, one day she receives some complaints from some fab managers about job assignments and bonus distribution.

   Currently, the IEDO company rewards fab workers for completing orders. Once an order is completed, those fabs that contribute to completing the order get bonuses to be shared by fab workers. The total amount of bonus is 10% of the order revenue. When multiple fabs contribute to one single order, one collects bonus based on the proportion of required items produced by that fab. For example, if order 1 is allocated to fabs 1 and 6 so that fab 1 makes item 5 and fab 6 makes items 4 and 10, then the bonuses for fabs 1 and 6 are $\$550 \times \frac{3000}{10000} = \$165$ and \$385, respectively.

   Fab managers complain that the bonuses are not distributed fairly. It is clear that, as long as there are some residual capacity in the fab, fab workers there would always prefer to be assigned more works. If a fab has residual capacity while another fab earns more bonuses than it, the fab owner complains.

   Given the issue, Mikasa's new challenge is to take the fairness issue into consideration. Of course, firm profit must still be kept in mind. She wants to define a quantitative indicator for fairness and include it into her new Integer Programming model.

   (a) Define an indicator for fairness. Explain your reasons.
   (b) Formulate a mathematical IP that solves Mikasa's new problem.
   (c) Solve Mikasa's problem by AMPL. Decouple the data from the model.

   Note. This is an open question. There is no best way to define the fairness indicator; there is no best way to combine firm profit and bonus fairness. You must make *your own* decision.

2 Submission rules

- **Things to submit.** Please put a hard copy of the work into the instructor's mailbox on the first floor of the Management Building 2. Limit your report to six pages (six single-sided sheets or three double-sided sheets), including everything. Please also send all your programs (including AMPL model/data files and other programs, if any) electronically to Amy Liu at r03725033@ntu.edu.tw. Indicate the file names in the report.
- **Deadline.** The deadline of this homework (for both the report and files) is 2pm, May 11, 2015. Works submitted between 2pm and 3pm will get 10 points deducted as a penalty. Submissions later than 3pm will not be accepted.
- **Teams.** Students may form teams to work on this case study. Each team can have at most three students. Each team should submit only one report. All team members must sign on the first page of the hard copy of the report. If one does not sign, she/he will get 10 points off as a penalty.