Lab06-CPLEX

CS214-Algorithm and Complexity, Xiaofeng Gao, Spring 2018.

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An engineering factory makes seven products (PROD 1 to PROD 7) on the following machines: four grinders, two vertical drills, three horizontal drills, one borer and one planer. Each product yields a certain contribution to profit (in £/unit). These quantities (in £/unit) together with the unit production times (hours) required on each process are given below. A dash indicates that a product does not require a process.

	PROD 1	**PROD 2**	**PROD 3**	**PROD 4**	**PROD 5**	**PROD 6**	**PROD 7**
Contribution to profit	10	6	8	4	11	9	3
Grinding	0.5	0.7	-	-	0.3	0.2	0.5
Vertical drilling	0.1	0.2	-	0.3	-	0.6	-
Horizontal drilling	0.2	-	0.8	-	-	-	0.6
Boring	0.05	0.03	-	0.07	0.1	-	0.08
Planing	-	-	0.01	-	0.05	-	0.05

There are marketing limitations on each product in each month, given in the following table:

	PROD 1	**PROD 2**	**PROD 3**	**PROD 4**	**PROD 5**	**PROD 6**	**PROD 7**
January	500	1000	300	300	800	200	100
February	600	500	200	0	400	300	150
March	300	600	0	0	500	400	100
April	200	300	400	500	200	0	100
May	0	100	500	100	1000	300	0
June	500	500	100	300	1100	500	60

It is possible to store up to 100 of each product at a time at a cost of £0.5 per unit per month (charged at the end of each month according to the amount held at that time). There are no stocks at present, but it is desired to have a stock of exactly 50 of each type of product at the end of June. The factory works six days a week with two shifts of 8h each day. It may be assumed that each month consists of only 24 working days. Each machine must be down for maintenance in one month of the six. No sequencing problems need to be considered.

When and what should the factory make in order to maximize the total net profit?

1. Use *CPLEX Optimization Studio* to solve this problem. Describe your model in *Optimization Programming Language* (OPL). Remember to use a separate data file (.dat) rather than embedding the data into the model file (.mod).

   Solution. I have described my model in the code detailly. □

2. Solve your model and give the following results.

   (a) For each machine:

   i. the month for maintenance.

   Solution. For four grinders, all of them should be maintened in April. For two vertical drills, one should be maintened in February, the other in April. For three horizontal drills, one should be maintened in January, the other two in April. For one borer, it should be maintened in April. For one planer, it should be maintened in April, too. □

表 1: The amount to make in each month for each product.

Product	January	February	March	April	May	June
PROD1	500	600	400	0	0	550
PROD2	1000	500	700	0	100	550
PROD3	300	200	100	0	500	150
PROD4	300	0	100	0	100	350
PROD5	800	400	600	0	1000	1150
PROD6	200	300	400	0	300	550
PROD7	100	150	200	0	0	110

(b) For each product:

i. The amount to make in each month.

Solution. Answer is in picture 1. □

ii. The amount to sell in each month.

Solution. Answer is in picture 2. □

表 2: The amount to sell in each month for each product.

Product	January	February	March	April	May	June
PROD1	500	600	300	100	0	500
PROD2	1000	500	600	100	100	500
PROD3	300	200	0	100	500	100
PROD4	300	0	0	100	100	300
PROD5	800	400	500	100	1000	1100
PROD6	200	300	400	0	300	500
PROD7	100	150	100	100	0	60

iii. The amount to hold at the end of each month.

Solution. Answer is in picture 3. □

表 3: The amount to hold in each month for each product.

Product	January	February	March	April	May	June
PROD1	0	0	100	0	0	50
PROD2	0	0	100	0	0	50
PROD3	0	0	100	0	0	50
PROD4	0	0	100	0	0	50
PROD5	0	0	100	0	0	50
PROD6	0	0	0	0	0	50
PROD7	0	0	100	0	0	60

(c) The total selling profit.

Solution. 109330 £. □

(d) The total holding cost.

Solution. 475 £. □

(e) The total net profit (selling profit minus holding cost).

Solution. 108855 £. □

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