

DM559/DM545 – Linear and Integer Programming

Computer Lab 2, Spring 2018

Factory Planning and Machine Maintenance

A firm makes seven products 1, . . . , 7 on the following machines: 4 grinders, 2 vertical drills, 3 horizontal drills, 1 borer, and 1 planer.

Each product yields a certain contribution to the profit (defined as selling price minus cost of raw materials expressed in Euro/unit). These quantities (in Euro/unit) together with the production times (hours/unit) required on each process are given below.

product	1	2	3	4	5	6	7
profit	10	6	8	4	11	9	3
grinding	0.5	0.7	0	0	0.3	0.2	0.5
vdrill	0.1	0.2	0	0.3	0	0.6	0
hdrill	0.2	0	0.8	0	0	0	0.6
boring	0.05	0.03	0	0.07	0.1	0	0.08
planning	0	0	0.01	0	0.05	0	0.05

In the first month (January) and the five subsequent months certain machines will be down for maintenance. These machines will be:

January	1 grinder
February	2 hdrill
March	1 borer
April	1 vdrill
May	1 grinder
May	1 vdrill
June	1 planer
June	1 hdrill

There are marketing limitations on each product in each month. That is, in each month the amount sold for each product cannot exceed these values:

product	1	2	3	4	5	6	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 products in a warehouse. The capacity of the storage is 100 units per product type per month. The cost is 0.5 Euro per unit of product per months. There are no stocks in the first month but it is desired to have a stock of 50 of each product type at the end of June.

The factory works 6 days a week with two shifts of 8 hours each day. (It can be assumed that each month consists of 24 working days.)

The factory wants to determine a production plan, that is, the quantity to produce, sell and store in each month for each product, that maximizes the total profit.

Task 1

Model the factory planning problem for the month of January as an LP problem.

Task 2

Model the multi-period (from January to June) factory planning problem as an LP problem. Use mathematical notation and indicate in general terms how many variables and how many constraints your model has.

Task 3

Implement the multi-period model in Python and Gurobi and solve the problem on the data given. A starting script containing the numerical data is available at [multiperiod.py](#).

- Report and comment relevant information from the run of Gurobi on the data.
- Report the production plan, that is, how much of each product should factory produce in each month.
- Indicate which resource capacity could be convenient to increase in some months and the impact that such increase would have on the total profit.