Problem set # 2

Optimization and Decision Analytics 2025/26

UC3M — *Master of Statistics for Data Science*

Due date: Friday October 31.

Note: This is an individual assignment. Evidence of plagiarism will be penalized. Hand in the assignment as a pdf file through the Assignment module in Aula Global, with Gurobi–Python code printouts and all required explanations.

Problem 1 (50 points). A company makes three discrete products, labeled by $j = 1, \ldots, 3$, in quantities that must not exceed 60 units, respectively. Making each product incurs a fixed cost, given by 40 €, 50 €, and 45 €, respectively. Furthermore, if product 3 is produced then product 1 must also be produced. The marginal profit per unit for each product is given in the following table.

product	marginal profit per unit
1	4 € for the first 10 units, 3 € for the remaining units
2	6 € for the first 8 units, 4 € for the remaining units
3	5 € for the first 10 units, 2.5 € for the next 10 units, and 1 € for the remaining units

The company uses four resources, labeled by $i = 1, \ldots, 4$, and the per unit usage of each resource by each product, as well as the daily resource availability, are given in the following table:

resource	usage product 1	usage product 2	usage product 3	resource availability
1	12	15	10	1500
2	15	14	12	1900
3	11	13	9	1800
4	13	12	15	1200

(a, 25 points) Formulate the problem of finding an optimal production plan as an integer optimization problem, explaining its elements.

(b, 25 points) Implement the model in Gurobi–Python and solve it. Discuss the optimal solution and the solution statistics, such as the number of nodes explored, etc.