



Exercise 1 *Model+Solve*

Consider the multi-product problem studied in the handout. Instead of having the same production costs at each quarter, these costs change from one quarter to the other as in the following table:

	Spring	Summer	Autumn	Winter
Sailboats	415	460	410	405
Surfboards	35	36	34	33

How would you modify the model and the code to solve this new version of the problem?

Exercise 2 *Model+Solve*

Sailco-bis Corporation must decide how many yellow, green and pink t-shirts make this summer. The demand is:

Month	June	July	August	September
Yellow demand	60	90	45	55
Green demand	70	120	50	60
Pink demand	10	80	150	80

Each t-shirt needs 1 hour of work and Sailco-bis have 230 hours of work available per month. The company has a warehouse for which the cost of storing a single t-shirt for a month is £1. If the cost of making a t-shirt is £7, what is the production plan that meets the demand at minimum cost? You can assume that whatever is produced in a month may also be used to satisfy the demand in that month.

Exercise 3 *Model+Solve*

Slats4U make garden seats and wooden sledges for which the demand is given in the following table:

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seats	10	10	35	200	275	450	400	200	100	20	10	10
Sledges	200	400	225	25	15	5	5	5	5	20	275	550

This demand does not need to be fully satisfied, but Slat4U know that they will not be able to sell any unit above the demand. The total combined number of seats and sledges that can be made in each month cannot exceed 200. There is a profit of £70 on each garden seat and of £60 on each wooden sledge. Slat4U have a warehouse for which the holding cost for one month is of £1.5 per seat and £1 per sledge (assume that the warehouse has unlimited capacity).

- a) Write and solve a linear programming model that finds a production schedule that maximizes the net profit?
- b) Does it change the solution if the warehouse has a limited capacity of 300 units (combining seats and sledges)?
- c) *** Given the limited storing capacity in Part b, Slat4U is considering the possibility of improving their facilities. This would increase the monthly production limit, but there would be a one-time cost of £450 per each unit that the monthly production limit is increased (eg, if we expand the monthly limit to be 210 instead of 200, there would be a fixed cost of $(210 - 200) \times 450 = £4,500$). Is it interesting to use this opportunity? How?

Exercise 4 Model

Write down the model in the Kellogg paper in your own words. Decide on short and clear notation. Explain the constraints in your own words. What sort of constraints do you think are missing and should be part of (C6)?

Note: The authors use notation like \leq to denote “elastic”, also called “soft”, constraints. Ignore this distinction and treat “elastic” constraints as standard constraints.

Bonus: If you are interested, read the description of “elastic” constraints. How would you incorporate them into the objective function?