

**Assignment 1: Linear optimization**

*Assigned: September 15; Due: September 28.*

**Exercise 2.10** from *Introduction to Linear Optimization*, Bertsimas & Tsitsiklis [15 pts]

**Exercise 3.25** from *Introduction to Linear Optimization*, Bertsimas & Tsitsiklis [25 pts]

**Exercise 3.31** from *Introduction to Linear Optimization*, Bertsimas & Tsitsiklis [25 pts]

**Problem: production-inventory optimization [35 pts]**

You optimize weekly production and inventory planning for a facility over a one-year period (i.e., 52 weeks). The facility manufactures 100 different product types from 500 materials that come in limited supply each week (materials have to be utilized on a weekly basis and cannot be carried over from one week to the next). Each product type generates a fixed per-unit profit that remains constant over time. You incur a holding cost based on the number of items held in inventory at the end of each week. The unit holding cost varies over time, but is identical across all product types. You have access to data on weekly demand for each product type. Of course, if materials supply is too low, you will not be able to satisfy all the demand. You aim to maximize net profitability.

You have access to the following data files:

- requirements.csv: A matrix of size  $500 \times 100$  that indicates the number of units of each of the 500 materials required to manufacture one unit of each of the 100 product types.
- availability.csv: A matrix of size  $500 \times 52$  that indicates the number of units of each of the 500 materials that can be used in the manufacturing process during each of the 52 weeks.
- demand.csv: A matrix of size  $100 \times 52$  that indicates the number of units demanded for each of the 100 product types during each of the 52 weeks.
- profit.csv: A vector of size 100 indicating the per-unit profit of each product type (in \$).
- holding.csv: A vector of size 52 indicating the per-unit holding cost in each week (in \$).

- a. Formulate a linear optimization model for the problem. Please specify your decision variables, your objective function and your constraints carefully. [10 pts]
- b. Implement your model computationally. Report the sales profit and holding cost. [10 pts]
- c. Represent graphically the number of units manufactured and the number of units stored in inventory, for each product type and each week. Interpret and explain your results. [10 pts]
- d. In week 30, how many of the 10 materials were fully utilized? For how many of the 100 product types was demand fully satisfied? Comment briefly. [5 pts]