Constructor University — November 28, 2023
Fall 2023

Operations Research

Homework 12

Due on December 6, 2023

Note: Your homework must be submitted via moodle (see the link on the class website) on the due day BEFORE THE TUTORIAL, i.e., before 20:45.

Problem 1 [8 points]

An airplane manufacturer is contracted to produce a small number of a particular type of airplane during the coming years. The manufacturer will need to decide each year whether to set up a production run with a fixed set-up cost of EUR 1 000 000 per run. During each production run, the manufacturer can make at most 6 airplanes. If an airplane is not delivered during the year it is produced, it will incur a holding cost of EUR 100 000 per year. The number of airplanes required are $r_1 = 1$, $r_2 = 6$, $r_3 = 2$, and $r_4 = 3$ during each of the years.

Which production schedule(s) minimize the total cost for setup and storage?

Problem 2 [6 points]

(HL, Exercise 18.7-8.) Suppose that the demand D for a spare airplane part has an exponential distribution with mean 50, that is,

$$\varphi_D(x) = \begin{cases} \frac{1}{50}e^{-x/50} & \text{for } x \geq 0, \\ 0 & \text{otherwise.} \end{cases}$$

This airplane will be obsolete in 1 year, so all production of the spare part is to take place at present. The production costs now are \$1 000 per item—that is, $c = 1\,000$—but they become \$10 000 per item if they must be supplied at later dates—that is, $p = 10\,000$. The holding costs, charged on the excess after the end of the period, are \$300 per item.

(a) Determine the optimal number of spare parts to produce.

(b) Suppose that the manufacturer has 23 parts already in inventory (from a similar, but now obsolete airplane). Determine the optimal inventory policy.

(c) Suppose that p cannot be determined now, but the manufacturer wishes to order a quantity so that the probability of a shortage equals 0.1. How many units should be ordered?

(d) If the manufacturer were following an optimal policy that resulted in ordering the quantity found in part (c), what is the implied value of p?

Problem 3 [6 points]

(a) Use the graphical method to maximize

$$Z = x_1 + 2\,x_2$$

subject to

$$x_1^2 + x_2^2 \leq 1\,,$$
$$x_1, x_2 \geq 0\,.$$

(b) Write a Pyomo program to confirm your answer. (Use the `ipopt` solver instead of `glpk`.)