Lab assignment 1

Optimization in ML (CSL4010)

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import numpy as pn
from cvxopt import matrix, solvers
c,b=pn.array([[1.0],[0.0],[0.0]]),pn.array([[0.0],[0],[9],[-24],[-6],[0],[0]])
A=pn.array([[-1,1,-3],[-1,3,-1],[0,1,2],[0,-3,-4],[0,-2,3],[0,-1,0],[0,0,-1]])
soln=solvers.lp(matrix(c,tc='d'),matrix(A,tc='d'),matrix(b,tc='d'))
print(pn.round_(soln['x'],decimals=5),soln['primal objective']
```

1. Solve the LPP:

$$\begin{aligned} \min\ \ 3x_1 - 4x_2 & \\ x_1 + 3x_2 & \leq 12 \\ 2x_1 - x_2 & \leq 20 \\ x_1 - 4x_2 & \geq 5 \\ x_1 \geq 0, & \quad x_2 \ is\ unrestricted\ in\ sign \end{aligned}$$

2. Construct and solve the following linear programming problem:

   (a) An airline offers coach and first-class tickets. For the airline to be profitable, it must sell a minimum of 25 first-class tickets and a minimum of 40 coach tickets. The company makes a profit of \$225 for each coach ticket and \$200 for each first-class ticket. At most, the plane has a capacity of 150 travelers. How many of each ticket should be sold in order to maximize profits?

   (b) A person requires at least 10, 12, and 12 units of chemicals for A, B and C respectively for his garden. A liquid product contains 5,2, and 1 units of A, B, and C per jar. A dry product contains 1, 2, and 4 units of A, B, and C per carton. The liquid product sells for Rs 30 per jar and the dry product sells Rs 20 per cartoon. Construct an optimization model to minimize the total cost of Jars and cartoons to meet the requirements.

(c) A small firm specializes in making five types of spare automobile parts. Each part is first cast from iron in the casting shop and then sent to the finishing shop where holes are drilled, surfaces are turned, and edges are ground. The required worker-hours (per 100 units) for each of the parts of the two shops are shown below:

$$\begin{array}{rccccc} Part: & 1 & 2 & 3 & 4 & 5 \\ Casting: & 2 & 1 & 3 & 3 & 1 \\ Finishing: & 3 & 2 & 2 & 1 & 1 \end{array}$$

The profits from the parts are \$ 30, \$ 20, \$ 40, \$ 25, and \$ 10 (per 100 units), respectively.
The capacities of the casting and finishing shops over the next month are 700 and 1000 worker-hours, respectively. Formulate the problem of determining the quantities of each spare part to be made during the month so as to maximize profit.

3.

$$\begin{aligned} \min \ (R+3)x_1 + (R+41)x_2 \\ 3x_1 - x_2 \leq 12 \\ 7x_1 + 11x_2 \leq 88 \\ x_1, x_2 \geq 0 \end{aligned}$$

4.

$$\begin{aligned} \min \ Rx_1 - (R-1)x_2 \\ 3x_1 - 2x_2 \leq 1 \\ 3x_1 - 2x_2 \leq 6 \\ x_1, x_2 \geq 0 \end{aligned}$$

5.

$$\begin{aligned} \max \ z = x_1 + x_2 + x_3 \\ 3x_1 + 2x_2 + x_2 \leq 3 \\ 2x_1 + x_2 + 2x_3 \leq 2 \\ x_1, x_2, x_3 \geq 0 \end{aligned}$$

6.

$$\begin{aligned} \max \quad z = (R+2)x_1 + (R+3)x_2 \\ s.\ t.\ 2x_1 + x_2 \leq 1000 \\ x_1 + x_2 \leq 600 \\ 2x_1 + 4x_2 \leq 2000 \\ x_1, x_2 \geq 0 \end{aligned}$$

7.

$$\begin{aligned} \min \quad 2x_1 + 3x_2 + 10x_3 \\ x_1 + 2x_3 = 0 \\ x_2 + x_3 = 1 \\ x_1, x_2, x_3 \geq 0 \end{aligned}$$

8.

$$\begin{array}{rcl} \min \quad 3x_1 - 4x_2 & & \\ x_1 + 3x_2 & \leq & 12 \\ 2x_1 - x_2 & \leq & 20 \\ x_1 - 4x_2 & \geq & 5 \\ x_1 \geq 0, & & x_2 \ is\ unrestricted\ in\ sign \end{array}$$

9.

$$\begin{aligned} \max \quad Rx_1 + (R+3)x_2 \\ s.\ t.\ 3x_1 + x_2 \geq 3 \\ x_1 + 4x_2 \geq 4 \\ x_1 + x_2 \leq 5 \\ x_1, x_2 \geq 0 \end{aligned}$$

10.

$$\begin{aligned} \min \quad Rx_1 + (2R+1)x_2 \\ 2x_1 + x_2 \le 4 \\ 3x_1 + 4x_2 \ge 24 \\ 2x_1 - 3x_2 \ge 6 \\ x_1, x_2 \ge 0 \end{aligned}$$

11.

$$\begin{aligned} \min \quad (R+3)x_1 + x_2 \\ x_1 + 2x_2 \le 3 \\ 4x_1 + 3x_2 \ge 6 \\ 3x_1 + x_2 = 3 \\ x_1, x_2 \ge 0 \end{aligned}$$

12.

$$\begin{aligned} \min \quad -3x_1 + x_2 \\ x_1 + 2x_2 = 0 \\ 2x_1 - 2x_2 = 9 \\ x_1, x_2 \ge 0 \end{aligned}$$

(R is last 2 digits of your roll no)