Date: 18/02/2022 Lab Session 6

Table of Contents

Problem

A fictional company AccessApple & Co. produces three types of covers for Apple products: one for iPod, one for iPad, and another for iPhone. The company's production facilities are such that if we devote the entire production to iPod covers, we can produce 6000 of them in a day. If we devote the entire production to iPhone covers or iPad covers, we can produce 5000 or 3000 of them, respectively, in one day.

The production schedule is one work week of 5 working days, and the week's production must be stored before distribution. Storing 1000 iPod covers (packaging included) takes up 40 cubic feet of space. Storing 1000 iPhone covers (packaging included) takes up 45 cubic feet of space, and storing 1000 iPad covers (packaging included) takes up 210 cubic feet of space. The total storage space available is 6000 cubic feet.

Due to a commercial agreement, AccessApple & Co. has to deliver at least 5000 iPod covers, and 4000 iPad covers per week in order to strengthen the products' diffusion.

The marketing department estimates that the weekly demand for iPod covers, iPhone, and iPad covers does not exceed 10000 and 15000 , and 8000 units,respectively. Therefore the company does not want to produce more than these numbers.

Finally, the net profits in USD for each iPod cover, iPhone cover, and iPad cover are USD 4, USD 6 and USD 10 respectively.

The aim is to determine a weekly production schedule that **maximizes the total net profit**.

Questions

(a) Formulate the problem as a Linear Program (LP). Start by stating any assumptions that you make. Label each constraint (except non-negativity).

For this first formulation, the decision variables should represent the *proportion of time spent* each day on producing each of the 3 items:

$x1$= proportion of time devoted each day to iPod cover production,
$x2$= proportion of time devoted each day to iPhone cover production,
$x3$= proportion of time devoted each day to iPad cover production.

(Different formulations will be required for parts (b) and (c).)

(b) Formulate the problem as a Linear Program (LP). Label each constraint (except non-negativity).

For this second formulation, the decision variables should represent the *number of items of each type* produced over the week:

$y1$= number of iPod covers produced over the week,
$y2$= number of iPhone covers produced over the week,
$y3$= number of iPad covers produced over the week.

Note: The data is the same but you must make sure—everything matches the new decision variables.

(c) Formulate the problem as a Linear Program (LP). Label each constraint (except non-negativity). Assume that each working day has 8 working hours.

For this third formulation, the decision variables should be:
$z1$= number of hours devoted to the production of iPod smart covers in one week,
$z2$= number of hours devoted to the production of iPhone smart covers in one week,
$z3$= number of hours devoted to the production of iPad smart covers in one week.

Express the objective function in thousands of dollars.
Note: The data is the same but you must make sure—everything matches the new decision variables.

(d) What is the relationship between the variables z1, z2, z3 of part (c) and the variables x1, x2, x3 of part (a) of this problem?

Give a formula to compute z1, z2, z3 from x1, x2, x3.

(e) Solve the problem using CVXPY. Find the optimal solution and objective value.

Submission Guidelines

1. Write down the answers for parts (a) through (d) on a separate sheet, scan and upload pdf
2. Solve part (e) using cvxpy and submit a Colab notebook/Python script

   Note*:* Your submission should contain both the scanned pdf, and the Colab notebook (or Python script) to receive full credits.