CS69011: Computing Lab
Assignment 5: Linear Programming (Part - B)

September 6, 2023

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1. Regarding submission: Create separate Python file(s): **<RollNo>_Q3.py, <RollNo>_Q4.py.**
2. Create a .zip file containing the two Python file(s) with the name: **<RollNo>_A5_Part_B.zip** and submit it to Moodle.
3. The input to the program will be available in a .txt file given as **command line arguments**.
4. The final output for the program needs to be stored in a separate .txt file as 'Summary_Q3.txt' for Q3 and 'Summary_Q4.txt' for Q4.
5. Feel free to modify the problem to suit your needs and implement the linear programming optimization using libraries like `ortools`, `SciPy`, or others that provide LP solvers, **but you need to restrict yourselves to using only LP solvers to solve this problem.**

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Q 3: Sweet Box Problem

You are the owner of ABC & Son's Sweet Company and have decided to manufacture some special sweet gift boxes for a well-known festival in West Bengal. For your simplicity, assume that each sweet is a "Sandesh" (rectangle of dimension **x** and **y**). You have **k** types of sweets $\{S_1, S_2, \ldots, S_k\}$ with their market price $\{C_1, C_2, \ldots, C_k\}$ respectively available in your company, but you cannot place more than one sweet of the same kind in a box . You have a box **B** of dimensions (**m,n**). You have to maximize the price of the sweet box.

Fig. 1 represents a box and 3 sweets and respective dimensions. w_i

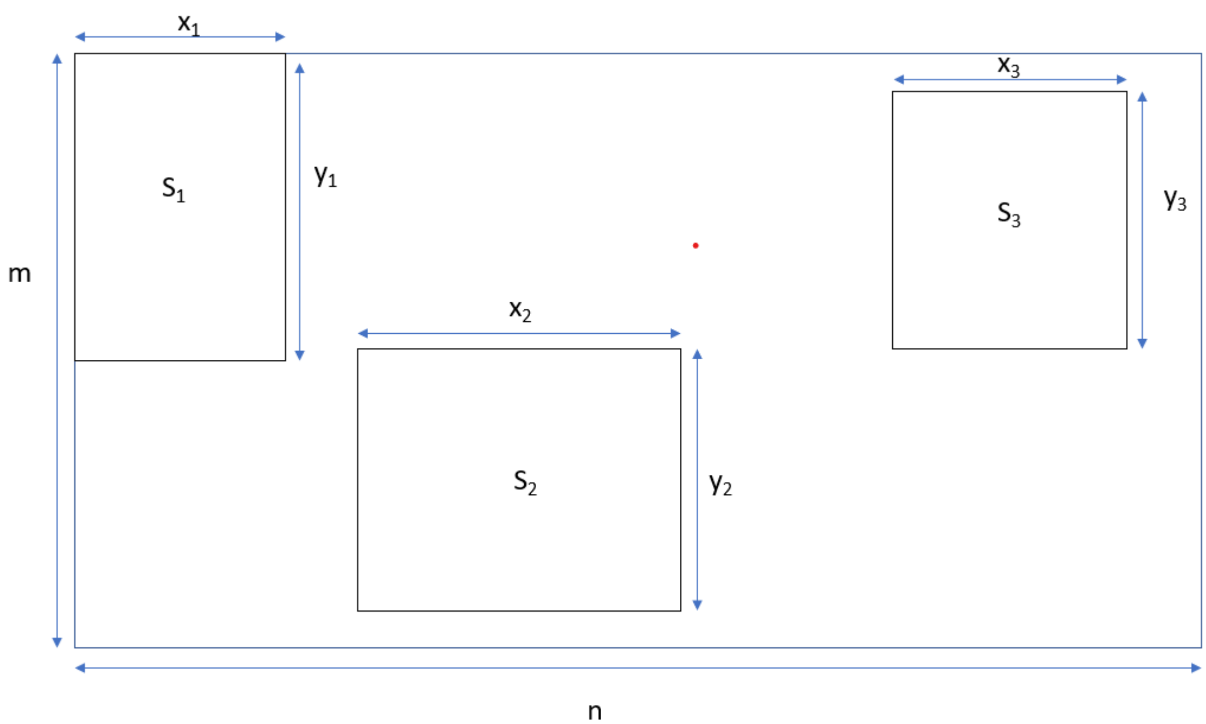

Figure 1

1. **Input Format:**
   - The first line contains the number of sweets ‘k’.
   - The second line contains two space separated numbers the dimensions of box ‘m’, ’n’.
   - The third line contains \`k\` space-separated numbers denoting the length ‘x’ of each sweet.
   - The fourth line contains \`k\` space-separated numbers denoting the width ‘y’ of each sweet.
   - The fifth line contains \`k\` space-separated numbers denoting the market cost **{C_1, C_2, ….,C_k}** of each sweet.

2. **Output:**
   - Display the maximum cost of the box and size of each sweet used

3. **Sample Input:**

3
3 4
1 2 1
2 4 8
10 15 6

4. **Sample Output:**

Size of sweet 1: 2
Size of sweet 2: 8
Size of sweet 2: 0
Maximum Profit: 140

Q 4: Relaxed Sweet Box Problem

It is observed that the price of a sweet depends on the size of the sweet (area). The bigger the size, the bigger is the market price of the sweet. As you reduce the size of the sweet, the cost is also getting reduced by the same fraction. Consider you can add a fractional part **λ** (**λ**<=1) of a sweet that can be placed in the box with a scaling factor λ (λ<1).

Example:- If you take a sweet **S** with market cost **C** with **λ** = 0.8, then the new market cost of that sweet becomes 0.8***C**.

Fig. 2 and Fig. 3 show a fractional sweet operation (not necessarily optimal solution). In Fig. 2, three sweets S_1, S_2, S_3 having A_1, A_2, A_3 size respectively are shown and it is seen we cannot incorporate sweet S_2. In Fig. 3, using a fractional part, it is seen we are able to fit S_2 sweet in box B.

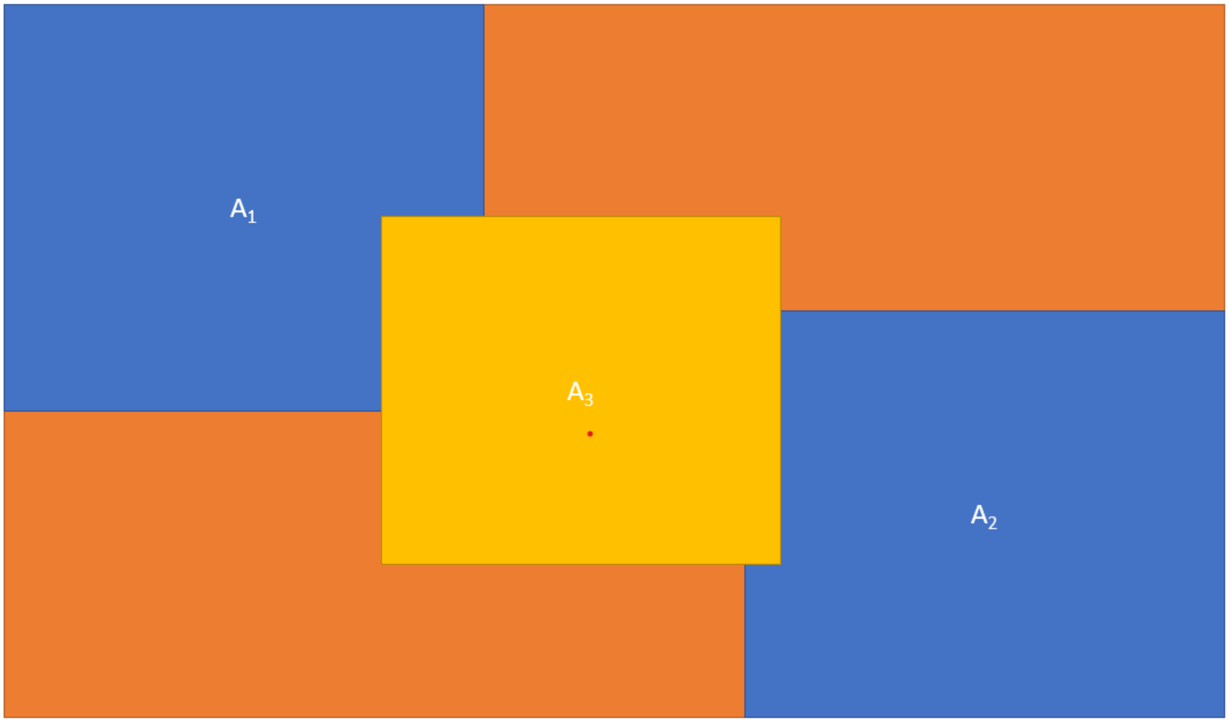

Figure 2

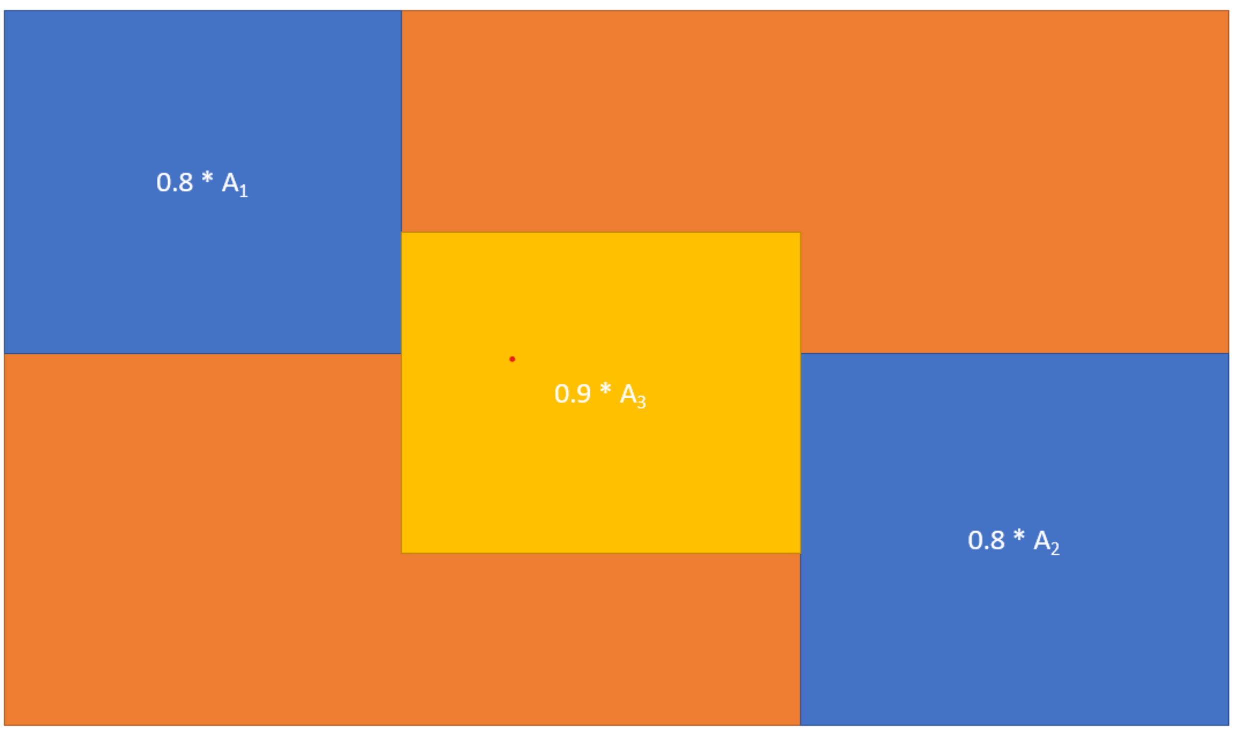

Figure 3

1. **Input Format:**
   - The first line contains the number of sweets ‘k’.
   - The second line contains two space separated numbers the dimensions of box ‘m’, ’n’.
   - The third line contains `k` space-separated numbers denoting the length ‘x’ of each sweet.
   - The fourth line contains `k` space-separated numbers denoting the width ‘y’ of each sweet.
   - The fifth line contains `k` space-separated numbers denoting the market cost $\mathbf{\{C_1, C_2, \ldots, C_k\}}$ of each sweet.

2. **Output:**
   - Display the maximum cost of the box and size of each sweet used

3. **Sample Input:**

3
3 4
1 2 1
2 4 8
10 15 6

4. **Sample Output:**

Size of sweet 1: 2
Size of sweet 2: 8
Size of sweet 2: 2
Maximum Profit: 141.5