CMOR 360 HW2

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Problem 1

Let x_i be the number of employees starting their workweek on the ith day of the week (1 = monday, 2 = tuesday, etc.)

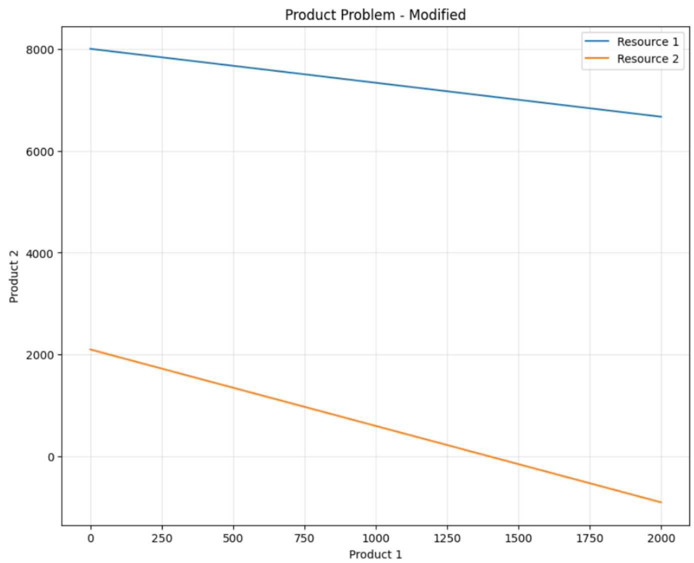
$$\begin{aligned}
&\min(x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7) \\
\text{s.t.} \quad & x_1 + x_4 + x_5 + x_6 + x_7 \geq 17 \\
& x_1 + x_2 + x_5 + x_6 + x_7 \geq 13 \\
& x_1 + x_2 + x_3 + x_6 + x_7 \geq 15 \\
& x_1 + x_2 + x_3 + x_4 + x_7 \geq 19 \\
& x_1 + x_2 + x_3 + x_4 + x_5 \geq 14 \\
& x_2 + x_3 + x_4 + x_5 + x_6 \geq 16 \\
& x_3 + x_4 + x_5 + x_6 + x_7 \geq 11 \\
& x_i \geq 0, \forall i = 1, 2, 3, 4, 5, 6, 7
\end{aligned}$$

Problem 2

Let x_A be the amount invested in A and x_B in B.

$$\begin{aligned}
&\max(0.16x_A + 0.2x_B) \\
\text{s.t.} \quad & x_A + x_B = 12000000 \\
& x_A \leq 1000000 \\
& x_B \leq 5000000 \\
& x_A \geq \frac{x_B}{2} \\
& x_B \geq \frac{x_A}{2} \\
& x_A, x_B \geq 0
\end{aligned}$$

The feasible region is bounded by max investment B, $A \geq \frac{B}{2}$, and lies on the total budget constraint line. The optimal solution is the upper left corner: 7 million in A and 5 million in B.

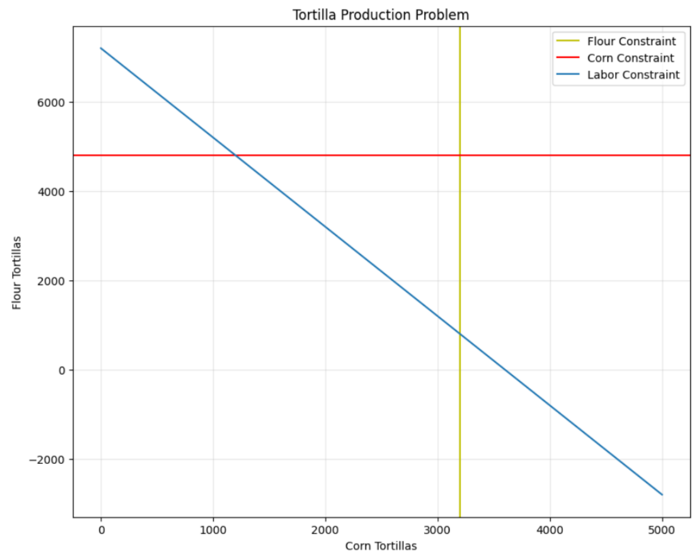


Problem 3

Let c be the number of corn tortilla packs and f be the number of flour tortilla packs.

$$\begin{aligned} &\max(0.50c + 0.75f) \\ \text{s.t.} \quad & 10f \leq 32000 \\ & \frac{c}{4} \leq 1200 \\ & \frac{c}{30} + \frac{f}{15} \leq 240 \\ & c, f \geq 0 \end{aligned}$$

The feasible region is on the labor constraint line, below the corn constraint, and left of the flour constraint. The upper right corner is the optimal solution. 4800 corn tortillas and 1200 flour tortillas.

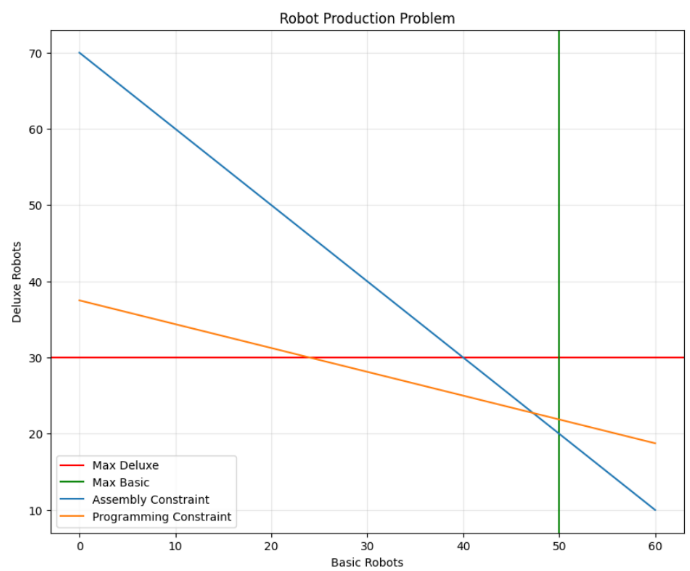


Problem 4

Let x_1 and x_2 be the number of basic and deluxe robots respectively.

$$\begin{aligned} \max(180x_1 + 360x_2) \\ \text{s.t.} \quad x_1 \leq 50 \\ x_2 \leq 30 \\ 5(x_1 + x_2) \leq 350 \\ 0.5x_1 + 1.6x_2 \leq 60 \\ x_1, x_2 \geq 0 \end{aligned}$$

The feasible region is on the intersection of assemble constraint and programming constraint lines. This point also satisfies the maximum deluxe and basic robot constraints. The intersection point is approximately (47.27, 22.73). The nearest feasible point is (47,22).

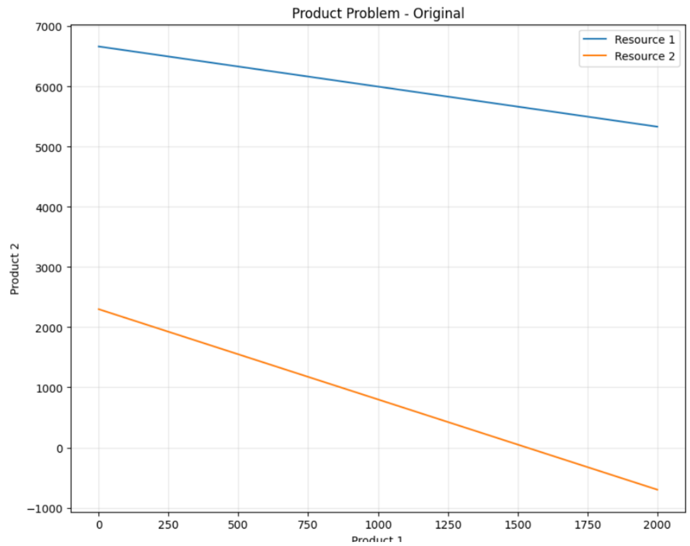


Problem 5

Let x_1 and x_2 be the number of product 1 and 2, respectively.

$$\begin{aligned} &\max(0.4 \cdot 3x_1 + 0.3 \cdot 4x_2) \\ \text{s.t.} \quad & x_1 + 1.5x_2 \leq 10000 \\ & 3x_1 + 2x_2 \leq 4600 \\ & x_1, x_2 \geq 0 \end{aligned}$$

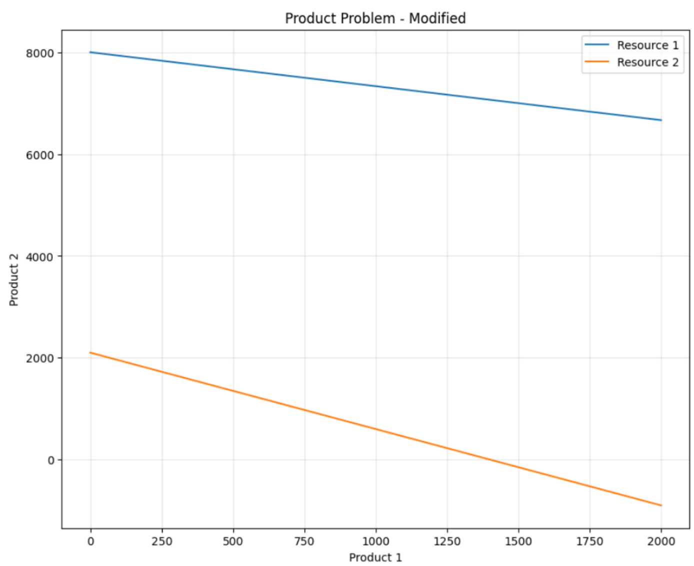
The feasible is on the orange line. The optimal solution is 2300 units of product 2 and no units of product 1.



For part c, we reformulate the problem.

$$\begin{aligned} &\max(0.4 \cdot 3x_1 + 0.3 \cdot 4x_2) \\ \text{s.t.} \quad & x_1 + 1.5x_2 \leq 12000 \\ & 3x_1 + 2x_2 \leq 4200 \\ & x_1, x_2 \geq 0 \end{aligned}$$

Here the feasible region is again on the orange line, and the solution is 2100 units of product 2. Since this nets less profit, we would not take the offer.



Product Problem - Modified
Resource 1
Resource 2
8000
6000
4000
2000
0
Product 2
0
250
500
750
1000
1250
1500
1750
2000
Product 1