X_{12} : the road between O_1 and D_2

X_{13} : the road between O_1 and D_3

X_{21} : the road betwen O_2 and D_1

X_{22} : the road between O_2 and D_2

X_{23} : the road between O_2 and D_3

- Objective function

$$\text{Min } Z = 8x_{11} + 6X_{12} + 10x_{13} + 10x_{21} + 4x_{22} + 9X_{23}$$

- Constraints

$$X_{11} + X_{12} + X_{13} = 2000$$
$$X_{21} + X_{22} + X_{23} = 2500$$
$$X_{11} + X_{21} = 1500$$
$$X_{12} + X_{22} = 2000$$
$$X_{13} + X_{23} = 1000$$

$$X_{11}, X_{12}, X_{13}, x_{21}, x_{22}, x_{23} \geq 0$$

TD 02

Question 01 :

- Reformulate in canonical form (max):

1) $\text{Max } Z = -2x_1 - 2x_2$

$$2x_1 - 3x_2 \leq -2$$
$$-2x_1 + 3x_2 \leq 2$$
$$4x_1 - x_2 \leq 3$$
$$x_1, x_2 \geq 0$$

Rules:

$$ax = b \begin{cases} ax \leq b \\ ax \geq b \end{cases}$$

2) $x_1 \in \mathbb{R} \Rightarrow x_1 = x_1' - x_1''$

$\Rightarrow x_1', x_1'' \geq 0$

$$\text{Max } Z = x_1' - x_1'' - 2x_2 - x_4$$

$$x_1' - x_1'' + x_2 + x_3 + 2x_4 \leq 3$$
$$-x_1' + x_1'' - x_2 - x_3 - 2x_4 \leq -3$$
$$2(x_1' - 2x_1'') - x_2 + 5x_3 \leq -6$$
$$-2x_1' + 2x_1'' + x_2 - 5x_3 \leq 6$$
$$-3x_1' + 3x_1'' - 2x_2 + 3x_4 \leq -2$$
$$x_1', x_1'', x_2, x_3, x_4 \geq 0$$

Rules:

- $x \in \mathbb{R} \Rightarrow x = x' - x''$

$\Rightarrow x', x'' \geq 0$

- $ax \leq b \Rightarrow -ax \geq -b$

Question 02

- Reformulate to standard form

$x_2 \in \mathbb{R}$, $x_2 = x_2' - x_2''$

$\Rightarrow x_2', x_2'' \geq 0$

$$\text{Max } Z = 2x_1 - 3x_2' + 3x_2''$$

$$2x_1 + x_2' - x_2'' + S_1 = K$$
$$4x_1 + 3x_2' - 3x_2'' + S_2 = B$$
$$x_1 + 3x_2' - 3x_2'' - S_3 = 4$$
$$x_1, x_2', x_2'', S_1, S_2, S_3 \geq 0$$

Rules:

- $ax \geq b \Rightarrow ax - S_1 = b$
- $ax \leq b \Rightarrow ax + S_2 = b$

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Question 03:

• Testing the optimality of the bases:

1) $B_1 = \{4, 5, 6\}$

$4 - 5 + 6 \nleq 3$

B_1 isn't a solution

2) $B_2 = \{3, 5, 6\}$

$3 - 5 + 6 \nleq 3$

B_2 isn't a solution

3) $B_3 = \{2, 3, 4\}$

$2 - 3 + 4 \leq 3$

$3 \times 2 + 2 \times 3 + 4 \nleq 9$

B_3 isn't a solution

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