COMP 360 A2

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Part I

Question 1

Original LP

Variables

- Staple-poor = x_1
- Staple-average = x_2
- Staple-premium = x_3
- Nail-poor = x_4
- Nail-average = x_5
- Nail-premium = x_6
- Screw-poor = x_7
- Screw-average = x_8
- Screw-premium = x_9

Objective

Maximize:
$15x_1 + 25x_2 + 40x_3 + 20x_4 + 40x_5 + 50x_6 + 80x_7 + 110x_8 + 130x_9$

Subject To

$10x_1 + 15x_2 + 25x_3 + 15x_4 + 25x_5 + 30x_6 + 70x_7 + 100x_8 + 115x_9 \leq 1000,$
$x_1 + x_2 + x_3 \geq 80,$
$x_4 + x_5 + x_6 \geq 25,$
$x_7 + x_8 + x_9 \geq 20,$
$x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 + x_9 \geq 0,$
$-10x_2 + x_3 \geq 0,$
$-10x_5 + x_6 \geq 0,$
$-10x_8 + x_9 \geq 0,$

Dual

Objective

Minimize:
$100y_1 - 80y_2 - 25y_3 - 20y_2$

Subject To

$10y_1 - y_2 \geq 15$
$15y_1 - y_2 + 10y_5 \geq 25$

$25y_1 - y_2 - y_5 \geq 40$
$15y_1 - y_3 \geq 20$
$25y_1 - y_3 - 10_6 \geq 50$
$70y_1 - y_4 \geq 80$
$100y_1 - y_4 - 10y_7 \geq 110$
$115y_1 - y_4 - y_y \geq 130$

Solution

$y_1 = 2$
$y_2 = 5$
$y_3 = 10$
$y_4 = 60$
$y_5 = 5$
$y_6 = 0$
$y_7 = 0$
$z = -1650$

Rough Work

$\max 15x_1 + 25x_2 + 40x_3 + 20x_4 + 40x_5 + 50x_6 + 80x_7 + 110x_8 + 130x_9$

$10x_1 + 15x_2 + 25x_3 + 15x_4 + 25x_5 + 30x_6 + 70x_7 + 100x_8 + 115x_9 \leq 100$

2 $-x_1 - x_2 - x_3 \leq -80$

3 $-x_4 - x_5 - x_6 \leq -25$

4 $-x_7 - x_8 - x_9 \leq -20$

5 $10x_2 - x_3 \leq 0$

6 $10x_5 - x_6 \leq 0$

7 $10x_8 - x_9 \leq 0$

Dimal

$(10y_1 - 1y_2)x_1 + (15y_1 - y_2 + 10y_5)x_2 + (25y_1 - y_2 - y_5)x_3$

$+ (15y_1 - y_3)x_4 + (25y_1 - y_3 - 10y_6) + (30y_1 - y_3 - y_6)x_6$

$+ (70y_1 - y_4)x_7 + (100y_1 - y_4 - 10y_7)x_8 + (115y_1 - y_7 - y_7)x_9$

Minimize $100y_1 - 80y_2 - 25y_3 - 20y_4$

Subject to.

1 $10y_1 - 1y_2 \geq 15$

2 $15y_1 - y_2 + 10y_5 \geq 25$

3 $25y_1 - y_2 - y_5 \geq 40$

4 $15y_1 - y_3 \geq 20$

5 $25y_1 - y_3 - 10y_6 \geq 40$

6 $30y_1 - y_3 - y_6 \geq 50$

7 $70y_1 - y_4 \geq 80$

8 $100y_1 - y_4 - 10y_7 \geq 110$

9 $115y_1 - y_4 - y_7 \geq 130$

Figure 1. Rough Work

Question 2

Row Player Optimal Solution

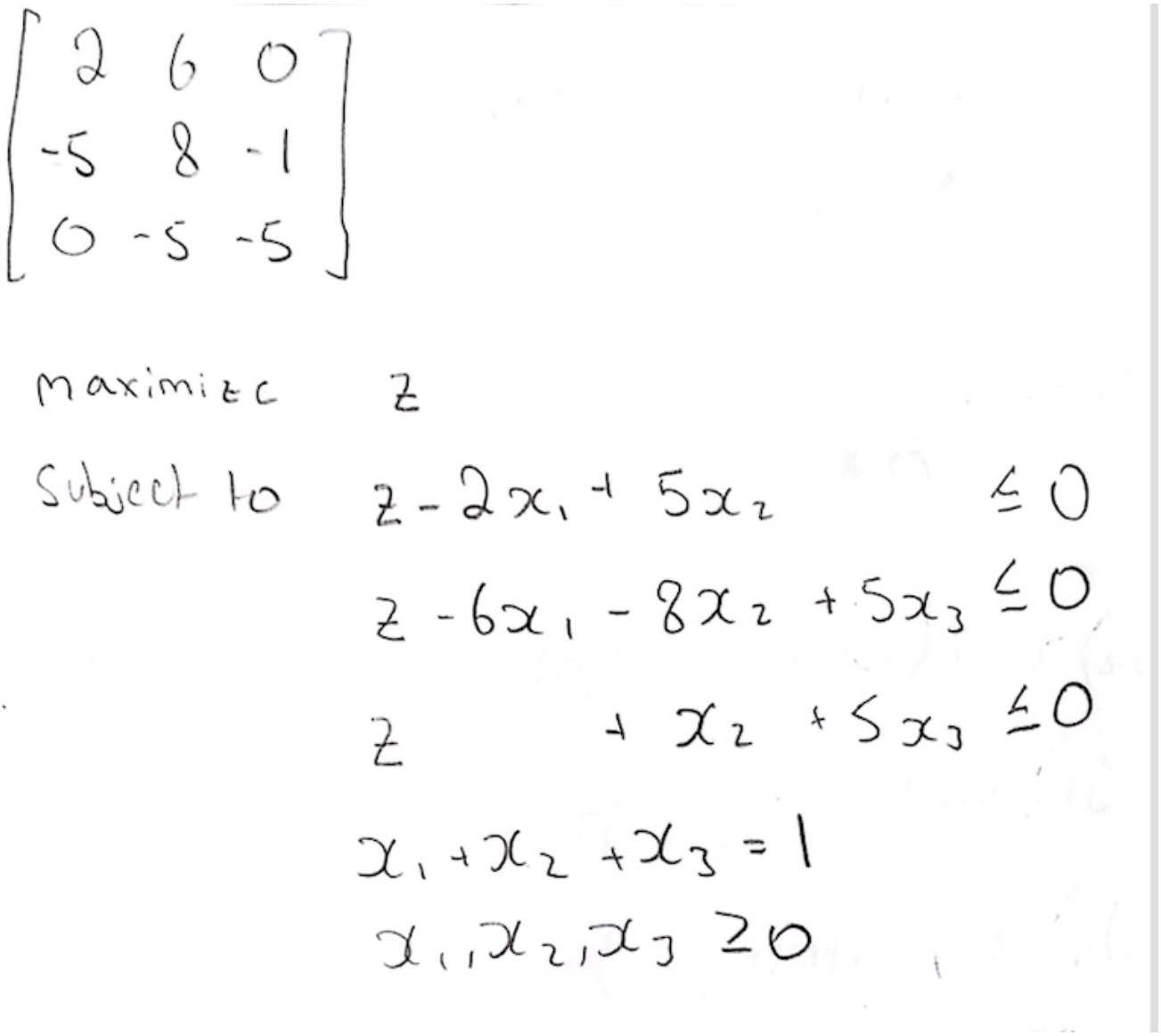

Figure 2. Formulation

Solution

$x_1 = 1$
$x_2 = 0$
$x_3 = 0$

Column Player Optimal Solution

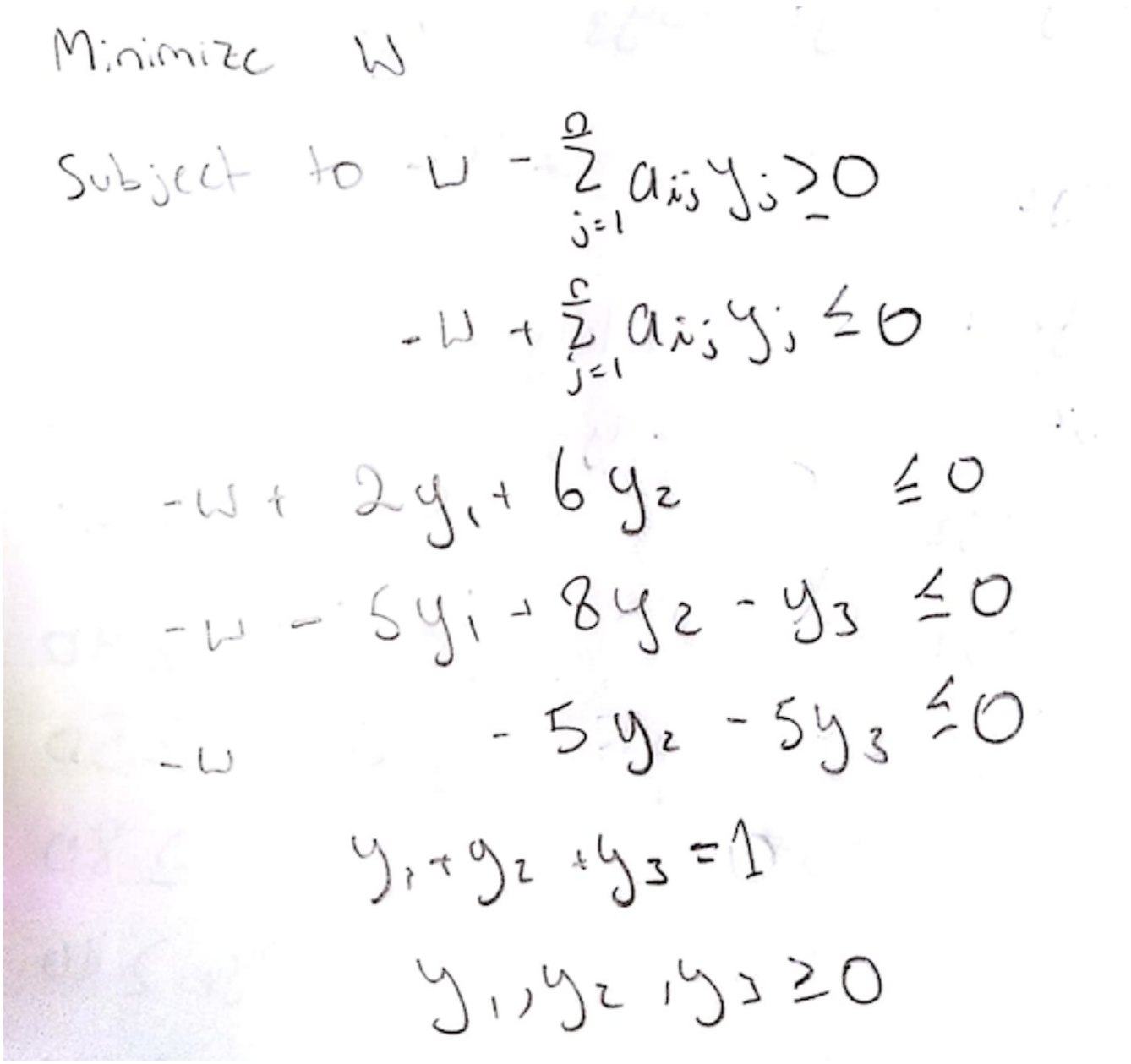

Figure 3. Formulation

Solution

$y_1 = 0$
$y_2 = 0$
$y_3 = 1$

Comments

If the row player is playing optimally and the column player is playing optimally then on average the row player will win 0.