

Problem 4 (30 points – Extra credit)

Suppose you have the following LP model

$$\begin{aligned} \text{Minimize } z &= x_1 + 2x_2 \\ \text{s.t.} \quad & x_1 + 2x_2 \leq 4 \\ & 4x_1 + x_2 \geq 4 \\ & x_1, x_2 \geq 0 \end{aligned}$$

You would like to solve it using Simplex Tableau. Since you need to standardize the LP model before using Simplex to solve it, you start by constructing its associated standard form (below):

$$\begin{aligned} \text{Minimize } z &= x_1 + 2x_2 \\ \text{s.t.} \quad & x_1 + 2x_2 + s_1 = 4 \\ & 4x_1 + x_2 - s_2 = 4 \\ & x_1, x_2, s_1, s_2 \geq 0 \end{aligned}$$

- a. (5 points extra credit) If you want to use the big M method to initialize and solve the problem, what would be the associated big M optimization problem to be solved?

$$\begin{aligned} \min z &= -x_1 + 2x_2 = z + x_1 - 2x_2 - Mr \\ \text{s.t.} \quad & x_1 + 2x_2 + s_1 + r_1 = 4 \\ & 4x_1 + x_2 - s_2 - r_2 = 4 \\ & x_1, x_2, s_1, r_1, r_2 \geq 0 \end{aligned}$$

- b. (5 points extra credit) If you want to initialize and solve the problem from part a with the two-phase method, what would be the associated phase-1 optimization problem to be solved?

$$\begin{aligned} \min z - 1 &= 0 \\ \text{s.t.} \quad & x_1 + 2x_2 + s_1 + r_1 = 4 \\ & 4x_1 + x_2 - s_2 - r_2 = 4 \\ & x_1, x_2, s_1, r_1, r_2 \geq 0 \end{aligned}$$