TD - Week 2

October 2025

Questions

Part A: Simplex Method (Standard Form) - 10 Questions

1. A bakery produces cakes and cookies. Each cake requires 2 hours of baking and 1 hour of decoration, while each cookie requires 1 hour of baking and 0.5 hours of decoration. The bakery has 100 hours of baking time and 60 hours of decoration time available per week. The profit is \$15 per cake and \$8 per cookie. Formulate and solve using the Simplex method to maximize profit.

2. Solve the following LP problem using the Simplex method:

$$\text{Maximize } Z = 5x_1 + 4x_2$$

$$\begin{aligned} \text{Subject to: } & 6x_1 + 4x_2 \leq 24 \\ & x_1 + 2x_2 \leq 6 \\ & -x_1 + x_2 \leq 1 \\ & x_1, x_2 \geq 0 \end{aligned}$$

3. A furniture manufacturer produces tables, chairs, and cabinets. Each table requires 4 hours of carpentry, 2 hours of assembly, and 1 hour of finishing. Each chair requires 2 hours of carpentry, 1 hour of assembly, and 1 hour of finishing. Each cabinet requires 3 hours of carpentry, 3 hours of assembly, and 2 hours of finishing. Available weekly: 240 hours carpentry, 180 hours assembly, 100 hours finishing. Profit per unit: table \$70, chair \$40, cabinet \$90. Formulate and solve using Simplex method.

4. Solve using the Simplex method:

$$\text{Maximize } Z = 3x_1 + 2x_2 + x_3$$

$$\begin{aligned} \text{Subject to: } & 2x_1 + x_2 + x_3 \leq 8 \\ & x_1 + 2x_2 + x_3 \leq 10 \\ & x_1 + x_2 + 2x_3 \leq 6 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

5. A toy company makes robots, dolls, and cars. Each robot needs 3 units of plastic and 2 hours of labor. Each doll needs 2 units of plastic and 1 hour of labor. Each car needs 1 unit of plastic and 1 hour of labor. Available daily: 150 units plastic, 80 hours labor. Profit: robot \$25, doll \$18, car \$12. Formulate and solve using Simplex.

6. Solve the following problem:

$$\text{Maximize } Z = 7x_1 + 5x_2 + 3x_3$$

$$\begin{aligned} \text{Subject to: } & 3x_1 + 2x_2 + x_3 \leq 12 \\ & x_1 + x_2 + x_3 \leq 5 \\ & 2x_1 + 3x_2 + 2x_3 \leq 15 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

7. A farm produces corn, wheat, soybeans, and barley. Land required (acres per ton): corn 2, wheat 1.5, soybeans 1.8, barley 1.2. Labor required (hours per ton): corn 4, wheat 3, soybeans 5, barley 2. Water required (units per ton): corn 6, wheat 4, soybeans 7, barley 3. Available: 200 acres land, 500 hours labor, 800 units water. Profit per ton: corn \$200, wheat \$150, soybeans \$220, barley \$130. Formulate and solve using Simplex.

8. Solve:

$$\text{Maximize } Z = 4x_1 + 6x_2$$

$$\begin{aligned} \text{Subject to: } 2x_1 + 3x_2 &\leq 18 \\ 3x_1 + 2x_2 &\leq 24 \\ x_1 + x_2 &\leq 8 \\ x_1, x_2 &\geq 0 \end{aligned}$$

9. Solve using Simplex method:

$$\text{Maximize } Z = 2x_1 + 3x_2 + 4x_3 + x_4$$

$$\begin{aligned} \text{Subject to: } x_1 + 2x_2 + x_3 + x_4 &\leq 10 \\ 2x_1 + x_2 + 3x_3 + 2x_4 &\leq 20 \\ x_1 + x_2 + x_3 + 3x_4 &\leq 15 \\ x_1, x_2, x_3, x_4 &\geq 0 \end{aligned}$$

10. A textile company produces shirts and pants. Each shirt requires 3 meters of fabric and 2 hours of sewing. Each pant requires 4 meters of fabric and 3 hours of sewing. Available daily: 240 meters fabric, 180 hours sewing. Profit: \$30 per shirt, \$45 per pant. Formulate and solve using Simplex method.

Part B: Big-M Method - 5 Questions

11. A diet must provide at least 60 grams of protein and exactly 80 grams of carbohydrates daily. Food A provides 10g protein and 20g carbs per unit at $3/unit. Food B provides 15g protein and 10g carbs per unit at $4/unit. Formulate and solve using Big-M method to minimize cost.

12. Solve using Big-M method:

$$\text{Minimize } Z = 3x_1 + 2x_2 + 4x_3$$

$$\text{Subject to: } x_1 + x_2 + x_3 \geq 10$$

$$2x_1 + x_2 + 3x_3 = 20$$

$$x_1, x_2, x_3 \geq 0$$

13. A chemical company must produce at least 500 units of product A and exactly 300 units of product B daily. Production requires two processes. Process 1: each hour produces 10 units of A and 5 units of B, costs $100/hour. Process 2: each hour produces 8 units of A and 6 units of B, costs $120/hour. Formulate and solve using Big-M method to minimize cost.

14. Solve the following minimization problem using Big-M method:

$$\text{Minimize } Z = 5x_1 + 6x_2$$

$$\text{Subject to: } 2x_1 + 3x_2 \geq 12$$

$$x_1 + x_2 = 5$$

$$3x_1 + 2x_2 \geq 15$$

$$x_1, x_2 \geq 0$$

15. Solve using Big-M method:

$$\text{Minimize } Z = 4x_1 + 5x_2 + 3x_3$$

$$\begin{aligned} \text{Subject to: } x_1 + 2x_2 + x_3 &\geq 8 \\ 2x_1 + x_2 + 2x_3 &= 12 \\ x_1 + x_2 + x_3 &\geq 6 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

Part C: Two-Phase Method - 5 Questions

16. A manufacturing plant must meet minimum production quotas: at least 100 units of product X and at least 150 units of product Y per week. Machine A produces 5 units of X and 3 units of Y per hour. Machine B produces 4 units of X and 6 units of Y per hour. Operating cost: Machine A \$50/hour, Machine B \$60/hour. Formulate and solve using Two-Phase method to minimize cost.

17. Solve using Two-Phase method:

$$\text{Minimize } Z = 2x_1 + 3x_2 + x_3$$

$$\begin{aligned} \text{Subject to: } & x_1 + 2x_2 + x_3 \geq 6 \\ & 2x_1 + x_2 + 3x_3 \geq 8 \\ & x_1 + x_2 + x_3 = 4 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

18. A hospital needs at least 30 nurses for day shift and at least 20 nurses for night shift. Type A contract provides 3 day nurses and 1 night nurse at \$500/contract. Type B contract provides 2 day nurses and 2 night nurses at \$400/contract. Formulate and solve using Two-Phase method to minimize cost.

19. Solve the following problem using Two-Phase method:

$$\text{Maximize } Z = 3x_1 + 4x_2 + 2x_3$$

$$\begin{aligned} \text{Subject to: } & x_1 + x_2 + x_3 = 10 \\ & 2x_1 + 3x_2 + x_3 \geq 15 \\ & x_1 + 2x_2 + 2x_3 \geq 12 \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

20. Solve using Two-Phase method:

$$\text{Minimize } Z = x_1 + 2x_2 + 3x_3 + 4x_4$$

$$\begin{aligned} \text{Subject to: } & x_1 + x_2 + 2x_3 + x_4 \geq 5 \\ & 2x_1 + 3x_2 + x_3 + x_4 = 10 \\ & x_1 + 2x_2 + x_3 + 2x_4 \geq 8 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$