Assignment - 2

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Solution 1) The details provided in the problem are as follows:

Backsavers is a company that produces two types of bags made from nylon. Each week, the company receives a supply of 5,000 square fit of nylon.

i) collegiate Bag

ii) Mini Bag

→ collegiate Bag: Requires 3 sqft of nylon per unit. Profit of $32 per unit.

→ Mini Bag: Requires 2 sqft of nylon per unit
Profit of $24 per unit.

Production Capacities:-

→ Up to 1,000 collegiate bags can be sold per week

→ up to 1,200 Mini bags can be sold per week.

Production Time:-

→ Each collegiate bag takes 45 minutes to produce

→ Each Mini bag takes 40 minutes to produce.

Labor Details:-

→ 35 laborers are available, each working 40 hours per week, totaling 1,400 hours

Decision variables:

→ Let x be the no. of collegiate bags produced.

→ Let y be the no. of Mini bags produced.

objective Function:

The goal is to maximize the profit from the production of the bags. The objective function is

$$Z = 32x + 24y$$

Where $x \geq 0$ and $y \geq 0$

Constraints:

1) Nylon usage: The total nylon used should not exceed 5,000 sqft:

$$3x + 2y \leq 5000$$

2) Labor Hours: Each collegiate bag takes 45 min (or 0.75 hours) and each Mini bag takes 40 min (or 2/3 hours). The total available labor hours is 1,400:

$$\frac{3}{4}x + \frac{2}{3}y \leq 1400$$

3) Sales Limits:

$$0 \leq x \leq 1000$$

$$0 \leq y \leq 1200$$

Solution 2) A company operates three plants, each producing three sizes of products: Large (L), Medium (M), and Small (S). The details are as follows:

→ Net Profit per Unit:

- Large: $420 per Unit
- Medium: $360 per Unit
- Small: $300 per Unit

→ Production capacity (Units per Day)

- Large: 750 units
- Medium: 900 units
- Small: 450 units

→ In-Process Storage capacity:

- Plant 1: 13,000 sqft
- Plant 2: 12,000 sqft
- Plant 3: 5,000 sqft

→ Storage Space Required per Unit:

- Large: 20 sqft
- Medium: 15 sqft
- Small: 12 sqft

→ Sales Forecast:

- Large : 900 Units
- Medium: 1,200 units
- Small: ~~700~~ 750 units

Decision variables:

Let P_{ij} represent the no of units produced, where:

- i indicates the plant (1, 2 or 3),
- j indicates the product size (L, M or S)

objective Function:

The goal is to maximize the total profit from all plants. The objective function is:

$$Z = 420(P_{1L} + P_{2L} + P_{3L}) + 360(P_{1M} + P_{2M} + P_{3M}) + 300(P_{1S} + P_{2S} + P_{3S})$$

Constraints:

1. Production capacity:

$$P_{1L} + P_{2L} + P_{3L} \leq 750$$

$$P_{1M} + P_{2M} + P_{3M} \leq 900$$

$$P_{1S} + P_{2S} + P_{3S} \leq 450$$

2. Storage capacity

$$20P_{1L} + 15P_{1M} + 12P_{1S} \leq 13000$$

$$20P_{2L} + 15P_{2M} + 12P_{2S} \leq 12000$$

$$20P_{3L} + 15P_{3M} + 12P_{3S} \leq 5000$$

3. Sales Forecast:

$$P_{1L} + P_{2L} + P_{3L} \leq 900$$

$$P_{1M} + P_{2M} + P_{3M} \leq 1200$$

$$P_{1S} + P_{2S} + P_{3S} \leq 750$$

4. capacity Utilization:

To avoid layoffs, management has decided that each plant should use the same percentage of its excess capacity to produce the new products:

$$\frac{P_{1L} + P_{1M} + P_{1S}}{750} = \frac{P_{2L} + P_{2M} + P_{2S}}{900} = \frac{P_{3L} + P_{3M} + P_{3S}}{450}$$

Linear Programming Model:

The Linear programming model to maximize profit is:

$$Z = 420(P_{1L} + P_{2L} + P_{3L}) + 360(P_{1M} + P_{2M} + P_{3M}) + 300(P_{1S} + P_{2S} + P_{3S})$$

Subject to the above constraints