Assignment_2.
Linear Programming.

Solution 1:-

Given the following information: Back savers manufactures two types of bags using nylon, and the available nylon each week is 5,000 square feet

(1) Collegiate Bags

- Nylon requirement : 3 square feet per bag.
- sold per week : 1,000 Units
- production time : 45 minutes per bag.
- profit per bag : $32.

(2) Mini Bags :-

- Nylon requirement : 2 square feet per bag.
- sold per week : 1200 units.
- production time : 40 minutes per bag.
- profit per bag : $24.

Labor details :-

- Number of workers : 35
- weekly working hours per worker : 40
- Total weekly labor hours : 1400.

Decision Variables :- Let

- Z represents the objective function, which is the total profit.
- C represents the numbers of collegiate bags produced.
- M represents the numbers of Mini bags produced.

The objective is to Maximize the total profit, defined as,

$$Z = 32C + 24M.$$

with,

$$C \geq 0 \text{ and } M \geq 0.$$

Constraints:-

- Available nylon per week : $3C + 2M \leq 5000$
- Maximum number of collegiate bags : $0 \leq C \leq 1000$
- Maximum number of Mini bags : $0 \leq M \leq 1200$
- Total Available Labor hours per week : $\frac{3}{4}C + \frac{2}{3}M \leq 1400$

Thus, the mathematical model to maximize profit subject to constraints is ;

$$\text{Maximize } Z = 32C + 24M$$

Subject to:

$3C + 2M \leq 5000$, $\frac{3}{4}C + \frac{2}{3}M \leq 1400$, $0 \leq C \leq 1000$,

$0 \leq M \leq 1200$.

Solution 2:-

A Company operates three branch plants of different sizes {Large, medium, small} with the following data:

- Profit per unit ; \$420 (Large), \$360 (medium), \$300 (small).
- Excess capacity : 750 units (Large), 900 units (medium), 450 units (small).
- In-process storage space : 13,000 square feet (Large), 12000, Square feet (medium), 5,000 square feet (small).
- Space per unit produced : 20 square feet (Large), 15 square feet (medium), 12 square feet (small).
- Sales forecasts : 900 units (Large), 1200 units (medium), 750 units (small).

Decision Variables:- Let

- P_{il}, P_{im}, and P_{is} represent the number of Large, medium, and small units produced by plant i.

(Where $i = 1, 2, 3$ corresponds to the Large, medium and small plants).

objective function :- The goal is to maximize profit by producing the correct number of units in each plant

$$Z = 420(P_{1l} + P_{2l} + P_{3l}) + 360(P_{1m} + P_{2m} + P_{3m}) + 300(P_{1s} + P_{2s} + P_{3s})$$

where 420, 360 and 300 represent the profit per unit for each plant size.

Constraints:-

- production limits:

$P_{1L} + P_{2L} + P_{3L} \le 750,$

$P_{1m} + P_{2m} + P_{3m} \le 900,$

$P_{1s} + P_{2s} \le 450.$

- Storage capacity constraints:

$20P_{1L} + 15P_{1m} + 12P_{1s} \le 13000, \quad 20P_{2L} + 15P_{2m} + 12P_{2s} \le 12000,$

$20P_{3L} + 15P_{3m} + 12P_{3s} \le 5000.$

- Sales forecasts:

$P_{1L} + P_{2L} + P_{3L} \le 900, \quad P_{1m} + P_{2m} + P_{3m} \le 1200, \quad P_{1s} + P_{2s} + P_{3s} \le 750$

The Company has decided to ensure that each point (or) each plant utilizes the same percentage of it's excess capacity of production:

$$\frac{P_{1L} + P_{1m} + P_{1s}}{750} = \frac{P_{2L} + P_{2m} + P_{2s}}{900}.$$

The linear programming model is:

Maximize $Z = 420(P_{1L} + P_{2L} + P_{3L}) + 360(P_{1m} + P_{2m} + P_{3m}) + 300(P_{1s} + P_{2s} + P_{3s})$

Subject to the constraints mentioned above.