Assignment 1

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Question 1

1.Define the decision Variables.

The decision variables are Number of Collegiate(W_c) and Mini backpacks(W_m) generated per week

$$The\ \ number\ \ of\ \ Collegiate\ \ Backpacks = W_c$$

$$The\ \ number\ \ of\ \ Minis\ \ Backpacks = W_m$$

$$The\ \ Total\ \ Profit = T_P$$

2.What is Objective function?

The objective function is to maximize profit.So W_c makes Profit of 32 dollars and W_m Generates Profit of 24 dollars

$$Max \quad z = 32W_c + 24W_m$$

3.What are the Constraints?

Material Constraint:

Bank savers receive a nylon fabric of 5000 sq.ft

3Sq.ft Nylon fabric needed for W_c

2Sq_ft needed for W_m

$$3W_c + 2W_m \leq 5000$$

Time Constraint:

35 Employees works 40hours per week

W_c Requires 45minutes of labor to generate Profit of 32$ and W_m Requires 40minutes to earn profit of 25$

$$45W_c + 40W_m \leq 35Employees * 40hours * 60mintues$$

* Non-Negativity Constraint: *

$$0 \leq W_c \leq 1000$$

$$0 \leq W_m \leq 1200$$

4. Write Down the full Mathematical formulation of this LP Problem?

$$W_c = Number\ \ of\ \ collegiate\ \ backpacks\ \ per\ \ week$$

$$W_m = Number\ \ of\ \ Mini\ \ backpacks\ \ per\ \ week$$

$$Max \quad = 32W_c + 24W_m$$

Subject to

$$W_c \leq 1000\ \ Collegiates\ \ sold\ \ per\ \ week$$

$$W_m \leq 1200\ \ Minis\ \ Sold\ \ per\ \ week$$

$$45W_c + 40W_m \leq 84000\ minutes\ per\ week\ (35employees * 40hours * 60minutes)$$

$$3W_c + 2W_m = 5000sq.ft\ of\ material\ required\ per\ week$$

Question 2 :

1. Define the Decision Variables.

The number of units of the new Product , regardless of the size , that should be produced on each plant to maximize the profit of the weight corporation.

Note:

$$N_p = Number\ of\ units\ produced\ on\ each\ plant$$

i.e,

p = 1(Plant1),2(Plant2),3(plant3).

$$L, M, S = Product's\ \ Size$$
$$Where\ \ L = Large, M = Medium, S = Small$$

Decision Variables :

$$N_pL = No.of\ \ Large\ \ sized\ \ items\ \ produced\ \ on\ \ plant\ \ P$$
$$N_pM = No.of\ \ Medium\ \ sized\ \ items\ \ produced\ \ on\ \ plant\ \ P$$
$$N_pS = No.of\ \ Small\ \ sized\ \ items\ \ produced\ \ on\ \ plant\ \ P$$

B. Formulate a Linear Programming for this Problem:

$$N_pL = No.of\ \ Large\ \ sized\ \ items\ \ produced\ \ on\ \ plant\ \ P$$

$$N_pM = No.of\ \ Medium\ \ sized\ \ items\ \ produced\ \ on\ \ plant\ \ P$$

$$N_pS = No.of \ \ Small \ \ sized \ \ items \ \ produced \ \ on \ \ plant \ \ P$$

Where

$$P = 1(Plant1), 2(Plant2), 3(Plant3)$$

Maximize Profit:

$$Max \quad Z = 420(N_1L + N_2L + N_3L) + 360(N_1M + N_2M + N_3M) + 300(N_1S + N_2S + N_3S)$$

Constraints:

Total Number of Size's units Produced regardless the plant:

$$L = N_1L + N_2L + N_3L$$

$$M = N_1M + N_2M + N_3M$$

$$S = N_1S + N_2S + N_3S$$

Production Capacity per unit by plant each day i.e,

$$Plant\ 1 = N_1L + N_1M + N_1S \leq 750$$

$$Plant\ 2 = N_2L + N_2M + N_2S \leq 900$$

$$Plant\ 3 = N_3L + N_3M + N_3S \leq 450$$

Storage capacity per unit by plant each day:

$$Plant \ \ 1 = 20N_1L + 15N_1M + 12N_1S \leq 13000$$
$$Plant \ \ 2 = 20N_2L + 15N_2M + 12N_2S \leq 12000$$
$$Plant \ \ 3 = 20N_3L + 15N_3M + 12N_3S \leq 5000$$

Sales Forecast per day

$$L = N_1L + N_2L + N_3L \leq 900$$

$$M = N_1M + N_2M + N_3M \leq 1200$$

$$S = N_1S + N_2S + N_3S \leq 750$$

The Plants always utilize the same % of their excess capacity to produce the new product.

$$\frac{N_1L + N_1M + N_1S}{750} = \frac{N_2L + N_2M + N_2S}{900} = \frac{N_3L + N_3M + N_3S}{450}$$

It Can be Denoted as :

a)

$$900(N_1L + N_1M + N_1S) - 750(N_2L + N_2M + N_2S) = 0$$

b)

$$450(N_2L + N_2M + N_2S) - 900(N_3L + N_3M + N_3S) = 0$$

c)

$$450(N_1L + N_1M + N_1S) - 750(N_3L + N_3M + N_3S) = 0$$

All Values Must be greater or equal to zero

$$L, M \quad and \quad S \geq 0$$

$$N_PL, N_PM, N_PS \geq 0$$