Assignment 1

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Problem 1

A. Clearly Define the Decision Variables

Back Savers company considered offering two different (Collegiate and Mini) Backpacks to students per week.

Let,

X_1 = Number of collegiate Backpacks to be Produced per week.

X_2 = Number of Mini Backpacks to be Produced per week.

B. What is the Objective Function?

Objective Function Z = 32X1 + 24X2

C. What are the Constraints?

$X_1 \leq 1000$ maximum collegiates sold per week

$X_2 \leq 1200$ maximum Mini sold per week

$45X_1 + 40X_2 \leq 84000$ Labor minutes per week (35 People * 40 Hours * 60 Minutes)

$3X_1 + 2X_2 \leq 5000$ Square-Foot of material Per week

Non-Negativity:

$X_1 \geq 0$

$X_2 \geq 0$

D. Write down the full mathematical formulation for this LP Problem

Let,

X_1 = Number of Collegiate Backpacks to be Produced per week.

X_2 = Number of Mini Backpacks to be Produced per week.

Max $Z = 32X_1 + 24X_2$

Subject To

$X_1 \leq 1000$ maximum Collegiate Sold per week

$X_2 \leq 1200$ Maximum Mini Sold per week

$45X_1 + 40X_2 \leq 84000$ Minutes per week (35 people * 40 Hours * 60 Minutes)

$3X_1 + 2X_2 \leq 5000$ Square-foot of material per week

$X_1 \geq 0$

$X_2 \geq 0$

Problem 2

A. Define the decision variables

Decision Variables are the number of units of the new product, regardless its size that should be produced on each plant to maximize the weigelt corporation's profit.

Note:

Y_i = number of unites produced on each plant,

Where i = 1 (Plant 1), 2 (Plant 2), 3 (Plant 3).

L, M and S = Product's Size, Where L = large, M = medium, S = small.

Decision Variables:

Y_iL = Number of Large sized items produced on plant i

Y_iM = Number of Medium sized items produced on plant i

Y_iS = Number of Small sized items produced on plant i,

Where i = 1 (Plant 1), 2 (Plant 2), 3 (Plant 3).

B. Formulate a Linear Programming for this Problem:

Let,

Y_iL = Number of Large sized items produced on plant i

Y_iM = Number of Medium sized items produced on plant i

Y_iS = Number of Small sized items produced on plant i,

Where i = 1 (Plant 1), 2 (Plant 2), 3 (Plant 3).

Maximize Profit

$$Z = 420 (Y_1L + Y_2L + Y_3L) + 360 (Y_1M + Y_2M + Y_3M) + 300 (Y_1S + Y_2S + Y_3S)$$

Constraints:

Total number of size's units produced regardless the plant:

$L = Y_1L + Y_2L + Y_3L$

$M = Y_1M + Y_2M + Y_3M$

$S = Y_1S + Y_2S + Y_3S$

Production Capacity per unit by plant each day:

Plant 1 = $Y_1L + Y_1M + Y_1S \leq 750$

Plant 2 = $Y_2L + Y_2M + Y_2S \leq 900$

Plant 3 = $Y_3L + Y_3M + Y_3S \leq 450$

Storage capacity per unit by plant each day:

Plant 1 = $20Y_1L + 15Y_1M + 12Y_1S \leq 13000$

Plant 2 = $20Y_2L + 15Y_2M + 12Y_2S \leq 12000$

Plant 3 = $20Y_3L + 15Y_3M + 12Y_3S \leq 5000$

Sales forecast per day:

$L = Y_1L + Y_2L + Y_3L \leq 900$

$M = Y_1M + Y_2M + Y_3M \leq 1200$

$S = Y_1S + Y_2S + Y_3S \leq 750$

The Plants should use the same percentage of their excess capacity to produce the new product.

$$\frac{Y_1L + Y_1M + Y_1S}{750} = \frac{Y_2L + Y_2M + Y_2S}{900} = \frac{Y_3L + Y_3M + Y_3S}{450}$$

It can be simplified as:

a) $900\ (Y_1L + Y_1M + Y_1S) - 750\ (Y_2L + Y_2M + Y_2S) = 0$

b) $450\ (Y_2L + Y_2M + Y_2S) - 900\ (Y_3L + Y_3M + Y_3S) = 0$

c) $450\ (Y_1L + Y_1M + Y_1S) - 750\ (Y_3L + Y_3M + Y_3S) = 0$

All Values must be greater or equal to zero

$L, M \text{ and } S \geq 0$

$Y_iL, Y_iM \text{ and } Y_iS \geq 0$