QMM Assignment

2023-09-10

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knitr::opts_chunk$set(echo = TRUE)
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Quantitative Management Modeling ASSIGNMENT-1

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Question 1:

a. Clearly define the decision variables.

The decision variables are the numbers of collegiate(b_c) and Mini bags pack(b_m) that are generated every week.

Suppose the total profit is

$$t_p$$

Suppose the number of collegiate back packs is

$$b_c$$

Suppose the number of mini back packs is

$$b_m$$

b. What is the objective function?

The objective function is to maximize profit.collegiate back packs generate a profit of '$32' and mini back packs generate a profit of '$24'.

Maximized Profit is

$$m_p$$

$$m_p = 32b_c + 24b_m$$

c. What are the constraints?

Material Constraints: Back savers receive a nylon fabric of 5,000 Sq.ft and 3sq.ft nylon fabric needed for collegiate back packs and 2Sq.Ft needed for mini back packs.

$$3b_c + 2b_m \leq 5000$$

Time constraint: 35 Employees works 40 hours a week. Collegite bags require 45 minutes of labour to generate profit of $32 and mini back packs need 40 minutes to earn profit of $25.

$$45b_c + 40b_m \leq 35$$

employees*40hours*60 minutes

Non-Negativity:

$$0 \leq b_c \leq 1000$$

$$0 \leq b_m \leq 1200$$

d. Write down the full mathematical formulation for this LP problem.

Number of collegiate backpacks per week:

$$b_c$$

Number of Mini backpacks per week:

$$b_m$$

Maximized profit

$$m_p = 32b_c + 24b_m$$

Subject to collegiate backpacks sold per week:

$$b_c \leq 1000$$

mini backpacks sold per week:

$$b_m \leq 1200$$

minutes per week: (35 employees*40 hours*60 minutes)

$$45b_c + 40b_m \leq 84000$$

Material required per week:

$$3b_c + 2b_m \leq 5000sq.ft$$

Question 2:

A. Define the decision variables.

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

Note: X= number of units produced on each plant,

i.e., 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:

Number of Large sized items produced on plant 1

$$XL_1$$

Number of Medium sized items produced on plant 2

$$XM_2$$

Number of Small sized items produced on plant 3

$$XS_3$$

B. Formulate a Linear Programming for this Problem:

Number of Large sized items produced on plant i

$$XL_i$$

Number of Medium sized items produced on plant i

$$XM_i$$

Number of Small sized items produced on plant i

$$XS_i$$

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

Maximized Profit: z=maximized profit

$$Z = 420(XL_1 + XL_2 + XL_3) + 360(XM_1 + XM_2 + XM_3) + 300(XS_1 + XS_2 + XS_3)$$

Constraints:

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

$$L = XL_1 + XL_2 + XL_3$$

$$M = XM_1 + XM_2 + XM_3$$

$$S = XS_1 + XS_2 + XS_3$$

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

$$Plant1 = XL_1 + XM_1 + XS_1 \leq 750$$

$$Plant2 = XL_2 + XM_2 + XS_2 \leq 900$$

$$Plant3 = XL_3 + XM_3 + XS_3 \leq 450$$

Storage capacity per unit by plant each day:

$$Plant1 = 20XL_1 + 15XM_1 + 12XS_1 \leq 13000$$

$$Plant2 = 20XL_2 + 15XM_2 + 12XS_2 \leq 12000$$

$$Plant3 = 20XL_3 + 15XM_3 + 12XS_3 \leq 5000$$

Sales forecast per day:

$$L = XL_1 + XL_2 + XL_3 \leq 900$$

$$M = XM_1 + XM_2 + XM_3 \leq 1200$$

$$S = XS_1 + XS_2 + XS_3 \leq 750$$

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

$$XL_1 + XM_1 + XS_1/750 = XL_2 + XM_2 + XS_2/900 = XL_3 + XM_3 + XS_3/450$$

It can be denoted as: a)

$$900(XL_1 + XM_1 + XS_1) – 750(XL_2 + XM_2 + XS_2) = 0$$

b)

$$450(XL_2 + XM_2 + XS_2) – 900(XL_3 + XM_3 + XS_3) = 0$$

c)

$$450(XL_1 + XM_1 + XS_1) – 750(XL_3 + XM_3 + XS_3) = 0$$

All Values must be greater or equal to zero L, M and S ≥ 0

$$XL_i, XM_i, XS_i \geq 0$$