

QUANTITATIVE MANAGEMENT- Assignment 1

Back Savers is a company that produces backpacks primarily for students. They are considering offering some combination of two different models—the Collegiate and the Mini. Both are made out of the same rip-resistant nylon fabric. Back Savers has a long-term contract with a supplier of the nylon and receives a 5000 square-foot shipment of the material each week. Each Collegiate requires 3 square feet while each Mini requires 2 square feet. The sales forecasts indicate that at most 1000 Collegiates and 1200 Minis can be sold per week. Each Collegiate requires 45 minutes of labor to produce and generates a unit profit of \$32. Each Mini requires 40 minutes of labor and generates a unit profit of \$24. Back Savers has 35 laborers that each provides 40 hours of labor per week. Management wishes to know what quantity of each type of backpack to produce per week.

A) Defining the decision variables:

X_1 : Number of Collegiate bags

X_2 : Number of Mini bags

$Z_{(\max)}$: Maximum Profit

Y_1 : Time required to make Collegiate bags (in minutes)

Y_2 : Time required to make Mini bags(in minutes)

A_1 : Material required to make Collegiate bags (in sq feet)

A_2 : Material required to make Mini bags(in sq feet)

B) Objective Function:

Maximizing the profit of the company, can be denoted by

$$32 X_1 + 24 X_2 = Z_{(\max)}$$

C) Constraints:

Backsavers is planning to sell collegiate bags and mini bags.Let,

Collegiate bags be X_1

Number of Mini bags be X_2

Area of material required for Collegiate : 3_{sqft}

Area of material required for Mini: 2_{sqft}

Backsavers receives $5000_{\text{sqft/week}}$.

So , the equation will be:

$$3 A_1 + 2 A_2 \leq 5000_{\text{sqft}}$$

Collegiate bags makes 32\$ profit and require 45 mins to be prepares and Mini Bags makes 24\$ profit and requires 40 mins to produce. The total labours for the company is 35 and works for 40hrs/week. Therefore,

$$\text{Total Labour time in mins} = 40 \times 24 \times 35 = 84000 \text{ mins.}$$

$$45 Y_1 + 40 Y_2 \leq 84000 \text{ mins}$$

Sales forecast predicts that at most 1000 Collegiates and 1200 Mini bags could be sold. So,

$$X_1 \leq 1000$$

$$X_2 \leq 1200$$

D) Full mathematical formulation :

$$32 X_1 + 24 X_2 = Z_{(\max)} \dots\dots\dots(1)$$

$$3 A_1 + 2 A_2 \leq 5000 \text{ sqft}) \dots\dots\dots(2)$$

$$45 Y_1 + 40 Y_2 \leq 84000 \text{ mins}) \dots\dots\dots(3)$$

$$X_1 \leq 1000) \dots\dots\dots(4)$$

$$X_2 \leq 1200) \dots\dots\dots(5)$$

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