

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 longterm contract with a supplier of 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 provide 40 hours of labor per week. The management wishes to know what quantity of each type of backpack to produce per week.

- a. Clearly define the decision variables
- b. What is the objective function?
- c. What are the constraints?
- d. Write down the full mathematical formulation for this LP problem.

Solution below:

Solution to Asstgt. 1.

a. The decision variables are a combination of two different models namely the Collegiate and the Mini made from the same oil-resistant nylon fabric. Backsavers would now make a decision on these two variables (the quantity to produce)

b. The objective function: The management wants to ascertain what quantity of each type of backpack to produce each week to meet the demand of 5000 square-foot of backpack each week, while optimally utilizing its limited 35 number of labours for profit maximization

c. The constraints are the number of minutes (time) to produce individual product model, and the number of ^{per labour} labours that are required to produce the products per week to meet the demand; and Profit maximization

d. The Mathematical formula:

✓ weekly demand of backpack = 5,000 square foot

✓ Collegiate = x_1

Mini = x_2

$$x_1 \geq 1,000$$

$$x_2 \geq 1,200$$

✓ To maximize Profit; $= 32x_1 + 24x_2$

✓ we know that 3 and 2 required sq ft of each has a demand of 5000

✓ 1 week = 24 hrs \times 7 days \times 60 minutes = 10,080 minutes

1 Collegiate requires \rightarrow 45 min

1 Mini \rightarrow 40 min, so $35 \times 40 \times 60 = 84,000$ min

we now have:

$$\begin{aligned} 32x_1 + 24x_2 &\leq 5,000 \\ 45x_1 + 40x_2 &\leq 84,000 \\ x_1, x_2 &\geq 0 \end{aligned}$$