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 labour to produce and generates a unit profit of $32. Each Mini requires 40 minutes of labour and generates a unit profit of $24. Back Savers has 35 laborers that each provides 40 hours of labour per week. 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.

Answer:

Consider,

X1 is the number of units of Collegiate backpacks to be produced per week.

X2 is the number of units of Mini backpacks to be produced per week.

a. The decision variables for the above problem are the number of units of each model to be produced to obtain maximum profits i.e., X1 and X2.
b. The objective function of the above problem is as below,

$$32X1 + 24X2 = Z$$

Where,

32 and 24 are profit per unit backpack of each model.

Z is the total profit per week.

c. The constraints are the limits to which labour, raw material and number of units of each model that can be produced per week.

Labour constraint: $45X1 + 40X2 \leq 84,000$

Material constraint: $3X1 + 2X2 \leq 5,000$

Unit production constraints: $X1 \leq 1000$, $X2 \leq 1200$

$X1, X2 > 0$

d. The mathematical formulation for the above problem is as below.

$$32X1 + 24X2 = Z$$

Where,

$$45X1 + 40X2 \leq 84,000$$

$$3X1 + 2X2 \leq 5,000$$

$$X1, X2 > 0$$