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.
   1. Clearly define the decision variables
   2. What is the objective function?
   3. What are the constraints?
   4. Write down the full mathematical formulation for this LP problem.

**Solution:**

**a. Clearly define the decision variables**

Decision variable are:

-How many collegiate to produce

-How many minis to produce

Let c= Number of collegiate to produce

Let m= number of minis to produce

**b. What is the objective function?**

In this case the objective function would be to produce number of each type of backpack to achieve maximum profit.

The objective function is therefore

Maximize total profit= $32c + 24m

**c. What are the constraints?**

The constraint are nylon and labor hours

Nylon: 3c + 2m ≤5000 sq. foot

Labor: (3/4)c +(2/3)m ≤1400 hours (35 hours =40 labors)

(Total hours = 1400 hours)

The final constraint is that they should not produce more minis and collegiate than sales forecast

Sales forecast: c ≤1000

m ≤1200

and,

c ≥ 0

m ≥ 0

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

Let c = no of collegiate to produce

Let m = no of minis to produce

Maximum total profit = $32c + $24m

s.t. nylon: 3c + 2m ≤ 5000sq foot

labor hour: (3/4)c + (2/3)m ≤ 1400 hours

Sales forecast c ≤ 1000

m ≤1200

c ≥ 0

m ≥ 0