Assignment 1

2. 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. 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:

The problem above says the following information about Back Savers Company.

2 Models	Collegiate	Mini
Fabric Used	Rip-Resistant Nylon	Rip-Resistant Nylon
Nylon Received / Week	5000Sft	
Nylon Usage / Bag	3Sft	2Sft
Sales / Week	1000	1200
Labor Time	45 Min	40 Min
Unit Profit	$32	$24
Labor Count	35	35
Labor Hrs./Week	40	40

Based on the above content the Management wishes to know what quantity of each type of backpack to produce per week.

A. Clearly define the decision variables.

Answer: As we have **two** models to be produced **per week** i.e., Collegiate & Mini.

We have two decisions which can be defined as.

C_p= Collegiate to be Produced **M_p = Mini to be Produced**

B. What is the objective function?

Answer: The main objective is to find the **count** of each type of backpack production which would help in achieving **higher profits**.

C. What are the constraints?

Answer: The major constraints would be availability of the fabric and labor.

So, we can say that **Nylon Fabric** and **Labor** are the constraints.

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

Answer:

C_p= Collegiate to be Produced
M_p = Mini to be Produced

Profit Max $\$_M = [32C_p + 26M_p]$ ------ ($32 & $24 values are from the given unit profits above)

35 Labors work for 40 Hrs./Week = 35*40 = 1400 Hours

Since Labor time is in Hrs. Converting the above minutes to Hours.

Labor Time – (Mins to Hours - Dividing by 60)
Collegiate 45 Min = 0.75 Hrs.
Mini 40 Min = 0.66 Hrs.

Nylon Used Per bag - **$3C_p + 2M_p \leq 5000$ Sft**
Labor Hours - **$0.75C_p + 0.66M_p \leq 1400$ Hrs.**
Sales - **$C_p \leq 1000$, $M_p \leq 1200$**
and **$C_p \geq 0$, $M_p \geq 0$**

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