Assignment 1

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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

Decision variables is quantity for units of backpack (Mini and Collegiate backpack) to produce for each week.

b. What is the objective function?

X_1= Number of Collegiate backpacks to produce for each week.
X_2= Number of Mini backpacks produced for each week.
Z = Profit ($)

Objective function is to find how many units to produce each week so the profit is maximized:

$Z = 32X_1 + 24X_2$

c. What are the constraints?

$X_1 \leq 1000$ maximum units sold each week
$X_2 \leq 1200$ maximum units sold each week
$45X_1 + 40X_2 \leq 84000$ minutes each week (35*40*60)
$3X_1 + 2X_2 \leq 5000$ square-foot of material each week
$X_1 \geq 0$
$X_2 \geq 0$

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

Let X_1 = Number of Collegiate backpacks to produce for each week.
Let X_2 = Number of Mini backpacks produced for each week.
Let Z = Profit ($)

Maximum profit function:
$Z = 32X_1 + 24X_2$

$X_1 \leq 1000$ maximum units sold each week
$X_2 \leq 1200$ maximum units sold each week
$45X_1 + 40X_2 \leq 84000$ minutes each week (35*40*60)
$3X_1 + 2X_2 \leq 5000$ square-foot of material each week
$X_1, X_2 \geq 0$