**Assignment 1**

**Question:** 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 Collegiate 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:**

**Given:**

Total shipment of material per week = 5000 sq. ft.

Material required for each Collegiate bag = 3 sq. ft.

Material required for each Mini bag = 2 sq. ft.

Sales forecast for Collegiate bag per week <= 1000 units

Sales forecast for Mini bag per week <= 1200 units

Cost Co-efficient:

Unit profit for Collegiate = $32

Unit profit for Mini = $24

Total labor hours = 35 labors \* 40 hours = 1400 hours

1. **To define decision variable:**

Let, X1 = Quantity of Collegiate Bags to be produced per week.

X2 = Quantity of Mini Bags to be produced per week.

1. **Objective Function:**

Maximum Total Profit gained by Collegiate and Mini bags per week.

Maxz = 32X1 + 24X2

1. **Constraints:**
2. Total available Material

3X1 + 2X2 <= 5000 sq. ft.

1. Sales Forecast

X1 <= 1000 units

X2 <= 1200 units

1. Labor Hours

(45/60) X1 + (40/60) X2 <= 1400 hours - (45 min and 40 min are converted into hours)

1. **Mathematical Formulation of Linear Programming Problem:**

Let,

X1 = Quantity of Collegiate Bags to be produced per week.

X2 = Quantity of Mini Bags to be produced per week.

Maxz = 32X1 + 24X2

Subject to

3X1 + 2X2 <= 5000 sq. ft.

X1 <= 1000 units

X2 <= 1200 units

(45/60) X1 + (40/60) X2 <= 1400 hours

And

X1 >= 0, X2 >= 0

Srushti Padade

spadade@kent.edu