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# Quantitative Management Modeling - Module 2 - The LP Model

**1. Back Savers**

a. Decision Variables: x = Number of Collegiate backpacks to produce
y = Number of Mini backpacks to produce

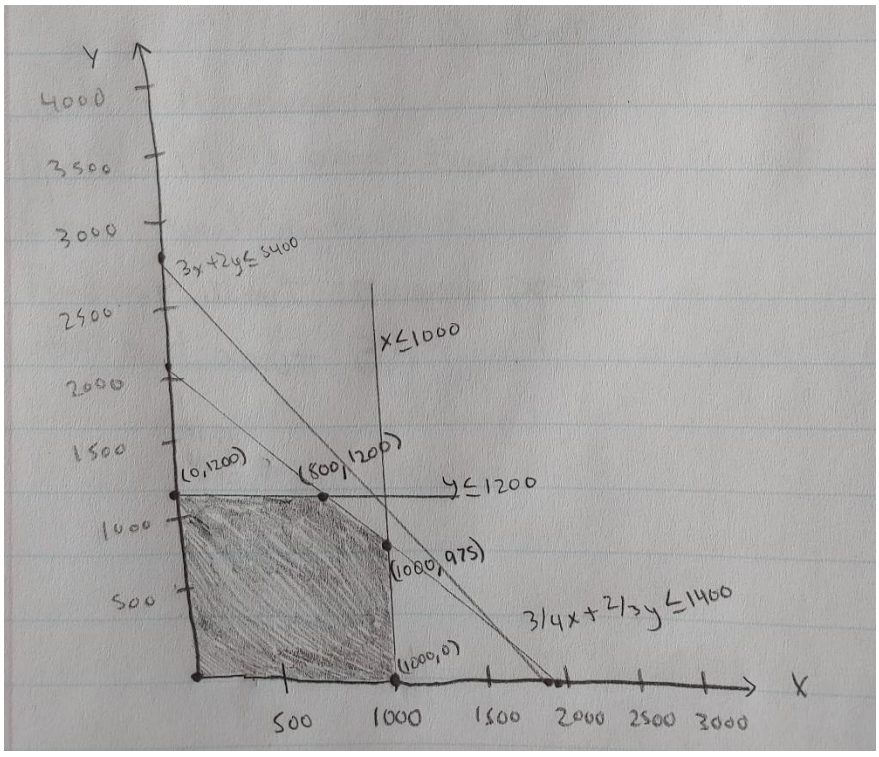
b. Objective Function: Maximize Profit: Z = 32x +24y

c. Constraints: Nylon Material: 3x +2y <= 5400 sqft

Labor Hours: ¾ x + 2/3y <= 1400 hrs; 45mins -> ¾ hrs, 40mins -> 2/3 hrs

Sales Forecast: x <= 1000; y <= 1200

Non-Negativity Constraint: x >= 0; y >= 0




d. Decision Variables: x = Number of Collegiate backpacks to produce
y = Number of Mini backpacks to produce

Objective Function: Maximize Profit: Z = 32x +24y

Constraints: Nylon Material: 3x +2y <= 5400 sqft

Labor Hours: ¾ x + 2/3y <= 1400 hrs; 45mins -> ¾ hrs, 40mins -> 2/3 hrs

Sales Forecast: x <= 1000; y <= 1200

Non-Negativity Constraint: x >= 0; y >= 0

e. Finding the remaining 2 optimal points
   i. y = 1200
      3/4x + 2/3y = 1400
      3/4x + 2/3(1200) = 1400
      3/4x + 800 = 1400
      3/4x = 600
      x = 800
      Optimal Coordinate 1 (800, 1200)

   ii. x = 1000
      3/4x + 2/3y = 1400
      ¾(1000) + 2/3y = 1400
      750 + 2/3y = 1400
      2/3y = 650
      y = 975
      Optimal Coordinate 2 (1000, 975)

   iii. Which is the optimal solution?
      1. (0, 1200)
         32(0) + 24(1200)
         = 28,800
      2. (800, 1200)
         32(800) + 24(1200)
         = 54,400
      3. (1000, 975)
         32(1000) + 24(975)
         = 55,400
      4. (1000, 0)
         32(1000) + 24(0)
         = 32,000

   iv. The optimal solution would be to produce 1000 Collegiate and 975 Mini backpacks.

**2. Weigelt Corporation**

a. Decision Variables: $S_1$ = Number of small units produced at Plant 1 daily
$S_2$ = Number of small units produced at Plant 2 daily
$S_3$ = Number of small units produced at Plant 3 daily
$M_1$ = Number of medium units produced at Plant 1 daily
$M_2$= Number of medium units produced at Plant 2 daily
$M_3$ = Number of medium units produced at Plant 3 daily
$L_1$ = Number of large units produced at Plant 1 daily
$L_2$ = Number of large units produced at Plant 2 daily
$L_3$ = Number of large units produced at Plant 3 daily

b. Objective Function: Maximize Profit: $Z = (300 * S_1) + (300 * S_2) + (300 * S_3) + (360 * M_1) + (360 * M_2) + (360 * M_3) + (420 * L_1) + (420 * L_2) + (420 * L_3)$

Constraints: Excess Capacity: $L_1 + M_1 + S_1 <= 750$

$L_2 + M_2 + S_2 <= 900$

$L_3 + M_3 + S_3 <= 450$

Storage Space: $20L_1 + 15M_1 + 12S_1 <= 13,000$

$20L_2 + 15M_2 + 12S_2 <= 12,000$

$20L_3 + 15M_3 + 12S_3 <= 5,000$

Sales Forecast: $L_1 + L_2 + L_3 <= 900$

$M_1 + M_2 + M_3 <= 1200$

$S_1 + S_2 + S_3 <= 750$

Eliminate Excess Capacity: $((L_1 + M_1 + S_1) / 750) - ((L_2 + M_2 + S_2) / 900) = 0$

$((L_2 + M_2 + S_2) / 900) - ((L_3 + M_3 + S_3) / 450) = 0$

$((L_1 + M_1 + S_1) / 750) - ((L_3 + M_3 + S_3) / 450) = 0$

Non-Negativity Constraint: $L_1 >= 0$; $L_2 >= 0$; $L_3 >= 0$; $M_1 >= 0$; $M_2 >= 0$; $M_3 >= 0$; $S_1 >= 0$; $S_2 >= 0$; $S_3 >= 0$