Assignment 1

Name: Avinash Ravipudi (Vravipud@kent.edu)
Course: QUANTITATIVE MANAGEMENT MODELING (MIS-64018-002)

1.

a. Clearly define the decision variables

Collegiate and Mini are decision variables
Let x1 = Number of collegiate backpacks manufactured
x2 = Number of Mini backpacks manufactured
Z = Total profit produced per week

b. What is the objective function?

Let Z be the Max profit,

$$Z = 32x1 + 24x2$$

c. What are the constraints?

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 square feet.

$3x1 + 2x2 <= 5000$

The sales forecasts indicate that at most 1000 Collegiates and 1200 Minis can be sold per week

$x1 <= 1000, x2<=1200$

Collegiate requires 45 minutes of labor
Mini requires 40 minutes of labor
Back Savers has 35 laborers that each provides 40 hours of labor per week

$45/60x1 + 40/60x2 <= 35x40$
$3/4x1 + 2/3x2 <= 1400$

$x1>=0, x2>=0$

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

Maximize $Z = 32x1 + 24x2$

Subject to restrictions:

$$3x1 + 2x2 <= 5000$$
$$x1 <= 1000, x2<=1200$$
$$3/4x1 + 2/3x2 <= 1400$$

And

$$x1>=0, x2>=0$$

2.

a. Define the decision variables

Let three plants be p1, p2, p3
Three sizes of product be Large(l), Medium(m), Small(s)

Let, The Number of Large size products produced by plant 1 be p1l
The Number of Medium size products produced by plant 1 be p1m
The Number of Small size products produced by plant 1 be p1s

The Number of Large size products produced by plant 2 be p2l
The Number of Medium size products produced by plant 2 be p2m
The Number of Small size products produced by plant 2 be p2s

The Number of Large size products produced by plant 3 be p3l
The Number of Medium size products produced by plant 3 be p3m
The Number of Small size products produced by plant 3 be p3s

Decision variables: p1l, p1m, p1s , p2l, p2m, p2s, p3l, P3m, p3s

b. Formulate a linear programming model for this problem

Objective Function:
product can be made in three sizes large, medium, and small that yield a net unit profit of $420, $360, and $300, respectively.

Let Z be the Max profit,

$$Z = 420(p1l + p2l +p3l) + 360(p1m + p2m +p3m) + 300(p1s + p2s +p3s)$$

Constraints:
Plants 1, 2, and 3 have the excess capacity to produce 750, 900, and 450 units per day of this product, respectively, regardless of the size or combination of sizes involved.
P1l + p1m +p1s <= 750

P2l + p2m +p2s <= 900
P3l + p3m +p3s <= 450

plants 1, 2, and 3 have 13,000, 12,000, and 5,000 square feet, respectively, of in process storage space available for a day's production of this product. Each unit of the large, medium, and small sizes produced per day requires 20, 15, and 12 square feet, respectively

20p1l + 15p1m + 12p1s <= 13000
20p2l + 15p2m + 12p2s <= 12000
20p3l + 15p3m + 12p3s <= 5000

Sales forecasts indicate that if available, 900, 1,200, and 750 units of the large, medium, and small sizes, respectively, would be sold per day

p1l + p1m +p1s <= 900
p2l + p2m +p2s <= 1200
p3l + p3m +p3s <= 750

To avoid layoffs if possible, management has decided that the plants should use the same percentage of their excess capacity to produce the new product.

750(p1l + p1m +p1s) − 900(p2l + p2m +p2s) = 0
900(p2l + p2m +p2s) − 450(p3l + p3m +p3s) = 0
450(p3l + p3m +p3s) – 750(p1l + p1m +p1s) = 0

p1l, p1m, p1s >= 0
p2l, p2m, p2s >= 0
p3l, p3m, p3s >= 0

Formulating the problem,

Maximize Z = 420(p1l + p2l +p3l) + 360(p1m + p2m +p3m) + 300(p1s + p2s +p3s)

Subject to restrictions:

p1l + p1m +p1s <= 750
p2l + p2m +p2s <= 900
p3l + p3m +p3s <= 450

20p1l + 15p1m + 12p1s <= 13000
20p2l + 15p2m + 12p2s <= 12000

$20p3l + 15p3m + 12p3s <= 5000$

$p1l + p1m + p1s <= 900$
$p2l + p2m + p2s <= 1200$
$p3l + p3m + p3s <= 750$

$750(p1l + p1m + p1s) - 900(p2l + p2m + p2s) = 0$
$900(p2l + p2m + p2s) - 450(p3l + p3m + p3s) = 0$
$450(p3l + p3m + p3s) - 750(p1l + p1m + p1s) = 0$

And

$p1l,\ p1m, p1s >= 0$
$p2l, p2m, p2s >= 0$
$p3l, p3m, p3s >= 0$