Assignment 2

Question 1

a) The decision variables are the quantity of Collegiate backpack produced and the quantity of mini backpacks produced.

b) Let x_j = type of backpack where: j=1 – Collegiate; j=2 – Mini and Z = profit.

$$\text{Maximize (Z)} - Z = 32x_1 + 24x_2$$

c) Functional constraints include demand Constraints, nylon resource constraint and labor constraint. The LP model assumes non-negativity constraints. See full equations below.

d) Objective Function:

$$\text{Maximize (Z)} - Z = 32x_1 + 24x_2$$

Functional Constraints:

$x_1 \leq 1000$
$x_2 \leq 1,200$ } Demand constraints

$3x_1 + 2x_2 \leq 5,000$ } Nylon resource constraint

$45x_1 + 40x_2 \leq 84,000$ } Labor constraint

Nonnegativity Constraints:

$x_1, x_2 \geq 0$

Question 2

a) The decision variables would be number of each size produced at each plant.

Let $X_{j,k}$ = size, plant # where:

j = 1 – large; j = 2 – medium; j = 3 – small
k = 1 – plant 1; k = plant 2 – medium; k = 3 – plant 3

b) Objective Function:

Let Z = Profit

$$Z = 420x_{11} + 420x_{12} + 420x_{13} + 360x_{21} + 360x_{22} + 360x_{23} + 300x_{31} + 300x_{32} + 300x_{33}$$

$$x_{11} + x_{21} + x_{31} \leq 750$$
$$x_{12} + x_{22} + x_{32} \leq 900$$
$$x_{13} + x_{23} + x_{33} \leq 450$$

production constraint

$$20x_{11} + 15x_{21} + 12x_{31} \leq 13{,}000$$
$$20x_{12} + 15x_{22} + 12x_{32} \leq 12{,}000$$
$$20x_{13} + 15x_{23} + 12x_{33} \leq 5{,}000$$

space constraint

$$x_{11} + x_{12} + x_{13} \leq 900$$
$$x_{21} + x_{22} + x_{23} \leq 1{,}200$$
$$x_{31} + x_{32} + x_{33} \leq 750$$

demand constraint

$$((x_{11} + x_{21} + x_{31})/ 750) = ((x_{12} + x_{22} + x_{32})/ 900)$$
$$((x_{12} + x_{22} + x_{32})/ 900) = ((x_{13} + x_{23} + x_{33})/ 450)$$
$$((x_{11} + x_{21} + x_{31})/ 750) = ((x_{13} + x_{23} + x_{33})/ 450)$$

$$((x_{11} + x_{21} + x_{31})/ 750) - ((x_{12} + x_{22} + x_{32})/ 900) = 0$$
$$((x_{12} + x_{22} + x_{32})/ 900) - ((x_{13} + x_{23} + x_{33})/ 450) = 0$$
$$((x_{11} + x_{21} + x_{31})/ 750) - ((x_{13} + x_{23} + x_{33})/ 450) = 0$$

labor constraints

$$x_{11}, x_{12}, x_{13}, x_{21}, x_{22}, x_{23}, x_{31}, x_{32}, x_{33} \geq 0$$

Nonnegativity constraint