Assignment- QMM

Question 1:

a Decision variables

Let's assume c- number of collegiate backpacks produced per week

d- number of mini backpacks produced per week

b Objective function

The objective/linear function is "Maximize Z= 32c+24d"

Where each collegiate generates a profit of $32 per unit

Each mini generates a profit of $24 per unit

c Constraints

As per the square feet, for each collegiate requires 3 sq. ft and for each mini requires 2 sq. Ft for the total nylon it receives 5000 sq. Ft.

$$3c+2d \leq 5000$$

The quantity of sales forecasts indicates for collegiate is at most 1000(i.e., less than or equal to) while for mini is at most 2000.

$$c \leq 1000$$

$$d \leq 2000$$

For each collegiate requires 45min to complete and as for each mini requires 40min to complete. And there are 35 laborers that each provides 40 hours of labour each week (i.e., 40*60=2400)

$$45c+35d \leq 84000$$

Where the total working time is 35*2400 = 84000

As per the real time problem the decision variables should be greater than zero because in the production it is possible to create at least one backpack that should be a collegiate/mini

$$c, d \geq 0 \text{ (non-negativity)}$$

d Mathematical formulation

Maximize Z= 32c+24d

Subjected to, $3c+2d \leq 5000$;

$c \leq 1000$;

$d \leq 2000$;

$45c+35d \leq 8400$;

Where c, $d \geq 0$(non-negativity)

Question 2

Let C be the large sized product

D be the medium sized product

E be the small sized product

And Plant 1,2, and 3 are three production plants

a Define the decision variables

	Large(C)	Medium(D)	Small(E)
Plant 1	C1	D1	E1
Plant 2	C2	D2	E2
Plant 3	C3	D3	E3

Where C1 – large sized quantities produced by Plant 1

C2 – medium sized quantities produced by Plant 1

C3 – small sized quantities produced by Plant 1

D1 – large sized quantities produced by Plant 2

D2 – medium sized quantities produced by Plant 2

D3 – small sized quantities produced by Plant 2

E1 – large sized quantities produced by Plant 3

E2 – medium sized quantities produced by Plant 3

E3 – small sized quantities produced by Plant 3

B Formulating the linear programming model

As the profit for the three sizes that are large, medium, small is as follows:

The profit for the large sized products per unit = $420

The profit for the medium sized products per unit = $360

The profit for the small sized products per unit = $300

Objective function:

To maximize the profit (Z) = $420C_x+360D_x+300E_x$ where x is plant number.

(i.e., Z = 420(C1+C2+C3) +360(D1+D2+D3) +300(E1+E2+E3))

Constraints:

For the plant 1, 2 and 3 has excess capacity to produce different product sizes per day:

1. As for the plant 1 the production capacity should not exceed 750units per day

$$C1+D1+E1 \leq 750$$

Similarly for plant 2 and 3 the production capacity should not exceed 900 and 450 units per day

$$C2+D2+E2 \leq 900$$

$$C3+D3+E3 \leq 450$$

2. As for the square feet which is occupied by plants 1, 2 and 3 are 13,000, 12,000 and 5000. And for each unit of large, medium and small sizes produced per day requires 20, 15 and 12 sq. Ft.

$$20C1+15D1+12E1 \leq 13000$$

$$20C2+15D2+12E3 \leq 12000$$

$$20C3+15D3+12E3 \leq 9000$$

3. As per the sales forecasts the large, medium and small product sized quantities would be sold per day are 900, 1200 and 750

$$C1+D1+E1 \leq 900$$

$$C2+D2+E2 \leq 1200$$

$$C3+D3+E3 \leq 750$$

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, and to

know how much of each of the sizes should be produced by each of the plants to maximize the profit:

(C1+D1+E1)/750 =(C2+D2+E2)/900 = (C3+D3+E3)/450

Where C1, C2, C3, D1, D2, D3, E1, E2, E3 $\geq$ 0 (non-negativity)

Because at each plant the product will be produced at least one large, medium and small as per the real scenario.