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Course: 64018-QUANTITATIVE MANAGEMENT MODELING

Question 1:

A) Decision Variables

Consider,

X_1= No. of collegiate Backpacks Produced per week

X_2= No. of Mini Backpacks Produced per week

B) Objective Function

The Profit per unit on collegiate Backpacks= $32

The Profit per unit on mini Backpacks= $24

To get the maximum profit,

Maximize $Z= 32X_1 + 24X_2$

C) Constraints

i. As mentioned, the total nylon that the company receives is 5000 sq. ft per week and it requires 3 sq. ft for collegiate and 2 sq. ft for mini, So

$$3X_1 + 2X_2 <= 5000$$

ii. The quantity of collegiate bags that were to be produced in a week should be less than or equal to 1000, while mini bags were 1200. So,

$$X_1 <= 1000 \text{ (for collegiate)}$$

$$X_2 <= 1200 \text{ (for mini)}$$

iii. The Labour Time required to make one collegiate bag was 45min, whereas for mini, it was 40min. And there are only 35 laborers working 40 hours each for a week. So,

$$45X_1 + 40X_2 <= 84000$$

Total working time= 35*40*60=84000min

iv. And the quantity of both the bags should be greater than or equal to 0.

$$X_1, X_2 => 0$$

D) Mathematical Formulation

Maximize $Z= 32X_1 + 24X_2$

Subjected to,

$3X_1 + 2X_2 <= 5000$

$X_1 <= 1000$

$X_2 <= 1200$

$45X_1 + 40X_2 <= 84000$ or $(3/4)X_1 + (2/3)X_2 <= 1400$

Where,

$X_1, X_2 >= 0$

Question 2:

A be the large size Product

B be the medium size product

C be the Small size Product

And Plant1, Plant2, and Plant3 are three Manufacturing Plants.

A) Decision Variables

	Large(A)	Medium(B)	Small(C)
Plant1	A1	B1	C1
Plant2	A2	B2	C2
Plant3	A3	B3	C3

Decision variables for 3 plants

A1= Quantity of products produced by Plant1 of size large

B1= Quantity of products produced by Plant1 of size medium

C1= Quantity of products produced by Plant1 of size small

A2= Quantity of products produced by Plant2 of size large

B2= Quantity of products produced by Plant2 of size medium

C2= Quantity of products produced by Plant2 of size small

A3= Quantity of products produced by Plant3 of size large

B3= Quantity of products produced by Plant3 of size medium

C3= Quantity of products produced by Plant3 of size small

B) Formulation Of linear Programming Model

Profit per unit on Large-size Product = $420

Profit per unit on medium-sized product= $360

Profit per unit on Small size Product= $300

Decision Variables—Ax, Bx, Cx. (x=Plant number)

Objective Function:

To maximize the Profit(Z),

Maximize Z = 420*(A1+A2+A3) + 360*(B1+B2+B3) + 300*(C1+C2+C3)

Constraints

Excess Production Capacity Constraint:

The Excess productivity that was to be produced by Plant1 should not exceed 750 units, whereas for Plant2, it was 900 units and for Plant3 it was 450 units per day. So,

Plant1….. A1 +B1 +C1 <=750

Plant2….. A2 +B2 +C2 <=900

Plant3….. A3 +B3 +C3 <=450

Storage Space Constraint:

The storage capacity of Plant1 was 13000 Sq. ft, whereas for Plant2 it was 12000 Sq. ft and for Plant 3 it was 5000 Sq. ft. Each unit of the large, medium, and small sizes produced per day requires 20, 15, and 12 sq. ft, respectively. So,

20A1 +15B1 +12C1 <= 13000

20A2 +15B2 +12C2 <= 12000

20A3 +15B3 +12C3 <= 5000

Sales Forecast Constraint:

It was given that Sales indicate that there are 900, 1,200, and 750 units of the large, medium, and small sizes, respectively, would be sold per day. So,

A1 +A2 +A3 <= 900

B1 +B2 +B3 <= 1200

C1 +C2 +C3 <= 750

In some of the plants, due to excess productivity, the employees need to be laid off. So, the plants should use the same percentage of the employees to produce the new product to reduce the layoffs.

$$(A1 + B1 + C1)/ 750 = (A2 + B2 + C2)/ 900 = (A3 + B3 + C3)/ 450$$

Or

$$900 * (A1 + B1 + C1) = 750 * (A2 + B2 + C2)$$

$$450 * (A2 + B2 + C2) = 900 * (A3 + B3 + C3)$$

$$450 * (A1 + B1 + C1) = 750 * (A3 + B3 + C3)$$

And,

$A1, A2, A3, B1, B2, B3, C1, C2, C3 >= 0$(non negativity)