Assignment - 2 Name. - Sandhya Kamireddy

LP Model

KSUID - 811292364

1) Solution :-

Given data :-

Material Availability :- Rip Resistant nylon per week 5000sqft

Required Materials :-

Collegiate Backpack - 3sqft/unit.

Mini Backpack - 2 sqft /unit.

Availability of Labour :- 35 laborers working for 40 hours each per week, which totals 1400 hours.

Labor Requirements :-

Collegiate Backpack - 45 minutes (0.75 hours)/unit.

Mini Backpack - 40 minutes (0.67 hours)/unit.

Profit :-

collegiate Backpack :- $32 per unit

Mini Backpack :- $ 24 per unit.

Sales forecast :-

Maximum of 1000 collegiates can be sold per week.

Maximum of 1200 Minis can be sold per week

a) Defining Decision Variables :-

(z, x_1, x_2) z = Objective function.

x_1 = No. of collegiate backpacks to produce each week

x_2 = No. of Minibacks to be Produced each week.

b) Defining objective function :-

The objective is to maximize the total Profit.

Maximize $z = 32x_1 + 24x_2$

c) constraints :-

① Material constraint :-

$3x_1 + 2x_2 \leq 5000$ This means that the total square footage of Nylon used will not exceed the amount available.

② Labour constraint :-

$45x_1 + 40x_2 \leq 84000$ Each unit of collegiate and Mini requires 45 and 40 minutes of labor, and the labor time available is 35 laborers x 40 hours x 60 minutes = 84000 ~~minutes~~.

③ Sales forecast constraints :- $x_1 \leq 1000$
$x_2 \leq 1200$

These constraints makes sure that the Production of each type doesn't exceed the maximum sales forecast.

5) Non-negativity constraint :- $x_1 \geq 0$
$x_2 \geq 0$

These constraints will ensure that the no. of backpacks Produced cannot be negative.

d) Maximize $Z = 32x_1 + 24x_2$

$3x_1 + 3x_2 \leq 5000$

$0.75x_1 + \frac{2}{3}x_2 \leq 1400$

$0 \leq x_1 \leq 1000$ and $0 \leq x_2 \leq 1200$

Question 2

2) Solution :-

Product Sizes given from the Question,

Product Sizes :- Large, Medium, Small.

① Profit Per unit :- Large Produt - \$420
Medium Product - \$360
Small Product - \$300

② Production capacity :- Plant 1 - 750 units/day
Plant 2 - 900 units/day
Plant 3 - 450 units/day

③ Storage constraints :- each plant has a limited amount of storage space.

Plant 1 - 13000 sq.ft
Plant 2 - 12000 sq.ft
Plant 3 - 5000 sq.ft

4) Space requirement per Product :-

Large Product - 20 sq.ft
Medium Product - 15 sq.ft
Small Product - 12 sq.ft

5) Sales forecast constraints :- (Maximum units that can be sold) :-

Large - 900 units / day
Medium - 1200 units / day
Small - 750 units / day.

6) Capacity utilization requirement :-

Each plant has to use Same Percentage of the Plant capacity to produce the product.

Objective function :- The goal here is to maximize Profit by determining how much of each Product size. that is large, medium, small that should be Produced in each Plant while meeting all the above constraints

a) Defining the Decision Variables:-

→ X_1L, X_1M, X_1S will be the no. of Large, Medium and Small products Produced in Plant 1.

→ X_2L, X_2M, X_2S plant 2 capacity.

→ X_3L, X_3M, X_3S Plant 3 capacity.

Constraints

a) Production capacity constraints:-

→ Each plant has a maximum daily Production capacity

$X_1L + X_1M + X_1S \le 750$ (Plant 1 capacity)

$X_2L + X_2M + X_2S \le 900$ (Plant 2 capacity)

$X_3L + X_3M + X_3S \le 450$ (Plant 3 capacity)

b) Storage space constraints :- Each unit size requires a different amount of in-process storage capacity and each plant has a limited amount of storage space.

$20X_1L + 15X_1M + 12X_1S \le 13{,}000$ → Plant 1 storage

$20X_2L + 15X_2M + 12X_2S \le 12{,}000$ → Plant 2 storage

$20X_3L + 15X_3M + 12X_3S \le 5000$ → Plant 3 storage

c) Sales forecast Constraints:- Sales limits for each Product Size:-

$X_1L + X_2L + X_3L \leq 900$ → Large units Sales limit

$X_1M + X_2M + X_3M \leq 1200$ → Medium units Sales limit

$X_1S + X_2S + X_3S \leq 750$ → Small units Sales limit

d) Capacity utilization constraints:-

$X_1L + X_1M + X_1S \leq 750$ Plant 1 capacity

$X_2L + X_2M + X_2S \leq 900$ Plant 2 capacity

$X_3L + X_3M + X_3S \leq 450$ Plant 3 capacity.

e) Non- Negativity constraints :- All the decision Variables must ~~be~~ non- negative.

$X_1L, X_1M, X_1S, X_2L, X_2M, X_2S, X_3L, X_3M, X_3S \geq 0$

Capacity utilization constraint (Same across all plants)

$$\frac{X_1L + X_1M + X_1S}{750} = \frac{X_2L + X_2M + X_2S}{900} = \frac{X_3L + X_3M + X_3S}{450}$$

Full Matematical formulation:-

Maximize $Z = 420(X_1L + X_2L + X_3L) + 360(X_1M + X_2M + X_3M)$
$+ 300(X_1S + X_2S + X_3S)$

Subject to all the constraints.