Assignment 1

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	Materials required	Profit/unit	Time required
Collegiate →	3 sq ft	$32	45 mins
Minis →	2 sq ft	$24	40 mins

⇒ Total materials available = 5000 sq ft.

⇒ Total available hours of labour/week = Total employees * No. hours each employee works/week

= 35 × 40 = 1400 hours

⇒ Let P be the total profit

C be the no. of collegiate manufactured

M be the no of Minis manufactured

∴ Maximize(P) = 32 * C + 24 * M

$0 \leq C \leq 1000$

$0 \leq M \leq 1200$

* Material constraints:

$$3C + 2M \leq 5000$$

* Time constraints:

$$\frac{3}{4}C + \frac{2}{3}M \leq 1400$$

45 mins → hours

$= \frac{45}{60} = \frac{3}{4}$ hr

40 mins → hours

$= \frac{40}{60} = \frac{2}{3}$ hr

(A) Decision variable

P = Total profit

C = no. of collegiate manufactured

M = no of Minis manufactured

(D) Mathematical Formulation

Objective function

Maximize (P) = $32 * C + 24 * M$

subject to

Constraints

$3C + 2M \leq 5000$ (material constraints)

$\frac{3}{4}C + \frac{2}{3}M \leq 1400$ (time constraints)

$0 \leq C \leq 1000$
$0 \leq M \leq 1200$

{ sales forecast limit for collegiate & Minis)

(Non-negativity of decision variables)

(2) Mathematical Formulation

Maximize $(P) = 32 * C + 24 * M$ (objective function)

subject to

$3C + 2M \leq 5000$ (material constraints)

$\frac{3}{4}C + \frac{2}{3}M \leq 1400$ (time constraints)

$0 \leq C \leq 1000$

$0 \leq M \leq 1200$

} sales forecast limit, non-negativity of decision variables

Variables)

Plant	Excess capacity	Storage space
Plant 1	750 units / day	13,000 sq.ft
Plant 2	900 units / day	12,000 sq.ft
Plant 3	450 units / day	5000 sq.ft

Plant size	Profit/unit	Material/unit	Sales/day
Large	$420	20 sq.ft	900
Medium	$360	15 sq.ft	1200
Small	$300	12 sq.ft	750

let N = no. of units produced

consider $N_{(x\,y)}$

where $x = (1, 2, 3) \rightarrow$ Plant number

$y = (L, M, S) \rightarrow$ size of product produced.

for eg: N_2M = no. of units of medium products produced in plant 2.

Objective function

let P = profit

Maximize $P = 420(N_1L + N_2L + N_3L) + 360(N_1M + N_2M + N_3M) + 300(N_1S + N_2S + N_3S)$

$N_{1L} \Rightarrow$ no. of units of large product in plant (1)

$N_2L \Rightarrow$ " plant (2)

$N_3L \Rightarrow$ " plant (3)

$N_{1M} \Rightarrow$ no. of units of medium product produced in plant (1)

$N_{2M} \Rightarrow$ " plant (2)

$N_{3M} \Rightarrow$ " plant (3)

$N_{1S} \Rightarrow$ no. of units of small product produced in plant (1)

$N_{2S} \Rightarrow$ " plant (2)

$N_{3S} \Rightarrow$ " plant (3)

where ~~$N(x,y) \rightarrow$~~

$N_{xy} \geq 0$

(non-negativity constraints)

$x = (1, 2, 3)$

$y = (L, M, S)$

Constraints

① Excess capacity constraints

Plant ① $\Rightarrow N_{1L} + N_{1M} + N_{1S} \leq 750$

Plant ② $\Rightarrow N_{2L} + N_{2M} + N_{2S} \leq 900$

Plant ③ $\Rightarrow N_{3L} + N_{3M} + N_{3S} \leq 450$

② Space constraints

Plant ① $\rightarrow 20N_{1L} + 15N_{1M} + 12N_{1S} \leq 13,000$

Plant ② $\Rightarrow 20N_{2L} + 15N_{2M} + 12N_{2S} \leq 12,000$

Plant ③ $\Rightarrow 20N_{3L} + 15N_{3M} + 12N_{3S} \leq 5000$

③ Sales as per forecast

Large units $\Rightarrow N_{1L} + N_{2L} + N_{3L} \leq 900$

Medium units $\Rightarrow N_{1M} + N_{2M} + N_{3M} \leq 1200$

small units $\Rightarrow N_{1S} + N_{2S} + N_{3S} \leq 750$

④ Percentage of excess capacity to avoid layoff's

Plant ① $\Rightarrow \dfrac{N_{1L} + N_{1M} + N_{1S}}{750} * 100$

Plant ② $\Rightarrow \dfrac{N_{2L} + N_{2M} + N_{2S}}{900} * 100$

Plant ③ $\Rightarrow \dfrac{N_{3L} + N_{3M} + N_{3S}}{450} * 100$