ASSIGNMENT 1

Problem 1:

Given Data about the product:

Product	Material Required (sq. ft)	Labour Required (minutes)	Profit (Per unit)
Collegiate	3	45	32$
Mini	2	40	24$

Decision Variables:

Let C be the number of Collegiate bag product units

Let M be the number of Mini bag product units

Objective Function:

The management wishes to maximize the profit by knowing the quantities of each product to produce per week which is, let Z be the function then the objective would be,

$$\boxed{\textbf{Maximise } Z=32*C + 24*M}$$

Constraints:

Material Constraint:

It has been stated that a total of 5000 sq. ft of material will be received every week

Therefore,

$$\boxed{3*C + 2*M \leq 5000}$$

Time Constraint:

The problem states that there are 35 laborers and each work 40 hours per week. Hence total hours available per week is 35*40=1400 hrs

Total Minutes of labour available in week=1400*60=84000

Therefore, the time constraint will be,

$$\boxed{45*C + 40*M \leq 84000}$$

Also given that at most 1000 collegiates and 1200 minis can be sold in a week,

Therefore,

$$\boxed{\begin{array}{c} \mathbf{C \leq 1000,} \\ \mathbf{M \leq 1200} \end{array}}$$

Non-negativity constraints,

$$\boxed{C \geq 0,\ M \geq 0}$$

Therefore, the mathematical model for the problem is,

$$\boxed{\begin{array}{c} \textbf{Maximise } \mathbf{Z=32*C + 24*M} \\ \text{Subject to,} \\ \mathbf{3*C + 2*M \leq 5000,} \\ \mathbf{45*C + 40*M \leq 84000,} \\ \mathbf{C \leq 1000,} \\ \mathbf{M \leq 1200,} \\ \mathbf{C \geq 0,\ M \geq 0} \end{array}}$$

Problem 2

Given data about plants of Weigelt corporation,

Plants	Excess Capacity to produce units per day	Available excess storage space (Sq. ft)
Plant 1	750	13000
Plant 2	900	12000
Plant 3	450	5000

New Product data that needs to be produced in the plants

Product Size	Units to be produced per day	Space required per unit (Sq. ft)	Net profit per unit
Large	900	20	420$
Medium	1200	15	360$
Small	750	12	300$

Decision Variables:

Let **L_1, M_1, and S_1** be the quantities of products with large, medium, and small sizes of **Plant 1**.

Let **L_2, M_2, and S_2** be the quantities of products with large, medium, and small sizes of **Plant 2**.

Let **L_3, M_3, and S_3** be the quantities of products with large, medium, and small sizes of **Plant 3**.

Similarly, below is the table which provides all the decision variables for the 3 plants,

		Plants		
Product Sizes		1	2	3
	Large	L_1	L_2	L_3
	Medium	M_1	M_2	M_3
	Small	S_1	S_2	S_3

Objective Function:

The company wants to maximize profit by increasing the quantities produced by each plant, let Z be the function then the objective would be,

Maximise $Z = 420 * (L_1 + L_2 + L_3) + 360 * (M_1 + M_2 + M_3) + 300 * (S_1 + S_2 + S_3)$

Constraints:

Space Constraint:

It has been stated that the production is limited to the available storage in each plant,

Therefore, from the above table references,

$$20 * L_1 + 15 * M_1 + 12 * S_1 \leq 13000$$

$$20 * L_2 + 15 * M_2 + 12 * S_2 \leq 12000$$

$$20 * L_3 + 15 * M_3 + 12 * S_3 \leq 5000$$

Time Constraint:

No. of units produced by plants per day is limited by the constraints below,

$$L_1 + M_1 + S_1 \leq 750$$

$$L_2 + M_2 + S_2 \leq 900$$

$$L_3 + M_3 + S_3 \leq 450$$

Given that at most sold in a day for each size is,

$$L_1 + L_2 + L_3 \leq 900$$

$$M_1 + M_2 + M_3 \leq 1200$$

$$S_1 + S_2 + S_3 \leq 750$$

Also given that each plant should use an equal percentage of its production units.

Therefore,

$$(L_1 + M_1 + S_1)/750 = (L_2 + M_2 + S_2)/900$$

$$(L_2 + M_2 + S_2)/900 = (L_3 + M_3 + S_3)/450$$

Which can be written as,

$$900 * (L_1 + M_1 + S_1) = 750 * (L_2 + M_2 + S_2)$$

$$450 * (L_2 + M_2 + S_2) = 900 * (L_3 + M_3 + S_3)$$

Non-Negativity:

$$L_1, L_2, L_3, M_1, M_2, M_3, S_1, S_2, S_3 \geq 0$$

Therefore, the mathematical model for the problem is,

$$\textbf{Maximise } Z = 420 * (L_1 + L_2 + L_3) + 360 * (M_1 + M_2 + M_3) + 300 * (S_1 + S_2 + S_3)$$

Subject to,

$$20 * L_1 + 15 * M_1 + 12 * S_1 \leq 13000$$

$$20 * L_2 + 15 * M_2 + 12 * S_2 \leq 12000$$

$$20 * L_3 + 15 * M_3 + 12 * S_3 \leq 5000$$

$$L_1 + M_1 + S_1 \leq 750$$

$$L_2 + M_2 + S_2 \leq 900$$

$$L_3 + M_3 + S_3 \leq 450$$

$$L_1 + L_2 + L_3 \leq 900$$

$$M_1 + M_2 + M_3 \leq 1200$$

$$S_1 + S_2 + S_3 \leq 750$$

$$900 * (L_1 + M_1 + S_1) = 750 * (L_2 + M_2 + S_2)$$

$$450 * (L_2 + M_2 + S_2) = 900 * (L_3 + M_3 + S_3)$$

$$L_1, L_2, L_3, M_1, M_2, M_3, S_1, S_2, S_3 \geq 0$$