Q 1a: The decision variables can be denoted and defined as follows:

the **Collegiate** and the **Mini**are considered as **C** and **M**.

Q 1b: The Objective function of the given problem is to **Maximize** the profit

 Q 1c: The Constraints in the problem are:

* The sales forecasts indicate that at most 1000 Collegiates and 1200 Minis can be sold per week.
* Each Collegiate requires 3 square feet while each Mini requires 2 square feet from the total material 5000 sqft received per week.
* Each Collegiate requires 45 minutes of labor and each Mini requires 40 minutes of labor and maximum resources available 35 labors and 40 hrs per week (i.e, 35 \*40 = 1400 hrs)

 Q 1d: The Objective function is given by:

**Maximize, Z = $32C + $24M**

 The constraints are as below:

3C + 2M <= 5000 sq.ft

(45/60)C + (40/60)M <= 1400 hrs

Where, C <= 1000; M <= 1200

 Q 2a: The decision variables can be denoted and defined as follows:

P depicts number of products produced per day

i =1,2,3. where i is the plant number

j = 1,2,3. Where j is the size of the products produced per day. 1: Small, 2: Medium, 3: Large

 Therefore, the decision variables are given by

P11 = number of small products produced per day at Plant 1,

P12 = number of medium products produced per day at Plant 1,

P13 = number of large products produced per day at Plant 1,

P21 = number of small products produced per day at Plant 2,

P22 = number of medium products produced per day at Plant 2,

P23 = number of large products produced per day at Plant 2,

P31 = number of small products produced per day at Plant 3,

P32= number of medium products produced per day at Plant 3,

P33= number of large products produced per day at Plant 3.

 Q 2b: **Total net profit** is given by,

**Maximize, Z = 420 P11 + 360 P12 + 300 P13 + 420 P21+ 360 P22+ 300 P23+ 420 P31 + 360 P32+ 300 P33**

subject to constraints,

Excess capacity produced by each plant

          P11 + P12+ P13≤ 750

                                P21+ P22 + P23≤ 900

                                P31 + P32+ P33≤    450

Storage limitations for the new product

                                20P11+ 15P12+ 12P13 ≤ 13000

                                20P21+ 15P22+ 12P23 ≤ 12000

                                20P31 + 15P32 + 12P33 ≤ 5000

Sales forecast per day

              For large products, P13 + P23 + P33 ≤ 900

              For medium products, P12 + P22 + P32≤ 1200

              For small products, P11+ P21 + P31≤ 750

And

Pij≥ 0, where i,j= 1,2,3.

The below set of constraints are the layoffs of the plants

(P11 + P12 + P13) - ( P21 + P22 + P23) = 0

(P11 + P12 + P13) - (P31 + P32 + P33) = 0