## MODULE-1

### Linear Programming Problems

1) Old hens can be bought at Rs. 50/- each but young ones cost Rs. 100/- each. The old hens lay 3 eggs/week and young hens 5 eggs/week. Each egg costs Rs. 2/-. A hen costs Rs. 5/- per week to fee. If a person has only Rs. 2000/- to spend for hens, formulate the problem to decide how many of each kind of hen should he buy ? Assume that he cannot house more than 40 hens.

2) A computer company manufactures laptops & desktops that fetches profit of Rs. 700/- & 500/- unit respectively. Each unit of laptop takes 4 hours of assembly time & 2 hours of testing time while each unit of desktop requires 3 hours of assembly time & 1 hour for testing. In a given month the total number of hours available for assembly is 210 hours & for inspection is 90 hours. Formulate the problem as LPP in such a way that the total profit is maximum.

3) A toy company manufactures two types of dolls, a basic version-doll A and a deluxe version-doll B. Each doll of type B takes twice as long to produce as one of type A and the company would have time to make maximum of 2000 dolls per day. The supply of plastic is sufficient to produce 1500 dolls per day( Both A & B combined). The deluxe version requires a fancy dress of which there are only 600 per day available. If the company makes a profit of Rs. 10/- & Rs. 18/- per doll on doll A & B respectively, then how many of each doll should be produced per day in order to maximize the total profit. Formulate the problem as LPP.

4) The standard weight of a special purpose brick is 5Kg and it contains two ingredients B1 & B2. B1 cost Rs. 5/- per kg & B2 costs Rs. 8/- per kg. Strength considerations dictate that the brick contains not more than 4 kg of B1 & a minimum of 2 kg of B2, since the demand for the product is likely to be related to the price of the brick. Formulate the above problem as LP model.

5) A marketing manager wishes to allocate his annual advertising budget of Rs. 20,000 in two media group M & N. The unit cost of the message in the media 'M' is Rs. 200 & 'N' is Rs. 300. The media M is monthly magazine & not more than two insertions are desired in one issue. At least five messages should appear in the media N. The expected effective audience per unit message for media M is 4,000 & for N is 5,000. Formulate the problem as Linear Programming problem.

6) A manufacturer produces two types of models M1 & M2. Each M1 model requires 4 hours of grinding & 2 hours of polishing, whereas each M2 model requires 2 hours of grinding & 5 hours of polishing. The manufacturer has 2 grinders & 3 polishers. Each grinder works for 40 hours a week & each polisher works for 60 hours a week. Profit of M1 model is Rs. 3/- & on M2 model is Rs. 4/-. How should the manufacturer allocate his production capacity to the two types of models so as to make maximum profit in a week. Formulate the above problem as LPP.
7) A company produces two types of products. Each product of first type requires twice as much time as the second type. The company can produce a total of 600 products a day. The market limits the daily sales of the first & second types of products of 175 & 250 respectively. If the profits per product are Rs. 9/- for the first & Rs. 6/- for second product. Formulate the problem as LPP.

8) A company produces two types of Hats. Each hat of the first type requires twice as much labour time as the second type. The company can produce a total of 500 hats a day. The market limits daily sales of the first & second type to 150 & 250 hats. Assuming that the profits/hat are Rs. 8/- for type A & Rs. 5 for type B. Formulate the problem as LP model in order to determine the number of hats to be produced of each type so as to maximize the profit.
9) An agriculturist has a farm with 126 acres. He produces Tomato, Mango and Potato. Whatever he raises is fully sold in the market. He gets Rs. 5/- for tomato/kg, Rs. 4/- for mango/kg and Rs. 5/- for potato/kg. The average yield is 1,500 kg of tomato/acre, 1800 kg of mango/acre and 1200 kg of potato/acre. To produce each 100 kg of tomato and mango and to produce each 80 kg of potato a sum of Rs. 12.50 has to be used for manure. Labour required for each acre to raise the crop is 6 man-days for tomato and potato each and 5 man-days for mango. A total of 500 man-days of labour at a rate of Rs. 40/- per man day are available. Formulate this as a LP model to maximize the agriculturist's total profit.
10) A company manufactures two products A & B. Theses products are processed in the same machine. It takes 10 minutes to process one unit of product A and 2 minutes for each unit of product B and the machine operates for a maximum of 35 hours in a week. Product A requires 1 kg and B 0.5 kg of raw material per unit the supply of which is 600 kg per week. Market constraint on product B is known to be 800 unit every week. Product A costs Rs. 5/- per unit and sold at Rs. 10/-. Product B costs Rs. 6/- per unit and can be sold in the market at a unit price of Rs. 8/-. Determine the number of units of A & B per week to maximize the profit.
11) A person requires 10,12 and 12 units chemicals A,B,C respectively for his garden. One unit of liquid product contains 5,2 and 1 units of A,B and C respectively. One unit of dry product contains 1,2 and 4 units of A,B,C. If the liquid product sells for Rs. 3/- and the dry product sells for Rs. 2/-, how many of each should be purchased, in order to minimize the cost and meet the requirements.

12) A paper mill produces two grades of paper namely X and Y. Because of raw material restrictions, it cannot produce more than 400 tons of grade X and 300 tons of grade Y in a week. There are 160 production hours in a week. It requires 0.2 and 0.4 hours to produce a ton of products X and Y respectively with corresponding profits of Rs. 200/- and Rs. 500/- per ton. Formulate the above as a LPP to maximize profit and find the optimum product mix.

13) The owner of fancy goods shop is interested to determine how many advertisement to release in the selected three magazines A,B and C. His main purpose is to advertise in such a way that total exposure to principal buyers of his goods is maximized. Percentage of readers for each magazine are known. Exposure in any particular magazine is the number of advertisements released multiplied by the number of principal buyers. The following data are available.

| Particulars | Magazines | | |
|---|---|---|---|
| | A | B | C |
| Readers | 1.0 lakh | 0.6 lakh | 0.4 lakh |
| Principal Buyers | 20 % | 15 % | 8 % |
| Cost per advertisement | 8,000 | 6,000 | 5,000 |

The budgeted amount is at the most Rs. 1.0 lakh for the advertisements. The owner has already decided that magazine A should have no more than 15 advertisements and that B and C each gets at least 8 advertisements. Formulate a linear programming model for this problem.

14) Farmer furniture makes chairs, arm-chairs and sofas, the profits are $ 50 per chair, $60 per arm-chair and $ 80 per sofa. The material used to manufacture these items are fabric and wood. A supplier can provide a maximum of 300 meters of fabric and 350 units of wood each week. Each item requires a certain amount of wood and fabric as well as certain assembly time.

These are given in the following table.

| Item | Fabric | Wood | Ass. Time |
|---|---|---|---|
| Chair | 2m | 6 units | 8 hours |
| Armchair | 5m | 4 units | 4 hours |
| Sofa | 8m | 5 units | 5 hours |
| Avail./Wk | 300m | 350 units | 480 hours |

How many chairs, armchairs and sofas that the company should make per week so that the total profit is maximized?