

CHAPTER -12

Linear programming

One mark questions:

- 1) Define linear programming problem
- 2) Define an objective function of a LPP
- 3) Define a constraints of a LPP
- 4) Define a feasible region of a LPP
- 5) Define a feasible solution of a LPP
- 6) Define a infeasible solution of a LPP
- 7) In a LPP, if the feasible region is bounded, with corner points. Where does the optimum value of LPP exists.
- 8) Define optimal (feasible) solution of a LPP
- 9) If the corner points of the feasible region determined by the linear constraints of LPP are (0,5), (4, 3), (0, 6) then find the minimum value of the objective function $Z = 200x + 500y$
- 10) If the corner points of the feasible region determined by the linear constraints of a LPP are (0, 0) (30,0) (20, 30) and (0, 50) find the maximum value of the objective function $Z = 4x + y$

Six mark questions

1, Solve the following linear programming problems graphically

- 1) Maximize $z=3x+4y$ subject to $x + y \leq 4, x \geq 0, y \geq 0$
- 2) Maximize $z = 3x + 2y$ subject to $x + 2y \leq 10, 3x + y \leq 15, x, y$
- 3) Maximize and minimize : $z = 5x + 10y$ subject to $x + 2y \leq 120, x + y \geq 60, x - 2y \geq 0, x, y \geq 0$.
- 4) Maximize and minimize : $z = x + 2y$ subject to $x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0$.

- 1) Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain at least 8 units of vitamin A and 11 units of vitamin B. Food P costs Rs 60/kg and Food Q costs Rs 80/kg. Food P contains 3 units/kg of Vitamin A and 5 units / kg of Vitamin B while food Q contains 4 units / kg of Vitamin A and 2 units / kg of vitamin B. Determine the minimum cost of the mixture.
- 2) One kind of cake requires 200g of flour and 25g of fat, and another kind of cake requires 100g of flour and 50g of fat. Find the maximum number of cakes which can be made from 5kg of flour and 1 kg of fat assuming that there is no shortage of the other ingredients used in making the cakes.
- 3) A factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftman's time in its making while a cricket bat takes 3 hours of machine time and 1 hour of craftman's time. In a day, the factory has the availability of not more than 42 hours of machine time and 24 hours of craftsman's time.
 - ☛ What number of rackets and bats must be made if the factory is to work at full capacity?
 - ☛ If the profit on a racket and on a bat is Rs 20 and Rs 10 respectively, find the maximum profit of the factory when it works at full capacity.
- 4) A manufacturer produces nuts and bolts. It takes 1 hour of work on machine A and 3 hours on machine B to produce a package of nuts. It takes 3 hours on machine A and 1 hour on machine B to produce a package of bolts. He earns a profit of Rs 17.50 per package on nuts and Rs 7.00 per package on bolts. How many packages of each should be produced each day so as to maximize his profit, if he operates his machines for at the most 12 hours a day ?
- 5) A factory manufactures two types of screws, A and B. Each type of screw requires the use of two machines, an automatic and a hand operated. It takes 4 minutes on the automatic and 6 minutes on hand operated machines to manufacture of package of screws A, while it takes 6 minutes on automatic and 3 minutes on the hand operated machines to manufacture a package of screws B. Each machine is available for at the most 4 hours on any day. The manufacturer can sell a package of screws A at a profit of Rs 7 and screws B at a profit of Rs 10. Assuming that he can sell all the screws he manufactures, how many packages of each type should the factory owner produce in a day in order to maximize his profit? Determine the maximum profit.

- 6) A cottage industry manufactures pedestal lamps and wooden Shades, each requiring the use of a grinding / cutting machine and a sprayer. It takes 2 hours on grinding / cutting machine and 3 hours on the sprayer to manufacture a pedestal lamp. It takes 1 hour on the grinding / cutting machine and 2 hours on the sprayer to manufacture a shade. On any day, the sprayer is available for at the most 20 hours and the grinding / cutting machine for at the most 12 hours. The profit from the sale of a lamp is Rs 5 and that from a shade is Rs 3. Assuming that the manufacturer can sell all the lamps and shades that he produces, how should he schedule his daily production in order to maximize his profit ?
- 7) A company manufactures two types of novelty souvenirs made of plywood. Souvenirs of type A require 5 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours 20 minutes available for cutting and 4 hours for assembling. The profit is Rs 5 each for type A and Rs 6 each for type B souvenirs. How many souvenirs of each type should the company manufacture in order to maximize the profit?
- 8) A merchant plans to sell two types of personal computers – a desktop model and a portable model that will cost Rs 25,000 and Rs 40,000 respectively. He estimates that the total monthly demand of computers will not exceed 250 units. Determine the number of units of each type of computers which the merchant should stock to get maximum profit if he does not want to invest more than Rs 70 lakhs and if his profit on the desktop model is Rs 4,500 and on portable model is Rs 5000.
- 9) There are two types of fertilizers F_1 and F_2 , F_1 consists of 10% nitrogen and 6% phosphoric acid and F_2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions, a farmer finds that she needs atleast 14 kg of nitrogen and 14 kg of phosphoric acid for her crop. If F_1 costs Rs 6/kg and F_2 costs Rs 5/kg. determine how much of each type of fertilizer should be used so that nutrient requirements are met at a minimum cost. What is the minimum cost ?
- 10) (Diet problem) : A dietician has to develop a special diet using two foods P & Q. each packet (containing 30g) of food P contains 12 units of calcium, 4 units of iron 6 units of cholesterol and 6 units of vitamin A. each packet of the same quantity of food Q contains Z unit of calcium, 20 units of iron, 4 units of cholesterol and Z units of vitamin A. the diet requires atleast 240 units of calcium, at least 460 units of iron and atmost 300 units of

cholesterol. How many packets of each food should be used to minimize the amount of vitamin A in the diet ? That is the minimum amount of vitamin A.

- 11) Manufacturing problem : A manufacturing company makes two models A and B of a product. Each piece of model A requires 9 labour hour for fabricating and 1 labour hour for finishing. Each piece of model B requires 12 labour hours for fabricating and 3 labour hour for finishing. For fabricating and finishing, the maximum labour house available are 180 and 30 respectively. The company makes a profit of Rs 8,000 on each piece of model A & Rs 12,000 on each piece of model B. how many pieces of model A & B should be manufactured in a week to realize maximum profit. What is maximum profit per week.
- 12) (allocation problem) : A cooperative society of farmers has 50 hectares of land to grow two crops X and Y. the profit from the crops X & Y per hectare are estimated as Rs 10,500 and Rs 9,000 respectively to control weeds, a liquid herbicide has to be used for crops X and Y at rates of 20 litres and 10 litres per hectare. Further no more than 800 litres of herbiade should be used in order to protect fish and wild life using a pond which collects rinage from this land. How much land should be allocated each crop so as to maximize the total profit of the society.