

Grade: XII **LINEAR PROGRAMMING**

1. Find graphically, the maximum value of $z = 2x + 5y$, subject to constraints given below: $2x + 4y \leq 8$, $3x + y \leq 6$, $x + y \leq 4$, $x \geq 0$, $y \geq 0$

Ans: $Z = 10$ at $x = 0$ and $y = 2$.

2. A company manufactures 3 kinds of calculators: A, B and C in its two factories I and II. The company has got an order for manufacturing at least 6400 calculators of kind A, 4000 of kind B and 4800 of kind C. The daily output of factory I is of 50 calculators of kind A, 50 calculators of kind B, and 30 calculators of kind C. The daily output of factory II is of 40 calculators of kind A, 20 of kind B and 40 of kind C. The cost per day to run factory I is Rs.12,000 and of factory II is Rs.15,000. How many days do the two factories have to be in operation to produce the order with the minimum cost? Formulate this problem as an LPP and solve it graphically.

Ans: $Z = 1860000$ at $x = 80$, $y = 60$

3. Maximize $z = 8x + 9y$ subject to the constraints given below:
 $2x + 3y \leq 6$, $3x - 2y \leq 6$, $y \leq 1$, $x, y \geq 0$. **Ans: $Z = 22.62$ at $x = 30/13$, $y = 6/13$**

4. A dealer in rural area wishes to purchase a number of sewing machines. He has only Rs.5760 to invest and has space for at most 20 items for storage. An electronic sewing machine cost him Rs.360 and a manually operated sewing machine Rs.240. he can sell an electronic sewing machine at a profit of Rs.22 and a manually operated sewing machine at a profit of Rs.18. assuming that he can sell all the items that he can buy, how should he invest his money in order to maximise his profit? Make it as LPP and solve it graphically? **Ans: $Z = 392$ at $x = 8$, $y = 12$**

5. A manufacturing company makes two types of teaching aids A and B of Mathematics for class XII. Each type of A requires 9 labour hours of fabricating and 1 labour hour for finishing. Each type of B requires 12 labour hours for fabricating and 3 labour hours for finishing. For fabricating and finishing, the maximum labour hours available per week are 180 and 30 respectively. The company makes a profit of Rs.80 on each piece of type A and Rs.120 on each piece of type B. How many pieces of type A and type B should be manufactured per week to get a maximum profit? Make it as a LPP and solve graphically. What is the maximum profit per week? **Ans: $z = 1680$ at $x = 12$ and $y = 6$**

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 the 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.25 and that from the shade is Rs.15. assuming that the manufacturer can sell all the lamps and shades that he produces, how should he schedule his daily production in order to maximise his profit. Formulate as a LPP and solve. Ans: $z = 160$ at $x = 4, y = 4$
7. A cooperative society of farmers has 50 hectares of land to grow two crops A and B. The profits from crops A and B 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 A and B at the rates of 20 l and 10 l per hectare, respectively. Further not more than 800 litres of herbicide should be used in order to protect fish and wildlife using a pond which collects drainage from this land. Keeping in mind that the protection of fish and other wildlife is more important than earning profit, how much land should be allocated to each crop so as to maximise the total profit? Form a LPP from the above and solve. Ans: $z=4,95,000$ at $x = 30, y = 20$
8. A manufacturer considers that men and women workers are equally efficient and so he pays them at the same rate. He has 30 and 17 units of workers and capital respectively, which he uses to produce two types of goods A and B. To produce one unit of A, 2 workers and 3 units of capital are required while 3 workers and 1 unit of capital is required to produce one unit of B. If A and B are priced at Rs.100 and Rs120 per unit respectively, how should he use his resources to maximise the total revenue? Form as a LPP and solve. Ans: $z = 1260$ at $x = 3, y = 8$
9. An aeroplane can carry a maximum of 200 passengers. A profit of Rs.500 is made on each executive class ticket out of which 20% will go to the welfare fund of the employees. Similarly a profit of Rs.400 is made on each economy ticket out of which 25% will go for the improvement of facilities provided to economy class passengers. In both cases , the remaining profit goes to the airline's fund. The airline reserves at least 20 seats for executive class. However at least four times as many passengers prefer to travel by economy class than by the executive class. Determine how many tickets of each type must be sold in order to maximise the net profit of the airline? Ans: $z = 64,000$ at $x = 40, y = 160$

10. 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 per package on bolts. How many packages of each should be produced each day so as to maximise his profit, if he operates his machines for at the most 12 hours a day? Formulate this as a linear programming problem and solve it. Ans: $z=73.50$ at $x=3, y=3$
11. A dietician wishes to mix two types of foods in such a way that vitamin contents of the mixture contain at least 8 units of vitamin A and 10 units of vitamin C. Food I contains 2 units/kg of vitamin A and 1 unit/kg of vitamin C while food II contains 1 unit/kg of vitamin A and 2 units/kg of vitamin C. It costs Rs.5 per kg to purchase food I and Rs.7 per kg to purchase food II. Determine the minimum cost of such a mixture. Formulate the above as LPP. Ans: $z=38$ at $x=2$ and $y=4$
12. A company produces soft drinks that has a contract which requires a minimum of 50 units of chemical A and 60 units of chemical B go into each bottle of the drink. The chemicals are available in prepared mix packets from two different suppliers. Supplier S has a packet of mix of 4 units of A and 2 units of B that costs Rs.10. the supplier T has a packet of mix of 1 unit of A and 1 unit of B that cost Rs.4. how many packets of mixes from S and T should the company purchase to honour the contract requirement and yet minimise cost? Form as a LPP and solve. Ans: $z = 260$ at $x = 10, y = 40$
13. A factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftsman's time in its making while a cricket bat takes 3 hours of machine time and 1 hour of craftsman'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. If the profit on a racket and on a bat is Rs. 20 and Rs.10 respectively, find the number of tennis rackets and cricket bats that the factory must manufacture to earn the maximum profit. Make it as LPP and solve. Ans: $z = 200$ and $x = 4$ and $y = 12$
14. A merchant plans to sell two types of personal computer – a desktop model and a portable model that will cost Rs 25,00 and Rs 40,000 respectively. He estimates that the total monthly demand of computer 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 lakh and his profit on the desktop model is Rs

- 4,500 and on the portable model is Rs 5,000 . Make a L.P.P. and solve it graphically. Ans: $z = 11,50,000$ at $x = 200$ and $y = 50$
15. A cottage industry manufactures pedestal lamps and wooden shades, each requiring the use of grinding / cutting machine and a sprayer. It takes 2 hours on the grinding / cutting machine and 3 hours on the sprayer to manufacture a pedestal lamp. It takes one hour on the grinding / cutting machine and 2 hours on the sprayer to manufacture a shade . one 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 maximise his profit? Make a L.P.P. and solve it graphically. Ans: $z = 32$ at $x = 4$ and $y = 4$
 16. A small firm manufactures gold rings and chains. The total number of rings and chains manufactured per day is at most 24. It takes 1 hour to make a ring and 30 minutes to make a chain. The maximum number of hours available per day is 16. If the profit on a ring is Rs.300 and that on a chain is Rs.190, find the number of rings and chains that should be manufactured per day, so as to earn the maximum profit. Make it as a LPP and solve it graphically. Ans: $z = 5440$ at $x = 8$, $y = 16$
 17. One kind of cake requires 300 g of flour and 15 g of fat, another kind of cake requires 150 g of flour and 30 g of fat. Find the maximum number of cakes which can be made from 7.5 kg of flour and 600 g of fat, assuming that there is no shortage of the other ingredients used in making the cakes. Make it as a LPP and solve it. Ans: $z = 30$ at $x = 20$, $y = 10$
 18. A factory makes two types of items A and B made of plywood. One piece of item A requires 5 minutes for cutting and 10 minutes for assembling. One piece of item B requires 8 minutes for cutting and 8 minutes for assembling. There are 3 hours and 20 minutes available for cutting and 4 hours for assembling. The profit on one piece of item A is Rs.5 and that on item B is Rs.6. how many pieces of each type should the factory make so as to maximise profit? Make it as a LPP and solve it. Ans: $z = 160$ at $x = 8$, $y = 20$
 19. A diet is to contain at least 80 units of Vitamin A and 100 units of minerals. Two foods F1 and F2 are available. Food F1 costs Rs.4 per unit and food F2 costs Rs.6 per unit. One unit of food F1 contains 3 units of Vitamin A and 4 units of minerals. One unit of food F2 contains 6 units of Vitamin A and 3 units of minerals. Formulate this as a linear programming problem. Find graphically the minimum cost for diet that consists of

mixture of these two foods and also meets the minimal nutritional requirements. Ans: $z = 104$ at $x = 24$, $y = 4/3$.

20. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs.5760 to invest and has space for at the most 20 items. A fan costs him Rs.360 and a sewing machine Rs.240. His expectation is that he can sell a fan at a profit of Rs.22 and a sewing machine at a profit of Rs.18. assuming that he can sell all the items he can buy, how should he invest money in order to maximise the profit? Solve it. Ans: $z = 392$ at $x = 8$, $y = 12$
21. One kind of cake requires 200 g of flour and 25 g of fat, and another kind of cake requires 100 g of flour and 50 g of fat. Find the maximum number of cakes which can be made from 5 kg of flour and 1 kg of fat assuming that there is no shortage of the other ingredients used in making the cakes. Formulate this as LPP and solve it graphically.
Ans: $Z=30$ at $x = 20$ and $y=10$.