

2008 Delhi

1. A factory owner purchases two types of machines A and B for his factory. The requirements and the limitations for the machines are as follows:

Machine	Area occupied	Labour force	Daily output (in units)
A	1000 m ²	12 men	60
B	1200 m ²	8 men	40

He has maximum area of 9000 m² available, and 72 skilled labourers who can operate both the machines. How many machines of each type should he buy to maximize the daily output?

2008 foreign

2. A farmer has a supply of chemical fertilizer of type A which contains 10% nitrogen and 5% phosphoric acid, and type B which contains 6% nitrogen and 10% phosphoric acid. After testing the soil conditions of the field, it was found that at least 14 kg of nitrogen and 14 kg of phosphoric acid is required for producing a good crop. The fertilizer of type A costs Rs 5 per kg and the type B costs Rs. 3 per kg. How many kg of each type of the fertilizer should be used to meet the requirement at the minimum possible cost? Using L. P. P. solve the above problem graphically.

2009 delhi

3. 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 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 and find graphically the minimum cost for diet that consists of mixture of these two foods and also meets the minimum nutritional requirements.

2009 AI

4. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs. 5,760 to invest and has space for at 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 that he can buy, how should he invest his money in order to maximize the profit? Formulate this as a linear programming problem and solve it graphically.

2009 Foreign

5. 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 the above as a linear programming problem and solve graphically.

2010 Delhi

6. 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 an L.P.P. and solve it graphically.

2010 AI

7. One kind of cake requires 300 g of flour and 15 g of fat, and 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 an L.P.P. and solve it graphically.

2010 Foreign

8. 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 three 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 maximize profit? Make it as an L.P.P. and solve it graphically.

2010 comptmnt.

9. A library has to accommodate two different types of books on a shelf. The books are 6 cm and 4 cm thick and weigh 1 kg and 1½ kg each respectively. The shelf is 96 cm long and at most can support a weight of 21 kg. How should the shelf be filled with the books of two types in order to include the greatest number of books? Make it as an L.P.P. and solve it graphically.

2011 Delhi

10. 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 each 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 an L.P.P. and solve it graphically.

2011 AI

11. 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 his profit on the desktop model is Rs. 4,500 and on the portable model is Rs. 5,000. Make an L.P.P. and solve it graphically.

2011 Foreign

12. A cottage industry manufactures pedestal lamps and wooden shades, each requiring the use of grinding/cutting machine and a sprayer. It takes two 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. 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 maximise his profit? Make an L.P.P. and solve it graphically.

Answers to some of the board questions

6. [ans: gold rings = x ; chains = y ; $Z = 300x + 190y$; $x + y \leq 24$; $x + 1/2y \leq 16$; max = 5440 at (8, 16)]
7. [ans: Cake I = x ; Cake II = y ; $Z = x + y$; $2x + y \leq 50$; $x + 2y \leq 40$ max = 30 at (20, 10)
8. [ans: A = x ; B = y ; $Z = 5x + 6y$; $5x + 8y \leq 200$; $10x + 8y \leq 240$; At Corner points A(24, 0) value = 120, B(8, 20) value = 160 and C(0, 25) value = 150]
10. [ans. Max = 200 at $x = 4$ and $y = 12$]

Practice Questions:

1. An aeroplane can carry a maximum of 200 passengers. A profit of Rs. 400 is made on each first class ticket and a profit of Rs. 300 is made on each economy class ticket. The airline reserves at least 20 seats for first class. However, at least 4 times as many passengers prefer to travel by economy class to by the first class. Determine how many of each type ticket must be sold in order to maximize the profit for the airline. What is the maximum profit? Frame an L.P.P and solve it graphically.
2. If a young man rides his motor cycle at 25 km per hr. he has to spend Rs.2 per Km on petrol. If he rides it at a faster speed of 40 km /hr the petrol cost increases to Rs.5 per km. He has Rs.100 to spend and wishes to find the maximum distance he can travel within one hour. Express this as a linear programming problem and then solve it.
3. Two godowns A and B have grain capacities of 100 quintals and 50 quintals respectively. They supply to three ration shops D, E and F whose requirements are 60, 50 and 40 quintals respectively. The cost of transportation /quintal from the godown to the shops are given in the table. How should the supplies be transported in order that the transportation cost is minimum. Also find the minimum cost.
- | From | To | A | B |
|------|----|-----|---|
| D | | 6 | 4 |
| E | | 3 | 2 |
| F | | 2.5 | 3 |
4. A house wife wishes to mix up two kind of foods X and Y in such a way that mixture contains at least 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. The vitamin contents of 1 kg of food X and 1 kg of food Y are as given in the following table:
- | Food | Vit A | Vit B | Vit C |
|------|-------|-------|-------|
| X | 1 | 2 | 3 |
| Y | 2 | 2 | 1 |
5. Solve the linear programming problem graphically. Maximize $Z = 3x_1 + 4x_2$ subject to the constraints $2x_1 + 2x_2 \leq 80$, $2x_1 + 4x_2 \leq 120$, $x_1, x_2 \geq 0$
6. Minimise $C = 3x + 2y$ subject to the constraints, $5x + y \geq 10$, $x + y \geq 6$, $x + 4y \geq 12$, $x \geq 0$ and $y \geq 0$.

7. A manufacturing company produces two models A and B of a product .Each piece of model A requires 9 labour hours for fabricating and 1 hour for finishing .Each piece of model B requires 12 labour hours for fabricating and 3 hour for finishing. For fabricating and finishing the maximum labour hours available are 180 and 30 respectively .The company makes a profit of Rs.8000 on each piece of model A and Rs.12000 on each piece of model B .How many pieces of model A and model B should manufactured per week to get a maximum profit ? What is the maximum profit (Solve as a linear programming problem)
8. A manufacture produces two types of steel trunks. He has two machines A and B. The first type of the trunk requires 3 hours on machines A and 3 hours on machines B and second type of the trunk requires 3 hours on machines A 2 hours on machine B. Machines A and B are run daily for 18 hours and 15 hours respectively. There is a profit of Rs. 30 on the first type Rs.25 on second type of the trunk. How many trunks of each type should be produced and sold to make maximum profit?
9. A firm produces two types of dolls type A and type B. Each doll of type B takes as long to produce as one doll type A. The firm has time to make a maximum of 2000 dolls of type A per day. The supply of plastic is sufficient to produce 1500 dolls per day and each type requires equal amount of it. Type B requires a fancy dress of which there are 600 per day available. If the firm makes a profit of Rs.3 and Rs.5 per doll on type A and type B respectively, how many of each type should be produced per day to maximize the profit. Solve graphically.
10. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs.5760 to invest and has space for at 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 that he can buy, how should he invest his money in order to maximise his profit? Solve it by graphical method.
11. Maximize $C=4x+9y$ subject to constraints $x+5y \leq 200$, $2x+3y \leq 134$, $x \geq 0$ and $y \geq 0$. Exhibit graphically
12. A manufacturer produces two products A and B. Both the products are processed on two different machines. The available capacity of the first machine is 12hours and the second machine is 9hrs. Each unit of product A requires 3hrs on both machines and each unit of B requires 2hrs on the first machine and 1hr on the second machine. Each unit product A is sold at a profit of Rs. 5 and B at a profit of Rs. 6. Find the production level for maximum profit graphically.
13. A furniture firm manufactures chairs and tables, each requiring the use of three machines A, B and C. Production of one chair requires 2 hours on machine A, 1 hour on machine B and 1 hour on machine C. Each table requires 1 hour each on machine A and B and 3 hours on machine C. The profit obtained by selling one chair is Rs. 30 while by selling one table the profit is Rs. 60. The total time available per week on machine A is 70 hours, on machine B is 40 hours and on machine C is 90 hours. How many chairs and tables should be made per week so as to maximize profit? Formulate the problem as L.P.P. and solve it graphically.
14. Every gram of wheat provides 0.1 gm of proteins and 0.25 gm of carbohydrates. The corresponding values for rice are 0.05 gm and 0.5 gm respectively. Wheat costs Rs. 4 per kg and rice Rs. 6 per kg. The minimum daily requirements of proteins and carbohydrates for an average child are 50 gms and 200 gms respectively. In what quantities should wheat and rice be mixed in the daily diet to provide minimum daily requirements of proteins and carbohydrates at minimum cost. Frame an L.P.P. and solve it graphically.
15. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs.5760 to invest and has space for at 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 that he can buy, how should he invest his money in order to maximize his profit ? Translate this problem into an L.P.P and solve it.
16. A furniture firm manufactures chairs and tables, each requiring the use of three machines A, B and C. Production of one chair requires 2 hours on machine A, 1 hour on machine B and 1 hour on machine C. Each table requires 1 hour each on machine A and B and 3 hours on machine C. The profit obtained by selling one chair is Rs. 30 while by selling one table the profit is Rs. 60. The total time available per week on machine A is 70 hours, on machine B is 40 hours and on machine C is 90 hours. How many chairs and tables should be made per week so as to maximize profit? Formulate the problem as L.P.P. and solve it graphically.
17. Every gram of wheat provides 0.1 gm of proteins and 0.25 gm of carbohydrates. The corresponding values of rice are 0.05 gm and 0.5 gm respectively. Wheat cost Rs.4.00 per kg and rice Rs.6.00 per kg. The minimum daily requirements of proteins and carbohydrates for an average child are 50 gm and 200 gm respectively. In what quantities should wheat and rice be mixed in the daily diet to provide minimum daily requirements of proteins and carbohydrates at minimum cost?

18. A firm deals with two kinds of fruit juices, pine-apple and orange juice. These are mixed and the two types of mixture are obtained which are sold as soft drinks A and B. One tin of A needs 4 pounds of pine-apple juice and 1 pound of orange juice. One tin of B needs 2 pounds of pine -apple and 3 pounds of orange juice. The firm has only 46 pounds of pine-apple juice and 24 pounds of orange juice. Each tin of A is sold at a profit of Rs. 4 and each tin of B is sold at a profit of Rs. 3. How many tins of A and B should the firm produce to maximise profit? Solve it by graphical method.
19. If an old man rides his motor cycle at 25 km/hr, he has to spend Rs 2 per Km on petrol. If he rides at a faster speed of 40 km/hr, the petrol cost increases to Rs 5 per Km. He has Rs 100 to spend on petrol and wishes to find maximum distance he can travel within one hour. Express this as a linear programming problem and then solve it graphically.
20. 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 the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements.
21. There are two factories located at place P and Q .From these locations a certain commodity is to be delivered to each of the three depots situated at A,B,C the weekly requirements of the depots are respectively 5,5,4 units of commodity while the production capacity of the factories at P and Q are respectively 8 and 6 units. The cost of transportation is given below:

From/To	Cost in Rs.		
	A	B	C
P	160	100	150
Q	100	120	100

How many units should be transported from each factory to each depot in order that the transportation cost is minimum? Also find the minimum transportation cost

22. Every gram of wheat provides 0.1 gm of proteins and 0.25 gm of carbohydrates. The corresponding values for rice are 0.05 gm and 0.5 gm respectively. Wheat costs Rs. 4 per kg and rice Rs. 6 per kg. The minimum daily requirements of proteins and carbohydrates for an average child are 50 gms and 200 gms respectively. In what quantities should wheat and rice be mixed in the daily diet to provide minimum daily requirements of proteins and carbohydrates at minimum cost. Frame an L.P.P. and solve it graphically.