MATHS

Assignment 1.0

Linear Programming

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1. A producer has 30 and 17 units of labour and capital respectively which he can use to produce two types of goods X and Y. To produce one units of X, 2 units of labour and 3 units of capital are required. Similarly, 3 units of labour and 1 unit of capital is required to produce one unit of Y. If X and Y are priced at Rs.100 and Rs.120 per unit respectively, how should the producer use resources to maximize the total revenue? Solve the problem, graphically.

2. A firm manufactures two types of products A and B and sells them at a profit of Rs. 5 per unit of type A and Rs. 3 per unit of type B. Each product is processed on two machines M_1 and M_2. One unit of type A requires one minutes of processing time on M_1 and two minutes of processing time on M_2; whereas one unit of type B requires one minute of processing time on M_1 and one minute on M_2; Machines M_1 and M_2 are respectively available for atmost 5 hours and 6 hours in a day. Find out how many units of each type of product should the firm produce a day in order to maximize the profit. Solve the problem graphically.

3. A small firm manufactures items A and B. The total number of items A and B that it can manufacture in a day is at the most 24. Item A takes one hour to make while item B takes only half an hour. The maximum time available per day is 16hours. If the profit on one unit to item A be Rs. 300 and one unit of item B be Rs. 160, how many of each type of item be produced to maximize the profit? Solve the problem graphically.

4. A manufacturer produces two types of steel trunks. He has two machines A and B. The first type of trunk requires 3 hours on machine A and 3 hours on machines B. The second type requires 3 hours on machine A and 2 hours on machine B. Machine A and B can work at most for 18 hours and 15 hours per day respectively. He earns a profit of Rs. 30 and Rs. 25 per trunk of the first type and second type respectively. How many trunks of each type must he make each day to make maximum profit?

5. A company manufactures two types of toys A and B. Type A requires 5 minutes each for cutting and 10 minutes each for assembling. Type B requires 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours available for cutting and 4 hours available foe assembling in a day. The profit is Rs. 50 each on type A and Rs. 60 each on type B. How many days of each type should the company manufacture in a day to maximize the profit?

6. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs. 57,600 to invest and has space for atmost 20 items. A fan costs him Rs. 3,600 and a sewing machine Rs. 2,400. Profit on selling a fan and a sewing machine are Rs. 220 and Rs. 180 respectively. Assuming that he can sell all the items that he can buy, how should he invest his money in order to maximize his profit? Formulate this problem mathematically and solve it graphically.

7. A farmer has a supply of chemical fertilizer of type I which contains 10% nitrogen and 6% phosphoric acid and type II fertilizer which contains 5 % nitrogen and 10 % phosphoric acid. After testing the soil conditions of a field, it is found that at least 14 kg of nitrogen and 14 kg of phosphoric acid is required for a good crop. The fertilizer type I costs Rs. 2.00 per kg and the type II costs Rs. 3.00 per kg. How many kilograms of each fertilizer should be used to meet the requirement and the cost be minimum?

8. Kellogg is a new cereal formed of a mixture of bran and rice that contains at least 88 grams of protein and atleast 36 milligrams of iron. Knowing that bran contains 80 grams of protein and 40 milligrams of iron per kilogram, and that rice contains 100 grams of proteins and 30 milligrams of iron per kilogram, find the minimum cost of producing this new cereal if bran costs Rs. 5 per kilogram and rice costs Rs. 4 per kilogram.

9. A company manufactures two articles A and B. There are two departments through which these articles are processed : (i) assembly and (ii) finishing departments. The maximum capacity of the first department is 60 hours a week and that of the other department is 48 hours a week. The production of each article A requires 4 hours in assembly and 2 hours in finishing and that of each unit of B requires 2 hours in assembly and 4 hours in finishing. If the profit is Rs. 6 for each units of A and Rs. 8 for each unit of B, find the number of units of A and B to be produced per week in order to have maximum profit.

10. A factory owner wants to purchase two types of machines, A and B for his factory. The machine A requires an area of 1000 m^2 and 12 skilled men for running it and its daily output is 50 units, whereas the machine B requires 1200 m^2 and 8 skilled men, and its daily output is 40 units. If an area of 7600m^2 and 72 skilled men be available to operate the machine, how many machines of each type should be brought to maximize the daily output?

11. A housewife wishes to mix up two kinds 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 food Y are as given in the following table:

Food	Vitamin A	Vitamin B	Vitamin C
X	1	2	3
Y	2	2	1

If one kg of food X costs Rs. 6 and one kg of food Y costs Rs. 10, find the least cost of the mixture which will produce the desired diet.

12. A manufacturer makes two types of cups, A and B. Three machines are required to manufacture the cups and the time in minutes required by each is as given below:

Type of Cup	Machines		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum period of 6 hours per day. If the profit on each cup A is 75 paisa, and on B it is 50 paisa, show that 15 cups of type B should be manufactured per day to get the maximum profit.

13. A company sells two different products A and B. The two products are produced in a common production process which has a total capacity of 500 man hours. It takes 5 hours to produce a unit of A and 3 hours to produce a unit of B. The demand in the market shows that the maximum number of units of A that can be sold is 70 and that for B is 125. Profit on each unit of A is Rs. 20 and that on B is Rs. 15. How many units of A and B should be produced to maximize the profit? Solve it graphically.

14. A company manufactures, two types of toys A and B. Toy A requires 4 minutes for cutting and 8 minutes for assembling and Toy B requires 8 minutes for cutting and 8 minutes for assembling. There are 3 hours and 20 minutes available in a day for cutting and 4 hours for assembling. The profit on a piece of toy A in Rs. 50 and that on toy B is Rs. 60. How many toys of each type should be made daily to have maximum profit? Solve the problem graphically.

15. A shopkeeper deals in two items thermos flasks and air tight containers. A flask costs him Rs. 120 and an air tight container costs him Rs. 60. He has at the most Rs.12, 000 to invest and has space to store a maximum of 150 items. The profit on selling a flask in Rs. 20 and an air tight container is Rs. 15. Assuming that he will be able to sell all things he buys, how many of each item should he buy to maximize his profit? Solve the problem graphically.

16. An oil company requires 13,000; 20,000; and 15,000 barrels of high grade, medium grade and low grade oil respectively. The Refinary A produces 100, 300 and 200 barrels per day of high, medium and low grade oil respectively whereas the refinery B produces 200; 400 and 100 barrels per day respectively. If A costs Rs.400 per day and B costs Rs.300 per day to operate, how many days should each be run to minimize the cost of requirement?

17. A firm makes items A and B and the total number of items it can make in a day is 24. It takes one hour to make an item of A and only half an hour to make an item of B. The maximum time available per day is 16 hours. The profit on an item of A is Rs. 300 and on one item of B is Rs. 160. How many items of each type should be produced to maximize the profit? Solve the problem graphically?

18. A diet for a sick person must contain atleast 4000 units of vitamins, 50 units of minerals and 1400 calories. Two foods X and Y are available at a cost of Rs. 4 and Rs. 3 per unit respectively. One unit of the food X contains 200 units of vitamins, 1 unit of minerals and 40 calories, whereas one unit of food Y contains 100 units of vitamins, 2 units of minerals and 40 calories. Find what combination of X and Y should be used to have least cost, satisfying the requirements.

19. Solve the following linear programming problem graphically :
    Minimize $z = x - 5y + 20$ subject to the constraints
    $x - y \geq 0, \ -x + 2y \geq 2, \ x \geq 3, \ y \leq 4, \ x, \ y \geq 0$

20. Two tailors A and B earn Rs. 15 and Rs. 20 per respectively. A can stitch 6 shirts and 4 pants per day while B can stitch 10 shirts and 4 pants per day. How many days shall each work, if it is desired to produce at least 60 shirts and 32 pants at a minimum labour cost? Solve the problem graphically?

21. Anil wants to invest at most Rs. 12,000 in Bonds A and B. According to the rules, he has to invest at least Rs. 2,000 in bond A and at least Rs. 4,000 in bond B. If the rate of interest on bond A is 8 % per annum and on bond B is 10 % per annum, how should he invest his money for maximum interest? Solve the problem graphically.

22. A man has Rs. 1,500 for purchase of rice and wheat. A bag of rice and a bag of wheat cost Rs. 180 and Rs. 120 respectively. He has a storage capacity of 10 bags only. He earns a profit of Rs. 11 and Rs. 9 respectively per bag of rice and wheat. Formulate it as a linear programming problem and solve it graphically for maximum profit.

23. Solve the following linear programming problem graphically:
    Maximize $z = 60x + 15y$ subject to the constraints $x + y \leq 50,\ 3x + y \leq 90,\ x,\ y \geq 0$

24. Solve the following linear programming problem graphically:
    Maximize $z = 3x + 5y$ subject to the constraints $x + y \geq 2,\ x + 3y \geq 3,\ x,\ y \geq 0$

25. 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 machine A and 3 hours on machine B. The second type of trunk requires 3 hours on machine 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 of the trunk and Rs. 25 on the second type of the trunk. How many trunks of each type be produced and sold to make maximum profit?

26. Solve the following linear programming problem graphically :
    Minimize $z = x - 7y + 190$ subject to the constraints $x + y \leq 8,\ x \leq 5,\ y \leq 5,\ x + y \geq 4,\ x \geq 0,\ y \geq 0$

27. Solve the following linear programming problem graphically :
    Maximize $z = 8x - 7y$ subject to the constraints $3x + y \leq 66,\ x + y \leq 45,\ x \leq 20,\ y \leq 40, x, y \geq 0$

28. A manufacturer makes two products, A and B. products A sells at Rs. 200 per unit and takes 30 minutes to make. Product B sells Rs. 300 per unit and takes 1 hour to make. There is a permanent order of 14 units of product A and 16 units product B. A working week consists of 40 hours of production and the weekly turnover must not be less than Rs. 10,000. If the profit in each of product A is Rs. 20 and on product B is Rs. 30, then how many of each should be produced so that the profit is maximum? Also, find the maximum profit. Solve the problem graphically.

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

	Area occupied by the machine	Labour force for each machine	Daily output (in units)
Machine A	1000 sq.m	12 men	60
Machine B	1200 sq.m	8 men	40

He has an area of 9000 sq. m available and 72 skilled men who can operate the machines. Form a L.P.P. to determine how many machines of each type should he buy to maximize the daily output.

30. A furniture dealer deals only in two item; tables and chairs. He has Rs. 10,000 to invest and a space to store at most 60 pieces. A table costs him Rs. 500 and a chair Rs. 200. He can sell a table at a profit of Rs.50 and a chair at a profit of Rs. 15. Assume that he can sell all items that he buys. Using linear programming formulates the problem for maximum profit and solve it graphically.

31. A shopkeeper sells only tables and chairs. He has only Rs. 6,000 to invest and has space for at most 20 items. A table costs him Rs. 400 and a chair Rs. 250. He can sell a table at a profit of 25 and a chair for a profit of Rs.40. Supposing that he can sell whatever he buys, formulate the problem as L.P.P. and solve it graphically for maximum profit.

32. If a young man rides his motorcycle at 25km/hour, he had to spend Rs. 2 per km on petrol. If the rides at a faster speed of 40 km/hr, the petrol cost increases at Rs. 5 per km. He has Rs. 100 to spend on petrol and wishes to find what is the maximum distance he can travel within one hour. Express this as LPP and solve it graphically.

33. A dealer wishes to purchase a number of fans and radios. He has only Rs. 5760 to invest and has a space for atmost 20 items. A fan costs him Rs. 360 and a radio Rs. 240. His expectation is that he can seel a fan at a profit of Rs. 22 and a radio at a profit of Rs. 18. Assuming that he can sell all the items he purchases, how should he invest his money for maximum profit? Translate the problem as LPP and solve it graphically.

34. 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 LPP solve the above problem graphically.

35. 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 second class ticket. The airline reserves at least 20 seats for first class. However, at least four times as many passengers prefer to travel by second class than by first class. Determine how many tickets of each type must be sold to maximize profit for the airline. Form an LPP and solve it graphically.

36. 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	$1000m^2$	12 men	60
B	$1200m^2$	8 men	40

He has maximum area $9000m^2$ available, and 72 skilled labours who can operate both the machines. How many machines of each type should he buy to maximize the daily output?

Note : if any mistake on this, kindly inform on the mail id :

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