MATHS

BOOKS - PSEB

LINEAR PROGRAMMING

Example

1. Solve the following linear programming problem graphically : Maximize : $z = 4x + y$ Subject to the constraints : $x + y \leq 503x + y \leq 90x \geq 0, y \geq 0$

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2. Solve the following linear programming problem graphically: Minimise $Z = 200x + 500y$ subject to the constraints:

$x + 2y \geq 10, 3x + 4y \leq 24, x \geq 0, y \geq 0$

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3. Solve the following problem graphically: Minimise $Z = 3x + 9y$ subject to the constraints:

$x + 3y \leq 60, x + y \geq 10, x \leq y, x \geq 0, y \geq 0$

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4. Solve the following problem graphically: Maximise $Z = 3x + 9y$ subject to the constraints:

$x + 3y \leq 60, x + y \geq 10, x \leq y, x \geq 0, y \geq 0$

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5. Determine graphically the minimum value of the objective function $Z = -50x + 20y$ subject to the constraints:

$2x - y \geq -5, 3x + y \geq 3, 2x - 3y \leq 12, x \geq 0, y \geq 0$

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6. Determine graphically the minimum value of the objective function $Z = -50x + 20y$ subject to the constraints:

$2x - y \geq -5, 3x + y \geq 3, 2x - 3y \leq 12, x \geq 0, y \geq 0$

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7. Minimise $Z = 3x + 2y$ subject to the constraints:

$x + y \geq 8, 3x + 5y \leq 15, x \geq 0, y \geq 0$

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8. Solve the following Linear Programming Problem graphically: Minimise $Z = 3x + 5y$ such that: $x + 3y \geq 3, x + y \geq 2, x, y \geq 0$

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9. Solve the following linear programming problem graphically : Maximize : $z = 3x + 2y$ subject to the constraints :

$x + 2y \leq 10, 3x + y \leq 15, x \geq 0, y \geq 0$

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10. Solve the following linear programming problems graphically

Minimise $z = 3x + 2y$ subject to $3x + y \geq 3, x + 2y \geq 6, x, y \geq 0$

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11. Graphically minimize and maximize $z = 5x + 10y$ subject to the constraints: $x + 2y \leq 120, x + y \leq 60, x - 2y \geq 0x, y \geq 0.$

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12. Maximise $Z = 5x + 10y$ subject to:

$x + 2y \leq 120, x + y \geq 60, x - 2y \geq 0, x, y \geq 0$

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13. Minimise $Z = x + 2y$ subject to:

$x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0$

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14. Maximise $Z = x + 2y$ subject to:

$x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0$

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15. A dietician wishes to mix two types of foods in such a way that vitamin contents of the mixture contain atleast 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. Food 'II' contains 1 unit/kg of vitamin A and 2 units/kg of vitamin C. It costs Rs 50 per kg to purchase Food 'I' and Rs 70 per kg to purchase Food 'II'. Formulate this problem as a linear programming problem to minimise the cost of such a mixture.

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16. A cooperative society of farmers has 50 hectare of land to grow two crops X and Y. The profit from crops X and 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 herbicide should be used in order to protect fish and wild life using a pond which collects drainage from this land. How much land should be allocated to each crop so as to maximise the total profit of the society?

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17. (Diet problem)A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) 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 3 units of calcium, 20 units of iron, 4 units of cholesterol and 3 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and at most 300 units of cholesterol. How many packets of each food should be used to minimise the amount of vitamin A in the diet? What is the minimum amount of vitamin A?

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Exercise

1. Maximise $Z = 3x + 4y$, subject to the constraints $x + y \leq 4, x \geq 0, y \geq 0$

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2. Solve the following linear programming problem graphically : Minimize $Z = -3x + 4y$ subject to constraints $x + 2y \leq 8, 3x + 2y \leq 12, x \geq 0, y \geq 0.$

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3. Solve the following linear programming problem Graphically : Maximize $Z = 5x + 3y$, subject to the constraints : $5x + 2y \leq 10, 3x + 5y \leq 15, x, y \geq 0.$

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4. Maximise $Z = -x + 2y$ subject to: $x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0$

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5. Maximise $Z = -x + 2y$ subject to: $x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0$

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6. Minimise $Z = -x + y$ subject to:

$x - y \leq -1, -x + y \leq 0, x, y \geq 0$

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7. Maximise $Z = -x + y$ subject to:

$x - y \leq -1, -x + y \leq 0, x, y \geq 0$

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8. One kind of cake requires 100 gm of flour and 50 gm of fat and another kind of cake requires 50 gm of flour and 100 gm of fat. Find the maximum number of cakes that can be made from 4 kg of flour and 5 kg of fat. Form a linear programming problem and solve it graphically.

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9. 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 hour 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. 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.

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11. 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 Rs17.50 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 maximise his profit, if he operates his machines for at the most 12 hours a day?

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12. 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 a 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 maximise his profit? Determine the maximum profit

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13. 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 maximise his profit?

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14. 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 maximise the profit?

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15. A merchant plans to sell two types of personal computers – a desktop model and a portable model that will cost Rs 25000 and Rs 40000 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 4500 and on portable model is Rs 5000.

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16. A diet is to contain at least 80 units of vitamin A and 100 units of minerals. Two food F1 and F2 are available. Food F1 costs Rs. 4 per unit food 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 linear programming problem. Find the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements.

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17. There are two types of fertilisers 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 fertiliser should be used so that nutrient requirements are met at a minimum cost. What is the minimum cost?

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18. The corner points of the feasible region determined by the following system of linear inequalities: : $2x + y \leq 10, x + 3y \leq 15, x, y \geq 0$ are $(0, 0), (5, 0), (3, 4)$ and $(0, 5)$. Let $Z = px + qy$, where $p, q > 0$, Condition on p and q so that the maximum of Z occurs at both (3, 4) and (0, 5) is:

A. $p = q$

B. $p = 2q$

C. $p = 3q$

D. $q = 3p$

Answer:

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19. An aeroplane can carry maximum of 200 passengers, A profit of ₹ 400 is made on each first class ticket and a profit of ₹ 300 is made in each second class ticket. The airline reserves at least 20 seates for first class. However, at least four times as many passengers prefer to travel by second class than first class. Determine how many tickets of each type must be sold to maximise profit for the airline. Form an L.P.P. and solve it graphically.

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20. A toy company manufactures two types of dolls, A and B. Market tests and available resources have indicated that the combined production level should not exceed 1200 dolls per week and the demand for dolls of type B is at most half of that for dolls of type A. Further, the production level of dolls of type A can exceed three times the production of dolls of other type by at most 600 units. If the company makes profit of Rs 12 and Rs 16 per doll respectively on dolls A and B, how many of each should be produced weekly in order to maximise the profit?

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