GRAPHICAL METHOD

LINEAR PROGRAMMING

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1. A manufacturer produced equipment E1 and E2, each equipment of E1 requires 4 hours of grinding and 2 hours of polishing, whereas equipment type 2 requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishers. Each grinder works 40 hours per week while each polisher works 60 hours per week. Profit from E1 is 3$ and 4$ from E2. Whatever is produced in a week is sold in the market. How should the manufacturer allocate his production capacity to the two types of equipment, so that the profit is maximized.
2. A paper mill produces two types of papers namely A and B and production capacity is limited to 400 tons of grade A and 300 tons of grade B papers per sheet due to raw material restrictions. There are 160 production hours in a week, and it requires 0.2 and 0.4 hours to produce a ton of paper A and B respectively with corresponding profit of Rs 200 and Rs 500 per ton. Formulate the above as a LLP to maximise the profit and find the optimum product mix.
3. A company produces two products, A and B, which are processed in the same machine. It takes 10 minutes and 2 minutes to process product A and B respectively while the machine operates maximum 35 hours in a week. Product A requires 1kg and product B requires 0.5 kg of raw materials from 600kg weekly supply. The market constraint on product B is known to be 800 units per week. Product A costs Rs.5 per unit and sold at Rs.10. whereas Product B costs Rs.6 per unit and sold at Rs.8. determine the optimum units to be produced in a such way that the profit is maximised.
4. A merchant to sell two models of home computers at the cost of $250 and $400 respectively. The $250 model yields a profit of $45 and the $400 model yields a profit of $50. The merchant estimates that the total monthly demand will not exceed 250 units. Find the number of units of each model that should be stocked in order to maximize profit. Assume that the merchant does not want to invest more than $70,000 in computer inventory.
5. A fruit grower has 150 acres of land available to raise two crops, A and B. It takes one day to trim an acre of crop A and two days to trim an acre of crop B, and there are 240 days per year available for trimming. It takes 0.3 days to pick an acre of crop A and 0.1 days to pick an acre of crop B, and there are 30 days per year available for picking. Find the number of acres of each fruit that should be planted to maximize profit, assuming that the profit is $140 per acre for crop A and $235 per acre for crop B.
6. A farming cooperative mixes two brands of cattle feed. Brand X costs $25 per bag and contains 2 units of nutritional element A, 2 units of element B, and 2 units of element C. Brand Y costs $20 per bag and contains 1 unit of nutritional element A, 9 units of elements B, and 3 units of element C. Find the number of bags of each brand that should be mixed to produce a mixture having a minimum cost per bag. The minimum requirements for nutrients A, B and C are 12 units, 36 units, and 24 units respectively.

7. Two gasoline, Type A and Type B, have octane ratings of 80 and 92, respectively. Type A costs \$0.83 per gallon and Type B costs \$0.98 per gallon. Determine the blend of the minimum cost with an octane rating of at least 90. [Hint: Let x be the fraction of each gallon that is Type A and y be the fraction that is Type B.
8. A company makes two products (X and Y) using two machines (A and B). Each unit of X that is produced requires 50 minutes processing time on machine A and 30 minutes processing time on machine B. Each unit of Y that is produced requires 24 minutes processing time on machine A and 33 minutes processing time on machine B.

   At the start of the current week there are 30 units of X and 90 units of Y in stock. Available processing time on machine A is forecast to be 40 hours and on machine B is forecast to be 35 hours.

   The demand for X in the current week is forecast to be 75 units and for Y is forecast to be 95 units. Company policy is to maximize the combined sum of the units of X and the units of Y in stock at the end of the week.

   a. Formulate the problem of deciding how much of each product to make in the current week as a linear program.
   b. Solve this linear program graphically.

9. The demand for two products in each of the last five weeks is shown below.

Week	1	2	3	4	5
Demand - product 1	23	27	34	40	37
Demand - product 2	11	13	15	14	14

   Demand figures for product 1 and 2 are forecasts (Currently you are at the beginning of week 5)

   These products are produced using two machines, X and Y. Each unit of product 1 that is produced requires 15 minutes processing on machine X- and 25-minutes processing on machine Y. Each unit of product 2 that is produced requires 7 minutes processing on machine X and 45 minutes processing on machine Y. The available time on machine X in week 5 is forecast to be 20 hours and on machine Y in week 5 is forecast to be 15 hours. Each unit of product 1 sold in week 5 gives a contribution to profit of £10 and each unit of product 2 sold in week 5 gives a contribution to profit of £4.

   It may not be possible to produce enough to meet your forecast demand for these products in week 5 and each unit of unsatisfied demand for product 1 costs £3, each unit of unsatisfied demand for product 2 costs £1.

   a. Formulate the problem of deciding how much of each product to make in week 5 as a linear program.
   b. Solve this linear program graphically.

10. A company is involved in the production of two items (X and Y). The resources need to produce X and Y are twofold, namely machine time for automatic processing and craftsman time for hand finishing. The table below gives the number of minutes required for each item:

Item	**Machine time**	**Craftsman time**
X	13	20
Y	19	29

The company has 40 hours of machine time available in the next working week but only 35 hours of craftsman time. Machine time is costed at £10 per hour worked and craftsman time is costed at £2 per hour worked. Both machine and craftsman idle times incur no costs. The revenue received for each item produced (all production is sold) is £20 for X and £30 for Y. The company has a specific contract to produce 10 items of X per week for a particular customer.

a. Formulate the problem of deciding how much to produce per week as a linear program.
b. Solve this linear program graphically.

11. Min $z = 3x_1 + 2x_2$

S.t: $x_1 + 2x_2 \geq 3$

$2x_1 + 3x_2 \geq 5$

$x_1, x_2 \geq 0$