

Exemplar Problem

Problem 1:

Example 7 (Allocation problem) 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?

Solution Let x hectare of land be allocated to crop X and y hectare to crop Y. Obviously, $x \geq 0, y \geq 0$.

Profit per hectare on crop X = Rs 10500

Profit per hectare on crop Y = Rs 9000

Therefore, total profit = Rs $(10500x + 9000y)$

The mathematical formulation of the problem is as follows:

Maximise $Z = 10500x + 9000y$

subject to the constraints:

$$x + y \leq 50 \quad (\text{constraint related to land}) \quad \dots (1)$$

$$20x + 10y \leq 800 \quad (\text{constraint related to use of herbicide})$$

$$\text{i.e.} \quad 2x + y \leq 80 \quad \dots (2)$$

$$x \geq 0, y \geq 0 \quad (\text{non negative constraint}) \quad \dots (3)$$

Let us draw the graph of the system of inequalities (1) to (3). The feasible region OABC is shown (shaded) in the Fig 12.8. Observe that the feasible region is **bounded**.

The coordinates of the corner points O, A, B and C are $(0, 0)$, $(40, 0)$, $(30, 20)$ and $(0, 50)$ respectively. Let us evaluate the objective function $Z = 10500x + 9000y$ at these vertices to find which one gives the maximum profit.

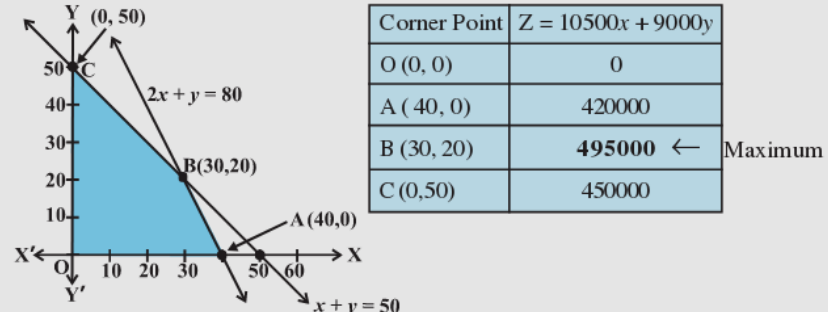


Fig 12.8

Hence, the society will get the maximum profit of Rs 4,95,000 by allocating 30 hectares for crop X and 20 hectares for crop Y.