CHAPTER-12

LINEAR PROGRAMMING PROBLEMS

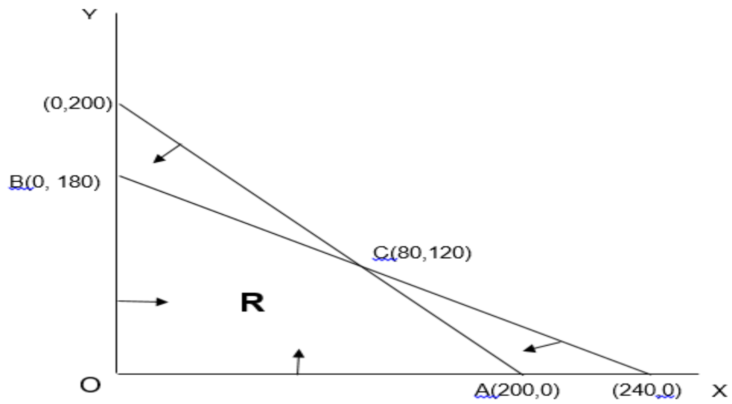
05 MARKS TYPE QUESTIONS

<table>
<tr><th>Q. NO</th><th>QUESTION</th><th>MARK</th></tr>
<tr><td>1.</td><td>A company produces two types of TVs, one is black and white, while the other is colour. The company has the resources to make at most 200 sets a week. Creating a black and white set costs Rs. 2700 and Rs. 3600 to create a coloured set. The business should spend no more than Rs. 648000 a week producing TV sets. If it benefits from Rs. 525 per set of black and white and Rs. 675 per set of colours, How many sets of black/white and coloured sets should it produce in order to get maximum profit? Formulate this using LPP.</td><td>5</td></tr>
<tr><td>2.</td><td>A jet fuel company has two X and Y depots with 7000 L and 4000 L capacities, respectively. The firm is distributing fuel to three jet fuel pumps, D, E and F, respectively in three cities containing 4500L, 3000L, and 3500L. In the following table, the distances (in km) between the depots and jet fuel pumps are given within the following desk:
<table>
<tr><td>DISTANCE (KM)</td><td></td><td></td></tr>
<tr><td>From/To</td><td>X</td><td>Y</td></tr>
<tr><td>D</td><td>7</td><td>3</td></tr>
<tr><td>E</td><td>6</td><td>4</td></tr>
<tr><td>F</td><td>3</td><td>2</td></tr>
</table>
If the transport cost of 10 litres of jet fuel is Re. 1 per km, how should the distribution be planned to mitigate the transport cost? What’s the lowest cost?</td><td>5</td></tr>
<tr><td>3.</td><td>Maximize $Z = -x + 2y$, subject to the constraints
$x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0.$</td><td>5</td></tr>
<tr><td>4.</td><td>Minimize $Z = 4x + 6y$
Subject to the constraints: $3x + 6y \geq 80,\ 4x + 3y \geq 100, x, y \geq 0$</td><td>5</td></tr>
<tr><td>5.</td><td>Minimize $Z = 5x + 7y$
subject to the constraints
$2x + y \geq 85000$,
$x + 2y \geq 10$
and $x, y \geq 0$</td><td>5</td></tr>
<tr><td>6.</td><td>Maximize $Z = 300x + 190y$
subject to the constraints
$x + y \leq 24$,
$2x + y \leq 32$
and $x, y \geq 0$</td><td>5</td></tr>
</table>

ANSWERS:

<table>
<tr><th>Q. NO</th><th>ANSWER</th><th>MARKS</th></tr>
<tr><td>1</td><td>

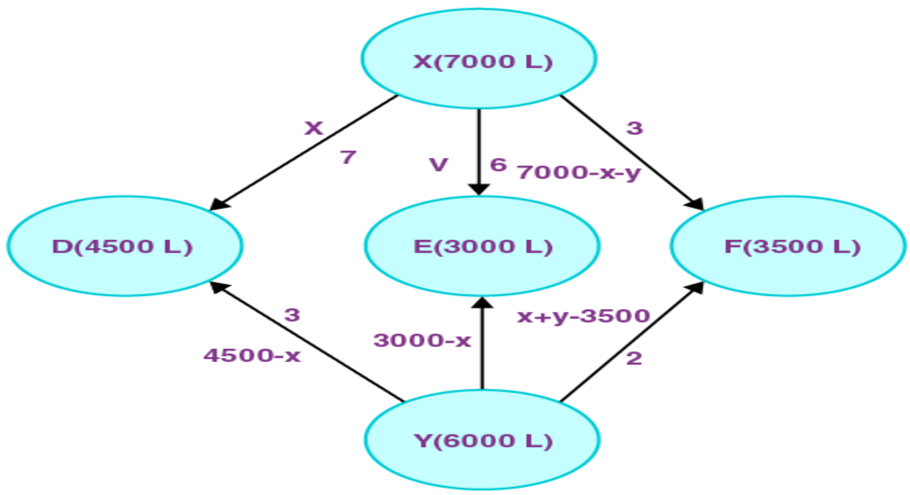
Solution: Let x and y be the number of black/white and coloured TVs, respectively
Subject to constraints:
x, y ≥ 0 (Non-negative constraint)
x + y ≤ 200 (Quantity constraints)
2700x + 3600y ≤ 648000 (Cost constraints)
Objective function: Z = 525x + 675y (objective is to maximize profit)



Feasible region R are bounded as shown in the figure above.

<table>
<tr><th>Corner Point</th><th>Objective Function(Z)</th></tr>
<tr><td>O(0,0)</td><td>525(0) + 675(0) = 0</td></tr>
<tr><td>A(200,0)</td><td>525(200) + 675(0) = 105000</td></tr>
<tr><td>C(80,120)</td><td>525(80) + 675(120)= 123000</td></tr>
<tr><td>B(0,180)</td><td>525(0) + 675(180) = 121500</td></tr>
</table>

Thus maximum value of Z occurs at C(80,120), i.e., 123000. So the company should manufacture 80 black/white and 120 coloured TV sets to get maximum profit.</td><td>5</td></tr>
<tr><td>2</td><td>


</td><td>5</td></tr>
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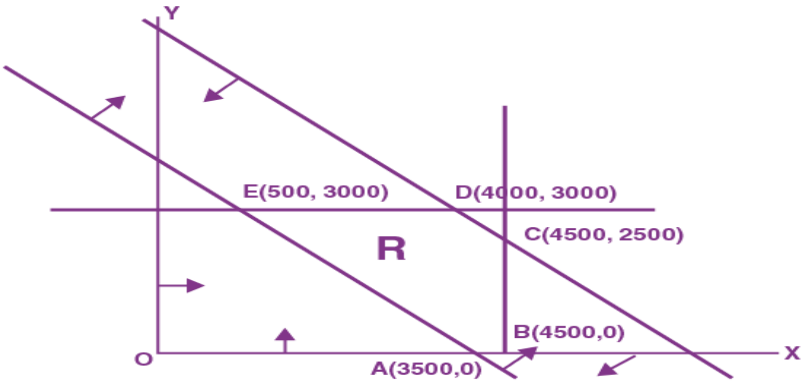
Let X supply the fuel pumps, D and E with x and y litres of jet fuel.
So, (7000 − x − y) from X to fuel pump F will be delivered. At fuel pump D, the requirement is 4500 L.
The remaining (4500 − x) L will be transferred from fuel pump Y while L is transported from depot X.
Similarly, (3000 − y) L and 3500 − (7000 − x − y) = (x + y − 3500) L will be transported from depot Y to F fuel pump.

Subject to constraints:
$x, y \geq 0$
$7000 - x - y \geq 0$ (XF constraint)
$4500 - x \geq 0$ (YD constraint)
$3000 - y \geq 0$ (YE constraint)
$x + y - 3500 \geq 0$ (YF constraint)
Cost of transporting 10 L of jet fuel is 1 rupee.
Objective function:

$$Z = \frac{7}{10} \times x + \frac{6}{10} \times y + \frac{3}{10} \times (7000 - x - y) + \frac{3}{10} \times (4500 - x) + \frac{4}{10} \times (3000 - y)$$

$$+ \frac{2}{10} \times (x + y - 3500)$$



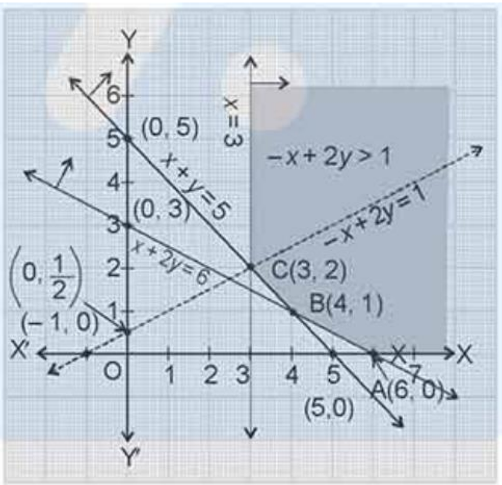
Corner Points	Z = 0.3x + 0.1y + 3950
A(3500, 0)	5000
B(4500, 0)	5300
C(4500, 2500)	5550
D(4000, 3000)	5450
E(500, 3000)	4400 (Minimum)

The minimum value of Z is 4400 at E (500, 3000).

Thus, the jet fuel supplied from depot A is 500 L, 3000 L, and 3500 L and from depot B is 4000 L, 0 L, and 0 L to fuel pumps D, E, and F, respectively.

Therefore, the minimum transportation cost is Rs. 4400.

3 The feasible region of the following LPP is as shown in the figure



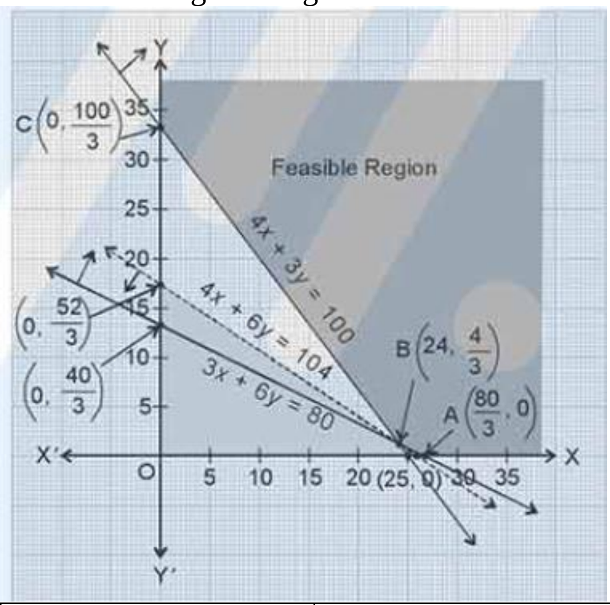
Corner Points	$z = -x + 2y$
(6,0)	-6
(4,1)	-2
(3,2)	$1 = M$

From this table we find that 1 is the maximum value of Z at $(3,2)$.

Since feasible region is unbounded so we have to check it further.

So, we draw the inequality $Z > M(-x + 2y > 1)$ by dotted line in the graph and will check whether this inequality and the feasible region has any other common points. Clearly there are common points with the feasible region. Therefore, $Z = -x + 2y$ has no maximum value subject to the given constraints.

4 The feasible region the given LPP is as shown in the figure



Corner Points	$Z = 4x + 6y$
$\left(\frac{80}{3}, 0\right)$	$\frac{320}{3}$
$\left(24, \frac{4}{3}\right)$	$104 = m$

<table>
<tr><td></td><td>
<table>
<tr><td>$\left(0, \frac{100}{3}\right)$</td><td>$200$</td></tr>
</table>
From this table we find that 104 is the minimum value of Z at $\left(24, \frac{4}{3}\right)$.
Since feasible region is unbounded so we have to check it further.
So, we draw the inequality $Z > m(4x + 6y < 104)$ by dotted line in the graph and will check whether this inequality and the feasible region has any other common points. Clearly there are no common points with the feasible region. Therefore, $Z = 4x + 6y$ has 104 as the minimum value of Z at $\left(24, \frac{4}{3}\right)$.
</td><td></td></tr>
<tr><td>5</td><td>Z= 38 at x=2 and y =4</td><td>5</td></tr>
<tr><td>6</td><td>Z=5440 when x = 8 and y =16</td><td>5</td></tr>
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