Yogoda Satsanga Mahavidyalaya

M.COM Sem III

Subject: Quantitative Techniques for Business Decision Making

Topic: Formulation of LPP & Graphic Solution
(Online Lecture 04 & 05)

Ms. Simran Kaur, Assistant Professor, Department of Commerce

Illustration 03

A small scale industry manufactures electrical regulators, the assembly of which is being accomplished by a small group of skilled workers, both **men and women.**

Due to limitation of space and finance **the number of workers cannot exceed 11** and their **salary bill not more than R s.60,000 per month**.

The **male members** of the skilled workers are **paid Rs.6000 per month** while the **female workers** doing the same work as the male members get **Rs 5000 per month.**

Data collected on the performance of these workers indicate that **a male member contributes R s 10,000 per month to total return** of the industry while the **female worker contributes R s 8500 per month**.

Determine the number of male and female workers to be employed in order to **maximize the monthly total return**.

Solution:

Step 1: Formulate the Linear Programming Problem (Lecture 01, 02 & 03)

- Identification of Decision Variable
- Objective Function
- Constraints
- Non negative restriction

Step 2: Construct the graph.

Identification of Decision Variable

x_1 = Number of male workers to be employed.

x_2 = Number of female workers to be employed.

Objective Function

Contribution of male members= R s 10,000 per month;

No. of male members= x_1

Contribution of female members= R s 8,500 per month

No. of female members= x_2

Maximize (total monthly return) $Z = 10000\, x_1 + 8500\, x_2$

Constraints

Constraints	Male	Female	Limit
Number	x_1	x_2	11
Salary Bill	R s. 6000	Rs. 5000	Rs 60,000 per month

(i) $x_1 + x_2 \leq 11$

(ii) $6000x_1 + 5000x_2 \leq 60000$ or $6x_1 + 5x_2 \leq 60$

Non negative restriction

$x_1 \geq 0;\ x_2 \geq 0$

Solution (Construction of Graph)

- Since any point that satisfies the conditions **$x_1 \geq 0$ and $x_2 \geq 0$ lies in the first quadrant only** and thus our search for the desired pair **(x_1, x_2)** is restricted to the points on the first quadrant only.
- In the above graph, the inequalities are **graphed taking them as equalities:**

1st constraint: $x_1 + x_2 \leq 11$

(i) The first constraint **$x_1 + x_2 \leq 11$** will be graphed as **$x_1 + x_2 = 11$.**

x_1	x_2
0	**11**
11	**0**

The above constraint can be plotted using the coordinates (0,11) and (11,0).

2nd constraint: $6x_1 + 5x_2 \leq 60$

(ii) The second constraint $6x_1 + 5x_2 \leq 60$ will be graphed **$6x_1 + 5x_2 = 60$**

x_1	x_2
0	**12**
10	**0**

The above constraint can be plotted using the coordinates **(0,12) & (10,0).**

FEASIBLE REGION(SOLUTION SPACE): OAPC

- **Identify the feasible region (Solution space)**

  The feasible region will be bounded by the two axes and two lines $x_1 + x_2 = 11$ and 6x +5x=60 and will be the common area which falls to the left of these constraints equation as both the constraints are of 'less than equal to type'.

- **Locate the extreme (or corner) points**

  The area OAPC represents the set of all feasible solutions.

  The coordinates of the extreme points of the feasible region are:

  O(0,0)

  A(0.11)

  P(5,6)

  C(10,0)

- **Evaluate the objective function at Extreme Points**

  Maximize $Z=10{,}000\ x_2 + 8500x$

Extreme Point	Coordinate	Objective Function
O	(0,0)	10000(0)+8500(0)=0
A	(0,11)	10000(0)+8500(11)=93,500
P	(5,6)	10000(5)+8500(6)=1,01,000
C	(10,0)	10000(10)+8500(0)=1,00,000

- **Optimal value of the objective Function**

  The maximum value of the objective function Z=1,01,000 occurs at the extreme point (5,6).

  Hence, optimal solution to the given LP problem is

  $x_1=5$, $x_2= 6$, Max Z=Rs 1,01,000