RD Sharma Solutions Class 12 Maths Chapter 30 Ex 30.5

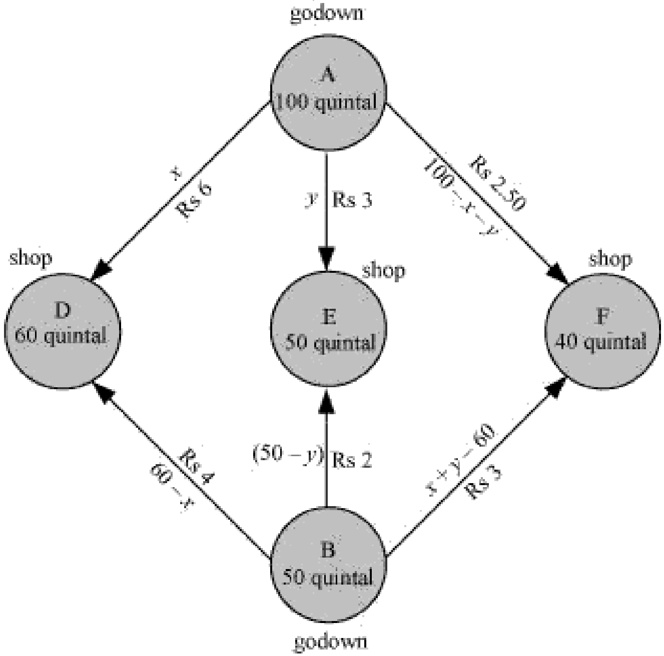
Linear Programming Ex 30.5 Q1

Let godown A supply x and y quintals of grain to the shops D and E respectively. Then, $(100 - x - y)$ will be supplied to shop F.

The requirement at shop D is 60 quintals since x quintals are transported from godown A. Therefore, the remaining $(60 - x)$ quintals will be transported from godown B.

Similarly, $(50 - y)$ quintals and $40 - (100 - x - y) = (x + y - 60)$ quintals will be transported from godown B to shop E and F respectively.

The given problem can be represented diagrammatically as follows.



$x \geq 0,\ y \geq 0,\ \text{and } 100 - x - y \geq 0$
$\Rightarrow x \geq 0,\ y \geq 0,\ \text{and } x + y \leq 100$

$60 - x \geq 0,\ 50 - y \geq 0,\ \text{and } x + y - 60 \geq 0$
$\Rightarrow x \leq 60,\ y \leq 50,\ \text{and } x + y \geq 60$

Total transportation cost *z* is given by,

$$\begin{aligned} z &= 6x + 3y + 2.5(100 - x - y) + 4(60 - x) + 2(50 - y) + 3(x + y - 60) \\ &= 6x + 3y + 250 - 2.5x - 2.5y + 240 - 4x + 100 - 2y + 3x + 3y - 180 \\ &= 2.5x + 1.5y + 410 \end{aligned}$$

The given problem can be formulated as

Minimize *z* = 2.5*x* + 1.5*y* + 410 ... (1)

subject to the constraints,

$x + y \leq 100$ ...(2)

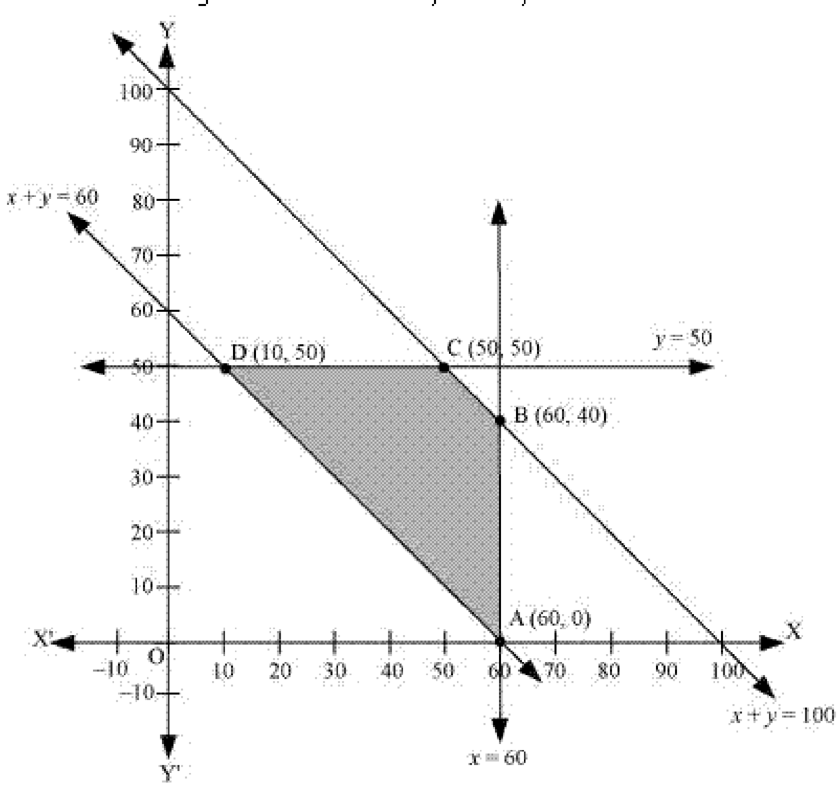
$x \leq 60$ ...(3)

$y \leq 50$ ...(4)

$x + y \geq 60$ ...(5)

$x,\ y \geq 0$ ...(6)

The feasible region determined by the system of constraints is as follows.



The corner points are A (60, 0), B (60, 40), C (50, 50), and D (10, 50).

The values of z at these corner points are as follows.

Corner point	$z = 2.5x + 1.5y + 410$	
A (60, 0)	560	
B (60, 40)	620	
C (50, 50)	610	
D (10, 50)	510	→ Minimum

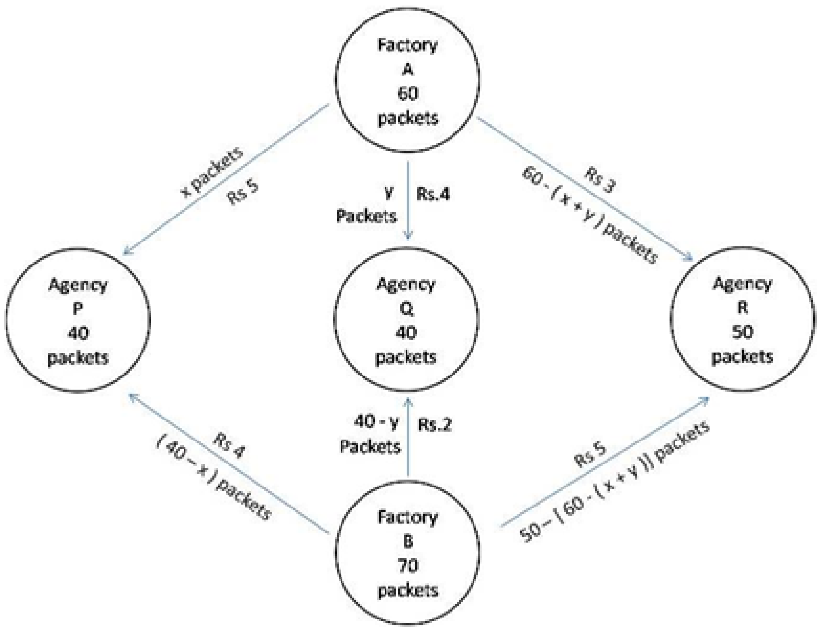
The minimum value of z is 510 at (10, 50).

Thus, the amount of grain transported from A to D, E, and F is 10 quintals, 50 quintals, and 40 quintals respectively and from B to D, E, and F is 50 quintals, 0 quintals, and 0 quintals respectively.

The minimum cost is Rs 510.

Linear Programming Ex 30.5 Q2

The given information can be exhibited diagramatically as below:



Let factory A transports x packets to agency P and y packet to agency Q. Since factory A has capacity of 60 packets so, rest $\left[60-(x+y)\right]$ packets transported to agency R.

Since requirements are always non negative so,

$\Rightarrow \quad x, y \geq 0 \qquad$ (first constraint)

and $\quad 60-(x+y) \geq 0$

$(x+y) \leq 60 \qquad$ (second constraint)

Since requirement of agency P is 40 packet but it has recieved x packet, so $(40-x)$ packets are transported from factory B, requirement of agency Q is 40 packets but it has recieved y packets, so $(40-y)$ packets are transported from factory B. Requirement of agency R is 50 packets but it has recieved $(60-x-y)$ packets from factory A, so $50-\left[60-x-y\right]=(x+y-10)$ is transported from factory B, As the requirements of agencies P, Q, R are always non negative, so,

$40-x \geq 0$

$\Rightarrow \quad x \leq 40 \qquad$ (third constraint)

$40-y \geq 0$

$\Rightarrow \quad y \leq 40 \qquad$ (fourth constraint)

$x+y-10 \geq 0$

$\Rightarrow \quad x+y \geq 10 \qquad$ (fifth constraint)

Costs of transportation of each packet from factory A to agency P, Q, R are Rs 5,4,3 respectively and costs of transportation of each packet from factory B to agency P, Q, R are Rs 4,2,5 respectively,

Let Z be total cost of transportation so,

$$Z = 5x+4y+3\left[60-x-y\right]+4(40-x)+2(40-y)+5(x+y-10)$$

$$= 5x+4y+180-3x-3y+160-4x+80-2y+5x+5y-50$$

$$= 3x+4y+370$$

Hence, mathematical formulation of LPP is find x and y which

maximize $Z = 3x+4y+370$

subject to constraints,

$x, y \geq 0$

$x + y \leq 60$

$x \leq 40$

$y \leq 0$

$x + y \geq 10$

Region $x, y \geq 0$: It is represents first quandrant.

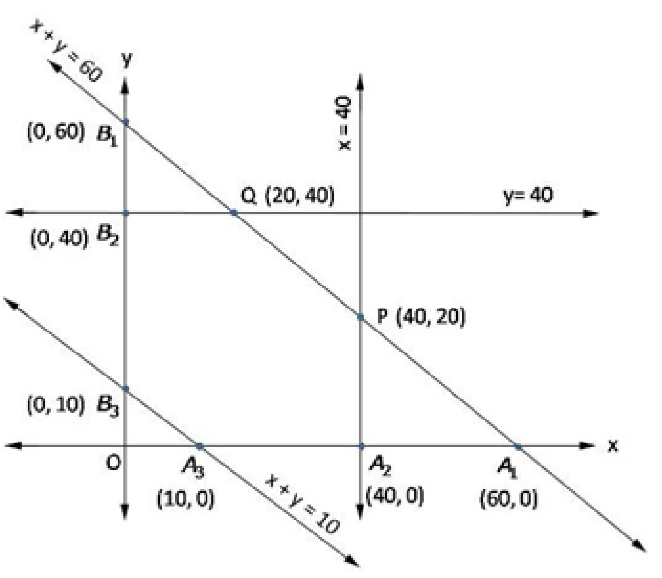
Region $x + y \leq 60$: line $x + y = 60$ meets axes at $A_1(60,0)$, $B_1(0,60)$ respectively.
Region containing origin represents $x + y \leq 60$ as $(0,0)$ satisfies $x + y \leq 60$.

Region $x \leq 40$: line $x = 40$ is parallel to y-axis and meets x-axis at $A_2(40,0)$.
Region containing origin represents $x \leq 40$ as $(0,0)$ satisfies $x \leq 40$.

Region $y \leq 40$: line $y = 40$ is parallel to x-axis and meets y-axis at $B_2(0,40)$.
Region containing origin represents $y \leq 40$ as $(0,0)$ satisfies $y \leq 40$.

Region $x + y \geq 10$: line $x + y = 10$ meets axes at $A_2(10,0)$, $B_3(0,10)$ respectively.
Region containing origin represents $x + y \geq 10$ as $(0,0)$ does not satisfy $x + y \geq 10$.

Shaded region $A_3A_2PQB_2B_3$ represents feasible region.
Point $P(40,20)$ is obtained by solving $x = 40$ and $x + y = 60$
Point $Q(20,40)$ is obtained by solving $y = 40$ and $x + y = 60$



The value of $Z = 3x + 4y + 370$ at

$A_3(10,0) = 3(10) + 4(0) + 370 = 400$

$A_2(40,0) = 3(40) + 4(0) + 370 = 490$

$P(40,20) = 3(40) + 4(20) + 370 = 570$

$Q(20,40) = 3(20) + 4(40) + 370 = 590$

$B_2(0,40) = 3(0) + 4(40) + 370 = 530$

$B_3(0,10) = 3(0) + 4(10) + 370 = 410$

minimum $Z = 400$ at $x = 10$, $y = 0$

From $A \to P =$ 10 packets

From $A \to Q =$ 0 packets

From $A \to R =$ 50 packets

From $B \to P =$ 30 packets

From $B \to Q =$ 40 packets

From $B \to R =$ 0 packets

minimum cost = Rs 400