5.9.7

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Question

A part of monthly hostel charges in a college hostel are fixed and the remaining depends on the number of days one has taken food in the mess. When a student A takes food for 25 days, he has to pay ₹4,500, whereas a student B who takes food for 30 days, has to pay ₹5,200. Find the fixed charges per month and the cost of food per day. (10, 2019)

Solution

Let x be the fixed charge and y be the cost of food per day. The system according to the information is

$$x + 25y = 4500 \tag{1}$$
$$x + 30y = 5200 \tag{2}$$

In matrix form:

$$\begin{pmatrix} 1 & 25 \\ 1 & 30 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 4500 \\ 5200 \end{pmatrix}. \tag{3}$$

Let

$$A = \begin{pmatrix} 1 & 25 \\ 1 & 30 \end{pmatrix}, \quad \vec{b} = \begin{pmatrix} 4500 \\ 5200 \end{pmatrix}. \tag{4}$$

Solving it using Gauss-Jordan elimination, we get

Solution

$$\left[\begin{array}{cc|c} 1 & 25 & 4500 \\ 1 & 30 & 5200 \end{array}\right] \xrightarrow{R_2 \to R_2 - R_1} \left[\begin{array}{cc|c} 1 & 25 & 4500 \\ 0 & 5 & 700 \end{array}\right] \tag{5}$$

$$\xrightarrow{R_2 \to \frac{1}{5} R_2} \left[\begin{array}{cc|c} 1 & 25 & 4500 \\ 0 & 1 & 140 \end{array}\right] \tag{6}$$

$$\xrightarrow{R_1 \to R_1 - 25 R_2} \left[\begin{array}{cc|c} 1 & 0 & 1000 \\ 0 & 1 & 140 \end{array}\right] \tag{7}$$

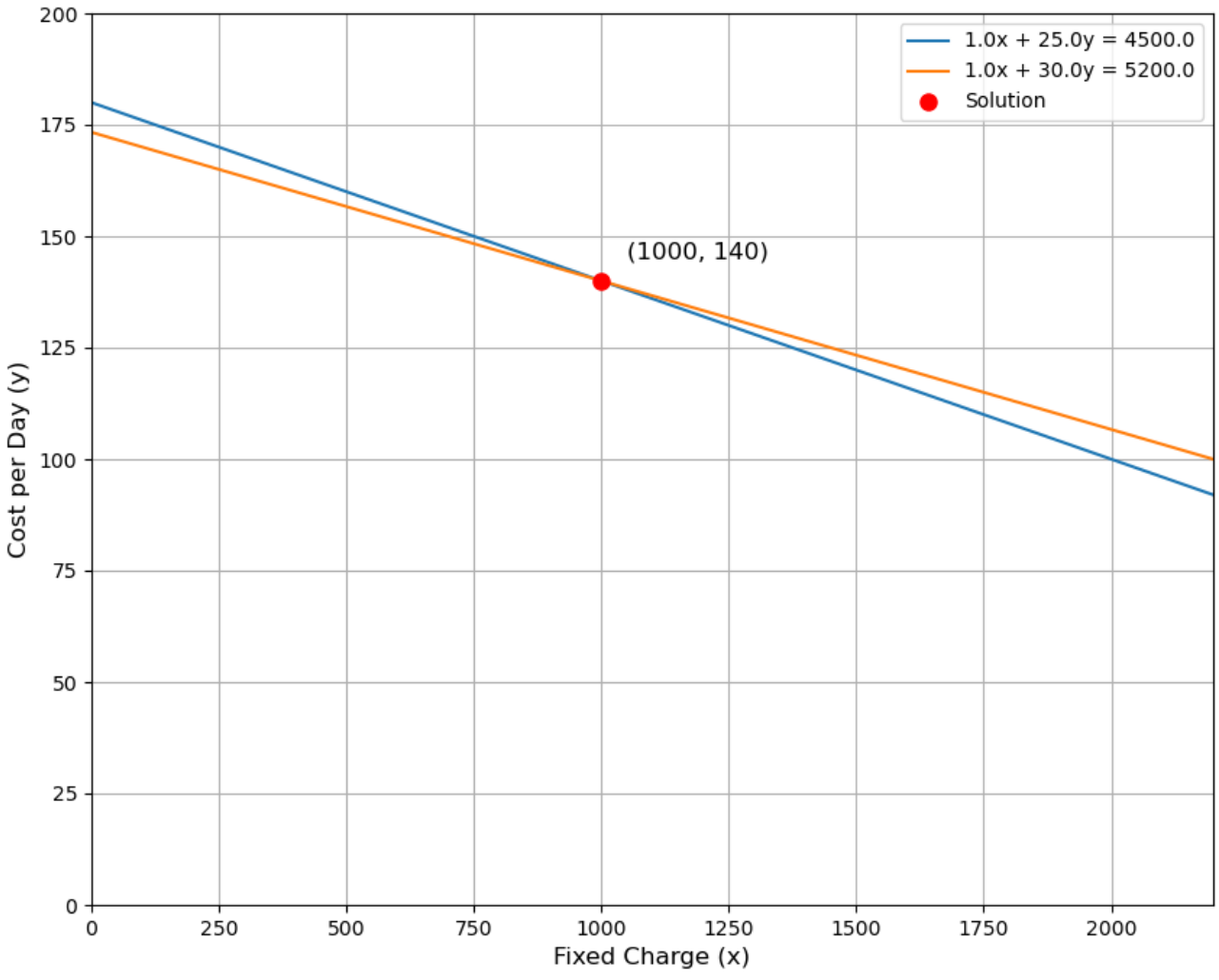
From the reduced row echelon form, we have the solution:

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1000 \\ 140 \end{pmatrix} \tag{8}$$

Therefore,

$$x = 1000 \quad \text{(fixed charge)}, \qquad y = 140 \quad \text{(cost per day)}. \tag{9}$$

Plot


1.0x + 25.0y = 4500.0
1.0x + 30.0y = 5200.0
Solution
(1000, 140)
Cost per Day (y)
Fixed Charge (x)
0
25
50
75
100
125
150
175
200
0
250
500
750
1000
1250
1500
1750
2000